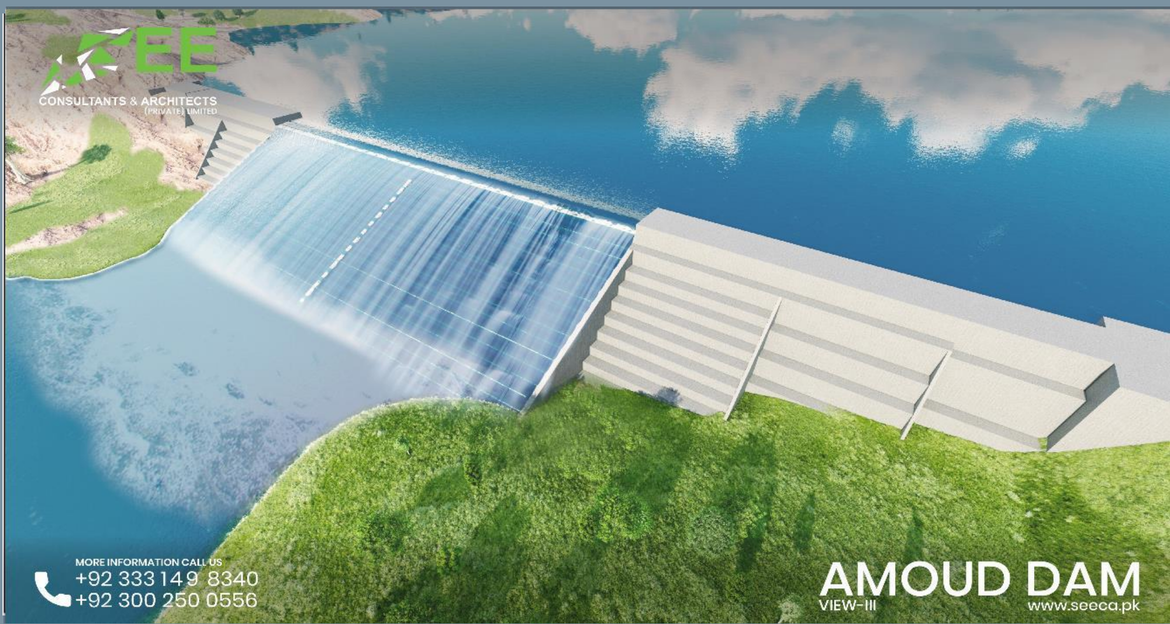
PROJECT PROPOSAL
for
Constructing a Dam for
BORAMA CITY



BORAMA GRAVITY DAM WITH CAPACITY OF 6 MILLION M3 AT UPPER STREAM OF AMOUD

Chairman of SHABA

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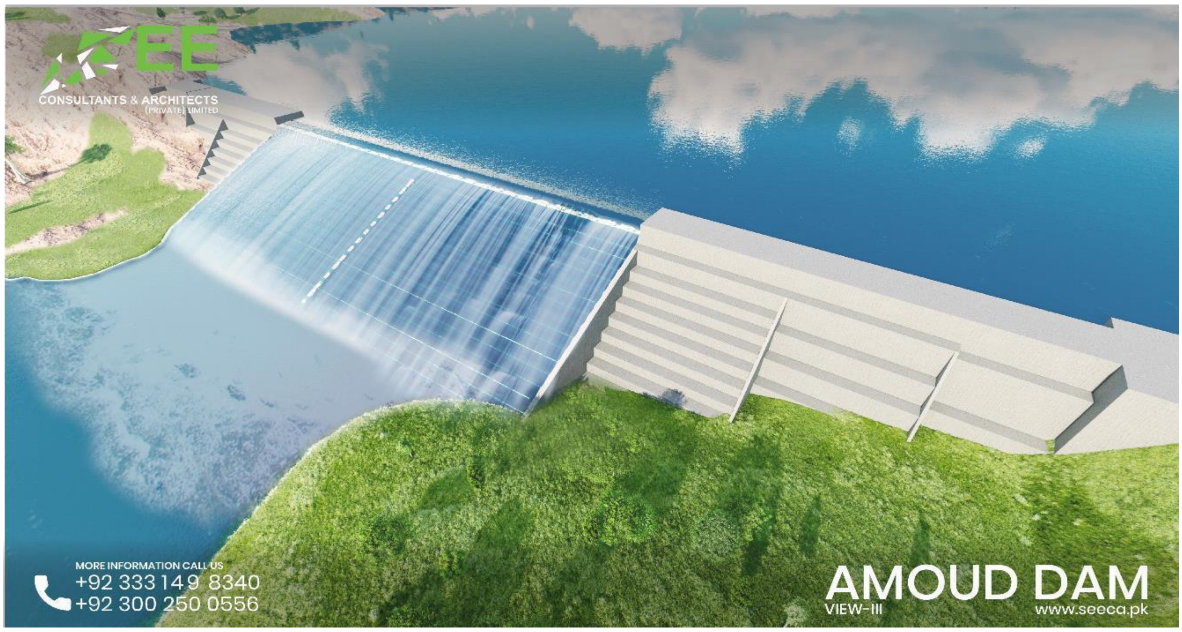
Borama

SHABA

Project Proposal

For

Construction of High Capacity Gravity Dam for Borama Town Water Supply



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Borama - Somaliland

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Table of Contents

II List of abbreviations and acronyms

ADB	African Development bank
AWF	African water facilities
AWP	Annual work Plan
BOD	Board of Directors
BWD	Borama Water Board
BGL	Below ground level
CUM	Cubic metre
Dwl	Dynamic water level
GA	General assembly
HH	House Hold
lcd	litre per capita per day
lpd	litre per person Per day
M cum	*million metre cubic*
MONP&D	Ministry of National planning &Development
MOWRD	Ministry of Water Resources Development
PPP	public private Partnership
SHABA	Awdal Utility Company (shirkada Adeegga Bulshada Awdal)
SWL	static water level
PESS	population estimation survey
TS	TERRA SOLIDLI
UNICEF	united nations children fund
UNFPA	United nations population fund

III Weight and measures

IV Executive summary

Over the past three years, SHABA was struggling to the cover the huge gap between the supply and the demand of Borama town, eight production boreholes drilled by the Chinese in the eastern aquifer dried up with in very short period due to their shallow depth (less than 80m bgl). Several hydrological studies carried out by Terra Solidali (an international organization) revealed the depletion of the aquifer. TS & SHAAC geophysical company carrying out further compressive hydrological study of the area and had discovered another aquifer in Amoud which is adjacent the previous aquifer, they recommended the possibilities of drilling deeper boreholes, the PPP company with the assistance of the Somaliland government and WASH partners succeeded to drill another 8 deeper BH with maximum production of 5,200 CUM/day.

The population of Borama town are growing very fast, the peace, stability and the better education of Amoud University attracted more families. During the start of the PPP management, the total population estimate was nearly 50,000 people with total daily production of 480 CUM, the present population estimate is more than 384,000 with daily production of 5,200 CUM with coverage of 15 lpd. The minimum urban standard for urban centre is 40litres/person /day and the present production are far below that. The company, to cover the gap between the supply and demand, has started water supply rationing and adapted working more than 22Hrs/day. This is not wise solution as the population growth is still going on and the demand for reliable water supply is increasing as well.

Rain water/surface water are the primary water sources, Borama town locates in mountainous areas and the average annual rainfall is above 500mm. The 25 years master Plan for Borama town carried out by TS through UNICEF funds and the IWRMIP carried out by NIRAS through the AWF/AWF funding has recommended the construction of potential rain water catchment in south east of Amoud (seasonal river) for the future Borama town water supply, its catchment area is 33.3 km sq. with embankment of height 20m high and can store up to 6 million CUM. This dam can provide to Borama inhabitants daily supply of 16,400 CUM/day, the total cost of the dam is …… as indicated in the attached BOQ

Therefore, Borama town and SHABA company are hereby kindly requesting from HE Muse Bihi Abdi the president of Somaliland, the Minister of Ministry of Water resources and the potential international aid communities to kindly provide the required funds so that Borama citizen will have enough water supply.

SUMMARY		
I	Preparatory Works	$53,000.00
II	Earthworks	$1,841,734.00
III	Concrete and Reinforcement Works	$18,486,720.00
IV	Water Supply System works	$3,185,000.00
V	Purification and Sanitation works	$1,500,000.00
VI	Installations Works	$68,030.00
VII	AUSCULTATION MEASURES	$59,200.00
VIII	Final Works	$104,000.00
IX	SPILLWAY	$1,248,808.00
	TOTAL	**$26,546,492.00**
	PLUS Phiysical Contingency (10%)	**$2,654,649.20**
	TOTAL	**$ 29,201,141.20**
	PLUS Price Contingency (2.5%)	**$730,028.53**
	GRAND TOTAL	**$29,931,169.73**

1. Background
1.1 introduction

SHABA is the first PPP company in country which was established by the Ministry of Water resources and Borama town Municipality to take the responsibility of providing safe and adequate drinking water supply to its customers. The company has signed 10 years tri party lease contract agreement in 31 November 2003 and the contract was renewed for another ten years which will expire by 31 November 2023. During that period SHABA PPP succeeded to realized one of the best water providers in the country, region and the world wide as indicated in UNICEF report 2019.

The company consists of 19 shareholders, five BOD members including the chairman represents the company and leads its policies, the BOD selects the manager, departmental directors and core staff through competitive and transparent recruitment procedures to manage the company activities. before the establishment of the PPP company the population of the town was very small (50,000 people) with daily water production of 320CUM/day with a total connection of 380 HH, most of them used kiosks and water tankers for their daily water supply from 8 production boreholes in Dhamoud aquifer which locate 4 Kms east of the town.

During SHABA management the problems of water shortage, the frequent of water equipment breakdown and prevalent water borne diseases were totally eliminated and the customers are enjoying with reliable and safe water supply 24/7. This issue attracted many families from abroad to bring their family members for better education and reliable water supply. The enormous population increment created huge demand for water. There is huge gap between the supply and demand which is the major problem faced the town.

Several studies carried out by international organizations (TERRA SOLIDLI) and SHAAC geophysical company showed the depletion of the eastern aquifer and as result of that the Chinese drilled borehole dried up. The study discovered adjacent aquifer in Amoud and 6 production boreholes were drilled which are now supplying the town with total production of 5,200 CUM/day. The Ministry of water and took the lead to draft 25 years master plan for Borama water and Integrated Water resources management Investment Plans (IWRMIP) which has recommended the future and long-term use of rainwater catchment as complement to the depleting ground water and support the coverage of the town water present and future demand.

1.2 Project Location-

Borama town is facing water stress as indicated in the recent studies carried out by certain professional organizations, the major aquifers of the eastern part of the town showed drop down to the water table which is negative sign for the future of Borama town water, the western aquifer is still under implementation and nobody knows when it will be completed, the forecast is that the ground water alone are not sufficient to the town water supply. Before the start of the PPP management, the total population estimate of Borama was 50,000 people with maximum daily production of 420 CUM which provide 8.4lpd, while present estimate is more than 384,000 and the present daily production is 5,200 CUM/day with coverage of 15 lpd. The minimum standard for urban centers taken as baseline for urban centers is 40lpd. Using this standard for calculations, the present demand is 10,000 CUM/day which is double of the present production.

This shows that Borama people are receiving half of the required quantity. SHABA, to cover that gap between the supply and demand, SHABA has started water supply rationing and adapted working more than 22Hrs/day. This could not be wise solution as the population growth is still going on and the demand for reliable water supply is increasing as well.

Borama town is facing great challenge if immediate measures are not taken in time, the fast-growing urbanization is an existing reality, there is huge gap between the supply and demand. the potential ground water resources are gradually approaching their upper limits and some boreholes already started to dry up.

This project proposal is advocating the construction of high capacity dams in the upper stream of Amoud river as recommended African Water facility project carried out by NIRAS[1] (international company who published the IWRM IP).

1,2,1 Population growth

Somaliland is among one of the fast urbanizing as indicated in UNDP report of 2006, and Borma is among the fastest urbanizing Demographic statistics, including the size and composition of the population and spatial distribution, are cornerstones in development planning and project design, particularly in connection with projection of future water requirements. Somaliland is lacking comprehensive and reliable population data because the statistical infrastructure and systems that were in place were destroyed during the protracted conflict the country endured in the late 1980s and early 1990s. Needless to say, the data from the only two previously conducted censuses in 1975 and 1986 are outdated.

To fill this gap, United Nations Population Fund (UNFPA) in collaboration with the Government of Somaliland conducted a Population Estimation Survey (PESS) in late 2013 (UNFPA, 2013). It should be noted that the PESS was not a formal population census, but was intended to set an integrated baseline for basic demographic information and providing tools such as sampling procedures systems for future surveys and in preparation of a new formal population census.

The PESS results provided a Somaliland population size of 250,000. By adopting this estimated 2013/2014 population size and using the present population growth rate for Somaliland as a whole of 3.2% annually (MoNPD, 2017), the Somaliland population can be estimated to be about 4.0 million in 2017. The estimate of Borama population is nearly 384,000

as indicated in Somaliland in figures. this will be the basis for the calculation of the water demand in this project proposal.

[1] NIRAS Norwegian company for international water studies

1.3 political, educational, and cultural importance of the city etc.

Borama town locates in strategic area which connects western region of Somaliland to Ethiopia and Djibouti, the communities of the region are very civilized and their culture is mostly based on peace and stability, the first University in the country locates in Borama and the town is very famous with centre for education, the water supply of the town is the most reliable in the country as the first public Private partnership was established as the model for all the country and private company was managing the town water supply for the past 17 years till now.

The peace and the stability and the better social services in Borama town has attracted many families from Somalia regions and abroad to bring and settle their children and families for better education and friendly neighbourhood, this resulted fast growth to the population of the town, research done by SHABA management showed 12% growth to the town water demand and as a result of that there is usually big gap between the water supply and the demand

On the other hand, the town is very famous its elders and educated who has taken great role in reconciliation to injuries from the civil war that took place in Northern regions of Somalia and they were leading the peace processes for establishment of Somaliland as all the different stakeholders of Somaliland tribes, politician and social groups participated in Borama conference for the peace and state building in 1993 at Sheikh Ali Jawhar Secondary School.

2 WATER SUPPLY AND SANITATION SITUATION IN BORAMA

2.1 Strategic Policies for water development.

2.1.1 country context

Somaliland has proclaimed its independence from Somalia in 1991, though not yet recognized internationally, the country has succeeded to maintain peace and stability. The country geographically locates in water stressed area where climate is arid or semi-arid, the average annual rainfall is 350mm, the global warming and climate changes prevailing in the world has affected the rainfall patterns and as a result of that prolonged dry seasons and recurrent droughts are prevalent.

The ministry of water resources Development is the mandated government institution for the WASH sector of the country. There are four regulatory framework documents for the management of the country WASH sector such as the National Water Policy, the national water strategy, the National Water act and the National water regulation which are working documents. The country has Somaliland vision of 2030 which highlights water as the first priority for all, there are National Development Plan II 2017-2021 where development of ground water and surface water resources are among the top priorities in country context. There are also bi-annual regional and district development plans for Awdal region as well as Borama district. Borama town has 25 years master plan which are defining well the immediate, intermediate and long-term plans of the water intervention of town.

2.1.1 Awdal region and Borama City.

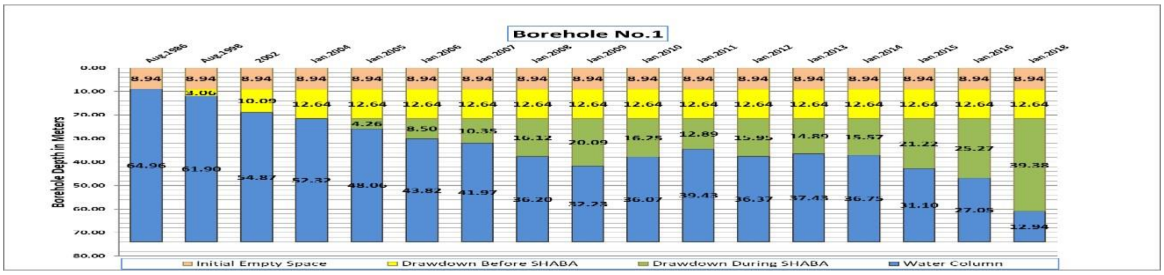
Awdal Region is very strategic as it connects the country to Djibouti, Ethiopia and the red sea, Borama is the capital of Awdal region with an estimate population of 250,000 inhabitants, the region is very famous for the center for education in Somaliland/Somalia as the first university in Somaliland was established in

Amoud before two decades. Borama town locates in mountainous areas and the average annual rainfall is 504mm/year.

African water Faculty/ African Development bank supported comprehensive study for IWRMIP which was carried out by the Norwegian Company (NIRAS). The study recommended the construction of two high capacity dams for of the future Borama town water supply and this project proposal is based on that recommendation.

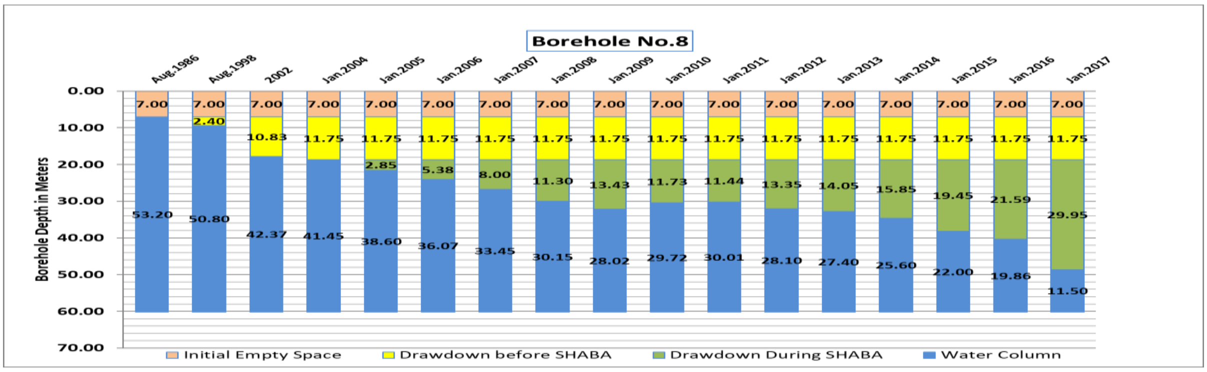
2.2 Water resources in the city environs.

Ground water resources are the major water sources the water supply of Borama town, the development of surface water has not net exploited to contribute to the town water. However, due to the fast population growth and the variation to the ground water recharge most of the production boreholes dried up while the water table of remaining ones showed drop down, the daily water consumption per person is far below the international set standard for urban water supply, the fast-growing town population created huge gap between supply and the demand. The company, putting more emphasis to cover the demand, noticed that there is drastic dropping down to the water table on regular basis (8-10m/year) , the global warming and climate related issues also reduced the recharge of the ground water table and as a result of that nearly 8 boreholes dried up so far as indicated in this graph.



Dried borehole No.1

this shows that the aquifer and the ground water in that areas are under stress and it is evident that in the future the use of ground water alone is not sufficient to cover the growing demand for water in Borama town



Dried borehole No.8

The town receives enough rainfall compared to the country but the exploitation of the surface water is quite limited or does not exist. Rain water is the primary water resources for all kind of uses but harvesting culture is minimum in all over the country including Borama town citizens, the country locates in arid and semi-arid area but compared to some countries in northern Africa and Arabian countries, Somaliland receives better average annual rainfall which is quite enough if rainwater harvesting schemes are adapted and it will definitely complement the depleting ground water. Recent studies carried out by African Water facility project has recommended the construction of Mass storage dam in south east of Amoud with a capacity of 6 million Cubic meters and could provide 16,400 cubic meter/day. The town gets most of the support from UNICEF who is close partner for the town water development as they have imitated the first project for the expansion of town water supply and establishment of the PPP management in Borama in 2002. UNICEF has also supported during the past decade, the connection of three production boreholes to the town water supply, construction of high spot tank and connection of water supply to 5 IDP centres

The town has recently received from SDF the development of the western aquifer which locates near the Ethiopian border but has no yet completed.

2.4 Present situation of the town

Borama town is facing water stress as indicated in the recent studies carried out by certain professional organizations, the major aquifers of the eastern part of the town showed drop down to the water table which is negative sign for the future of Borama town water, the western aquifer is still under implementation and nobody knows when it will be completed, the forecast is that the ground water alone are not sufficient to the town water supply. Before the start of the PPP management, the total population estimate of Borama was 50,000 people with maximum daily production of 420 CUM which provide 8.4lpd, while present estimate is more than 384,000 and the present daily production is 5,200 CUM/day with coverage of 15 lpd. The minimum standard for urban centers taken as baseline for urban centers is 40lpd. Using this standard for calculations, the present demand is 10,000 CUM/day which is double of the present production.

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Borama town is facing great challenge if immediate measures are not taken in time, the fast-growing urbanization is reality, there is huge gap between the supply and demand. the potential ground water resources are gradually approaching their upper limits and some boreholes already started to dry up.

This project proposal is advocating the construction of large dams in the upper stream of Amoud river as proposed by NIRAS[2] (international company who published the IWRM IP)

2.5 population group and water demand

Demographic statistics, including the size and composition of the population and spatial distribution, are cornerstones in development planning and project design, particularly in connection with projection of future water requirements. Somaliland is lacking comprehensive and reliable population data because the statistical infrastructure and systems that were in place were destroyed during the protracted conflict the country endured in the late 1980s and early 1990s. Needless to say, the data from the only two previously conducted censuses in 1975 and 1986 are outdated.

To fill this gap, United Nations Population Fund (UNFPA) in collaboration with the Government of Somaliland conducted a Population Estimation Survey (PESS) in late 2013 (UNFPA, 2013). It should be noted that the PESS was not a formal population census, but was intended to set an integrated baseline for basic

[2] NIRAS Norwegian company for international water studies

demographic information and providing tools such as sampling procedures systems for future surveys and in preparation of a new formal population census

Estimated population growth 2020-2045

Town	2020 Population base line	2025		2035		2045	
		p.a %	Population	p.a %	Population	p.a %	Population
Borama	384,000	3.2	494,000	3	664,000	2.8	875,000

Access to save water supply calculation parameters

Service level parameters	Group of the population	2020	2045
Unit consumption	Urban	40lpd	80lpd

Water supply demand projection in CUM/day

Town	2020 Population base line	2025	2035	2045
Borama	9,200	17,300	34,000	64,000

The PESS results provided a Somaliland population size of 250,000. By adopting this estimated 2013/2014 population size and using the present population growth rate for Somaliland as a whole of 3.2% annually (MoNPD, 2017), the Somaliland population can be estimated to be about 4.0 million in 2017. The estimate of Borama population is nearly 250,000 as indicated in Somaliland in figures. this will be the basis for the calculation of the water demand in this project proposal.

According to the NDPII (MONP 2017) 42% [3]of the urban water supply get safe water supply. the NDPII target is to increase this ratio to reach the threshold of 50.4% [4]by the end of 2021. Additionally, the daily consumption is well below the international standards set potable water. In Borama the coverage is little bit better than the other towns but it will be the worst of all if the present trend of fast aquifer depletion is not tackled.

[3] NDP 1

[4] NDP II

Access to safe public water supply – calculation parameters

Service level Parameter	Population group	2017 (baseline)	2045
Unit consumption	Urban	40 lcd	80 lcd
	Rural	20 lcd	40 lcd
	Nomadic	10 lcd	20 lcd
Water supply coverage	Urban	60 %	90 %
	Rural	30 %	80 %
	Nomadic	20 %	60 %

Note: The unit consumption figure (lcd) for the nomadic group assumes 'human' water demand only and not water for their livestock.

: Public water supply demand projections (2017-2045)

Region	2017 (baseline)	2025	2035	2045
Borama Total (m^3/day)	9,200	17,300	34,500	63,000

2.5 Current Demand and Demand Projections up to 2041 or any other planning horizon.

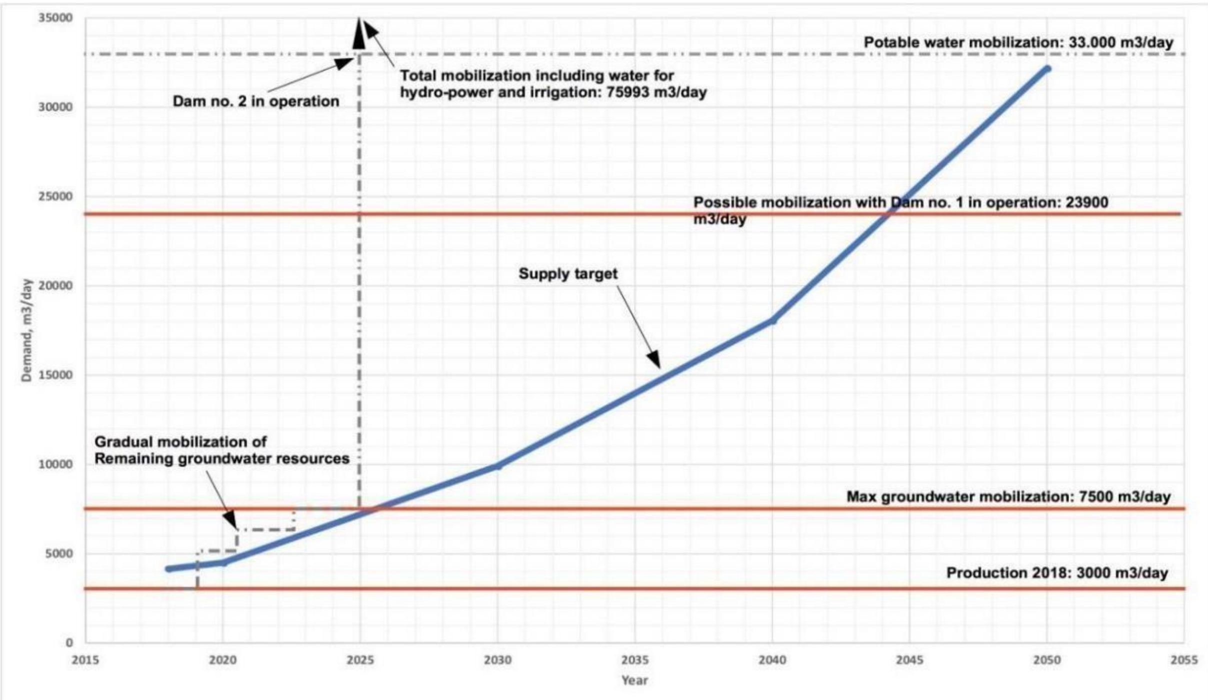
The present production is5200M^3 /dayforapproximately 250,000 peoplewithprovision of 20.8 lpd, this far below the international minimum standard for urban centres which is 40lpd. the rough estimate for presentdemandusingthatstandardis10,000 M^3/day with a gap of 4,800 M3/day.

The development in the forecasted supply target in the Borama zone during the planning period up to 2050 isshown in Figure97 togetherwiththe available groundwater resources, the current production and a mobilization and augmentation plan. It can be seen, that the available groundwater resources, includingthenew well-fieldwithadditionalboreholes, onlywill beable to satisfythedemand uptoaround 2025. After thistime, itwillbenecessaryto use and mobilize surface water resources. The first step, and as an immediate measure, the demand deficit should be satisfied by an increased groundwater exploitation carriedoutasagradualmobilizationofthe remaining groundwater resources. As indicated in the Figure below, the option to introduce a dam for Borama city has been assessed. The Dam can mobilize surface water resources at a safe abstraction rate of 16,400 m^3/day, which can satisfy the demand up to 2044.

2.5.1 Industrial/commercial and institutional water requirements

Additional to the domestic water demand, particularly in urban settings like Borama, potable water is also supplied to industrial and commercial activities as well as institutions. At this stage where it is attempted to provide an overall assessment of the town water supply requirements, it is assumed that these additional water requirements are included in the above calculated water requirements. At the time when specific water supply schemes are going to be planned for and designed, the demand projections have to be carried out in more details whereby the various user categories can be incorporated in a more realisticmanner.

Mobilization and augmentation plan for Borama zone



Source: African Water Facility - 2018

2.6 Sanitation situation and issues faced by the city including waste disposal

The situation of Borama town sanitation is very poor due to in appropriate management of liquid and solid waste management, there private companies who have signed agreement with the town municipality but they do not have the required equipment and experience the town dot have well plan Sanitation situation and issues faced by the city-including waste disposal facilities measures. The sanitation inside the house are quite well and every house hold is responsible on his family while the community and town roles are not in good shape such as the intermediate and final damping sites and as a result of that you can notice the wide dispersal of used plastic containers and bags inside the town.

On other hand the town locates in mountainous area, the floods from the rains do have enough drainage system and during the rainy seasons runoff water are the major vehicle for transporting wastes to the wadis and dry rivers and are the major contaminant of the surface, shallow and ground water resources. There are some tried efforts to establish PPP management for the solid and liquid waste management but are not still at the required level and the waste management issue is among the major problems in Borama town. There are small private companies with are in contract with the Borama Municipality but introduction of PPP management is the recommended option like the water supply.

3 PROJECT AREA

3.1 Location of the Borama Dam1

The location of the Dam is 6 kilometres south east of Borama town on the upper stream of Amoud river as indicated in map and the description of the project the site locates between two hills exactly at the vicinity of where Awrdil and Aroqolaab attributes meet with a catchment area of 33.4Km^2

The Coordinates of the dam site are: from 43.237911568° E 9.915365858° N To 43 2431732157° E 9,9144222128 °N. the dam site was first marked by the master plan of Borama town which was carried out by Terra Solidali which was down stream of the same dry river (Amoud River). How ever the social and economic impact was enormous as the collected water should the University compound which one of the major economic income for Borama town and nearly half of Borama town people get direct or in direct employment from the University, in that regard African water facility project for IWRMIP project selected the upper stream of the same Amoud dry river as the best option for the construction of the 6 million Cum dam for the future Borama town water supply with minimum negative impact to environment, social and economy as indicated by the comprehensive study carried out by the experts from the ministries of Environment and Water resources Development.

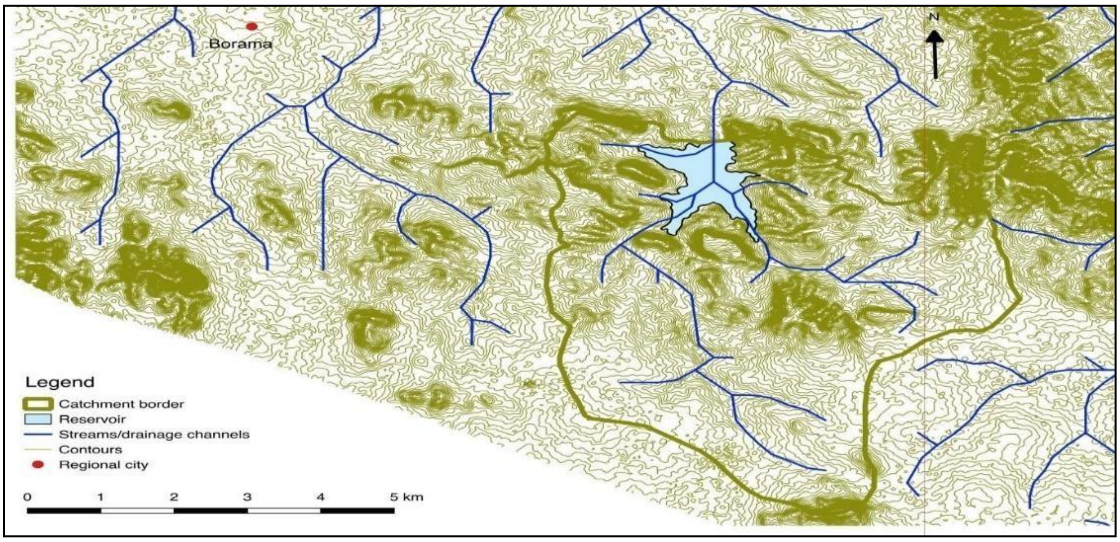


Figure 1 Amoud RCC Dam location from satellite

3.2 General Geological Formations and characteristics of project area (including upstream and downstream areas.

The area is dominated by basement units of different types metamorphic rocks and intrusive igneous rocks. These unites include metamorphosed quartzofeldspathic sediments (psammites) possibly originally arkoses, with common amphibolite, mica-schists with amphibolite. Low grade metamorphic rocks of pelitic and semi-pelitic. The older metamorphic rocks are often intruded by intrusive rocks of both acidic and mafic, such as gabbros, granites granodiorites and pegmatites forming large batholiths dykes and sills.

The basal Adigrat sandstone is observed and documented to the present in the area, Adigrad in unconformity on the crystalline basement. This unit, well visible mostly in the Amoud basin, is constituted by crossed layers of sand and gravel, mostly made by quartz. Sometimes finer levels like fine sand and silt are present, like those find in drilling both eastern and western basin. In the visited outcrops the prevalence of the coarser clasts has been ascertained. The thickness of the unit does not 50m in the study areas.

The main sedimentary rocks of the area are Jurassic limestone outliers, which are typically seen as isolated. Elongated hills, faulted against the Precambrian basement metasediments limestone outcrop examined immediately north of the fault separating the Precambrian basement and the limestone down stream of the dam site is hard, grey in colour. The upstream of the site proposed for the dam, the rock formation is basement apart from some isolated limestone units in the southwest of the drainage basin. The slope is relatively steeper, hence minimum loss of water through infiltration.

The earthquake associated risk is very minimum for the dam as the magnitude and frequency of earthquake in Borama is very small, RCC gravity dams have generally good resistance and is recommended.

The spill way will be integral part of the main structure which will discharge floodwater over the crest of the dam,

In conclusion the proposed site for the dam possesses the favourable conditions for this type of dam in terms of geological, stream morphological and drainage basin runoff .

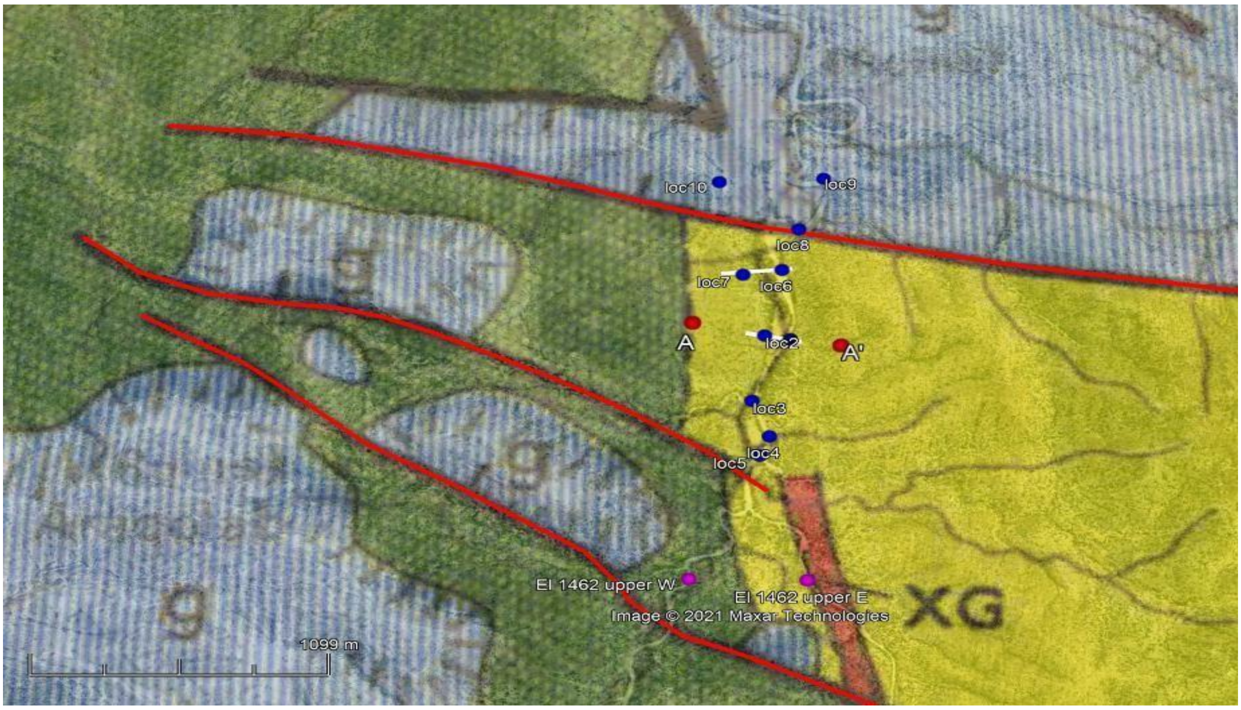


Figure 2 geological map indicating differs formations of the dam area (consultant report)

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3.3 Socio-economic situation of the inhabitants of the area

The communities in the upper stream of Amoud river are totally different from the lower who own irrigated farm for cash crop and rain fed farms for crop production, they raise different types of life stock and the area near the river banks is rich with thick forest, the is only one rainfed farms in catchment area. The other occupation for the communities in the project area is the collection of the construction materials such as stone from the lime stone small hills and sand from the river beds.

3.4 Flora and fauna

Flora is all the plant life present in a particular region or time and are generally occurring native plants. The corresponding term for animal is fauna.

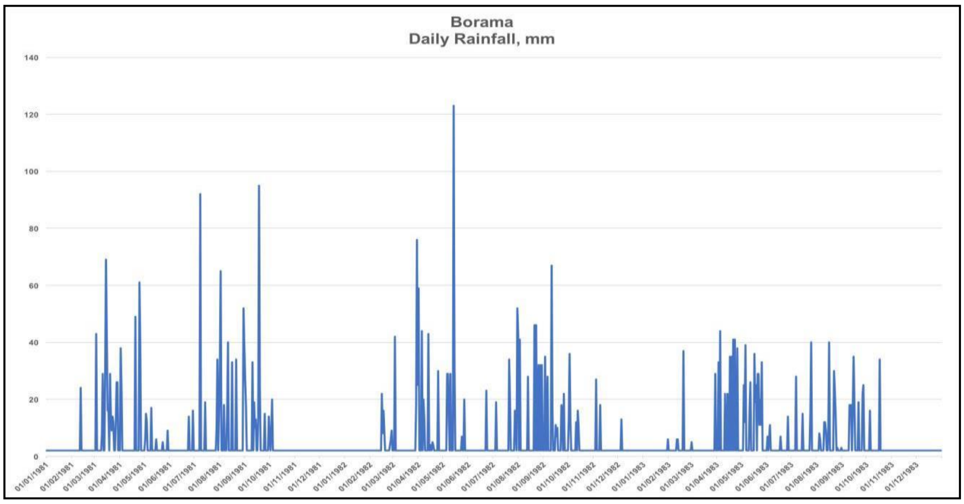
Flora and fauna are a part of the ecosystem and they interdependent on each other for their survival. besides the ecosystem becomes imbalanced if there are any adverse effects on flora and fauna, such as an extinction of a certain species. The status of Flora and fauna of the project area is like the other locations of the Borama and the region.

Figure 3 location of Amoud River upper stream

The climate of Borama town has the characteristic of mountainous area where the temperature is hot during the summer and cool in the winter, the town gets enough rains compared to the other towns of the country during Gu'(April-May) and Dayr (July-Oct). the average annual rainfall is 504mm/year. The town gets water supply from boreholes in the eastern aquifer of Amoud/Dhamoug which several kilometres away from the eastern part of the town. However, the water table has dropped down from 30m to 90m which is resulted from the climate change and the global warming. The town population is growing very fast and the demand for clean water supply is increasing is increasing as well several studies supported by ADB and UNICEF revealed that harvesting of rain water is the best option which can supply enough water to growing town lie Borama. Underneath is the rainfall records

3.5 Rainfall statistics since 1944 - 1982 was collected by C. FAILLACI report (hydrogeology of Northern Somali) VOL.1 1986.

Borama town like the other location of the country locates in arid/semi-arid area where the rainfall availability is sporadic. However, the town locates in mountainous areas with high altitude and gets an average annual rainfall of 540mm/year which is high compared to the other towns of the country except Erigavo which gets about 600mm/year. The interim report for IWRMIP carried out NIRAS and funded by the African Water Facility funded project collected the below mentioned table for Borama rainfall record.



The British colony started the record of the rainfall of the major towns of the country including Borama and below is the rainfall record of thirty years (C. FAILLACI 1952-1982)

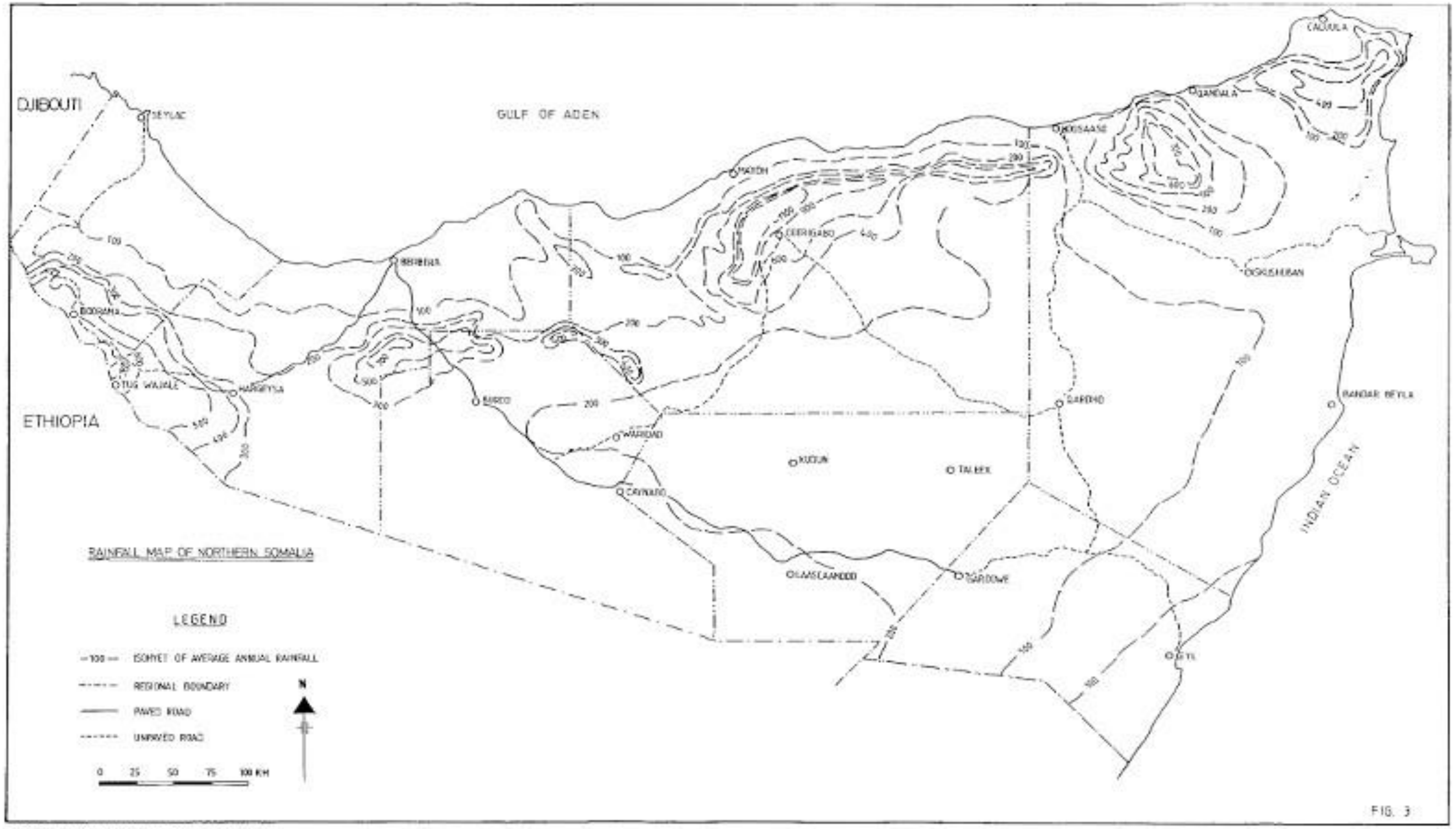
Table No. 1: Rainfall Records in Northern Somalia Updated to May 1982 Source: RMR

Station	Latitude	Longitude	Elev. (m)	Mean Annual Rainfall(mm)	Years of Records
Seylac	11°21'	43°29'	1	93	24
Boosaaso	11°15'	49°10'	5	17	10
Berbera	10°26'	45°02'	8	57	44
Eyl	7°49'	49°49'	50	140	7
Silil	10°59'	43°27'	70	129	14
Iskushuban	10°16'	50°13'	300	60	7
Xudun	9°07'	47°28'	620	101	7
Buuhoodle	8°15'	46°20'	650	157	7
Laas Caanood	8°28'	47°22'	700	163	18
Qardho	9°30'	49°05'	720	112	18
Caynabo	8°57'	46°26'	770	146	7
Beer	9°22'	45°47'	930	157	7
Buraan	10°13'	48°47'	980	70	7
Gudubi	8°48'	45°00'	1000	177	7
Ceel Afweyne	9°55'	47°13'	1010	136	7
Burco	9°31'	45°34'	1040	186	31
Oodweyne	9°24'	45°05'	1050	206	7
Ceel Same	9°23'	45°10'	1050	251	7
Ceelal	9°56'	46°17'	1080	206	7
Bown	10°12'	43°05'	1310	322	7
Hargeysa	9°31'	44°06'	1370	429	50
Shiikh	9°57'	45°12'	1430	523	34
Boorama	9°56'	43°11'	1450	508	38
Gebiley	9°47'	43°37'	1450	432	8
Tug Wajale	9°37'	43°17'	1550	551	8
Ceerigabo	10°37'	47°22'	1740	314	27
Daloh	10°47'	47°17'	2060	725	6

Below is also the rainfall record of Borama town for thirteen years (2006-20190)

Year	Rainfall in mm
2006	50.5
2007	432
2008	493.5
2009	414.5
2010	781.1
2011	405.5
2012	456.8
2013	624.8
2014	340
2015	299
2016	370.5
2017	465.5
2018	587.5
2019	577

Rainfall records collected by the centre of meteorology of ministry of agriculture (2006-2019)



RAINFALL MAP OF NORTHERN SOMALIA

FIG. 3

ADAPTED FROM RESOURCES MANAGEMENT & RESEARCH

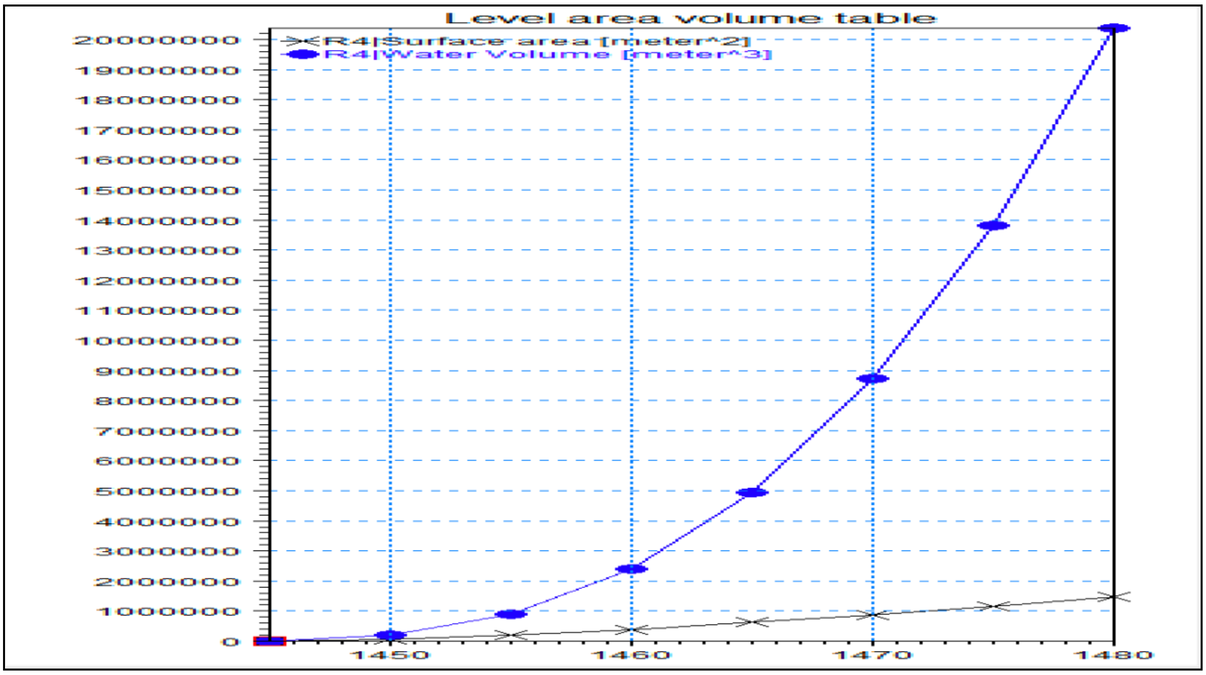
3.6 Estimated annual Water runoff in million cubic meters

The average annual rainfall of Borama is 504mm/year as indicated in the data collected by C. FAILLACI report and MOA data centre with maximum of 781.5mm/year and minimum of 299mm/year. the catchment area project area is 33.4 km.

catchment area and capacity of the aquifer

The minimum annual runoff water that passes though the catchment area proposed for the construction of the gravity RRC dam is 9.9 million m^3 and the maximum of 26.1 million m^3 Harvesting of one third of the calculated minimum amount can store 3.3 million m^3 and maximum of 8.7 million m^3. The requirement of the town water supply, the capacity of the recommended dam is 3-4 million m^3

figure The volume -area-level relation is indicated below



4 The project

4.1 Project Rationale

Borama town is growing very vast due to enormous influx of more people from abroad for the peace, stability and better education, the urbanization and economic growth is also growing gradually as huge buildings, large business centres, small industries and government premises are under constant construction. The need for the different uses of safe and adequate water supply is increasing exponentially as well and there is always huge gap between the supply. The major sources for the town water supply is ground from the boreholes in eastern part of the town but due to the population growth and change to rainfall patterns the aquifer showed drastic drop which resulted the dry up of some production wells.

4.1.2 Policies, water regulatory frameworks and reforms

Somaliland is in process of putting in place the regulatory framework that will compromise the institutions, policies and tools outline below: -

National Water Policy (approved June 2004), which sets out the objectives, general principles and guidelines to be followed in developing the water sector.

National Water Strategy (approved Sept. 2004), indicating priorities and detailed measures to be taken to permit the policy to be implemented.

Water Act (draft Sept. 2004), establishing the legal framework to support the strategy, defining organisations, mandates and responsibilities, as well as procedures, obligations and interdictions in a general way.

Water Regulations (under preparation), gathering all the by-laws necessary to enforce the Water Act.

The Policy and Strategy may need to be updated to reflect any changes to the sector policy, governance and support frameworks; or strategic water resources management priorities and implementation measures

All these regulatory framework documents are pointing out that rainwater are the primary water sources for domestic and agriculture food production and encouraging to put in the priority its wise and safe exploitation for various uses in the WASH sector which is now very limited. The policy is supporting the start of rainwater harvesting schemes for urban water supply as the ground water resources are not merely sufficient to cover alone the demand to the fast-growing urbanization which is active in Somaliland major towns as indicated by UNHABITAT report of 2006.

4.1.3 Somaliland planning and priorities

The Ministry of National Planning and Development, in collaboration with the various line ministries including the Ministry of Water Resources Development (MoWRD), have prepared a number of relevant plans setting out their short, medium and long term priorities ,the five strategic water development plan II 2017-2021 for Somaliland consists of 5 years plan for nine sectors including the WASH sector and the rainwater harvesting is considered as the major appropriate resource for all uses including the for major towns water supply, there are regional and district development plans for Awdal region and Borama district that are giving the safe and wise harvesting of rainwater be the first priority for all major urban towns as the notion for the sole use of ground water for the major towns will no longer be sufficient to cover the fast and growing demand major towns like Borama.

Although the country locates in semi-arid and drought prone areas According to several studies carried out by the professional international institutions, the country gets better rains compared to certain countries in North Africa and middle east countries but its harvesting through construction of higher capacity water catchments is not yet practical. African Development Bank has recently supported the comprehensive study to the Somaliland water sector “integrated water resources management Investment Plan for Somaliland. ”

Like the other towns in the developing countries the use of rainwater high capacity schemes for the town water supply are the most suitable option for full coverage of huge gap between the supply and demand in the major towns of Somaliland including Borama town which is facing huge water scarcity.

4.1.4 Awdal region and Borama district WASH plans priorities

Awdal region borders with Djibouti, Borama town has 25 years master plan supported by the EU through UNICEF WASH sector, the immediate and the intermediate plans were already done or ongoing while the long-term plans are based on the development of surface/rain water harvesting schemes in Amoud and Baki through construction of high capacity water storage mega dams.

The African Water facility has also supported the preparation of integrated water resources management investment plan through out the country through comprehensive study for the surface and ground water resources and have prioritized the most suitable schemes that are sufficient to supply sufficient water supply to all different locations of the country. The study has recommended the construct of two dams for Borama town water supply , Dam 1 (gravity RCC dam) in the upper stream of Amoud with a storage capacity of 6 million CUM/ year while Dam2 locates in the downstream of Darimacaane with a capacity of 19 CUM/year which will be used for all uses including town water supply, irrigation and production of hydroelectric power for Borama town.

This project aims to support the construction of Dam 1 to address the realization of secured water for Borama town in the future through the exploitation of runoff water from the rains and will be the first model for mass storage water resource for urban water supply systems and then the model will be replicated in the rest of the other major towns.

4.1.5 Problem Definition

Despite the existence of the best water management which is PPP model, Water is scarce in Borama town, the eastern aquifers of Amoud and Dhamoug showed drastic drop down to the water table. The water table of the aquifer dropped down from 20 m to about 90m and as a result of that nearly 12 boreholes dried up during the past two decades, the major reason for is due to the climatic effects and global warming coupled with very active town population growth. The company is struggling to cover the gap between the supply and demand. The exponential increase of the town water demand is not marching with the small aquifer and as the master plan has recommended there is the need for rainwater harvesting and construction of huge runoff storage.

4.2 Project description

4.2.1 Project Goal, Objectives and Outputs

The impact of this project is to contribute to the efforts for initiating rain water harvesting scheme with high storage capacity that can contribute to supply adequate water for Borama town and also recharge the ground water to elevate the water table of Amoud/Dhamoug aquifers.

4.2.2 Overall objective and purpose

he overall objective of the project is to build a resilient and sustainable water supply with sanitation measures t that meets the needs of all users in Borama town as well as to provide safe, adequate and affordable water supply with a view to improving livelihoods and building resilience against climate variability and change.

4.2.3 The outcomes are:

- Procurement process including information, data, other services, goods information and data, related to the project completed.
- Insured safe water supply provided to Borama town inhabitants and their economic dependants.
- Water supply with high quality which are fit for human consumption (as per WHO & ministry of health guidelines using modern water purification facilities, pipes, equipment and tools.
- Borama water supply company (SHABA) capacitated in all aspects to ensured sustainable management.

4.3 Project Components, Outputs and Activities

The project has five main components:

Component one	Preparatory works for construction of the Dam.
Component two	Construction of high capacity Mam with 6 million CUM
Component three	Procurement, installation of modern purification plant
Component four	procurement /construction of pipes, reservoirs, other infrastructure and related accessories
Component five	Capacity building to the MOWR and SHABA

4.3.1 Component 1: Review the design and carry out all preparatory works for the construction of the dam

This component is focused on the reviewing the data, information, BOQ and designs of the prepatory works for the construction of the dam and then adjust it with the related procurement procedures and standards for construction of gravity RCC dams and other water works. The project will hire qualified consultants to prepare relevant TOR for hiring qualified experts.

The main activities to be undertaken include review of assessment and investigation of hydrogeological information needs; reviewing detailed design and preparation of tender documents; procurement of contractors to undertake the works; and implementation dam works, linking to the community capacity building activities; and dissemination of the results to all stakeholders and beneficiaries. SHABA and one local NGOs may be engaged to demonstrate how to build capacity of communities, households, pastoralists, etc. to meet their water needs and sustainably manage their water resources.

4.3.2 Component 2: Construction of high capacity RCC gravity Dam. The component is focused on to the construction of high capacity dam with all necessary accessories in order to meet high demand for clean water for Borama town. The project will work closely with the MOWR, SHABA and other stakeholders to prioritize the works which will be implemented under the project. Activities include; construction of high capacity dam which can hold 6 million CUM/year and can provide 16,400 CUM/day to Borama town). This component will focus on enhanced water availability and accessibility through water harvesting and supply for human consumption, in a sustainable manner. Where feasible, multiple water services such as minor irrigation and livestock watering will be incorporated; and for systems using solar energy for pumping, power generated from the system will also be availed for domestic purposes

4.2.3 Component 3: procurement and construction of modern of purification plant. Surface water are not pure physically and biologically, the runoff water from the rains dissolve the soil and the other particles during the rains including dirt, debris and other solids the floods also carry the wastes from organic particles and its subject for all kinds of contaminations and thus are fit for human consumption. High turbidity is an indicator for impurity and there is need for eliminating all suspended particles, dissolved minerals and pathogenic organic contaminants.

The component is focused the PIU to prepare the TOR for qualified water quality professional who will prepare the specifications and standards for modern purification plant, recommend the selection of appropriate manufacturer and supervise the installation. The production from the dam should satisfy the WHO and ministry of health and ministry of resources guidelines and standards of potable water supply for domestic purposes.

4.2.4 Component 4: procurement and construction/installation of pipes, water reservoirs and related infrastructure and all related equipment and other accessories: This component will transmission of the raw water from dam to the purification plant and transmit the water.

The PIU will prepare TORS for qualified water Engineer, civil engineer and chemical engineers and they will advise the PIU unit in selecting qualified companies for the procurement of goods and implementation of the

The component activates procurement of pipes, fittings, construction materials control equipment and other essential Operation and Maintenance (O&M)

4.2.5 Component 5: Capacity Building: This component will support capacity development of the MOWR, SHABA and the water users of Borama town water supply to enhance the sustainable management of the system. Proposed activities include; procurement of essential Operation and Maintenance (O&M), procurement of chemicals and reagent for the purification plant as well as the laboratory equipment and provide relevant training. The component will also offer support to the Water training centre in Borama including procurement of training facilities and equipment. The component will further support the MOWR and SHABA to extend PPP concepts in the management to the other urban and rural centres.

The component will s Support will MOWR and SHABA to improve surface/ground water governance so as to enhance sustainable development of the resource.

To enhance sustainability of the water and sanitation facilities, the operators and the staff of beneficiary of the project will be trained (minimum 50% women) on basic O&M. In addition, water board /committee will participate in trainings and increase their knowledge on basic plumbing including operation and maintenance of pumping systems. The committees should overcome their time-poverty challenges. Training for communities will include hygiene promotion and sensitization with emphasis on scaling up Community

Led Total Sanitation and community-based climate change adaption activities (water resources protection through soil management, conservation, optimization of green water and re-forestation (including strengthening traditional regulations that govern use of water resources). Piloting of drip irrigation in educational institutions to promote water use efficiency will also be undertaken.

This component will also promote women and youth empowerment through establishment of tree nurseries and appropriate conservation with community management. The program will also emphasis on - the - job training using labour-based construction methods targeted at women and youth. The promotion of integrated rainwater harvesting and management for improving water supply, food security and sustainable livelihood will also be undertaken. To facilitate this, training will be provided in development of gender equitable community water user committees and community-based decision-making around water resource management. Campaign

project detailed design and parameters

4.3.1 The project was designed by a group of professionals from Somaliland diaspora from Pakistan and Australia who have enough experience and advanced qualifications and knowledge for water harvesting and related works they produced the first draft. The engineers consulted with Lahore University to update by using the modern applications for the designing such huge dams as indicated in the attached design(see 2D$,3D). The engineers also prepared the detailed costing of all the project components, activities and tasks.

4.3.2 The geological team and the hydrological team discussed thoroughly the parameters for designing the huge dam which can hold 6 million CUM as recommended by the AWF project for IWRMIP which was carried out by Norwegian international company.

4.3.3 The water study considered to design spillway which technically very essential for the safety of the dam which is based on calculated formulas for spilling away from the rains before it damages the infrastructure of the system. The spillway is integral part of the main structure as indicated in the attached spillway design

4.3.4 Surface water are subject for contamination as the water sources are open for air, the floods swipe away all dirt around the catchment areas and into the dam, the turbidity of runoff water is very high and storage from the catchment area contain suspended particles, silt, vegetable and other stranger materials. surface water should treat, all these contribute to the physical and chemical contaminations of the collected water and are not fit for domestic/urban use. Other hand the collected water from rainfall should be definitely contaminated by biological materials including pathogenic micro-organisms which could have health impacts. According to WHO guidelines, drinking water should be free from colour, odour, and dissolved materials up to certain levels recommended by the guidelines for potable water.

The project, considering the importance of water quality, planned to procurement and installation of modern water treatment plant which inline with the agreed standards for the treatment of potable urban water. See the attached design and the catalogue.

4.3.5 the transmission works and design parameters compromise two reservoirs of 2000 Cum each will receive treated water from system, chlorination will take place there through automatic gravity dozer for the disinfection of the treated water. 8.5KMs Transmission main pipe line will supply the town with through 24-inch diameter compromising (7,300m uPVC RRJ 630mm 16P and 1,200M of galvanized steel pipe 500mm Diameter) which will be connected to town main distribution system through gravity.

4.3.6 The water supply from the RCC gravity dam will be connected to the town water supply system using standard guidelines for joining balanced water supply system in terms of hydrological pressure and delivery capacity using all the required fittings, control equipment, tools and related equipment as recommended by design and project engineer.

4.3.7 Environmentally the nature of the project is category 2, the hired consultant from the Ministry of Environment carried out comprehensive report with all the required mitigation plan for all types adverse impact which could result from the planned activities to environment, social and economic related issues as indicated in the attached report ESIA and ESMP.

4.3.8 Project Engineer/supervisor Engineer will be hired by the project through international competitive bid using standard procurement procedure for the recruit for the recruitment of experienced candidate which is experienced in similar works with minimum experienced

4.4 Project cost

Cost summary project cost total cost of the project including physical and price contingencies is estimated $25,128,531 as shown in the table below. The detailed cost estimates are provided in Annex annex 2 …

SUMMARY		
I	Preparatory Works	$53,000.00
II	Earthworks	$1,841,734.00
III	Concrete and Reinforcement Works	$18,486,720.00
IV	Water Supply System works	$3,185,000.00
V	Purification and Sanitation works	$1,500,000.00
VI	Installations Works	$68,030.00
VII	AUSCULTATION MEASURES	$59,200.00
VIII	Final Works	$104,000.00
IX	SPILLWAY	$1,248,808.00
	TOTAL	**$26,546,492.00**
	PLUS Phiysical Contingency (10%)	**$2,654,649.20**
	TOTAL	**$ 29,201,141.20**
	PLUS Price Contingency (2.5%)	**$730,028.53**
	GRAND TOTAL	**$29,931,169.73**

5 Environmental and financial impacts

5.1 Environmental and social studies

The livelihoods of Somaliland population, particularly the rural communities, are dependent on environmental resources. The livestock economy which accounts for 60% of GDP is totally dependent on the availability of grazing areas and forage that is produced from fragile ecosystems. Therefore, the protection and management of the environment is critical to the country's development and survival of its population. The main legislative which ensures the safeguard of the environment and promote, sustainable exploitation, utilisation, management and conservation of the environment and natural resources is the Environment Conservation Act and Proclamation (1998). The Constitution (2001- also Revised in 2009) provides for protection and safeguards of the environment as well as the natural resources. Other relevant legislation framework include: Somaliland Decentralisation Policy, 2014; National Water Act 2011; Agricultural Land Ownership Law (Law No. 8/), 1999; and Land Management Law (Law No. 17, 2001). However, there exists no explicit legal framework of mechanism providing for Environmental Impact Assessment (EIA). There is no legal basis on which to request the proponent to carry out an EIA and no such assessments are routinely undertaken as part of environmental policy. There is no Department of Environmental Protection of MoERD is tasked with environmental impact assessment, monitoring compliance of taking enforcement actions

According to the standards for ESAP, **the project is classified as Category 2** mainly because most impacts are site specific and have no significant and irreversible detrimental effect. According to the Bank's Climate Safeguards System, the program is classified **as Category II**, requiring the implementation of adaptation measures to increase the resilience of communities and the water infrastructure to be rehabilitated and constructed to withstand the impacts of climate change. The program details are at preliminary stage and the detailed designs shall be developed during project implementation. For these reasons, the type of Environmental Assessment tool for at this stage is the development of the Environmental and Social Management Framework (ESMP).

5.2 Environmental impacts

5.2.1 negative impact

- The construction phase of the propose Dam Project has potential negative impacts associated with engineering works including the risks associated with Disturbance to topsoil created by machineries and trucks inappropriate handling construction wastes.

- Vegetation Clearing/ trees loss : Many trees will be remove and more soil especially top fertile soil will be also removed some wildlife species will immigrate there will be ecosystem changes that may affect the project area.

5.2.2 Environmental Mitigation measures

The project activities shall be executed in compliance with the constitution of the Somaliland government and the Bank's requirements.

The main measures for preventing, mitigating and managing potential negative impacts of the projects can be summarized as follows: (i) Measures for reducing land clearing (ii) Measures for limiting the impacts of the project phases by preventing soil erosion and protecting Eco health systems, (iii) Measures for disposing of the excavated and dredged material in an appropriate way, (iv) Measures to Restoration and backfilling of land. Trees and vegetation restoration by carrying out reforestation programs and establishment of Tree nursery

An Environmental and Social Management and Monitoring Programme (ESMMP) embedding the framework of an ESMP and monitoring plan is detailed below. The required organization and costs for implementing these measures are described in the ESMP.

5.3 Potential Positive Impacts

The construction or improvement of water supply systems has a lot of beneficial aspects which includes.

a) Access to safe drinking water and improved standard of living, e.g. through:

- Better domestic hygiene and reduction in water-borne diseases such as dysentery, diarrhoea, etc.; Time savings, especially for women and girls; Financial benefits, especially for those (poor) people that presently buy their water in small quantities and at high prices from ambulant water vendors;
- Capacity building and training in the community, and resulting enhancement of organizational, financial and technical capacities of community;

b) Employment and Improved Service Delivery:

- Increased employment opportunities, improved service delivery to enterprises and the population across the water sector in general remains one of the positive benefits that will arise from the proposed projects. This project will therefore provide substantive employment opportunities to local populations.
- **Enhance livelihoods of the target population:** raise the quality of life of the Borama population in general, benefitting an estimated 0.25 million people.
- **Enhanced access to water:** 90 per cent improvement of the target beneficiary households with average water use for drinking, cooking and personal hygiene over 40 litres per person.
- **Improved functionality of the water resources.** Increased water access through improved operation and maintenance of water infrastructure, though training of the staff-based water technicians and policy efficiency.
- The proposed project will create reliable and clean sources of water and reduce periodic outbreak of water-borne related diseases in mainly drought prone regions of Somaliland. . The project also intends to increase access to sanitation by constructing latrines and with hygiene and sanitation promotion activities using CLTS and CHAST approaches. This will reduce incidents of waterborne diseases.

  Increased child survival rate: The proposed project intends to improve access to clean water and sanitation and this will improve the child mortality rate, particularly the under-five year. According to UNICEF (2014) only one in seven children under the age.

6 Project feasibility.

Technical feasibility: according to the comprehensive studies carried out by the geologist and environmentalist experts including the water engineer interpretation to the hydrological data the project is technically feasible, based on that the dam was designed to their recommendations.

Financial feasibility

Economic feasibility

7 Executing agency SHABA

7.1 SHABA was established in 2003 by 19 shareholder with a total of 21 shares who meets annually, the shareholders select 5 members as the board of directors who are elected every 2 years. The company has bye law approved by the government and the attorney general office. The company have signed 10 years lease contract agreement with the ministry of Water development and Borama town Municipality. The mandate supply water to Borama town as the first PPP model and have signed lease contract agreement with the MOWRD and Borama Municipality through increased cooperation with the partners SHABA has the technical capacity to execute the implementation arrangements with collaboration of Ministry of Water engineers,

7.2 SHABA staff consists the GA, BOD and the company executive team including the general manager, departmental directors and head of the various sections. The total staff are 104 employees SHABA has skilled staff with different qualifications including water engineer, electric engineers, civil engineers, qualified professionals in project management, technicians, operators, financers and lineskilled staff.

7.3 SHABA has the capacity to work with international organization and has enough knowledge applying project implementation manual for handling such huge water work projects. SHABA is also familiar with applying procurement procedure for services, works and goods. SHABA is experienced in timely approval and supervision of implementation of the project activities. As Executing Agency SHABA will follow project documents and binding documents signed. It is not the first time that SHABA acted as the leader for big projects like this, the Company worked with UNICEF, TS and CARE international as the executing agency and has implemented drilling of boreholes, water connection to town , extension of the water system to 8 IDPs settlements, construction of high capacity RCC water reservoirs. All these projects were completed successfully. SHABA is the model PPP company that has realized sustainable management according to UNICEF report for 170 countries who get UNICEF fund support for sustainable management and many water providers from other towns and neighbouring countries visit to increase their knowledge in sustainable management.

7.4 SHABA has recognized transparent financial procedures which are transparent and accountable to all stakeholders, SHABA uses computerized systems for handling the collected fund and supplies. revenue and expenditure handling and provide quarterly and annual report to the GA and the stakeholders. SHABA business is growing and all parties are satisfied with their stake and role. The local government and central government get fees, taxes and official payments, the shareholders gets good income from their investment and company staff gets enough salaries and other benefits.

8 project implementations

8 Implementation Arrangements

8.1 The project will be implemented by a Project Management Unit (PMU) funded under the project which will report to the donor. The PMU will be hosted at the SHABA and consist of four staff; a Project Manager supported by a Financial Manager/Accountant, Procurement Specialist and Administrative Assistant (see TOR of the key staff in Annex 8). The PMU will be responsible for all aspects of implementation, including project management and coordination, financial management and procurement, and oversee the design and supervision activities. Provisions of equipment and transport will be included in the project to facilitatethe operation of the PMU.

The SHABA will form a Project Implementation Team (PIT) comprising staff of the SHABA. The PIT will work with the PMU and the consultant and support all aspects of implementation, including project management, coordination, design, procurement and supervision. The PIT will consist of a counterpart project coordinator assigned by the MMEWR, supported by a procurement officer, an M&E officer and design and supervisory engineers. At district and town/community level the local government will participate in implementation in accordance with the GoS decentralisation policies. They will support regional coordination of project activities, collection of data, aspects of design and supervision of pilot works.

One local/international consulting firm will be recruited to support the PMU and PIT in implementing the project. This will include undertaking the preparation of detailed designs and tender documents, supervision of works, and sector support and capacity building activities. As part of these activities, the consulting firm will provide technical assistance to the PMU and other staff of the SHABA in the form of on- the-job training and support. This will serve to increase the overall capacity of the SHABA to support the implementation of the project and to undertake the downstream projects that will be prepared by the donor of the project.

A Project Steering Committee (PSC) will be formed comprised of the following people or their representatives as voting members: SHABA chairman (chairperson)MOWRD regional coordinator (Deputy Chairman); governor of Awdal region, mayor of Borama town, representative from Amoud University, representative from Ministry of Environment, The PSC could include non-voting members representing the donors' agencies relevant to the water sector n Somaliland. The PSC will be tasked with approval of work progress, reviewing project progress, establishing and directing the activities of the advisory committee, and ensuring compliance with GOSL policies, plans and procedures.

To help ensure the success of the project, MOWRD will be taken in a special advisory role, whereby the Hargeisa office would provide technical support to the project team, including the consultant, SHABA, PMU etc. This may include support in the use of the ministry database on water resources in Somaliland, support to finalise the TOR for consultancy services, technical inputs with respect to the supervision and review of the consultant's activities and deliverables, participation in the Project Steering Committee and in project workshops, etc. An MOU or letter of agreement with a fee for services will be negotiated and prepared.

Consulting Services: Consultancy services under the project will include (i) Recruitment of a consulting firm for preparation of the preparatory works, planning, recruitment of the implementing agency for design of priority works, construction of supervision of the works, to be procured through Quality and Cost Based Selection (QCBS) method; (ii) Project Advisory Services to be procured through Single Source Selection method; (iii) Organisation of the community level training and capacity building to be procured through Consultants Qualification Selection (CQS) method using a shortlist comprising entirely of NGOs; and (iv) Recruitment of staff for the PMU (project manager, accountant, procurement and administrative assistant), shall be done using procedures for Selection of Individual Consultants.

Civil Works contracts consisting of the construction of s water storage facilities and related works will be implemented in one or more contracts, with the procurement of the contractors done through National Competitive Bidding (NCB). The character, size and value of the construction works to be undertaken are such that they are unlikely to attract international bidders. There are an adequate number of sufficiently qualified local contractors inSomaliland to ensure competitive bidding.

3.4.4 ***Goods*** Procurement of different types of goods shall be carried out as follows: (i) procurement of excavation equipment, trucks, loaders and vehicles shall be done through shopping; (ii) hydrological equipment shall be done through shopping due to the specialised nature of the items; and (iii) office/IT equipment ($4,200) shall be done through shopping due to the nature of the items (mainly computer hardware and software) and their small value.

Prior/Post Review**:** Procurement of goods and works in excess of $10,000, and all consultancy services, will be subject to prior review by the donor. The following documents will be reviewed prior to approval by the donor: Specific Procurement Notices (SPN), tender/ bid documents or requests for proposals from consulting firms, tender/bid evaluation reports or reports on evaluation of consultants' proposals. All other procurement will be subject to post review by the donor in accordance with procurement guidelines. Procurement documents will be kept by the executing agency for periodic review by the donor supervision missions or special audits.

The Executing Agency SHABA will be responsible for the procurement of works, goods and services. A PMU, reporting to SHABA, will be established to be in charge of the day to day activities of project implementation. The MOWRD will support project procurement activities through the appointment of a counterpart procurement specialist. The MOWRD is building its experience in implementing smaller local development projects throughout Somaliland for a variety of donors (UNICEF, ActionAid, etc.) which involve mainly local procurement of goods and works. The consulting firm will also support the procurement of works and the GIS and hydrological monitoring equipment.

General Procurement Notice: The text of a General Procurement Notice (GPN) shall be agreed with (Executing Agency) and it will be issued for publication in *local press online* and in the *other agreed Internet Website*, uponapproval of the Financing Proposal.

Procurement Plan: SHABA, as the Executing Agency, will prepare and submit a Procurement Plan acceptable to the donor, as a condition of first disbursement, setting forth (a) the particular contracts for goods, works and consulting services during the life of the project; (b) the proposed modes of procurement; and (c) the related DONOR review procedures (prior or post review). The Procurement Plan shall also set out in detail the items to be paid for from the Special Account. SHABA shall update the Procurement Plan annually or as needed throughout the duration of the project. Any revisions to the Procurement Plan will be subject to prior approval by the DONOR.

8.2 Design engineer

The PCU will prepare the TOR for design engineer and publish expression of interest in the international agreed website and most prominent local press openly and fulfil the procurement process and recruit the most successful candidate with the approval of the head of the steering. The design engineer will review the designs and BOQs drafted by consultant engineers and Lahore university and will finalize standards, specifications and guideline procedures for the construction of high capacity RCC gravity dams

8.3 supervisor Engineer

The PCU will prepare the TOR for project supervisor engineer and publish expression of interest in the international agreed website and most prominent local press openly and fulfil the procurement process and recruit the most successful candidate with the approval of the head of the steering. The supervisor engineer will implement the terms, conditions and contents of the signed contract agreements for all works related to the project implementation at all levels he will work with project coordinator selected from the PCU and report to him, he will submit timely reports from daily progress report to monthly and final report respectively.

8.4 construction company

international/national successful candidates for the implementation of the project activities will sign contract agreement with the executing agency and the donor after satisfying of all the procurement procedures and their role is carry out construction works using the agreed standards and specification for high capacity RCC gravity dams

8.5 Ministry of Water development is the government institution who repressible for water affairs at national level and also the owner of the primary asset including the water resources such as dams, boreholes and water systems in general. The ministry of water development is the regulatory body for all the partners and the successful contraction companies will apply for permission in working inside the country and define the policy, laws and bye- laws for water works in Somaliland.

8.6 Implementation Schedule

The duration of the project implementation is 36 months from the date of approval. The detailed implementation schedule will be drafted and approved. Some of the key activities and milestones are preparation of preparatory works by month 8, completion of the dam construction by month 24, purification plant 27and reservoir and pipes/ by month 34, capacity building and commissioning by month 36.

9 project risks

9.1 There possible different types of risks which are associated with geological formation of the project area and nature of environment of society near the project area. Major risks including:

prolonged drought resulted by the climate and global warming related issues which could result insufficientwater or excessive water
seepage due to permeability of the land or poor
constructionstructure damage due to earth quick
desertification of the area due to the transportation and
constructioncontamination from different kind of wastes to the
area
community related issues including land, internal conflict etc.

9.2 Mitigation measures

Two consultant issues were hired to study all kinds of mitigation measures for the above mentioned risks and comprehensive geological and ESIA assessments they submitted reports with all the mitigation plans for each and everykind of risk as indicated in the attached two reports carried out by: -

1 Eng. Abdikarim Adan Omer senior consultant for ESIA/MP for the minister of Ministry of Environment

2 Eng Ahmed Mohamed Adan Director of petroleum department for the ministry of Minerals and energy

10.Concrete gravity dam and apparent structures-basic layout

The basic shape of a concrete gravity dam is triangular in section (Figure 1a), with the top crest often widened to provide a roadway (Figure 1b).

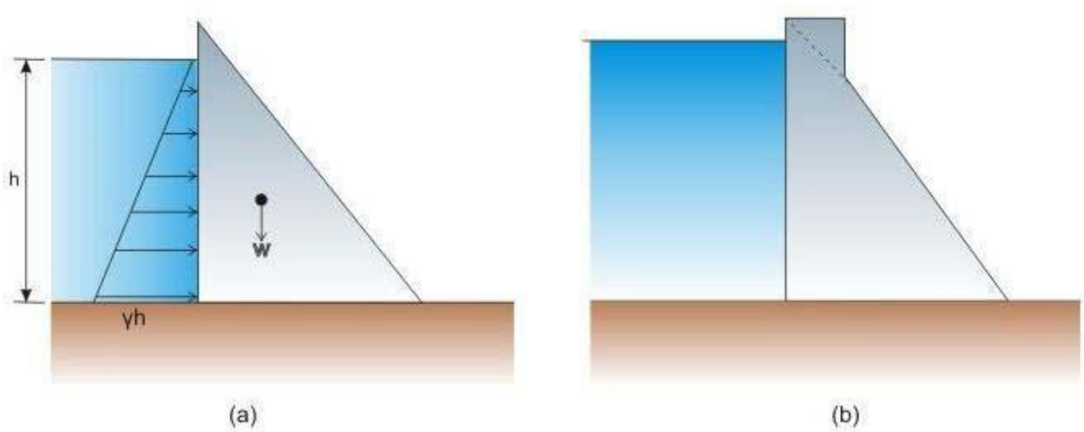


FIGURE 1 : Concrete gravity dam section (a) Basic triangular shape (b) Modified shape

10.1. Design of concrete gravity Dam sections

Fundamentally a gravity dam should satisfy the following criteria:

1. It shall be safe against overturning at any horizontal position within the dam at the contact with the foundation or within the foundation.

2. It should be safe against sliding at any horizontal plane within the dam, at the contact with the foundation or along any geological feature within the foundation.

3. The section should be so proportional that the allowable stresses in both the concrete and the foundation should not exceed.

Safety of the dam structure is to be checked against possible loadings, which may be classified as primary, secondary or exceptional. The classification is made in terms of theapplicability and/or for the relative importance of the load.

1. Primary loads are identified as universally applicable and of prime importance of the load.

2. Secondary loads are generally discretionary and of lesser magnitude like sediment load orthermal stresses due to mass concreting.

3. Exceptional loads are designed on the basis of limited general applicability or having low probability of occurrence like inertial loads associated with seismic activity.

Technically a concrete gravity dam derives its stability from the force of gravity of the materials in the section and hence the name. The gravity dam has sufficient weight so as to withstand the forces and the overturning moment caused by the water impounded in the reservoir behind it. It transfers the loads to the foundations by cantilever action and hence good foundations are pre requisite for the gravity dam.

The forces that give stability to the dam include:

1. ***Weight of the dam***
2. Thrust of the tail water

The forces that try to destabilize the dam include:

1. Reservoir water pressure
2. ***Uplift***
3. Forces due to waves in the reservoir
4. ***Ice pressure***
5. Temperature stresses
6. ***Silt pressure***
7. Seismic forces
8. ***Wind pressure***

The forces to be resisted by a gravity dam fall into two categories as given below:

1. Forces, such as weight of the dam and water pressure which are directly calculated from the unit weight of materials and properties of fluid pressure and

2. Forces such as uplift, earthquake loads, silt pressure and ice pressure which are assumed only on the basis of assumptions of varying degree of reliability. In fact to evaluate this category of forces, special care has to be taken and reliance placed on available data, experience and

judgment. Figure 23 shows the position and direction of the various forces expected in a concrete gravity dam. Forces like temperature stresses and wind pressure have not been shown. Ice pressures being uncommon in Indian context have been omitted.

10.2 For consideration of stability of a concrete dam, the following assumptions are made:

1. That the dam is composed of individual transverse vertical elements each of which carries its load to the foundation without transfer of load from or to adjacent elements. However, for convenience, the stability analysis is commonly carried out for the whole block.

2. That the vertical stress varies linearly from upstream face to the downstream face on any horizontal section.

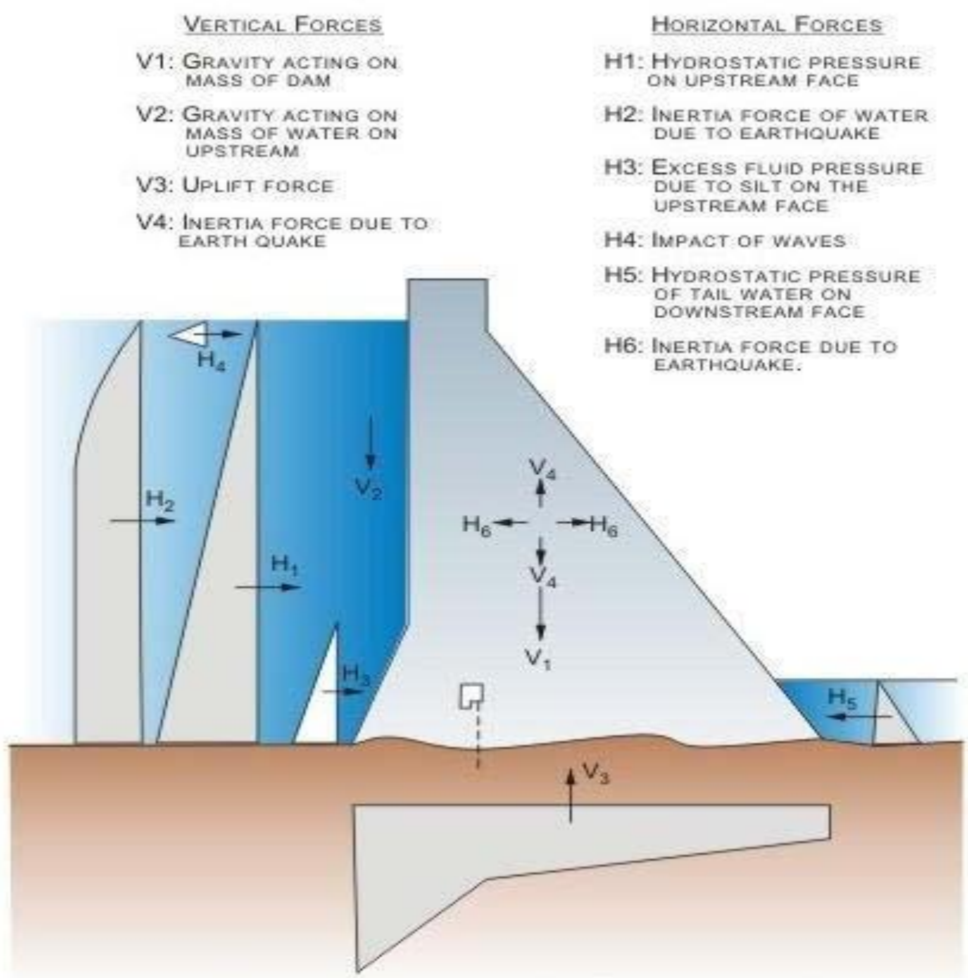


FIGURE 23: Different forces acting on a concrete gravity dam

The Bureau of Indian Standards code IS 6512-1984 “Criteria for design of solid gravity dams” recommends that a gravity dam should be designed for the most adverse load condition of the seven given type using the safety factors prescribed.

Depending upon the scope and details of the various project components, site conditions and construction programmer one or more of the following loading conditions may be applicable and may need suitable modifications. The seven types of load combinations are as follows:

1. Load combination A (construction condition): Dam completed but no water in reservoir or tailwater.
2. ***Load combination B (normal operating conditions): Full reservoir elevation, normal dry weather tail water, normal uplift, ice and silt (if applicable).***
3. Load combination C: (Flood discharge condition) - Reservoir at maximum flood pool elevation , all gates open, tailwater at flood elevation, normal uplift, and silt (if applicable).
4. ***Load combination D: Combination of A and earthquake.***
5. Load combination E: Combination B, with earthquake but no ice.
6. ***Load combination F: Combination C, but with extreme uplift, assuming the drainage holes to be inoperative.***
7. Load combination G: Combination E but with extreme uplift (drains inoperative).

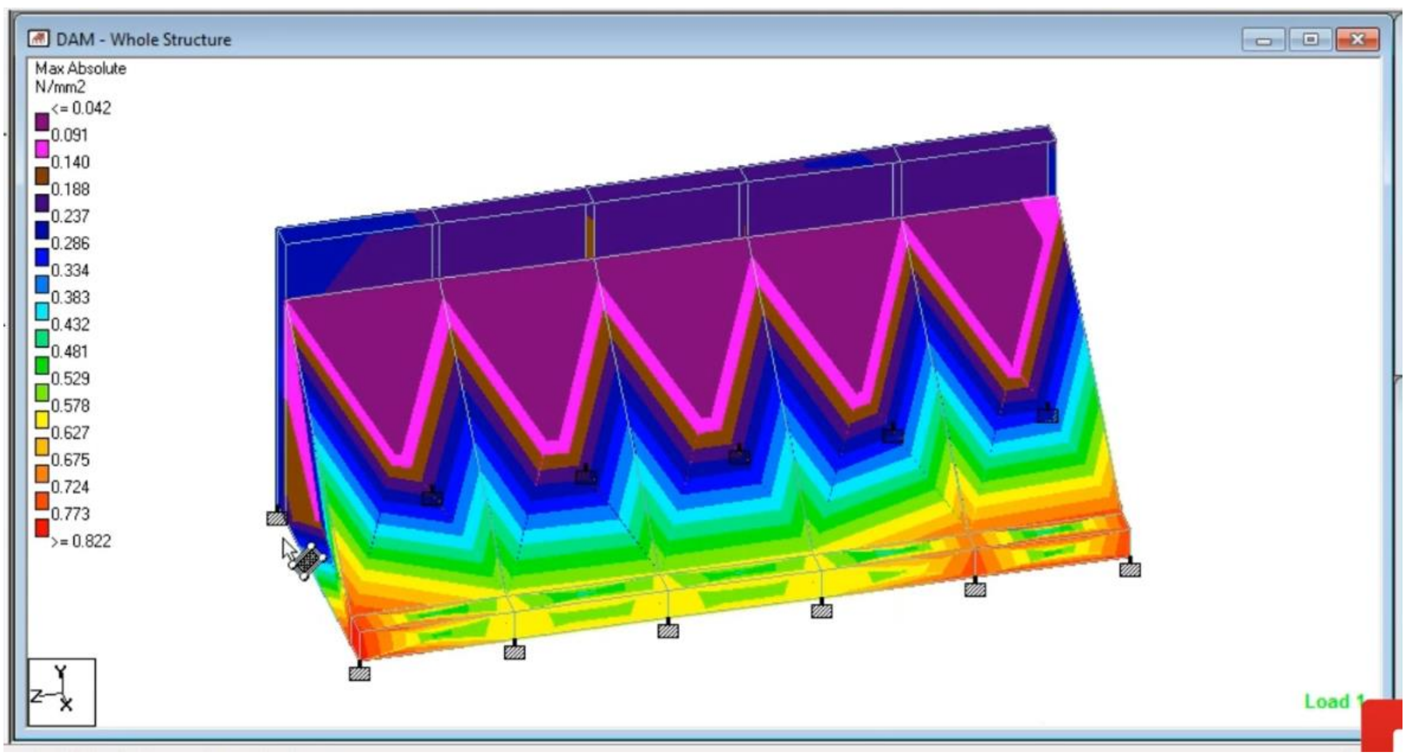
It would be useful to explain in a bit more detail the different loadings and the methods required to calculate them. These are explained in the following sections.

Loadings for concrete Gravity Dams

The significant loadings on a concrete gravity dam include the self-weight or dead load of the dam, the water pressure from the reservoir, and the uplift pressure from the foundation. There are other loadings, which either occur intermittently, like earthquake forces, or are smaller in magnitude, like the pressure exerted by the waves generated in the reservoir that hit the upstream of the dam face. These loadings are explained in the following section.

Dead load

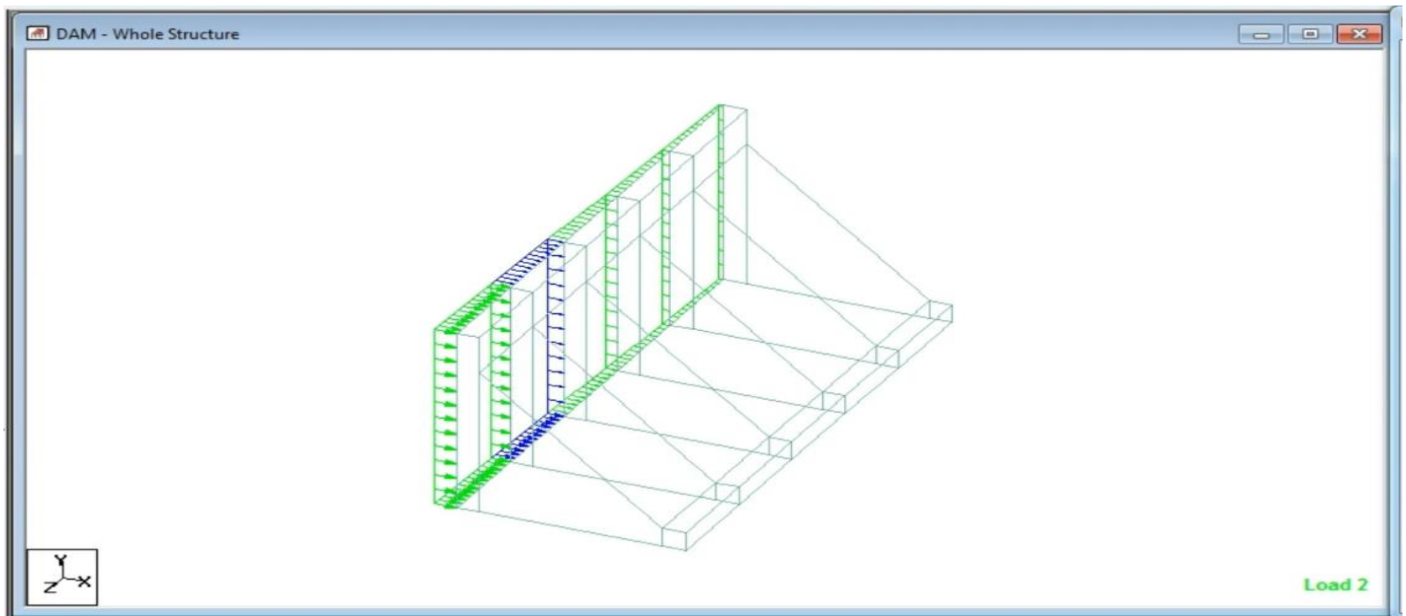
The dead load comprises of the weight of the concrete structure of the dam body in addition to pier gates and bridges, if any over the piers. The density of concrete may be considered as ***2400 kg/m³.*** Since the cross section of a dam usually would not be simple, the analysis may be carried out by dividing the section into several triangles and rectangles and the dead load (self weight) of each of these sections (considering unit width or the block width) computed separately and then added up.

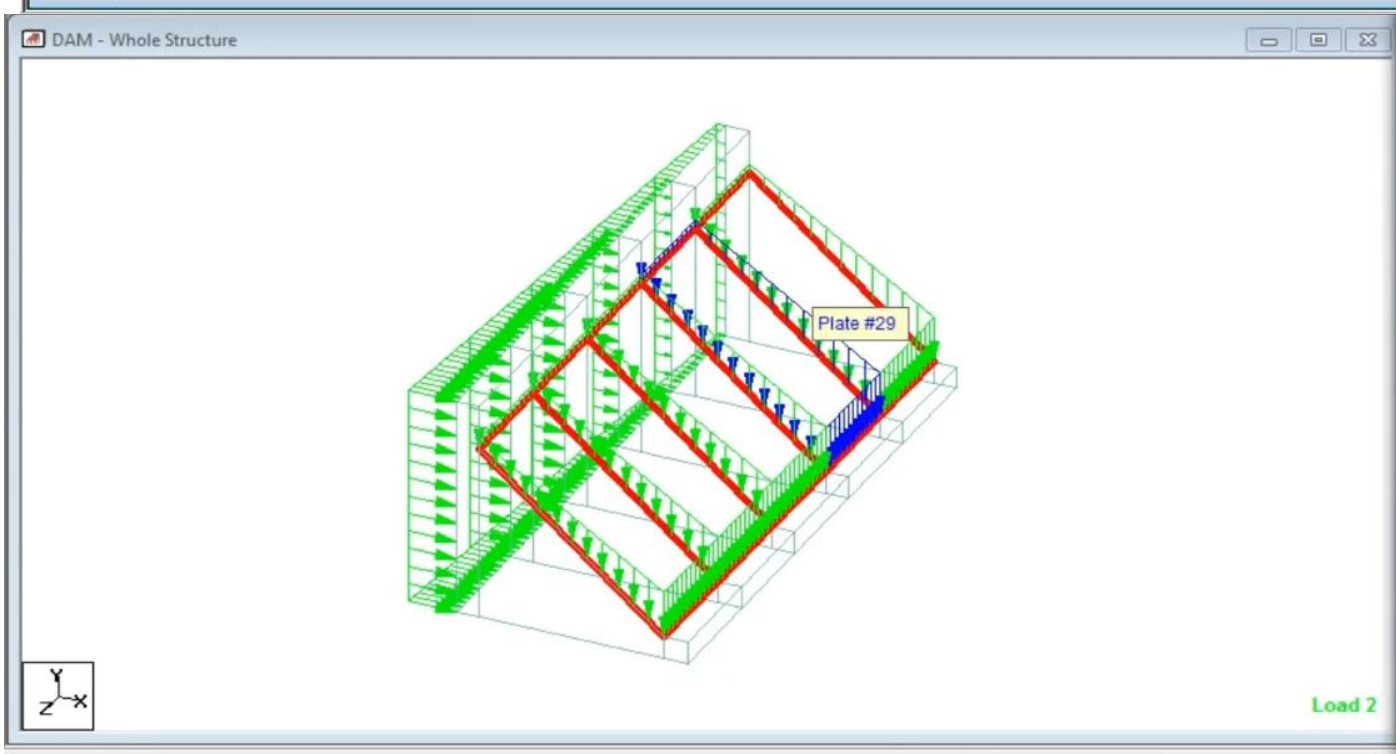


Dead load distribution of the dam structur

Hydro Static Loads

Although the weight of water varies slightly with temperature, the weight of fresh water should be taken at ***1000 kg/m³.*** A linear distribution of the static water pressure acting normal to the surface of the dam should be applied.





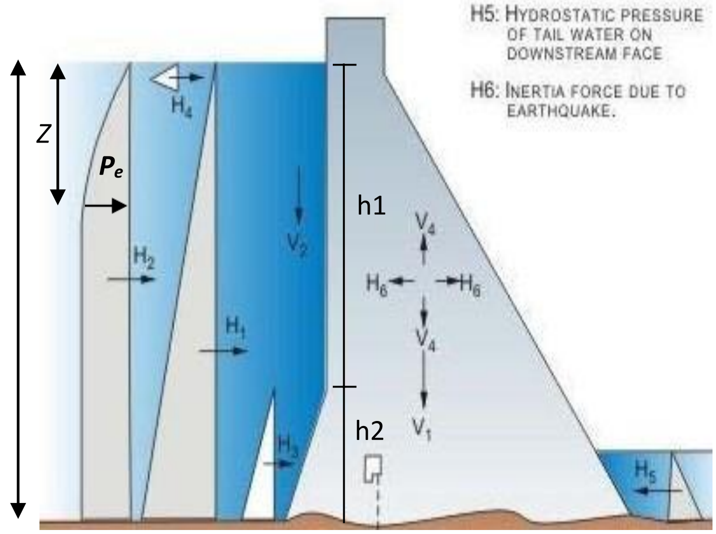
Hydrostatic pressure of upstream and downstream of the dam

10.3.1 Hydrodynamic pressure of the water

$P_e = C. k_h. \gamma. h$

$$\boldsymbol{C = \frac{Cm}{2} \left[\frac{Z}{h} \left(2 - \frac{Z}{h}\right) + \sqrt{\frac{Z}{h} \left(2 - \frac{Z}{h}\right)}\right]}$$

$\boldsymbol{C_m = 0.73}$



h

P_e = Pressure intensity

h = Maximum depth of the reservoir

z = Depth from the top of the

reservoirSo:

$$Force = H_2 = 0.726\, P_e\, Z \quad at\ \frac{4h}{3\pi}$$

$$Moment = m_e = 0.3\, P_e\, Z^2 = 0.4132\, Z\, H_2$$

Note that if h1 > (h1 + h2 = h)/2 , use β=90, else use β from the heel point to the point of water surface at the upstream face.

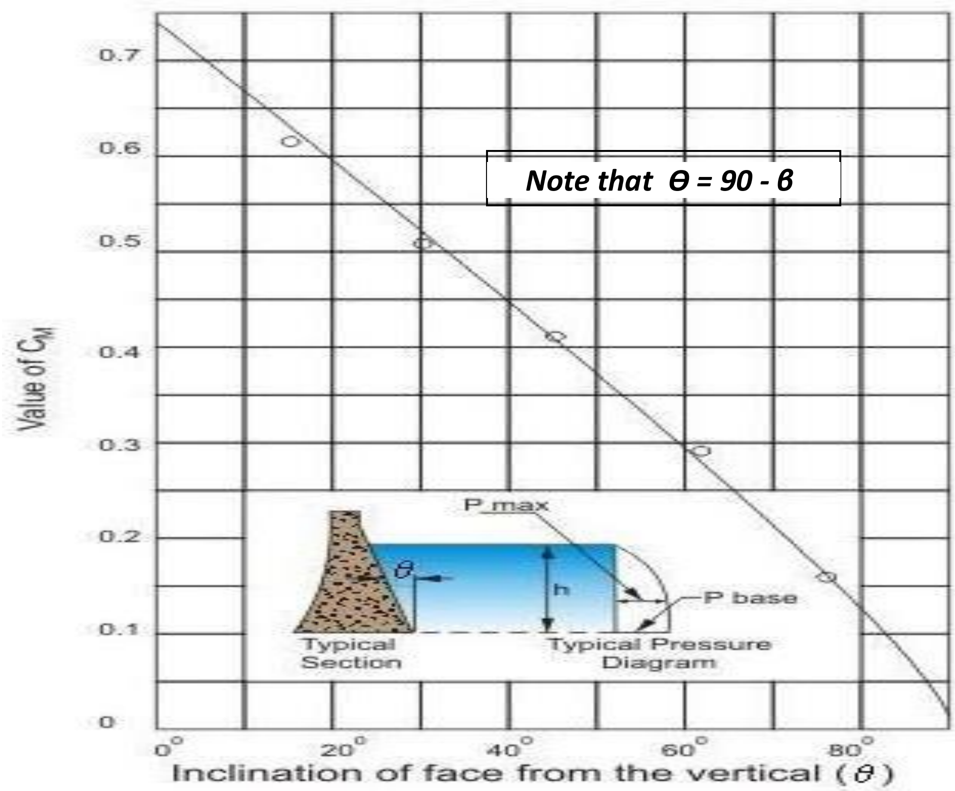


FIGURE.35: Maximum values of pressure coefficient (C_M) for dams with constant sloping faces

List of annexes

APPENDIX 3B

ROCKING RESPONSE OF BLOCKS

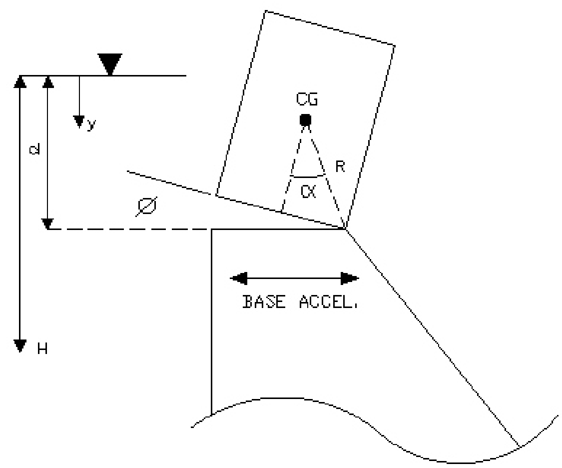
This appendix describes a method for the investigation of the response of rigid blocks in response to seismic excitation. Dynamic moment equilibrium of the block shown in figure 1B requires the satisfaction of equation 1.

$$M \cdot \left[A_B \quad + \quad R \cdot COS(\alpha - \phi) \cdot \frac{\partial^2 \phi}{\partial t^2} \right] \cdot R \cdot COS(\alpha - \phi) \quad +$$

$$M \cdot R \cdot SIN(\alpha - \phi) \cdot \frac{\partial^2 \phi}{\partial t^2} \cdot R \cdot SIN(\alpha - \phi) \quad +$$

$$W \cdot R \cdot SIN(\alpha - \phi) \quad + \quad \tfrac{1}{6}\gamma_w d^3 \quad + \quad HydroDyne \quad = \quad 0$$

EQ 1



Where:

A_B Acceleration of the block base. This is the ground acceleration if the block is sitting on the ground. It is the acceleration modified by structural response if the block is sitting on top of a structure.

W Weight of the block. M

Mass of the block.

$4_w q_w$ Weight and mass density of water.

$$Hydrodyne = A_B \rho_w \sum_{i=1,3,5}^{\infty} K1_i \cdot C_i \quad + \quad \frac{\partial^2 \phi}{\partial \phi^2} \rho_w \sum_{i=1,3,5}^{\infty} K2_i \cdot C_i$$

Where:

$$K1_i = \frac{8H}{(\pi i)^2}$$

$$K2_i = \left[\frac{2d}{(\pi i)^2} - \frac{4H}{(\pi i)^3} SIN(\frac{\pi i d}{2H}) \right]$$

$$C_i = \left[\frac{2dH}{(\pi i)} - \frac{4H^2}{(\pi i)^2} SIN(\frac{\pi i d}{2H}) \right]$$

Equation 1 and 2 can be combined as shown below:

$$A_B \left[M \cdot R \cdot COS(\alpha - \phi) + \rho_w \sum_{i=1,3,5}^{\infty} K1_i \cdot C_i \right] +$$

$$\frac{\partial^2 \phi}{\partial t^2} \cdot \left[\rho_c I_p + \rho_w \sum_{i=1,3,5}^{\infty} K2_i \cdot C_i \right] +$$

EQ 3

$$W \cdot R \cdot SIN(\alpha - \phi) \quad + \quad \tfrac{1}{6} \gamma_w d^3 \quad = \quad \mathbf{0}$$

where I_P is the polar moment of inertia about the pivot point and q_c. is the mass density of concrete.

```
ITERATION # 1, ASSUMED CRACK LENGTH=  0
```

FORCE DESCRIPTION	F->	ARM	F^	ARM	M @ 0,0
DAM DEAD LOAD-->			-630.00	126.55	79725.00
RESERVOIR LOAD-->	312.00	133.33			41600.00
TAILWATER LOAD-->	-3.12	93.33	-2.18	177.67	96.82
UPLIFT-->	22.23	96.43	177.84	128.60	-20726.06
TOTAL FORCE =	331.11		-454.34		100695.77

```
RESULTANT LINE Y AXIS INTERCEPT  @ 304.1158,   X AXIS INTERCEPT @ 221.6289
RESULTANT INTERSECTS BASE @   153.64 , 93.30
```

Foundation Design Parameters

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
1	DD
2	DL

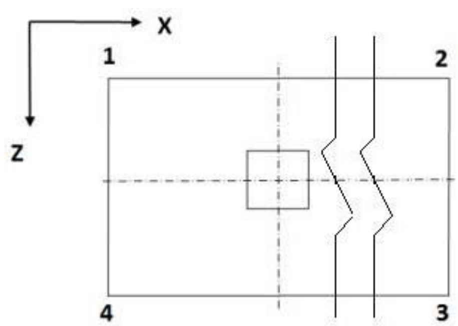
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
1	DD
2	DL LD

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X(kN)	Shear Z(kN)	Moment X (kNm)	Moment Z (kNm)
1	1487.644	-219.071	-180.536	192.524	-53.799
2	42.100	8.674	83.458	6.242	14.104

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
1	1487.644	-219.071	-180.536	192.524	-53.799
2	42.100	8.674	83.458	6.242	14.104



Load Case	Pressure at corner 1 (q_1) (kN/m2)	Pressure at corner 2 (q_2) (kN/m2)	Pressure at corner 3 (q_3) (kN/m2)	Pressure at corner 4 (q_4) (kN/m2)	Area of footing in uplift (A_u) (m^2)
1	**56.4384**	55.3589	66.7586	67.8381	0.000
1	56.4384	**55.3589**	66.7586	67.8381	0.000
1	56.4384	55.3589	**66.7586**	67.8381	0.000
1	56.4384	55.3589	66.7586	**67.8381**	0.000

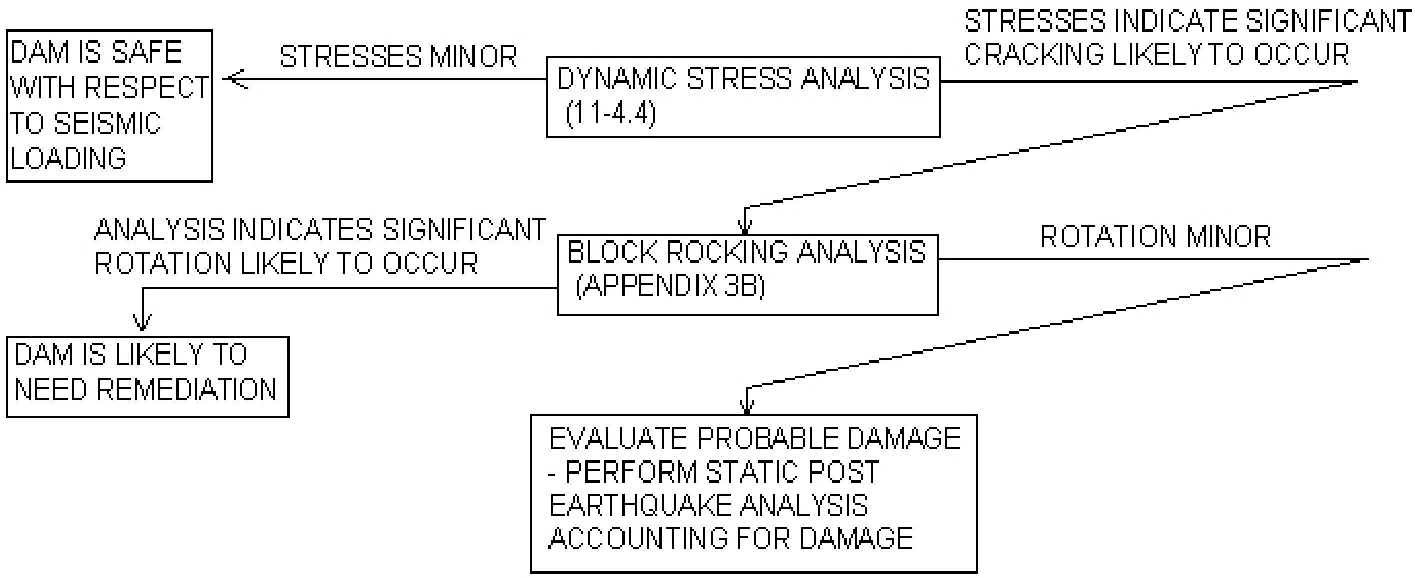
If A_u is zero, there is no uplift and no pressure adjustment is necessary. Otherwise, to account for uplift, areas ofnegative pressure will be set to zero and the pressure will be redistributed to remaining corners.

Summary of adjusted Pressures at Four Corner

Load Case	Pressure at corner 1 (q_1) (kN/m2)	Pressure at corner 2 (q_2) (kN/m2)	Pressure at corner 3 (q_3) (kN/m2)	Pressure at corner 4 (q_4) (kN/m2)
1	**56.4384**	55.3589	66.7586	67.8381
1	56.4384	**55.3589**	66.7586	67.8381
1	56.4384	55.3589	**66.7586**	67.8381
1	56.4384	55.3589	66.7586	**67.8381**

APPENDIX 3D
Dynamic & Post Earthquake Analysis

The flow chart below depicts the seismic analysis process applicable to concrete gravity dams.



FORCE DESCRIPTION	F->	ARM	F^	ARM	M @ 0,0
DAM DEAD LOAD-->			-124.20	12.00	1490.40
RESERVOIR LOAD-->	18.73	183.67			3439.67
UPLIFT-->			18.35	8.00	-146.78
TOTAL FORCE =	18.73		-105.85		4783.30

CRACK LENGTH= 0   100 % OF BASE IN COMPRESSION

HEEL OR CRACK TIP STRESS= -2.053036 TOE STRESS= -6.768102

(KSF) SLIDING SAFETY FACTOR= 3.263296

The analyses above indicate that structure will continue to maintain the reservoir.

Annex 1

Supply and demand projection for 20 years

Estimated population growth 2020-2045

Town	2020 Population base line	2025		2035		2045	
		p.a %	Population	p.a %	Population	p.a %	Population
Borama	384,000	3.2	494,000	3	664,000	2.8	875,000

Access to save water supply calculation parameters

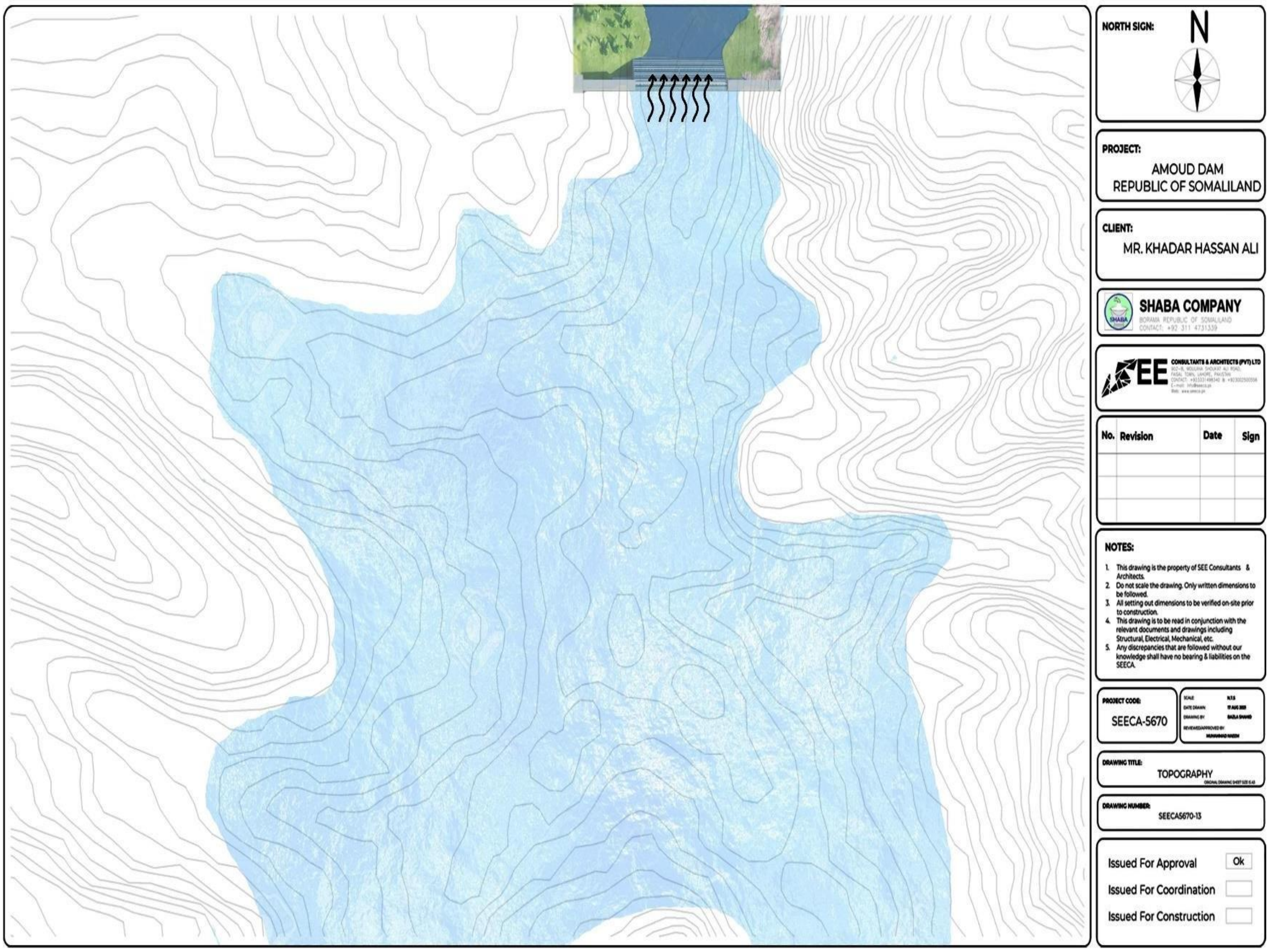
Service level parameters	Group of the population	2020	2045
Unit consumption	Urban	40lpd	80lpd

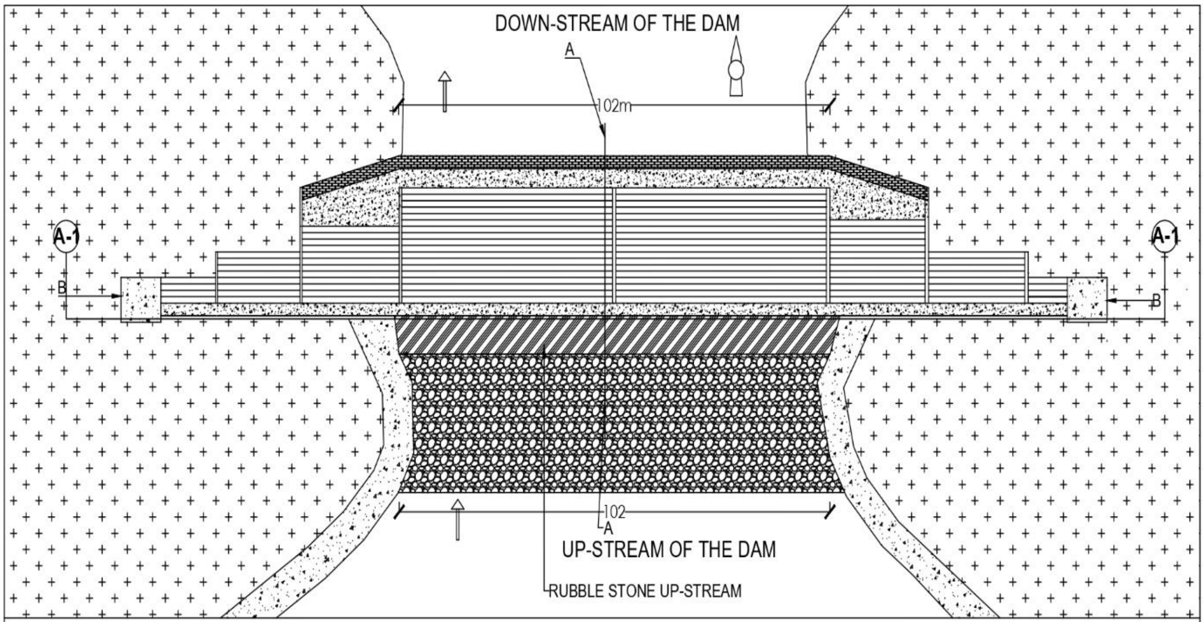
Water supply demand projection in CUM/day

Town	2020 Population base line	2025	2035	2045
Borama	9,200	17,300	34,000	64,000

Annex 2

Project design





PLAN VIEW

NORTH SIGN: N

PROJECT:
AMOUD DAM
REPUBLIC OF SOMALILAND

CLIENT:

SHABA COMPANY
BORAMA REPUBLIC OF SOMALILAND
CONTACT: +92 311 4731339

SEE CONSULTANTS & ARCHITECTS (PVT) LTD
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REVIEWED/APPROVED BY: MUHAMMAD NAEEM

DRAWING TITLE: DAM PLAN VIEW
ORIGINAL DRAWING SHEET SIZE IS A3

DRAWING NUMBER: SEECA5670–02

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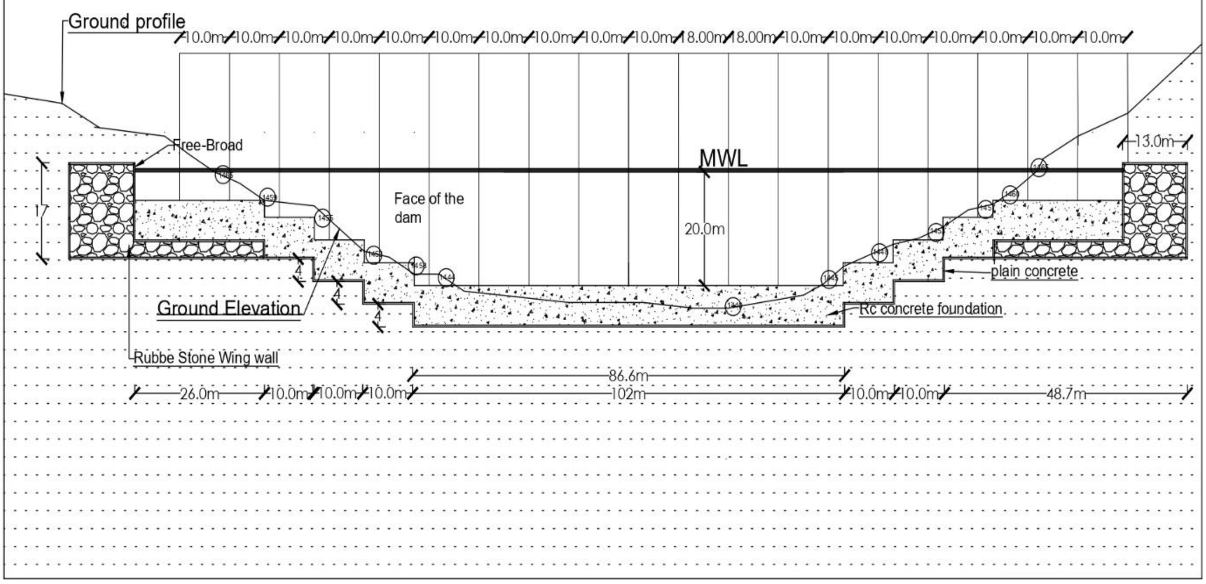
LONGITUDINAL SECTION A-A



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REVIEWED/APPROVED BY: MUHAMMAD NAEEM

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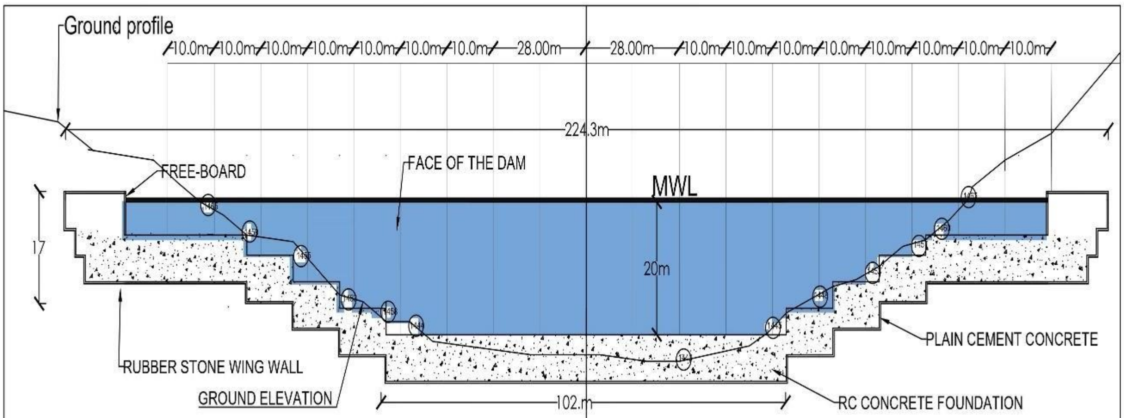

LONGITUDINAL SECTION B-B(UPSTREAM)

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REPUBLIC OF SOMALILAND

CLIENT:

SHABA COMPANY
BORAMA REPUBLIC OF SOMALILAND
CONTACT: +92 311 4731339

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REVIEWED/APPROVED BY: MUHAMMAD NAEEM

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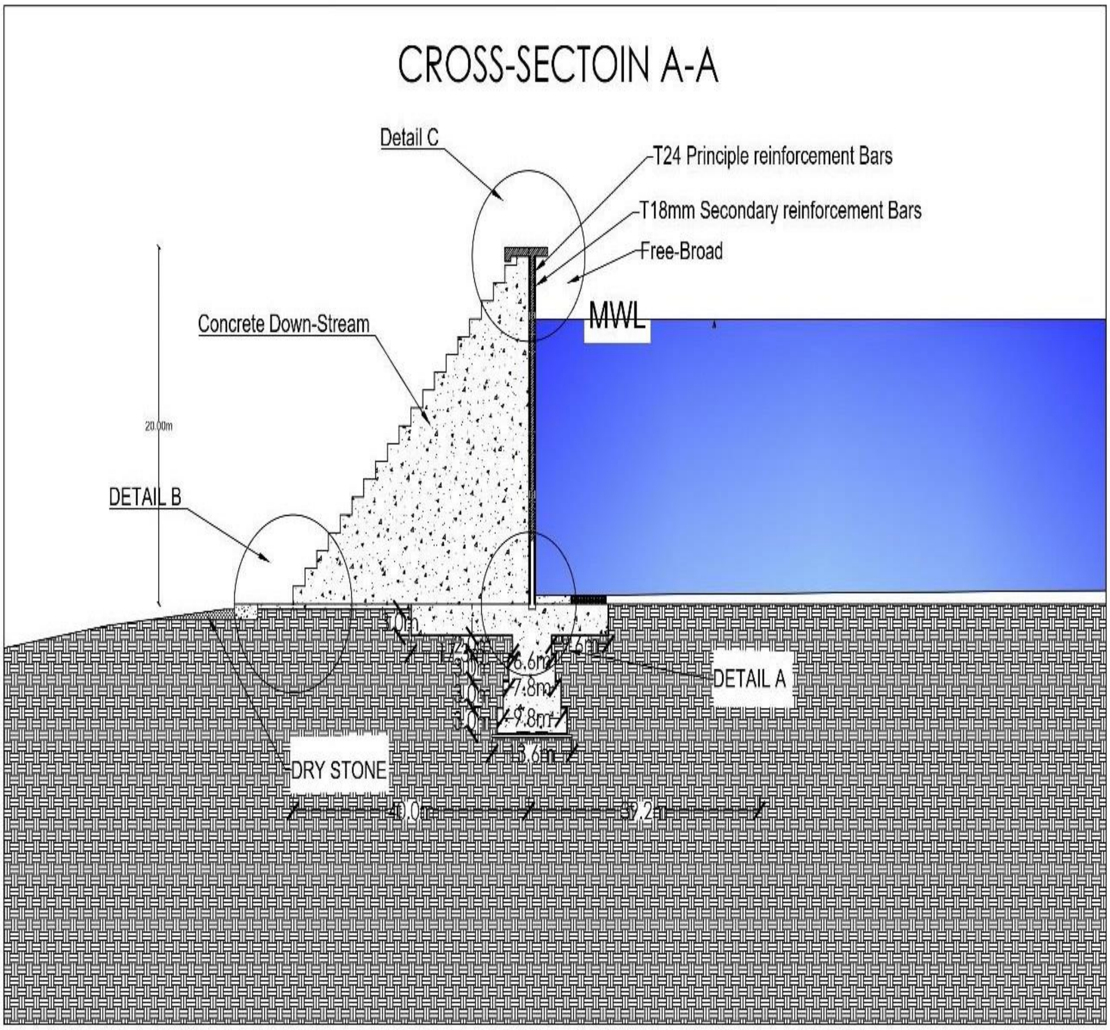

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CLIENT:	
SHABA COMPANY	BORAMA REPUBLIC OF SOMALILAND
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DRAWING NUMBER:	SEECA5670-05

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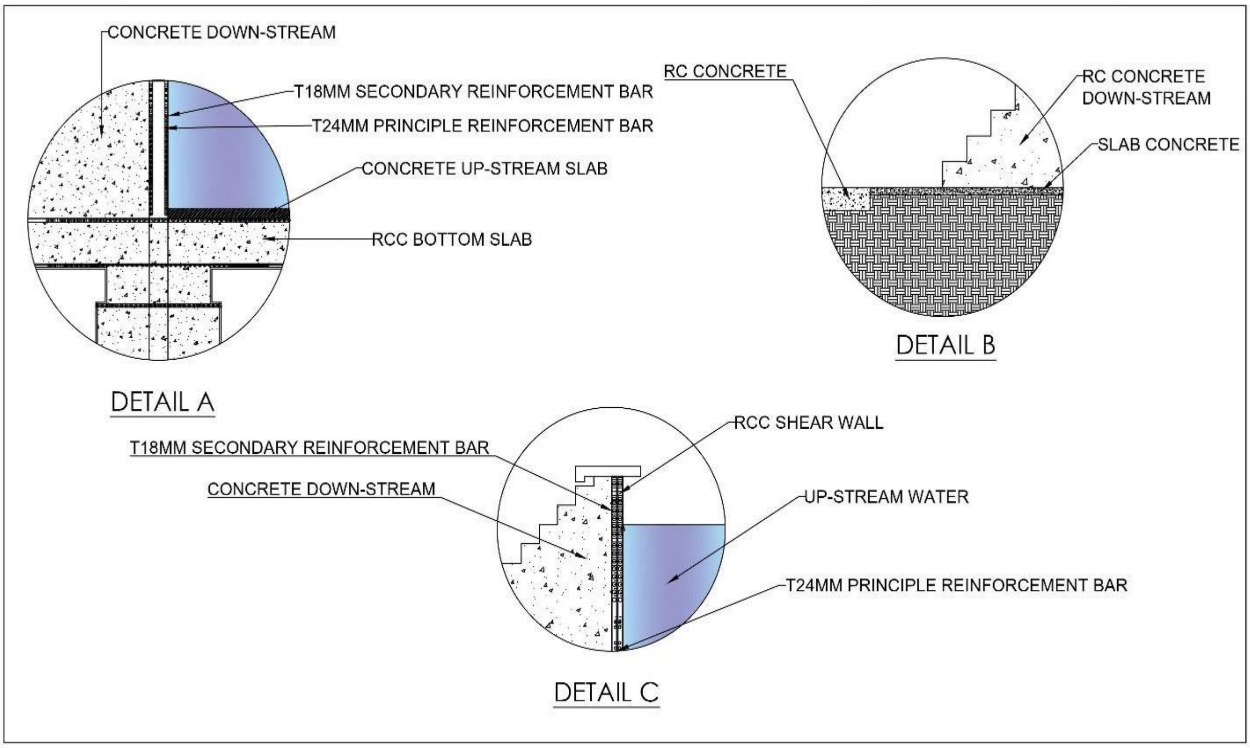

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CLIENT:

SHABA COMPANY

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DRAWING TITLE: DETAILS

DRAWING NUMBER: SEECA5670-06

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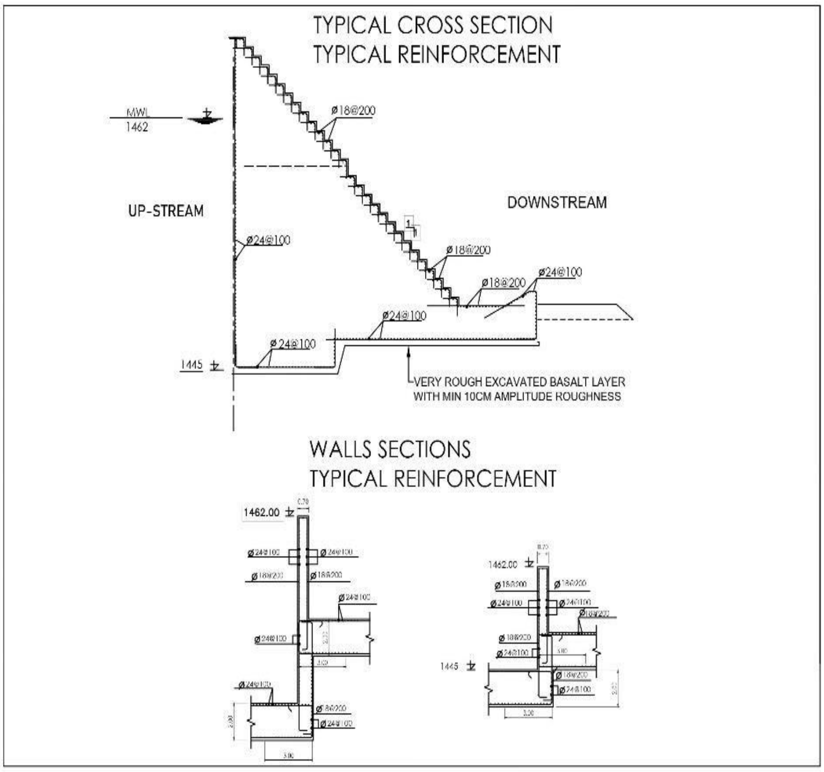

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PROJECT: AMOUD DAM REPUBLIC OF SOMALILAND

CLIENT:

SHABA COMPANY

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PROJECT CODE: SEECA-5670

DRAWING TITLE: TYPICAL CROSS SECTION TYPICAL REINFORCEMENT

DRAWING NUMBER: SEECA5670-10

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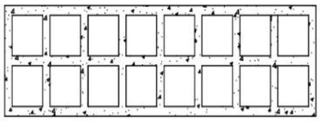
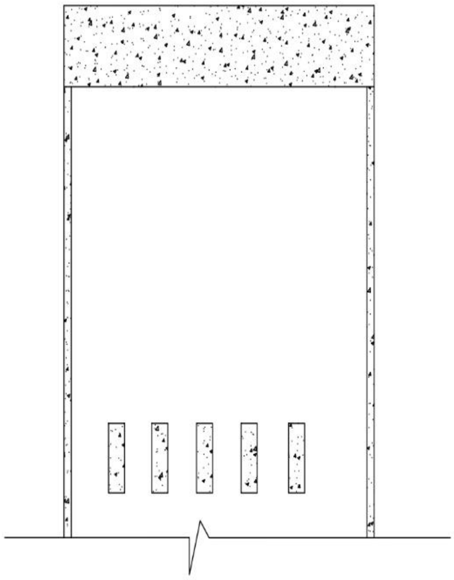


SPILLWAY ELEVATION



SPILLWAY PLAN VIEW

NORTH SIGN:

PROJECT:

AMOUD DAM
REPUBLIC OF SOMALILAND

CLIENT:

SHABA COMPANY
BORAMA REPUBLIC OF SOMALILAND
CONTACT: +92 311 4731339

CONSULTANTS & ARCHITECTS (PVT) LTD
903-B, MOULANA SHOUKAT ALI ROAD,
FAISAL TOWN, LAHORE, PAKISTAN

No.	Revision	Date	Sign

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PROJECT CODE:
SEECA-5670

SCALE: N.T.S
DATE DRAWN: 17 AUG 2021
DRAWING BY:
REVIEWED/APPROVED BY:
MUHAMMAD NAEEM

DRAWING TITLE:
SPILLWAY

DRAWING NUMBER:
SEECA5670-13

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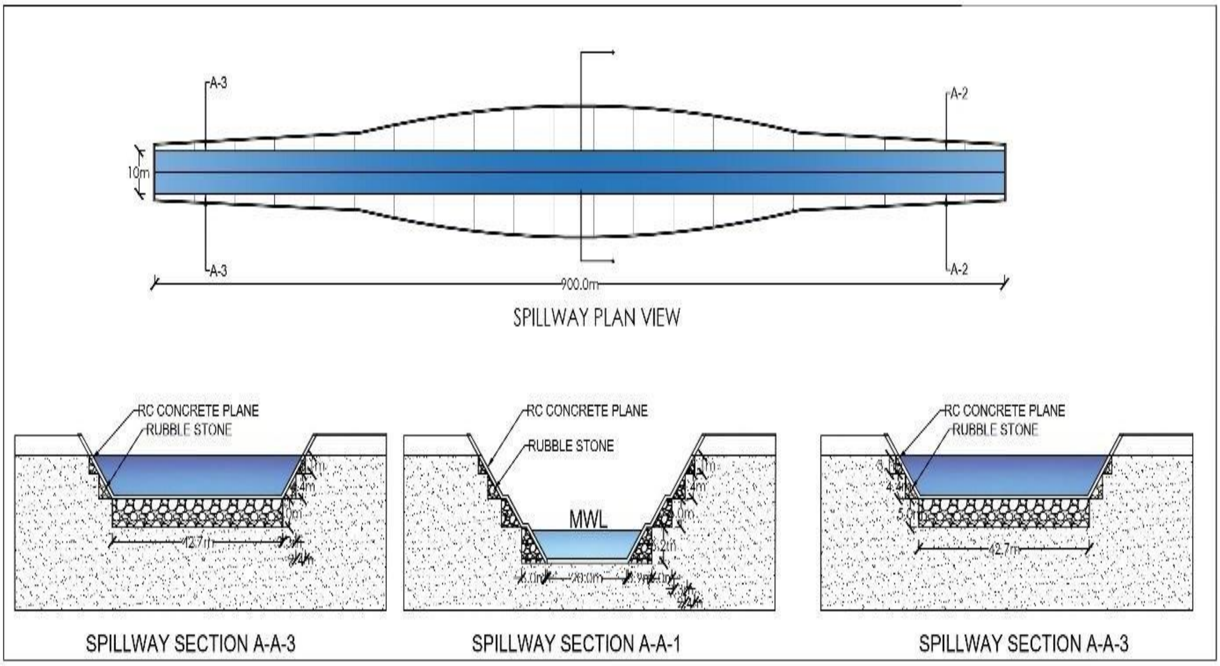
Issued For Coordination	
Issued For Construction	



NORTH SIGN: N

PROJECT:
AMOUD DAM
REPUBLIC OF SOMALILAND

CLIENT:
MR. KHADAR HASSAN ALI

SHABA COMPANY
BORAMA REPUBLIC OF SOMALILAND
CONTACT: 252 211 4731530

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PROJECT CODE: SEECA-5670

SCALE: N.T.S

DRAWING TITLE: SPILLWAY

DRAWING NUMBER: SEECA5670-13

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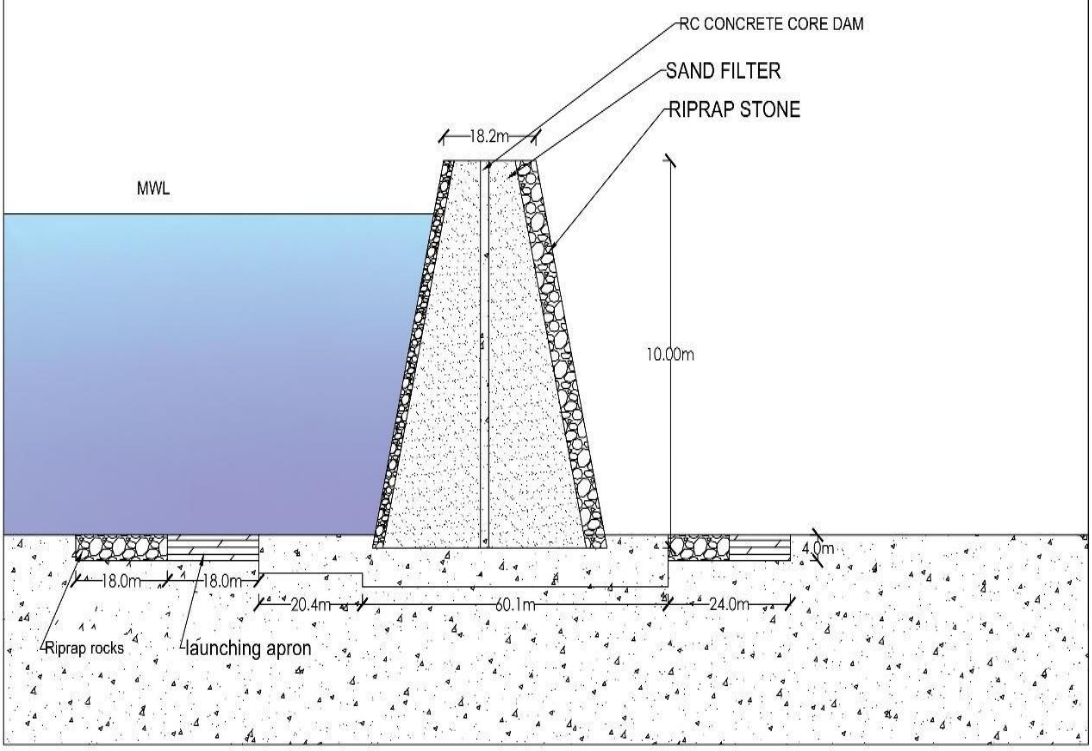
DIVERSIOIN DAM SECTION A-A



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PROJECT:
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REPUBLIC OF SOMALILAND

CLIENT:

SHABA COMPANY
DORAMA REPUBLIC OF SOMALILAND
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PROJECT CODE: SEECA–5670

SCALE: N.T.S
DATE DRAWN: 17 AUG 2021

DRAWING TITLE: DIVERSIOIN DAM SECTION A-A

DRAWING NUMBER: SEECA5670–12

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3D DESIGN OF THE DAM


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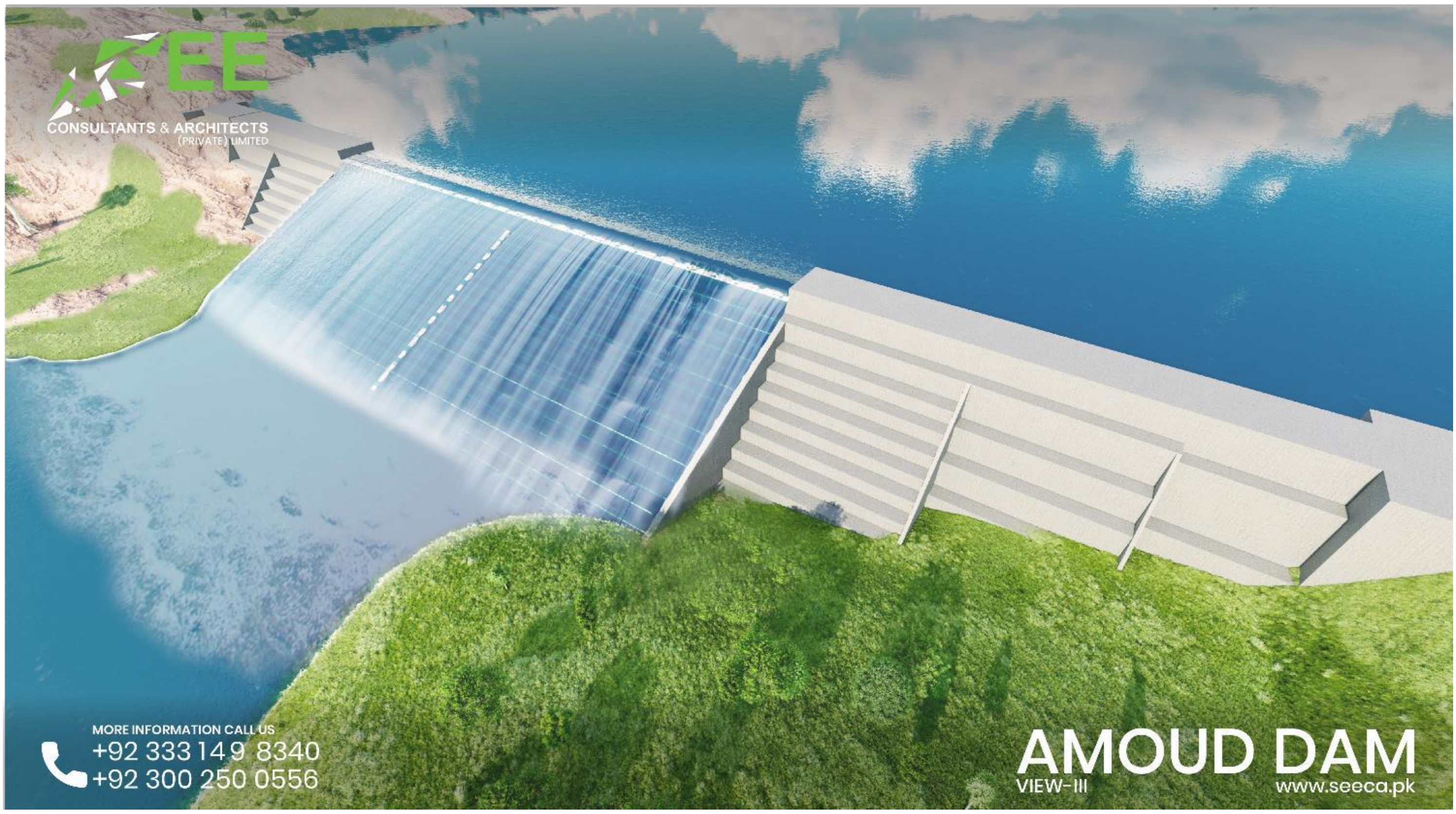
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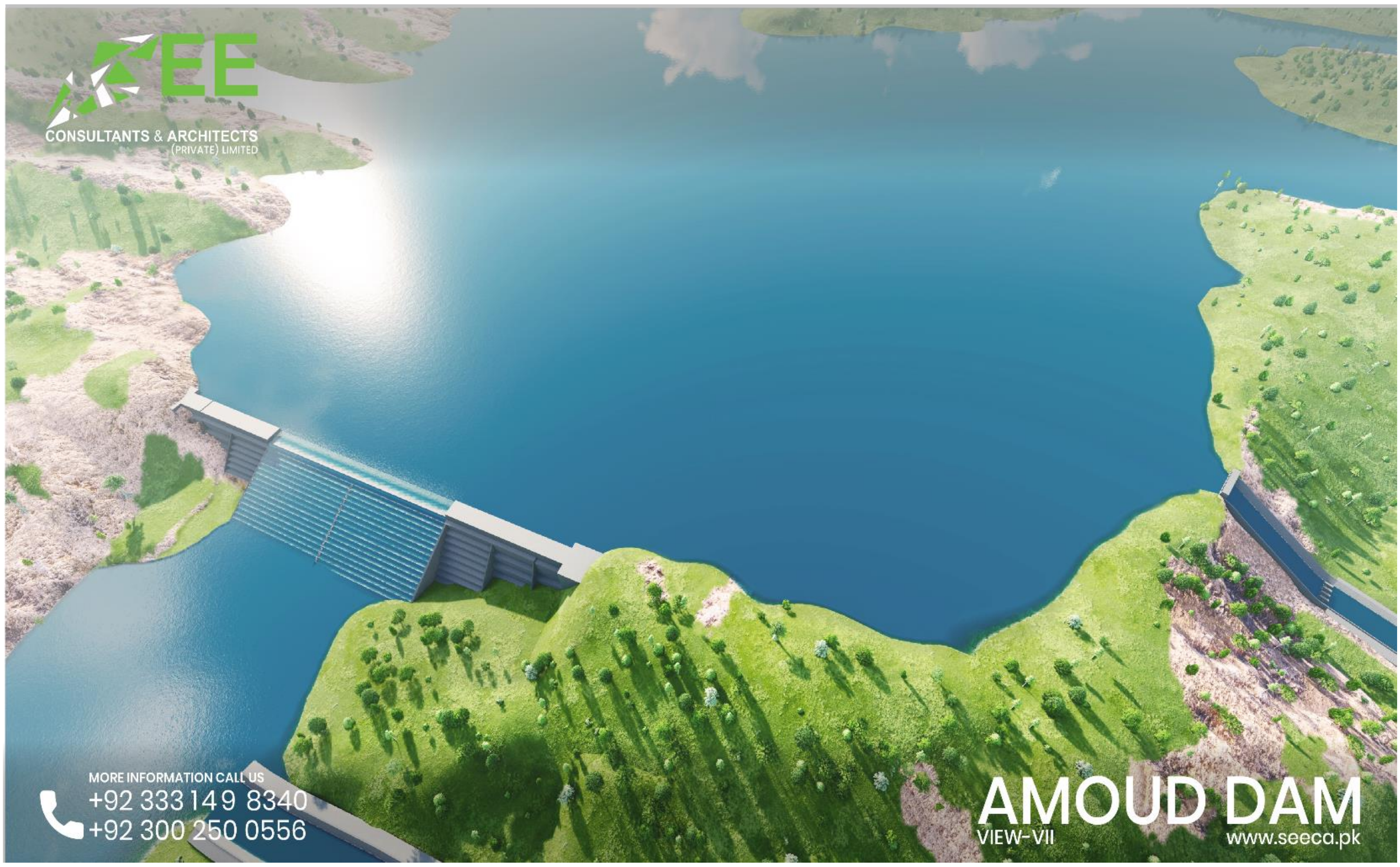
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Annex 3

Detailed project description per component

8.2 Project Components, Outputs and Activities

The project has five main components:

Component one	Preparatory works for construction of the Dam.
Component two	Construction of high capacity Mam with 6 million CUM
Component three	Procurement, installation of modern purification plant
Component four	procurement /construction of pipes, reservoirs, other infrastructure and related accessories
Component five	Capacity building to the MOWR and SHABA

4.3.1 Component 1: Review the design and carry out all preparatory works for the construction of the dam

This component is focused on the reviewing the data, information, BOQ and designs of the prepatory works for the construction of the dam and then adjust it with the related procurement procedures and standards for construction of gravity RCC dams and other water works. The project will hire qualified consultants to prepare relevant TOR for hiring qualified experts.

The main activities to be undertaken include review of assessment and investigation of hydrogeological information needs; reviewing detailed design and preparation of tender documents; procurement of contractors to undertake the works; and implementation dam works, linking to the community capacity building activities; and dissemination of the results to all stakeholders and beneficiaries. SHABA and one local NGOs may be engaged to demonstrate how to build capacity of communities, households, pastoralists, etc. to meet their water needs and sustainably manage their water resources.

4.3.2 Component 2: Construction of high capacity RCC gravity Dam. The component is focused on to the construction of high capacity dam with all necessary accessories in order to meet high demand for clean water for Borama town. The project will work closely with the MOWR, SHABA and other stakeholders to prioritize the works which will be implemented under the project. Activities include; construction of high capacity dam which can hold 6 million CUM/year and can provide 16,400 CUM/day to Borama town). This component will focus on enhanced water availability and accessibility through water harvesting and supply for human consumption, in a sustainable manner. Where feasible, multiple water services such as minor irrigation and livestock watering will be incorporated; and for systems using solar energy for pumping, power generated from the system will also be availed for domestic purposes

4.2.3 Component 3: procurement and construction of modern of purification plant. Surface water are not pure physically and biologically, the runoff water from the rains dissolve the soil and the other particles during the rains including dirt, debris and other solids the floods also carry the wastes from organic particles and its subject for all kinds of contaminations and thus are fit for human consumption. High turbidity is an indicator for impurity and there is need for eliminating all suspended particles, dissolved minerals and pathogenic organic contaminants.

The component is focused the PIU to prepare the TOR for qualified water quality professional who will prepare the specifications and standards for modern purification plant, recommend the selection of appropriate manufacturer and supervise the installation. The production from the dam should satisfy the WHO and ministry of health and ministry of resources guidelines and standards of potable water supply for domestic purposes.

4.2.4 Component 4: procurement and construction/installation of pipes, water reservoirs and related infrastructure and all related equipment and other accessories: This component will transmission of the raw water from dam to the purification plant and transmit the water.

The PIU will prepare TORS for qualified water Engineer, civil engineer and chemical engineers and they will advise the PIU unit in selecting qualified companies for the procurement of goods and implementation of the

The component activates procurement of pipes, fittings, construction materials control equipment and other essential Operation and Maintenance (O&M)

4.2.5 Component 5: Capacity Building: This component will support capacity development of the MOWR, SHABA and the water users of Borama town water supply to enhance the sustainable management of the system. Proposed activities include; procurement of essential Operation and Maintenance (O&M), procurement of chemicals and reagent for the purification plant as well as the laboratory equipment and provide relevant training. The component will also offer support to the Water training centre in Borama including procurement of training facilities and equipment. The component will further support the MOWR and SHABA to extend PPP concepts in the management to the other urban and rural centres.
The component will s Support will MOWR and SHABA to improve surface/ground water governance so as to enhance sustainable development of the resource.

Annex 4

Detailed cost estimate

BILL OF QUANTITIES - FOR CONSTRUCTION OF AMOUD DAM					
Ord #	Description of position	UOM	QTY	unit price [USD]	Total [USD]
I	**PREPARATORY WORKS**				
1	Community mobilesatoin Cleaning the site before the construction commencement from woods, shrubs and roots and depositing the material to a landfill of supposed distance ≈ 200 m	m^2	6,000.00	$ 7.00	$ 42,000.00
2	Preparation of 3-4 examination holes for additional geotechnical examination of the dam site during the restoration measures implementation (with laboratory	m	60	$ 150.00	$ 9,000.00
3	Preparation of laboratory tests on earthen materials obtained from the site in accordance with the technical	Roughly	1	$ 1,000.00	$ 1,000.00
4	Providing a field laboratory for full monitoring of the construction of earthen objects on the dam and conduct of experiments in	Roughly	1	$ 1,000.00	$ 1,000.00
				Total Preparatory Works	**$ 53,000.00**

II	EARTHWORKS				
1	Mechanical excavation of soil material (III category according to GN 200) for dam construction, with appropriate fieldwork, in line with the enclosed charts by temporarily disposing in the vicinity of the site	m_3	50,000.00	$ 7.00	$ 350,000.00
2	Mechanical excavation of rock material (V and VI category according to GN 200) for the construction of the dam, with appropriate fieldwork, in line with the enclosed charts	m3	50,000.00	$ 3.75	$ 187,500.00
3	by temporarily disposing in the vicinity of the site and for further use to fill in the dam body	m_3	40,000.00	$ 7.00	$ 280,000.00
4	"Levelling of unevenness from the excavation that are larger than 20 cm with pickers and manual removal of the loose rocky blocks, cleaning the cracks and mitigation of local slopes > 1: 1 by transporting the material to a landfill (2% of the total quantity) "	m_3	250	$ 7.00	$ 1,750.00
5	Pouring separated earthen material (III category according to GN 200) obtained from excavation, by spreading and compacting to the optimum density into layers, for the supporting body of the dam, by proving the achieved quality for condensation and water-permeability	m_3	1,000.00	$ 50.00	$ 50,000.00
6	Procurement, transport, installation and compacting of the material into layers to a density of at least 100% of the standard Proctor procedure, by proving the achieved quality for condensation and water-permeability, for a filter layer underneath the screen of geo-synthetics	m_3	742	$ 2.00	$ 1,484.00
7	Procurement, transport and installation of angular rocks for the formation of an counter-watercourse protection of the inclination, with fractions Ø100 - 200 mm, from the riverbed of the rivers to a maximum of 500m upstream the dam	m_3	15,700.00	$ 30.00	$ 471,000.00
8	Constructing of temparory diversion dam and including its removing from the site	m_3	10,000.00	$ 50.00	$ 500,000.00
				Total Earthworks	**$ 1,841,734.00**

III	**CONCRETE AND REINFORCEMENT WORKS**				
1	RC Concrete Foundation of the Dam.	m_3	17,000.00	$ 400.00	$ 6,800,000.00
2	RC Concrete face of the dam	m_3	2,036.80	$ 400.00	$ 814,720.00
3	RC Concrete downstream slab foundation	m_3	1,000.00	$ 400.00	$ 400,000.00
4	RC Concrete upstream slab foundation	m_3	180.00	$ 400.00	$ 72,000.00
5	RC Concrete downstream face	m_3	26,000.00	$ 400.00	$ 10,400,000.00
	Total Concrete and Reinforcement Works				**$ 18,486,720.00**
IV	**Water Supply System Works**				
1	water tank (1000m3)	pcs	3	$ 400,000.00	$ 1,200,000.00
2	booster pump 55kw	pcs	3	$ 30,000.00	$ 90,000.00
3	operation houses(office guse house)	pcs	1	$ 20,000.00	$ 20,000.00
4	main transmission pipe (upvc RRJ 630mm PN16)	m	7300	$ 200.00	$ 1,460,000.00
5	ND 500mm galvanised steel pipe	m	1200	$ 300.00	$ 360,000.00
6	fittting and all other accesseiries	LM	1	$ 15,000.00	$ 15,000.00
7	fencing	m_2	10000	$ 4.00	$ 40,000.00
	Total Water Supply System				**$ 3,185,000.00**

V	**Purification and Sanitization Plant**				
1	supply and install a slow sand filtration plant operation with automatic backwash with multiple cells in order to produce clean water also during filteration of media (sand).	lsp	1	$ 1,000,000.00	$ 1,000,000.00
2	supply and install a snitization device operating with calcium hypochorite by the capacity of 120 lit/sec (432cum/hour)	lsp	1	$ 500,000.00	$ 500,000.00
	Total Purification and Sanitization Plant				**$ 1,500,000.00**
VI	**INSTALLATION WORKS**				
1	Procurement, transport and installation of waterproof HDPE geo-membrane (crude, with micro-pricks on both sides), with a thickness of d = 2 mm (the tests of the joints of the geo-membrane panels are included in the price)	m_2	2,000.00	$ 20.00	$ 40,000.00
2	Procurement, transport and installation of non-wove geo-textile as a substrate beneath the geo-membrane, weight g=800 gr./m2	m_2	2,670.00	$ 5.00	$ 13,350.00
3	Procurement, transport and installation of non-woven geo-textile above the geo-membrane, weight g = 800 gr. / m2	m_2	2,670.00	$ 4.00	$ 10,680.00
4	Supply, transport and installation of stainless steel strips (b = 20 cm, d = 0.3 cm, L = 106.5 m and special screws ø10, n = 213, stainless steel, for fixing the screen of geo-synthetics for the concrete foundation	Roughly	1	$ 4,000.00	$ 4,000.00
	TOTAL INSTALLATION WORKS				**$ 68,030.00**

VII	**AUSCULTATION MEASURES**				
1	Preparation and placement of benchmarks with posts with their fixing and securing	Pcs	6	$ 200.00	$ 1,200.00
2	Setting geodetic points for monitoring of the site and supporting structure with their fixing and securing	Pcs	20	$ 2,000.00	$ 40,000.00
3	Drilling and installation of piezometers structures in the body and banks of the dam and downstream the dam	m'	60	$ 300.00	$ 18,000.00
	TOTAL AUSCULTATION MEASURES				**$ 59,200.00**
VIII	**FINAL WORKS**				
1	Removal of machinery, arrangement of the construction site and surface used for machinery works and where the construction works were performed, by satisfying the ecological aspects	roughly	1	$ 4,000.00	$ 4,000.00
2	Planting grass on the downstream gradient	m_2	50,000.00	$ 2.00	$ 100,000.00
	TOTAL FINAL WORKS				**$ 104,000.00**

SUMMARY		
I	Preparatory Works	$53,000.00
II	Earthworks	$1,841,734.00
III	Concrete and Reinforcement Works	$18,486,720.00
IV	Water Supply System works	$3,185,000.00
V	Purification and Sanitation works	$1,500,000.00
VI	Installations Works	$68,030.00
VII	AUSCULTATION MEASURES	$59,200.00
VIII	Final Works	$104,000.00
IX	SPILLWAY	$1,248,808.00
	TOTAL	**$26,546,492.00**
	PLUS Phiysical Contingency	**$2,654,649.20**
	TOTAL	**$ 29,201,141.20**
	PLUS Price Contingency	**$730,028.53**
	GRAND TOTAL	**$29,931,169.73**

Annex 5

Summary of environment and social impact assessment study

Environmental and social management plan (ESMP)

Main program activities	ES Impact	Mitigation measures	Actor Responsibility	Monitoring/indicators
Pollution (Air and noise	The dust, noise and smoke pollution relate to the bush clearing by the heavy machinery, particularly during the land clearance excavation work and other vehicle/trucks movements of the project sits. Amy result human health problems	Human health care facilities should be provided including face masks over coats and other measures that is suitable for human health	The implementing Contractors, Government Institutions (MoWRD, MoERD. MoHD	Monitoring Secure health safety of the workers
Vegetation Clearing/ trees loss	Many trees will be removed	Reforestation programs should be implemented and tree nursery should be established in the project area	Project implementing partner (Contractor) and MoERD	Reforestation programs implemented
Water Sanitation and Hygien	There will be waterborne diseases	Water purification plant should be established. Mosquito protection fish should	Implementing partner, MoWRD	Water purification plan established

Households immigration	Some households near the Dam will be resettled far from the Dam	Resettlement program is needed to take care the those selected	Project implementing partner, local and regional authorities	Households resettlement program
Spilway construction	Proper spillway may result flooding and damage the dam	Proper spillway should be constructed that ensure the safety of the dam and surround environment	Implementing partner and steering committee	Performance and design of the spillway

Annex 6

Log frame for construction of Amoud RCC HighCapacity Dam

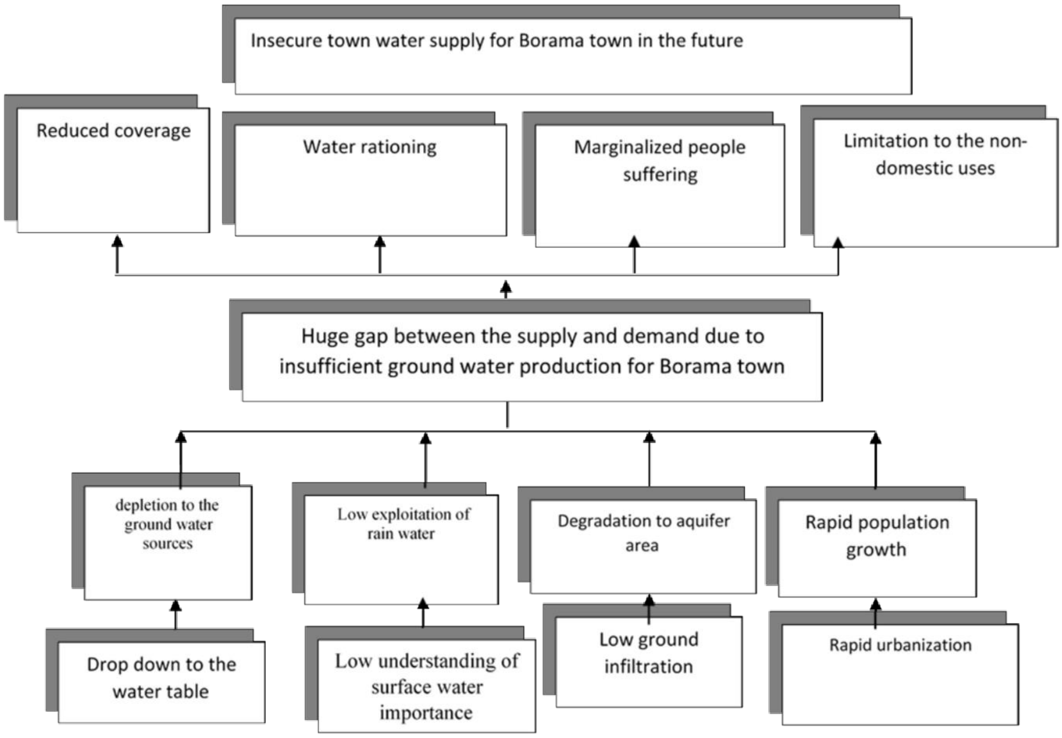
	Intervention Logic	Measurable Indicators	Sources of Verification	Risks and Assumptions
Go al	Secured water supply for the present & the future demand to Borama town with sanitation measures and sustainable management throughout the year by construction of high capacity gravity Dam in the upper stream of Amoud river			
Objective	Increased production capacity of Borama water supply which can supply adequate and safe water supply to all citizen of the town with long term project by the year 2024	▪ Borama citizens get 50 lpd of safe & adequate water supply throughout the year. ▪ Reduced water borne diseases. ▪ Safed time and energy.	▪ Monthly and quarterly reports ▪ Daily Monitoring reports ▪ Case studies and photos ▪ Physical verification ▪ Functional water managemen t committee	**Assumptions** Normal Rainfall availability Ensured funds **Risks** Climate related issue (Droughts Change to the rainfall pattern) Lack of adequate funds
Result 1	High capacity dam constructed in upper stream of Amoud dry river with capacity of 6 million CUM and daily production of 16,400 CUM as per the design. Ensured dam safety by construction of appropriate spillway constructed as per the design.	▪ No. activities in Workplan schedule implemented. Targets and milestones realized. ▪ Quantity and quality of daily water production	▪ monthly and quarterly report ▪ Monitoring visit report ▪ Focus group discussions reports ▪ Case studies and Photos ▪ Committee meeting minutes ▪ Physical verification	**Assumption** ▪ Community acceptance to the project. ▪ Selection of qualified dam construction company with enough experience **Risk** ▪ Land related dispute ▪ Lack of local experienced companies
Re sul t 2	Nine-kilometre transmission pipeline	▪ No. of kilometres of transmission pipeline	▪ monthly and quarterly report	**Assumption**

	reservoirs constructed and connected to the town water supply as per the design.	▪ No. of water reservoirs constructed	▪ Monitoring visit report ▪ Case studies and Photos ▪ Physical verification ▪	▪ Community acceptance to the project. ▪ Selection of qualified dam construction company with enough experience **Risk** ▪ Land related dispute ▪ Lack of local experienced companies
Result 3	Automatic water purification plant constructed using slow sand filtration and water treatment technology constructed with Chlorine dozer	▪ Quantity of water treated ▪ No. of samples analysed and approved ▪ monthly and quarterly report. ▪ Water quality results approved ▪ Water quality analysis for physical, chemical and bacteriological tests analysed and approved for domestic use. ▪ Regular water quality surveillance	▪ monthly and quarterly report ▪ Monitoring visit report ▪ Case studies and Photos ▪ Physical verification ▪ Site Photos	**Assumption** ▪ Availability of reagents. ▪ Availability of qualified water analyses technicians **Risk** ▪ Pandemic diseases ▪ Availability of reagents. ▪ House hold contamination
Result 4	**Increased rainwater infiltration and ground water recharge augmentation to minimize the problem of the ground water resources depletion to of Amoud and Dhamoug Aquifers**	▪ Metres of ground water table increased ▪ No. of sand dams, subsurface constructed ▪ No. of soil and water conservation schemes implemented. ▪ Regular water table monitoring	▪ monthly and quarterly report ▪ Monitoring visit report ▪ Case studies and Photos ▪ Physical verification Site Photos	**Assumption** ▪ Safe yield regular monitoring by the MOWRD. **Risk** ▪ Over pumping Pandemic diseases ▪ Availability of reagents.House

				hold contamination
Activities	▪ Preparatory works as per design & BOQ ▪ Earthworks as per design & BOQ ▪ Concrete and reinforcement work (according to Dam construction standards, specifications and procedures) ▪ Water supply system works (as per pipe work standards, specification and procedures for water works) ▪ Purification and sanitization plant ▪ Installation woks ▪ Auscultation works ▪ Construction of spillway ▪ Capacity building of SHABA & Ministry of water	**Necessary Means:** ▪ No. of standard contracts approved by the Bid committees ▪ No. of days supervised by the field and chief engineer. ▪	**Budget:** $ 29,931,169.73	**Preconditions** 1. Company with appropriate profile with qualified hydrologist, civil engineers and dam construction specialists 2. Enough and appropriate earth work and RCC equipment.

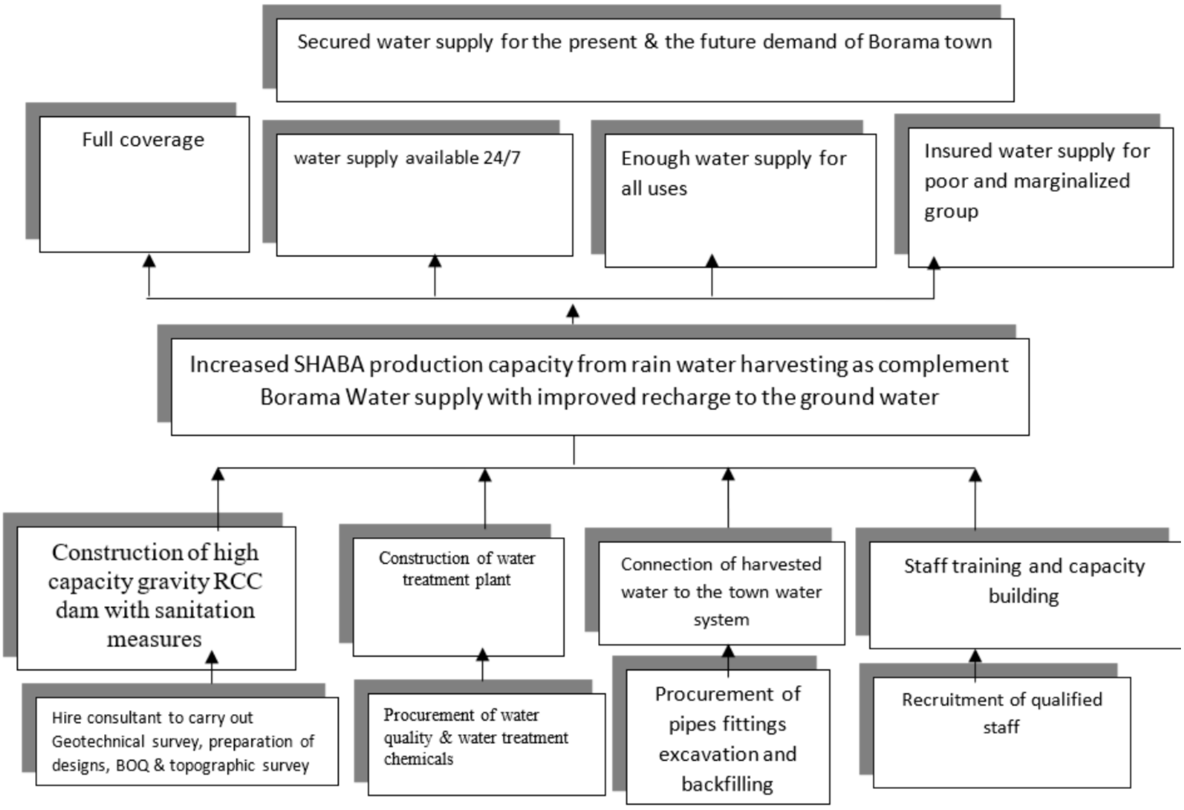
Annex 7

Problem tree



Annex 8

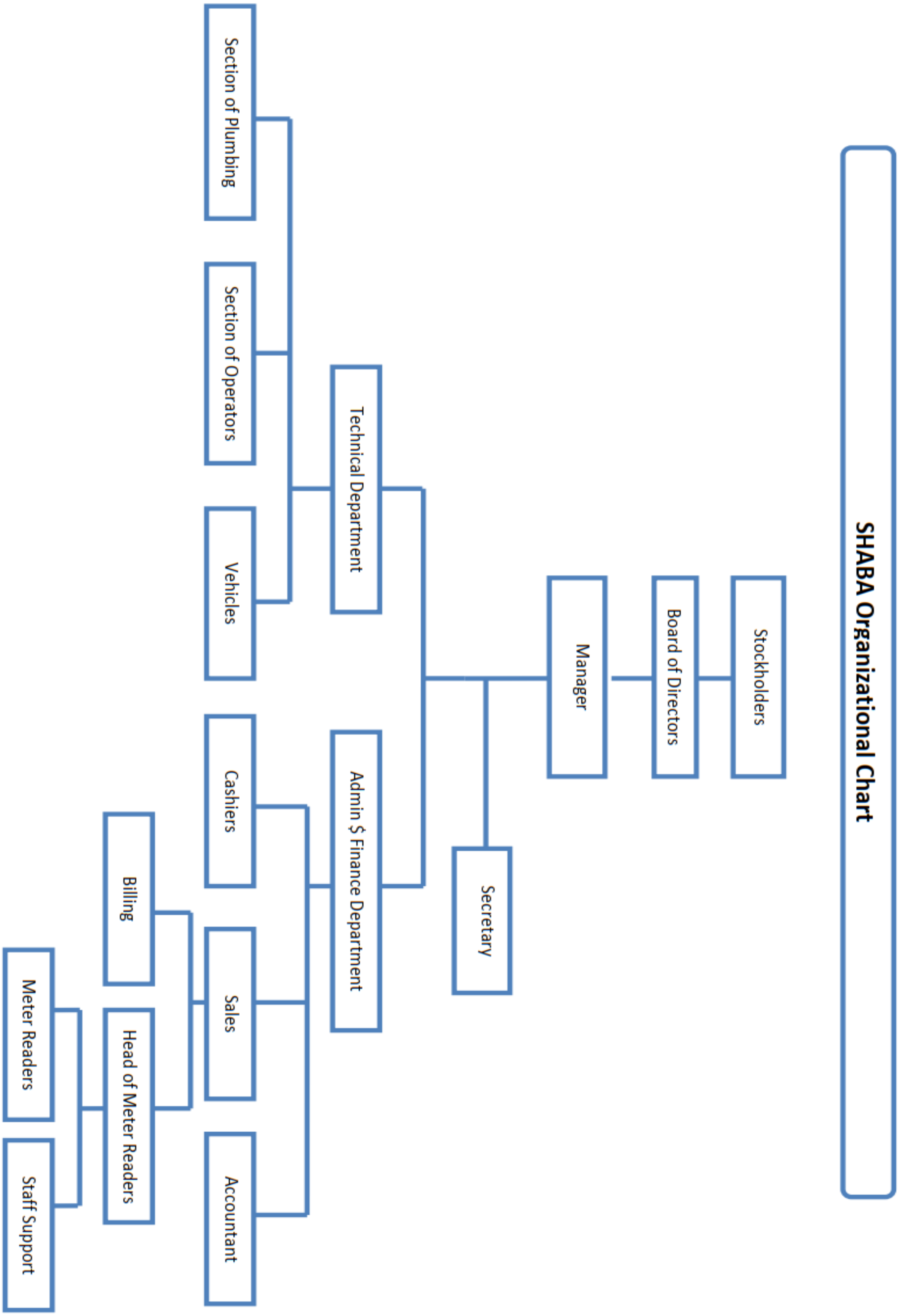
Objective Tree



Objective tree

[i] Geological assessment report Ahmed M Adan

Annex 9



SHABA Organizational Chart
Stockholders
Board of Directors
Manager
Secretary
Technical Department
Admin $ Finance Department
Section of Plumbing
Section of Operators
Vehicles
Cashiers
Sales
Accountant
Billing
Head of Meter Readers
Meter Readers
Staff Support

Environmental and Social Management

Project Title

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN AND RAP IMPLEMENTATION FOR AMOUD RCC GRAVITY DAM

By

Eng. Abdikarim Adam Omer   director of Planning MOE&RD
Eng. Mohamed Omer dhimbiil Awdal Regional Coordinator MOWD
Eng. Abdirahman Abdisalam Sh. Ali   SHABA General Manager

August 2021

Table of Contents

ACRONYMS

Berked	Under ground water harvesting storage
CLTS	Community Led Total Sanitation
CBM	Community Based Managment
CHAST	Children Hygiene and Sanitation Training
DNH	Do No Harm
EIA	Environmental Impact Assessment
ES	Enviromental and Social
ESMP	Enviromental and Social Management Plan
ESS	Enviromental and Social Management Screening
GIFT	Governance, institutional funtionlity tool kit.
MOH	Ministry of Heath
MOWR	Ministry of Water Resource
MoERD	Ministry of Enviroment and Rural development
O&M	Operations and Management
NERAD	National Environmental Research and Disaster Preparedness Authority
PPP	Public and private partnership
PPP4RA	Public Private Partnership for Rural Areas
PHAST	Participatory Hygiene and Sanitation Transformation
SWALIM	Somali Water and Land information Management
WIDRP	Water Infrastructure Development For Resileince in Somaliland Program
PIU	Project Impelementing Unit

1. Background

Borama town is the capital of Awdal region locates at the south west of the Golis range near the Ethiopian border with an estimated population of nearly 370,000.

Borama town is facing water stress as indicated in the recent studies carried out by certain professional organizations, the major aquifers of the eastern part of the town showed drop down to the water table which is negative sign for the future of Borama town water, the western aquifer is still under implementation and nobody knows when it will be completed, the forecast is that the ground water alone are not sufficient to the town water supply. Before the start of the PPP management, the total population estimate of Borama was 50,000 people with maximum daily production of 420 CUM which provide 8.4lpd, while present estimate is more than 250,000 and the present daily production is 5,200 CUM/day with coverage of 20.8 lpd. The minimum standard for urban centers taken as baseline for urban centers is 40lpd. Using this standard for calculations, the present demand is 10,000 CUM/day which is double of the present production.

This shows that Borama people are receiving half of the required quantity. SHABA, to cover that gap between the supply and demand, has started water supply rationing and adapted working more than 22Hrs/day. This could not be wise solution as the population growth is still going on and the demand for reliable water supply is increasing as well.

Borama town is facing great challenge if immediate measures are not taken in time, the fast-growing urbanization is reality, there is huge gap between the supply and demand. the potential ground water resources are gradually approaching their upper limits and some boreholes already started to dry up.

This project proposal is advocating the construction of large dams in the upper stream of Amoud river as proposed by NIRAS (international company who published the IWRM IP).

Due to the recent dry spells caused by the failed rain seasons. Somaliland estimates say that 55% of Somaliland communities live in rural areas but less than 20% have access to improved water supplies and nearly 88% lack access to universal sanitation.

The Water for Infrastructure Development for Resilience in Somaliland appraisal documents stressed the following issues be addressed and this is complicated significantly by: (i) Continued conflict, (ii) The low rainfall and very complex hydrogeology of the country, (iii) The centrality of pastoralist livelihoods to the economy, (iv) Weak or absent local government institutions.

2. Introduction

The Somaliland's Ministry of Water Resources (executing agency) and African Water facility have signed MOU for the carrying out comprehensive water resources study throughout the country to produce investment plan for integrated water resources management. The parties hired international Norwegian Company water Works Company as the project implementation agency. The company was assigned to submit IWRMIP report and submit to round table meeting participated by the potential donors.

The study comprised major town water supply demand for present future and long-term periods and Borama town was among that the study recommended the Construction of RCC Gravity Dam to contribute the scarce water supply of Borama town. The company has completed the preliminary studies for the construction of RCC gravity dam at the upper stream of Amoud river which is about six kilometres south east of Borama town and has recommended the construction of high capacity dam which can collect 6 CUM annual storage water from the catchment area and make possible daily supply 16,400 CUM/day to the town. The

SHABA representing the town water supply with the technical assistance of the Ministry Of water resources Development has prepared the remaining part of project appraisal including the designs, BOQs and all other technical specifician for RCC Gravity Dam construction.

The overall objective of the program is to get long and permanent solution for the huge water demand in Borama town and insure rinsure the provision of safe and adequate water supply and sanitation infrastructure to the water scarce in Borama town and surrounding areas

Hence, the Ministry of Environment and Rural Development (MoERD) which is a lead sector on matters of environment management in Somaliland will be consulted during this study, moreover, the draft of the comprehensive Environment Act for Somaliland, including guidelines for environmental impact assessment, is available in the MoERD. It is projected that a total population of approximately 378,000 (50% women) including livestock units (through multiple water use) will directly benefit from the Program

2.1 Program operations

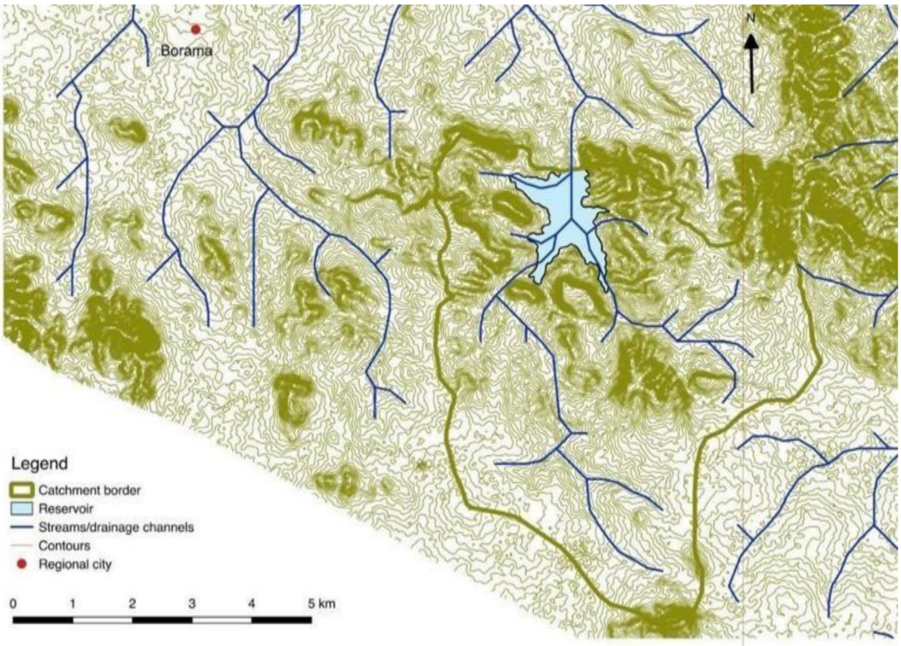
The project has five main components:

Component	Outcome
Component One	Preparatory works for construction of the Dam.
Component Two	Construction of high capacity Dam with 6 million CUM
Component Three	Procurement, installation of modern purification plant
Component Four	Procurement/Construction of Pipes, Reservoirs, Other Infrastructure and Related Accessories
Component Five	Capacity Building to The MOWRD and SHABA

(see the details in the project document).

2.2 Program Outcomes

The proposed interventions will enhance the water availability for Borama town and strengthen resilience and raise the quality of life of the town population in general, benefitting an estimated 378,000 people. The dilapidated state of the water and sanitation infrastructure is a major contributing factor to the severe outbreaks of water borne diseases in the country. Improved access to water supply will also sustain other basic socio-economic activities, including fighting against CORONO VIRUS, livestock rearing, which contributes significantly to the economy of Borama. Primary health and education facilities will benefit from improved water and sanitation facilities.



The program focuses on strengthening the resilience of the population in Borama town through construction of new RCC gravity Dam for the town water supply. This is included and complements the physical activities in the AWF financed "Building Resilience to Water Stress in Somaliland Preparation of a Water Resources Management and Investment Plan" project and is in line with the National Development Plan of Somaliland, which states that appropriate practices for sustainable management of natural resources will contribute to building long-term resilience, sustainable peace and stability, and significantly improve the livelihoods of more of people, notably the pastoralists and agriculturalists.

3. Methodology and Approach

The Environmental and Social Impact Assessment (ESIA) has been carried out on the basis of data and information collected from primary and secondary sources. The collection of primary data is based on field level data, site visits, information gathering from surveys, as well as public and stakeholder consultations with local authorities and experts from different sector offices. The secondary data has been collected from existing project data obtained, as well as relevant documents from Government and non-governmental Institutions.

During the interviews, the questionnaires were filled out and notes were taken on issues that emerged which had not been exhaustively captured by the questionnaires. At the end of each day, the research team sat together to review and harmonize the results.

3.1 Desk Review and Documents

The consultant reviewed all the relevant available documents on project activities and components from the client. The consultant also reviewed all the available and relevant internal environmental guidelines, put in place by the stakeholders.

3.2 Field Data Collection

The consultant conducted the field visits to obtain further data, consult with the stakeholders and establish the nature of the surroundings of the project proposed area (the DAM). Existing infrastructure was noted during the site visits, as well as the economic and social set up of the local communities. The consultant collected existing information and administered interviews with a view to determining the environmental impacts on the day-to-day activities of the community.

3.3 Project Data Analysis

The consultant thereafter interpreted and used the data collected to prepare a comprehensive environmental and social management plan (ESMP) encompassing the potential negative environmental and social impacts, mitigation measures and monitoring indicators. The ESMP is incorporated in this report.

The scope of this study complies with the ToR provided and conforms to the provisions of the Somaliland legal requirements. This project report represents the findings of the ESIA and contains a description of the project environment, baseline environmental information, analysis of project alternatives, positive and negative environmental impacts and mitigation measures, and (ESMP).

4. Project Location

The project location is around 6 Km south East of Amoud River with position

From:	43.237911158	To:	43.2431732157
	9.9154365858		9.9144222128

5. Over view of Physical, Biological and socio-economic Environment

5.1 Topography

The area to be constructed the Dam is Mountainous and has also dry rivers that carries a huge water runoff during the rainy seasons. The slope is gentle around 2-5% with altitude of 1418 meters, the catchment area is quite enough 33.4 Sqkms. The available annual rainfall of the area is about 504mm.

5.2 Water sources

The town water supply used to depend on spring during the British Colony up to the independence but the water table dropped down and the major water sources for the town water supply were hand dug wells. During 1987 Chinese company drilled 8 boreholes and it was connected to the town water supply. All the Chinese drilled boreholes dried up due to the drop down of the water table and other new boreholes were drilled in Dhamoug and Amoud aquifers as indicated in the following table.

SN	Boreholes (BH)	Coordinates	Altitude (Meters)	Depth (Meters)	Water Table	Remarks
1	BH 8B	N 09.5020 E 43.22879	1385 M	190 M	71.1 M	Functioning
2	BH 7	N 09.94648 E 043.22342	1394 M	120 M	85.0 M	Abandoned
3	BH 12	N 09.94159 E 043.24771	1416 M	120 M	91.0 M	Abandoned
4	BH 13	N 09.92771 E 043.24475	1430 M	116 M	104 M	Abandoned
5	BH 19	N 09.94905 E 043.22172	1385 M	210 M	91.0 M	Functioning

6	BH 20	N 09.942218 E 043.23695	1390 M	210 M	89.0 M	Functioning
7	BH 21	N 09.94846 E 043.23320	1376 M	230 M	70.0 M	Functioning
8	BH 18 (B.Kuwait)	N 09.95145 E 043.22454	1382 M	180 M		Functioning
9	BH 22 (Amoud University)	N 09.9407 E 043.22527	1385 M	148 M	65.0 M	Functioning
10	BH 23	N 09.94486 E 43.23114	1378 M	160 M	81.0 M	Functioning
11	BH 24		1375 M	191 M	88.0 M	Functioning

6. Biological Environment (Flora and Fauna)

6.1 Flora

The vegetation in the study area is once forest with both shrubs, Grasses dominated by drought resistant Acacia species including Acacia Etbaica (sogsog), A. Tortilis (Qudhac),, A. Nilotica (Maraa), and A. Senegal (adaad). On the banks of the dry rivers A. Tortilis as well as Ziziphus mauritiana .

List of The Major Plants and Grass Species Dominated in The Project Sites

Name of the plant	Somali names
Species (Latin Name)	
Acacia Etbaica	**Sog sog**
Acacia Nilotica	**Maraa**
Acacia Tortilis	**Qudhac**
Acacia Mellifera	**Qansax**
Ziziphus mauritiana	**Gob**
Parthenium spp.	**Keligii noole**
Prosopis Juliflora	**Garan waa**

6.2 Fauna

The Dam area is also characterised by a variety of wild fauna. As described above, the excellent plant communities in the project area provide wild fauna with proper shelter and forage. As informed by the community consultation, wild fauna population of spotted hyena, dik dik, and warthogs are commonly observed groups.

6.3 Ecologically Sensitive and Protected Zones:

In this area there are no nationally or internationally recognized sensitive and protected areas, however the nature of ecology is fragile and needs proper care when different project activities are implemented. The existing acacia forest in this area is seen as an oasis for the dryland Somaliland. The local community has designated this area as forestland and protects it from any kind of encroachment.

6.4 Species found in the project areas

Name of the birds Species	Somali name
Mourning collared Dove (Streptopelia decipiens)	Qoolay xamaam
Ring-necked Dove (Streptopelia capicola)	Qoolay
Black Kite (Milvus migrans)	Dhuuryo
Little Owl	Guumeys
Little Bee-eater (*Merops pusillus*)	Maris yar yaro
Little Owl	Guumeys
(*Athene noctua*)	
Somali Bee-eater (*Merops revoilii*)	Maris ama Shimbir-malab
Somali Crow (*Corvus edithae*)	Tuke
Isabelline wheatear (*Oenanthe isabellina*)	Xamare
Hornbill	Qudun-quuto
Crested Guineafowl (*Guthera puacherani*)	Digirin
Red billed Quelea (*Quelea eathopica*)	Xamare
Red billed oxpecker (*Buphagus erythrorhynchus*)	Huryo
White-bellied go-away-bird (*Corythaixoides leucogaster*)	Gobyahan-dheere
African Goshawk (*Accipiter tachiro*)	Baas
Spur-winged lapwing (*Vanellus spinosus*)	Dacawo-sheeg
Buffalo weaver (*Bubalornis niger*)	Galaalo

Table 11: Wildlife Species Found In The Project Area

Name of Wild Animals	Somali Name
Spotted Hyena (*Crocuta crocuta*)	Waraabe
Guenther's Dikdik	Sagaaro

6.5 Socio-economic Environment

Pastoralism is predominant livelihood in the project area. The socio-economy of the people in the area is linked with the livestock production, although there are some households that are living in the and around the project area that gain their family income from the collection of construction stones in the dry river that they sell the tipper trucks that use to load the stores to Borama for building construction. There are also small number of private enclosures that produce fodder for livestock consumption

7. Program components

7.1 Component 1: Review the design and carry out all preparatory works for the construction of the dam

This component is focused on the reviewing the data, information, BOQ and designs of the predatory works for the construction of the dam and then adjust it with the related procurement procedures and standards for construction of gravity RCC dams and other water works. The project will hire qualified consultants to prepare relevant TOR for hiring qualified experts.

The main activities to be undertaken include review of assessment and investigation of hydrogeological information needs; reviewing detailed design and preparation of tender documents; procurement of contractors to undertake the works; and implementation dam works, linking to the community capacity building activities; and dissemination of the results to all stakeholders and beneficiaries. SHABA and one local NGOs may be engaged to demonstrate how to build capacity of communities, households, pastoralists, etc. to meet their water needs and sustainably manage their water resources.

7.2 Component 2: Construction of high capacity RCC gravity Dam.

The component is focused on to the construction of high capacity dam with all necessary accessories in order to meet high demand for clean water for Borama town. The project will work closely with the MOWR, SHABA and other stakeholders to prioritize the works which will be implemented under the project. Activities include; construction of high capacity dam which can hold 6 million CUM/year and can provide 16,400 CUM/day to Borama town). This component will focus on enhanced water availability and accessibility through water harvesting and supply for human consumption, in a sustainable manner. Where feasible, multiple water services such as minor irrigation and livestock watering will be incorporated; and for systems using solar energy for pumping, power generated from the system will also be availed for domestic purposes

7.3 Component 3: Procurement and Construction of Modern of Purification Plant.

Surface water are not pure physically and biologically, the runoff water from the rains dissolve the soil and the other particles during the rains including dirt, debris and other solids the floods also carry the wastes from organic particles and its subject for all kinds of contaminations and thus are fit for human consumption. High turbidity is an indicator for impurity and there is need for eliminating all suspended particles, dissolved minerals and pathogenic organic contaminants. The component is focused the PIU to prepare the TOR for qualified water quality professional who will prepare the specifications and standards for modern purification plant, recommend the selection of appropriate manufacturer and supervise the installation. The production from the dam should satisfy the WHO, ministry of health and ministry water of resources guidelines and other international standards for potable water supply for domestic purposes.

7.4 Component 4: Procurement and Construction/Installation of Pipes, Water Reservoirs and Related Infrastructure and All Related Equipment and Other Accessories.

This component will transmission of the raw water from dam to the purification plant and transmit the water.

The PIU will prepare TORS for qualified water Engineer, civil engineer and chemical engineers and they will advise the PIU unit in selecting qualified companies for the procurement of goods and implementation of the

The component activates procurement of pipes, fittings; construction materials control equipment and other essential Operation and Maintenance (O&M)

7.5 Component 5: Capacity Building:

This component will support capacity development of the MoWR, SHABA and the water users of Borama town water supply to enhance the sustainable management of the system. Proposed activities include; procurement of essential Operation and Maintenance (O&M), procurement of chemicals and reagent for the purification plant as well as the laboratory equipment and provide relevant training. The component will also offer support to the Water training centre in Borama including procurement of training facilities and equipment. The component will further support the MOWR and SHABA to extend PPP concepts in the management to the other urban and rural centres.

The component will s Support will MOWR and SHABA to improve surface/ground water governance so as to enhance sustainable development of the resource. To enhance sustainability of the water and sanitation facilities, the operators and the staff of beneficiary of the project will be trained (minimum 50% women) on basic O&M. In addition, water board /committee will participate in trainings and increase their knowledge on basic plumbing including operation and maintenance of pumping systems. The committees should overcome their time-poverty challenges. Training for communities will include hygiene promotion and sensitization with emphasis on scaling up Community Led Total Sanitation and community-based climate change adaption activities (water resources protection through soil management, conservation, optimization of green water and re-forestation (including strengthening traditional regulations that govern use of water resources). Piloting of drip irrigation in educational institutions to promote water use efficiency will also be undertaken.

This component will also promote women and youth empowerment through establishment of tree nurseries and appropriate conservation with community management. The program will also emphasis on - the - job training using labour-based construction methods targeted at women and youth. The promotion of integrated rainwater harvesting and management for improving water supply, food security and sustainable livelihood will also be undertaken. To facilitate this, training will be provided in development of gender equitable community water user committees and community-based decision-making around water resource management.

Project components

Component One	Project Preparatory Works
Component Two	Construction of High Capacity RCC Gravity Dam
Component Three	Procurement, Installation of Modern Purification Plant
Component Four	Procurement /Construction of Pipes, Reservoirs, Other Infrastructure and Related Accessories
Component Five	Capacity Building to The MOWRD and SHABA

Component & Outputs
1. **Preparatory works for construction of the Dam.** A. **Program management team** • Establishment of PIU (Engineer, finance, procurement, sociologist, TA, monitoring officer, internal auditor • Water quality technician/ water quality lab • Logistics and transportation B. **preparatory works** • Review designs, BOQs, existing data • community mobilization • Land acquisition. • Site demarcation • Procurement process • Selection criteria for contractors 2. **Construction of high capacity gravity dam** • Site clearance • Excavation works • Transportation of construction/building materials to the site • Implementation of construction works of the dam • Implementation of the spillway of the dam 3. **construction of water purification plants** • site clearance • excavation works • transportation of the water purification plant to the site • transportation construction /building materials to the site • installation and implementation of construction of infrastructure works 4. **procurement and pipeline work** • site clearance • excavation of the pipe line trench • pipe lying and backfilling • construction of control champers 5. **capacity building** • community mobilization • establishment of water committees • training of the committees

Component & Outputs
• capacity building of SHABA PPP company • exposure visit/study tour to • hygiene and sanitation • water quality surveillance • environmental mitigation trainings

8. Program Objectives

The project team emphasizes the effective governance of water and sanitation schemes as central to long-term functionality of the dam, It involves the construction of high quality mega water catchment with sanitation measures which can provide enough and safe water supply to Borama town in an environmental friendly manner for future sustainability and planning how best to strengthen governance in order to support longer-term functionality, including at times of acute water stress in low-rainfall years.

9. Environmental and Social Management Framework WIDR program

According to the ESMF done by the AFDB in March 2016, the WIDR program involves rehabilitation of existing earth dams and construction of boreholes and additional dams in unserved areas. According to the Bank's ESAP, the project is classified as Category 2 mainly because most impacts are site specific and have no significant and irreversible detrimental effect. According to the Bank's Climate Safeguards System, the program is classified as Category II, requiring the implementation of adaptation measures to increase the resilience of communities and the water infrastructure to be rehabilitated and constructed to withstand the impacts of climate change. The program details are at preliminary stage and the detailed designs shall be developed during project implementation. For these reasons, the type of Environmental Assessment tool for at this stage is the development of the Environmental and Social Management Framework (ESMP).

9.1 Environmental and Social Screening Baseline

9.1.1 Climate Change Impact

The outcome of the discussions with the agro-pastoralists indicates that the rainfall pattern is becoming more and more unpredictable and the amount, pattern and duration of is also changing. Historically the Gu rainy season is more reliable than the Deyr rainy season. However, today both are becoming unreliable and characterized by total failure for an extended period. The dry season is extending from the traditional six and eight months to the whole year. This has been compounded with water and wind erosion, decline of land productivity and resulting crop failure and pastures shortage and resource base conflicts.

9.2 Overview of the Rural Water Supply in Somaliland

Borama gets an average of 504 mm annual rainfall and the most of the urban populations depend on ground water in Dhamouqg and Amoud aquifers. The existing water sources faced huge drop down of the water table due to over pumping which were resulted from exponential population growth, that has increased the demand for water supply of the town.

9.3 Technical Options for Rural Community

The selection of feasible technologies for a rural water supply will vary according to environmental conditions, affordability and social acceptance. The technology alone does not determine sustainability, but it can have a major impact, especially the on ongoing capacity building and O&M needs of the rural water supply facilities.

Somaliland authorities are primarily concerned with strategic ground water sources, showing limited interest in shallow wells and with reliance on donor agencies in providing services (SWALIM 2014). Thus, “one of the strategic objectives of the Ministry of Water Resources (MoWR) was to increase the availability of clean and reliable water supply for rural communities through drilling more strategic boreholes with motorized water pumping systems, the Strategic borehole is the deep drilled boreholes that located at the droughts prone areas in Somaliland, which communities could rely on during the dry season. It has been also stated that the drilling of the deep borehole is extremely expensive in Somaliland, thus, in the last 3 years 113 new boreholes have been drilled in Somaliland and 80% of the newly drilled boreholes were located in rural areas. According to the key informed persons interviews done by the author the average depth of the deep borehole is 210m, with the cost of drilling soars up to $450 per meter, in that case drilling of 210m depth well costs $94,500, and then the cost of the diesel engine, submersible pump, water storage and distribution pipelines to be added to the drilling cost.

Recent functionality reports also underlined that more than 45% of the boreholes have fallen into disrepair within first two years of community based management, "communities are often unable to manage their water supplies by themselves in long time period due to the high cost of the diesel engine fuel consumption and the cost of the O&M, coupled with very limited technical knowhow of village based water supply operators.

Table 3. Generalized Water Supply Development Trend in Borama

<table>
<tr><td>1970-1990
Pre-war</td><td colspan="2">The Age of Groundwater Development
Shallow well fitted with mechanized systems and 4 KMs transmission pipe with few HH connections and 4 water kiosks
Management model WDA centralized and aid projects.</td></tr>
<tr><td>1990-2002
Civil War
Rehabilitation of basic systems</td><td colspan="2">Urban WS
Chinese drilled 8 boreholes and 4 of them were connected to the town water supply</td></tr>
<tr><td>2000-2010
Rehabilitation and transitional period</td><td>Urban WS
Supply works and transmission mains.
HH connections.
Start-up of the first PPP
Management model in Borama through lease agreement between Ministry of water resources, Borama Municipality and SHABA with 10 years</td><td>Model to be replicated through</td></tr>
<tr><td colspan="3">2010 onwards: implementation of large-scale projects based on sustainable development</td></tr>
</table>

10. Environmental protection and Management in Somaliland

The livelihoods of Somaliland population, particularly the rural communities, are dependent on environmental resources. The livestock economy which accounts for 60% of GDP is totally dependent on the availability of grazing areas and forage that is produced from fragile ecosystems. Therefore, the protection and management of the environment is critical to the country's development and survival of its population. The main legislative, which ensures the safeguard of the environment and promote, sustainable exploitation, utilization, management and conservation of the environment and natural resources is the Environment Conservation Act and Proclamation (1998). The Constitution (2001- also Revised in 2009) provides for protection and safeguards of the environment as well as the natural resources. Other relevant legislation framework include Somaliland Decentralization Policy, 2014; National Water Act 2011; Agricultural Land Ownership Law (Law No. 8/), 1999; and Land Management Law (Law No. 17, 2001). However, there exists no explicit legal framework of mechanism providing for Environmental Impact Assessment (EIA). There is no legal basis on which to request the proponent to carry out an EIA and no such assessments are routinely undertaken as part of environmental policy. There is no Department of Environmental Protection of MoERD is tasked with environmental impact assessment, monitoring compliance of taking enforcement actions

10.1 Policy, legal and administrative framework

The goal of Somaliland Government is to ensure environmental sustainability by reversing environmental damage, and ensuring the sustainable use of natural resources. However, a number of factors continue to constrain the achievement of this goal, including inadequate legal framework and lack of implementation and enforcement of the laws, while there are number of environmental and natural resource management policies and laws in writing, their implementation and enforcement remain challenge. Those policies include the newly reviewed Somaliland Environmental Policy. Inadequate mainstreaming of environmental and climate change issues into other sector policies and programmers is another challenge.

Somaliland has state laws and policies intended to conserve the environment and govern the ownership and use of land and natural resources. These includes the following

10.2 Constitution

The key legal instrument for environment management in Somaliland is the Constitution. Article 18 of the Constitution affirms that: The state shall give a special priority to the protection and safeguarding of the environment, which is essential for the well-being of the society, and to the care of the natural resources (Accordingly, all development projects have to comply with the Constitution to ensure a clean and healthy environment).

10.3 The National Policy on Environment

The overall vision of the policy is to provide a framework management guide for the management of Somaliland's environment and natural resources so as to ensure that they are managed on sustainable basis and retain their integrity to support the needs of the current and future generations.

10.4 Comprehensive Environment Management Act

Comprehensive Environment Management Act for Somaliland, including guidelines for environmental impact assessment, are being finalized and approved by the Parliament.

10.5 The Somaliland Forestry and Wildlife Conservation Law

The Somaliland Forestry and Wildlife Conservation Law – No. 69/2015 (As Gazetted 06/02/2016) has come into force on 02 February 2016. The Law is the first comprehensive law on this subject that has been passed in Somaliland.

10.6 Guidelines for Environmental Impact Assessments and Regulatory Procedures, Somaliland

These EIA Guidelines and Administrative procedures have been developed primarily to assist in the integration of environmental concerns into economic development to foster sustainable development.

10.7 The Bank's Environmental and Social Safeguards Policy

The African Development Bank's Integrated Safeguards System provides the framework that promotes the social and environmental sustainability of the Bank's projects outcomes. The Bank requires borrowers/ clients comply with these safeguards requirements during project preparation and implementation.

The Bank's Integrated Safeguards Policy Statement sets out the basic tenets that guide and underpin the Bank's approach to environmental safeguards. In addition, the Bank has adopted five Operational Safeguards (OSs), which sets out the Bank's overarching requirements for borrowers or clients to identify, assess, and manage the potential environmental and social risks and impacts of a project, including climate change issues. Operational Safeguard I requires the preparation of an Environment and Social Impact Assessment (ESIA), which assess the potential environmental and social impacts of the Project. The proposed Project is rated as environmental assessment category "2" and may have limited adverse environmental and social impacts, triggering the following safeguard policy

Table 4. Summary of WB Environmental and Social Standards relevant to the Project

Environmental and Social Standard	Description of expectations andactivities	Relevanc e
ESS1 Environmental and Social Assessment	An ESIA should be conducted in the project area that fall into or Category B.	■ Triggered: A partial ESIA is required due to the Project being classified as Category B, and no sensitive issues being touched (e.g. protected areas, archaeological sites, and areas containing valuable resources).
ESS2 Labor and Working Conditions	The WB expects the governments to develop and implement written labour management procedures applicable to the project. These procedures will set out the way in which project workers will be managed in	■ Triggered: The Programme will involve direct and contracted workers (and potentially community workers) requiring operational health and safety and labour management procedures to be established. This Programme will be cognizant of labour conditions and ensure working conditions are compliant with obligations imposedby Government

	accordance with the requirements of national law and this ESS.	of Somaliland, ILO, IFC, and KfW
ESS3 **Resource Efficiency and Pollution Prevention and Management**	This ESS sets out the requirement to address resource efficiency and pollution prevention and management through the project life cycle.	■ Not triggered: The Project does not consist of significant energy use, raw material use, or have potentially significant impacts on water quality. However, an ESMP has been established for mitigation strategies regarding air emissions and dust/noise pollution from machinery during the construction phases. The purification plant will use certain reagents for the water treatment and there should be safe disposal construction septic tanks, incineration champers should be included in the design.
ESS4 **Community Health and Safety**	ESS4 addresses the potential risks and impacts on communities that may be affected by project activities	■ Triggered: The Project H&S risks and impacts and proposed mitigation measures will be addressed in the ESIA and ESMP, as well as quality management systems to anticipate risks oncommunity H&S during construction and operationof the erosion control and water harvesting measures. ■ High flood level is possible risk during extra ordinary rainfall period; well designed spillway should be designed and included in project.
ESS5 **Land Acquisition, Restrictions on Land Use and Involuntary Resettlement**	This policy covers direct economic and social impacts that result from Bank- assisted investment projects and are caused by the taking of land, resulting in loss of assets, loss of shelter or loss of income sources or means of livelihood, whether or not the affected	■ Not triggered: Required land for the Project has been ensured through the implementing agency in cooperation with the local government. Involuntary resettlement is not anticipated under the Project.

	Persons must move to another location.	
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	The conservation of natural habitats and improved land use are essential for long-term sustainable development. ESS6 requires that a project which has substantial impacts on natural habitat must include appropriate mitigation measures, including direct support for conserving an ecologically similar area.	■ Not triggered: The Project area does not cover areas of natural habitat, forests, wetlands, or legally protected and internationally recognised areas of high biodiversity value

Environmental and Social Standard	Description of expectations and activities	Relevance
ESS7 **Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities**	This policy covers local indigenous people or distinct groups who are marginalized in society and who couldbe adversely affected by the project. The WB does not support projects that negatively affect these people.	■ Not triggered: All Project works are identified with no impact on specific ethnic minorities that could be identified as indigenous peoples.
ESS8 **Cultural Heritage**	The WB supports the preservation of cultural properties which includes sites with archaeological, paleontological, historical, religious or unique natural value.	■ Not triggered: No physical cultural sites identified in the Project area.

ESS10 Stakeholder Engagement and Information Disclosure	Meaningful consultations, transparency and a systematic approach to stakeholder engagement as part of the environmental and social assessment of the Project are required.	■ Triggered: As part of the ESIA a Stakeholder Engagement Plan and Grievance Redress Mechanism has been established.

Table 5: Safeguard Policies Triggered

Safeguard Policies Triggered	YES	NO	TBD
Environmental and Social Assessment (OS 1)	**X**		
The proposed project shall involve civil works / physical interventions on the natural environment; therefore OS 1 is triggered. A detailed ESIA (including ESMP) has been prepared to address all impacts attributed to the construction and operation phases.			
Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation (OS 2)		**X**	
Involuntary resettlement is unlikely to occur since the works will be carried out on existing systems and pre-designated sites.			
Biodiversity and Ecosystems Services (OS 3)	**X**		
The project infrastructures involve rehabilitation of exiting systems. It is not anticipated that new greenfield areas currently not under cultivation will be opened up. Therefore, OS.3 is not triggered.			
Pollution Prevention and Control, Hazardous Materials and Resources Efficiency (OS 4)	**X**		
OS 4 is triggered because of the potential pollution and wastes generated during construction phase of the project.			
Labour Conditions, Health and Safety (OS 5)	**X**		
OS.5 is triggered since the contractors shall employ staff or workers during project			
Safeguard Policies Triggered	**X**		

Table 6: Environmental Management Process - Implementation Responsibilities

Level	Responsibilities
Implementing Institution	▪ Designate technical staff that will take responsibility for environmental screening and generally for environmental management and get trained accordingly- this staff will ultimately prepare Environmental and Social Screening Forms and supervise the implementation by contractors of the Environmental Guidelines for Construction Contractors

	▪ Designate technical supervisor of works (nationality based ES focal staff), who, in the absence of the environmental focal staff mentioned above, will supervise the implementation by contractors of the Environmental Guidelines for Construction Contractors, ▪ Prepare environmental screening forms for all sub-programs and submit them to the Ministry of Environment and Rural Development and to the African Development Bank, ▪ Supervise the implementation of environmental mitigation measures at construction and operation phases, including those related to land ▪ Supervise the implementation of monitoring measures ▪ Provide an annual environmental monitoring report to the review of the Ministry of Water Resources
Construction contractors	Implement Environmental Guidelines for Construction Contractors as per the Environment Management Law Lr.79/2018 of Somaliland
ESIA Consultants	Develop ESIAs
Ministries of Environm ent and Water, and all stakeholders	▪ Participate in the provisions of training for regional community experts ▪ Participate in the finalization of the screening forms based on the framework proposed in this ESMF ▪ Review and clear screening forms submitted by implementing agencies or consultants ▪ Supervise the development by consultants of ESIAs where required, review Terms of Reference, review draft ESIAs, participate in public consultations ▪ Supervise the monitoring of environmental mitigations implemented by construction contractors ▪ Supervise the implementation of this ESMF in the entire regions

11. Environmental and Social Management Plan and RAP implementation

The Environmental and Social Assessment done by the consultants on July 2021 has been rated this program Category 2 under the African Development Bank Operational Policy on Environmental Assessment (OS 1). It has been recommended that an environmental and social screening to be conducted to determine the environmental and social management plan including safeguard and mitigation measures during project implementation phase.

11.1 Objective

The objective of the national ESMP is to provide pragmatic operational guidelines and procedures and reduce and/or mitigate the environmental and social risks associated with water infrastructure development work.

- Provide a framework for integration of social and environmental considerations in all stages of project design and execution to promote positive environmental and social outcomes
- Ensure compliance with World Bank safeguard policies;
- Prevent or compensate any loss of livelihood;
- Protect human health;
- Ensure appropriate institutional arrangements for implementing measures detailed in the ESMF.
- Offer practical advice on how to integrate safeguards considerations into project preparation and implementation;
- Facilitate access to country-specific information on physical, biological and social conditions.
- The ESMF is expected to cover the unknowns, to help in the screening, and to recommend mitigation measures.
- The screening and review process will determine whether a particular subproject will trigger a safeguard policy, and what mitigation measures will need to be put in place.

11.2 Environmental and social screening (ES) Field work

The main objective of the environmental and social screening is to predict the potential nature and magnitude of positive and adverse impacts and evaluate their significance and determine mitigation measures as part of the production of an Environmental Management Plan (EMP). Environmental Screening Form(s) were used to formalize a rapid field investigation to screen on-site whether any environmental and social issues may require specific attention and supplemental Environmental Assessment work. All sub-projects undergo the screening process in order to avoid any miss in screening potential environmental issues.

The Water Infrastructure intervention (DAM) on the bio-physical environment. Activities to be considered include. Water infrastructure will serve both human, livestock.

11.3 Potential Positive Impacts

The construction or improvement of water supply systems has many beneficial aspects, which includes.

A. **Access to safe drinking water and improved standard of living, e.g. through: -**

- Better domestic hygiene and reduction in water-borne diseases such as dysentery, diarrhea, etc.; Time savings, especially for women and girls; Financial benefits, especially for those (poor) people that presently buy their water in small quantities and at high prices from ambulant water vendors;

B. **Employment and Improved Service Delivery:**

- Increased employment opportunities, improved service delivery to enterprises and the population across the water sector in general remains one of the positive benefits that will arise from the proposed projects. This project will therefore provide substantive employment opportunities to local populations.
- Enhanced access to water: improvement of the target beneficiary households with average water use for drinking, cooking and personal hygiene.

- Improved functionality of the water resources. Increased water access through improved operation and maintenance of water infrastructure.
- Reduced risk of waterborne diseases: The proposed project will create reliable and clean sources of water and reduce periodic outbreak of water-borne related diseases. The project also intends to increase access to sanitation.
- Creation of employment opportunities: It is anticipated that the construction phase of the project will engage the local labour force. When the project becomes fully operational more people will be engaged in the operational phase of the project

12. Potential Negative Impacts

12.1 Negative Impacts during construction phase

The construction phase of the proposed Project has potential negative impacts associated with engineering works including the risks associated with Disturbance to topsoil created by machineries and trucks inappropriate handling construction wastes.

12.2 Vegetation Clearing/ trees loss:

Many trees will be remove and more soil especially top fertile soil will be also removed some wildlife species will immigrate there will be ecosystem changes that may pha

Proposed site for Dam construction, with vegetation cover

12.3 Pollution

The dust, noise and smoke pollution relate to the bush clearing by the heavy machinery, particularly during the land clearance excavation work and other vehicle/trucks movements of the project sits.

13. Enhancement and mitigation measures proposed against impacts

The project activities shall be executed in compliance with the constitution of the Somaliland government and the Bank’s requirements.

The main measures for preventing, mitigating and managing potential negative impacts of the projects can be summarized as follows: (i) Measures for reducing land clearing (ii) Measures for limiting the impacts of the project phases by preventing soil erosion and protecting Eco health systems, (iii) Measures for disposing of the excavated and dredged material in an appropriate way, (iv) Measures to Restoration and backfilling of land. Trees and vegetation restoration by carrying out reforestation programs and establishment of Tree nursery

An Environmental and Social Management and Monitoring Programme (ESMMP) embedding the framework of an ESMP and monitoring plan is detailed below. The required organization and costs for implementing these measures are described in the ESMP.

14. Environmental and social management plan (ESMP)

Main program activities	ES Impact	Mitigation measures	Actor Responsibility	Monitoring/indicators
Pollution (Air and noise	The dust, noise and smoke pollution relate to the bush clearing by the heavy machinery, particularly during the land clearance excavation work and other vehicle/trucks movements of the project sits. Amy result human health problems	Human health care facilities should be provided including face masks over coats and other measures that is suitable for human health	The implementing Contractors, Government Institutions (MoWRD, MoERD. MoHD	Monitoring Secure health safety of the workers
Vegetation Clearing/ trees loss	Many trees will be removed	Reforestation programs should be implemented and tree nursery should be established in the project area	Project implementing partner (Contractor) and MoERD	Reforestation programs implemented
Water Sanitation and Hygien	There will be waterborne diseases	Water purification plant should be established. Mosquito protection fish should	Implementing partner, MoWRD	Water purification plan established
Households immigration	Some households near the Dam will be resettled far from the Dam	Resettlement program is needed to take care the those selected	Project implementing partner, local and regional authorities	Households resettlement program

Spilway construction	Proper spillway may result flooding and damage the dam	Proper spillway should be constructed that ensure the safety of the dam and surround environment	Implementing partner and steering committee	Performance and design of the spillway

15. ESMP implementation and monitoring program

The overall responsibility of the environmental and social monitoring lies with The Somaliland's Ministry of Water Resources and Ministry of Environment and Rural Development (executing agencies) and the Implementing Agency The steering committee monitoring unit will nominated by both parties (the two Government Ministries and the project implementing Agency to ensure compliance to environmental standards and procedures including relevant policies and legislations.

The Steering committee as part of the project to provide advice on the implementation and monitoring of environmental and social measures. Before construction, and will review the works contract and document environmental and social requirements

16. Institutional arrangements

The institutional arrangement for monitoring the performance and compliance at national is summarized in Table 9. The following institutions will play key roles in the ESMP monitoring in all phases. The audits will be conducted in accordance with the Bank's audit procedures using the Bank's terms of reference (ToR) by an independent Audit.

Table 6: Roles and responsibilities of institutions in project monitoring

Institution	Responsibility
Ministry of Water Resources (MoWR) PIU and CARE Int.	• Facilitate and provide training for state staffs for water management and sanitation • Develop water sanitation strategies and worknorms
Ministry of Environment and Rural Development	• Supervision and monitoring the overall Implementation of the ESMP • Review/preparartion of TOR for EIAand/or screening studies if required • Seek for validation and endorsement of the ESMP
Program Steering Committee	Overall supervision and coordination with relevant institutions in the regions, Provide quality control and ensuring that PIU operates within the project framework • Direct responsibility for Implementation of ESMP at project sites • Approval of ESMF and monitor the overall implementation of ESMF & associated ESMP's and annual environmental reports • Monitoring of program activities and indicators • Resolve disputes on land issues

17. References

- ✓ *Somaliland Constitution*
- ✓ *Somaliland National Water Act*
- ✓ *Somaliland National Environment policy*
- ✓ *Environment Conservation Act*
- ✓ *Water Infrastructure Development for Resilience in Somaliland Program*
- ✓ *Guidelines for Environmental Impact Assessments and Regulatory Procedures, Somaliland*
- ✓ *Environmental and Social Management Framework WIDR program*
- ✓ *World Bank Environmental and Social Standards*

Geological assessment

Geological assessment for RCC gravity dam in Amoud upstream area

August 2021

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CONTENTS

ACRONYMS AND ABBREVIATIONS

MOWRD	Ministry of Water Resources Development
RCC	Roller-compacted concrete
SHABA	The company supplying and management Borama water
VES	Vertical Electrical Sounding

1.0 Introduction

In August 2021, Ahmed M Adan (a freelance geoscientist with 18 years experience in geosciences sector, including 10 years of water surveys/studies) has been assigned by SHABA Water Company to conduct general geological study to assess a proposed site in the upstream of Amoud dry river for a RCC gravity dam to be constructed. This report summarizes the result of geological study of the potential dam site.

1.1 Background

The ground water sources currently available for the Borama town cannot keep up with the ever increasing water demand of the town. Following the recommendation of the 25 years master plan of the town which pointed out mass water harvesting as the major option for the future urban water supply, SHABA requested from the Ministry of Water Resources Development (MOWRD) to assist the introduction of surface water harvesting for Borama water supply. The ministry requested from the African Development Bank to carry out comprehensive water study of the country.

MOWRD and African Water Facility signed an agreement to award NIRAS (An international Norwegian Company) to lead the preparation of integrated water resources management implementation plan. The study identified the possibility of constructing potential dam in the upper stream of Amoud dry river which locates 6 kilometres east of the town (Fig 1).

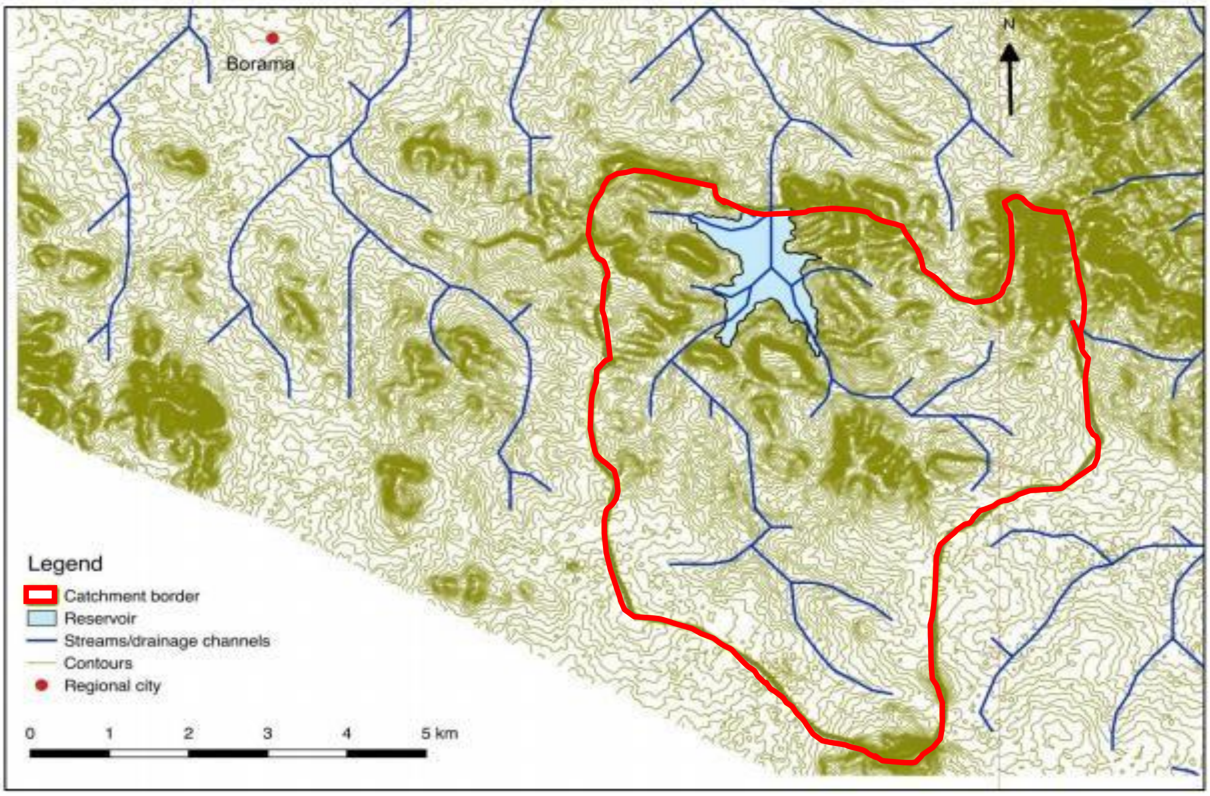


Figure 1. The reservoir of the proposed dam (blue area) and its drainage basin area (within the red line)

The study recommended the construction of large capacity dam about 4 million CUM stream section marked by the GPS coordinates of N9.915436 E43.23791 and N9.91442 E43.24317 (cover photo).

1.2 Assignment objectives

Implementation of such dam requires comprehensive study and evaluation of the various risks and challenges associated with it. The overall objective of the assignment was to carry out comprehensive study to the general geological characteristics of the sites of Amoud RCC gravity dam which is envisioned to safely supply enough water to Borama town.

Specific objectives of the assessment include:

(a) Examine feasibility of constructing RRC gravity dam in the proposed site
(b) Study to the characteristic of the dam site including the upper/downstream of the dam
(c) site Study to the formation of the dam bed nature of the dam
(d) Study of the potential risks in terms of :-

- earthquake risks
- soil seepage possibilities and degree
- spillway design recommendations
- dam siltation

1.3 Regional geological setting

The southern part of the Awdal region is dominated by basement units of different types of metamorphic rocks and intrusive igneous rocks. These units include metamorphosed quartzofeldspathic sediments (psammites) possibly originally arkoses, with common amphibolites, mica-schists with amphibolites. Low grade metamorphic rocks of pelitic and semi-pelitic. The older metamorphic rocks are often intruded by intrusive rocks of both acidic and mafic, such as gabbros, granites granodiorites and pegmatites, forming large batholiths, dykes and sills.

The basal Adigrat sandstones is observed and documented to present in the area by Bruno 2015 who described the unit as follows. 'Adigrat Sandstones deposited in unconformity on the crystalline basement. This unit, well visible mostly in the Amoud basin, is constituted by crossed layers of sand and gravel, mostly made by quartz. Sometimes finer levels like fine sand and silt are present, like those found in drillings both in the eastern and western basin. In the visited outcrops the prevalence of coarser clasts has been ascertained. The thickness of this unit does not exceed 50 m in the study area'.

The main sedimentary rocks of the area is Jurassic limestone outliers, which are typically seen as isolated, elongated hills, faulted against the Precambrian basement metasediments Limestone outcrop examined immediately north of the fault separating the Precambrian basement and the limestone downstream of the dam site is hard, grey in colour. The unit is well bedded with bedding thickness of tens of centimetres to over 1 meter, with some thin layers of marls (Fig 3).

Figure 3. Jurassic limestone outcrop downstream of the potential dam site (E9.92203 - N43.24264)

1.4 Tectonics and geological structure

The main tectonic regime of Somaliland was vertical movement of regional extent and was dominated by three trends of extensional faulting, namely Gulf of Aden trend (E-W to ENE-WSW), Red Sea trend (NW-SE to WNW-ESE) and East Africa (N-S). These deformational directions are not restricted to given geological time but at times there has been late stage reactivation of old-established trends. Important large-scale faulting movements appear to have taken place in the Mesozoic and, although at times it is usually difficult to differentiate between fault movements of this early age and younger movements, due to the rejuvenation of the younger stage activities on the old deformation structures and the two phases follow similar trends (Fig 2).

The southern part of Awdal region in influenced by the Gulf of Aden and Red Sea faulting trends, which are the two most important fault trends that shaped the Somaliland’s morphology (Fig 2), which produced large faults with significant displacement, down-throwing Jurassic sedimentary units against the Precambrian basement. These faults are mainly downthrowing to the north-north-east. The published maps are showing number of such faults present at Damuk and Amoud areas. Such WNW-ESE oriented fault are observed both upstream and downstream of the dam site (Fig 4).

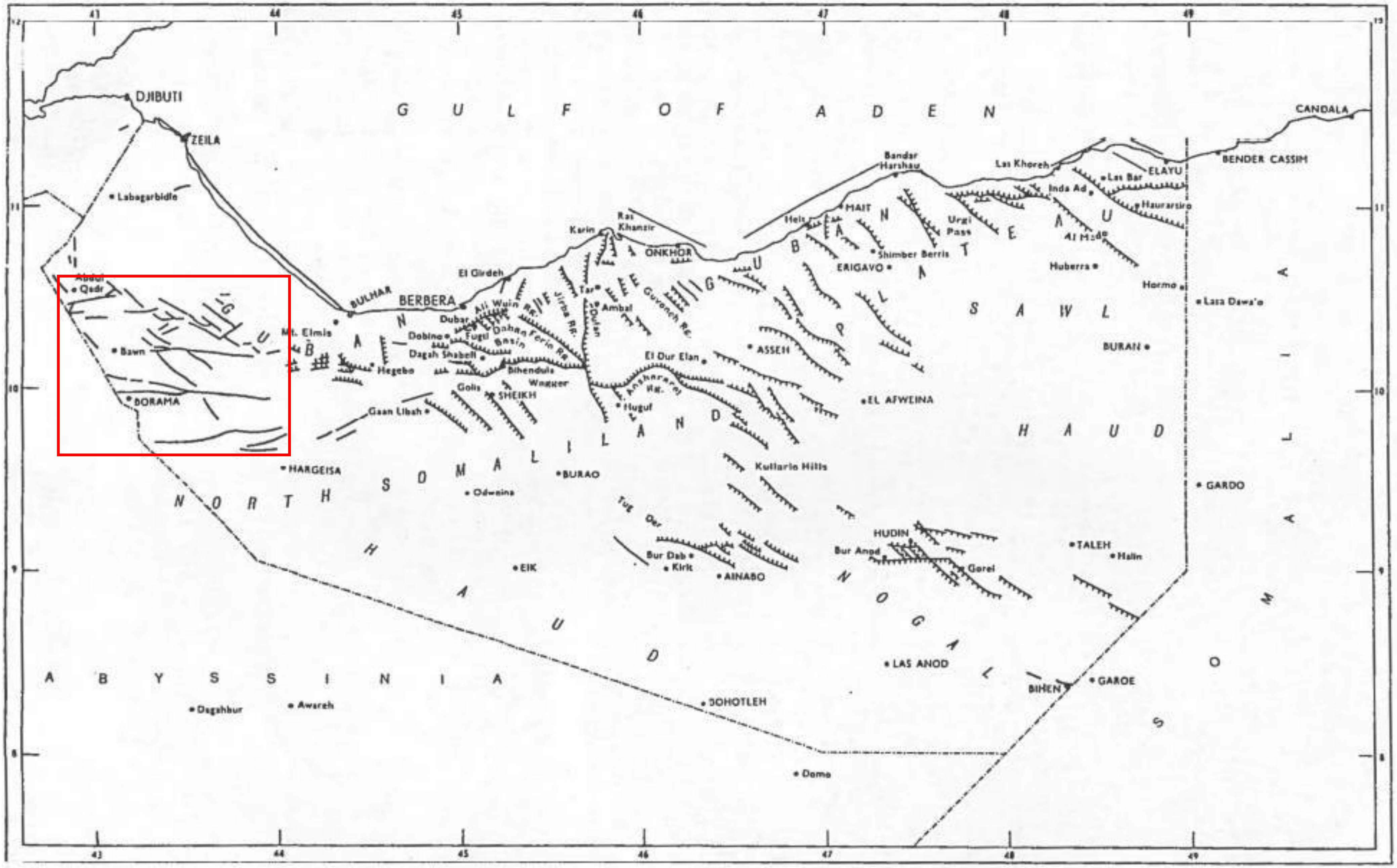


Figure 2. The density and tends of the different phases of faulting in Somaliland. Note the dominant faulting phase of southern Awdal region (red box).

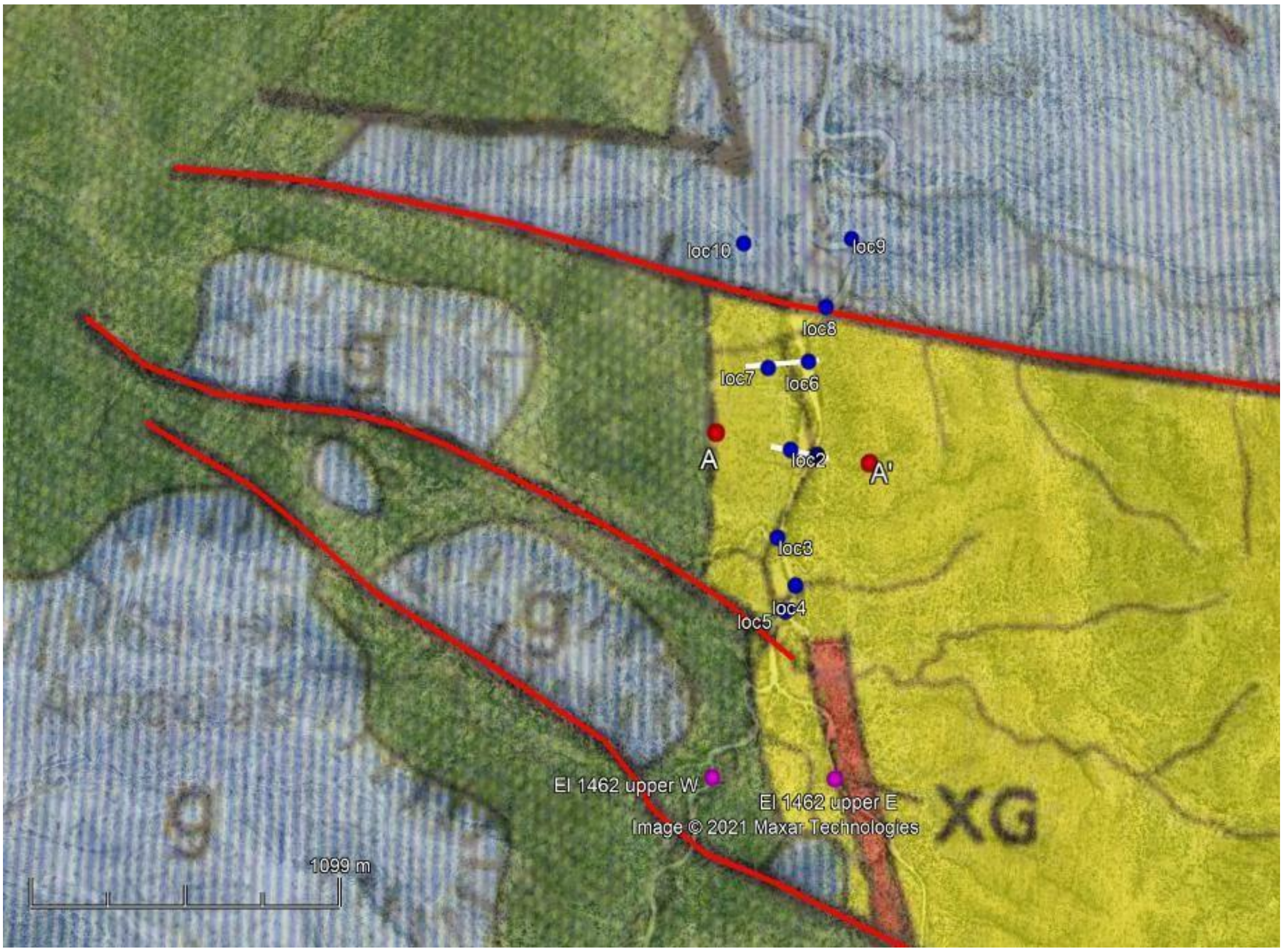


Figure 4. Geological map of the potential dam site, showing the geological faults (red lines), the two sites examined for potential dam (white line), locations of bedrock examinations (blue dots), initial GPS coordinate points given in the NIRAS interim report (red dots), upstream points of equal elevation with the 17m high dam crest (purple dots)

2. Dam site assessment

2.1 Assessment execution methodology

Dam types can be classified in different categories according to the material used in construction and how they withstand the thrust of water. The main parameters to be taken into account in choosing a dam site and type are the following: topography and inflow in the catchment area; morphology of the river valley; geological and geotechnical conditions; climate and flood regime.

The assessment work was started with desk study by revising and analysing the proposal stated in the NIRAS interim report, as well as examining previous water researches and geological maps and literature written on Borama and surrounding areas. This was followed by remotely mapping and studying of the area through Google Earth images, which yielded good geological and hydrogeological information that was important to understand prior to going to the field.

Having established a baseline data from above activities to guide the field activities, a field visit was then carried out to examine the area and to make direct observation and measurements to collect first-hand information. In addition to the site recommended in the NIRAS interim report, during the field excursion, another site downstream of the proposed site were evaluated (Fig 4). During the two days of the field mission, the input and the views of the SHABA Manager and the MOWRD regional coordinator for Awdal region (who were assisting the field mission) were noted and taken into consideration. The data was then integrates for analysis and for the compilation of the final project report.

2.2 Geological units in the potential dam site

The geological units of the site recommended in the NIRAS interim report are entirely metamorphosed basement rocks (Fig 4).

These units are well exposed along the stream section and on the hills next to the stream. The units observed outcropping and inspected include:

(a) **Psammites**: This unit is expressed in a number of exposures along the east side of the stream section. It also outcrops on hills to the west side of the stream. The unit is very hard, creamy in colour and the original sedimentary characteristics (such as grains, texture and stratification are still noticeable, mineralogical the unit is metamorphosed quartzofeldspathic sediments is dominated by quartz and orthoclase feldspar. The rock has some degree of fracturing oriented east-west direction. Some sites the unit is interbanding with other metasediment units and occasionally form massive body, showing significant fracturing on the exposed surface (Fig 5).

Figure 5. Fractured metamorphosed quartzofeldspathic rock exposure on the eastern side of the stream section (E9.91523 - N43.24145)

(b) Schists: schists are exposed along the stream sections and are hard, grey and contain feldspar phenocrysts. The schistosity is sub-vertical and its trend is north (350^0). The fractures of the units are towards ENE (062^0). In some area the schists form thin bands of dark pelitic/semi-pelitic mica-schists, this became, brownish and crumbly due to the wet-dry weathering on the exposed surface (Fig 6). In other locations the mica-schists is interbanded with amphibolites.

Figure 6. Mica schist with thin bands of dark pelitic/semi-pelitic rock, exposure on the eastern side of the stream section (E9.91052 - N43.24063)

(c) Granitic gneisses: Small exposures of granitic gneisses were observed on the west sides of the stream. The unit is grey-white in colour, hard and display a network of fractures.

2.3 Structural geology and tectonic risk analysis

The study of geological, with emphasis on the characteristics of the geological structures is a major importance for dam construction, accordingly, geological structure affects dam site and reservoir in number of ways including its impact on the geo-mechanical properties of rocks its role in seismo-tectonic and seismic risk analysis of dam projects. Site geology and availability of various geologic data obtained from site investigation are key points in dam construction. Geological structure plays an important role in dam site geology and imposes major limitations on dam behaviour. This role has its own effect on major subjects such as: geomorphology of rivers; geotechnical properties and engineering geology of dam sites; and hydrogeology of dam and reservoir.

Stating with geo-mechanical properties, the rocks of the dam site area are basement metamorphic rocks. Lithologicaly, these units have minimum permeability and their integrity to contain the pressure of the dam reservoir is sound, particularly the schists, gneisses and the psammites. However, number of points are needed to be pointed out. (a) On the exposed surfaces the rocks show significant degree of fracturing (Fig 4). Further examination of the condition of these units in necessary to check if this is the case for the underground units as well. These fractures if interconnected can be exploited by the water and may result some degree of seepage. Also when the water pressure increases more of it is forced into the ground, filling cracks and crevices. This water pressure can expand those cracks and cause some instability below ground, or the water may sinks deeper and act as sort of a lubricant for rock plates. The lubrication can cause those plates to slip. It important, for the purpose of comprehensiveness in the evaluation of the bedrock foundation strength to carry out pits or/and geophysical survey, to determine the physical properties and indeed the depth of the fresh bedrock. If the un-weathered bed rock is too deep it will also result significant increase in the construction cost. (b) The units also have well-developed schistosity, which is parallel with the stream flow. Again this could be allow water movement along the schistosity. (c) Some of the metasediment units are very low grade and have retained some of the sedimentary rock features, such as the stratification planes. Some of those units are observed folded into vertical positions in a direction parallel with the stream (Fig 7).

To examine the seismo-tectonic risk of dam, let us first look into the general earthquake factors causing dam failure or damage and the types of dams that are more resistant to earthquakes.

Earthquakes and the release of its energy are caused mostly by rupture of geological faults but also by other events. Earthquakes may cause failure or profound damage for dams. Factors contributing to this are, magnitude on the Richter scale, peak horizontal and vertical accelerations, time duration, in addition to the epicentre distance, nature of foundation rock, criteria of the design, and finally, if appropriate type of dam and materials has been used. The seismic ground motions are cyclic and have short durations. In this regard, concrete gravity dams have shown good resistance.

Case histories have shown that concrete dams suffered less damage from earthquakes compare to other dams (Appendix III). This may be due to the nature of these structures, the type of construction material, and to the relatively stronger foundations on which concrete dams are normally constructed. Apart from ShihKang dam, which failed on the 21st of September 1999, no more concrete dams have failed, and this was the first case in history so far. This dam was hit by Chi- Chi Earthquake (M= 7.6) in Taiwan. It was also located on a branch of a main fault. The earthquake that resulted from the rupture of this fault causing failure of the dam.

For a concrete gravity dam located in Borama the risk of damage as a result of earthquake is minimum. The magnitude of damage on dams is generally commensurate with the magnitude of the earthquake and the safety levels to which any dam is to be designed are defined in terms of the Maximum Credible Earthquake. Borama area the highest earthquake magnitude is reported to have been 3. 6 on rector scale (personal communication with SHABA Manager), can be felt but is unlikely to cause damage. The frequency of earthquake in the area is also limited. These minor earthquakes are probably associated with the tectonic activities of the East African rifting and the epicentre is some distance from Borama.

Locally, there are number of faults in the area surrounding the dam, most of which are downstream of the dam. One of these faults, which is separating the metasediment rocks and the Jurassic limestone, is some 550m from the site initially proposed in the NIRAS study. The fault is stable and its direction is parallel with the alignment of the dam crest (Fig 4). The dam is located a stable (non-faulted) area and this fault does not have any risk to the dam structure.

Figure 7. Folded metasediments units on the east side of the stream section, showing original sedimentary features (E9.91784 - N43.24110)

2.4 Dam parameters and site evaluation

The site recommended in the NIRAS interim report was established thought remote sensing data, satellite imageries and digital elevation models and its selection was based on a suitable valley profile that will minimise the need for a too long dam crest to be constructed across the valley, having good foundation, impermeable (or low permeable) bedrock to prevent seepage. Likewise the drainage basin feeding the dam reservoir should be of significant size to supply sufficient water into the dam reservoir.

The estimates/calculation from the NIRAS interim report is as follows:

1	The catchment area	33.4 km^2
2	The maximal dam height	35m
3	Reservoir volume corresponding the maximal dam height	20.4 million m^3
4	Reservoir volume corresponding to 17m dam height	4 million m^{3*}

* plotting of the volume-area-level relation graph actually gives 3.5 million m^3 not 4 million m^3

The NIRAS interim report indicated that the surface water available at the analysed Borama dam site is not sufficient to utilize the potential reservoir size with a dam height of 35m. Considering this and the associated extra cost of building 35m high dam instead of 17m, during the assessment 17m high dam was taken into account. The elevation of the stream level being 1445m, the elevation of corners of the crest of the dam shall be 1462m.

Figure 8. Potential dam site section, showing the location of the section and the dam crest length with 17m crest height

The two point given in the interim report was jointed with a line, which is the possible position of the proposed dam crest. The position of elevation 1462m along the line on either side for the stream were identified to produce the profile of the section (fig 8).The length of the crest come to 232m.

Further downstream a similar procedure was used to produce the profile of another location which was also assessed for being alternative section for the dam. The elevation of the stream bed at this location is 1441m and crest length of a potential dam at this location come to 391m (Fig 9), its highest point elevation being 1458m.

The two sites are about 350m apart and their geological units are same. The stream is wide at the downstream site and hence having more reservoir capacity. Another advantage that can be link with this width is having room, where, during construction as water can be diverted to one side as the other side is being constructed. However, there will be extra cost of constructing longer dam crest as well as the structural weakness this longer crest will bring about. The site is also closer to the fault separating the metasediment rocks (on the south) from the Jurassic limestone (on the north). Beyond the fault the slope becomes gentler and the geological formation is more permeable allowing higher infiltration of the lower underground reservoirs by the overflow water during heavy rains.

The upstream of the site proposed for the dam the rock formation is basement apart from some isolated limestone units in the southwest of the drainage basin. The slope is relatively steeper, hence minimum loss of water through infiltration. Therefore amount and the intensity of the rainfall will be the one of the main determinant factor of the water budget entering into the dam reservoir.

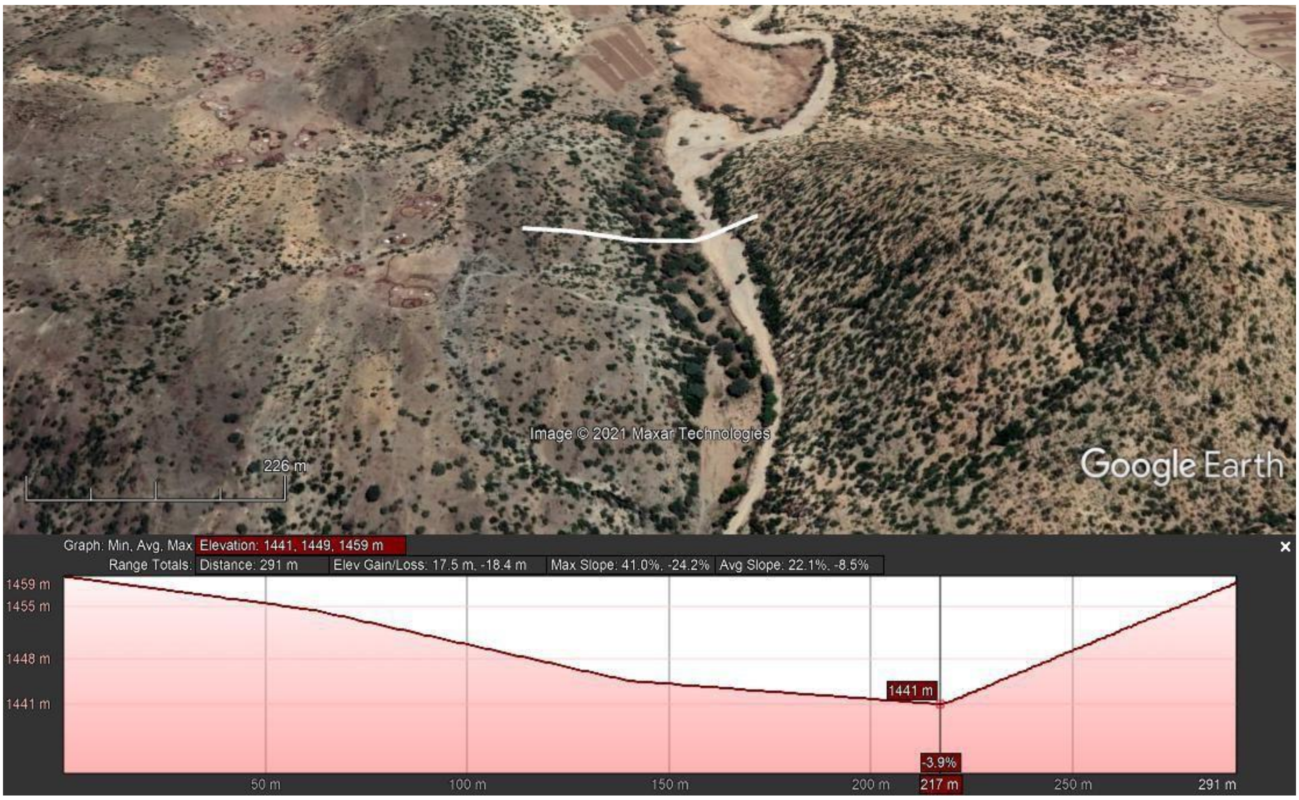


Figure 9. Second location for potential dam site section, showing the location of the section and the dam crest length with 17m crest height.

Soil/bedrock seepage is expected to be due to the lithology of the bedrock and stream bank units. On the exposed surface some of the pelitic units show degree of weathering and in general the basement units observed along the stream section have some fracturing at an angle of 60-800 to the stream direction. These fractures are exploited by weathering elements of water and the sun. The bedrock below the stream is certainly similar in lithology but bits or shallow drilling will be required to determine the depth to the hard rock. Similarly geophysical survey (using VES or refraction seismic) could be used initial, to give some idea on the amount of loose and weathered overburden on the hard bedrock below the stream. There is significant amount of water and gravity transported sediments that will require to be scope out to maximise the storage capacity.

The earthwork and removal of the loose materials on the foot of the hills within the dam reservoir area may result hillside instability and this may bring about loose sediments on the hillside to slide into the bottom on the reservoir, hastening siltation/filling of the dam. As the dam location is at the source of the erosion and there is no much sandy materials to be transported into the dam reservoir, the sediment entering into the dam reservoir will be mainly larger size materials that require higher energy to be transported. This will therefore depend on the intensity rainfall.

The primary function of a spillway is to release surplus water from reservoirs and to safely bypass the design flood downstream in order to prevent overtopping and possible failure of the dam. The overflow (ogee) spillway is the type usually associated with concrete gravity dams, which is typically integral part of the main structure. This can be economical, because very little alteration to the profile of such a dam is necessary to accommodate the overflow section. The water usually cascades down a smooth or stepped face of the dam. At the foot of the dam the water must be made to dissipate some of its energy, because the main danger with this type of overflow is scour at the toe of the dam during an extreme flood. The spillway is typically placed in the middle of the dam crest (Fig 10) to prevent overflow water damaging the abutment of the dam crest.

Figure 10. Typical concrete gravity dam spillway, allowing overflow descending over the middle part of the dam crest

3.0 Conclusions & recommendations

3.1 Conclusions

Rain water harvesting is underdeveloped in Somaliland and there is a great deal of country-wide need for various types of rain water harvesting projects in the country. Borama in particular has the need for such projects as well as having the favourable conditions for major surface water projects. The current capacity of water supply from the limited underground aquifers cannot keep up with the demand of the ever-growing population of the town. The dominant geological units, the geomorphology of the area and the annual rainfall are all favourable.

The specific site suggested by the NIRAS has the conditions needed for RCC gravity dam including:

- Drainage basin large enough to supply sufficient water into the potential dam reservoir with the proposed crest height.
- Stream morphology is relatively narrow to allow RCC gravity dam construction with not too long dam crest.
- The rock units of the potential dam site (bedrock and the reservoir holding surroundings are entirely metamorphic/metasediments and offer the lithological strength required to withstand

the water pressure as well as preventing soil seepage. The fractured nature of the units observed on the exposed surfaces needs further examination to see the condition of the unexposed rocks. The size and intensity may be less in the fresh, buried parts of the units. The schistosity and sedimentary structures retained by some of the low grade metasediments, such as the stratification planes may also be of a slight concern.

The initial study stated that the dam reservoir has the capacity to hold the potential flood flow budget from the drainage basin, however the immediate upstream of the dam structure could have ideally been wider and to compensate this and to enhance the reservoir capacity, stripping of the weathered, loose materials are required. Such excavation work could be costly but some of it could be used for the construction of the dam and other nearby water network facilities.

The Dam is proposed by the initial study to be built with a crest height of 17m and the report indicated that building crest height of 35m will not be logic since they considered the flow budget from the drainage catchment will not be sufficient to fill such large capacity. With is level and the surrounding areas being higher elevation, the method or scheme of diverting flows around the dam site during construction will be difficult and costly. During the construction concrete gravity dam a potential cost savings scheme is the option of diversion through alternate construction blocks, and lowers risk and delay. The spillway will be integral part of the main structure which discharge floodwater over the crest of the dam, which will be economical, because very little alteration to the profile of such a dam is necessary to accommodate the overflow section.

The earthquake associated risk is very minimum for the dam as the magnitude and the frequency of earthquake in Borama area is very small. Concrete gravity dams also generally have good resistance to earthquake activities.

In conclusion the proposed site for the dam possesses favourable conditions for this type of dam in terms of geological, stream morphological, drainage basin runoff water budgets.

3.2 Recommendations

The following are the recommendations put forward in order to make progress with the proposed project and to carry out a comprehensive site assessment of both technical and financial prior to commencement of the project implementation.

1. Initially proposed site is recommended over the other downstream site due to the cost and structural weakness that can associate with longer dam crest. The site is also slightly closer to the fault than the originally proposed site.

2. More detailed studies are needed to calculate more accurately the water budget from the drainage basin, taking into account the size of basin, the rainfall (amount and intensity) and other factors influencing infiltration in the upstream, such as slope and permeability of upstream units. The volume-area-level relation graph for the potential reservoir also requires some adjustment as the plotting of the graph does not give the presented volume.
3. Further evaluation of the foundation rock strength and its condition in underground is also needed. Geophysical survey and/or bits/trenches are required to be carried out.
4. The dam reservoir area will require substantial excavation to strip the loose, weathered materials to shape and enhance the reservoir capacity. The slope stability should be monitored while this undertaking is being carried out, as that may result sediment mass movement into the reservoir during heavy rains.
5. Diverting flows around the dam site during construction will be difficult and costly. Overflow (ogee) spillway is the type recommended with diversion water through alternate construction blocks during construction.
6. A dam may have all the advantageous natural conditions but if there is weakness in the engineering design, construction standard and quality of materials used that will determine its strength and functioning, therefore should be given great deal attention. The excavation of the dam reservoir area may be used for construction. It may be economical to install a dedicated temporary crusher in the area, since there are good quality rock formations for aggregate.

4. References

1. **Daniels J. L**. 1965. **The deformation of some banded gabbros in the northern Somalia fold-belt**. Quarterly Journal of the Geological Society 1965; v. 121; p. 111-137.

2. **Petrucci. B. and others.** 2015. **Improving urban water service delivery in Somaliland UNICEF pca/nwz/2013/427.** Borama town geological – hydrogeological – geophysical studies technical report.

3. **White. W. C** & **Daniels J. L.** 1970. **Geological Survey of Somali Democratic Republic. Geology Survey Sheet of 32 &44 Borama. Scale 1:125,000.**

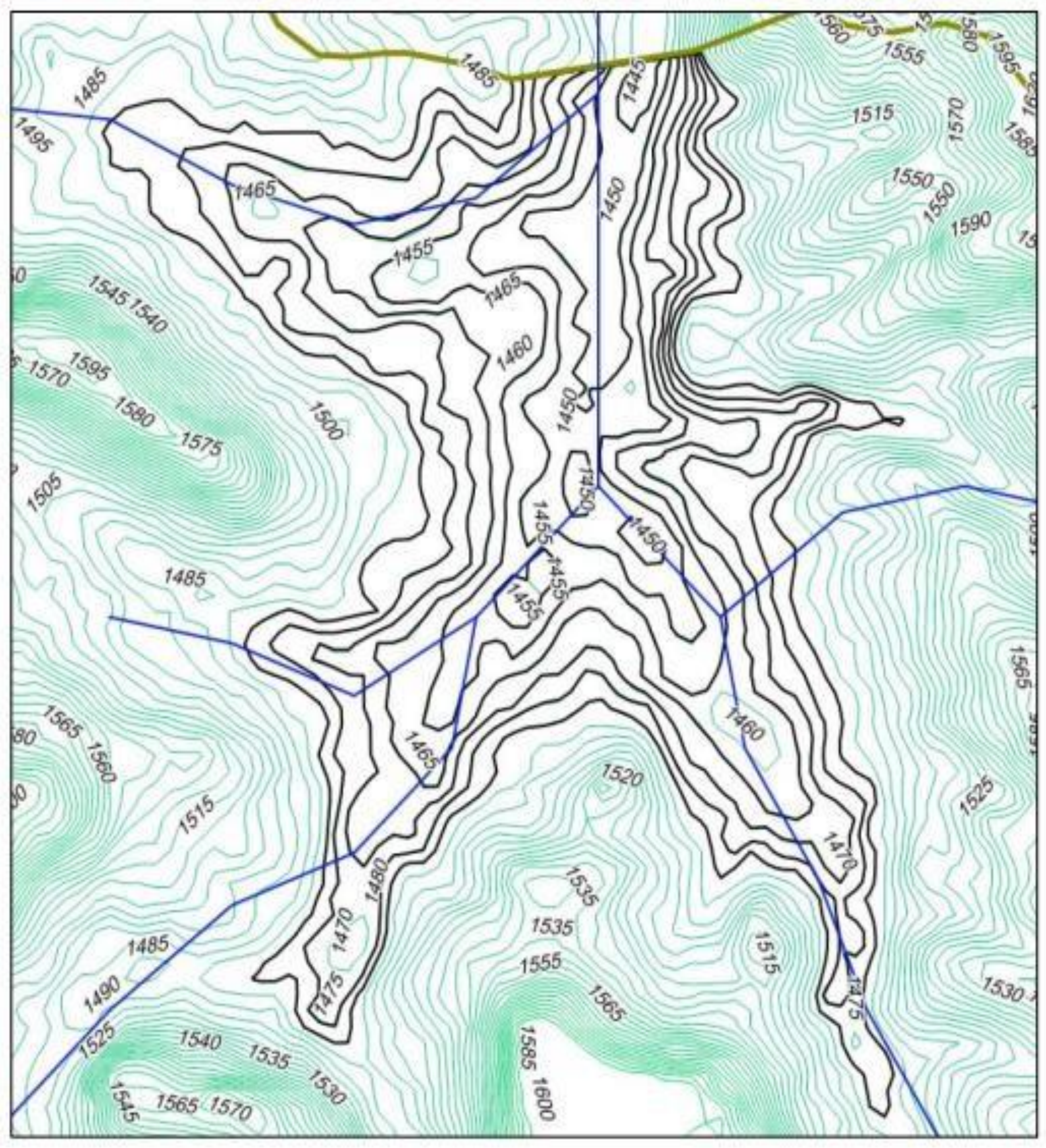
4. **NIRAS.** 2017**. Building Resilience to Water Stress in Somaliland Preparation of Water Resources Management and Investment Plan.** Interim report with thematic assessments.

5. **Adamo. N, Al-Ansariand. N** & others. 2020. **Dam Safety and Earthquakes.** Journal of Earth Sciences and Geotechnical Engineering, Vol. 10, No. 6, 2020, 79-132 ISSN: 1792-9040 (print version), 1792-9660 (online) Scientific Press International Limited.

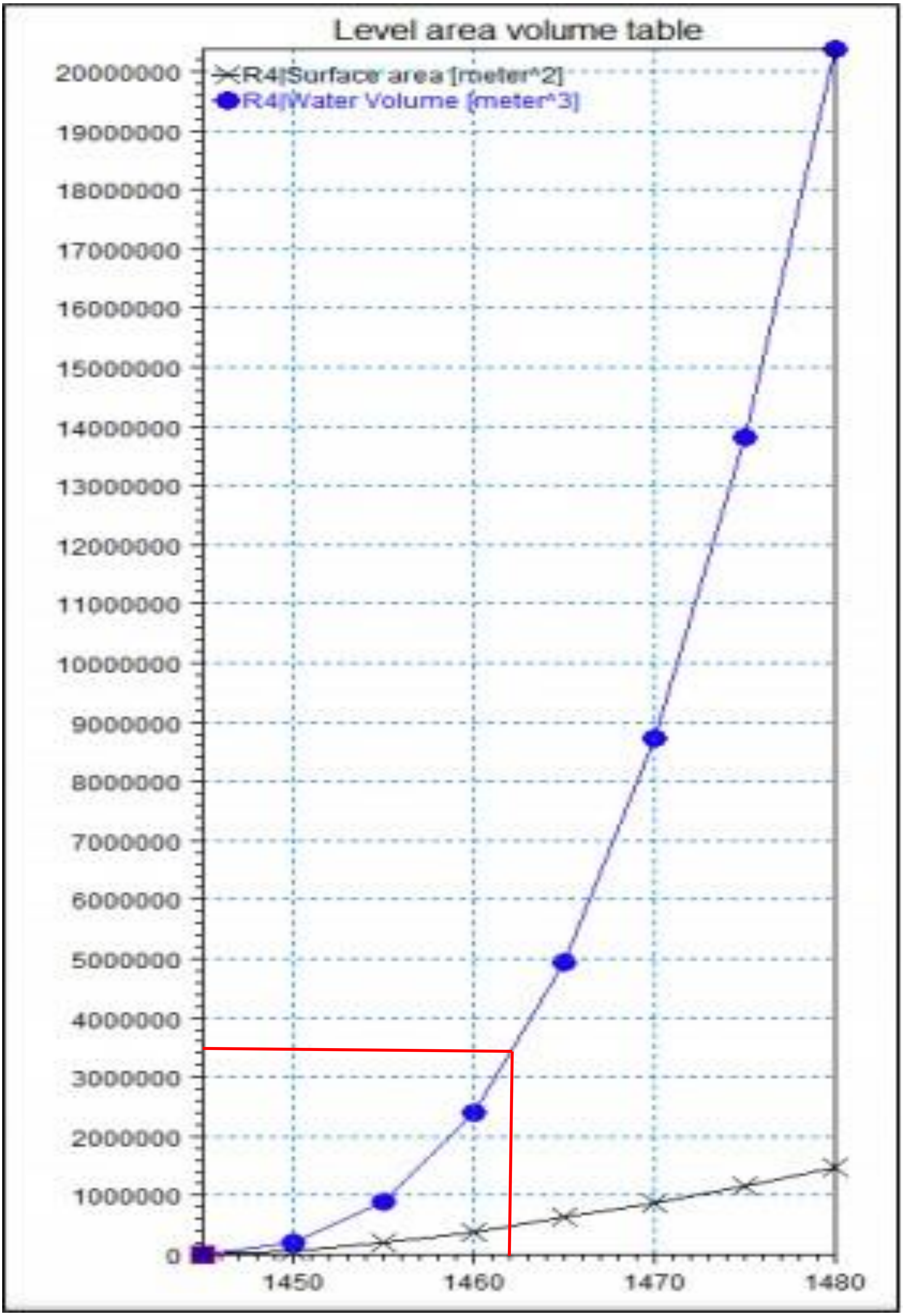
APPENDIX I

FIGURES OF DAM PARAMETERS FROM NIRAS INTERIM REPORT

(A) Contour lines for the reservoir bottom

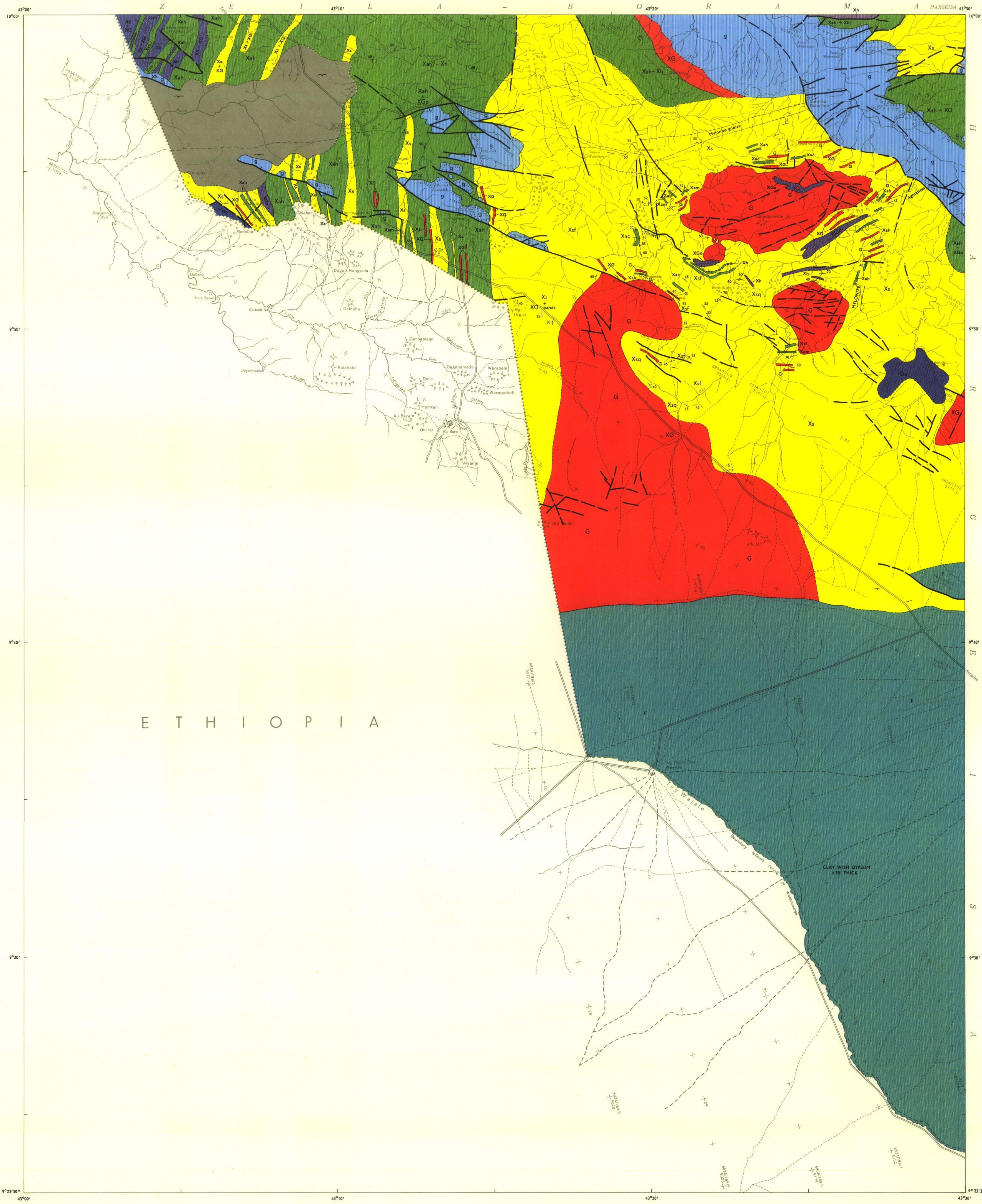


(B) Volume-area-level relation for the potential reservoir



APPENDIX I

1:125,000 SOMALI DEMOCRATIC REPUBLIC — BORAMA — GEOLOGICAL SURVEY SHEET 32 & 44



D.O.S. 1076
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3/70/4749/OS

SCALE 1:125,000

LEGEND

Symbol	
Geological boundary	
Geological boundary, inferred	
Fault	
Fault, inferred	
Joints	
Strike	
Igneous banding, angle in degrees	50
Bedding and foliation dip with angle in degrees	56
Bedding Horizontal	
Anticlinal fold axis	
Synclinal	
Pitching	
Monoclinal	
Xenoliths	Xen

Age	Unit	Symbol
PLIOCENE to RECENT	Alluvium	
	Boulder beds	
	Aden Volcanics, undifferentiated	b
	Rhyolites of Aden Volcanic Age	br
PALAEOCENE to EOCENE	Auradu Series	e_1
CRETACEOUS	Nubian Sandstone	f
JURASSIC	Limestone with Basal Adigrat Sandstone	g

Unit	Symbol
Psammites, undifferentiated	Xs
Quartzites	Xsq
Micaceous psammites	Xsm
Feldspathic psammites	Xsf
Micaceous feldspathic psammites	Xsmf
Amphibolitic psammites	Xsh
Pelitic and semi-pelitic, undifferentiated	Xa
Micaceous pelitic and semi-pelitic schists and gneisses	Xam
Chloritic " " " " " "	Xac
Hornblende " " " " " "	Xah
Garnetiferous " " " " " "	Xag
Semi-pelitic schists and gneisses	Xas
Calc-Silicate rocks	Xc
Marble	Xl
Talc	Xlt
Quartzo-feldspathic gneisses and schists	Xg
Granite gneiss	XG
Granite, granodiorite	G
Porphyritic granite	Gp
Acid pegmatites	P
Aplites	Ap
Dolerite	Do
Gabbro	Go
Meta-gabbro	XGo
Amphibolites of igneous origin	Xh
Ultrabasic rocks	U
Syenite	S
Undersaturated syenite	Su
Rhyolite and associated rocks	XR
Quartz porphyry	Qp

INDEX TO ADJOINING SHEETS

19	20	21
	32 & 44	33
		45

GEOLOGICAL SURVEY
SOMALI DEMOCRATIC REPUBLIC

GEOLOGY OF SHEET 32 & 44

BORAMA

SCALE 1:125,000

Geologically surveyed by

W. C. White 1953-55 and J. L. Daniels 1958-59

Agents for the sale of this map are:- Edward Stanford Ltd., 12/14, Long Acre, London, W.C.2. Price Code 3.

APPENDIX IIa: **Table 1: List of reported dams which failed as a result of earthquake (1896- 2000)[4].**

Dam Name	Country	Type	Height [ft]	Earthquake name	Earthquake Date	Magnitude	Distance [km]
Augusta	USA	E	-	Charleston	13 Aug 1886	7.0	180,0
Vulcano Lake	Mexico	E	12	Imperial Valley	22 June 1915	5.3	0.0
Fairmont	USA	E	-	Imperial Valley	22 October 1916	5.0	22.0
Sheffield- 2	USA	E	25	Santa Barbra	29 June 1925	6.3	11.2
Barahona	Chile	T	200	Talca	01 October 1928	8.4	160,0
Vulcano Lake	Mexico	E	12	El Centro	18 May 1940	7.1	0.0
Hosorogi	Japan	E	28	Fukui	28 January 1948	7.3	4.8
Coleman	USA	Comp	-	Fallon	23 August 1954	6.7	24.0
Saguspe	USA	E	-	Fallon	23 August 1954	6.7	24.0
Rogers	USA	M	-	Fallon	23 August 1954	6.7	80.0
El Soldado	Chile	T	-	Chile	28 March 1965	7.1	-
El Cobre	Chile	T	-	Chile	28 March 1965	7.1	35.0
Hayagakenuma	Japan	E	40	Tokachi- Oki	16 May1968	-	-
Ichrigoya	Japan	E	26	Tokachi- Oki	16 May 1968	-	-
Gamanosawa	Japan	E	34	Tokachi- Oki	16 May 1968	-	-
Shorey	Peru	T	-	Peru	1969	-	-
Huachopolca	Peru	T	-	Peru	1970	-	-
Salamanca	Chile	T		Chile	08 July 1971	7.5	110,0
Illapel	Chile	T	26	Chile	08 July 1971	7.5	100,0
Cerro Negro	Chile	T	-	Chile	08 July 1971	7.5	-
Mochinkoshi 1	Japan	T	98	NrIzu- Oshima	14 January 1978	7.0	35
Cerro Negro-2	Chile	T	105	Chile	03 March 1985	7.7	-
Veta De Aqua	Chile	T	-	Chile	03 March 1985	7.7	-
Upper Koyoen	Japan	E	30	Kobe	17 January 1995	6.9	-
Central Koyoen	Japan	E	30	Kobe	17 January 1995	6.9	-
Niteko	Japan	E	-	Kobe	17 January 1995	6.9	<10
Shih- Kang	Taiwan	CG	82	Chi- Chi	17 September 1999	7.6	0.0

Legend E= Earth dam. **Comp** = Composite (fill/ Concrete), **M**= Masonry, **T**= Tailing, **CG**= Concrete Gravity

APPENDIX IIb: List of reported dams which were severely damaged (but did not fail) as a result of earthquakes [4].

Dam Name	Country	Type	Height [ft.]	Earthquake name	Earthquake Date	M	Distance [km]
Ono	Japan	E	161	Kanto	01 September 1923	8.2	51.0
Misc. Embankments	Japan	E	50/8	Ojka	1939	6.6	-
Hebgen [1]	USA	E	90	Hebgen Lake	17 August 1959	7.1	16.0
Hsinfengkiang	Chile	CGB	344	Hsinfengkiang	19 March 1962	6.1	1.1
Bella vista	Chile	T	-	Chile	28 March 1965	7.1	55.0
Koyna [1]	India	CG	338	Koyna	11 December 1967	6.5	3.0
Yeyuan	China	E	82	Bohai Gulf	18 July 1968	7.2	?
U. Van Norman	U SA	HF	80	San Fernando	09 February 1971	6.5	11.2
El Cobri	Chile	T	-	Chile	08 July 1971	7.5	80.0
Lliu	Chile	T	-	Chile	08 July 1971	7.5	-
Shimen Ling	China	E	147	Haicheng	04 February 1975	7.3	33.0
Touho (Douhe)	China	E	72	Tangshan	28 July 1976	7.8	-
Mochinkoshi No2 [2]	Japan	T	98	Nr i- O Atssshk	15 January 1978	5.8	-
La Palma	Chile	T	26	Chile	03 March 1985	7.7	-
Austrian [1]	USA	E	185	Loma Prieta	17 October 1989	7.1	
Masy way [2]	Luzon	E	82	Philippines	16 July 1990	7.7	19.2
Niwajkumine	Japan	E	?	Hokkaido Nans	12 July 1993	7.8	74
Lower San Fernando	USA	HF	125	Northridge	17 January 1994	6.7	9.4
Lower Koyoen	Japan	E	30	Kobe	17 January 1995	6.9	-
Zhong Hai	China	CG	82	Lijang	03 February	7.0	4.0

Legend E= Earthfill. **CGB**= Concrete Gravity Buttress. **CG**= Concrete Gravity. **HF**= Hydraulic Fill. **T**= Tailing

APPENDIX IIIa– **POTENTIAL DAM SITE SECTION PROFILE.**

APPENDIX IIIb– **SECOND POTENTIAL DAM SITE SECTION PROFILE.**