



TECHNICAL FEASIBILITY STUDIES FOR THE DEVELOPMENT OF KENYA'S GCF PROJECT

**ENHANCING THE RESILIENCE OF COMMUNITIES AND
ECOSYSTEMS IN THE ATHI RIVER CATCHMENT AREA**

Technical Report



Technical Feasibility Studies for the Development of Kenya's GCF Project

**Enhancing the Resilience of Communities and
Ecosystems in the Athi River Catchment Area**

Technical Report

Submitted to

National Environmental Management Authority

(NEMA)

and

Korea Institute of Technology and Innovation

(KEITI)

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1.0 Introduction

The National Environment Management Authority (NEMA), Kenya's national accredited entity to the Green Climate Fund (GCF), in collaboration with the Korea Environmental Industry and Technology Institute (KEITI), is developing a US\$ 10 million project entitled 'Enhancing the resilience of communities and ecosystems in the Upper Athi River Catchment Area' for submission to GCF.

In 2016, NEMA submitted a draft proposal of the project to the GCF Secretariat to acquire initial feedback and received a list of additional tasks that needed to be carried out further to complete the proposal development. The objectives of the proposed project are:

- To increase water security through Integrated Water Resource Management;
- To enhance the health and well-being of the vulnerable population within the Upper Athi River Catchment Area (ARCA) of Kenya.

The Upper ARCA, located in Kenya (Figure 1), is classified as semi-arid land and suffers from frequent drought and flooding events exacerbated by climate change. During the long rainy seasons, extreme heavy rains give rise to bursting of the river banks especially in the upper and lower catchments. In order, to address the current problems, the draft proposal outlined three key outputs around which the project is structured:

Output 1: Enhanced water resource information access for improved adaptation planning,

Output 2: Increased access to potable water for domestic and commercial use, and

Output 3: Strengthened water governance and key stakeholder's decision-making institutions.

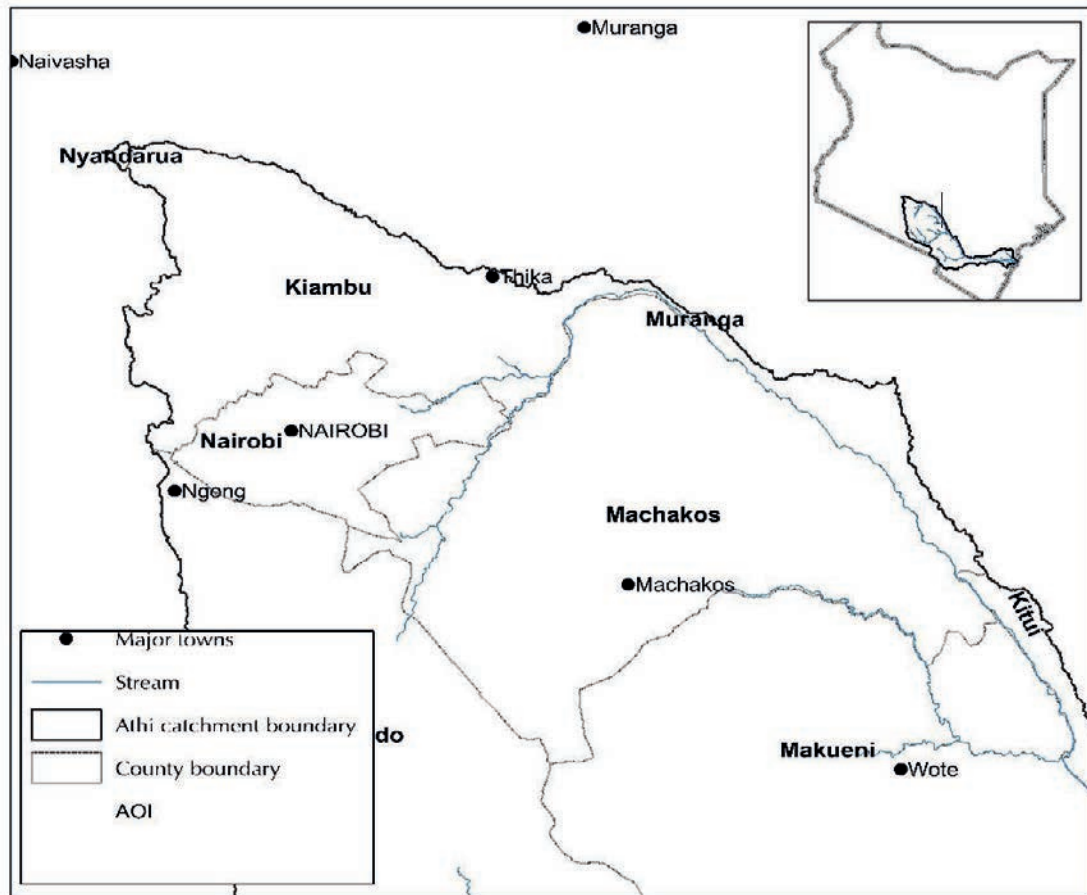


Figure 1: Location of Athi river catchment in Kenya

To be able to implement this project a local consultancy firm was required to work in close collaboration with the Korean consultants hired by KEITI and NEMA to complete the proposal development of the proposed project.

The main objectives of the consultancy were;

1. To undertake feasibility studies of the activities outlined under Output 2; increased access to potable water for domestic and commercial use, which are as follows:

- Providing water harnessing and storage facilities for communities and insti-

tutions;

- Providing technical designs of the project infrastructures that will include rehabilitating of minor water conservation structures (small water pans, sand dams, rock catchments);
- Restoring degraded riparian area and water catchment area; and
- Improving ground water qualities and spring protection (small ~ water pans, sand dams, rock catchments etc.)
- To develop technical designs of the proposed water conservation / storage structures in line with Output 2.

2.0 Summary of Adopted Methodology

2.1 Background Information

In this section, we provide an overview of the approach that was applied in feasibility assessment, technical designs and economic analysis of the project. This methodology is based on the provided Terms of References (ToR). Despite that this methodology is based on the ToR, the consultant also endeavoured to address and provide any additional information that could have been required for the project.

2.2 Conceptual Framework

The project took a comprehensive approach to integrated water resource management approach and responses to deal with interrelated issues in a cost-effective and sustainable way. The work was organized to respond to the Term of Reference (TOR) and additional data was collected through interview/discussions with the various stakeholders, observations and measurements using various instruments (topographical profiling, etc). The relevant drawings were then prepared using AUTOCAD and cost estimates were made. Finally, an economic analysis of the project was done.

2.2.1 Desktop review to develop inception note

The aim of desk study was to document past approaches to enhancing resilience of communities in various parts of the world as a basis to implementing the

proposed project. To achieve this a desktop study was carried out. In the desktop study various documents related to water development within the country were reviewed. The review involved subsequent field feasibility assessment, technical design, and technical and economic analysis.

As mentioned before in the desktop study, any relevant documents as well as published materials related to the project in Kenya and other developing countries were reviewed. The existing policy, legal, regulatory and institutional framework that would impact on implementation of such project were also reviewed and any overlaps and gaps identified.

2.2.2 Feasibility studies for increased access to potable water

The consultant carried out a detailed feasibility study for the proposed projects in Upper Athi River Catchment Area (ARCA). The proposed projects were based on various stakeholder meeting in the various counties. The feasibility assessment captured the following information: 1.) Analysis of demand for water for both human and livestock population in the area, 2.) Existence of adequate exploitable water resources to meet the local water demand and 3.) Viability of various technologies in harnessing water resources. The list of attendees to the various stakeholders' meetings at county level is given in Appendix 1.

2.2.3 Technical designs of the proposed water harnessing Technologies structures

The consultant prepared technical drawings and cost estimates of the various water harness technologies. The design of the system captured the following

information.

1. Accessibility, adequacy (quantity) and quality of the proposed source of water.
2. Detailed technical and infrastructure requirements
3. Detailed project area Map clearly showing the location of all the proposed infrastructures.
4. Detailed engineering design report of the sites, so that they can be used in the construction.
5. Where necessary equipment specifications were provided.
6. Costed Bills of Quantities.

All the drawings were being done in AutoCAD and presented as both soft and hard copies.

2.2.4 Technical and Economic Analysis report

The consultant gave guidance on technical and economic analysis of the proposed projects. The technical analysis demonstrated how the proposed structure would be acceptable to the community whereas economic analysis showed how the proposed technology would be of benefit to the community. This was achieved by determining the cost - benefit analysis of the project. The cost of provisioning water was compared to the current cost of buying the water in the three counties. However environmental benefits were not quantified.

3.0 Technical Design of Various Interventions

The technical designs considered the individual water structure identified by the various counties' stakeholders. The philosophy was to provide access to clean water whole year round. Hence the small reservoirs the current volume was increased so that they can provide water whole year. In addition, a filtration system made of sand filters was introduced. Thus, the water from the source will be less laden of particulate matter. The design of the filtration system, storage and means of water abstraction is described in the subsequent section. The subsequent section also present design of spring and borehole water distribution system.

3.1 Water Pan/Reservoirs with water filtration units

3.1.1 Filtration system

A typical household filtration system a sand filter with a pulverized charcoal filter medium supported by a bed of gravel will be adopted to remove suspended solid. The pulverized charcoal will be added to remove any odour and increase the acceptability of water. In the reservoir, the water entering the reservoir requires filtering and purification before human consumption. Hence, a filtration system using sand filters is proposed to be coupled with the reservoir.

A 2 mm pre-filtration screen will be used to remove any large particles which

might not have settled in the reservoirs. The screen will be attached to the flexible pipe with a floating ball to suspend the screen just below the water surface. The screen will also be protected with a steel to prevent it from sucking any deposited silt at low water level.

The maximum infiltration rate (Q_{max}) can be estimated by applying Darcy's equation

$$Q_{max} = kh (h_{max} + d) / d$$

where k is the hydraulic conductivity of the soil filter (m/s), A is the surface area of the sand filter (m²) h_{max} is the depth of pondage above the sand filter (m) and d is the depth of the filter media (m). To maximize on the capture potential of the filter to capture the gross pollutants the reservoir is expected to promote sedimentation of a majority of particles within the inlet zone. Further particle remove will be done by the screen before the water is transmitted to the sand filter. Hence a single layer of sand was proposed in this study. The sand to be used will have an effective size (d_{10}) of 0.2 mm and a uniformity coefficient of 2.

This sand characteristics will result in a head loss of about 1.25 m. This means that for water to flow through the sand filter a head of at least 1.25 m should be provided. Hence in the proposed design the sand filter will be located at about 1.5 m below the lowest level of water in the reservoir. Further the sand filter will have a steel at the lower and upper side. In the upper a geotextile material will underlie the steel frame to prevent the mobilization of the sand when the head is at maximum.

3.1.2 Storage

The capacity of the storage tank was marched with filtration rate of the sand

filter and average possible of abstraction rate. Considering the rate of infiltration (0.001 m/s) through filter and the fact we need to store water for 12 hours (overnight). The unit per area of the yield will be 43.2 m³. For a 2 m² sand filter then the yield will be 86.4 m³. Hence the minimum required storage tank of 31.53 m³. This assumes that even during water abstraction, filtration process will continue at an average rate of 7.2 m³/h. To avoid long queues and provide for the sand filter, the storage capacity was increased to 87.92 m³ and considering the filtration of the sand filters, this could be filled in about 6 hours. This also took into consideration of the dry period when the water level in the pan is likely to be low

The water level in the tank will be controlled primarily by the water level in the reservoir. The water level will also affect the filtration rate hence the rate of storage recharge. During dry season when the water level is low and filtration rate is also low the tank capacity had to be increased to store enough water for the estimate daily abstraction estimate.

3.1.3 Abstraction

The water in the storage tank will be abstracted using a Hand pump. Hand pump is a mechanical pump with low maintenance that rely on human power. In this sites we propose to use India Mark II brand which has a maximum lift of 50 meters. A drawing of India Mark II hand pump is shown Figure 2 (Source from SKAT – RWSN, 2008).

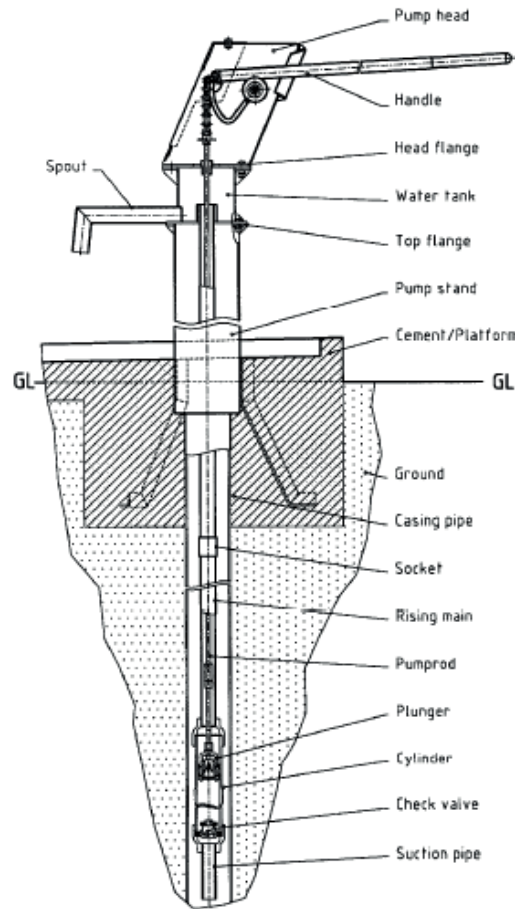


Figure 2: Drawing of India Mark II Hand pump

The installation will be as described by the manufacturer. The slab should however, be built with sufficient gradient to drain away any wastewater. Since every drop counts this will be drained into a small cistern where the community can fetch it for cleaning.

3.1.4 Spring protection

Springs were identified within the catchment for possible project consideration. These springs flow throughout the year indicating that they can be a reliable source of

water to the community. In the catchment the springs were also noted to be sources of good quality water that the local community rely on for their daily water uses including domestic purposes. However, to maintain the good quality water, the spring should be well protected. In protecting the spring, the catchment area above it is protected from animals and humans to prevent contamination. Further a cutoff drain above the spring is constructed to prevent surface runoff and contaminated water from entering or mixing with spring water. With variation in climate where extreme rain and droughts are experienced there is need to protect the springs. This will ensure that the springs catchment wall and water quality is not destroyed by excess floods.

Springs eye is protected by filling the area behind the dam with stones and gravel, with smaller stones being placed nearer the eye and larger ones near the wall. In addition, a spring box and a pipe for delivering the water to the users is constructed. This can be achieved by having a collection chamber with valve chamber connected to an open system where water flows freely through a pipe and collected by users. When the spring water carries sediment to the opening, a filter or sump may be required and should be located below the spring. In cases where the spring is located on a higher ground than the population it is supplying to, the water can be collected into a storage tank and then distributed by gravity. On the other hand, from the spring the outlet pipe can be connected to a sump and then pumped to storage reservoir which supplies water to local population through gravity.

To pump water to the storage reservoir which is located at higher grounds than the spring, a pump with either electrical, petrol, diesel or solar power is required. Solar pumps can be used to reduce the operation costs incurred when using other fuels and electricity.

3.1.5 Environmental Conservation

The main environmental conservation activities proposed are mainly planting

select species of trees. In the different part of the catchment trees will be planted for conservation purpose as a stand-alone project (e.g. in Ndarugu river, Kiambu County) or part of the other proposed project in several sites. It is proposed that indigenous trees will be planted in the catchment. For instance, Nyandarua county has a plan of protecting the water catchment areas by planting riverine trees and controlling soil erosion with the sub catchment (CGoNyandarua, 2018). The county is also focused to contribute in reducing the impacts of climate change by enforcing laws and regulations regarding encroachment of forests, wetlands and promoting alternative sources of energy for instance solar power other than the use of wood. This is in line with the commitment by Government of Kenya measures to secure the country's development against the risks and impacts of climate change as presented in National Climate Change Action plan, 2013 – 2017 (GOK, 2013). The plan considers rehabilitation and conservation of water towers by planting trees.

Under future climate intervention trees would play various critical roles. This include increased forest cover, providing alternative source of fuelwood, contribution to biodiversity diversification and carbon sequestration, reduction of overland erosion losses. In each project we have proposed the cost of planting a tree like bamboos with additional cost.

4.0 Selected County based interventions

In this consultancy a total of 46 sites were assessed. The sites were for water pans, boreholes, springs, pipelines, A summary of the assessed interventions in Upper Athi River Catchment is shown in Figure 3. The locations of the various structures are given in Appendix 1.2. These interventions are subsequently discussed per County.

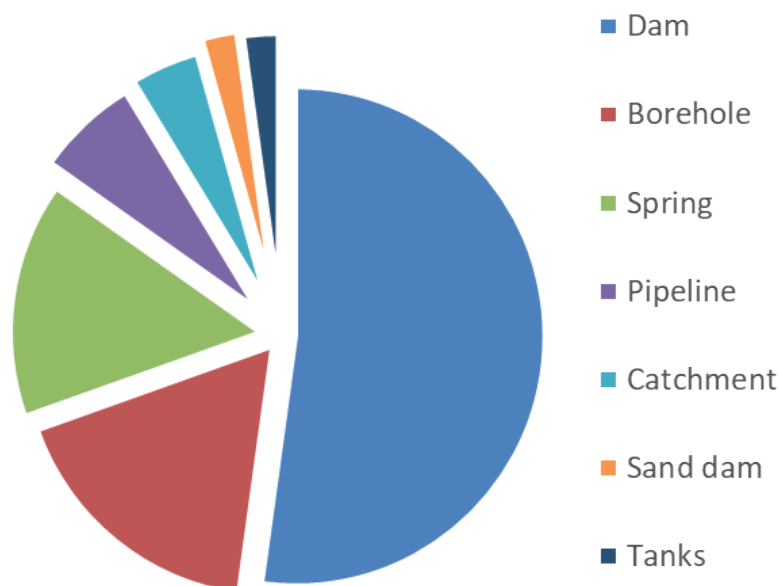


Figure 3: Distribution of the various types of structures assessed in Upper Athi River Catchment

4.1 Proposed interventions in Nyandarua County

Proposed interventions in Nyandarua were primarily water pans, water pans

and springs. There are 12 water pans that require rehabilitation. In addition, two springs and boreholes were proposed for rehabilitation. The status, provisional cost and estimated number of beneficiaries in Nyandarua county are given in Table 1. These sites were pre-selected by stakeholders and all were considered for rehabilitation.

Table 1: Characteristics of different structures assessed in Nyandarua County

Type of structure	Status	Number	Provision cost	Number of beneficiaries
Borehole	Rehabilitation	2	6,165,600.00	1,050
Water pans	Rehabilitation	12	177,461,601.45	4,720
Spring	Rehabilitation	2	4,175,010.00	5,200
Total		16	187,802,211.45	10,970

These structures are expected to serve about 10,970 households with clean water supply. Currently most of this communities relies on rainwater harvesting or unsafe waters sources. Development of these structures will provide portable for domestic use by the beneficiaries. Furthermore, this will also serve as source of water for over 40,000 livestock, made up of cattle, sheep and goats. The water will also support small scale irrigation currently been practised around the water pans.. Unique to Nyandarua county is the use of water from the water pans for washing carrots (Figure 4). Carrots from region outside the county are brought here for washing before repackaging them for market. This activity employs over 500 youths daily. The structures will also support environmental conservation activities, hence some structure which may not be a source of potable water might be considered given they support flora and fauna. It is proposed that around the structures tree planting will be included.

To be able to explore the potential of this structures fully is important to rehabilitated them to their initial conditions. The water pans have aged, on average

most of them are over 45 years. They will require desilting to restore their original volume or even increase in the event of increasing population and diversified uses. The other important intervention is reclaiming the original area of the structure sites. Most the structures (except Gachuchu spring – Appendix 1.2) proposed for rehabilitation are located in public utility land. However, there is encroachment into the area reserved for most of these structures. Therefore, the area will be surveyed to determine the official boundary and then fenced to prevent further encroachment.



Figure 4: Youths washing carrots in Kariani water pan, Nyandarua county

The description, bill of quantities (BOQ) and engineering drawing for the proposed water pans and spring protection are given in Section 6. It is estimated that the rehabilitation work in Nyandarua county will cost about KSh. 187,802,211.45.

4.2 Proposed interventions in Kiambu County

Proposed interventions in Kiambu were primarily rehabilitation and/or extension of dilapidated water distribution network, protection of springs, sinking of boreholes and rehabilitating existing ones and catchment protection to reduce erosion risks. In Kiambu county there are four springs that are proposed for protections, three pipelines that are due for rehabilitation, three water pans that are proposed for rehabilitation and protection and four boreholes are proposed for rehabilitation. The status, provisional cost and estimated number of beneficiaries in Kiambu county are given in Table 2. In the table where the number of beneficiaries is not shown means that the supply will feed into an already existing system which has been accounted for. Like the case of Nyandarua county, these sites were pre-selected by stakeholders and some were also selected for rehabilitation.

Table 2: Characteristics of different structures assessed in Kiambu County

Type of structures	Status	Number	Provisional cost	Number of beneficiaries
Borehole	New	1	44,511,600.00	5,000
	Rehabilitation	3	25,625,250.00	6,000
Water pans	New	1	2,824,500.00	-
	Rehabilitation	2	47,953,500.00	3,000
Spring	New	2	21,034,902.00	-
	Rehabilitation	2	40,314,750.00	-
Pipeline	Rehabilitation	3	63,343,822.50	11,500
Catchment	Rehabilitation	2	6,562,500.00	-
Total		16	252,170,824.50	25,500

These structures are expected to serve about 25,500 households with clean water supply. Currently most of this communities relies on intermittent supply within

the county, with some receiving once a week. Development of these structures will provide portable for domestic use by the beneficiaries. Furthermore, this will also serve as source of water for livestock, like cows which are mostly zero grazed and requires a constant supply of water. The water will also support small scale irrigation currently been practised around the structures. Kiambu county, being in close proximity to Kenya capital city – Nairobi, provides accommodation to the peri-urban population who commute to and from the city. Hence any available water resources should be adequately protected and utilized. Non-Revenue Water losses should also be minimized in order to utilize the limited water resources appropriately. This could include even abandoned quarries as shown in Figure 5. The structures will also support environmental conservation activities. It is proposed that around the structures tree planting will be included.



Figure 5: Unutilized water from abandoned quarry in Kikuyu, Kiambu County

To be able to fully utilize the potential of water, Kiambu stakeholders proposed development of four new structure and rehabilitation of existing 11 structures.. The

water pans in this county are highly affected by siltation, hence catchment conservation was proposed. In Ndarugu river catchment which is the main source of quarry stones rehabilitation is proposed. It is expected that planting of indigenous trees in this catchment will restore the former quarry sites. In Kikuyu town an abandoned quarry, Rungiri, will be considered as an alternative source of portable water. In all the proposed structures the designated location will be surveyed demarcated and fenced to reduce chance of human encroachment. Most the structures (except Romo springs) proposed for rehabilitation are located in public utility lands. The forest land is under the Government control hence it will be possible to get permission. These interventions are expected to increase access to portable water in the county and contribute to environmental conservation in Kiambu County under climate change scenarios.

The description, bill of quantities (BOQ) and engineering drawing for the proposed water pans and spring protection are given in Section 7. It is estimated that the rehabilitation work in Kiambu County will cost about KSh. 252,170,824.50.

4.3 Proposed interventions in Machakos County

Proposed interventions in Machakos County were primarily water pans. There are 12 water pans that were selected for rehabilitation in Machakos county. In addition, a spring and two boreholes were proposed for rehabilitation and establishment, respectively. The status, provisional cost and estimated number of beneficiaries in Machakos county are given in Table 3. These sites were pre-selected by stakeholders and all were considered for rehabilitation.

These structures are expected to serve about 161,300 households with clean water supply. Currently most of the communities rely on rainwater harvesting or unsafe water sources. Women and children walk for long distance each day

in search for water for domestic use. Development of these structures will provide portable for domestic use by the beneficiaries. Furthermore, this will also serve as source of water for over 40,000 livestock, made up of cattle, sheep and goats. The water will also support small scale irrigation currently been practised around the water pans as shown in Figure 6. The structures will also support environmental conservation activities. It is proposed that around the structures tree planting will be included.

Table 3: Characteristics of different structures assessed in Machakos County

Type of structure	Status	Number	Provisional cost	Number of beneficiaries
Borehole	New	2	21,888,300.00	4,800
Water pans	Rehabilitation	9	148,305,143.70	132,000
Spring	Rehabilitation	1	16,595,250.00	3,000
Tanks	New	1	41,580,000.00	20,000
Sand dam	Rehabilitation	1	9,276,960.00	1,500
Total		14	237,645,653.70	161,300

To be able to explore the potential of this structures fully is important to rehabilitated them to their initial conditions. The water pans have aged, on average most of them are over 45 years. They will require desilting to restore their original volume or even increase in the event of increasing population and diversified uses. The other important intervention is reclaiming the original area of the structure sites. Most the structures, (except Gachuchu springs), proposed for rehabilitation are located in public utility land. However, there is encroachment into the area reserved for most of these structures. Therefore, the area will be surveyed to determine the official boundary and then fenced to prevent further encroachment.



Figure 6: A farmer growing vegetables with water from Muumandu small dam in Machakos county

The description, bill of quantities (BOQ) and engineering drawing for the proposed waters pans and spring protection are given in Section 8. It is estimated that the rehabilitation works in Machakos County will cost about KSh. 187,501,344.5.

5.0 Technical and economic analysis

In this economic analysis was based on the cost of providing water from the water structure against the current cost of water. Technical analysis provided information on the cost of implementing the project as summarized in the BOQ. These costs were based on design market rate. The cost of implementing the project is expected to range from KES 285,600.00 to KES 41,580,000.00. On the other hand, the current cost of buying water was based on the average cost of water in the three counties under consideration. In Nyandarua, Kiambu and Machakos a 20 litre jerrican of water was estimated to cost KES 5. Using the Sphere water requirement per household per day, it was estimated that an average household of 6 members requires 30 and 45 litres per day in Nyandarua and Machakos, and Kiambu, respectively. Therefore, this consideration of the project costs against the costs of water it will upset was used to derive economic benefits of the project.

The capital recovery was based on an average 10 years lifespan and a 12% discount rate. The capital recovery cost with an estimated annual operation and maintenance cost of about 20% of the original capital cost gives the Total annual cost. This total cost and the water supplied was then used to determine the market cost of water.

Analysis of the collected data showed that for most of the project will payback period will be within the year. In Kiambu county for example five of the seven projects considered in the economic analysis will have a payback period of less than a year. The other two projects were found to have a payback period which was within two years (Figure 7). In Machakos county the payback period which range from a few days to 4.5 years (Figure 8). Finally, in Nyandarua some of the project payback ranges be-

tween from 22 days to 4 years (Figure 9). However, some of the projects will not meet their cost of construction within the planning lifespan of ten years.

In this analysis most project have a short payback period because they are using existing system or water would be collected at the point of treatment. This explains why the payback in Kiambu and Machakos is short. Most of the water supply will feed into existing network. In Nyandarua county most of the projects are being rehabilitated or a new and have. Furthermore, the number of beneficiaries in this county is lower compared to Kiambu and Machakos. However, when one considers the other benefits, for instance associated employment and environmental conversation, then the projects are worth considering.

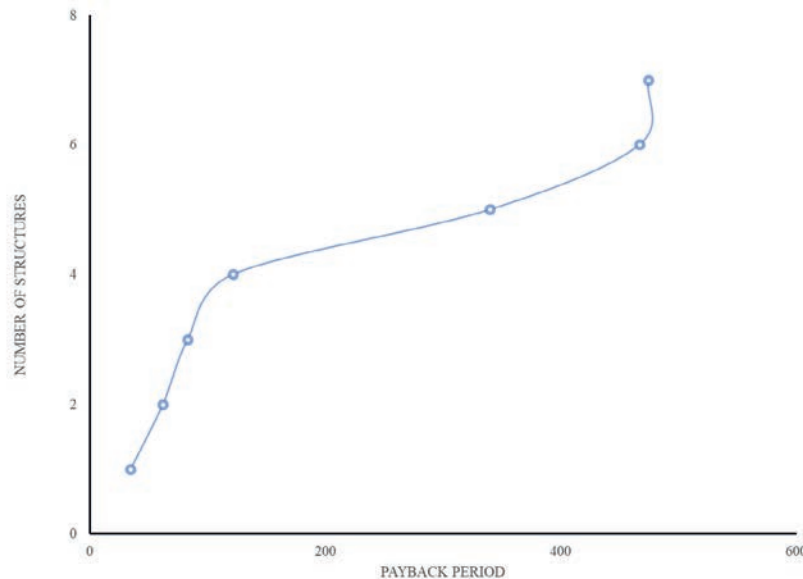


Figure 7: Payback period, in days, for structures proposed in Kiambu county

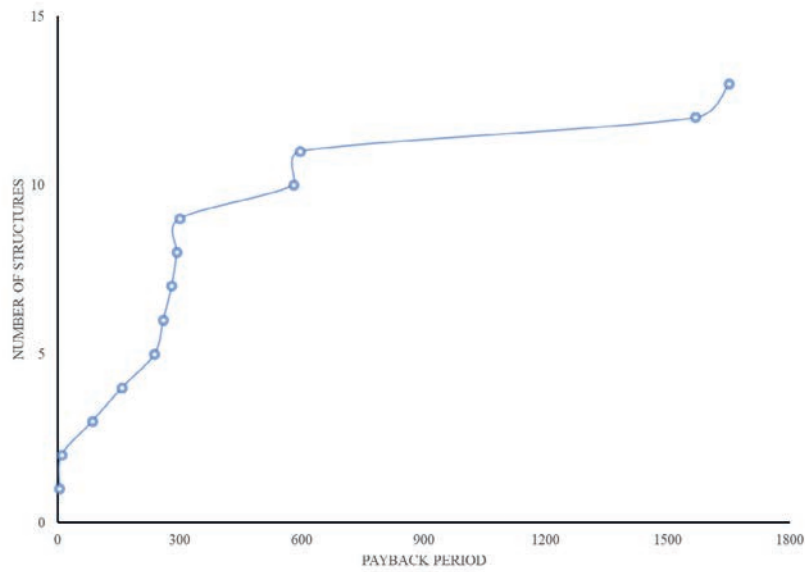


Figure 8: Payback period, in days, for structure in Machakos county

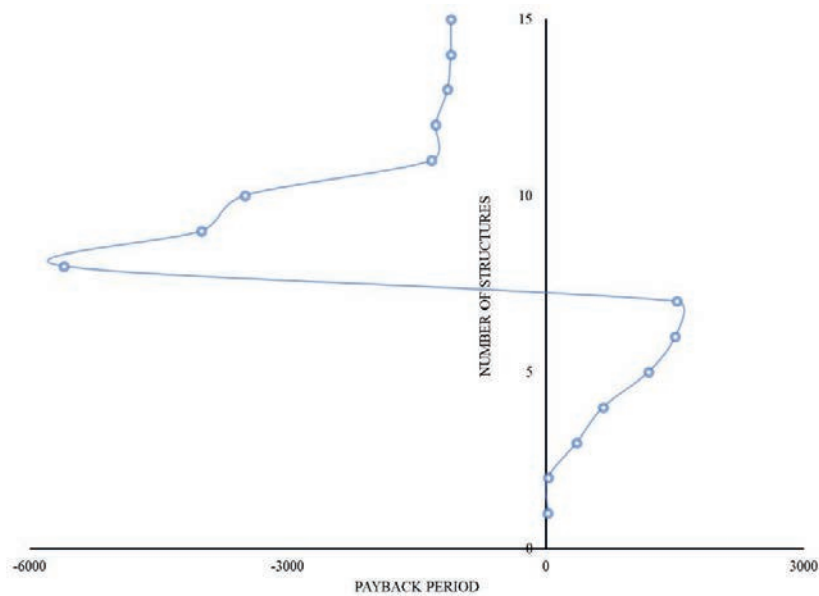


Figure 9: Payback period, in days, for structure in Nyandarua county

The economic analysis presented herein only considered projects that are meant for domestic water supply and associated cost of water. This analysis is only indicative because the effect of the dams beyond water supply was not quantified. The economic and environmental impact of the dams is certain. For example, over 500 youths depend on a water pan like Mutonyora for employment. As aforementioned they engage in washing carrots destined for market. This is also observed in other dams where employment activities like water supply using donkey carts was observed. The project is also expected to contribute to environmental conservation. Each water pan will support tree planting and nursery. If successful implemented the project will contribute immensely to environmental conservation and its payment of ecosystem cannot be easily quantified in the current assignment.

In addition to the environmental and economic impact it is anticipated that the project will also have an impact on health of the local populace. Availability of portable is like to reduce the incidence of water borne diseases in the area. This is achieved through the save on cost of medication and thus increase the economic output of the populace. Further, small scale irrigation will help to diverse the dietary sources of the local populace. Thus, it is anticipated that the project will have socio-economic and environmental impact.

6.0 Description of Water Structures in Nyandarua County

6.01 Description of Kariani water in Kinangop Sub-County, Nyandarua County

Kariani waterpan is located in Kinangop Sub-county of Nyandarua County. The volume of the waterpan was estimated at 73,997 m³. The waterpan is currently used for small scale irrigation, watering livestock and domestic water supply. The waterpan is also a source of water for the Kinale Primary School. Another unique use of water from this waterpan is washing carrots. Each year tons and tons of carrots are transported from various farms within and outside the sub-county to be cleaned in this waterpan before they are taken to markets in surrounding towns such as Nairobi- the capital city of Kenya. Despite its importance there is significant siltation and encroachment of waterpan boundaries and riparian zones.

The waterpan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The waterpan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery with will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 3,000 seedlings. To secure the waterpan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water

pan will be charged a reasonable fee. In turn the accrued income will be used form operation and maintenance of the project to enhance it sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

6.01.1 Figures showing the characteristic of Kariani water pan



Figure 10: Google image showing the location of the waterpan and its surroundings



Figure 11: A view of Kariani water pan



Figure 12: A typical water pump use to fetch water for washing carrots



Figure 13: Community youth hired to wash carrots in Kariani waterpan

6.01.2 Beneficiaries of Kariani waterpan

500 Households with an average of 6 members.

6.01.3 Bill of Quantities for the proposed rehabilitation of Kariani water pan

REHABILITATION OF KARIANI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	15,423	450.00	6,940,350.00	67,787.45
2.3.	Using dozer or other suitable plant, excavate to depth between 3 - 6 m deep, allow slope and form 4 m high embankment. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	18,508	300.00	5,552,280.00	54,229.96
	Sub-Total Carried to Summary - Element 2				12,642,630.00	123,482.48
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.7.	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16.	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17.	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18.	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88

REHABILITATION OF KARIANI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

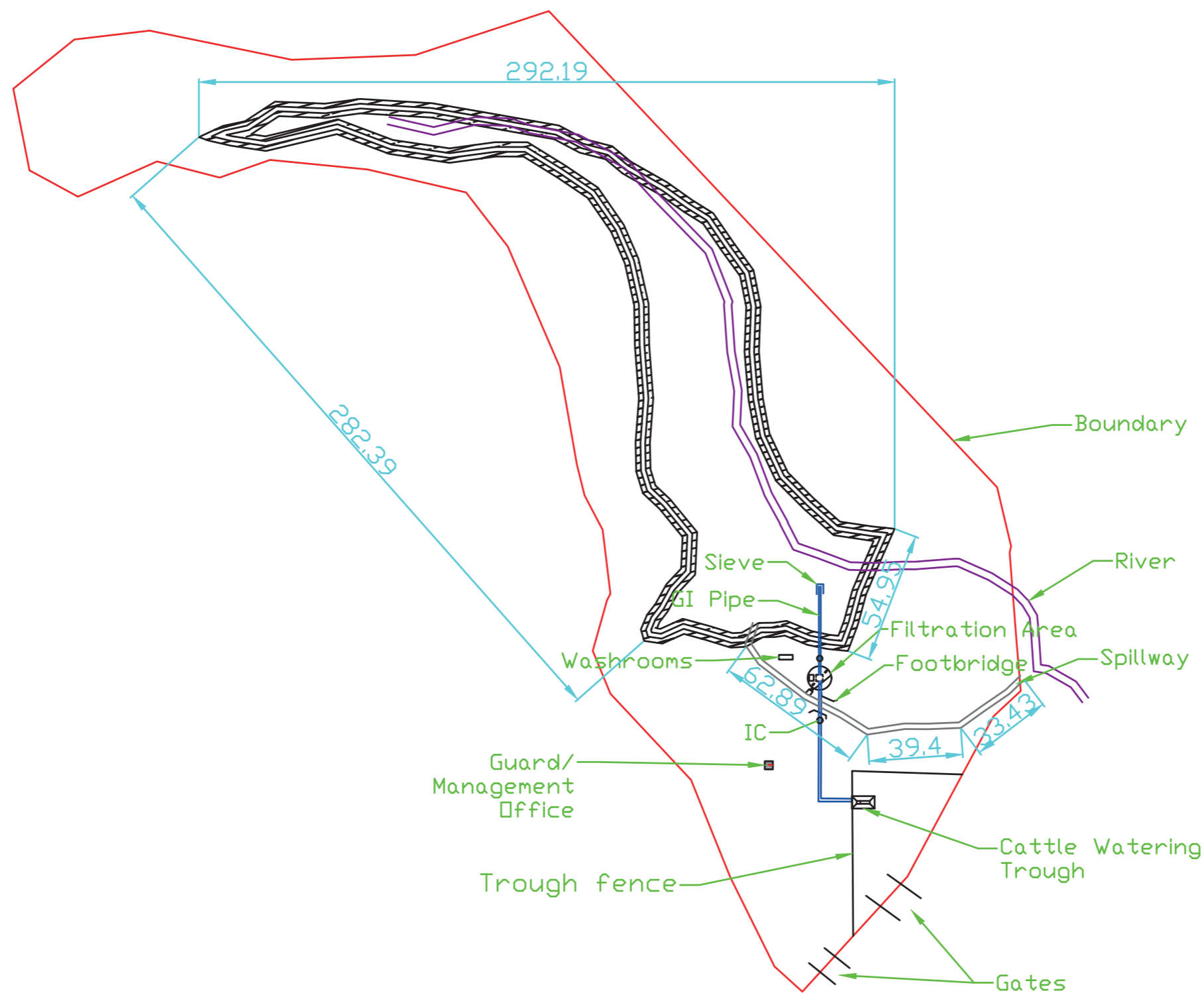
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
4	<u>Perimeter Fence, Guard house/shop and carrots washing slabs</u>					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,360.0	400.00	544,000.00	5,313.33
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
4.4	Construct Slaps for Washing Carrots.	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 4				994,000.00	9,708.55
5.0.	<u>Storage with filtration system and accessories</u>					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 7.5 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
5.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
5.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	2.0	35,000.00	70,000.00	683.70
5.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
5.10.	Allow provision for fabrication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
5.11.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.36
5.15.	Allow for construction of a laundry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
5.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
	Sub-Total Carried to Summary - Element 2				1,308,400.00	12,779.34
6.0.	<u>Cattle Trough Construction</u>					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigineous trees upstream and downstream of the dam	No	3,000	50.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 7				200,000.00	1,953.43

REHABILITATION OF KARIANI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				620,000.00	6,055.63
	ELEMENT 2 - EARTHWORKS				12,642,630.00	123,482.48
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				994,000.00	9,708.55
	ELEMENT 5 - EARTHWORKS				1,308,400.00	12,779.34
	ELEMENT 6 - AUXILIARY STRUCTURES				150,000.00	1,465.07
	ELEMENT 7 - PERIMETER FENCE				200,000.00	1,953.43
	ALL ELEMENTS TOTAL				16,823,880.00	164,321.38
	Allow of 5% for supervision				841,194.00	8,216.07
	Grand Total				17,665,074.00	172,537.45

6.01.3 Engineering Drawing for the proposed rehabilitation of Kariani water pan

KARIANI DAM



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA
Lead Experts, GIS
Experts, Water Resource Professionals.
Room 613 & 614
SuraJ Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

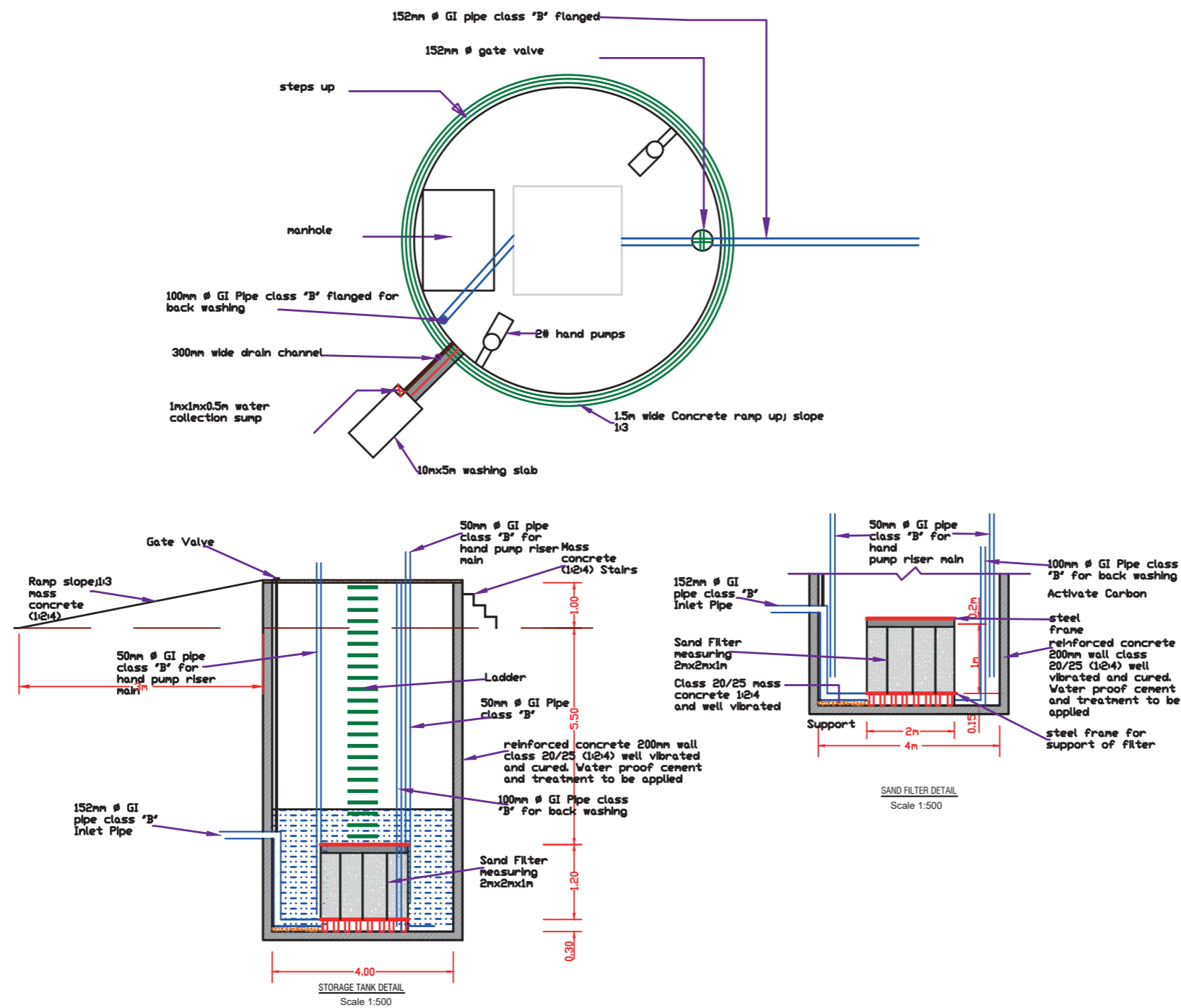
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1: 1

Sheet
01

Well & Accessories



Notes General

- All dimensions are in meters unless otherwise stated.
- All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
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- EL(=/-)0.00 corresponds to existing normal ground level.
- In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
- Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
- Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
- The lapping length of bars will be 50 x bar diameter
- Trenches shall be dug to the invert levels, graded and compacted to approval
- Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

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Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals, Room 613 & 614 Sura J Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project
Rehabilitation of water structures in Nyandarua county

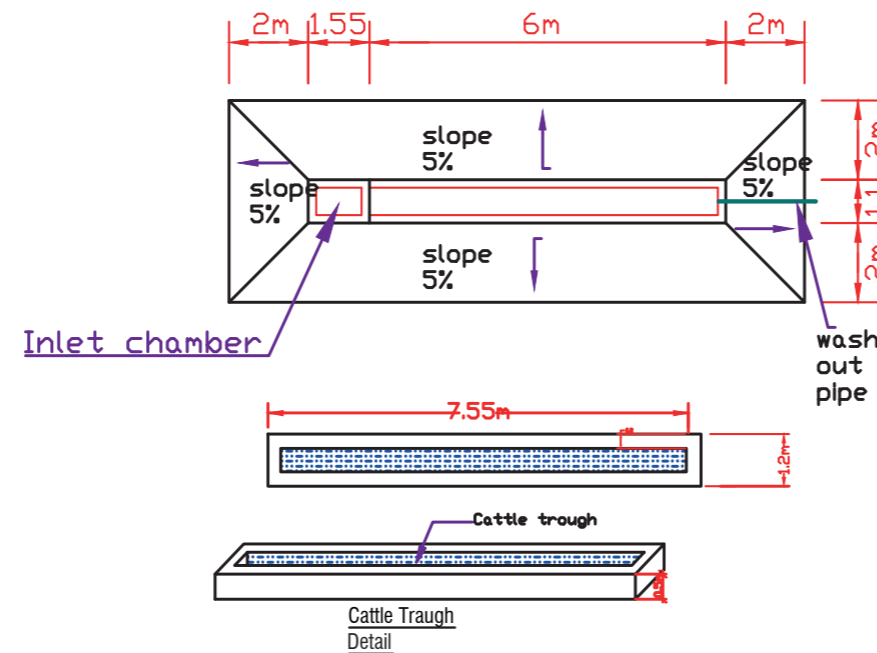
Drawing Title

Dam Layout

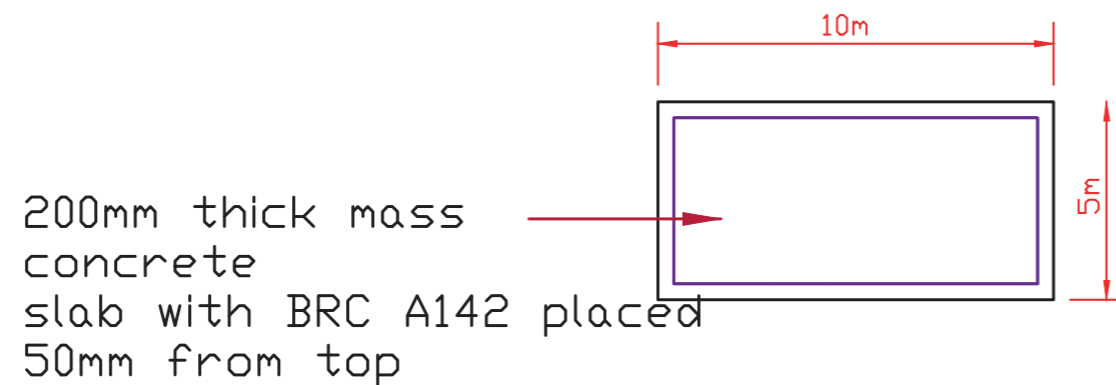
Designed: JS
Drawn: SN
Checked: JS
Date: 12 sep 2018
Scale: as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant, general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
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6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
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11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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Sura J Plaza, Limuru
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P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

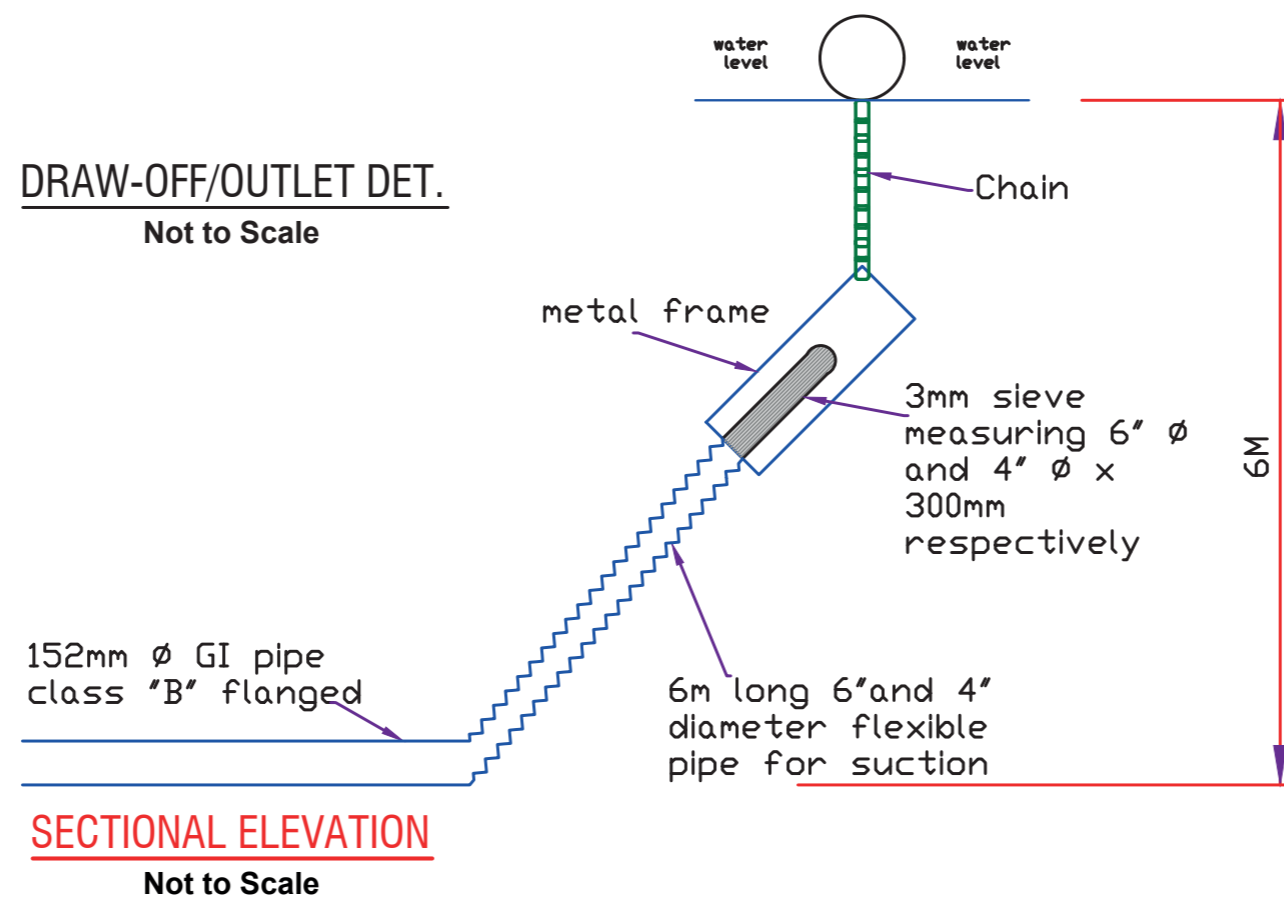
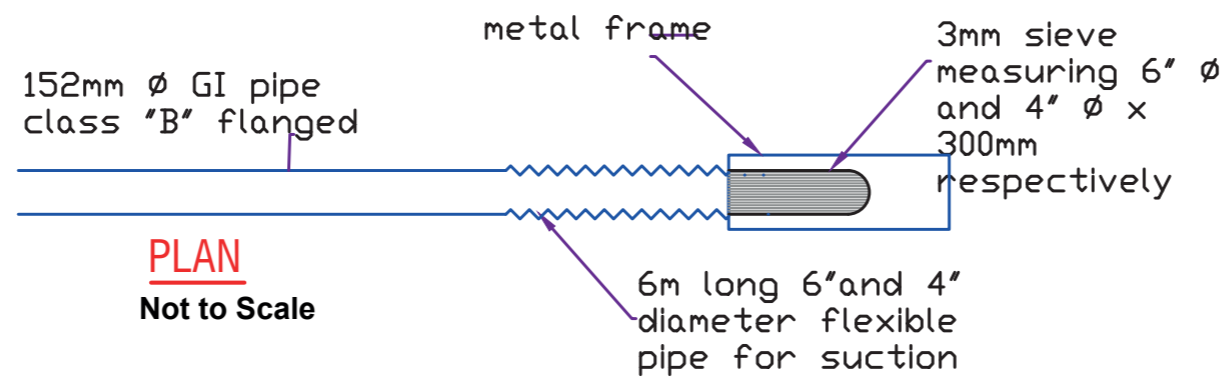
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

- GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
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Lead Experts, GIS
Experts, Water
Resource
Professionals.
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00400,
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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

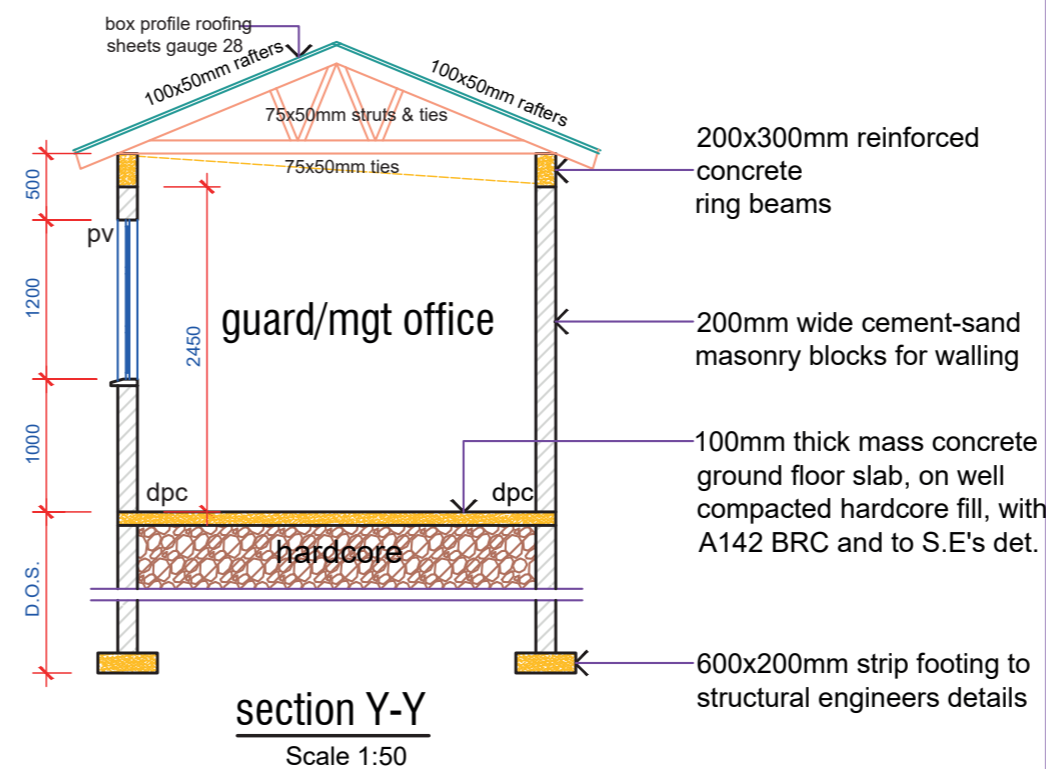
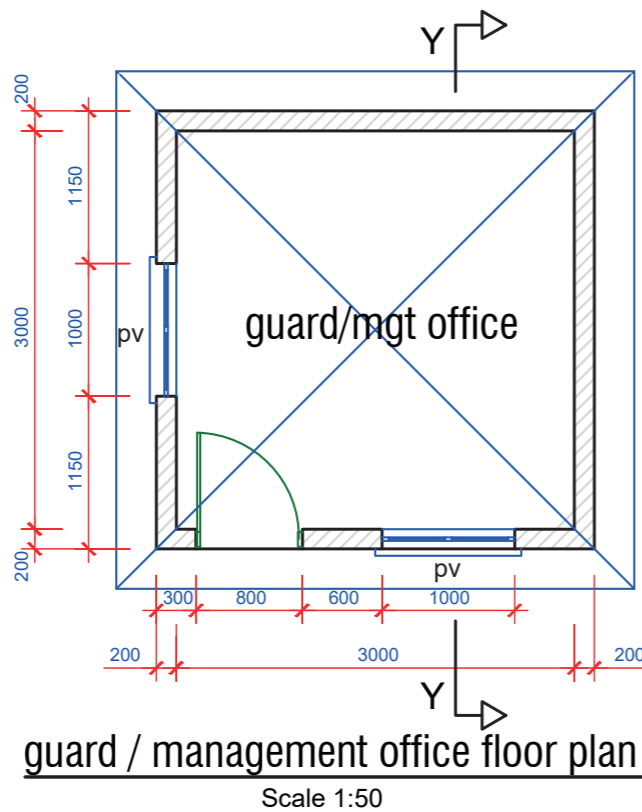
Drawing Title

Draw off/ Outlet

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
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Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.02 Description of Githwe borehole in Kinangop Sub-County, Nyandarua County

Gitwe borehole is located in Kinangop Sub-county of Nyandarua County. This is a newly constructed borehole and it is meant to serve about 500 households. It was proposed that the borehole and related investment needed to be secured, hence a chain link fence with a metallic weld mesh gate to be installed.

As a contribution to environmental conservation a tree nursery with will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the beneficiaries will be expected to plant at least 250 indigenous seedlings. In Gitwe, sanitation will be handled by existing household-based system. The site has management committee who will charge for water supply at a reasonable fee and in turn they will be responsible for operation and maintenance of the project.

6.02.1 Figures showing the characteristic of Githwe borehole



Figure 14: Location of Gitwe boreholes in Nyandarua. The figure also shows the beneficiaries

6.02.2 Beneficiaries of Githwe borehole

500 Households with an average of 6 members.

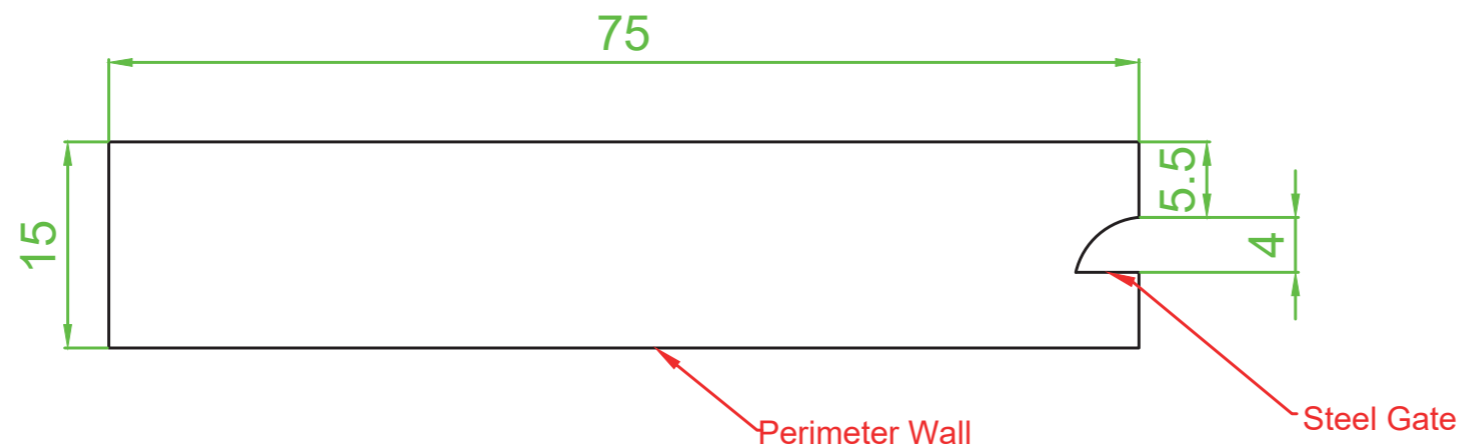
6.02.3 Bill of Quantities for the proposed rehabilitation work in Githwe borehole

FENCING AND ENVIRONMENT CONSERVATION IN GITWE BOREHOLE, NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	15,000.00	15,000.00	146.51
1.3.	Allow for Security Costs	PS	1	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 1				25,000.00	244.18
2.0.	Perimeter Fence					
2.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	180.0	400.00	72,000.00	703.23
2.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 4				92,000.00	898.58
3.0.	Environmental Conservation					
3.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
3.2.	Allow for planting of indigeneous trees around the borehole	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 7				155,000.00	1,513.91
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				25,000.00	244.18
	ELEMENT 2 - PERIMETER FENCE				92,000.00	898.58
	ELEMENT 3 - ENVIRONMENTAL CONSERVATION				155,000.00	1,513.91
	ALL ELEMENTS TOTAL				272,000.00	2,656.67
	Allow of 5% for supervision				13,600.00	132.83
	Grand Total				285,600.00	2,789.50

6.02.4 Engineering Drawing for the proposed rehabilitation work in Githwe borehole

Githure Borehole



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
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P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : SN

Date : 23 sep 2018

Scale : 1: 1

Sheet
01

6.03 Description of Kahora water pan in Kinangop Sub-County, Nyandarua County

Kahora waterpan is located in Kinangop Sub-county of Nyandarua County. The volume of the waterpan was estimated at 12,159 m³. The waterpan is currently not used for human economic activities but there are some birds who nests in the surroundings and swim in the waterpan. However, given its potential and lack of alternative water supply in the area, it was recommended for rehabilitation.

The waterpan was proposed for rehabilitation to increase its usefulness. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The waterpan will also be excavated to reduce siltation and thus increase its volume. In addition, a perimeter fence will be established to prevent further encroachment into the waterpan. Issues of sanitation around the waterpan will be handled at the homesteads where the water from the Kahora waterpan will be used.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be supported to plant at least 1,500 seedlings. The management, in addition, will be responsible for sustainable operation and maintenance of the waterpan.

6.03.1 Figures showing characteristics of Kahora water pan



Figure 15: Google image showing the location of the waterpan and its surroundings



Figure 16: A view of Kahora waterpan



Figure 17: Some of the birds living in Kahora waterpan

6.03.2 Beneficiaries of rehabilitation work in Kahora water pan

200 Households with an average of 6 members.

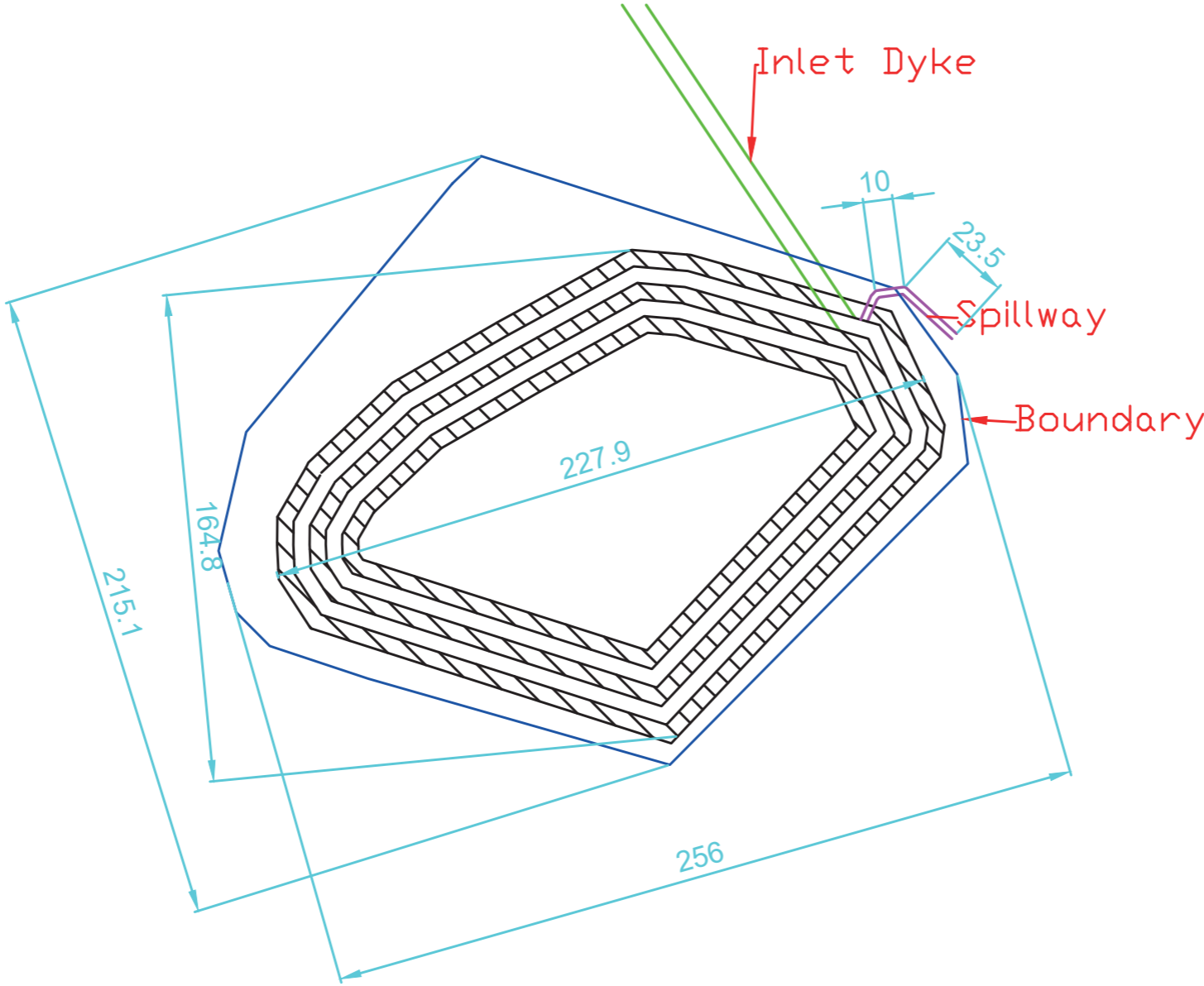
6.03.3 Bill of Quantities for the proposed rehabilitation work in Kahora water pan

REHABILITATION OF KAHORA DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1.0	150,000.00	150,000.00	1,465.07
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				470,000.00	4,590.56
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	4,600	3.00	13,800.00	134.79
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	12,000	350.00	4,200,000.00	41,022.03
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the	CM	15,000	400.00	6,000,000.00	58,602.91
	Sub-Total Carried to Summary - Element 2				10,213,800.00	99,759.73
3.0.	Perimeter Fence					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	290	600.00	174,000.00	1,699.48
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 4				194,000.00	1,894.83
4.0.	Environmental Conservation					
4.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
4.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
	Sub-Total Carried to Summary - Element 3				405,000.00	3,955.70
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				470,000.00	4,590.56
	ELEMENT 2 - EARTHWORKS				10,213,800.00	99,759.73
	ELEMENT 3 - PERIMETER FENCE				194,000.00	1,894.83
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				405,000.00	3,955.70
	ALL ELEMENTS TOTAL				11,282,800.00	110,200.81
	Allow of 5% for supervision				564,140.00	5,510.04
	Grand Total				11,846,940.00	115,710.85

6.03.4 Engineering Drawing for the proposed rehabilitation work in Kahora water pan

Kahora Dam



Notes General	
1. All dimensions are in meters unless otherwise stated.	
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3. All indicated levels are finished floor levels unless otherwise noted.	
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6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.	
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)	
8. The lapping length of bars will be 50 x bar diameter	
9. Trenches shall be dug to the invert levels, graded and compacted to approval	
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones	
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval	
Abbreviations	
Consultant:	
<div>ASAL EnviroTech Consult LTD</div> <div>Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke</div>	
Client:	
<div> nema</div>	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS	Sheet 01
Drawn : SN	
Checked : SN	
Date : 23 sep 2018	
Scale : 1: 1	

6.04 Description of Mutonyora water pan in Kinangop Sub-County, Nyandarua County

Mutonyora water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 165,774 m³. The water pan is currently used for small scale irrigation, watering livestock and domestic water supply. Another unique use of water from this water pan is washing carrots. Each year tones and tones of carrots are transported from various farms within and outside the sub-county to be cleaned in this water pan also before they are taken to markets in surrounding towns such as Nairobi - the capital city of Kenya. Despite its importance there is significant siltation of the water pan and encroachment of its boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation of the water pan will involves demarcating the official boundary of the water and fencing it off to reduce encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw-off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm depth below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery with will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings. To secure the water pan and all the

investment on site a perimeter fence, a management committee office/guard's house will be established on site. A management committee will be constituted to oversee the use of the water pan. The committee will charge a fee of usage and in turn will be responsible of operation and maintenance. In this site sanitation will be handled at the households where the water will be used.

6.04.1 Figures showing characteristics of Mutonyora water pan



Figure 18: location of Mutonyora water pan and its surroundings



Figure 19: A view of the Mutonyora water pan



Figure 20: Youths engaged in cleaning carrots in Mutonyora water pan



Figure 21: A view of Mutonyora showing hyacinth which have grown in the water pan and need to be cleared

6.04.2 Beneficiaries of Mutonyora Water pan

300 Households with an average of 6 members.

6.4.3 Bill of Quantities for proposed rehabilitation work in Mutonyora water pan

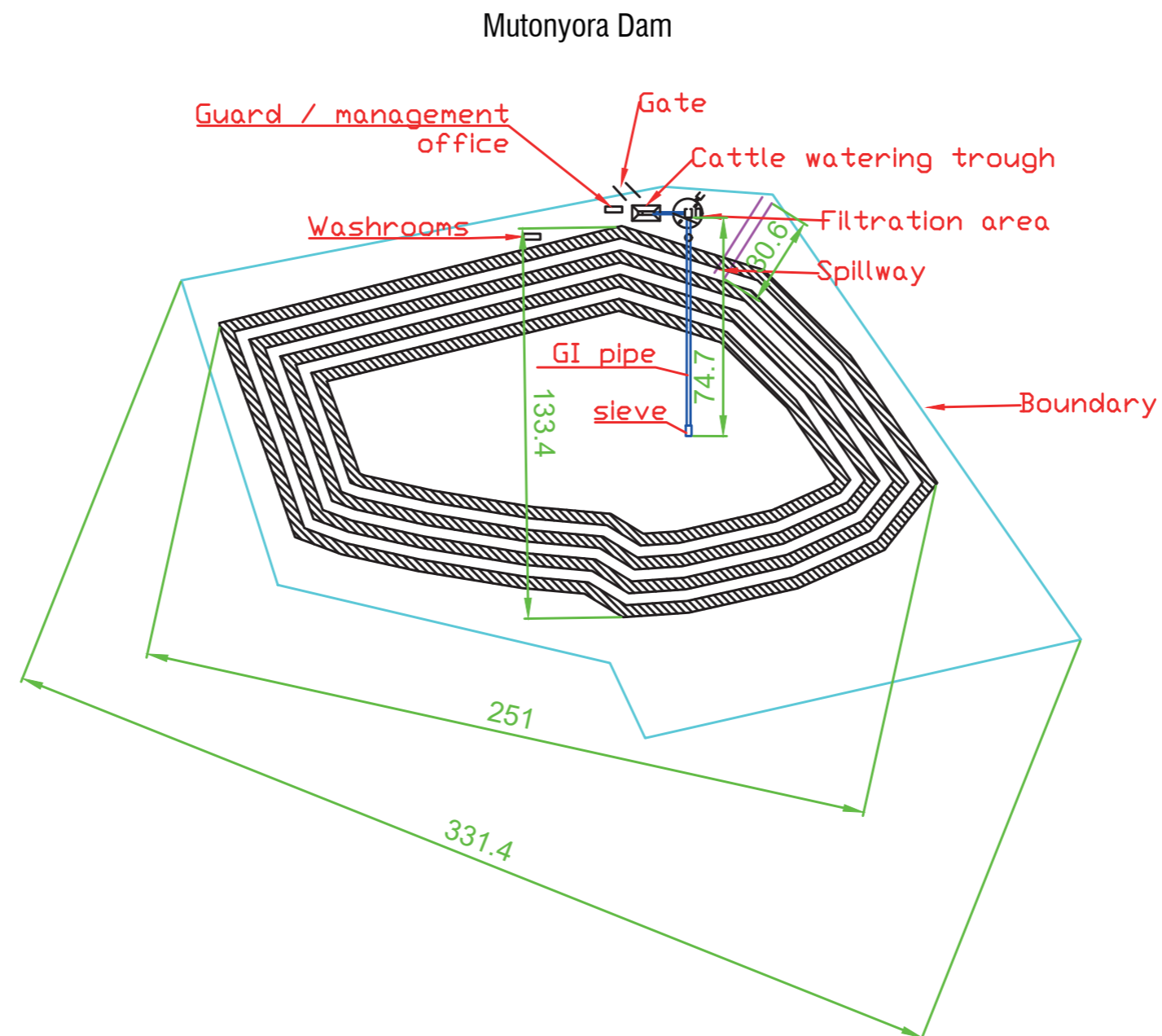
REHABILITATION OF MUTONYORA WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,955.34
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the waterpan	PS	1	250,000.00	250,000.00	2,444.18
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.84
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,173.20
	Sub-Total Carried to Summary - Element 1				620,000.00	6,061.55
2.0.	Earthworks					
2.1.	Clear the waterpan site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	22,869	3.00	68,607.00	670.75
2.2.	Excavate silt in the waterpan, remove from site and dispose as directed by the Engineer	CM	25,613	350.00	8,964,648.00	87,644.68
2.3.	Using dozer or other suitable plant, excavate to depth between 3 - 6 m deep, allow slope and form 4 m high embankment. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	17,152	400.00	6,860,700.00	67,075.01
	Sub-Total Carried to Summary - Element 2				15,893,955.00	155,390.43
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,346.41
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.90
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	260,000.00	260,000.00	2,541.94
3.4.	Excavate soil to create Intake Channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.60
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	977.67
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,004.22
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.61
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.42
3.9.	Cut trench for cattle trough draw-off pipe 25 m long x 0.6 m wide and 4.0 m average depth	CM	180.0	200.00	36,000.00	351.96
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering draw off and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.32
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.89
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.73
3.14	On Cattle line supply line, excavate from reduced level upto to a depth of 3.5 m and cart away as directed by Engineer	CM	11.0	200.00	2,200.00	21.51
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.77
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	100.00	3,300.00	32.26
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.71
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.77
	Sub-Total Carried to Summary - Element 3				1,143,750.00	11,182.10

4	Perimeter Fence, Guard house/shop and carrots washing slabs					
4.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,200.0	600.00	720,000.00	7,039.22
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.53
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	300,000.00	300,000.00	2,933.01
4.4	Construct Slaps for Washing Carrots.	LS	1.0	600,000.00	600,000.00	5,866.02
Sub-Total Carried to Summary - Element 4					1,640,000.00	16,033.79
5.0	Storage with filtration system and accessories					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.55
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	508.39
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.60
	<u>Sawn formwork to:</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.67
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,621.60
2.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.88
2.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.53
2.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	977.67
2.10.	Allow provision for farbication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,128.54
2.11.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.84
2.12.	Allow for construction of a laudry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.65
2.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	391.07
Sub-Total Carried to Summary - Element 2					1,258,400.00	12,303.00

3.0.	Cattle Trough Construction					
4.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.55
4.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	508.39
	<u>Mass concrete as described in:-</u>					
4.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.60
	<u>Sawn formwork to:-</u>					
4.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.67
	<u>Vibrated reinforced concrete as described in:-</u>					
4.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,643.93
4.9	Allow a Provisional Sum for Mark II handpumps	No	1	30,000.00	30,000.00	293.30
3.6.	Allow for construction a cattle trough 10 m long	Ls	1.0	200,000.00	200,000.00	1,955.34
	Sub-Total Carried to Summary - Element 3				838,400.00	8,196.79
7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	40,000.00	40,000.00	391.07
7.2.	Allow for planting of indigeneous trees upstream and downstream of the waterpan	No	1,000	250.00	250,000.00	2,444.18
	Sub-Total Carried to Summary - Element 7				290,000.00	2,835.24
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				620,000.00	6,061.55
	ELEMENT 2 - EARTHWORKS				15,893,955.00	155,390.43
	ELEMENT 3 - AUXILIARY STRUCTURES				1,143,750.00	11,182.10
	ELEMENT 4 - PERIMETER FENCE				1,640,000.00	16,033.79
	ELEMENT 5 - EARTHWORKS				1,258,400.00	12,303.00
	ELEMENT 6 - AUXILIARY STRUCTURES				838,400.00	8,196.79
	ELEMENT 7 - PERIMETER FENCE				290,000.00	2,835.24
	ALL ELEMENTS TOTAL				21,684,505.00	212,002.90
	Allow of 5% for supervision				1,084,225.25	10,600.15
	Grand Total				22,768,730.25	222,603.05

6.4.4 Engineering Drawing for proposed rehabilitation work in Mutonyora water pan



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

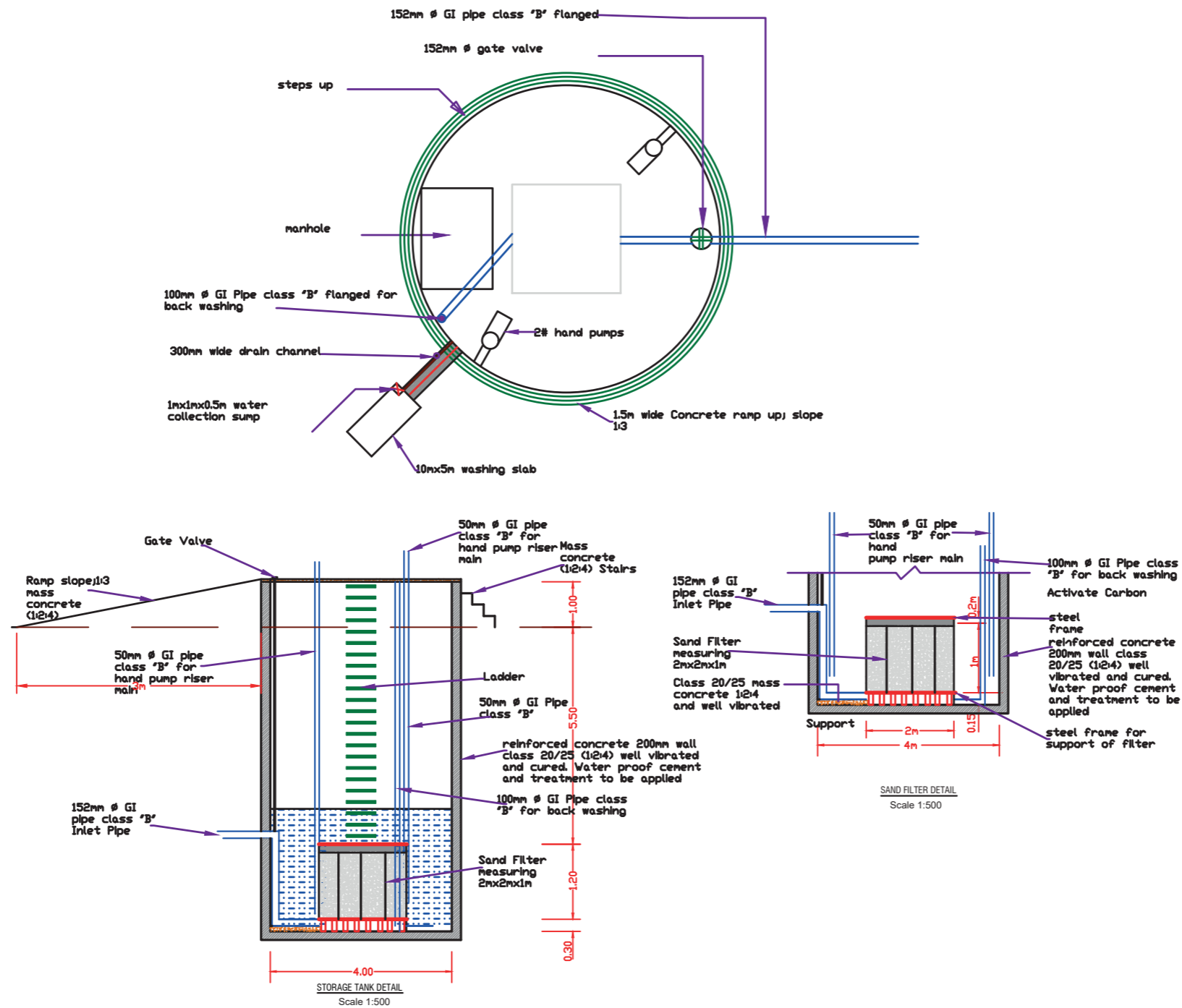
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1: 1

Sheet
01

Well & Accessories



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

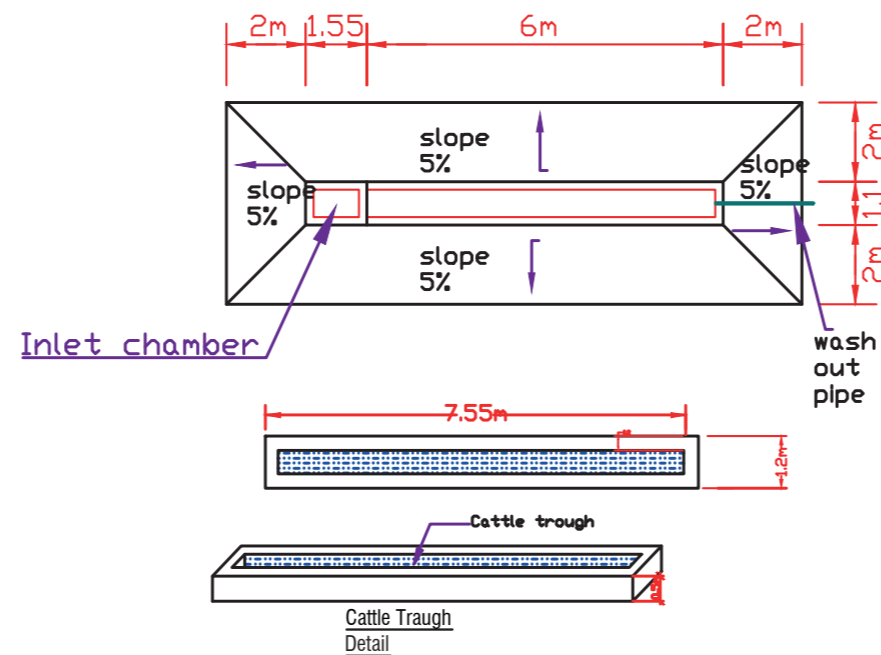
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Date : 12 sep 2018

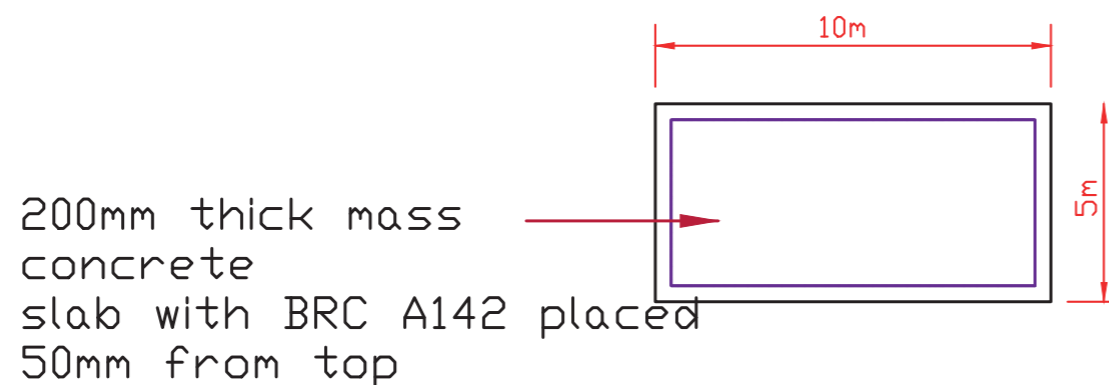
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
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Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

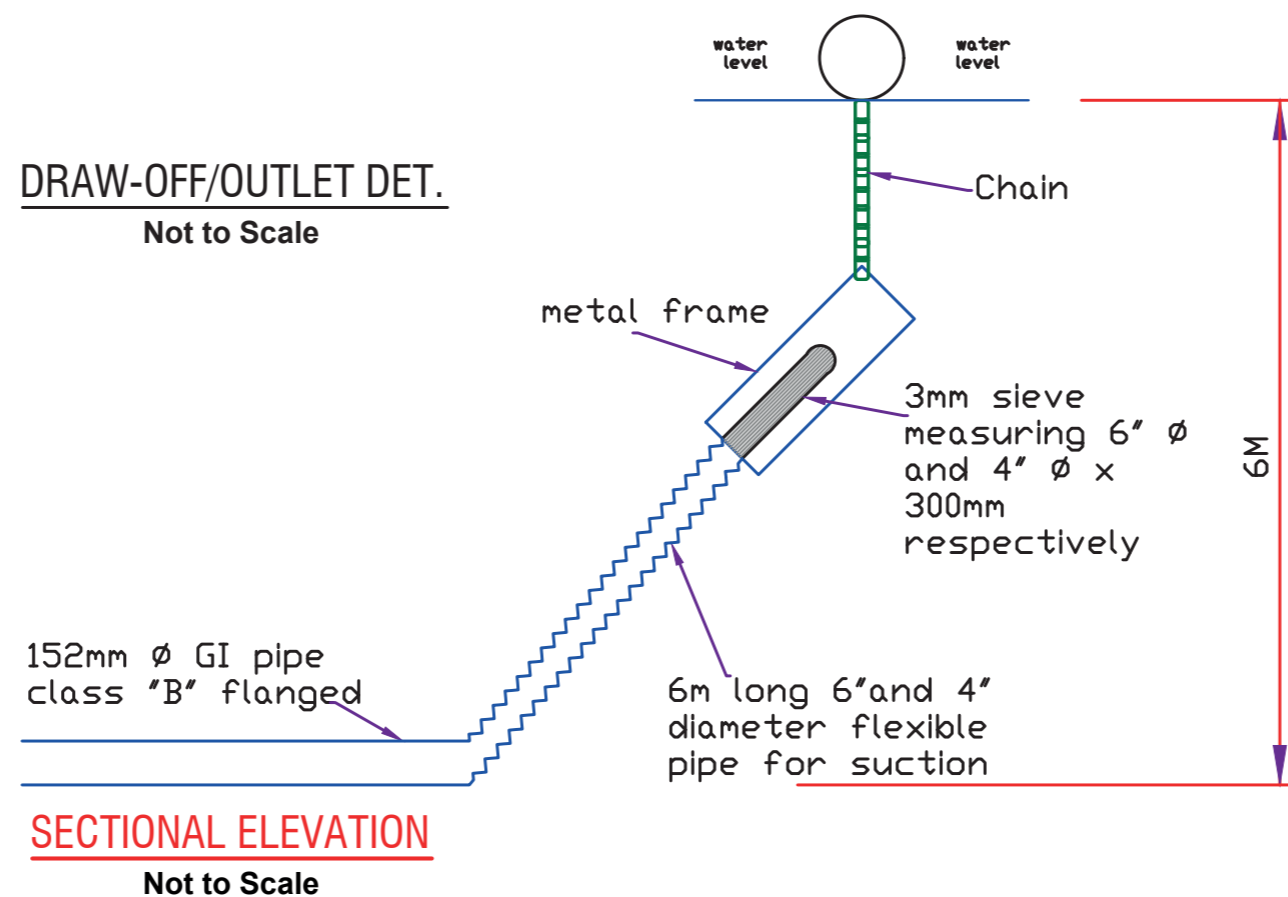
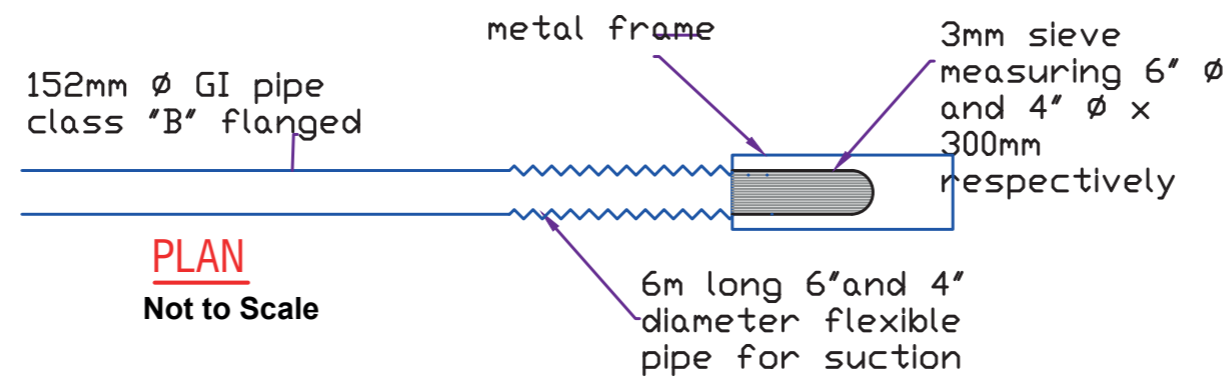
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

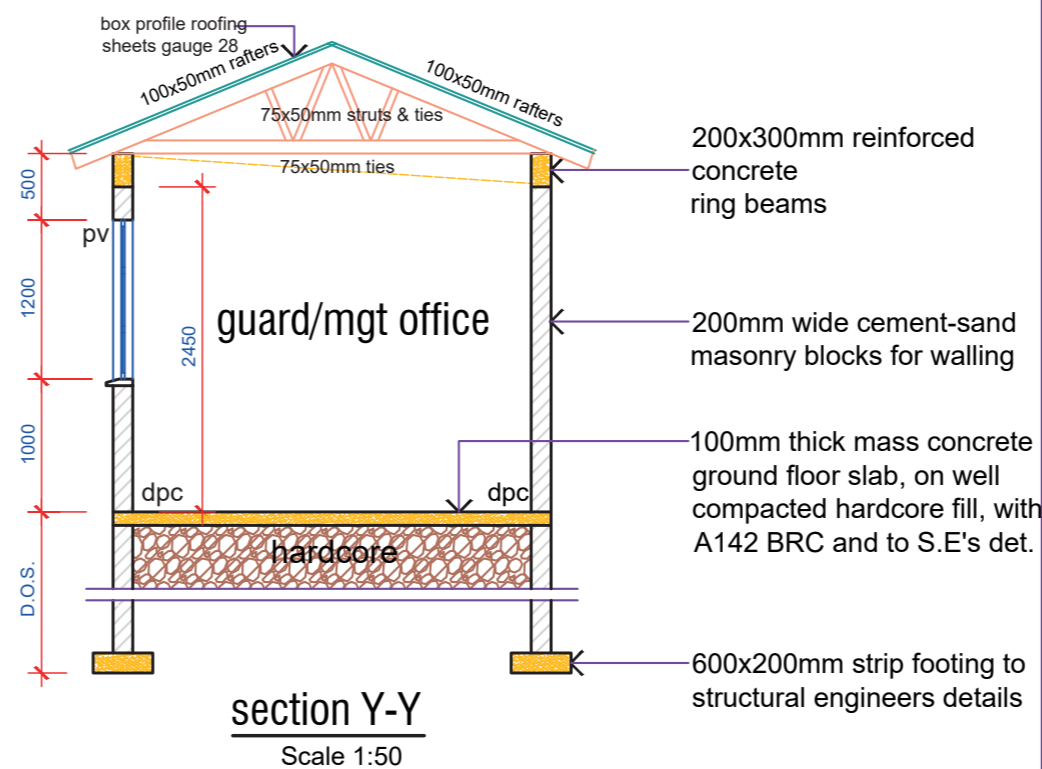
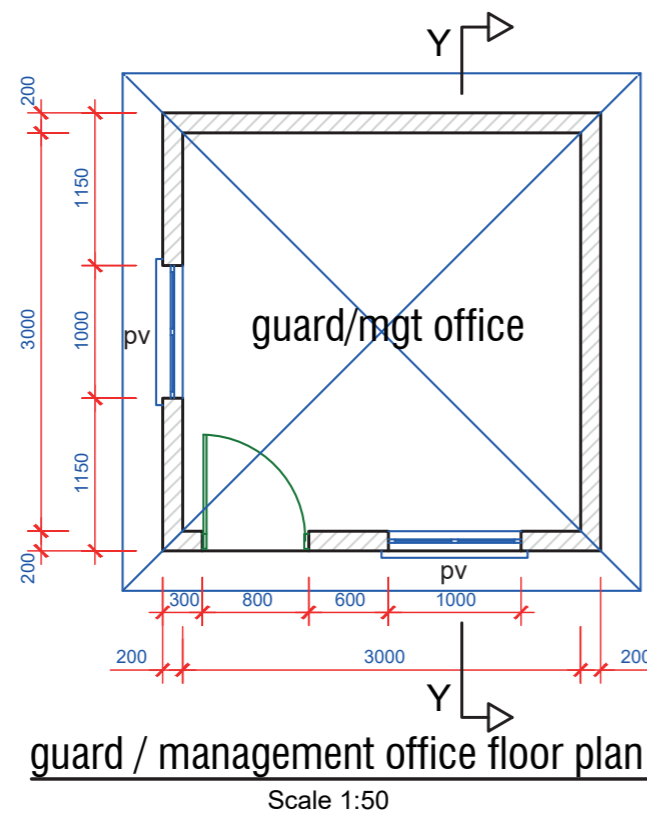
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
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Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.05 Description of Heni water pan in Kinangop Sub-County, Nyandarua County

Heni water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 102,835 m³. The water pan is currently used for small scale irrigation, watering livestock and domestic water supply. The water pan is also a source of water for the Heni Primary and Secondary School. Despite its importance there is significant encroachment of water pan boundaries for brick making.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation work will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. The committee will be responsible for the day-to-day operation and maintenance of the water pan. Whereas the beneficiaries will be

responsible for sanitation at the point of use.

6.5.1 Figures showing characteristics of Heni water pan



Figure 22: Location of the Heni water pan and the surrounding beneficiaries.



Figure 23: A view of a part of the Heni water pan



Figure 24: A woman fetching water from the water pan



Figure 25: A cattle trough that is leaking and in need of rehabilitation



Figure 26: Encroachment into the water pan for making bricks and watering animals directly from the water pan

6.05.2 Beneficiaries of Heni water pan

1000 Households with an average of 6 members. In addition, a primary school and secondary school will benefit from the rehabilitation of the Heni water pan.

6.4.3 Bill of Quantities for proposed rehabilitation works in Heni water pan

REHABILITATION OF HENI WATER PAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

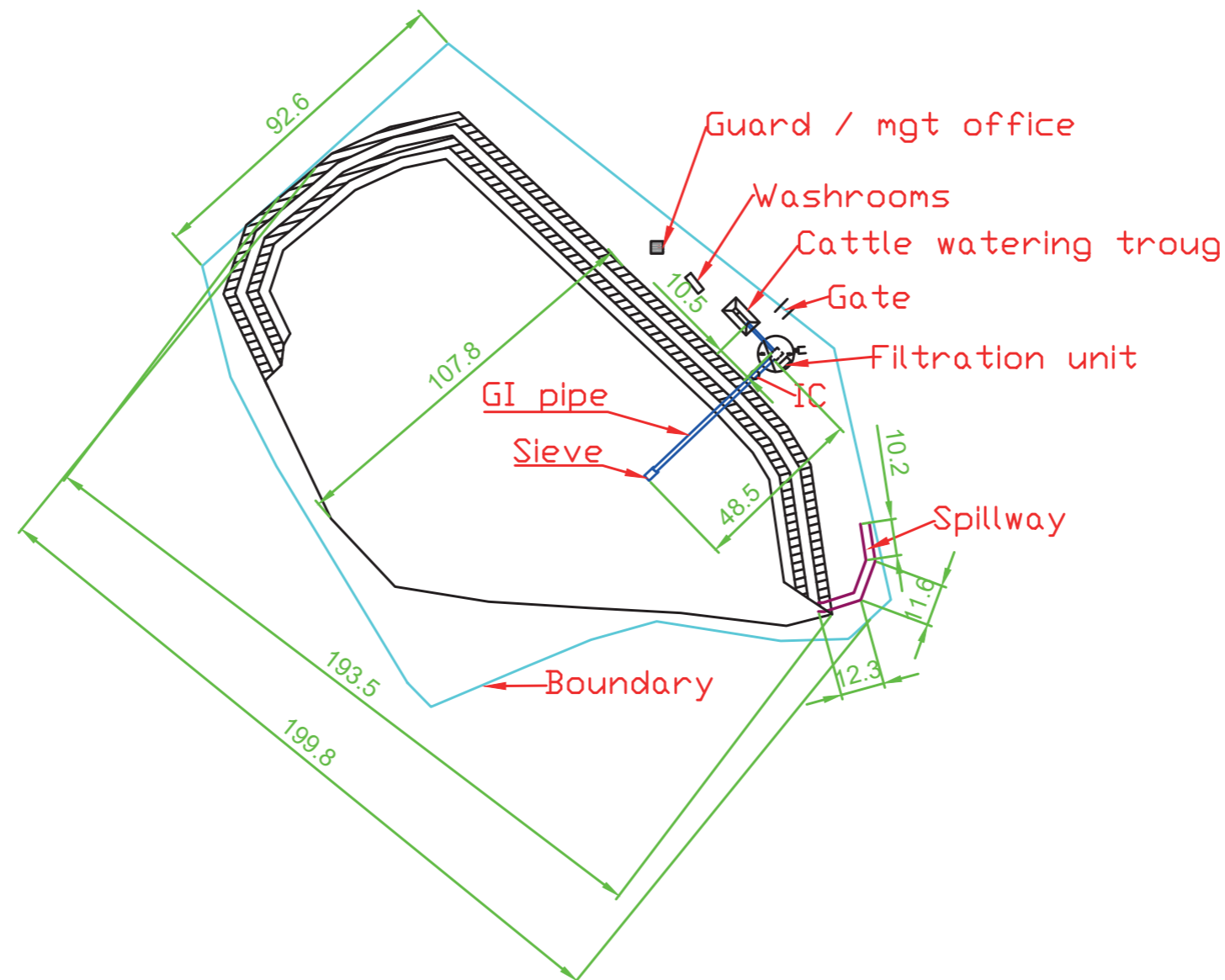
ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the waterpan	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the waterpan site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	15,419	3.00	46,257.00	451.80
2.2.	Excavate silt in the waterpan, remove from site and dispose as directed by the Engineer	CM	16,961	350.00	5,936,315.00	57,980.89
2.3.	Using dozer or other suitable plant, excavate to depth between 3 - 6 m deep, allow slope and form 4 m high embankment. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	11,564	400.00	4,625,700.00	45,179.91
	Sub-Total Carried to Summary - Element 2				10,608,272.00	103,612.60
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	160,000.00	160,000.00	1,562.74
3.4.	Excavate soil to create Intake Channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.9.	Cut trench for cattle trough draw-off pipe 25 m long x 0.6 m wide and 4.0 m average depth	CM	180.0	200.00	36,000.00	351.62
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering draw off and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	5,000.00	5,000.00	48.84
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	4,500.00	4,500.00	43.95
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				1,053,400.00	10,288.72

4	Perimeter Fence & Guard house/shop					
4.1	Provide and erect a perimeter fence with 4mm thickness apleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	600.0	600.00	360,000.00	3,516.17
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	300,000.00	300,000.00	2,930.15
Sub-Total Carried to Summary - Element 4				680,000.00	6,641.66	
5.0.	Storage with filtration system and accessories					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
5.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
5.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34
5.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
5.9.	Allow provision for fabrication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
5.10.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.36
5.11.	Allow for construction of a laudry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
5.12.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
Sub-Total Carried to Summary - Element 5				1,258,400.00	12,290.98	
6.0.	Cattle Trough Construction					
6.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53
6.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
6.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
6.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
6.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40
6.6.	Allow for construction a cattle trough 6 m long	Ls	1.0	200,000.00	200,000.00	1,953.43
Sub-Total Carried to Summary - Element 4				808,400.00	7,895.76	

7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	20,000.00	20,000.00	195.34
7.2.	Allow for planting of indigenous trees upstream and downstream of the waterpan	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 7				270,000.00	2,637.13
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				620,000.00	6,055.63
	ELEMENT 2 - EARTHWORKS				10,608,272.00	103,612.60
	ELEMENT 3 - AUXILIARY STRUCTURES				1,053,400.00	10,288.72
	ELEMENT 4 - PERIMETER FENCE AND GUARD HOUSE				680,000.00	6,641.66
	ELEMENT 5 - STORAGE AND FILTRATION CAPACITY				1,258,400.00	12,290.98
	ELEMENT 6 - CATTLE TROUGH CONSTRUCTION				808,400.00	7,895.76
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				270,000.00	2,637.13
	ALL ELEMENTS TOTAL				15,298,472.00	149,422.49
	Allow of 5% for supervision				764,923.60	7,471.12
	Grand Total				16,063,395.60	156,893.61

6.4.4 Engineering Drawing for proposed rehabilitation work in Heni Water pan

HENI DAM



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

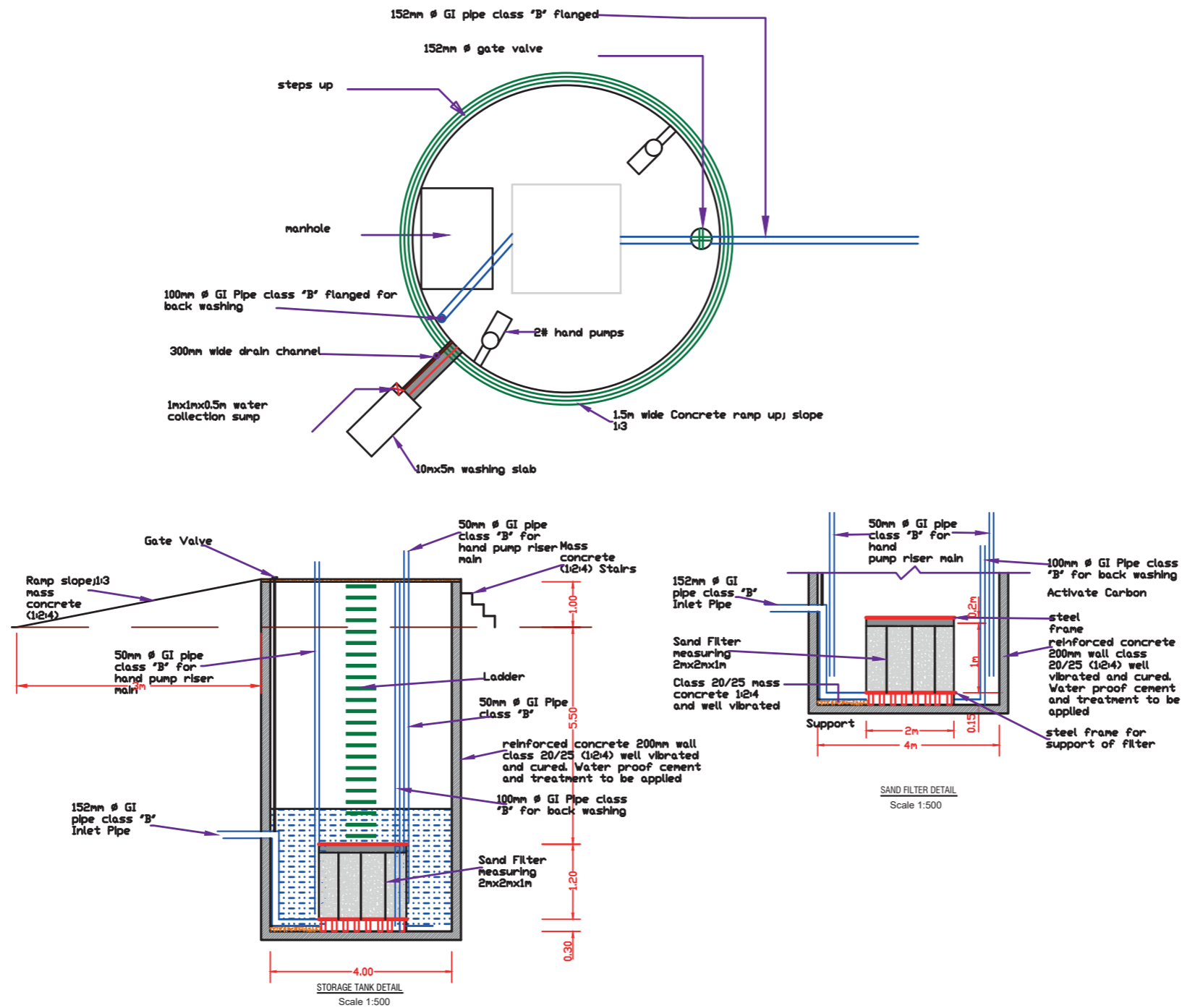
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1:1

Sheet
01

Well & Accessories



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke

Client:



Project
Rehabilitation of water structures in Nyandarua county

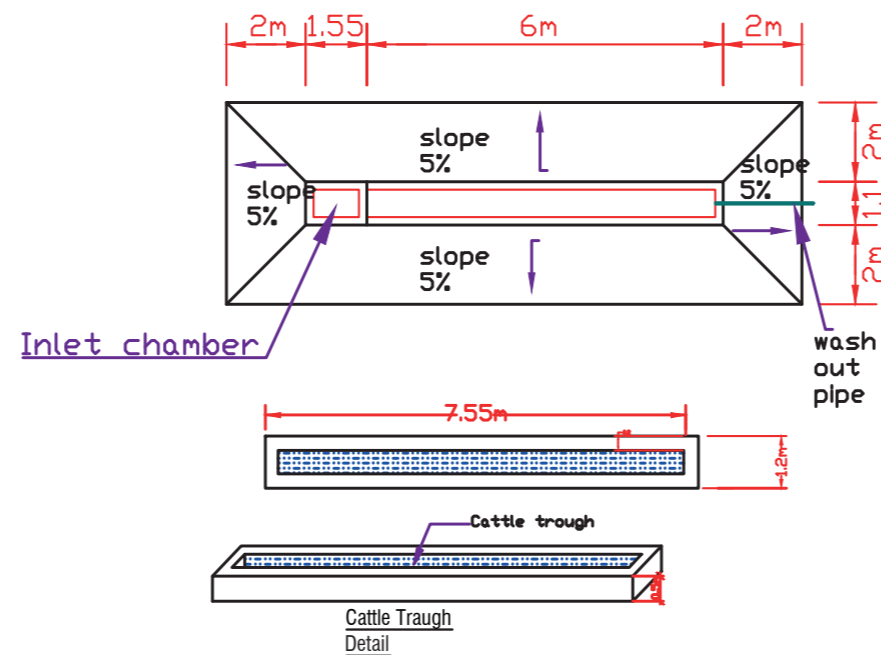
Drawing Title

Dam Layout

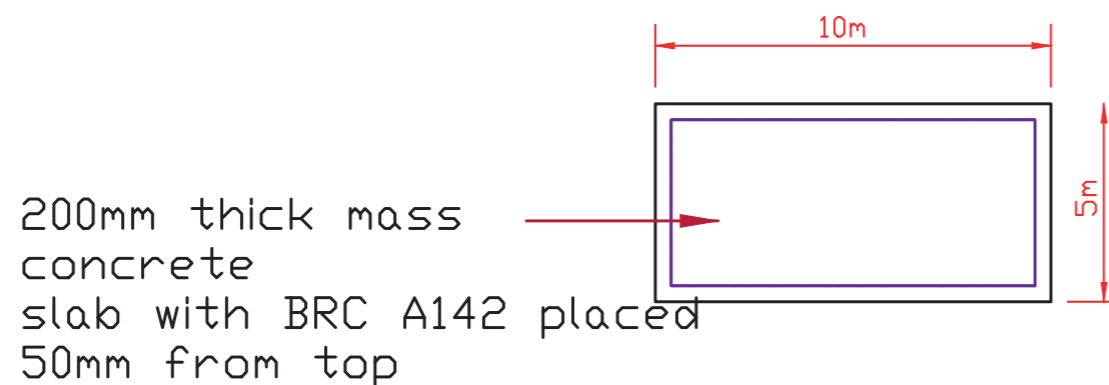
Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

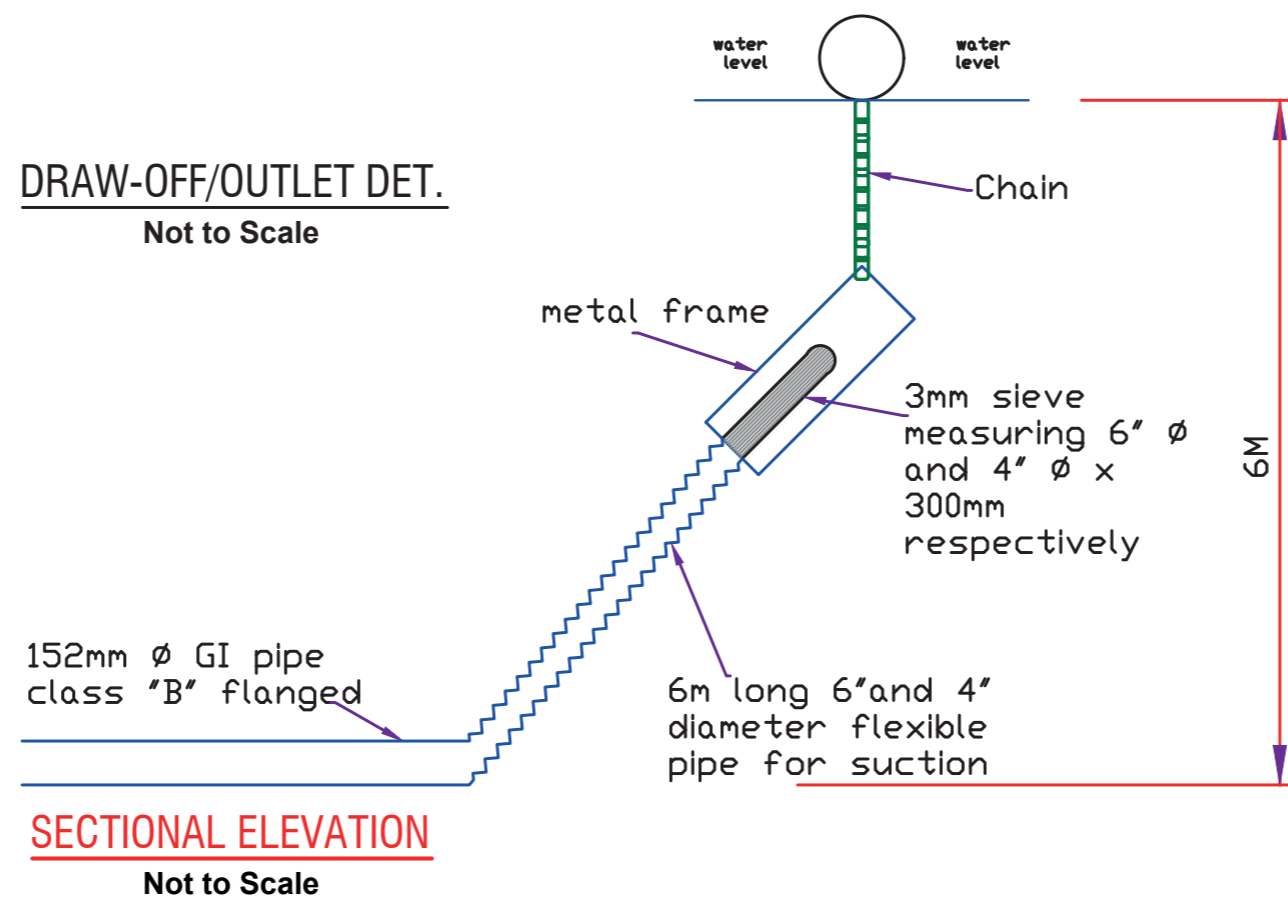
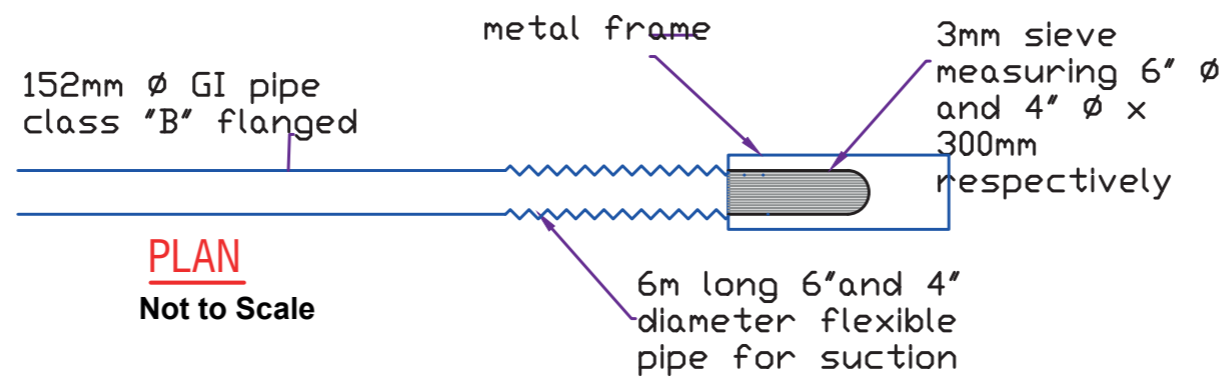
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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Lead Experts, GIS
Experts, Water
Resource
Professionals.
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00400,
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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

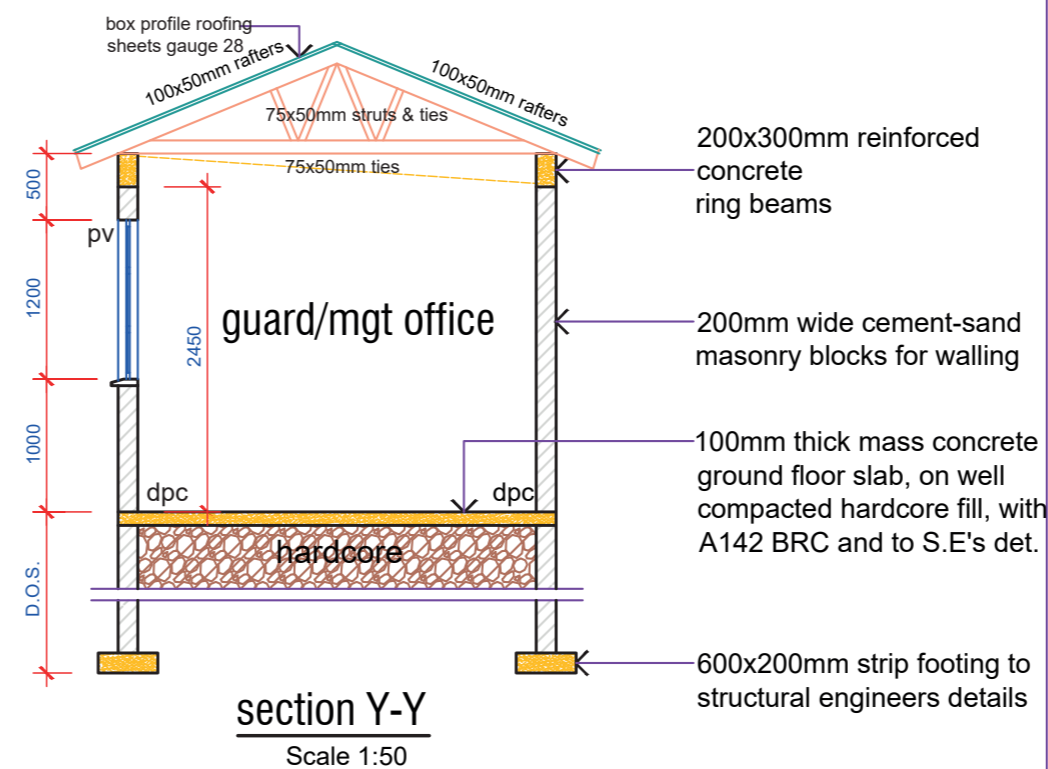
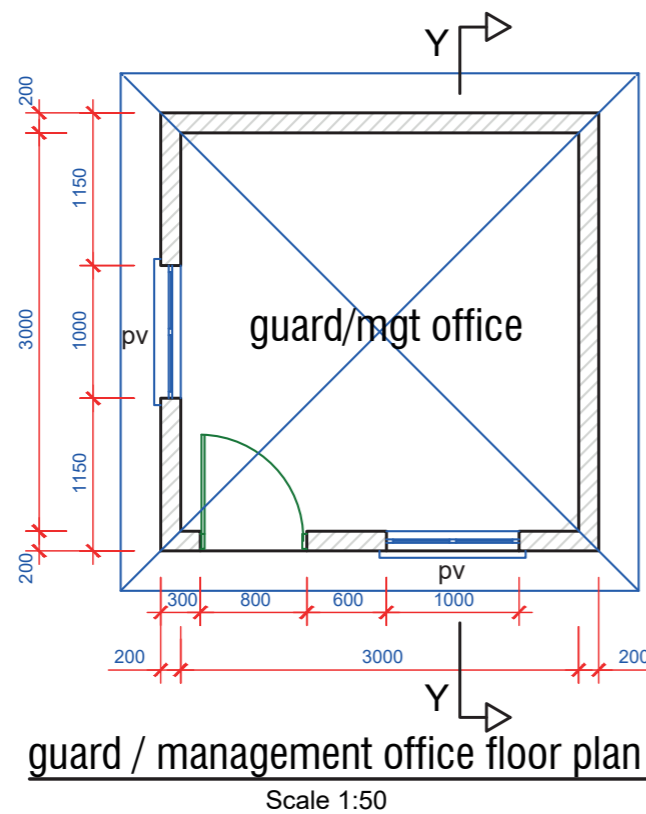
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS
Drawn: SN
Checked: JS
Date: 23 SEP 2018
Scale: as shown

Sheet

05

6.06 Description of Karanja Wanaina water pan in Kinangop Sub-County, Nyandarua County

Karanja Wanaina water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 128,719 m³. The water pan is currently used for watering livestock and domestic water supply. Approximately 5,000 cattle rely on this water pan. Despite its importance there is significant siltation and encroachment of water pan boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it off to prevent future re-encroachment. The water pan will also be excavated to remove deposited silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,500 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. The committee will be responsible for the day-to-day operation and maintenance of the water pan. Whereas the beneficiaries will be responsible for sanitation at the point of use/homestead.

6.06.1 Figures showing the characteristics of Karanja Wainana water pan



6.06.2 Beneficiaries of Karanja Wainana Water Pan

1,000 Households with an average of 6 members.

6.06.3 Bill of Quantities for rehabilitation of Karanja Wanaina water pan

REHABILITATION OF KARANJA WANAINA DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

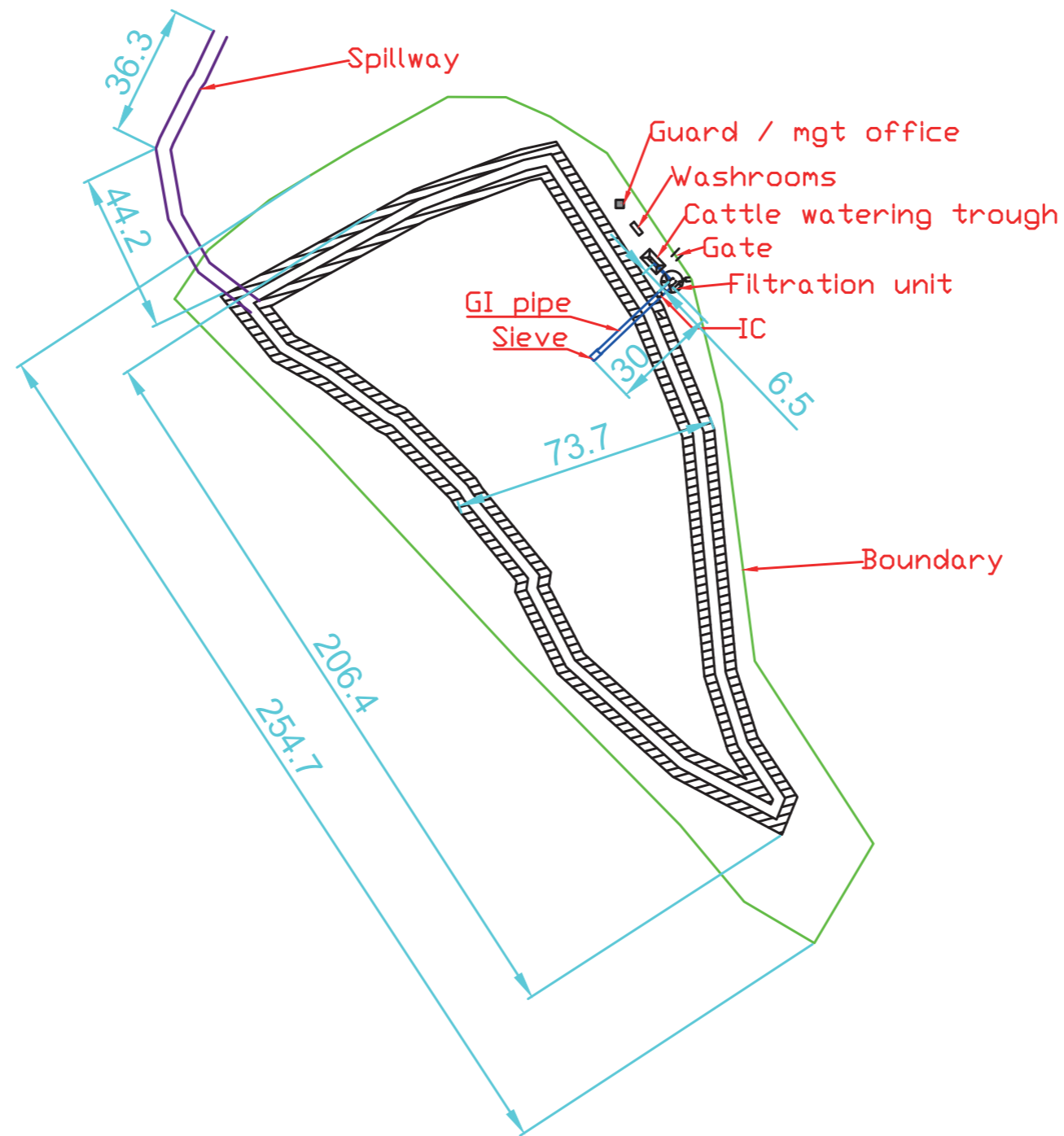
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	21,782	350.00	7,623,588.00	74,460.74
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	5,445	400.00	2,178,168.00	21,274.50
	Sub-Total Carried to Summary - Element 2				9,951,756.00	97,200.30
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	600.00	600.00	5.86
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for Berkad and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
3.14	On Cattle line supply line, excavate from reduced level upto to a depth of 2.5 m and cart away as directed by Engineer	CM	11.0		-	-
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	100.00	3,300.00	32.23
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				846,150.00	8,264.47

4	Perimeter Fence, Guard house/shop and carrots washing slabs						
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,200.0	600.00	720,000.00	7,032.35	
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34	
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	150,000.00	150,000.00	1,465.07	
4.4	Construct Slaps for Washing Carrots.	LS	1.0	600,000.00	600,000.00	5,860.29	
Sub-Total Carried to Summary - Element 4					1,490,000.00	14,553.06	
5.0.	Storage with filtration system and accessories						
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53	
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89	
	Mass concrete as described in:-						
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03	
	Sawn formwork to:						
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48	
	Vibrated reinforced concrete as described in:-						
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11	
5.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84	
5.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34	
5.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72	
5.10.	Allow provision for fabrication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49	
5.11.	Allow for installation of Mark II handpump	NO	1.0	25,000.00	25,000.00	244.18	
5.15.	Allow for construction of a laundry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51	
5.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69	
Sub-Total Carried to Summary - Element 2					1,233,400.00	12,046.80	
6.0.	Cattle Trough Construction						
6.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53	
6.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89	
	Mass concrete as described in:-						
6.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03	
	Sawn formwork to:						
6.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48	
	Vibrated reinforced concrete as described in:-						
6.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40	
6.9	Allow a Provisional Sum for Mark II handpumps	No	1	35,000.00	35,000.00	341.85	
6.10.	Allow for construction a cattle trough 10 m long	Ls	1.0	200,000.00	200,000.00	1,953.43	
Sub-Total Carried to Summary - Element 3					843,400.00	8,237.62	

7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
7.2.	Allow for planting of indigenous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
	Sub-Total Carried to Summary - Element 7				405,000.00	3,955.70
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				620,000.00	6,055.63
	ELEMENT 2 - EARTHWORKS				9,951,756.00	97,200.30
	ELEMENT 3 - AUXILIARY STRUCTURES				846,150.00	8,264.47
	ELEMENT 4 - PERIMETER FENCE				1,490,000.00	14,553.06
	ELEMENT 5 - EARTHWORKS				1,233,400.00	12,046.80
	ELEMENT 6 - AUXILIARY STRUCTURES				843,400.00	8,237.62
	ELEMENT 7 - PERIMETER FENCE				405,000.00	3,955.70
	ALL ELEMENTS TOTAL				15,389,706.00	150,313.58
	Allow of 5% for supervision				769,485.30	7,515.68
	Grand Total				16,159,191.30	157,829.26

6.06.4 Engineering Drawing for rehabilitation of Karanja Wanaina water pan

Karanja Wainana Dam



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter.
9. Trenches shall be dug to the invert levels, graded and compacted to approval.
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones.
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval.

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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Lead Experts, GIS
Experts, Water
Resource
Professionals.
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00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

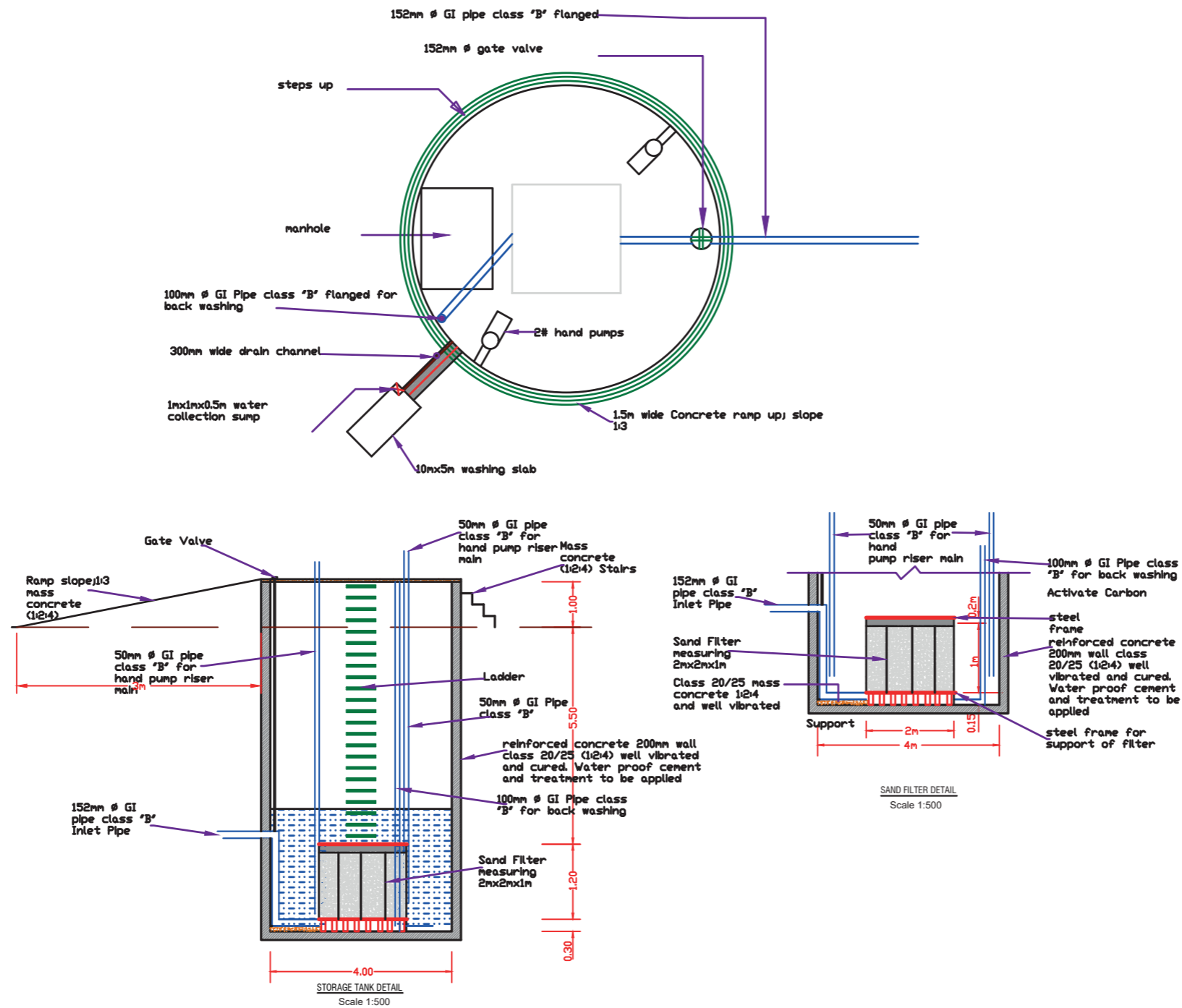
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1: 1

Sheet
01

Well & Accessories



Notes General

1. All dimensions are in meters unless otherwise stated.
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10. Open channels shall be excavated bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

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Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

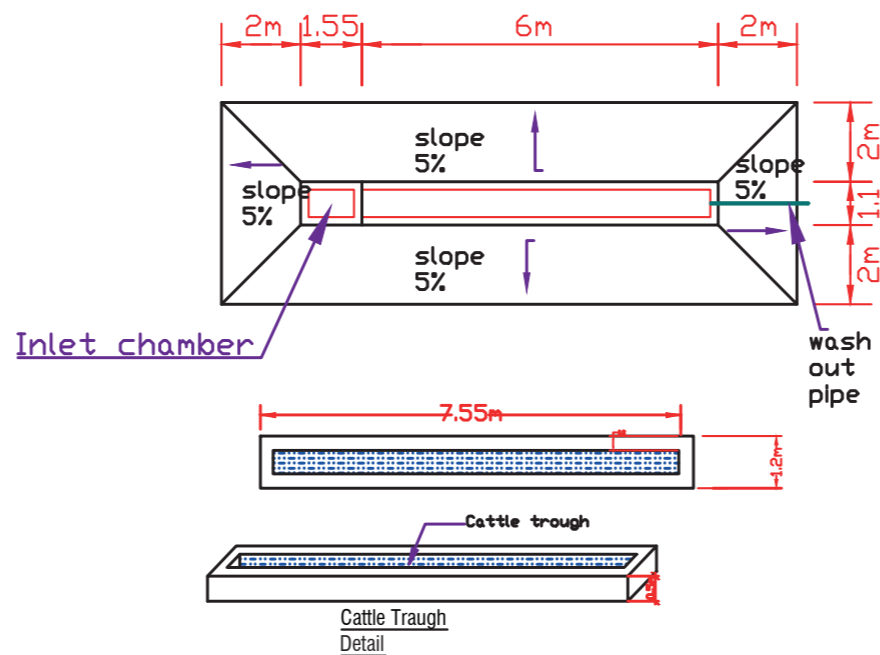
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Date : 12 sep 2018

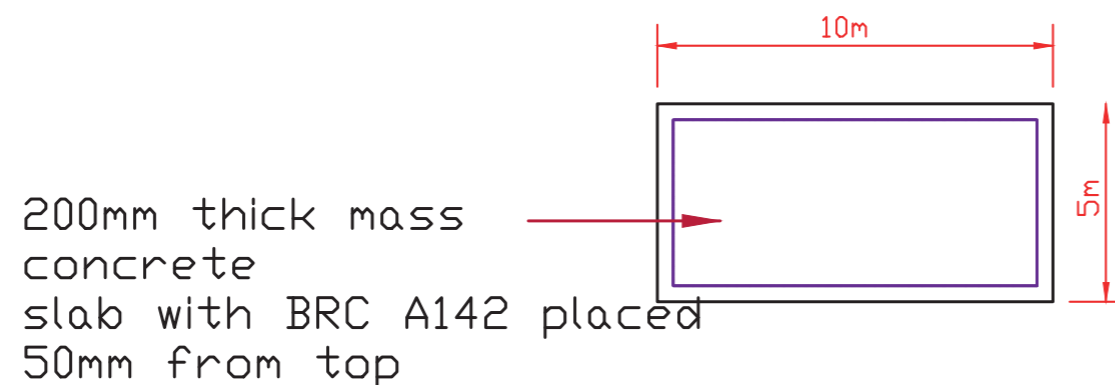
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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8. The lapping length of bars will be 50 x bar diameter
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11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

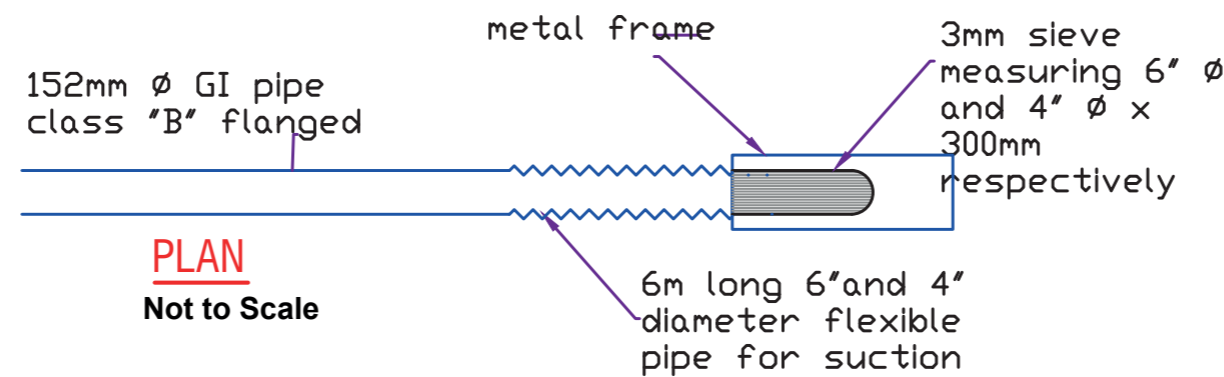
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

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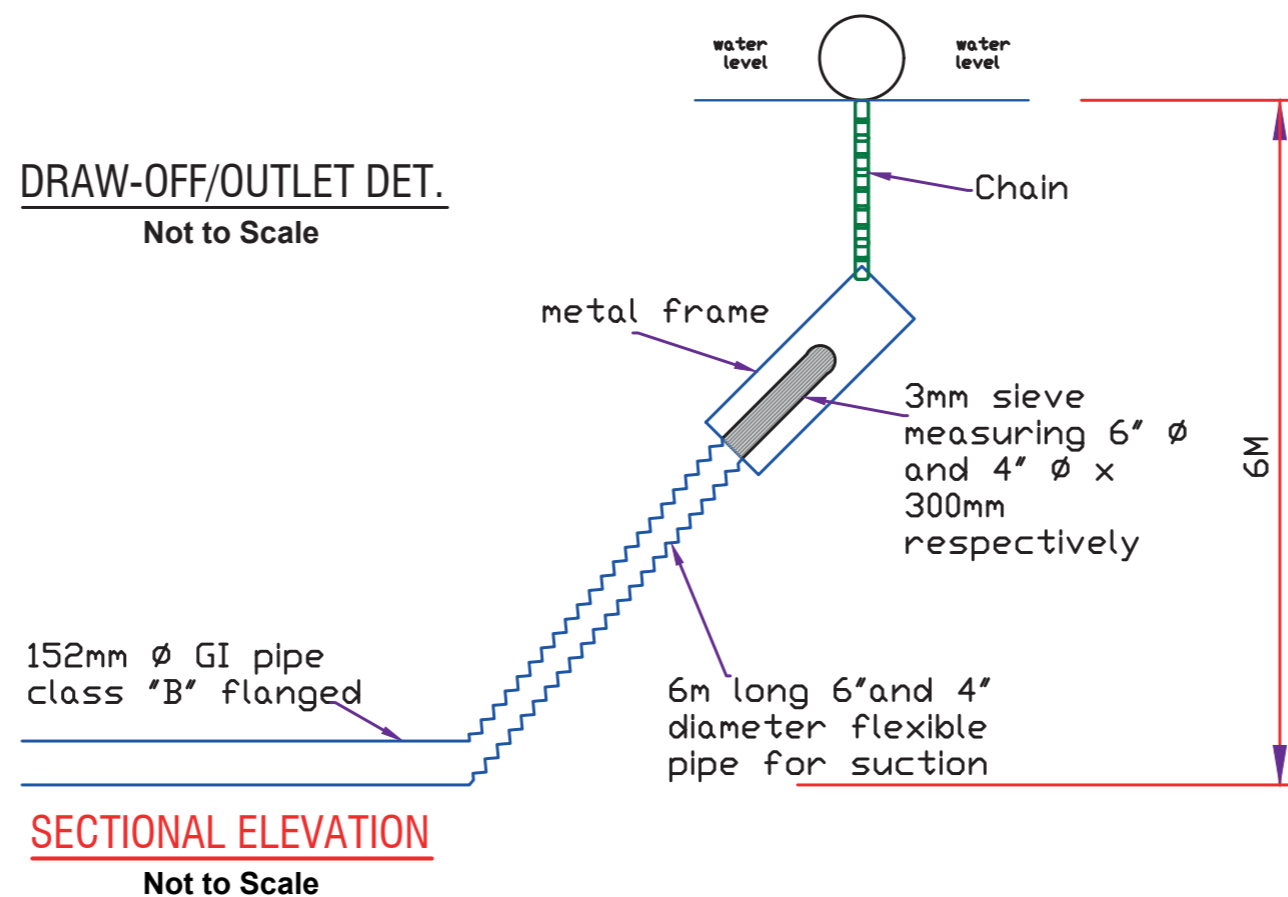
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DRAW-OFF/OUTLET



DRAW-OFF/OUTLET DET.

Not to Scale



Notes General

1. All dimensions are in meters unless otherwise stated.
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7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

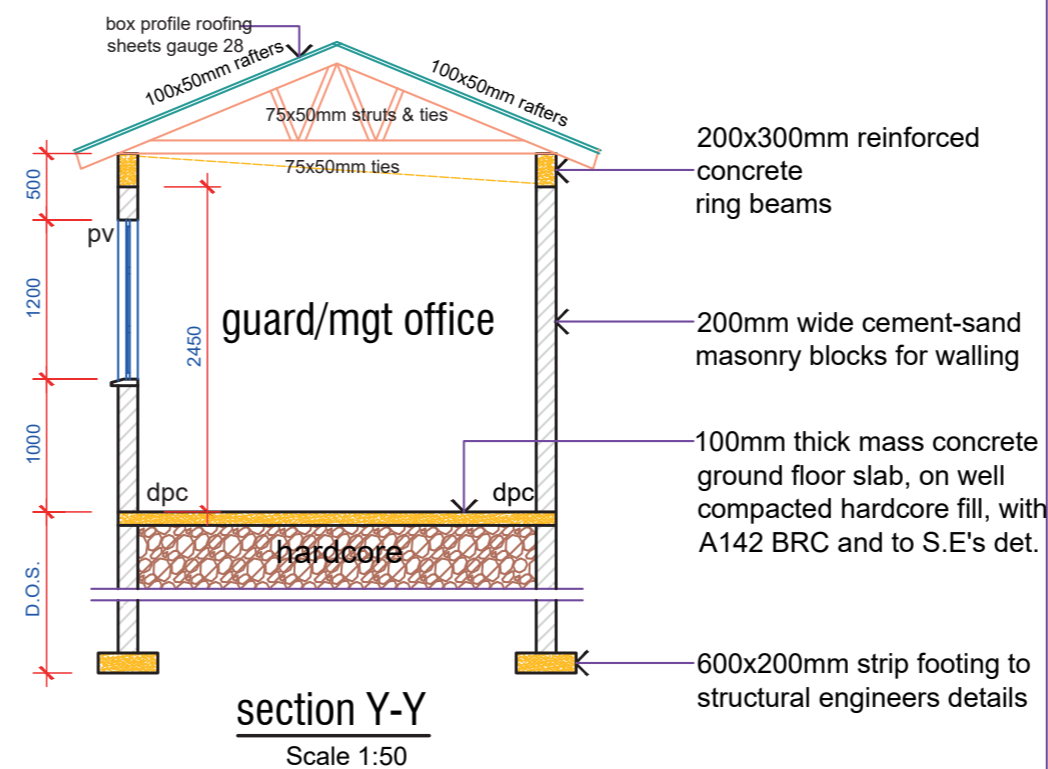
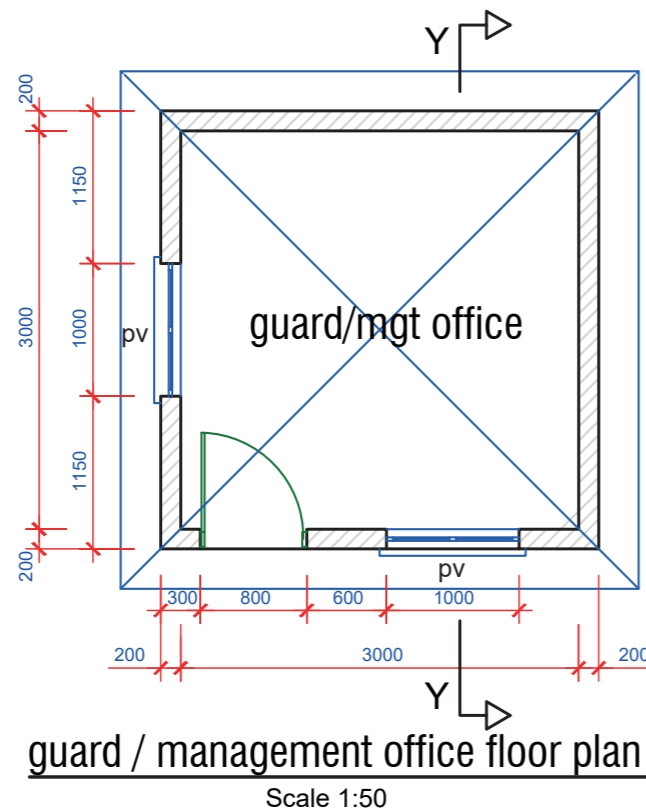
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS
Drawn: SN
Checked: JS
Date: 23 SEP 2018
Scale: as shown

Sheet

05

6.07 Description of Wanyeki water pan in Kinangop Sub-County, Nyandarua County

Wanyeki water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 23,562 m³. The water pan is currently used for small scale irrigation, watering livestock and domestic water supply. Despite its importance there is significant siltation, its embankment has some leakage and encroachment of water pan boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. The committee will be responsible for the day-to-day operation and maintenance of the water pan. Whereas the beneficiaries will be responsible for sanitation at the point of use/homesteads.

6.07.1 Figures showing the characteristics of Wanyeki water pan



6.07.2 Beneficiaries of Wanyeki water pan

100 Households with an average of 6 members.

6.07.3 Bill of Quantities for rehabilitation of Wanyeki water pan

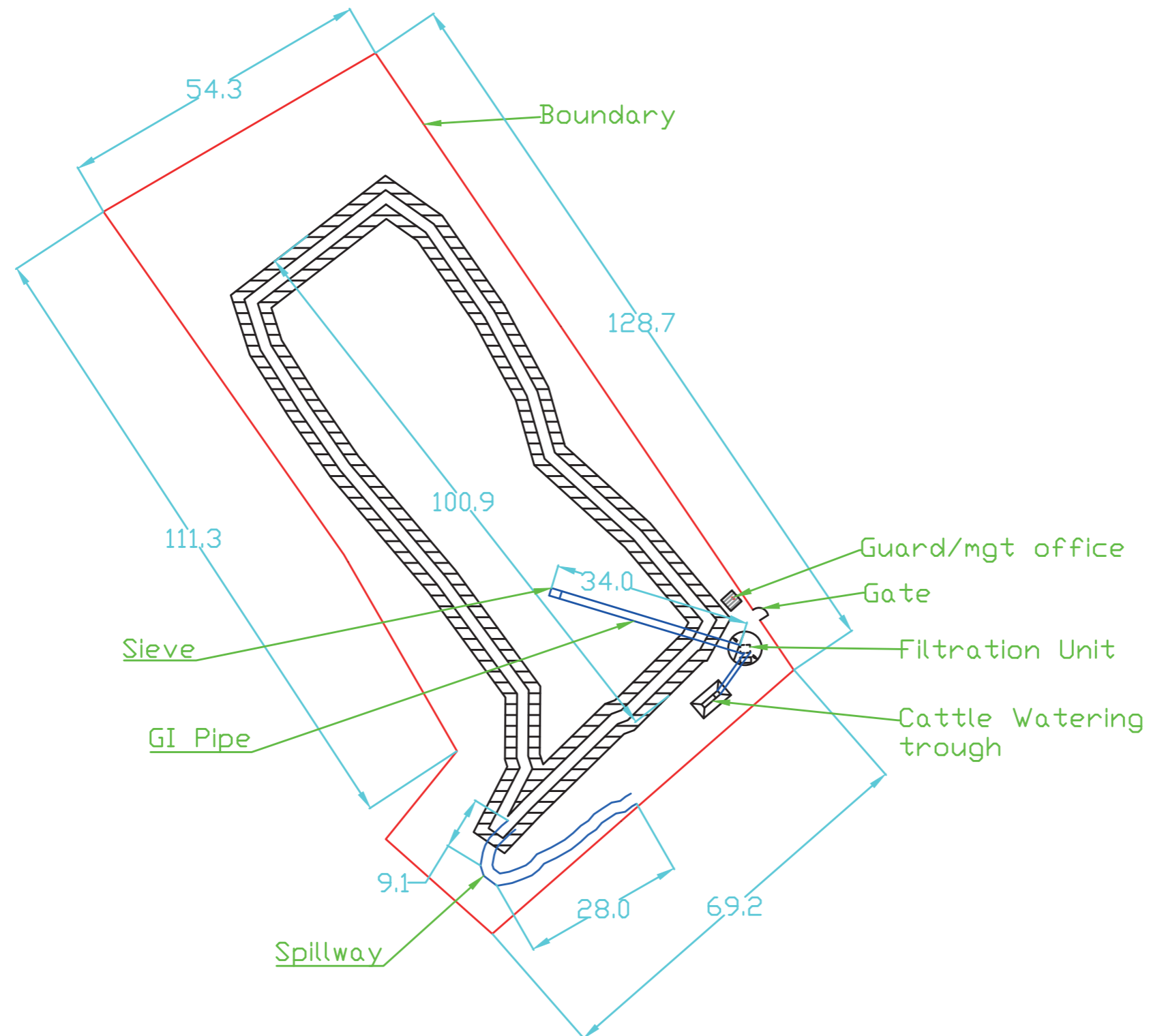
REHABILITATION OF WANYEKI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	22,869	3.00	68,607.00	670.09
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	22,869	350.00	8,004,150.00	78,177.74
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 3 m high embankment around the pan. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	11,435	400.00	4,573,800.00	44,673.00
	Sub-Total Carried to Summary - Element 2				12,646,557.00	123,520.83
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	600.00	600.00	5.86
3.4.	Excavate soil to create Intake Channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.9.	Cut trench for cattle trough draw-off pipe 25 m long x 0.6 m wide and 4.0 m average depth	CM	180.0	200.00	36,000.00	351.62
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle draw off and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
3.14	On Cattle line supply line, excavate from reduced level upto to a depth of 3.5 m and cart away as directed by Engineer	CM	11.0	200.00	2,200.00	21.49
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	100.00	3,300.00	32.23
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				884,350.00	8,637.58

4	Perimeter Fence, Guard house/shop					
4.1	Provide and erect a perimeter fence with 4mm thickness aagleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,200.0	600.00	720,000.00	7,032.35
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	300,000.00	300,000.00	2,930.15
4.4	Construct Slaps for Washing Carrots.	LS	1.0	600,000.00	600,000.00	5,860.29
Sub-Total Carried to Summary - Element 4				1,640,000.00	16,018.13	
5.0.	Storage with filtration system and accessories					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
2.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
2.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34
2.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
2.10.	Allow provision for fabrication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
2.11.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.36
2.12.	Allow for construction of a laudry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
2.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
Sub-Total Carried to Summary - Element 2				1,258,400.00	12,290.98	
3.0.	Cattle Trough Construction					
4.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53
4.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
4.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
4.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
4.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40
4.9	Allow a Provisional Sum for Mark II handpumps	No	1	30,000.00	30,000.00	293.01
3.6.	Allow for construction a cattle trough 10 m long	Ls	1.0	200,000.00	200,000.00	1,953.43
Sub-Total Carried to Summary - Element 3				838,400.00	8,188.78	
7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	20,000.00	20,000.00	195.34
7.2.	Allow for planting of indigineous trees upstream and downstream of the dam	No	1,000	250.00	250,000.00	2,441.79
Sub-Total Carried to Summary - Element 7				270,000.00	2,637.13	

6.07.4 Engineering Drawing for rehabilitation of Wanyeki water pan

Wanyeki Dam



Notes General

- All dimensions are in meters unless otherwise stated.
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- Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

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Consultant:

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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : SN

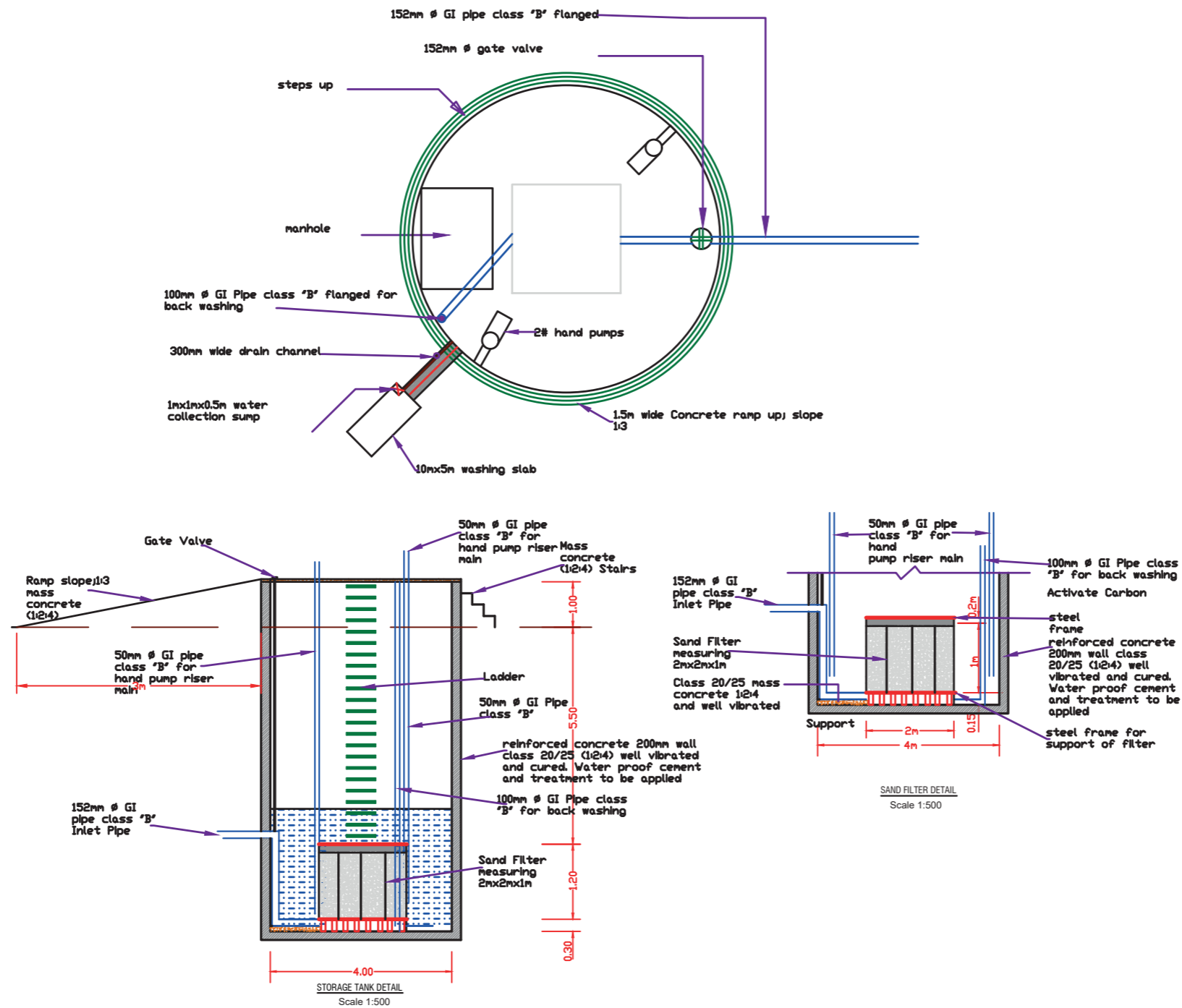
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Scale : 1:1

Sheet

01

Well & Accessories



Notes General

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Client:



Project
Rehabilitation of water structures in Nyandarua county

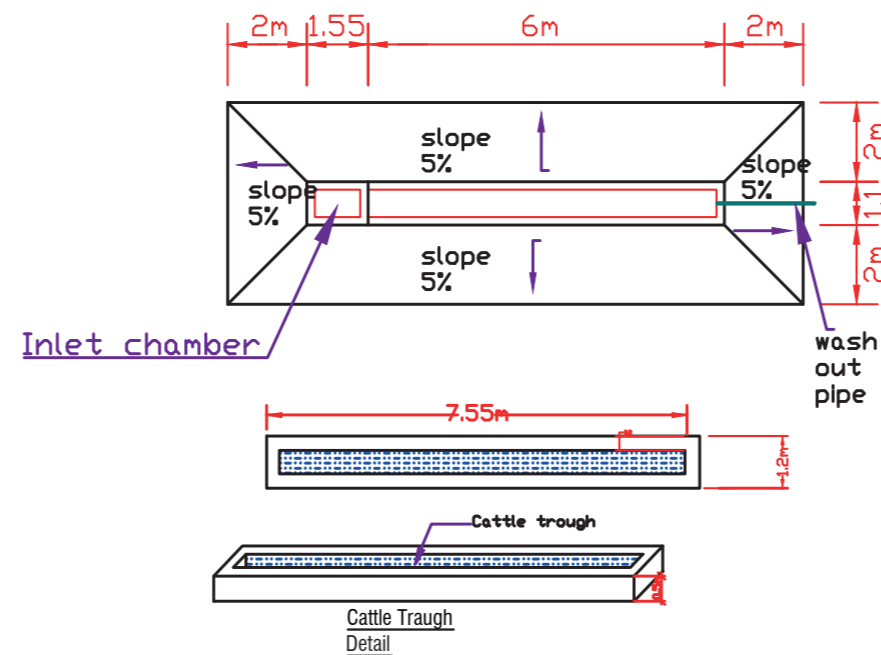
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Dam Layout

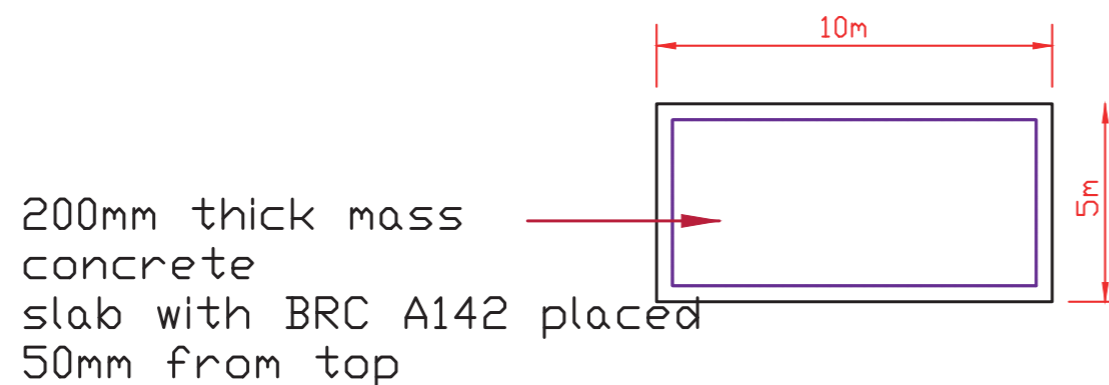
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Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

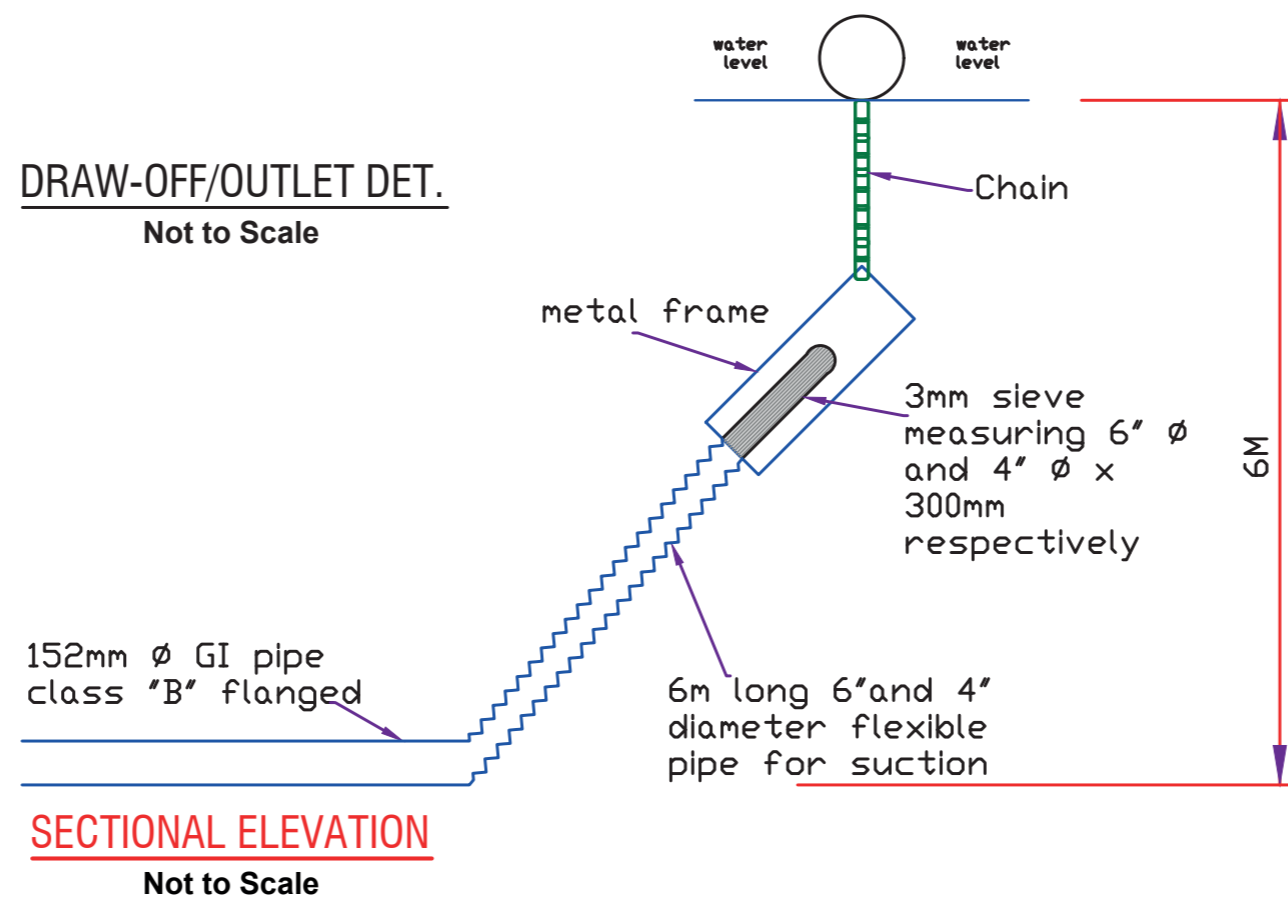
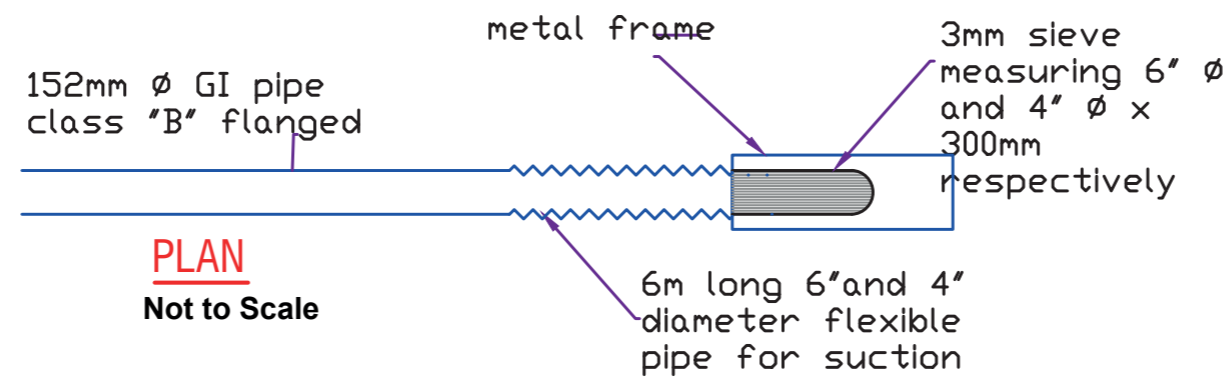
Date : 12 sep 2018

Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

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00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

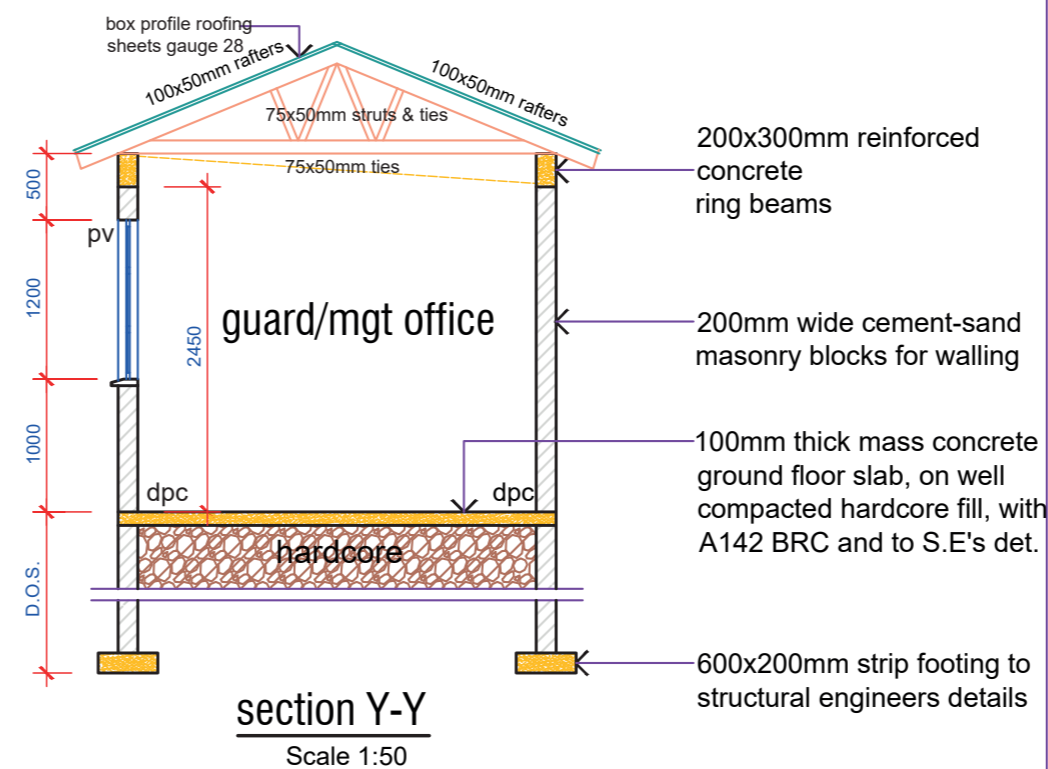
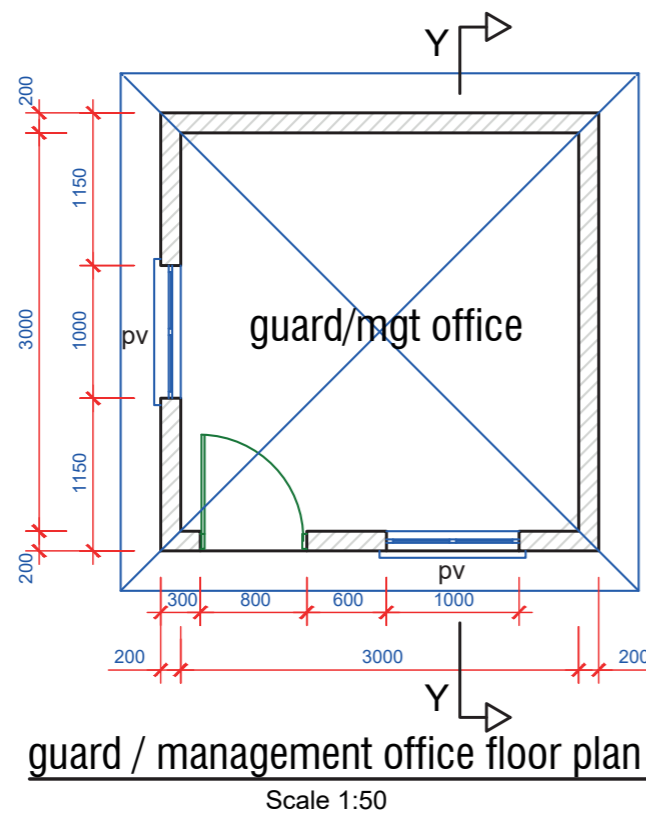
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

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11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

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Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
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Nairobi, Kenya.
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Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.08 Description of Koinange borehole in Kinangop Sub-County, Nyandarua County

Koinange borehole is located in Kinangop Sub-county of Nyandarua County. This was an existing borehole with potential to serve an additional 550 households. It was proposed that a coin operated water kiosk be constructed on site and an additional 4 km water distribution network be installed.

As a contribution to environmental conservation a tree nursery with will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the beneficiaries will be expected to plant at least 500 indigenous seedlings and take of them till they are full establish. The County Government of Nyandarua will take of charge a fee for water use and will also be responsible for operation and maintenance. On the other hand, the local populace benefiting from the water supply will be responsible for sanitation related issues at the point of use.

6.08.1 Figures showing characteristics of Koinange borehole

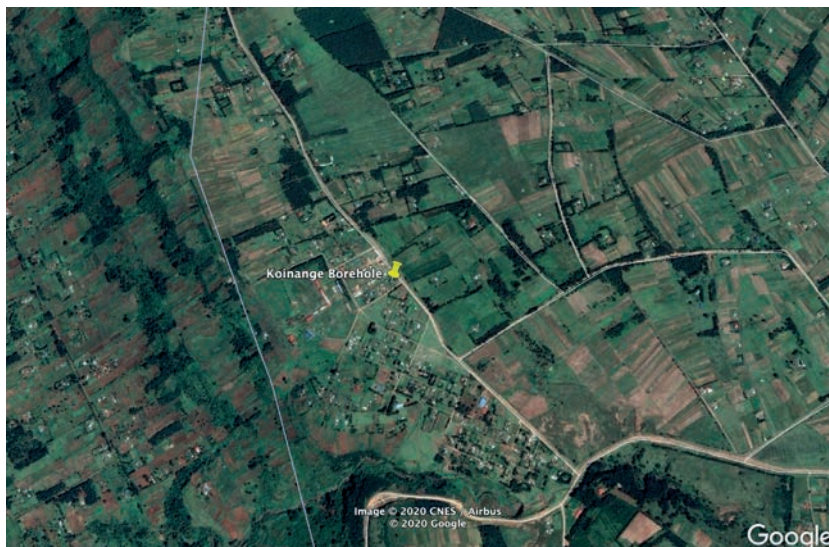


Figure 27: Location of Koinange borehole and surrounding homesteads



Figure 28: Metallic elevated tank in Koinange borehole



Figure 29: Existing water kiosk in Koinange borehole compound.

6.08.3 Beneficiaries of Koinange borehole

550 Households with an average of 6 members.

6.8.3 Bill of Quantities for proposed extension works in Koinange borehole

REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	<u>Preliminaries</u>					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	15,000.00	15,000.00	146.51
1.3.	Allow for Security Costs	PS	1	30,000.00	30,000.00	293.01
	Sub-Total Carried to Summary - Element 1				45,000.00	439.52
2.0.	<u>Additional Water Distribution system</u>					
2.1.	Additional water distribution network	LM	4,000.0	1,200.00	4,800,000.00	46,882.33
2.2.	Construct and install coin operated water kiosk as per the technical drawings and as directed by the engineer	LS	3	200,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 4				5,400,000.00	52,742.62
3.0.	<u>Environmental Conservation</u>					
3.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
3.2.	Allow for planting of indigeneous trees in the vicinity of the boreholes	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 7				155,000.00	1,513.91
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				45,000.00	439.52
	ELEMENT 2 - WATER DISTRIBUTION NETWORK				5,400,000.00	52,742.62
	ELEMENT 3 - ENVIRONMENTAL CONSERVATION				155,000.00	1,513.91
	ALL ELEMENTS TOTAL				5,600,000.00	54,696.05
	Allow of 5% for supervision				280,000.00	2,734.80
	Grand Total				5,880,000.00	57,430.85

6.09 Description of Wachira Waheni water pan in Kinangop Sub-County, Nyandarua County

Wachira Waheni is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 79,885 m³. The water pan is currently used for watering livestock and domestic water supply. Despite its importance there is significant siltation and encroachment of its reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. The committee will be responsible for the day-to-day operation and maintenance of the water pan using the funds accrued from small fees from water usage. Whereas the beneficiaries will be responsible for sanitation at the point of use/homesteads.

6.09.1 Figure showing characteristics of Wachira waheni water pan



Figure 30: Location of the Wachira Waheni Water pan and its surroundings



Figure 31: A view of Wachira waheni water pan during the time of survey



Figure 32: An eroded spillway in Wachira Waheni water pan



Figure 33: A non-indigenous trees growing on the side of Wachira Waheni water pan

6.09.2 Beneficiaries of Wachira waheni water pan

700 Households with an average of 6 members.

6.09.3 Bill of Quantities for rehabilitation of Wachira Waheni water pan

REHABILITATION OF WACHIRA WAHANI IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

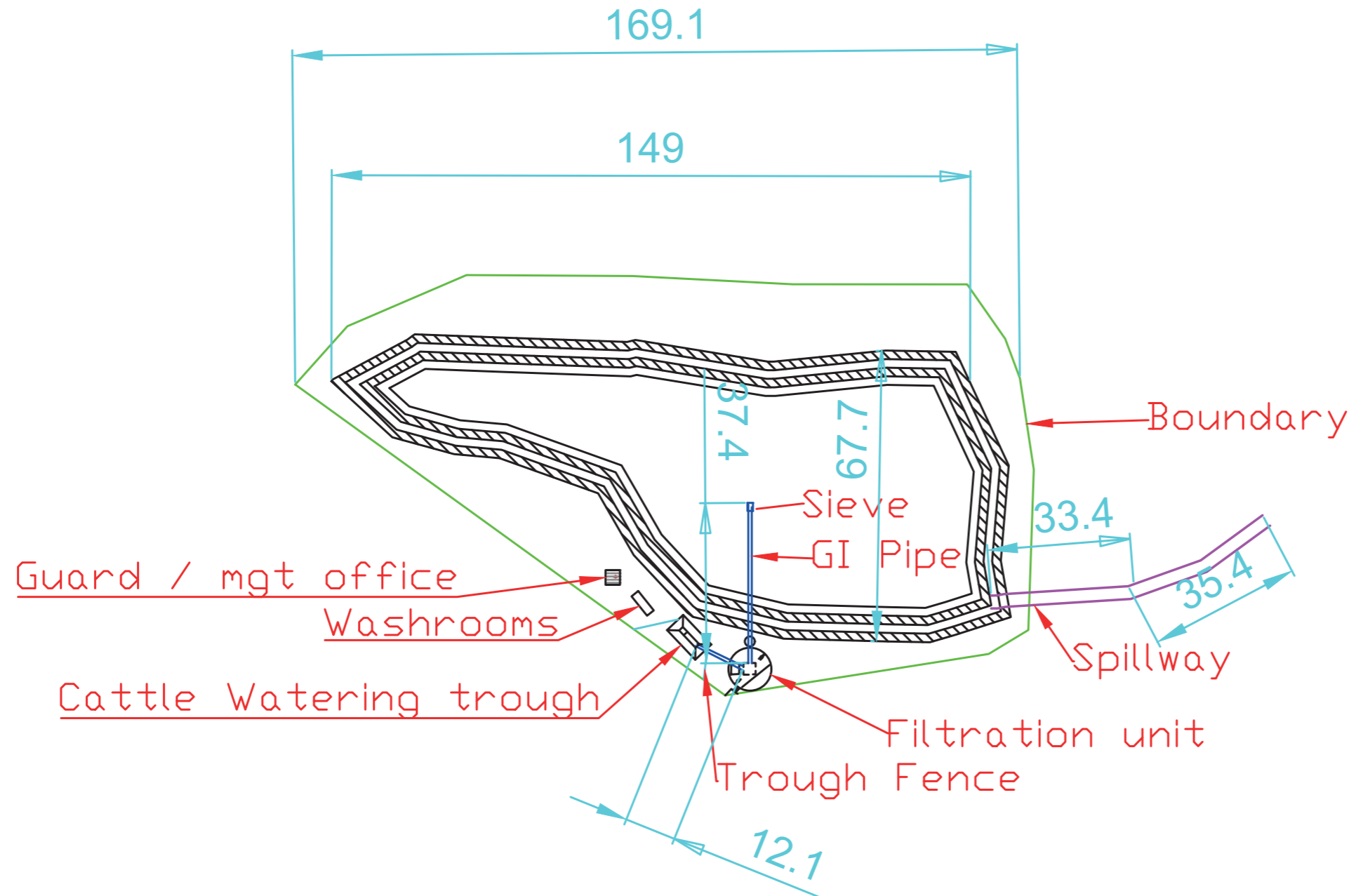
ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	12,065	3.00	36,195.00	353.52
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	8,059	350.00	2,820,510.00	27,548.35
2.3.	Using dozer or other suitable plant, excavate to depth between 3 - 6 m deep, allow slope and form 4 m high embankment. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	5,495	400.00	2,197,800.00	21,466.24
	Sub-Total Carried to Summary - Element 2				5,054,505.00	49,368.11
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	160,000.00	160,000.00	1,562.74
3.4.	Excavate soil to create Intake Channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 5 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for Berkad and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	5,000.00	5,000.00	48.84
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	4,500.00	4,500.00	43.95
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:-</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				1,017,400.00	9,937.10

4	Perimeter Fence & Guard house/shop					
4.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	600.0	600.00	360,000.00	3,516.17
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 4				680,000.00	6,641.66
5.0.	Storage with filtration system and accessories					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
5.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
5.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34
5.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
5.9.	Allow provision for fabrication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
5.10.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.36
5.11.	Allow for construction of a laudry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
5.12.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
	Sub-Total Carried to Summary - Element 5				1,258,400.00	12,290.98
6.0.	Cattle Trough Construction					
6.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53
6.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
6.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
6.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
6.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40
6.6.	Allow for construction a cattle trough 6 m long	Ls	1.0	200,000.00	200,000.00	1,953.43
	Sub-Total Carried to Summary - Element 4				808,400.00	7,895.76
7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	20,000.00	20,000.00	195.34
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 7				270,000.00	2,637.13

	GRAND SUMMARY			
	ELEMENT 1 - PRELIMINARIES			620,000.00
	ELEMENT 2 - EARTHWORKS			5,054,505.00
	ELEMENT 3 - AUXILIARY STRUCTURES			1,017,400.00
	ELEMENT 4 - PERIMETER FENCE AND GUARD HOUSE			680,000.00
	ELEMENT 5 - STORAGE AND FILTRATION CAPACITY			1,258,400.00
	ELEMENT 6 - CATTLE TROUGH CONSTRUCTION			808,400.00
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION			270,000.00
	ALL ELEMENTS TOTAL			9,708,705.00
	Allow of 5% for supervision			485,435.25
	Grand Total			10,194,140.25

6.09.4 Engineering Drawing for rehabilitation of Wachira Waheni water pan

Wachira Waheni Dam



Notes General

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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

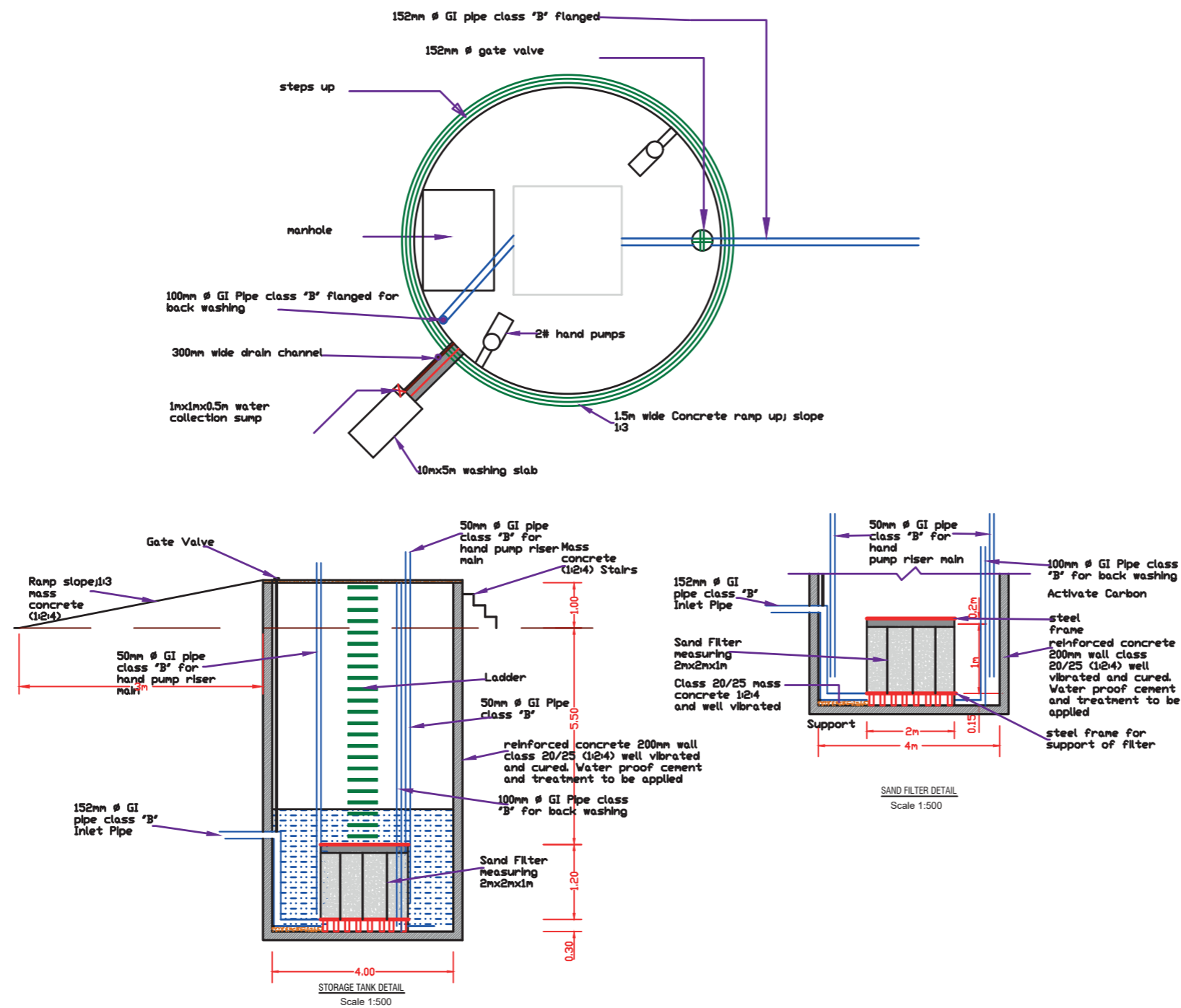
Checked : SN

Date : 23 sep 2018

Scale : 1: 1

Sheet
01

Well & Accessories



Notes General

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Client:



Project
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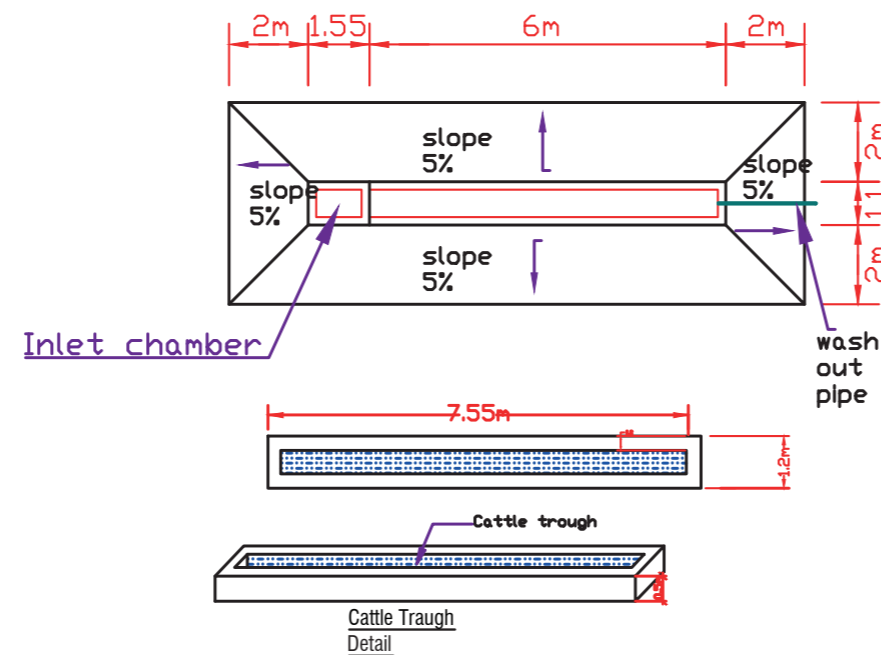
Drawing Title

Dam Layout

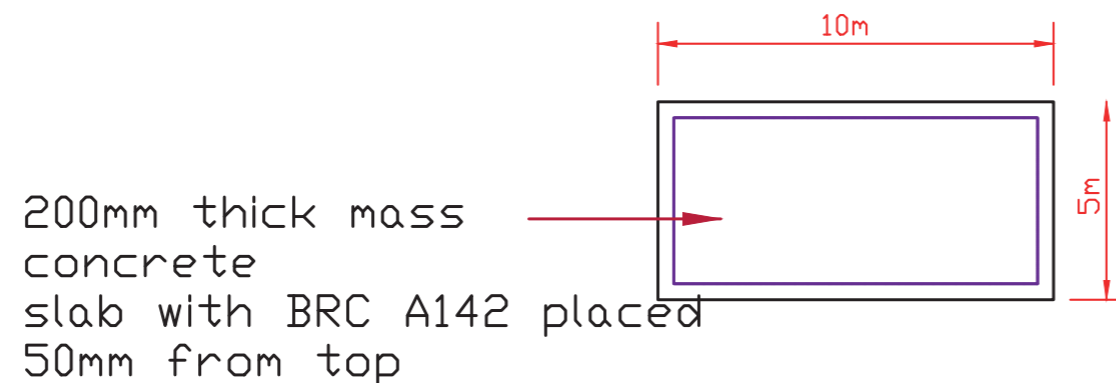
Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

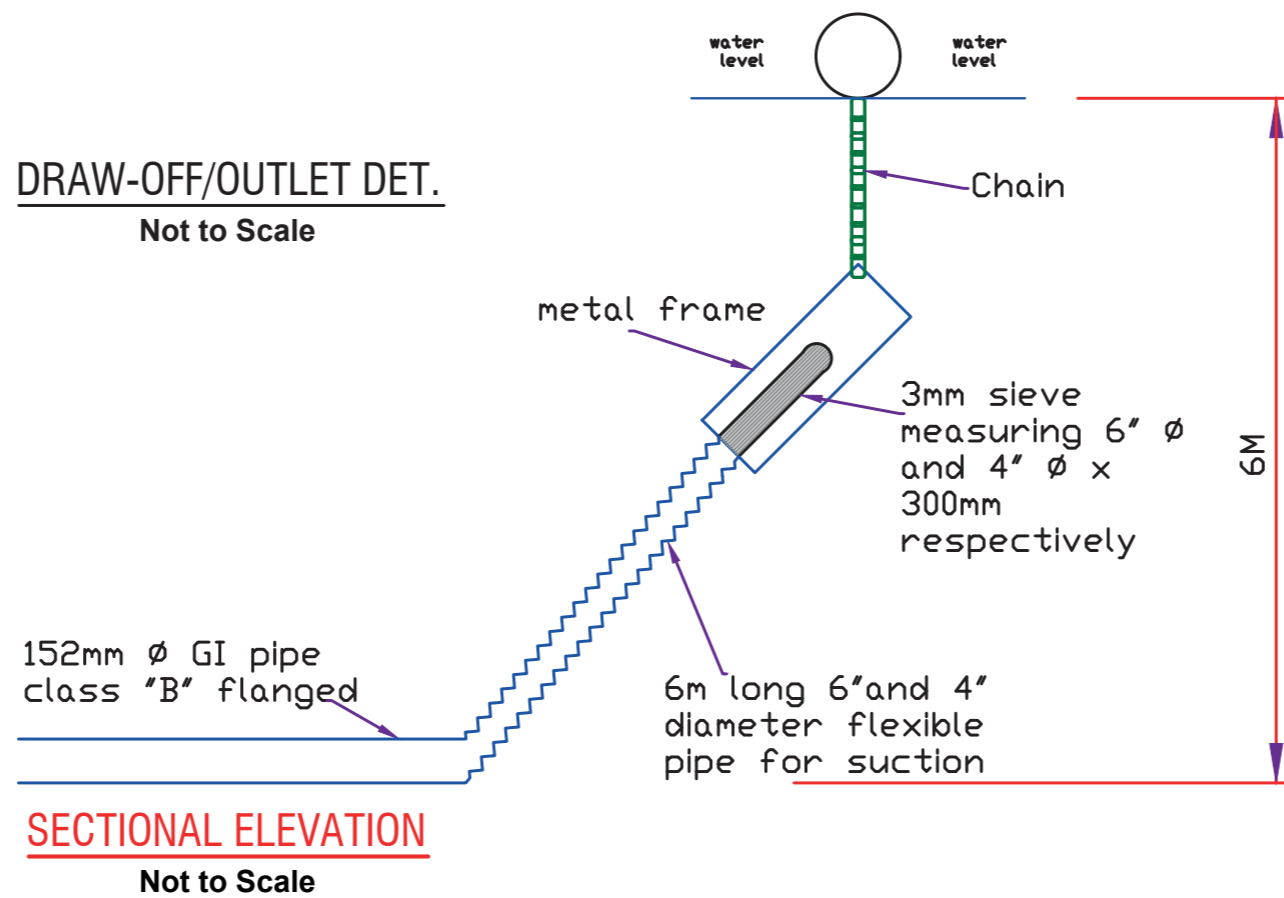
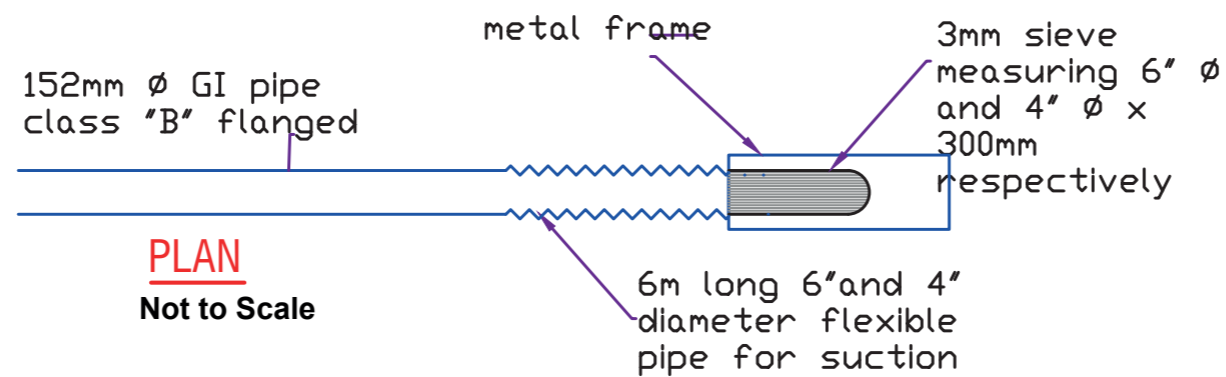
Date : 12 sep 2018

Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

- GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614 SuraJ Plaza, Linuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

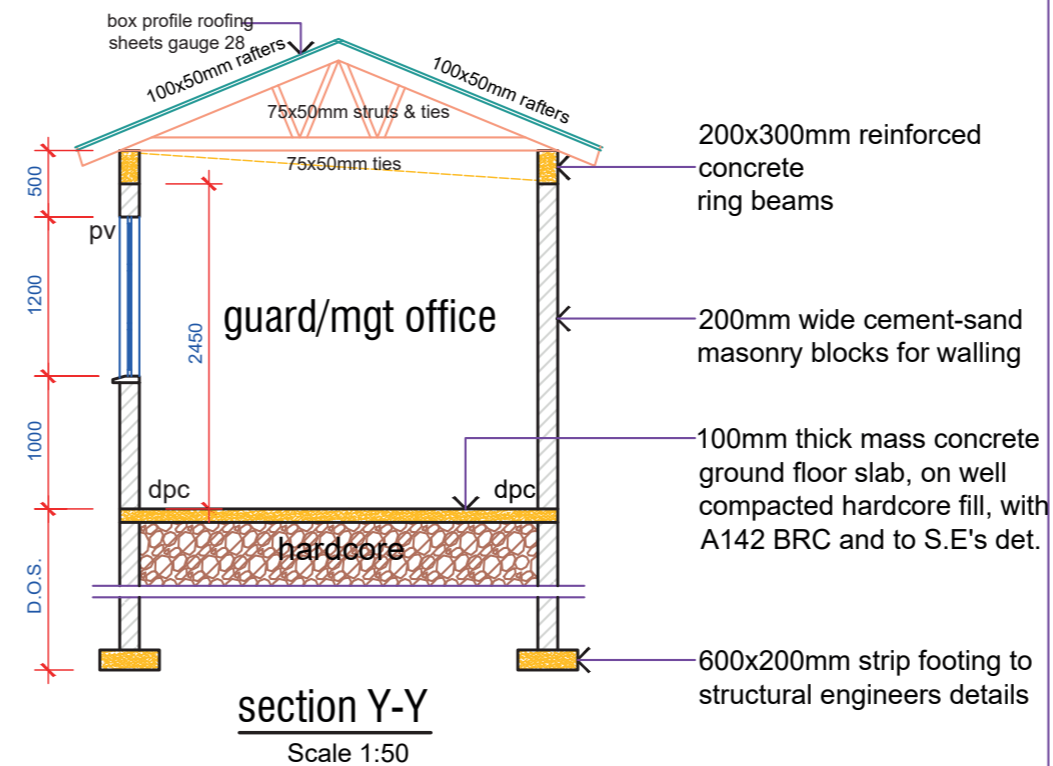
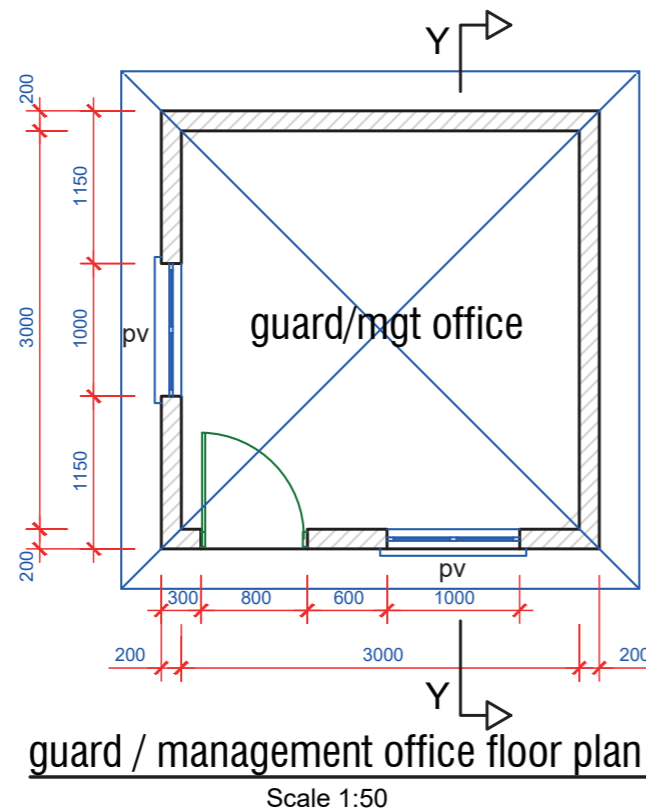
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.10 Description of Mbiru water pan in Kinangop Sub-County, Nyandarua County

Mbiru water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 4,114 m³. The water pan is currently used for small scale irrigation, watering livestock and domestic water supply. Despite its importance there is significant siltation and encroachment of water pan boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 3,000 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

6.10.1 Figures showing the characteristics of Mbiru water pan



Figure 34: Google image showing the location of Mbiru water and surrounding beneficiaries



Figure 35: A view of Mbiru water pan from the spillway

6.10.2 Beneficiaries of Mbiru water pan

500 Households with an average of 6 members.

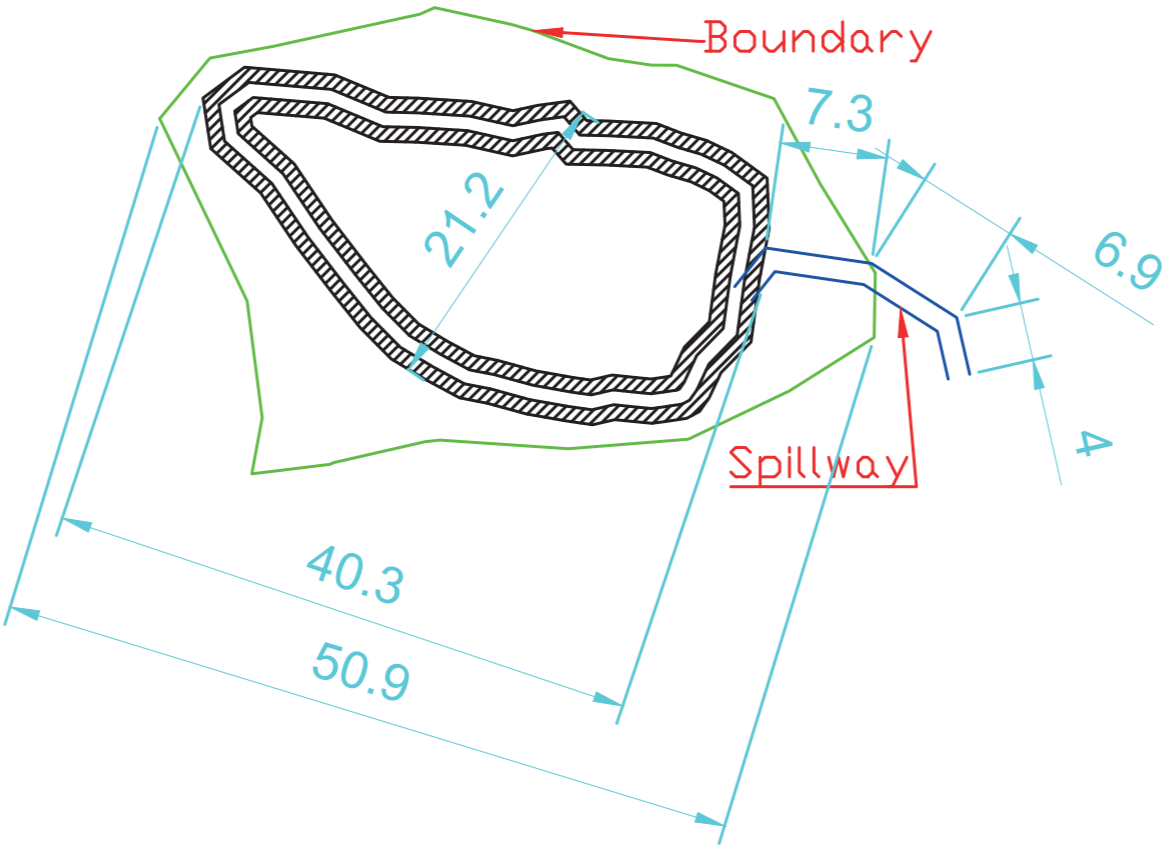
6.10.3 Bill of Quantities for rehabilitation of Mbiru water pan


REHABILITATION OF MBIRU DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1.0	150,000.00	150,000.00	1,465.07
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				470,000.00	4,590.56
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	4,600	3.00	13,800.00	134.79
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	1,110	350.00	388,325.00	3,792.83
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the	CM	1,395	400.00	557,920.00	5,449.29
	Sub-Total Carried to Summary - Element 2				960,045.00	9,376.90
3.0.	Perimeter Fence					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	143	600.00	85,800.00	838.02
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 3				105,800.00	1,033.36
4.0.	Environmental Conservation					
4.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
4.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
	Sub-Total Carried to Summary - Element 4				405,000.00	3,955.70
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				470,000.00	4,590.56
	ELEMENT 2 - EARTHWORKS				960,045.00	9,376.90
	ELEMENT 3 - PERIMETER FENCE				105,800.00	1,033.36
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				405,000.00	3,955.70
	ALL ELEMENTS TOTAL				1,940,845.00	18,956.53
	Allow of 5% for supervision				97,042.25	947.83
	Grand Total				2,037,887.25	19,904.35

6.10.4 Engineering Drawing for rehabilitation of Mbiru water pan

Mbiru dam



Notes General	
<p>1. All dimensions are in meters unless otherwise stated.</p> <p>2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.</p> <p>3. All indicated levels are finished floor levels unless otherwise noted.</p> <p>4. EL(=/-)0.00 corresponds to existing normal ground level.</p> <p>5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer</p> <p>6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.</p> <p>7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)</p> <p>8. The lapping length of bars will be 50 x bar diameter</p> <p>9. Trenches shall be dug to the invert levels, graded and compacted to approval</p> <p>10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones</p> <p>11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval</p>	
Abbreviations	
Consultant:	
<div><div>ASAL EnviroTech Consult LTD</div><div>Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke</div></div>	
Client:	
<div><div></div><div>nema</div></div>	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS	Sheet 01
Drawn : SN	
Checked : SN	
Date : 23 sep 2018	
Scale : 1: 1	

6.11 Description of Kahungura spring in Kinangop Sub-County, Nyandarua County

Kahungura spring is located in Kinangop Sub-county of Nyandarua County. The spring is a critical source of water for the surrounding community with 200 household depending on this spring for domestic water supply. Thus, it is recommended should be appropriately protected and fenced off to prevent any encroachment.

As a contribution to environmental conservation the beneficiaries will plant at least 1000 indigenous seedlings at the onset of the project and take of them till they are full established.

6.11.1 Figures showing the characteristics of Kahungura springs



Figure 36: Location of the Kahungura spring and the surrounding community



Figure 37: A view of Kahungura spring proposed for development



Figure 38: One the user of Kahungura spring giving information during fieldwork

6.11.2 Beneficiaries of Kahungura spring

200 Households with an average of 6 members.

6.11.3 Bill of Quantities for proposed rehabilitation works in Kahungura spring

PROTECTION OF KAHUNGURA SPRING IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	100,000.00	100,000.00	976.72
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1.0	100,000.00	100,000.00	976.72
1.3.	Allow for Security Costs	PS	1.0	50,000.00	50,000.00	488.36
	Sub-Total Carried to Summary - Element 1				250,000.00	2,441.79
2.0.	Earthworks & Masonry					
2.1.	Clear the spring site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	200	3.00	600.00	5.86
2.2.	Excavate the spring site appropriately, remove from site and dispose as directed by the Engineer	CM	500	350.00	175,000.00	1,709.25
2.3.	Provision of spring protection and construction of collection box	LS	1.0	600,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 2				775,600.00	7,575.40
3.0.	Perimeter Fence					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	100	600.00	60,000.00	586.03
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				70,000.00	683.70
5.0.	Environmental Conservation					
5.1.	Allow for planting of indigeneous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 4				250,000.00	2,441.79
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				250,000.00	2,441.79
	ELEMENT 2 - EARTHWORKS				775,600.00	7,575.40
	ELEMENT 3 - PERIMETER FENCE				70,000.00	683.70
	ELEMENT 5 - ENVIRONMENTAL CONSERVATION				250,000.00	2,441.79
	ALL ELEMENTS TOTAL				1,345,600.00	13,142.68
	Allow of 5% for supervision				67,280.00	657.13
	Grand Total				1,412,880.00	13,799.81

6.12 Description of Ebrahim Koikai water pan in Kinangop Sub-County, Nyandarua County

Ebrahim Koikai water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 40,538 m³. The water pan is currently used as alternative source of water for livestock and domestic water supply. Despite its importance there is significant siltation and encroachment of water pan boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,500 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

6.12.1 Figure showing the location of Ebrahim Koikai water pan



Figure 39: Google image showing the location of Ebrahim Koikai water pan and surrounding beneficiaries

6.12.2 Beneficiaries of Ebrahim Koikai Water pan

50 Households with an average of 6 members.

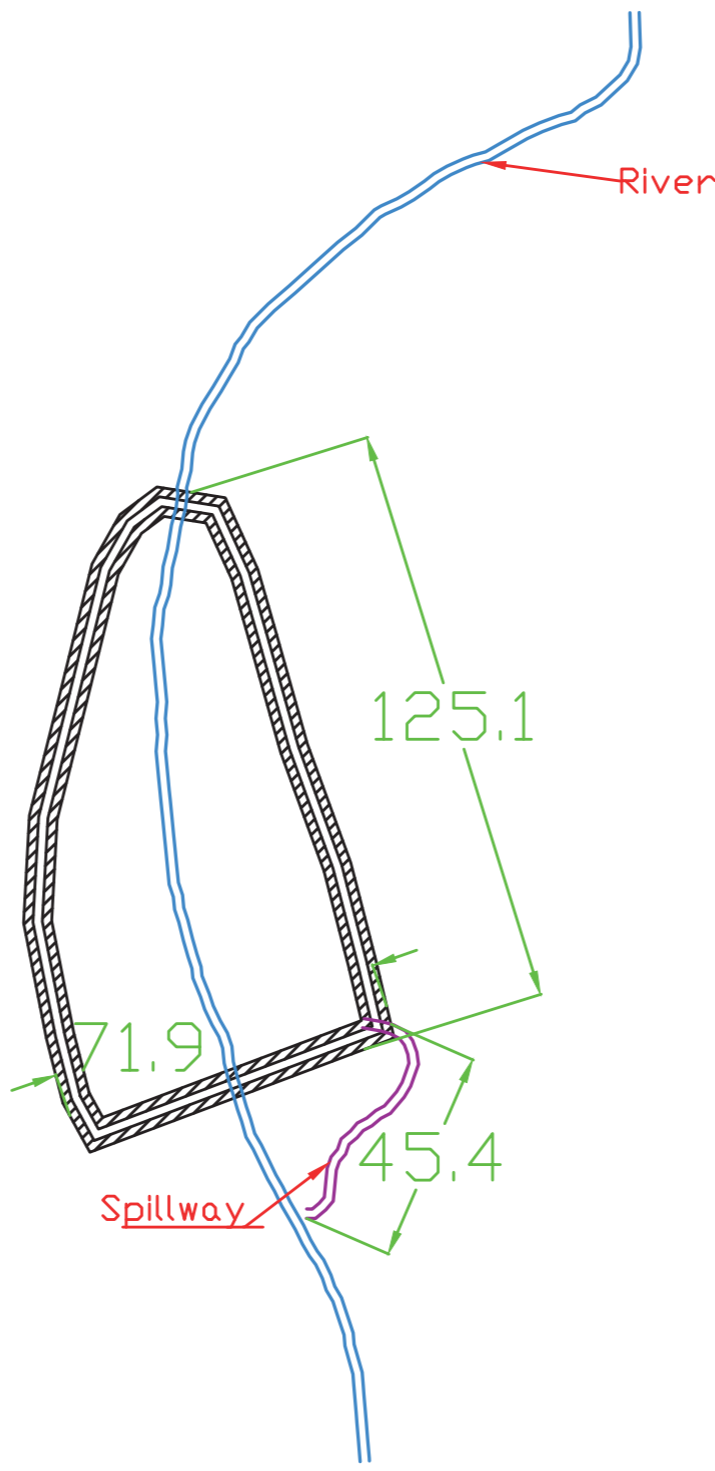
6.12.3 Bill of Quantities for the proposed rehabilitation work in Ebrahim Koikai water pan

REHABILITATION OF EBRAHIM KOKAI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1.0	150,000.00	150,000.00	1,465.07
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				470,000.00	4,590.56
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	13,543	3.00	40,629.00	396.83
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	11,039	350.00	3,863,580.00	37,736.17
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the	CM	16,098	400.00	6,439,300.00	62,893.62
	Sub-Total Carried to Summary - Element 2				10,343,509.00	101,026.62
3.0.	Perimeter Fence					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	511	600.00	306,600.00	2,994.61
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 3				326,600.00	3,189.95
4.0.	Environmental Conservation					
4.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
4.2.	Allow for planting of indigenous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
	Sub-Total Carried to Summary - Element 4				405,000.00	3,955.70
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				470,000.00	4,590.56
	ELEMENT 2 - EARTHWORKS				10,343,509.00	101,026.62
	ELEMENT 3 - PERIMETER FENCE				326,600.00	3,189.95
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				405,000.00	3,955.70
	ALL ELEMENTS TOTAL				11,545,109.00	112,762.82
	Allow of 5% for supervision				577,255.45	5,638.14
	Grand Total				12,122,364.45	118,400.97

6.12.4 Engineering Drawing for the proposed rehabilitation work in Ebrahim Koikai water pan

Ebrahim Koikai Dam



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1: 1

Sheet
01

6.13 Description of Kwa Musa water pan in Kinangop Sub-County, Nyandarua County

Kwa Musa water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 87,955 m³. The water pan is currently used for small scale irrigation, watering livestock and domestic water supply. Despite its importance there is significant siltation of the water pan and encroachment of its boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation of the water pan will involve demarcating the official boundary of the water and fencing it off to reduce encroachment. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet. A water filtration system with a flexible draw-off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm depth below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock. In addition, shaded slabs for washing the carrots will be constructed.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,500 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

6.13.1 Figures showing the characteristics of Kwa Musa Water pan



Figure 40: Google image showing the location of the Kwa Musa water and surrounding beneficiaries



Figure 41: A view of Kwa Musa water pan



Figure 42: Charcoal burning in the riparian zone of Kwa Musa water pan

6.13.2 Beneficiaries of Kwa Musa Water pan

300 Households with an average of 6 members.

6.13.3 Bill of Quantities for the proposed rehabilitation work in Kwa Musa water pan

REHABILITATION OF KARANJA WANAINA DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

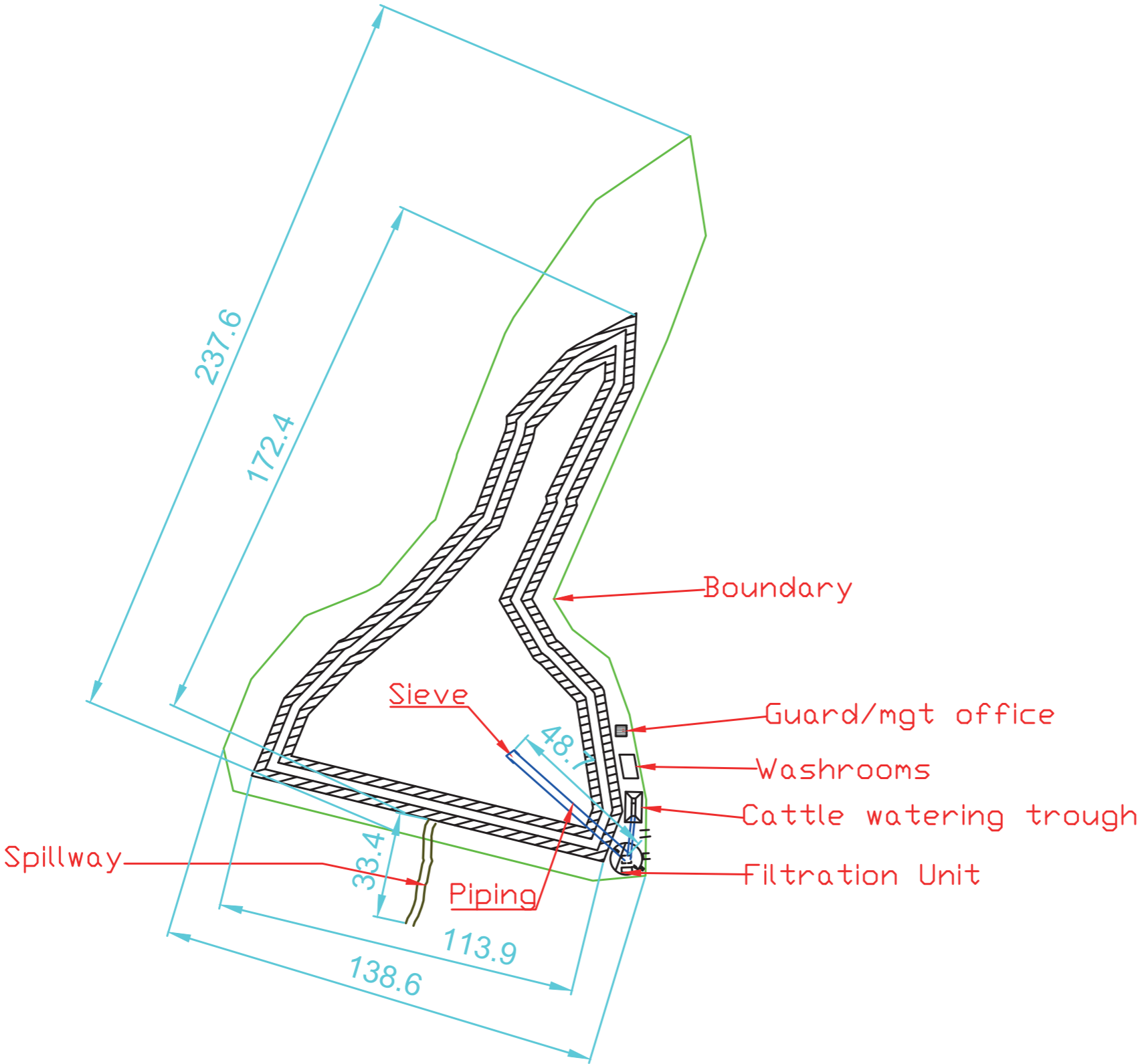
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				620,000.00	6,055.63
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	21,782	350.00	7,623,588.00	74,460.74
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	5,445	400.00	2,178,168.00	21,274.50
	Sub-Total Carried to Summary - Element 2				9,951,756.00	97,200.30
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	600.00	600.00	5.86
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for Berkad and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72



3.14	On Cattle line supply line, excavate from reduced level upto to a depth of 2.5 m and cart away as directed by Engineer	CM	11.0		-	-
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:-</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	100.00	3,300.00	32.23
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
Sub-Total Carried to Summary - Element 3					846,150.00	8,264.47
4	<u>Perimeter Fence, Guard house/shop and carrots washing slabs</u>					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,200.0	600.00	720,000.00	7,032.35
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	150,000.00	150,000.00	1,465.07
4.4	Construct Slaps for Washing Carrots.	LS	1.0	600,000.00	600,000.00	5,860.29
Sub-Total Carried to Summary - Element 4					1,490,000.00	14,553.06
5.0.	<u>Storage with filtration system and accessories</u>					
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:-</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
5.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
5.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34
5.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
5.10.	Allow provision for farbication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
5.11.	Allow for installation of Mark II handpump	NO	1.0	25,000.00	25,000.00	244.18
5.15.	Allow for construction of a laundry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
5.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
Sub-Total Carried to Summary - Element 2					1,233,400.00	12,046.80

6.0.	Cattle Trough Construction					
6.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53
6.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
6.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:</u>					
6.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
6.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40
6.9	Allow a Provisional Sum for Mark II handpumps	No	1	35,000.00	35,000.00	341.85
6.10.	Allow for construction a cattle trough 10 m long	Ls	1.0	200,000.00	200,000.00	1,953.43
	Sub-Total Carried to Summary - Element 3				843,400.00	8,237.62
7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
	Sub-Total Carried to Summary - Element 7				405,000.00	3,955.70
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				620,000.00	6,055.63
	ELEMENT 2 - EARTHWORKS				9,951,756.00	97,200.30
	ELEMENT 3 - AUXILIARY STRUCTURES				846,150.00	8,264.47
	ELEMENT 4 - PERIMETER FENCE				1,490,000.00	14,553.06
	ELEMENT 5 - EARTHWORKS				1,233,400.00	12,046.80
	ELEMENT 6 - AUXILIARY STRUCTURES				843,400.00	8,237.62
	ELEMENT 7 - PERIMETER FENCE				405,000.00	3,955.70
	ALL ELEMENTS TOTAL				15,389,706.00	150,313.58
	Allow of 5% for supervision				769,485.30	7,515.68
	Grand Total				16,159,191.30	157,829.26

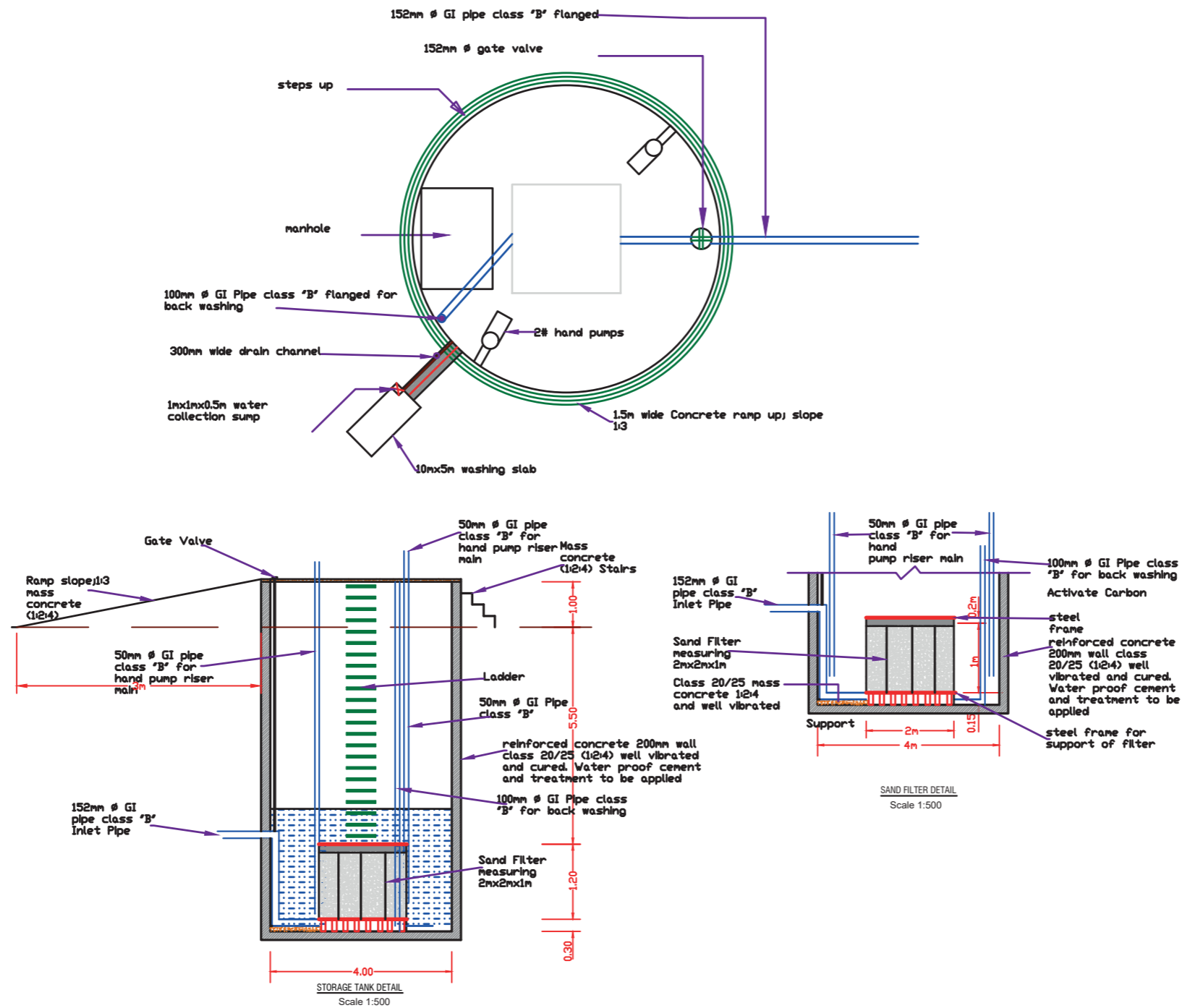
6.13.4 Engineering Drawing for the proposed rehabilitation work in Kwa Musa water pan

Musa Dam



Notes General	
<p>1. All dimensions are in meters unless otherwise stated.</p> <p>2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.</p> <p>3. All indicated levels are finished floor levels unless otherwise noted.</p> <p>4. EL(=/-)0.00 corresponds to existing normal ground level.</p> <p>5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.</p> <p>6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.</p> <p>7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)</p> <p>8. The lapping length of bars will be 50 x bar diameter</p> <p>9. Trenches shall be dug to the invert levels, graded and compacted to approval</p> <p>10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones</p> <p>11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval</p>	
Abbreviations	
Consultant:	
<div><p>Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke</p></div>	
Client:	
<div><p>nema</p></div>	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS	Sheet 01
Drawn : SN	
Checked : SN	
Date : 23 sep 2018	
Scale : 1: 1	

Well & Accessories



Notes General

- All dimensions are in meters unless otherwise stated.
- All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
- All indicated levels are finished floor levels unless otherwise noted.
- EL(=/-)0.00 corresponds to existing normal ground level.
- In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
- Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.
- Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
- The lapping length of bars will be 50 x bar diameter
- Trenches shall be dug to the invert levels, graded and compacted to approval
- Open channels shall be excavated bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 SuraJ Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

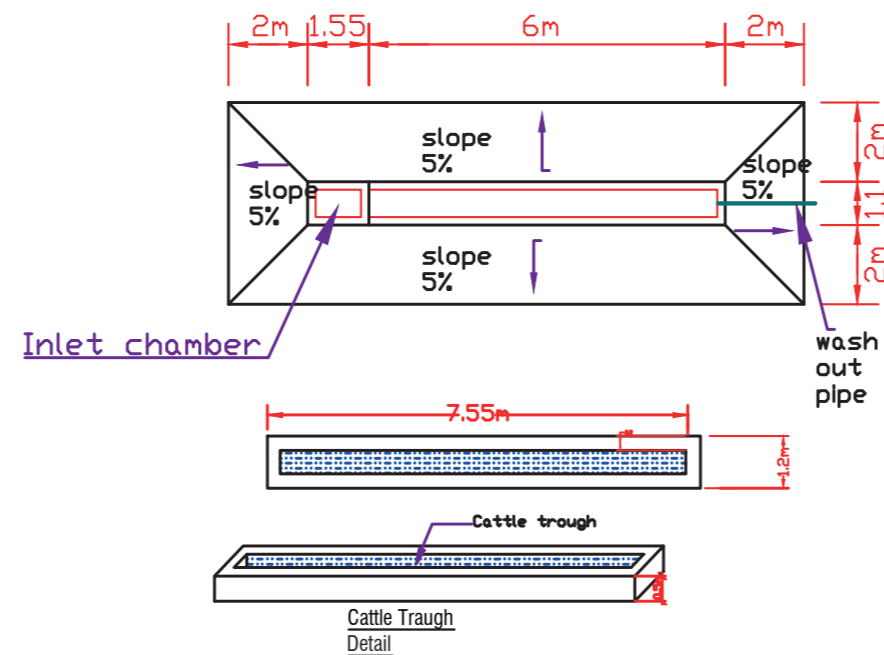
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Date : 12 sep 2018

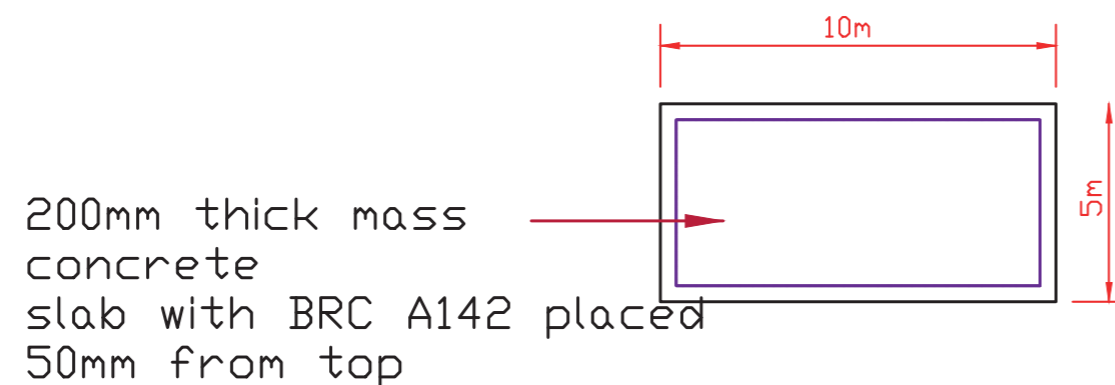
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Sheet



02



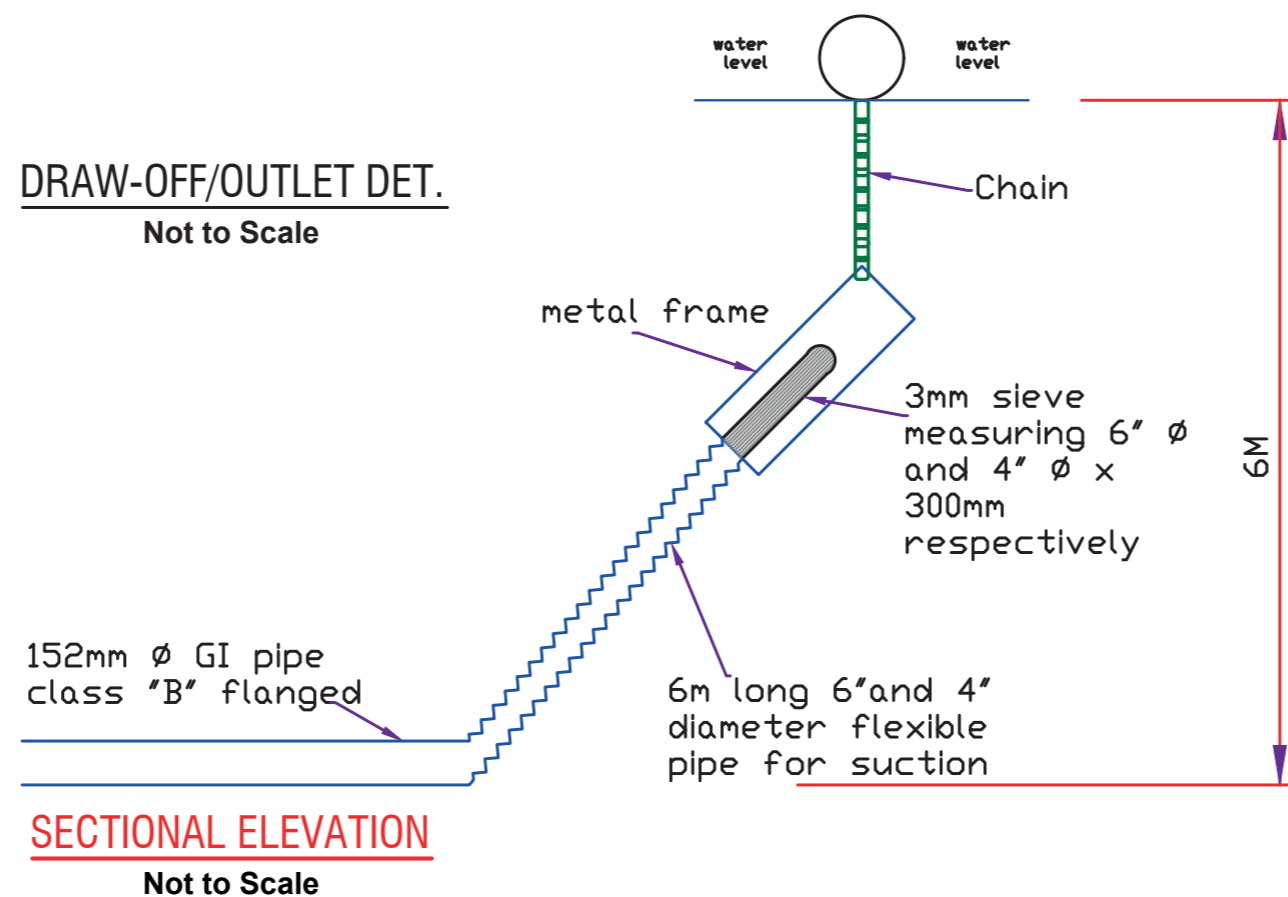
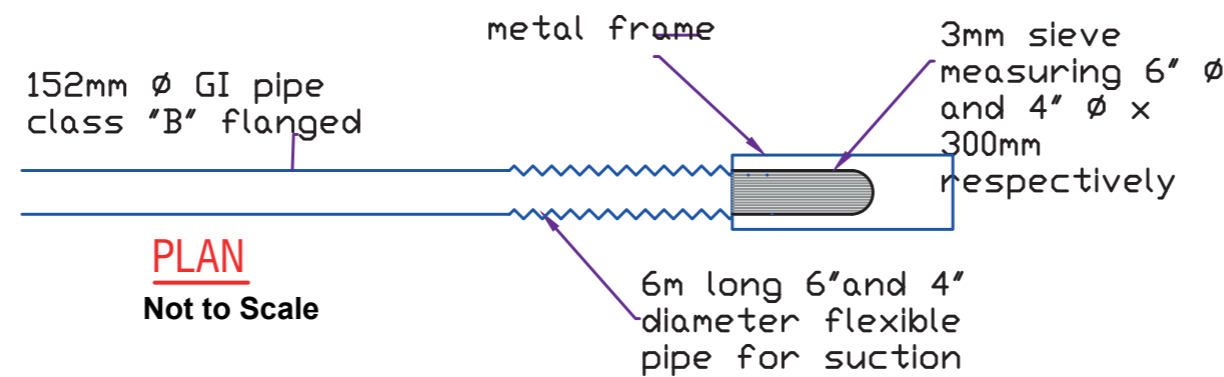
CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General	
<ol style="list-style-type: none"> All dimensions are in meters unless otherwise stated. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works. All indicated levels are finished floor levels unless otherwise noted. EL(=/-)0.00 corresponds to existing normal ground level. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm) The lapping length of bars will be 50 x bar diameter Trenches shall be dug to the invert levels, graded and compacted to approval Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval 	
Abbreviations	
GL = Ground Level IC = Inspection Chamber	
Consultant:	
	
Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Sura J Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke	
Client:	
	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS Drawn : SN Checked : JS Date : 12 sep 2018 Scale : as shown	Sheet 03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

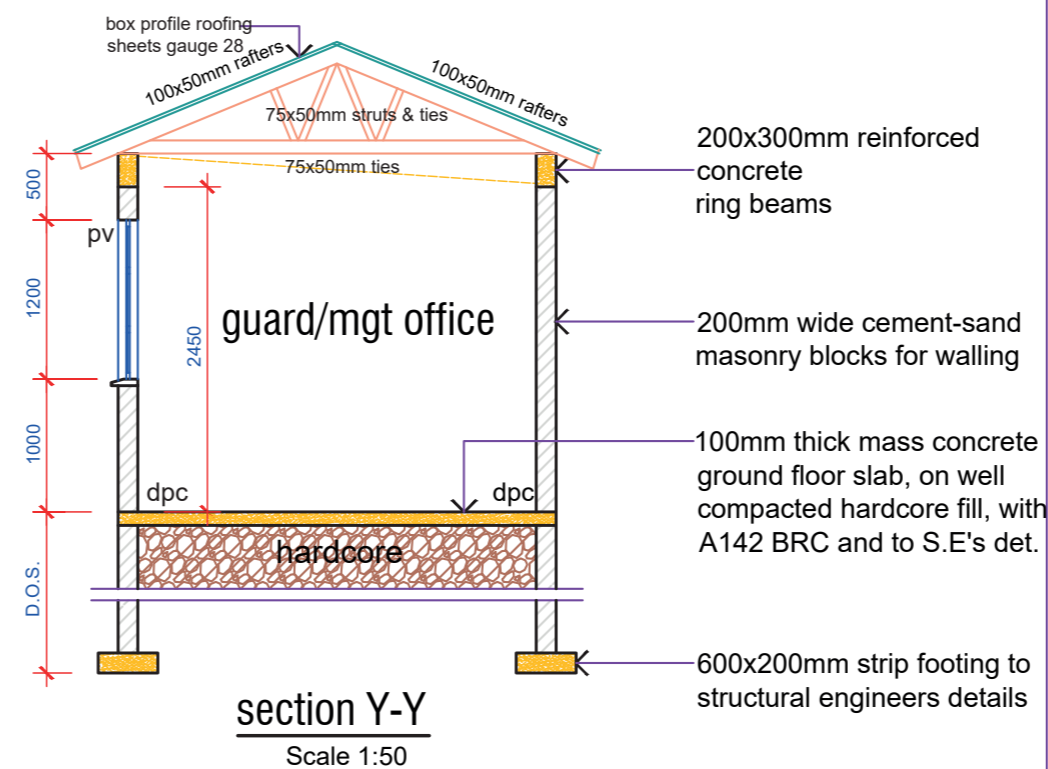
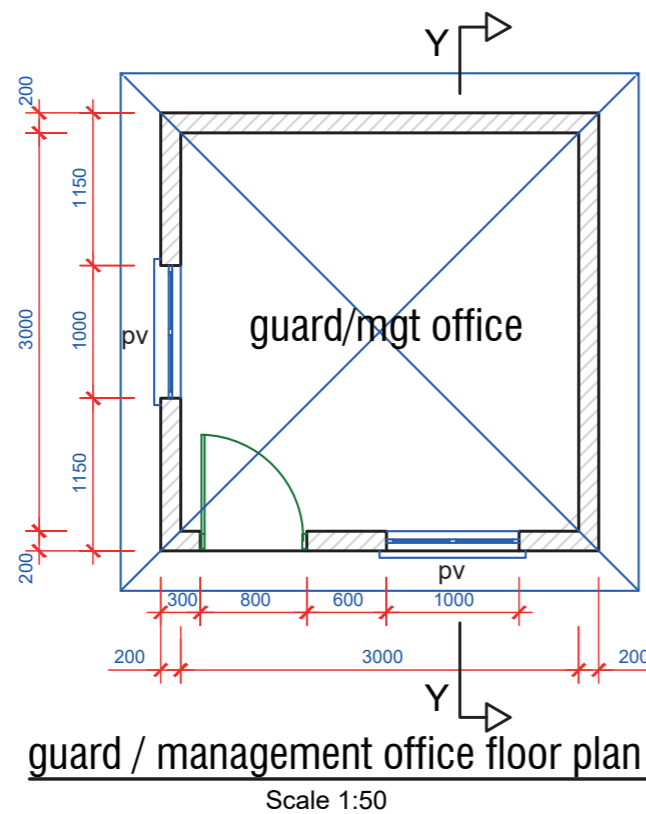
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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Nairobi, Kenya.
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www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.14 Description of Gachuchu spring in Kinangop Sub-County, Nyandarua County

Gachuchu spring is located in Kinangop Sub-county of Nyandarua County. The spring is a potential source of water to augment water supply to Sasumua village. Given its potential the spring was recommended for rehabilitation. The existing embankment should be restored and the area fenced off. The water should then be piped (approximately 1000 m) to existing Sasumua water supply system.

As a contribution to environmental conservation the beneficiaries will plant at least 500 indigenous seedlings at the onset of the project and take care of them till they are fully established. The community water supply committee who charges a fee for water use will be responsible for day-to-day maintenance of the system. The beneficiary households will be responsible for sanitation issues at household levels.

6.14.1 Figures showing the characteristics of Gachuchu springs



Figure 43: Google image showing the location of the Gachuchu spring and surroundings beneficiaries



Figure 44: A view of Gachuchu spring



Figure 45: Debilitate part of the structure in Gachuchu spring

6.14.2 Beneficiaries of Gachuchu spring

5000 Households with an average of 6 members.

6.14.3 Bill of Quantities for proposed rehabilitation work in Gachuchu spring

PROTECTION OF GACHUCHU SPRING IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	100,000.00	100,000.00	976.72
1.2.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
1.3.	Allow for Security Costs	PS	1.0	80,000.00	80,000.00	781.37
	Sub-Total Carried to Summary - Element 1				330,000.00	3,223.16
2.0. Earthworks & Masonry						
2.1.	Clear the spring site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	200	3.00	600.00	5.86
2.2.	Excavate the spring site appropriately, remove from site and dispose as directed by the Engineer	CM	500	350.00	175,000.00	1,709.25
2.3.	Provision of rehabilitation of weir and collection box	LS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 2				675,600.00	6,598.69
3.0. Perimeter Fence						
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	200	600.00	120,000.00	1,172.06
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				130,000.00	1,269.73
4.0. Pipework						
4.2.	Bush clearing	LM	800	50.00	40,000.00	390.69
4.2.	Excavation of channel for laying pipes	LM	800.0	350.00	280,000.00	2,734.80
4.3.	PE100 HDPE PN16, DN90	LM	1,000.0	1,200.00	1,200,000.00	11,720.58
	Sub-Total Carried to Summary - Element 4				1,520,000.00	14,846.07
5.0. Environmental Conservation						
5.1.	Allow for planting of indigeneous trees upstream and downstream of the spring	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 5				125,000.00	1,220.89
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				330,000.00	3,223.16
	ELEMENT 2 - EARTHWORKS				675,600.00	6,598.69
	ELEMENT 3 - PERIMETER FENCE				130,000.00	1,269.73
	ELEMENT 4 - PIPEWORK				1,520,000.00	14,846.07
	ELEMENT 5 - ENVIRONMENTAL CONSERVATION				125,000.00	1,220.89
	ALL ELEMENTS TOTAL				2,780,600.00	27,158.54
	Allow of 5% for supervision				139,030.00	1,357.93
	Grand Total				2,919,630.00	28,516.47

6.15 Description of Warunguna water in Kinangop Sub-County, Nyandarua County

Warunguna water pan is located in Kinangop sub-county of Nyandarua County. The volume of the water pan was estimated at 120,874 m³. The water pan is currently used for small scale irrigation, watering livestock and sometimes used domestic water supply. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be desilted to remove deposit silt and thus increase its current volume. Desilting will be done towards the end of the dry season in preparation for the long rains, when the water pan can be filled up again. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. A water filtration system with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. Two hand pumps for domestic water supply and a cattle trough for watering livestock.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings in the immediate surroundings and its upstream and downstream riparian zone. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house

will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

6.15.1 Figures showing the characteristics of the Warunguna water pan



Figure 46: Google image showing the location of the water pan and its surroundings



Figure 47: A view of Warunguna water pan



Figure 48: A silted part of the Warunguna water pan

6.15.2 Beneficiaries for Warungana water pan

600 Households with an average of 6 members.

6.15.3 Bill of Quantities for proposed rehabilitation work in Warunguna water pan

REHABILITATION OF WARUNGUNA WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

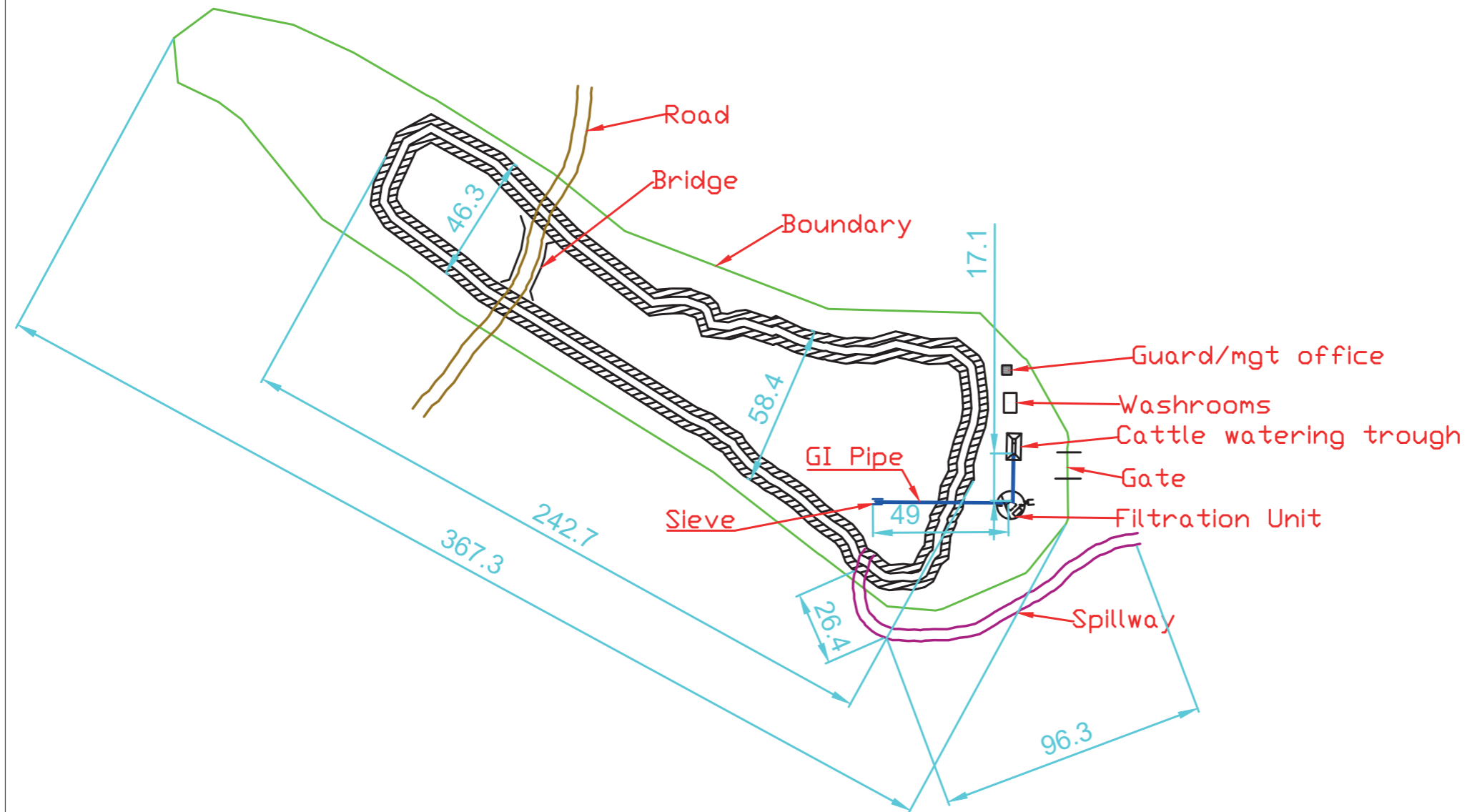
ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	22,869	3.00	68,607.00	670.09
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	25,613	350.00	8,964,648.00	87,559.07
2.3.	Using dozer or other suitable plant, excavate to depth between 3 - 6 m deep, allow slope and form 4 m high embankment. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	17,152	400.00	6,860,700.00	67,009.49
Sub-Total Carried to Summary - Element 2					15,893,955.00	155,238.66
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	260,000.00	260,000.00	2,539.46
3.4.	Excavate soil to create Intake Channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipe 50 m long x 0.6m wide and 2.5m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.9.	Cut trench for cattle trough draw-off pipe 25 m long x 0.6 m wide and 4.0 m average depth	CM	180.0	200.00	36,000.00	351.62
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering draw off and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
3.14	On Cattle line supply line, excavate from reduced level upto to a depth of 3.5 m and cart away as directed by Engineer	CM	11.0	200.00	2,200.00	21.49
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	100.00	3,300.00	32.23
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
Sub-Total Carried to Summary - Element 3					1,143,750.00	11,171.18



4 Perimeter Fence, Guard house/shop and carrots washing slabs						
4.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,200.0	600.00	720,000.00	7,032.35
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	300,000.00	300,000.00	2,930.15
4.4	Construct Slaps for Washing Carrots.	LS	1.0	600,000.00	600,000.00	5,860.29
Sub-Total Carried to Summary - Element 4				1,640,000.00	16,018.13	
5.0. Storage with filtration system and accessories						
5.1.	Excavate 300 mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4.0	500.00	2,000.00	19.53
5.2.	Excavate from reduced level upto to a depth of 6.7 m and cart away as directed by Engineer	CM	80.0	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
5.3.	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	3.0	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:-</u>					
5.4.	Sides of 200 mm thick Reinforced Concrete walls	SM	194.0	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
5.5.	Reinforced Concrete 200 mm thick walls	CM	23.0	25,000.00	575,000.00	5,616.11
2.6.	Supply and install 4" Ø GI pipes class "B" for backwashing as described in provided technical drawings including all unions and fittings	NO	2.0	2,500.00	5,000.00	48.84
2.7.	Allow a Provisional Sum for fabrication and fixing of a cat ladder on sides of the well	LS	1.0	20,000.00	20,000.00	195.34
2.8.	Allow a Provisional Sum for Sand Filter medium/unit	LS	1.0	100,000.00	100,000.00	976.72
2.10.	Allow provision for farbication of 1 m by 1 m steel frame support as shown in the technical drawing	NO	8.0	40,000.00	320,000.00	3,125.49
2.11.	Allow for installation of Mark II handpump	NO	2.0	25,000.00	50,000.00	488.36
2.12.	Allow for construction of a laudry slab with a 1 m by 1 m by 0.5 m sump as shown in the technical drawing	LS	1.0	15,000.00	15,000.00	146.51
2.13.	Supply 9 HP centrifugal sludge pump with 4" Ø suction pipe with coupling to outlet GI described in 4.6 and delivery pipes back to empty back in to the pan	LS	1.0	40,000.00	40,000.00	390.69
Sub-Total Carried to Summary - Element 2				1,258,400.00	12,290.98	
3.0. Cattle Trough Construction						
4.1	Excavate 300mm top soil from the water pump well and dispose from site as directed by Engineer	CM	4	500.00	2,000.00	19.53
4.2	Excavate from reduced level upto to a depth of 7 m and cart away spoil as directed by Engineer	CM	80	650.00	52,000.00	507.89
	<u>Mass concrete as described in:-</u>					
4.3	200mm thick mass concrete floor slab with BRC mesh No. A142	CM	3	20,000.00	60,000.00	586.03
	<u>Sawn formwork to:-</u>					
4.4	Sides of 200mm thick Reinforced Concrete walls	SM	194	100.00	19,400.00	189.48
	<u>Vibrated reinforced concrete as described in:-</u>					
4.5	Reinforced Concrete 200mm thick walls	CM	19	25,000.00	475,000.00	4,639.40
4.9	Allow a Provisional Sum for Mark II handpumps	No	1	30,000.00	30,000.00	293.01
3.6.	Allow for construction a cattle trough 10 m long	Ls	1.0	200,000.00	200,000.00	1,953.43
Sub-Total Carried to Summary - Element 3				838,400.00	8,188.78	

7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	40,000.00	40,000.00	390.69
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 7				290,000.00	2,832.47
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				120,000.00	1,172.06
	ELEMENT 2 - EARTHWORKS				15,893,955.00	155,238.66
	ELEMENT 3 - AUXILIARY STRUCTURES				1,143,750.00	11,171.18
	ELEMENT 4 - PERIMETER FENCE				1,640,000.00	16,018.13
	ELEMENT 5 - EARTHWORKS				1,258,400.00	12,290.98
	ELEMENT 6 - AUXILIARY STRUCTURES				838,400.00	8,188.78
	ELEMENT 7 - PERIMETER FENCE				290,000.00	2,832.47
	ALL ELEMENTS TOTAL				21,184,505.00	206,912.26
	Allow of 5% for supervision				1,059,225.25	10,345.61
	Grand Total				22,243,730.25	217,257.87

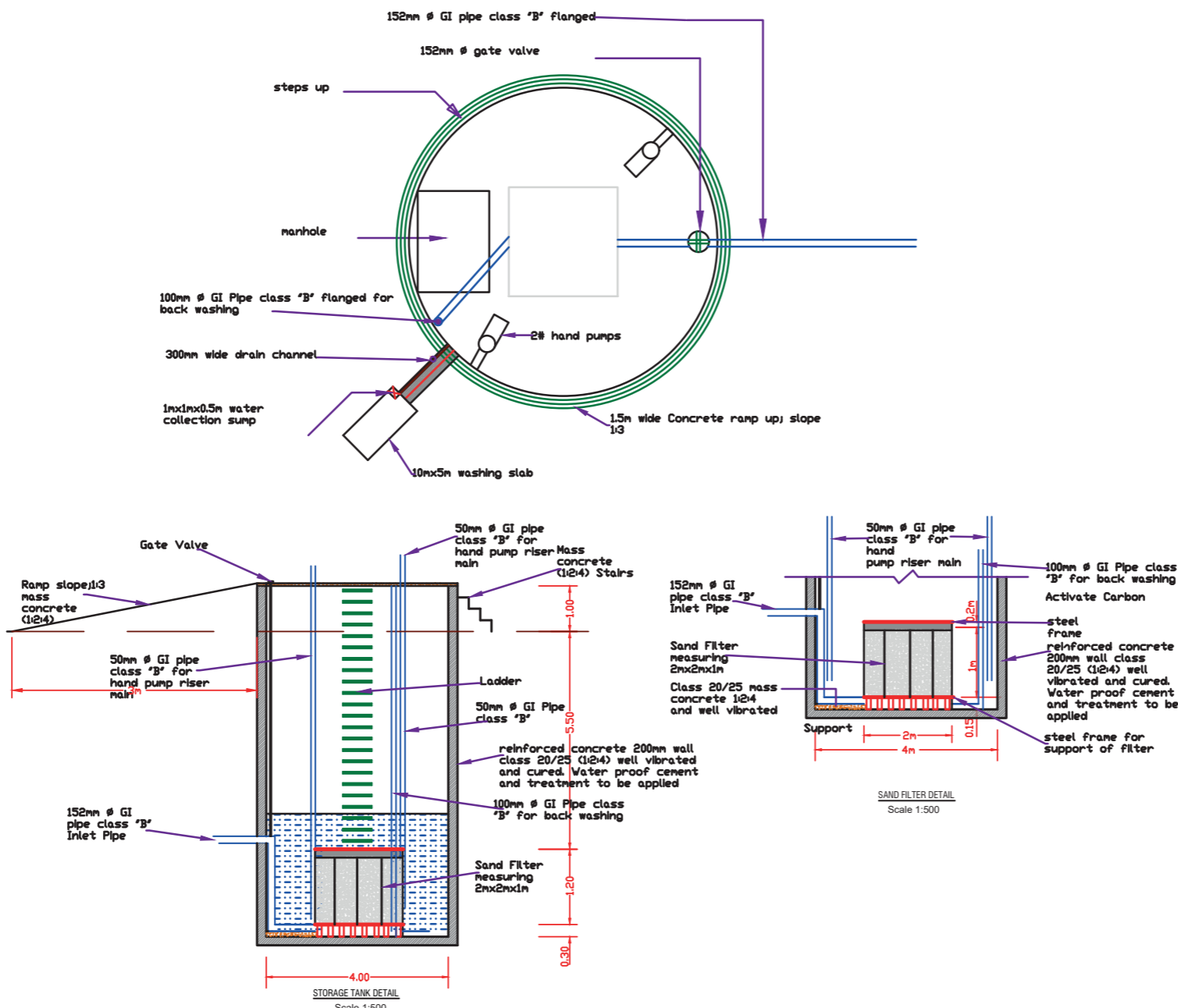
6.15.4 Engineering Drawing for proposed rehabilitation work in Warunguna water pan

Warungana Dam



Notes General	
1. All dimensions are in meters unless otherwise stated.	
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.	
3. All indicated levels are finished floor levels unless otherwise noted.	
4. EL(=/-)0.00 corresponds to existing normal ground level.	
5. In the event that any of the notes given in this drawing are in conflict with the requirements of technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.	
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.	
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)	
8. The lapping length of bars will be 50 x bar diameter	
9. Trenches shall be dug to the invert levels, graded and compacted to approval	
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones	
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval	
Abbreviations	
GL = Ground Level	
IC = Inspection Chamber	
Consultant:	
 ASAL EnviroTech Consult LTD Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Sura J Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke	
Client:	
 nema	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS	Sheet
Drawn : SN	01
Checked : SN	
Date : 23 sep 2018	
Scale : 1 : 1	

Well & Accessories



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

- GL = Ground Level
- IC = Inspection Chamber

Consultant:

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Client:



Project

Rehabilitation of water structures in Nyandarua county

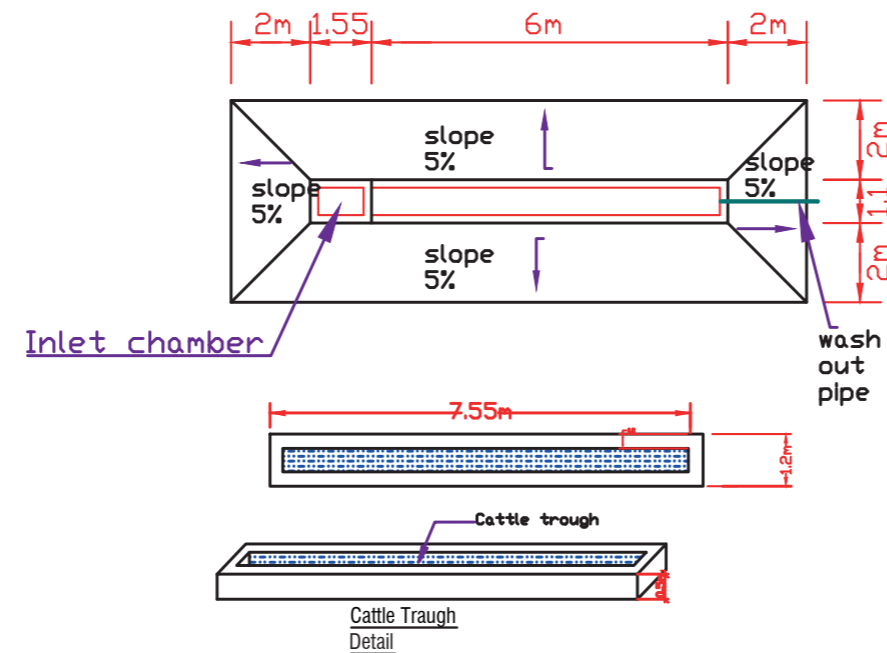
Drawing Title

Dam Layout

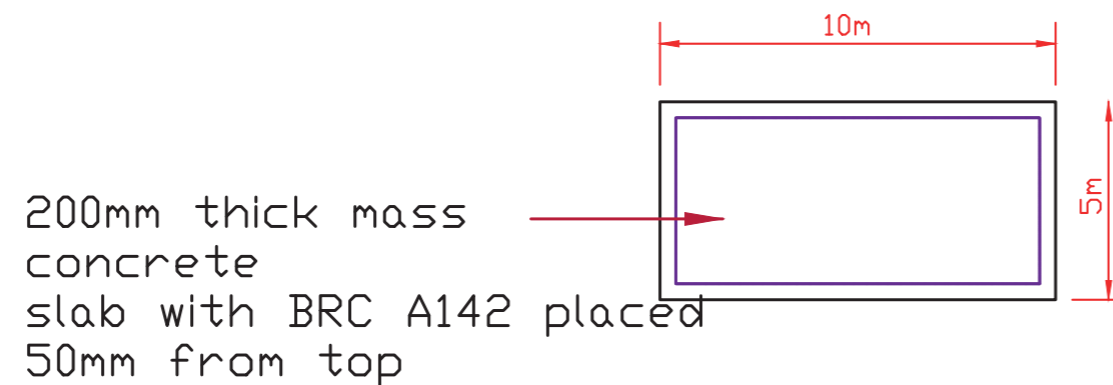
Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

02



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the solid works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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Nairobi, Kenya.
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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

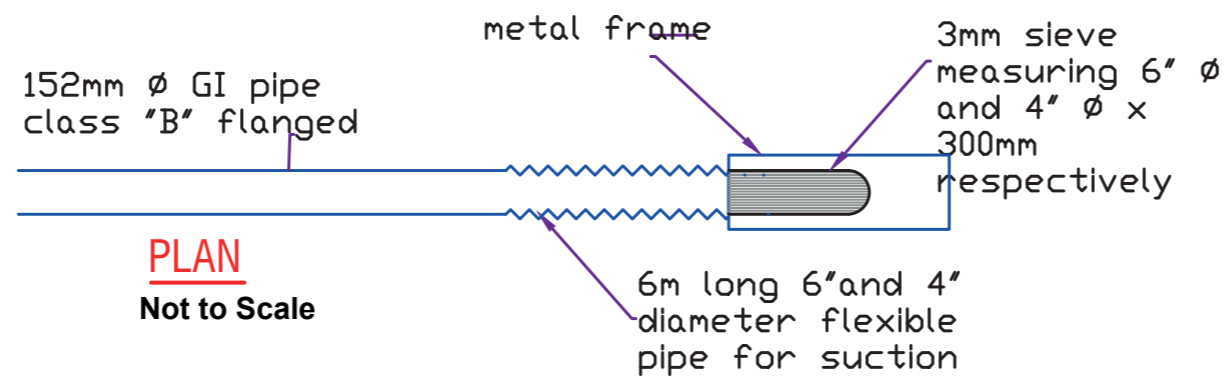
Date : 12 sep 2018

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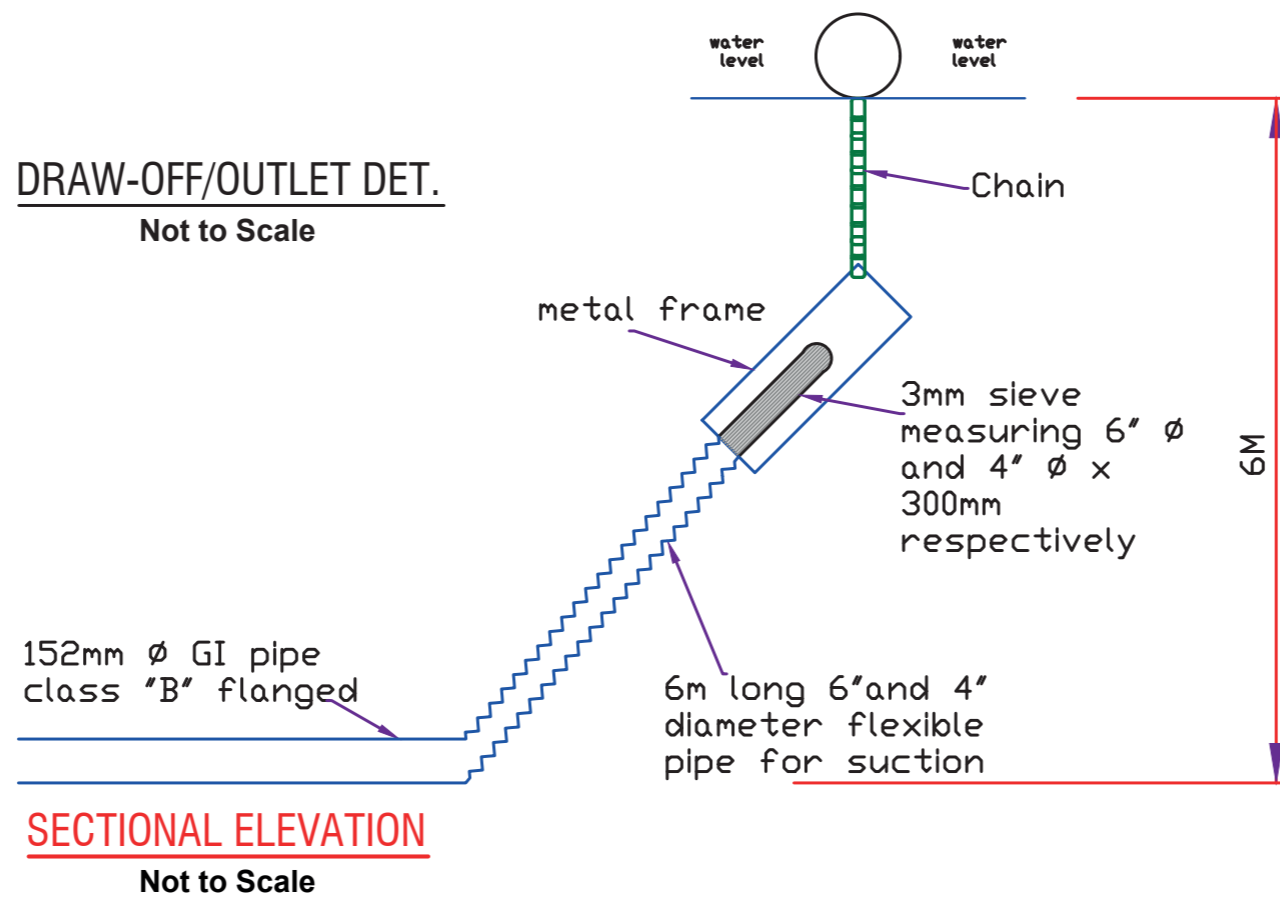
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03

DRAW-OFF/OUTLET



DRAW-OFF/OUTLET DET.
Not to Scale



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

- GL = Ground Level
IC = Inspection Chamber

Consultant:



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Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

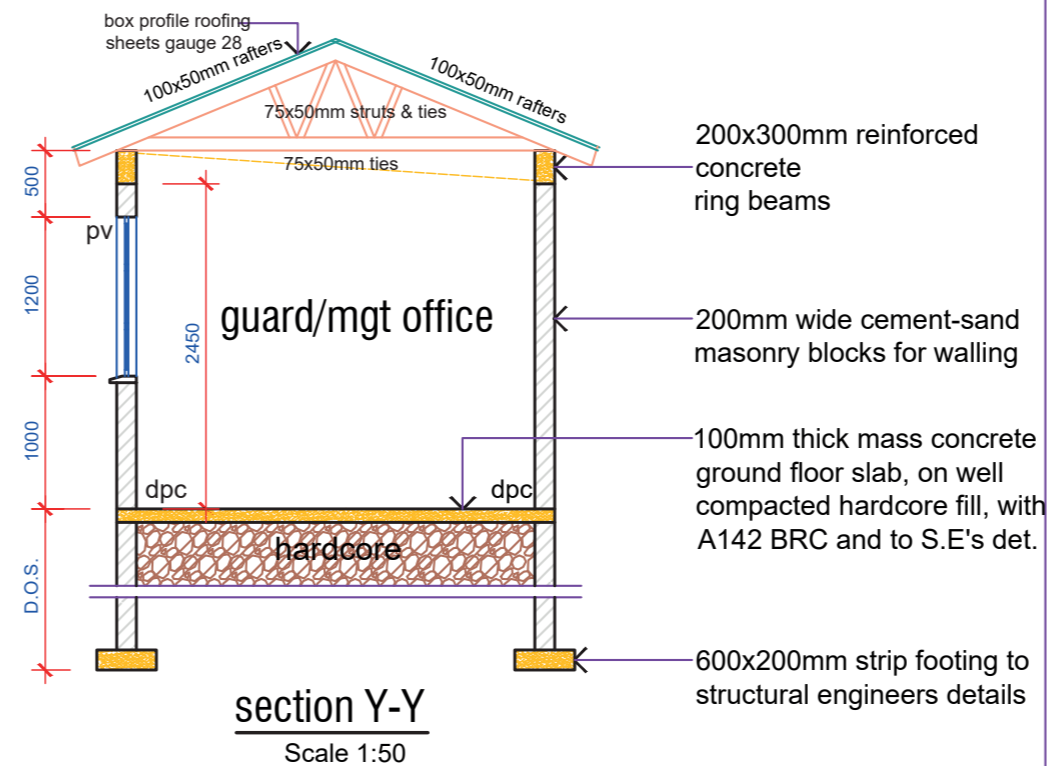
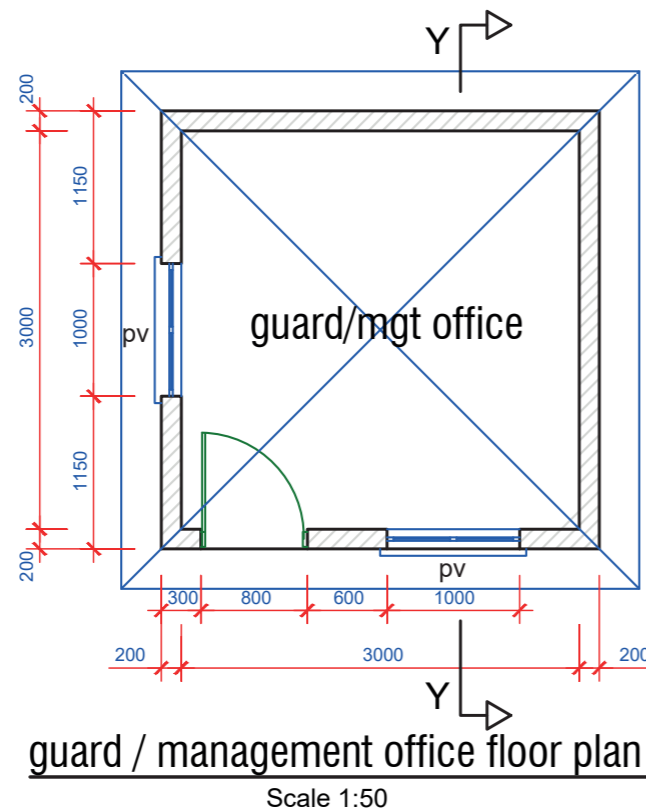
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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Nairobi, Kenya.
info@asalenvirotech.co.ke
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Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

6.16 Description of Churiri water pan in Kinangop Sub-County, Nyandarua County

Churiri water pan is located in Kinangop Sub-county of Nyandarua County. The volume of the water pan was estimated at 17,892 m³. The water pan is used for water livestock. However, given its potential and lack of alternative water supply in the area, it was recommended for rehabilitation.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. The water pan will also be desilted to reduce siltation and thus increase its volume. In addition, a perimeter fence will be established to prevent further encroachment into the water pan. Issues of sanitation around the water pan will be handled at the homesteads where the water from the Churiri water pan will be used.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 1,500 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be supported to plant at least 1,500 seedlings. The management, in addition, will be responsible for sustainable operation and maintenance of the water pan.

6.16.1 Figure showing the location of the Churiri water pan



Figure 49: Google image showing the location of Churiri water pan and its surroundings

6.16.2 Beneficiaries for Churiri water pan

50 Households with an average of 6 members.

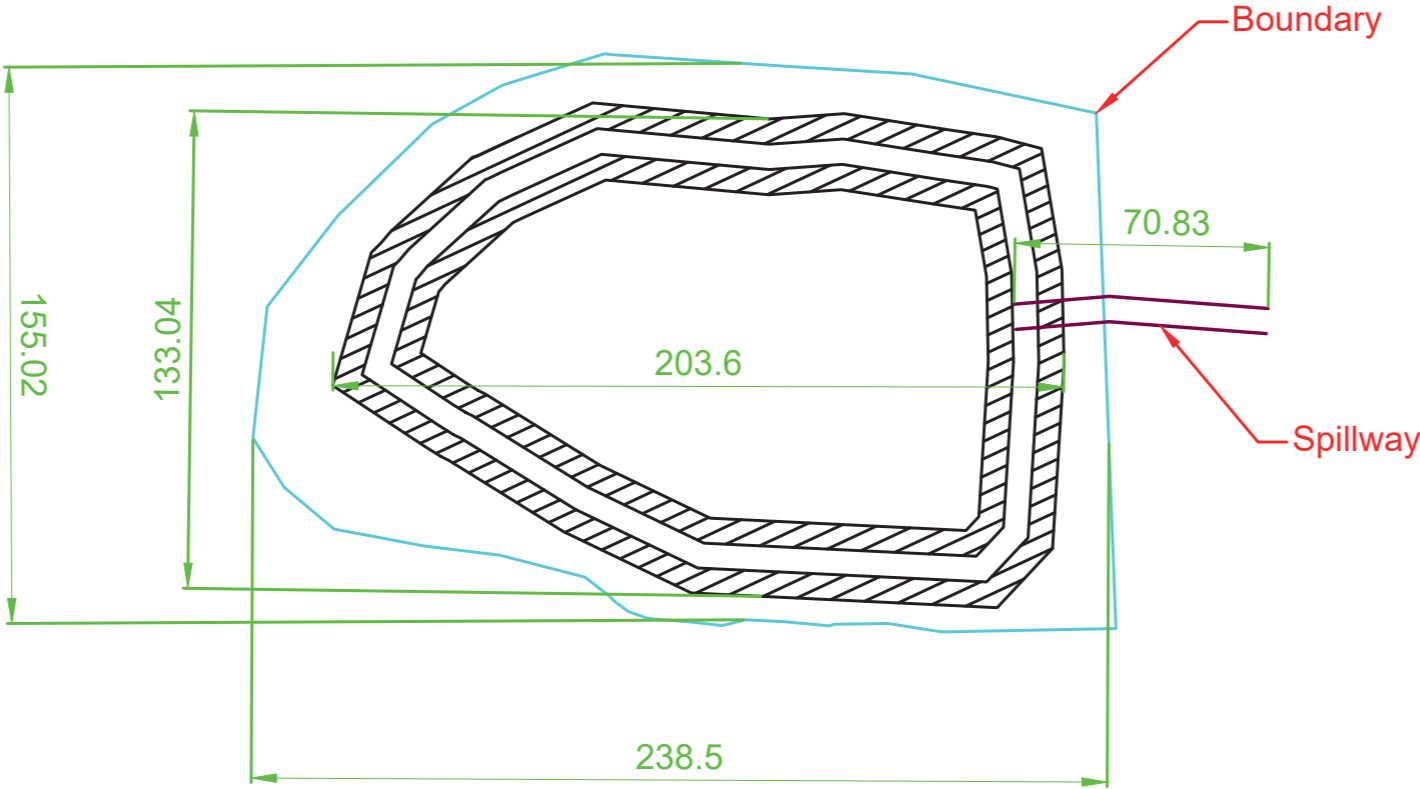
6.16.3 Bill of Quantities for proposed rehabilitation work in Churiri water pan


REHABILITATION OF CHURIRI WATERPAN IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1.0	150,000.00	150,000.00	1,465.07
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
Sub-Total Carried to Summary - Element 1					470,000.00	4,590.56
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the client	SM	13,543	3.00	40,629.00	396.83
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	11,039	350.00	3,863,580.00	37,736.17
2.3.	Using dozer or other suitable plant, excavate to depth between 0.3 - 1 m deep, allow slope and form 4 m high embankment around the pan. Allow for wheeling, ramming the soil and conducting 4 passes compaction	CM	16,098	400.00	6,439,300.00	62,893.62
Sub-Total Carried to Summary - Element 2					10,343,509.00	101,026.62
3.0.	Perimeter Fence					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1.8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	511	600.00	306,600.00	2,994.61
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1	20,000.00	20,000.00	195.34
Sub-Total Carried to Summary - Element 3					326,600.00	3,189.95
4.0.	Environmental Conservation					
4.1.	Allow for establishing of tree nursery on site	LS	1	30,000.00	30,000.00	293.01
4.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,500	250.00	375,000.00	3,662.68
Sub-Total Carried to Summary - Element 4					405,000.00	3,955.70
GRAND SUMMARY						
ELEMENT 1 - PRELIMINARIES					470,000.00	4,590.56
ELEMENT 2 - EARTHWORKS					10,343,509.00	101,026.62
ELEMENT 3 - PERIMETER FENCE					326,600.00	3,189.95
ELEMENT 4 - ENVIRONMENTAL CONSERVATION					405,000.00	3,955.70
ALL ELEMENTS TOTAL					11,545,109.00	112,762.82
Allow of 5% for supervision					577,255.45	5,638.14
Grand Total					12,122,364.45	118,400.97

6.16.4 Engineering Drawing for proposed rehabilitation work in Churiri water pan

Churiri Dam



Notes General	
<p>1. All dimensions are in meters unless otherwise stated.</p> <p>2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.</p> <p>3. All indicated levels are finished floor levels unless otherwise noted.</p> <p>4. EL(=/-)0.00 corresponds to existing normal ground level.</p> <p>5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.</p> <p>6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.</p> <p>7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)</p> <p>8. The lapping length of bars will be 50 x bar diameter</p> <p>9. Trenches shall be dug to the invert levels, graded and compacted to approval</p> <p>10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones</p> <p>11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval</p>	
Abbreviations	
Consultant:	
<div><div>ASAL EnviroTech</div><div>Consult LTD</div></div> <p>Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Sura J Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke</p>	
Client:	
<div><div></div><div>nema</div></div>	
Project	
Rehabilitation of water structures in Nyandarua county	
Drawing Title	
Dam Layout	
Designed: JS	Sheet 01
Drawn : SN	
Checked : SN	
Date : 23 sep 2018	
Scale : 1: 1	

7.0 Description of Water Structures in Kiambu County

7.01 Description of Karia-Kambara springs in Kiambaa Sub-County, Kiambu County

Karia and Kambara springs are located in Kiambaa Sub-county of Kiambu County. The springs are potential sources of water for peri urban Ruaka area and its surroundings. Given their potential the two springs were recommended for rehabilitation and development. Proposed rehabilitation activities include fencing of the area and then carrying rehabilitation works on the spring's protection, abandoned sump and pump house. In addition, a hybrid solar and three phase main power connection will be provided for JET multistage centrifugal pump. Finally, a 2.5 km pipeline to points of use will be installed to supply water to the point of use.

The Karia-Kambara springs system will be operated and managed by Karuri Water and Sewerage Company (KAWSCO). The company is responsible for supplying water to the peri urban Ruaka area and its surroundings, in turn the company will charge a fee for water supply. This fee will enable KAWSCO to maintain the system and also handle sanitation related issues in the area. The company also handle sewerage issues in the target area, and they will be responsible for sanitation issues.

As a contribution to environmental conservation the beneficiaries will plant at least 1,000 indigenous seedlings at the onset of the project and take care of them till they are full established.

7.01.1 Figures showing the characteristics of the Karia-Kambara springs

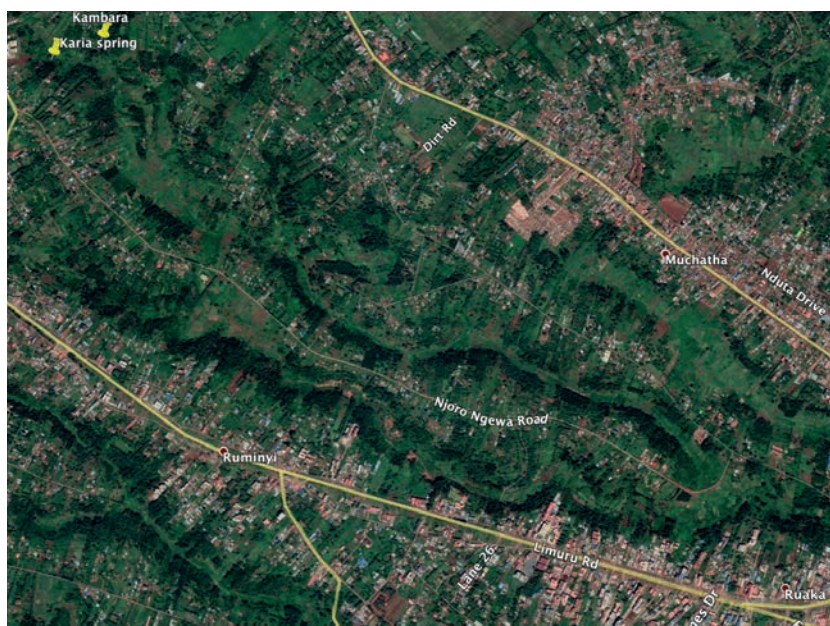


Figure 50: Location of Karia-Kambara spring in relation to potential to potential beneficiaries in Ruaka town



Figure 51: Abandoned sump recommended for rehabilitation



Figure 52: Estimating water yield from Kambara spring

7.01.2 Beneficiaries of the Karia-Kambara spring

2500 households with an average of 6 members.

7.01.3 Bill of Quantities for proposed rehabilitation work in Karia-Kambara spring

PROTECTION AND TAPPING OF KAMBARA-KARIA SPRING, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the spring	PS	1	150,000.00	150,000.00	1,465.07
1.3	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
1.4.	Allow for Security Costs	PS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 1				550,000.00	5,371.93
2.0. Masonry works						
2.1.	Provision for rehabilitation works of springs, sump and Pump house	LS	2.0	600,000.00	1,200,000.00	11,720.58
2.3.	Provision for reconnection of 3-phase power installation	LS	1.0	2,400,000.00	2,400,000.00	23,441.16
2.4.	Allow for purchase, installation and testing of Solar Panels and its accessories	LS	1.0	7,000,000.00	7,000,000.00	68,370.06
	Sub-Total Carried to Summary - Element 2				10,600,000.00	103,531.80
3.0. Pumping unit and Accessories						
3.1.	JET Multistage centrifugal pump	NO	2.0	1,200,000.00	2,400,000.00	23,441.16
3.2.	Starter/control panel for 20HP motor	NO	2.0	400,000.00	800,000.00	7,813.72
3.3.	Provision for installations and testing of the pumping units and its accessories	LS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				3,350,000.00	32,719.96
4.0. Pipework						
4.1.	Clearing of pipeline site	LS	1.0	180,000.00	180,000.00	1,758.09
4.2.	Excavation and laying of pipes of channel for laying pipes	LM	2,500.0	450.00	1,125,000.00	10,988.05
4.3.	3" Gravity Mains From Karia to Kambara Sump	LM	550.0	600.00	330,000.00	3,223.16
4.4.	4" Rising Mains From Kambara Sump Gachorue 225.0m³ Ground Masonry Tank	LS	1.0	3,148,240.00	3,148,240.00	30,749.34
	Sub-Total Carried to Summary - Element 4				4,783,240.00	46,718.63
5.0. Perimeter Fence, Guard house/shop						
5.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	500.0	600.00	300,000.00	2,930.15
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
5.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 5				620,000.00	6,055.63
6.0. Environmental Conservation						
6.1.	Allow for planting of indigineous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 6				250,000.00	2,441.79
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				550,000.00	5,371.93
	ELEMENT 2 - REHABILITATION WORK				10,600,000.00	103,531.80
	ELEMENT 3 - PUMPING UNIT				3,350,000.00	32,719.96
	ELEMENT 4 - PIPEWORK				4,783,240.00	46,718.63
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				620,000.00	6,055.63
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				250,000.00	2,441.79
	ALL ELEMENTS TOTAL				20,153,240.00	196,839.74
	Allow of 5% for supervision				1,007,662.00	9,841.99
	Grand Total				21,160,902.00	206,681.73

7.02 Description of Gathiri springs in Kiambaa Sub-County, Kiambu County

Gathiri spring is located in Kiambaa Sub-county of Kiambu County. The spring is a potential source of water for Karuri and Muchata peri-urban center and its surroundings. Given their potential the spring was recommended for development. Proposed rehabilitation activities include fencing of the area and then carrying rehabilitation works on the springs, abandoned sump and pump house. In addition, a hybrid solar and three phase main power connection will be provided for JET multistage centrifugal pumps to be installed. Finally, a water 2.5 km pipeline to point of uses will be installed to supply water to the point of use.

The Gathiri spring system will be operated and managed by Karuri Water and Sewerage Company (KAWSCO). The company is also responsible for supplying water to the Karuri and Muchata peri-urban and their surroundings, in turn the company will charge a fee for water supply. This will enable KAWSCO to maintain the system and also handle sanitation related issues in the area.

As a contribution to environmental conservation the beneficiaries will plant at least 1,000 indigenous seedlings at the onset of the project and take care of them till they are full established.

7.02.1 Figures showing the characteristics of Gathiri spring

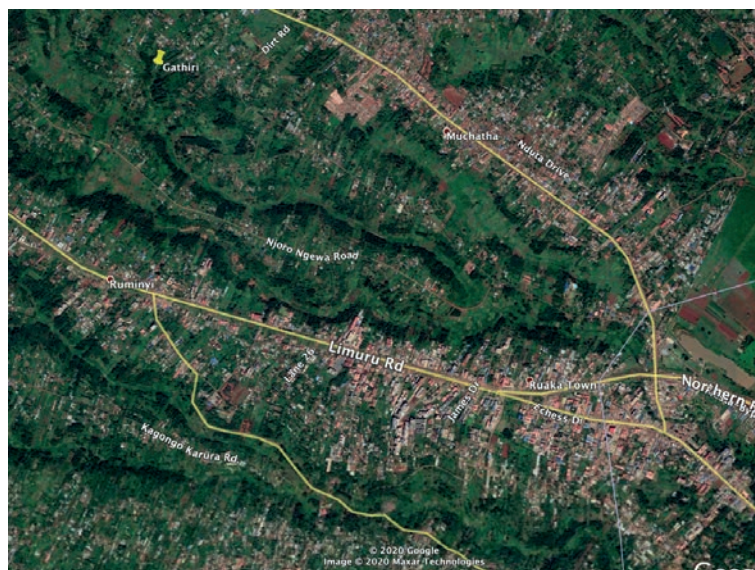


Figure 53: Location of Gathiri Spring in relation to the surrounding beneficiaries in Muchata and Karuri



Figure 54: Estimating water yield from nearby Gathiri spring



Figure 55: Survey team in Gathiri spring sump

7.02.2 Beneficiaries of Gathiri spring

2500 Households with an average of 6 members.

7.02.3 Bill of Quantities for rehabilitation work in Gathiri spring

REHABILITATION OF GATHIRI SPRING, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	100,000.00	100,000.00	976.72
1.2.	Allow for Security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				320,000.00	3,125.49
2.0. Rehabilitation works						
2.1.	Provision for rehabilitation works of springs, sump and Pump house	LS	1.0	600,000.00	600,000.00	5,860.29
2.2.	Provision for reconnection of 3-phase power installation	LS	1.0	2,400,000.00	2,400,000.00	23,441.16
2.3.	Allow for purchase, installation and testing of Solar Panels and its accessories	LS	1.0	7,000,000.00	7,000,000.00	68,370.06
	Sub-Total Carried to Summary - Element 2				10,000,000.00	97,671.51
3.0. Pumping unit and Accessories						
3.1.	JET Multistage centrifugal pump	NO	2.0	1,200,000.00	2,400,000.00	23,441.16
3.2.	Starter/control panel for 20HP motor	NO	2.0	400,000.00	800,000.00	7,813.72
3.3.	Provision for installations and testing of the pumping units and its accessories	LS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				3,350,000.00	32,719.96
4.0. Pipework						
4.1.	Clearing of pipeline site	LS	1.0	180,000.00	180,000.00	1,758.09
4.2.	Excavation and laying of pipes of channel for laying pipes	LM	2,500.0	450.00	1,125,000.00	10,988.05
4.3.	Rehabilitation of rising mains	LS	1.0	1,600,000.00	1,600,000.00	15,627.44
	Sub-Total Carried to Summary - Element 4				2,905,000.00	28,373.57
5.0. Perimeter Fence, Guard house/shop						
5.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	500.0	600.00	300,000.00	2,930.15
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
5.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 5				620,000.00	6,055.63
6.0. Environmental Conservation						
6.1.	Allow for planting of indigeneous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 6				250,000.00	2,441.79
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				320,000.00	3,125.49
	ELEMENT 2 - REHABILITATION WORK				10,000,000.00	97,671.51
	ELEMENT 3 - PUMPING UNIT				3,350,000.00	32,719.96
	ELEMENT 4 - PIPEWORK				2,905,000.00	28,373.57
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				620,000.00	6,055.63
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				250,000.00	2,441.79
	ALL ELEMENTS TOTAL				17,445,000.00	170,387.95
	Allow of 5% for supervision				872,250.00	8,519.40
	Grand Total				18,317,250.00	178,907.35

7.03 Description of Ite water pan in Kiambaa Sub-County, Kiambu County

Ite water pan is located in Kiambaa Sub-county of Kiambu County. The volume of the water pan was estimated at 117,241 m³. The water pan is currently used for watering livestock and domestic water supply. Despite its importance there is significant siltation and encroachment of water pan boundaries and reparation zones.

The water pan was proposed for rehabilitation to increase its usefulness. Rehabilitation will involve demarcating the official boundary of the water and fencing it off to prevent future re-encroachment. The water pan will also be excavated to remove deposited silt in part of the water pan and thus increase its current volume. A flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface and connect to Karuri water supply system.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. The water pan will be managed and maintained by Karuri Water and Sewerage Company (KEWASCO). The company will also be responsible for sanitation issues in the area.

7.03.1 Figures showing characteristics of Ite water pan



Figure 56: Google image showing the location of Ite water pan in Kiambu county and its surroundings



Figure 57: Panoramic view of the Ite dam in Kiambu County

7.03.2 Beneficiaries of Ite water pan

3,000 Households with an average of 6 members.

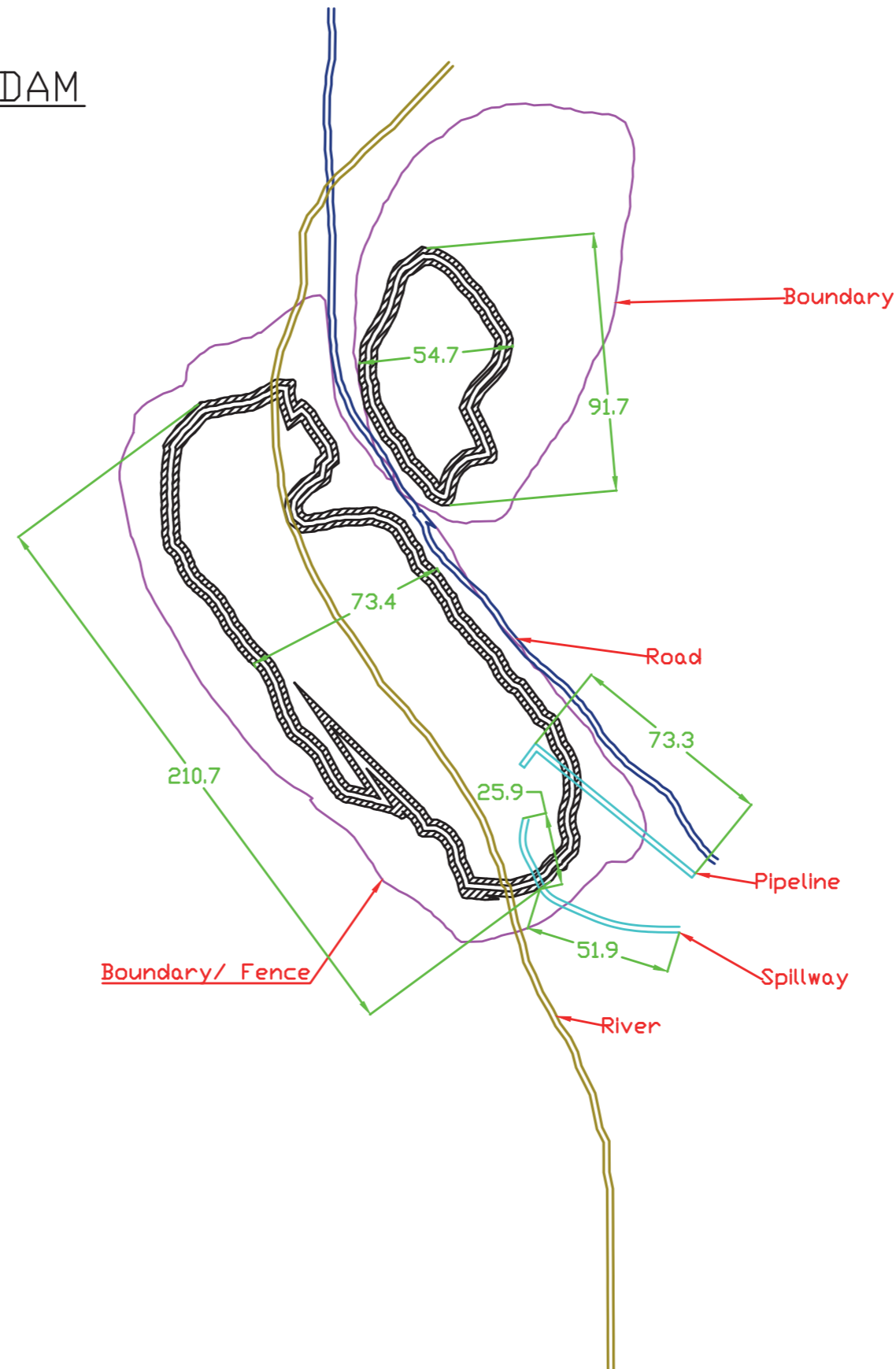
7.03.3 Bill of Quantities for proposed rehabilitation work in Ite water pan

REHABILITATION OF ITE WATERPAN IN KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	100,000.00	100,000.00	976.72
1.4.	Allow for Pre- and Post-rehabilitation bathymetric survey	PS	2	300,000.00	600,000.00	5,860.29
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
Sub-Total Carried to Summary - Element 1					1,270,000.00	12,404.28
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, in the upper part of the dams	LS	30,600	450.00	13,770,000.00	134,493.67
2.3.	Provision of drainage works	LS	1.0	2,000,000.00	2,000,000.00	19,534.30
2.4.	Allow for backwash water recycling 6" pipeline from Ultrafiltration unit plant	LS	1.0	500,000.00	500,000.00	4,883.58
2.5.	Allow for construction of 100 m3 Composite tank at the treatment plant	LS	1.0	9,500,000.00	9,500,000.00	92,787.94
Sub-Total Carried to Summary - Element 2					25,920,000.00	253,164.56
3.0.	Perimeter Fence and Guard house					
3.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	3,500.0	400.00	1,400,000.00	13,674.01
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
3.3.	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
Sub-Total Carried to Summary - Element 4					1,550,000.00	15,139.08
7.0.	Environmental Conservation					
7.1.	Allow for planting of indigineous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
Sub-Total Carried to Summary - Element 7					500,000.00	4,883.58
GRAND SUMMARY						
ELEMENT 1 - PRELIMINARIES					1,270,000.00	12,404.28
ELEMENT 2 - EARTHWORKS					25,920,000.00	253,164.56
ELEMENT 4 - PERIMETER FENCE					1,550,000.00	15,139.08
ELEMENT 7 - ENVIRONMENTAL CONSERVATION					500,000.00	4,883.58
ALL ELEMENTS TOTAL					29,240,000.00	285,591.50
Allow of 5% for supervision					1,462,000.00	14,279.57
Grand Total					30,702,000.00	299,871.07

7.03.4 Engineering Drawing for proposed rehabilitation work in Ite water pan

ITE DAM



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
Sura J Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : SN

Date : 23 sep 2018

Scale : 1:1

Sheet

01

7.04 Description of proposed Romo borehole in Lari Sub-County, Kiambu County

The proposed Romo borehole will be a solar powered and meant to augment domestic water supply in Limuru sub-county of Kiambu County. Some of the proposed preliminaries activities to develop this borehole includes hydrological survey, and Environmental and Socio Impact Assessment (ESIA). Drilling works will also involve preventing collapse in collapsible zones using suitable casing, which is provide for in the BOQ.

Once drilling is completed and the borehole appropriately cased a 24-hour test pumping will be carried out to determine its yield. Laboratory analysis will be carried to ascertain the suitability of the water for domestic use. Finally, solar panels, pumps, storage tanks and reticulations to point of use will be installed. The water will be supplied and will rely on existing sanitation service provided by Limuru Water and Sewerage Company limited (LIWASCO) or existing stand-alone systems at home. The company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 1,000 indigenous trees in borehole sites and its surrounding area.

7.04.1 Figures showing the characteristics of proposed Romo borehole



Figure 58: Google image showing the proposed location of borehole in Romo



Figure 59: Existing boreholes in the site proposed for additional borehole in Romo, Limuru sub-county

7.04.2 Beneficiaries of Romo Borehole

1,800 Households with an average of 6 members.

7.04.3 Bill of Quantities for development of Romo borehole

DRILLING OF ADDITIONAL BOREHOLES IN ROMO
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.2.	Provisional amount for hydrogeological sites to identify drilling sites.	PS	1.0	100,000.00	100,000.00	976.72
1.3.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
1.4.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				540,000.00	5,274.26
2.0. Drilling works						
2.1.	Drilling 203 mm diameter Borehole from 0-200 m depth	LM	200.0	7,500.00	1,500,000.00	14,650.73
2.2.	Additional Provisional costs in case of borehole collapse in collapsible zone. Installation of Non- Removable 8" Surface casings in the event of Borehole Collapse in the collapse zone	LM	50.0	7,000.00	350,000.00	3,418.50
2.3.	Supply of water used during drilling & development and for campsite use	CM	0.9	45,000.00	40,500.00	395.57
2.4.	6 Inch (153mm) diameter STEEL casings pipe	LM	200.0	4,000.00	800,000.00	7,813.72
2.5.	6 Inch (153mm) STEEL screens in Plasma Slots	LM	50.0	4,500.00	225,000.00	2,197.61
2.6.	Supply & filling of Gravel pack(2- 4mm)	KG	20,000.0	45.00	900,000.00	8,790.44
2.7.	Borehole development work/FLASHING using compressed air injected in to the borehole	HR	2.0	5,000.00	10,000.00	97.67
2.8.	24 Hours Test pumping Calibration, step test, and discharge test, recovery test after test pumping	LS	1.0	100,000.00	100,000.00	976.72
2.9.	Construction of concrete slab with well cap	NO	1.0	2,500.00	2,500.00	24.42
2.10.	Provisional amount for tanks and reticulations to point of use	PS	1.0	2,000,000.00	2,000,000.00	19,534.30
	Sub-Total Carried to Summary - Element 2				5,928,000.00	57,899.67
3.0. Laboratory analysis and completion reports						
3.1.	Allow for water analysis test - Bacteriological, chemical and physical tests to WHO standards	LS	1.0	20,000.00	20,000.00	195.34
3.2.	Allow for borehole completion report	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				30,000.00	293.01
4.0. Pumping and storages						
4.1.	Provisional sum for installing tanks, steel stand and solar pumping unit	PS	1.0	2,500,000.00	2,500,000.00	24,417.88
4.2.	Provision sum for reticulation of water to the point of use	PS	1.0	1,000,000.00	1,000,000.00	9,767.15
	Sub-Total Carried to Summary - Element 3				3,500,000.00	34,185.03
5.0. Perimeter Fence, Guard house						
5.1	Provide and erect a perimeter fence with 4mm thickness agletline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1.8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	50.0	600.00	30,000.00	293.01
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
5.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 5				350,000.00	3,418.50
6.0. Environmental Conservation						
6.1.	Allow for planting of indigeneous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 6				250,000.00	2,441.79
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				540,000.00	5,274.26
	ELEMENT 2 - DRILLING WORK				5,928,000.00	57,899.67
	ELEMENT 3 - LAB ANALYSIS AND COMPLETION REPORT				30,000.00	293.01
	ELEMENT 4 - PUMPING AND STORAGE				3,500,000.00	34,185.03
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				350,000.00	3,418.50
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				250,000.00	2,441.79
	ALL ELEMENTS TOTAL				10,598,000.00	103,512.27
	Allow of 5% for supervision				529,900.00	5,175.61
	Grand Total				11,127,900.00	108,687.88

7.06 Description of proposed Nguirubi borehole in Limuru Sub-County, Kiambu County

The proposed Nguirubi borehole will be a solar powered and meant to augment domestic water supply in Ndeiya, the drier part of Limuru sub-county of Kiambu County. The borehole currently relies on power from the national grid, which makes it expensive to operate and consequently expensive to supply water to the local community.

Some of the proposed activities involves installing solar panels, pumps, steel storage tanks and reticulations to point of use (water kiosk). The water will be supplied and will rely on existing sanitation service provided by Limuru Water and Sewerage Company limited (LIWASCO) or existing stand-alone systems at home. Furthermore, the company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 300 indigenous trees in borehole sites and its surrounding area.

7.06.1 Beneficiaries of Nguirubi borehole

2,000 Households with an average of 6 members.

7.06.2 Figures showing the characteristics of the Ngairubi borehole

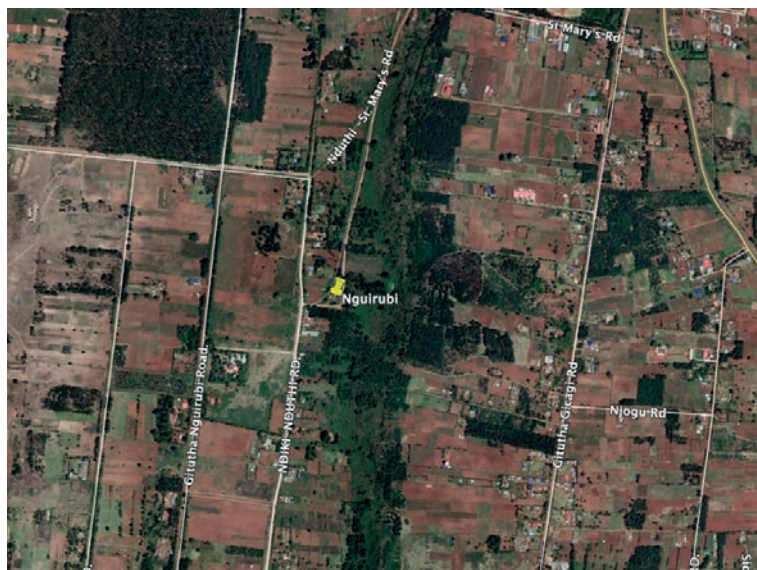


Figure 60: Google image showing the location of Ngwirubi borehole and its surroundings



Figure 61: Existing Ngairubi borehole proposed for rehabilitation in Limuru sub-county

7.06.3 Bill of Quantities for proposed rehabilitation work in Nguruibi borehole

REHABILITATION OF NGUIRUBI BOREHOLE IN NDEIYA, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.3.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				320,000.00	3,125.49
2.0. Pumping and storages						
2.1.	Provisional sum for installing tanks, steel stand and solar pumping unit	PS	1.0	7,000,000.00	7,000,000.00	68,370.06
2.2.	Provision sum for rehabilitation of water pipelines to the point of use	PS	1.0	600,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 2				7,600,000.00	74,230.35
3.0. Perimeter Fence, Guard house/shop						
3.1.	Provide and erect a perimeter fence with 4mm thickness agletline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	50.0	600.00	30,000.00	293.01
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
3.3.	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 3				350,000.00	3,418.50
6.0. Environmental Conservation						
6.1.	Allow for planting of indigineous trees upstream and downstream of the spring	No	300	250.00	75,000.00	732.54
	Sub-Total Carried to Summary - Element 4				75,000.00	732.54
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				320,000.00	3,125.49
	ELEMENT 2 - PUMPING AND STORAGE				7,600,000.00	74,230.35
	ELEMENT 3 - PERIMETER FENCE AND GUARD HOUSE				350,000.00	3,418.50
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				75,000.00	732.54
	ALL ELEMENTS TOTAL				8,345,000.00	81,506.88
	Allow of 5% for supervision				417,250.00	4,075.34
	Grand Total				8,762,250.00	85,582.22

7.06 Description of proposed Kiriri borehole in Limuru Sub-County, Kiambu County

The proposed Kiriri borehole will be a solar powered and meant to augment domestic water supply in Ndeiya, the drier part of Limuru sub-county of Kiambu County. The borehole located at a compound of Kiriri primary school.

Some of the proposed activities involves installing solar panels, pumps, steel storage tanks and reticulations to point of use. The water will be supplied and will rely on existing sanitation service provided by Limuru Water and Sewerage Company limited (LIWASCO) or existing stand-alone systems at home. The company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 300 indigenous trees in borehole sites and its surrounding area.

7.06.1 Beneficiaries of Kiriri borehole

2,000 Households with an average of 6 members.

7.06.2 Figures showing the characteristics of Kiriri borehole



Figure 62: Google image showing the location of Kiriri borehole in Kiriri Primary school and its surroundings



Figure 63: Existing Kiriri borehole proposed for rehabilitation in Limuru sub-county

7.06.3 Bill of Quantities for rehabilitation works proposed in Kiriri borehole

REHABILITATION OF KIRIRI BOREHOLE IN NDEIYA, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.3.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				320,000.00	3,125.49
2.0. Pumping and storages						
2.1.	Provisional sum for installing tanks, steel stand and solar pumping unit with sufficient capacity to light classrooms	PS	1.0	10,000,000.00	10,000,000.00	97,671.51
2.2.	Provision sum for rehabilitation of water pipelines to the point of use	PS	1.0	600,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 2				10,600,000.00	103,531.80
3.0. Perimeter Fence, Guard house						
3.1.	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,500.0	600.00	900,000.00	8,790.44
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
3.3.	Construct a guard houseas per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 3				1,220,000.00	11,915.92
6.0. Environmental Conservation						
6.1.	Allow for planting of indagineous near the borehole.	No	300	250.00	75,000.00	732.54
	Sub-Total Carried to Summary - Element 4				75,000.00	732.54
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				320,000.00	3,125.49
	ELEMENT 2 - PUMPING AND STORAGE				10,600,000.00	103,531.80
	ELEMENT 3 - PERIMETER FENCE AND GUARD HOUSE				1,220,000.00	11,915.92
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				75,000.00	732.54
	ALL ELEMENTS TOTAL				12,215,000.00	119,305.75
	Allow of 5% for supervision				610,750.00	5,965.29
	Grand Total				12,825,750.00	125,271.04

7.07 Description of catchment protection in Riara river catchment of Githunguri Sub-county, Kiambu County

As part of Kiambu County efforts to reduce environmental degradation in Riara river, upstream of the new constructed Riara dam it is proposed to plant over 5,000 indigenous. Planting trees in Riara catchment will reduce on the sediment getting into Riara dam and improve the local microclimate.

The cost of purchasing, planting and taking care of the trees till they are fully established is provided for at a rate of KES 250 (\$2.442).

7.07.1 Beneficiaries of Riara river catchment conservation

Given the coverage and the indirect benefit of rehabilitating the Riara catchment on water quality and cost of treatment the beneficiaries could be about 20,000 if the benefits of reduced water treatment cost are passed to the water consumers.

7.07.2 Figures showing the characteristics of the Riara catchment



Figure 64: Location of former quarry sites in Riara Dam and it upstream catchment



Figure 65: Newly constructed Riara dam wall

7.07.3 Bill of Quantities for proposed conservation activities in Riara catchment

REHABILITATION OF KIRIRI BOREHOLE IN NDEIYA, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.3.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				320,000.00	3,125.49
2.0. Pumping and storages						
2.1.	Provisional sum for installing tanks, steel stand and solar pumping unit with sufficient capacity to light classrooms	PS	1.0	10,000,000.00	10,000,000.00	97,671.51
2.2.	Provision sum for rehabilitation of water pipelines to the point of use	PS	1.0	600,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 2				10,600,000.00	103,531.80
3.0. Perimeter Fence, Guard house						
3.1.	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,500.0	600.00	900,000.00	8,790.44
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
3.3.	Construct a guard houseas per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 3				1,220,000.00	11,915.92
6.0. Environmental Conservation						
6.1.	Allow for planting of indagineous near the borehole.	No	300	250.00	75,000.00	732.54
	Sub-Total Carried to Summary - Element 4				75,000.00	732.54
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				320,000.00	3,125.49
	ELEMENT 2 - PUMPING AND STORAGE				10,600,000.00	103,531.80
	ELEMENT 3 - PERIMETER FENCE AND GUARD HOUSE				1,220,000.00	11,915.92
	ELEMENT 4 - ENVIRONMENTAL CONSERVATION				75,000.00	732.54
	ALL ELEMENTS TOTAL				12,215,000.00	119,305.75
	Allow of 5% for supervision				610,750.00	5,965.29
	Grand Total				12,825,750.00	125,271.04

7.08 Description of proposed catchment protection in Kamiti river catchment of Githunguri Sub-county, Kiambu County

As part of Kiambu County efforts to reduce environmental degradation in Kamiti river, upstream of the new constructed Kamiti reservoir it is proposed to plant over 5,000 indigenous. Planting trees in Kamiti catchment will reduce on the sediment getting into Kamiti river. Furthermore, sediment is currently a problem in the treatment where sludge build up is overwhelming the system. It is also proposed that sludge beds be constructed instead of realising the sludge back into Kamiti river.

7.08.1 Beneficiaries of Kamiti river catchment work

Given the coverage and the indirect benefit of rehabilitating the Kamiti catchment on water quality and cost of treatment the beneficiaries could be about 25,000 if the benefits of reduced water treatment cost are passed to the water consumers.

7.08.2 Figures showing the characteristics of Kamiti catchment



Figure 66: Location of Kamiti reservoir and part of it upstream catchment



Figure 67: Kamiti reservoir in River Kamiti



Figure 68: Excess sludge from Kamiti treatment works

7.08.3 Bill of Quantities for conservation and rehabilitation works in Kamiti river catchment

PLANTING OF TREES IN KAMITI RIVER CATCHMENT AND REHABILITATION OF TREATMENT WORKS, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	<u>Preliminaries</u>					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.3.	Allow for Security Costs	PS	1	100,000.00	100,000.00	976.72
	Sub-Total Carried to Summary - Element 1				300,000.00	2,930.15
1.0.	<u>Construction of Sludge bed</u>					
1.1.	Construct sludge beds that will hold 70% of sludge from the sedimentation basins that currently is discharged to the riparian land kamiti river.	PS	1	15,000,000.00	15,000,000.00	146,507.27
	Sub-Total Carried to Summary - Element 1				15,000,000.00	146,507.27
1.0.	<u>Environmental Conservation</u>					
1.1.	Allow for planting of indigeneous trees in the catchment riparian areas especially in abandoned quarry sites.	No	5,000	250.00	1,250,000.00	12,208.94
	Sub-Total Carried to Summary - Element 1				1,250,000.00	12,208.94
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				300,000.00	2,930.15
	ELEMENT 2 - CONSTRUCTION OF SLUDGE BED				15,000,000.00	146,507.27
	ELEMENT 1 - ENVIRONMENTAL CONSERVATION				1,250,000.00	12,208.94
	ALL ELEMENTS TOTAL				16,550,000.00	161,646.35
	Allow of 5% for supervision				827,500.00	8,082.32
	Grand Total				17,377,500.00	169,728.67

7.09 Description of Kikuyu springs in Kikuyu Sub-County, Kiambu County

Kikuyu springs are located in Kikuyu Sub-county of Kiambu County. The spring is a potential source of water to augment water supply to Kikuyu town. Given its potential the spring was recommended for rehabilitation.

The existing embankment, sump and pump house should be restored, and the area fenced off. Restoration works involve desilting the sump and repairing masonry that has failed. Similarly, restoration works will be carried out in the pump house. A 20 HP submersible pump and related accessories will be installed to pump the water to existing distribution center. The pump will rely on a hybrid system of solar energy and three phase grid power, hence installation of solar panels and related accessories will also be carried out. As part of effort to secure investment in this site the area will be fenced off to prevent encroachment and possible vandalism. Kikuyu Water and Sewerage Company Limited will be responsible for day to day running of the project. The company will also be responsible for related sanitation issues in the town.

As a contribution to environmental conservation the beneficiaries will plant at least 1000 indigenous seedlings at the onset of the project and take care of them till they are fully established.

7.09.1 Figure of Kikuyu spring



Figure 69: Google image showing the location of the Kikuyu springs and the nearby Kikuyu town



Figure 70: Kikuyu spring sump that requires rehabilitation



Figure 71: Pumping solution that rely mainly on grid power hence expensive to maintain

7.09.2 Beneficiaries of Kikuyu spring

200 Households with an average of 6 members.

7.09.3 Bill of Quantities for proposed rehabilitation of Kikuyu springs

REHABILITATION OF KIKUYU SPRINGS PUMPS HOUSE, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Security Costs	PS	1.0	130,000.00	130,000.00	1,269.73
1.3.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				480,000.00	4,688.23
2.0. Masonry works						
2.1.	Provision for rehabilitation works of springs, sump and Pump house	LS	1.0	250,000.00	250,000.00	2,441.79
2.3.	Provision for reconnection of 3-phase power installation	LS	1.0	2,400,000.00	2,400,000.00	23,441.16
2.4.	Allow for purchase, installation and testing of Solar Panels and its accessories	LS	1.0	12,000,000.00	12,000,000.00	117,205.81
	Sub-Total Carried to Summary - Element 2				14,650,000.00	143,088.76
3.0. Pumping unit and Accessories						
3.1.	Allow for installation of submersible pump	NO	2.0	2,000,000.00	4,000,000.00	39,068.60
3.2.	Starter/control panel for 20HP motor	NO	2.0	400,000.00	800,000.00	7,813.72
3.3.	Provision for installations and testing of the pumping units and its accessories	LS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				4,950,000.00	48,347.40
4.0. Pipework						
4.1.	Allow for rehabilitation of existing pipeline to the distribution tanks	LS	1.0	600,000.00	600,000.00	5,860.29
	Sub-Total Carried to Summary - Element 4				600,000.00	5,860.29
5.0. Perimeter Fence, Guard house/shop						
5.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1.8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	250.0	600.00	150,000.00	1,465.07
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 5				170,000.00	1,660.42
6.0. Environmental Conservation						
6.1.	Allow for planting of indigneous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	62,500.00
	Sub-Total Carried to Summary - Element 6				250,000.00	62,500.00
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				480,000.00	4,688.23
	ELEMENT 2 - REHABILITATION WORK				14,650,000.00	143,088.76
	ELEMENT 3 - PUMPING UNIT				4,950,000.00	48,347.40
	ELEMENT 4 - PIPEWORK				600,000.00	5,860.29
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				170,000.00	1,660.42
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				250,000.00	62,500.00
	ALL ELEMENTS TOTAL				21,100,000.00	62,703.645.10
	Allow of 5% for supervision				1,055,000.00	3,135,182.26
	Grand Total				22,155,000.00	65,838,827.36

7.10 Description of proposed Rugita borehole in Kikuyu Sub-County, Kiambu County

The proposed Rugita borehole will be a solar powered and meant to augment domestic water supply in Kikuyu town, Kiambu County.

Some of the proposed activities involves re-installing pumping unit with hybrid solar option. Finally, reticulate to Kikuyu spring for treatment and pumping to Kikuyu town. The water will be supplied and will rely on existing sanitation service provided by Kikuyu Water and Sewerage Company limited or existing stand-alone systems at home. The company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 300 indigenous trees in borehole sites and its surrounding area.

7.10.1 Beneficiaries of Rugita borehole

3,000 Households with an average of 6 members.

7.10.2 Figure showing characteristics of Rugita borehole



Figure 72: Google image showing the location of Rugita and its surroundings

7.10.3 Bill of Quantities for proposed rehabilitation works in Rugita borehole

DRILLING OF RUGITA COMMUNITY BOREHOLE IN KIKUYU, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.3.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				320,000.00	3,125.49
4.0. Pumping and storages						
4.1.	Provisional sum for reinstalling pumping unit with hybrid option for electricity and solar	PS	1.0	2,500,000.00	2,500,000.00	24,417.88
4.2.	Provision sum for reticulation of water to the point of use	PS	1.0	1,000,000.00	1,000,000.00	9,767.15
	Sub-Total Carried to Summary - Element 3				3,500,000.00	34,185.03
6.0. Environmental Conservation						
6.1.	Allow for planting of indigeneous trees in the environs of the borehole	No	100	250.00	25,000.00	244.18
	Sub-Total Carried to Summary - Element 6				25,000.00	244.18
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				320,000.00	3,125.49
	ELEMENT 4 - PUMPING AND STORAGE				3,500,000.00	34,185.03
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				25,000.00	244.18
	ALL ELEMENTS TOTAL				3,845,000.00	37,554.70
	Allow of 5% for supervision				192,250.00	1,877.73
	Grand Total				4,037,250.00	39,432.43

7.11 Description of Rungiri Quarry Reservoir in Kikuyu Sub-County, Kiambu County

Rungiri Quarry Reservoir is located in Kikuyu Sub-county of Kiambu County. The volume of the water pan was estimated at 128,385 m³. The quarry reservoir is currently used for small scale irrigation despite its potential in water supply.

The reservoir was proposed for rehabilitation to increase its usefulness. Rehabilitation works will involve fencing it off the area to prevent further encroachment. A bathymetric survey and water quality analysis will be carried out to ascertain the volume of the reservoir. A flexible draw off pipe will be attached to a floating ball so that it constantly remains at 30 cm below the water surface will be installed and connect to Kikuyu springs treatment works via a 6" pipe.

As a contribution to environmental conservation the water company will be expected to plant at least 2,000 seedlings at the onset of the project. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site. Note that this will also enclose the nearby Rugita borehole. The reservoir will be managed and maintained by Kikuyu Water and Sewerage Company. The company will also be responsible for sanitation issues in the area.

7.11.1 Figure showing the location of proposed work in Rungiri reservoir



Figure 73: Google image showing the location of Rungiri quarry reservoir in Kiambu county and proposed pipeline to Kikuyu springs

7.11.2 Beneficiaries of Rungiri quarry reservoir

3,000 Households with an average of 6 members.

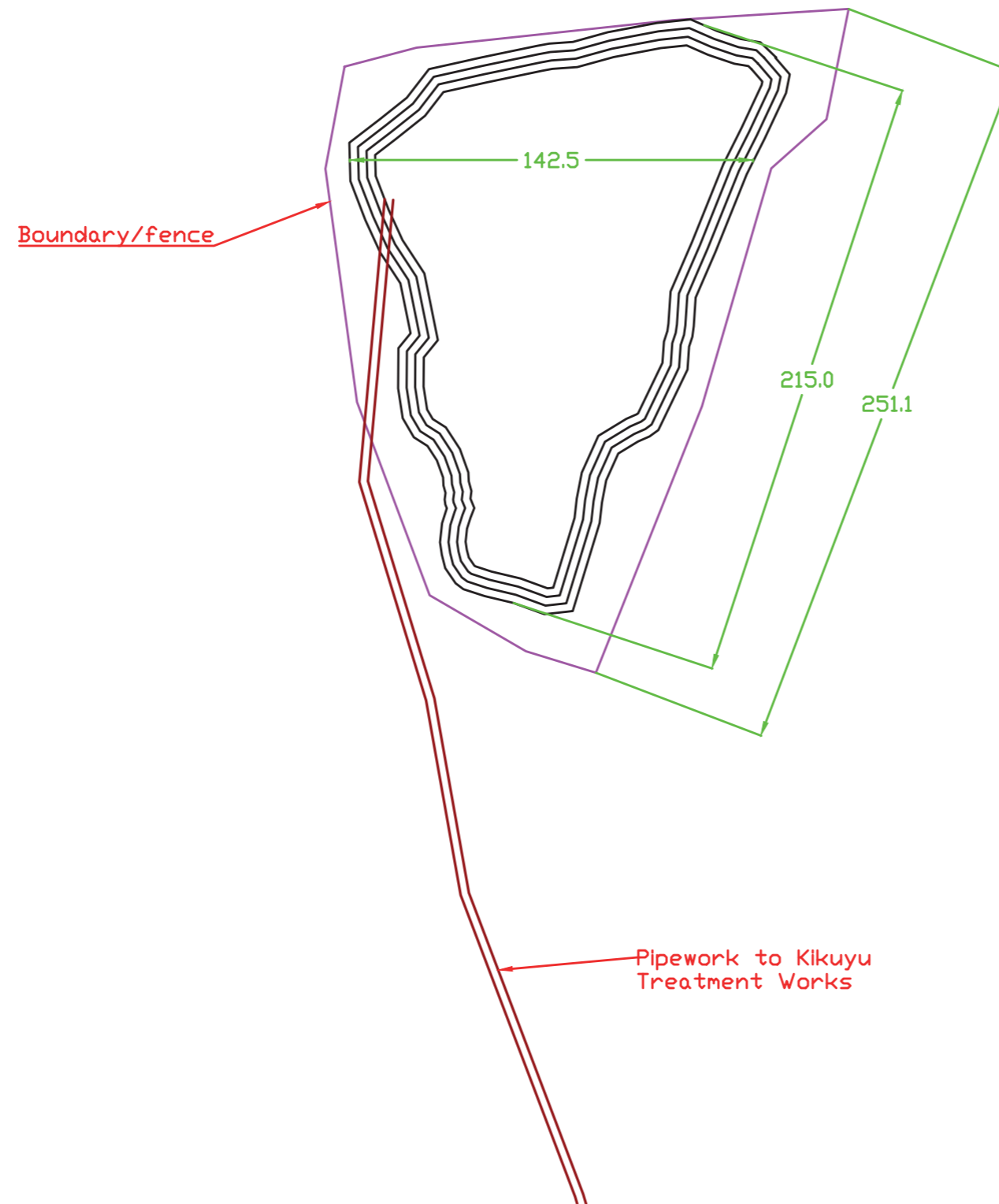
7.11.3 Bill of Quantities for the proposed development of Rungiri quarry reservoir

REHABILITATION OF RUNGIRI DAM IN KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	100,000.00	100,000.00	976.72
1.4.	Allow for bathymetric survey and water quality analysis	PS	1	550,000.00	550,000.00	5,371.93
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
	Sub-Total Carried to Summary - Element 1				1,220,000.00	11,915.92
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
2.3.	Provision of drainage works	LS	1.0	200,000.00	200,000.00	1,953.43
2.4.	Allow for construction of 6" pipeline to treatment works in Kikuyu spring	LS	1.0	800,000.00	800,000.00	7,813.72
	Sub-Total Carried to Summary - Element 2				1,150,000.00	11,232.22
3.0.	Perimeter Fence and Guard house					
3.1.	Allow construction of Masonry stone wall round the dam	LM	200.0	1,200.00	240,000.00	2,344.12
3.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
3.3.	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				390,000.00	3,809.19
4.0.	Environmental Conservation					
4.1.	Allow for planting of indigenous trees upstream and downstream of the dam	No	200	250.00	50,000.00	488.36
	Sub-Total Carried to Summary - Element 7				50,000.00	488.36
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,220,000.00	11,915.92
	ELEMENT 2 - EARTHWORKS				1,150,000.00	11,232.22
	ELEMENT 4 - PERIMETER FENCE				390,000.00	3,809.19
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				50,000.00	488.36
	ALL ELEMENTS TOTAL				2,810,000.00	27,445.69
	Allow of 5% for supervision				140,500.00	1,372.28
	Grand Total				2,950,500.00	28,817.98

7.11.4 Engineering Drawing for the proposed development of Rungiri quarry reservoir

RUNGIRI WATER PAN



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Kiambu
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : SN

Date : 23 sep 2018

Scale : 1:1

Sheet

01

7.12 Description of Rehabilitation of Ndarugu Quarry sites in Juja Sub-county, Kiambu County

As part of Kiambu County efforts to reduce environmental degradation and rehabilitate the former quarry sites in Ndarugu river, it is proposed to plant over 20,000 indigenous. The trees will play critical roles in rehabilitating the aesthetics of the quarry dotted landscape, slowing soil laden sediment and modifying the local microclimate.

The cost of purchasing, planting and taking care of the trees till they are fully established is provided for at a rate of KES 250 (\$2.442).

7.12.1 Figure showing the location of Ndarugu abandoned quarries



Figure 74: Location of former quarry sites in Ndarugu river valley

7.12.2 Beneficiaries of rehabilitation of abandoned quarries in Ndarugu river

Given the coverage and the indirect benefit of Quarry rehabilitation a specific number of beneficiaries was estimated at 20220 but the surrounding population is 156,041, (as per 2019 population census), and has a number of schools and a university in the neighbourhood.

7.12.3 Bill of Quantities for proposed rehabilitation work in Ndarugu river

PLANTING OF TREES IN NDARUGU RIVER CATCHMENT, KIAMBU COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Environmental Conservation					
1.1.	Allow for planting of indigineous trees in the catchment riparian areas especially in abandoned quarry sites.	No	20,000	250.00	5,000,000.00	48,835.76
	Sub-Total Carried to Summary - Element 1				5,000,000.00	48,835.76
	GRAND SUMMARY ELEMENT 1 - ENVIRONMENTAL CONSERVATION				5,000,000.00	48,835.76
	ALL ELEMENTS TOTAL				5,000,000.00	48,835.76
	Allow of 5% for supervision				250,000.00	2,441.79
	Grand Total				5,250,000.00	51,277.54

8.0 Description of Water Structures in Machakos County

8.01 Description of Musaalani water pan in Kathiani Sub-County, Machakos County

Musaalani water pan is located in Kathiani Sub-county of Machakos County. The volume of the water pan was estimated at 24,740 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings..

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.01.1 Figure showing the location of Musaalani water pan



Figure 75: Google image showing the location of the water pan and its surroundings beneficiaries

8.01.2 Beneficiaries of Musaalani water pan

1500 Households with an average of 6 members.

8.01.3 Bill of Quantities for rehabilitation work in Musaalani water pan

REHABILITATION OF MUSAALANI WATER IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

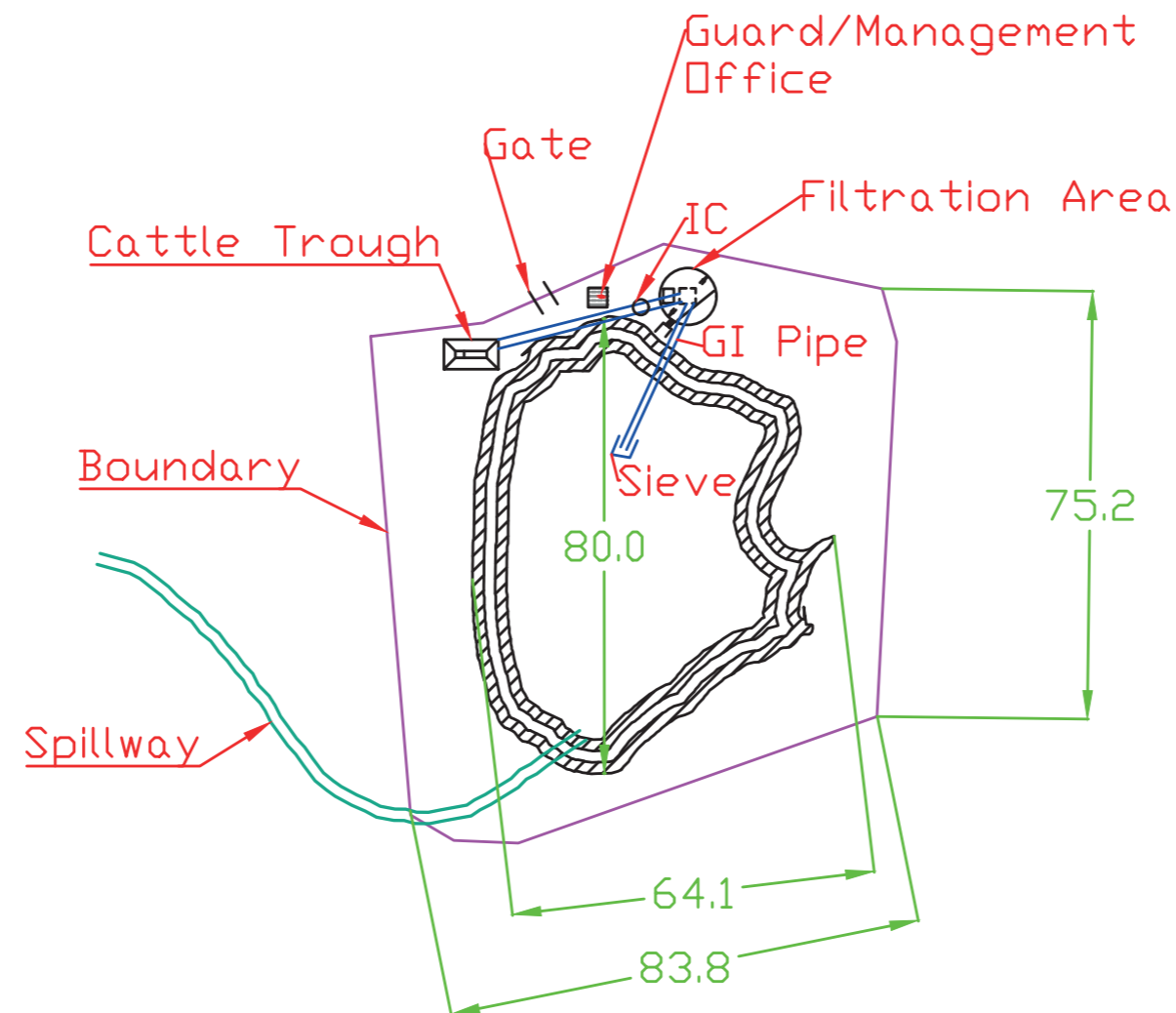
ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the Waterpan	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey and water quality analysis	PS	1	550,000.00	550,000.00	5,371.93
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,200,000.00	11,720.58
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	17,299	3.00	51,897.00	506.89
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	34,000	450.00	15,300,000.00	149,437.41
	Sub-Total Carried to Summary - Element 2				15,351,897.00	149,944.30
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67

REHABILITATION OF MUSAALANI WATER IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
4	<u>Perimeter Fence, Guard house/shop</u>					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,360.0	400.00	544,000.00	5,313.33
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				694,000.00	6,778.40
5.0.	<u>Treatment works</u>					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	2.0	2,000,000.00	4,000,000.00	39,068.60
5.2.	Allow for auxillaries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 2				4,500,000.00	43,952.18
6.0.	<u>Cattle Trough Construction</u>					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigineous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 7				550,000.00	5,371.93
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,200,000.00	11,720.58
	ELEMENT 2 - EARTHWORKS				15,351,897.00	149,944.30
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				694,000.00	6,778.40
	ELEMENT 5 - TREATMENT WORKS				4,500,000.00	43,952.18
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				550,000.00	5,371.93
	ALL ELEMENTS TOTAL				23,354,747.00	228,109.34
	Allow of 5% for supervision				1,167,737.35	11,405.47
	Grand Total for LOT 1				24,522,484.35	239,514.81

8.01.4 Engineering Drawing for rehabilitation work in Musaalani water pan

MUSAALANI WATER PAN



Notes General

- All dimensions are in meters unless otherwise stated.
- All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
- All indicated levels are finished floor levels unless otherwise noted.
- EL(=/-)0.00 corresponds to existing normal ground level.
- In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
- Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
- Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
- The lapping length of bars will be 50 x bar diameter
- Trenches shall be dug to the invert levels, graded and compacted to approval
- Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : SN

Date : 23 sep 2018

Scale : 1:1

Sheet

01



MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

- ## Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers,
EIA/EA Lead Experts, GIS
Experts, Water Resource
Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project	Rehabilitation of water structures in Machakos county
---------	---

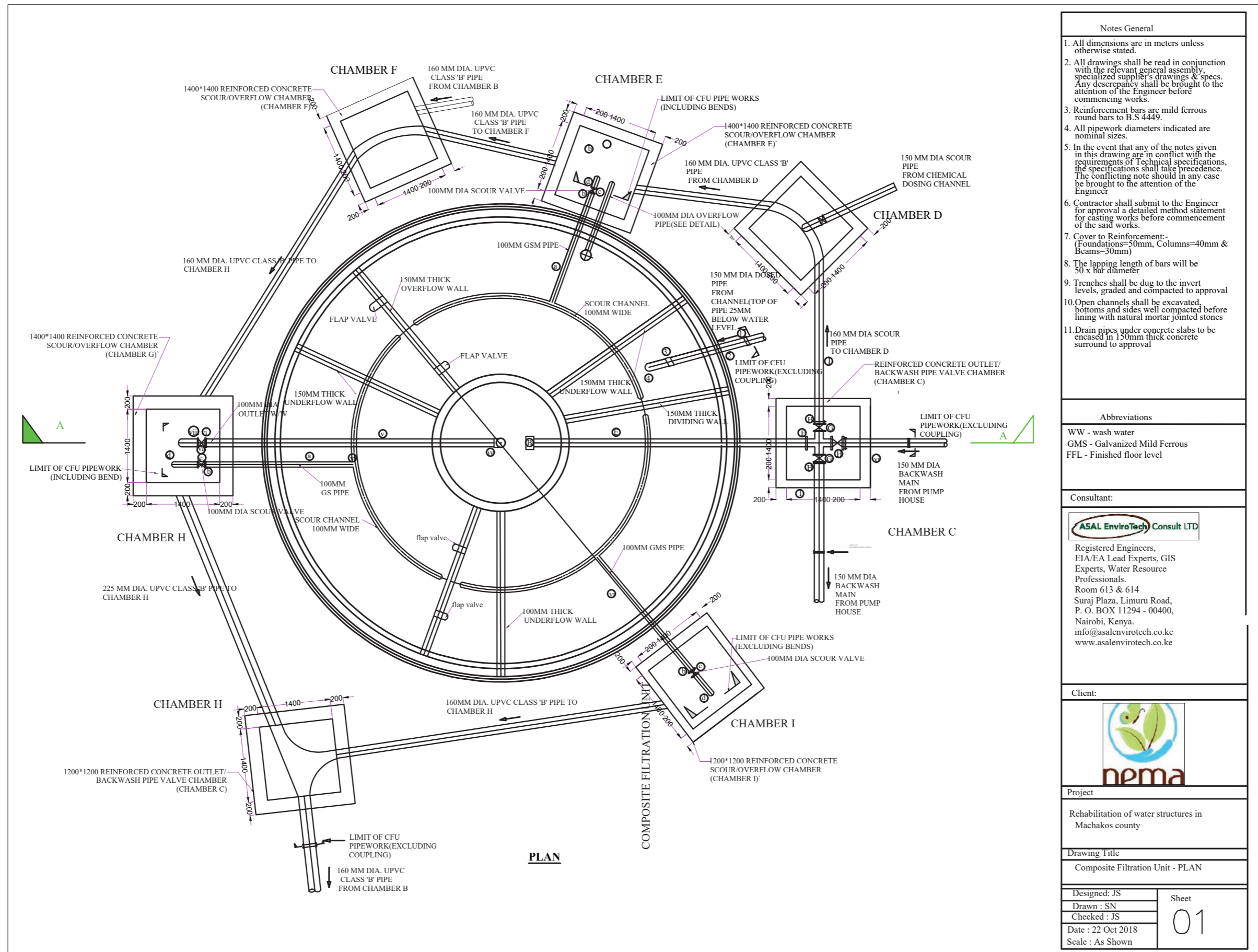
Drawing Title

Composite Filtration Unit - Section A-A

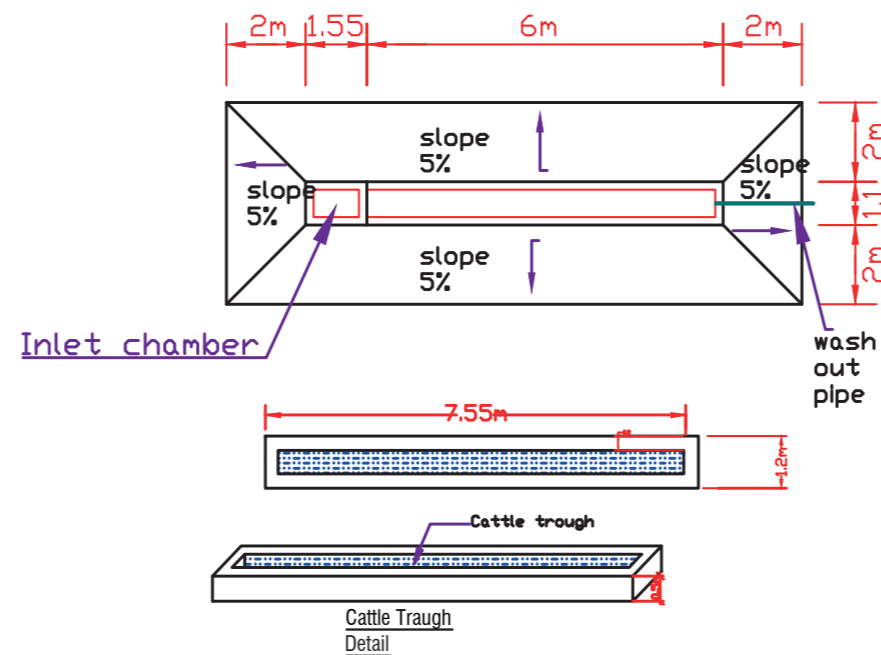
Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2019
Scale : 1/50

Sheet

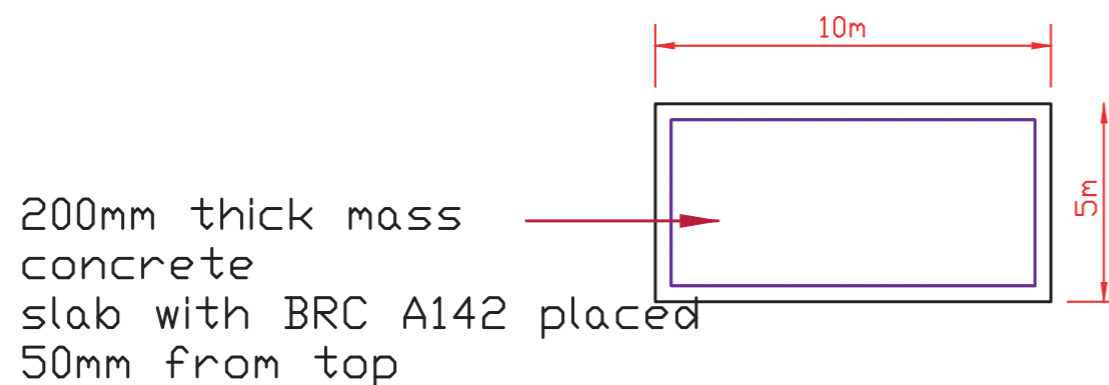
01



Notes General	
<ol style="list-style-type: none"> All dimensions are in meters unless otherwise stated. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works. Reinforcement bars are mild ferrous round bars to B.S 4449. All pipework diameters indicated are nominal sizes. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm) The lapping length of bars will be 50 x bar diameter Trenches shall be dug to the invert levels, graded and compacted to approval Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval 	
Abbreviations	
WW - wash water GMS - Galvanized Mild Ferrous FFL - Finished floor level	
Consultant:	
 Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Suraj Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke	
Client:	
	
Project	
Rehabilitation of water structures in Machakos county	
Drawing Title	
Composite Filtration Unit - PLAN	
Designed: JS	Sheet <div style="font-size: 2em; font-weight: bold; text-align: center;">01</div>
Drawn : SN	
Checked : JS	
Date : 22 Oct 2018	
Scale : As Shown	



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

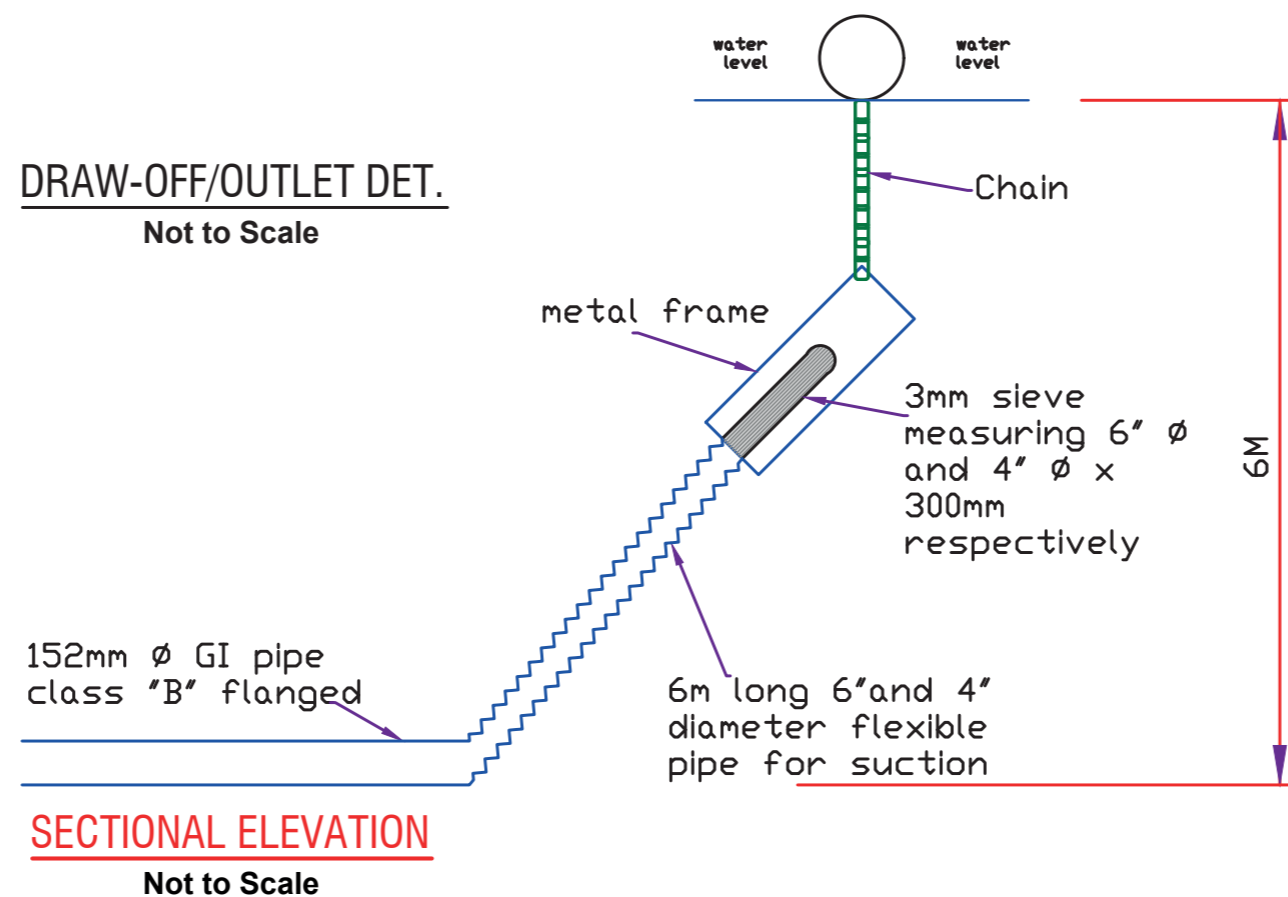
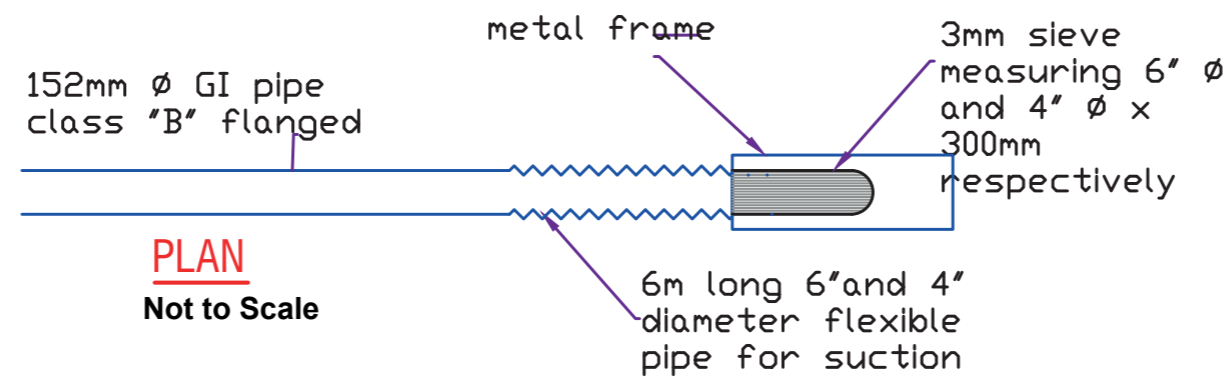
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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SuraJ Plaza, Limuru
Road,
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00400,
Nairobi, Kenya.
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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

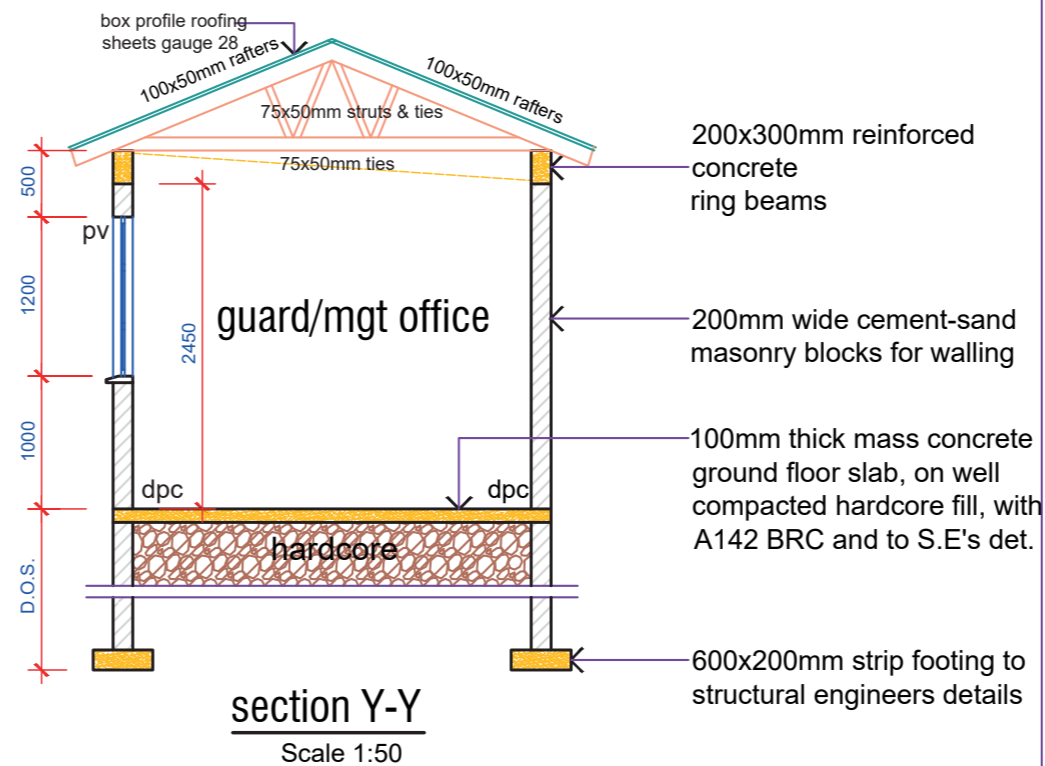
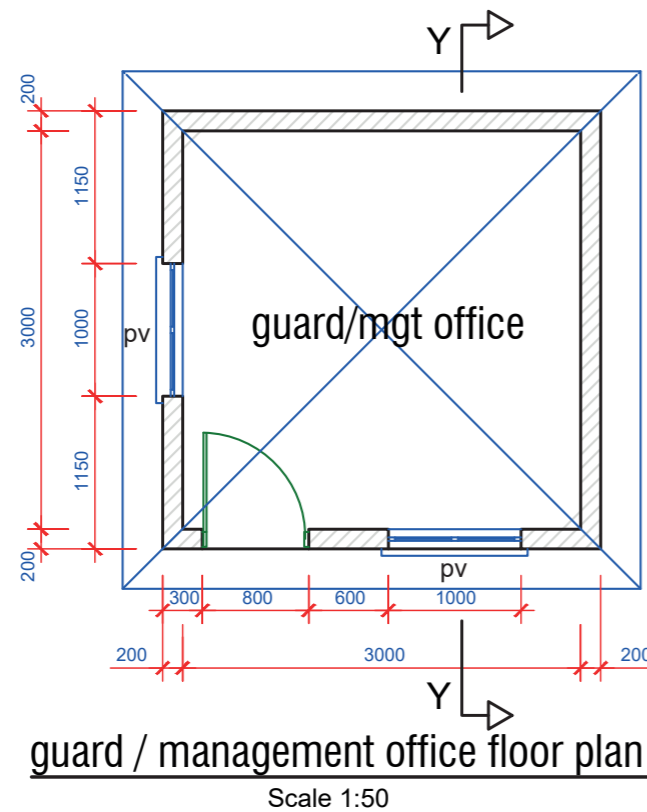
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
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P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.02 Description of Kwale water pan in Kangundo Sub-County, Machakos County

Kwale water pan is located in Yatta Sub-county of Machakos County. The volume of the water pan was estimated at 2,445,300 m³. The water pan is currently used for domestic water supply and livestock watering. There is also some small scale irrigation but not significant to warrant attention. However, there is no means of water treatment in this site. Hence there is need to secure the site and introduce water treatment system.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water, bathymetric survey to determine the current volume and assessment of the integrity of embankment. In addition, fencing it to prevent further encroachment will be done. Trees will be planted in the demarcated land to reduce direct runoff into the pan and act as windbreak in the plains. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. Water troughs will be provided for watering livestock.

As a contribution to environmental conservation a tree nursery with will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 tree and fruit seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house

will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.02.1 Figures showing the characteristic of Kwale water pan



Figure 76: Google image showing the location of Kwale water pan and its surroundings potential beneficiaries



Figure 77: A view of Kwale water pan



Figure 78: fetching water in Kwale water pan using Oxen cart, which comprises on the water quality

8.02.2 Beneficiaries

50,000 Households with an average of 6 members.

8.02.3 Bill of Quantities for the proposed rehabilitation works in Kwale Water pan

REHABILITATION OF KWALE WATERPAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

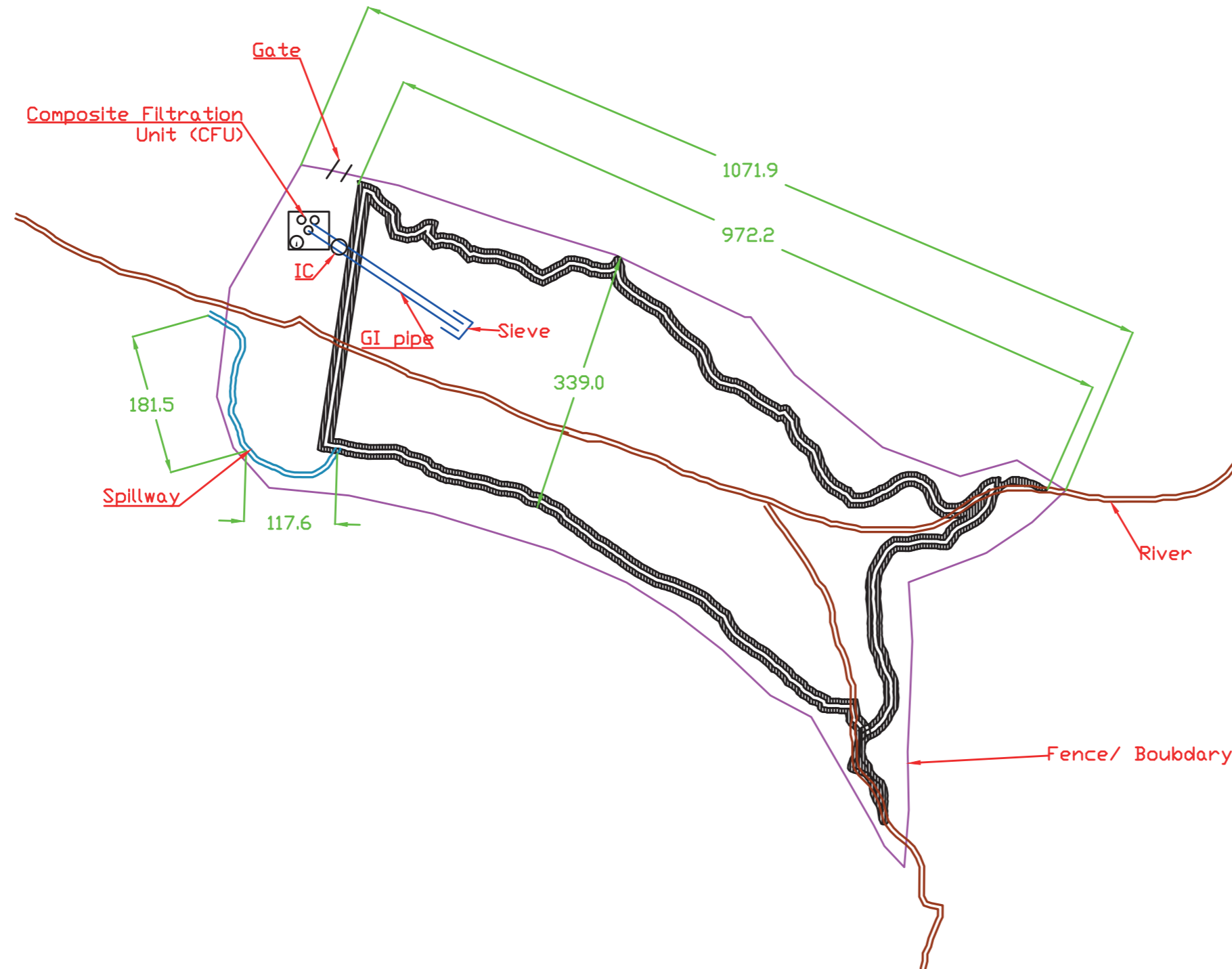
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey, embankment assessment and water quality analysis	PS	1	850,000.00	850,000.00	8,302.08
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,450,000.00	14,162.37
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 2				150,000.00	1,465.07
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88
4	Perimeter Fence, Guard house/shop					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	2,500.0	400.00	1,000,000.00	9,767.15
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				1,150,000.00	11,232.22

REHABILITATION OF KWALE WATERPAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
5.0.	Treatment works					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	3.0	2,000,000.00	6,000,000.00	58,602.91
5.2.	Allow for auxilliaries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 2				6,500,000.00	63,486.48
6.0.	Cattle Trough Construction					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	Environmental Conservation					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 7				550,000.00	5,371.93
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,450,000.00	14,162.37
	ELEMENT 2 - EARTHWORKS				150,000.00	1,465.07
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				1,150,000.00	11,232.22
	ELEMENT 5 - TREATMENT WORKS				6,500,000.00	63,486.48
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				550,000.00	5,371.93
	ALL ELEMENTS TOTAL				10,858,850.00	106,060.03
	Allow of 5% for supervision				542,942.50	5,303.00
	Grand Total				11,401,792.50	111,363.03

8.02.4 Engineering Drawing for the proposed rehabilitation works in Kwale Water pan

KWALE WATER PAN



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

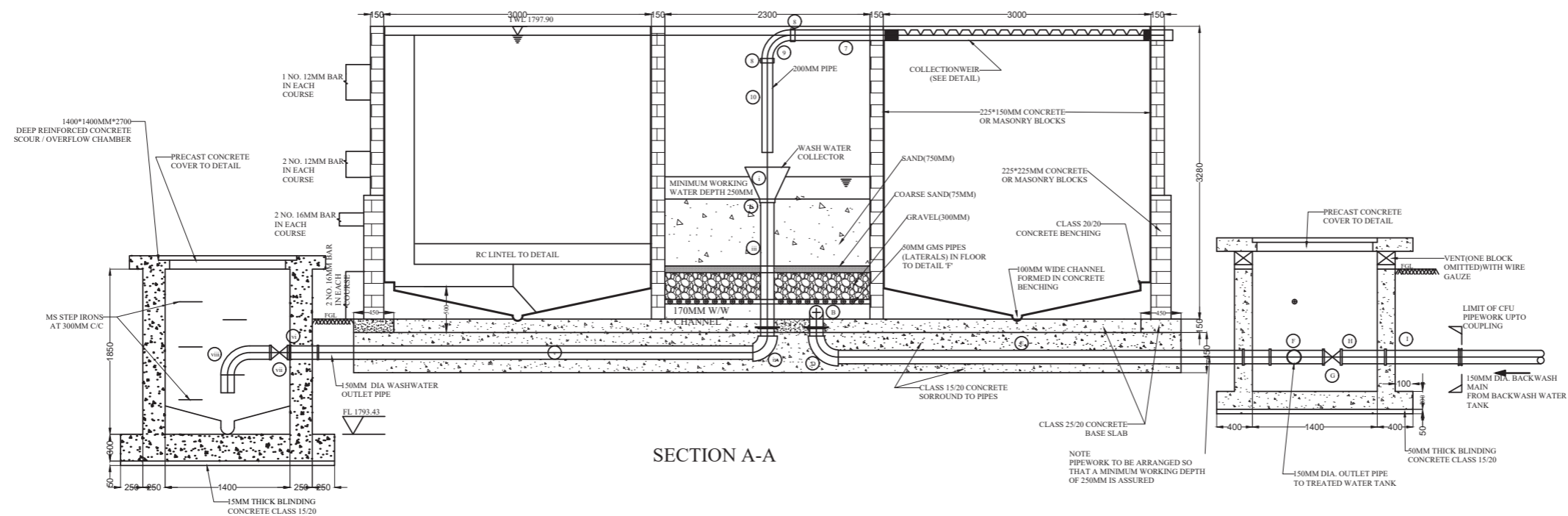
Checked : SN

Date : 23 sep 2018

Scale : 1:1

Sheet

01



FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

Notes General

- All dimensions are in meters unless otherwise stated.
- All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
- Reinforcement bars are mild ferrous round bars to B.S 4449
- All pipework indicated diameters are nominal sizes.
- In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
- Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
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- The lapping length of bars will be 50 x bar diameter
- Trenches shall be dug to the invert levels, graded and compacted to approval
- Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

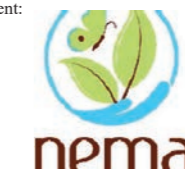
WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



Registered Engineers,
EIA/EA Lead Experts, GIS
Experts, Water Resource
Professionals.
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Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
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www.asalenvirotech.co.ke

Client:



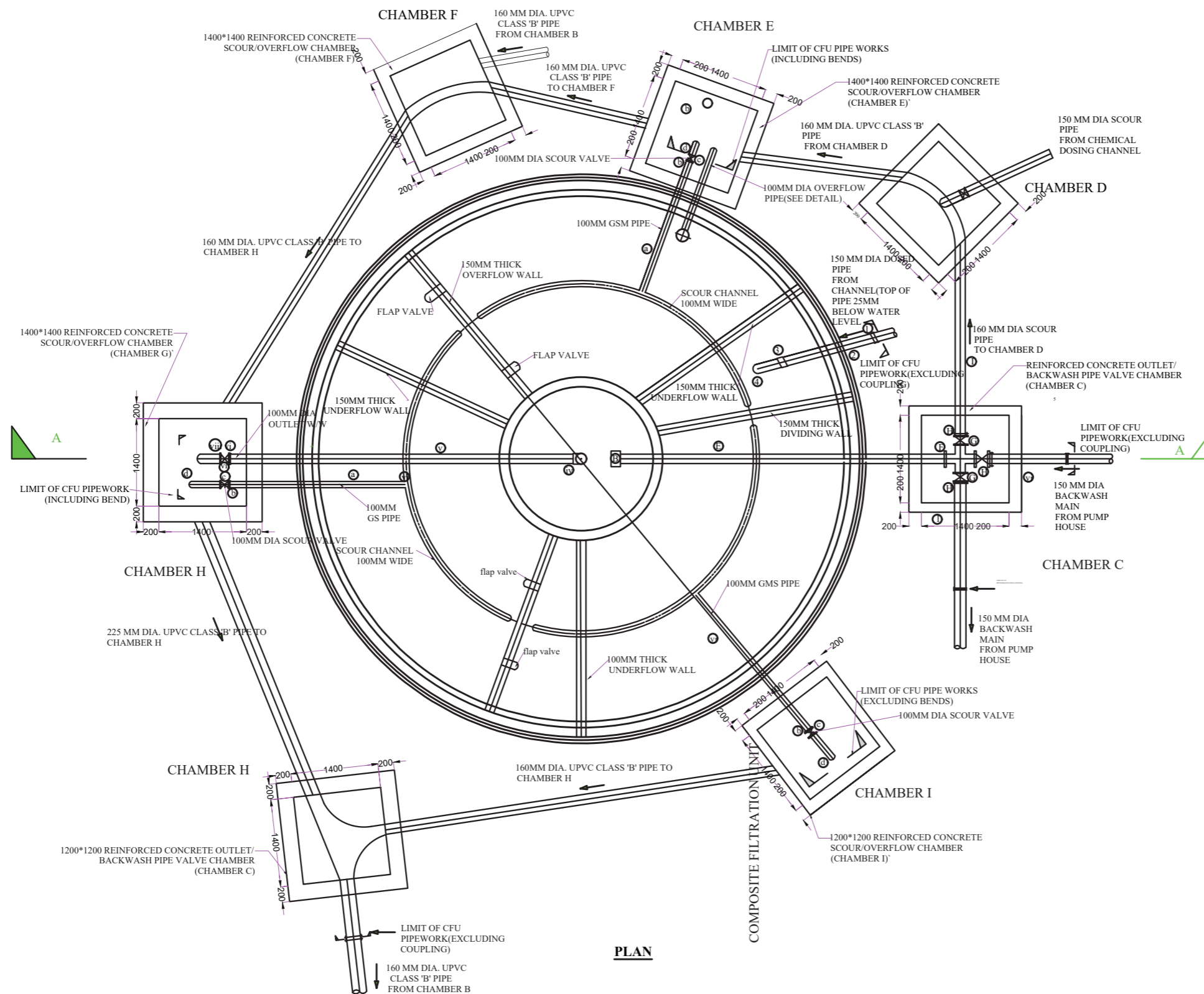
Project
Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - Section
A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

Sheet
01



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. Reinforcement bars are mild ferrous round bars to B.S 4449.
4. All pipework diameters indicated are nominal sizes.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
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10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - PLAN

Designed: JS

Drawn : SN

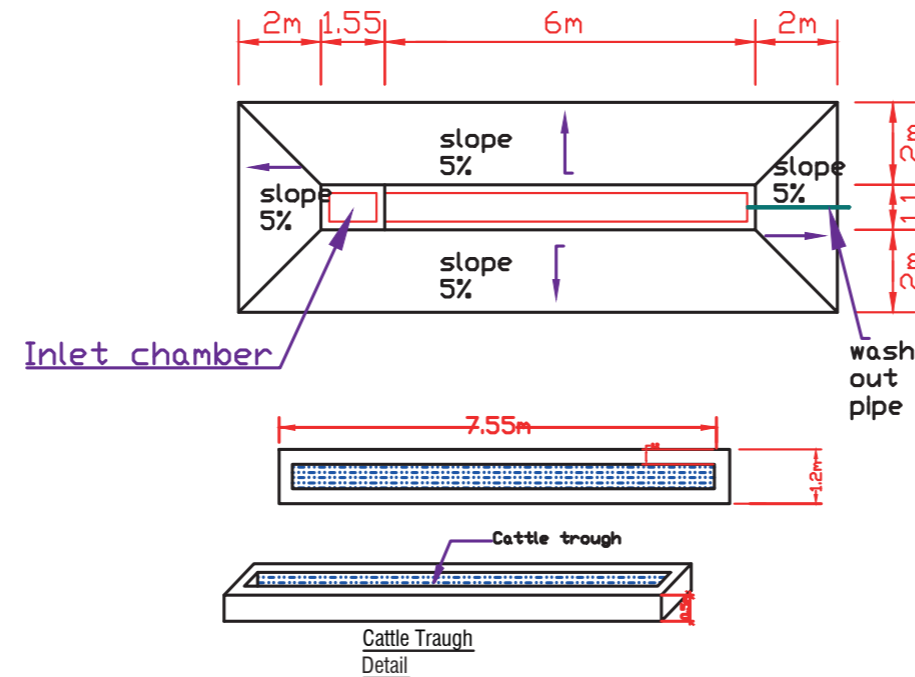
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Date : 22 Oct 2018

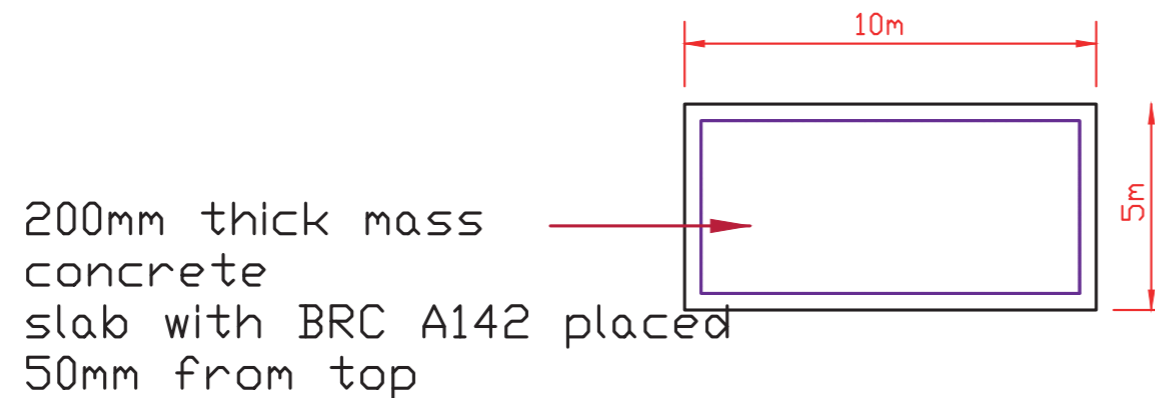
Scale : As Shown

Sheet

01



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
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7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
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11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
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Room 613 & 614
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00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

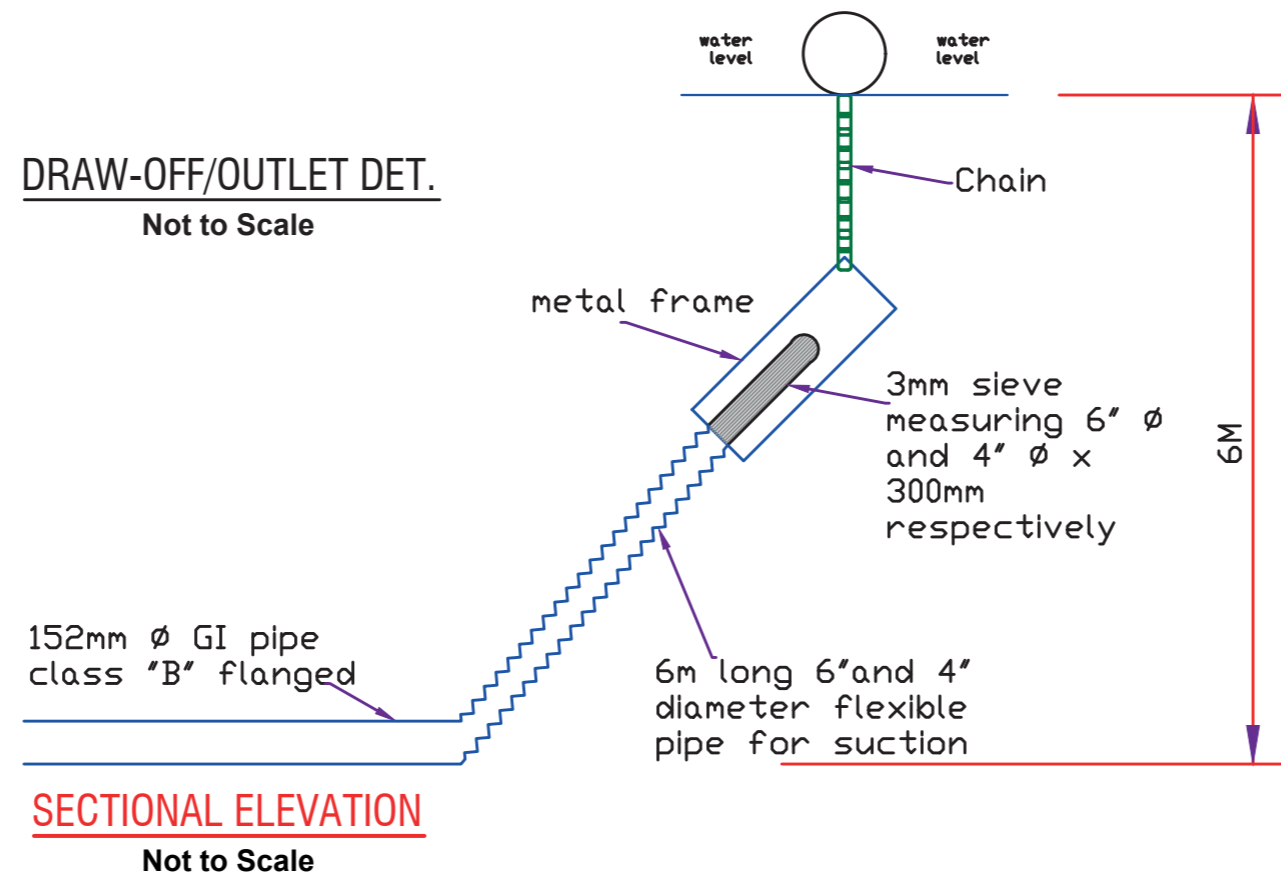
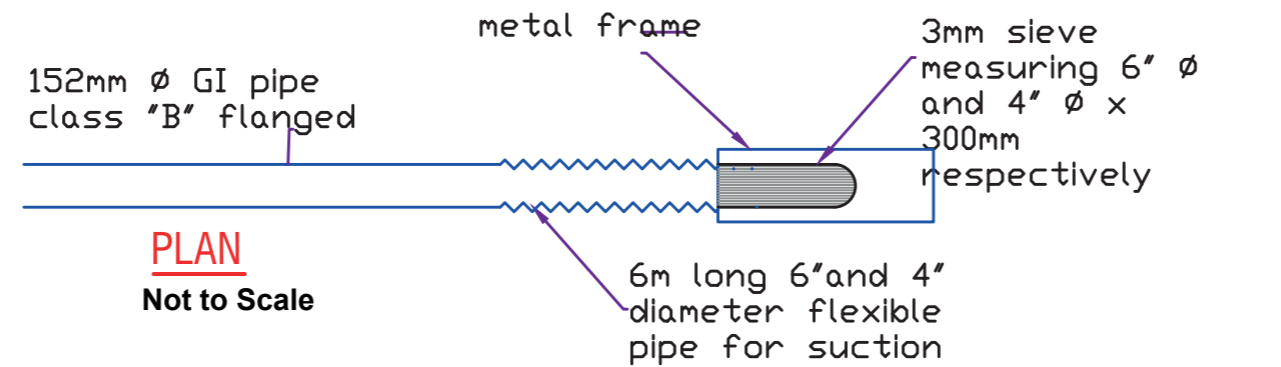
Date : 12 sep 2018

Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(-)/+0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
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11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

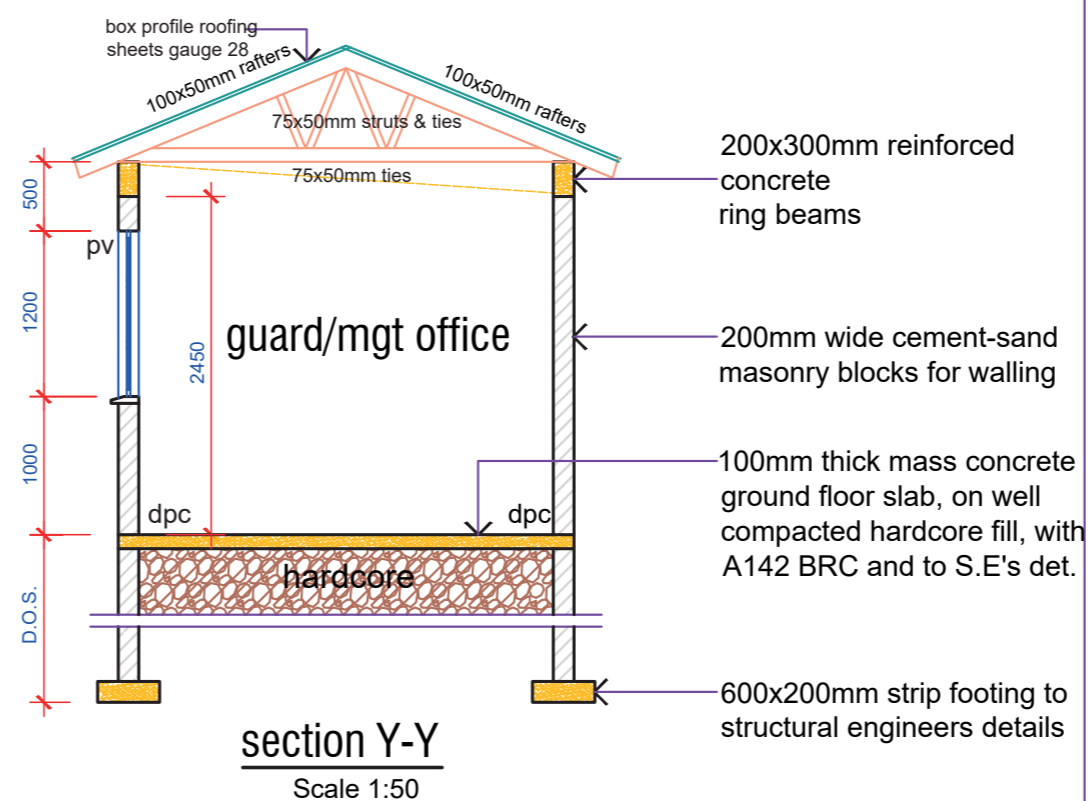
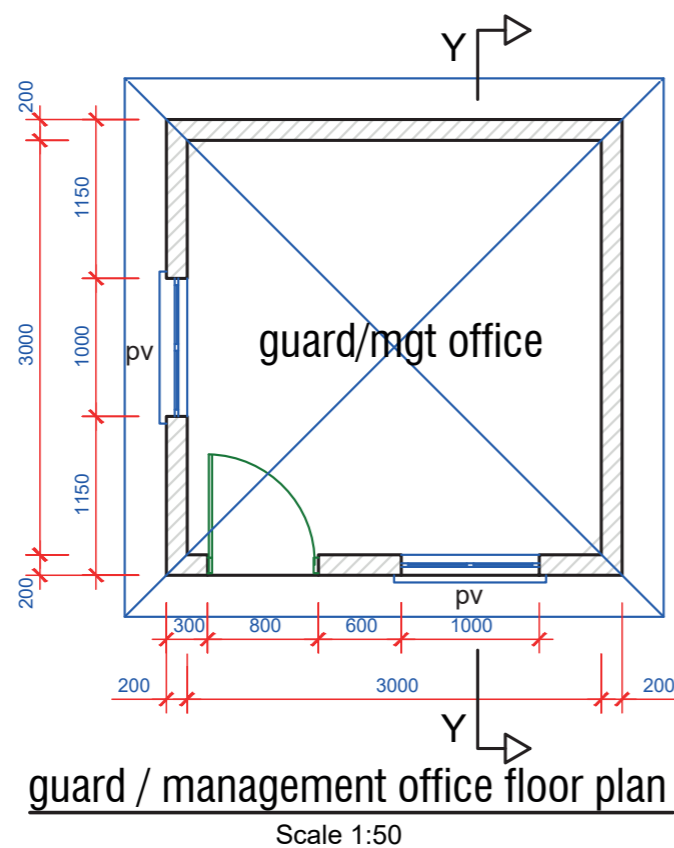
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.03 Description of Kailo spring in Kathiani Sub-County, Machakos County

Kailo spring is located in Kathiani Sub-county of Machakos County. The spring is a potential source of water to surrounding villages. Given its potential the spring was recommended for rehabilitation. The spring should be protected, and the area fenced off. Hybrid (solar and main electricity) pumping solution should be installed on site. The hybrid pumping solution was recommended because depending on main electricity was too expensive to use in the past. The water should then be piped (approximately 2,500 m) to beneficiaries' villages downstream.

As a contribution to environmental conservation the beneficiaries will plant at least 500 indigenous seedlings at the onset of the project and take care of them till they are fully established. The community water supply committee who charges a fee for water use will be responsible for day-to-day maintenance of the system. The beneficiary households will be responsible for sanitation issues at household levels.

8.03.1 Figures showing the characteristics of the Kailo springs



Figure 79: Google Earth image showing location of Kailo spring and the surroundings beneficiaries



Figure 80: Unprotected Kailo spring



Figure 81: Abandoned sump in Kailo spring



Figure 82: Women fetching water from Kailo spring

8.03.2 Beneficiaries of Kailo spring

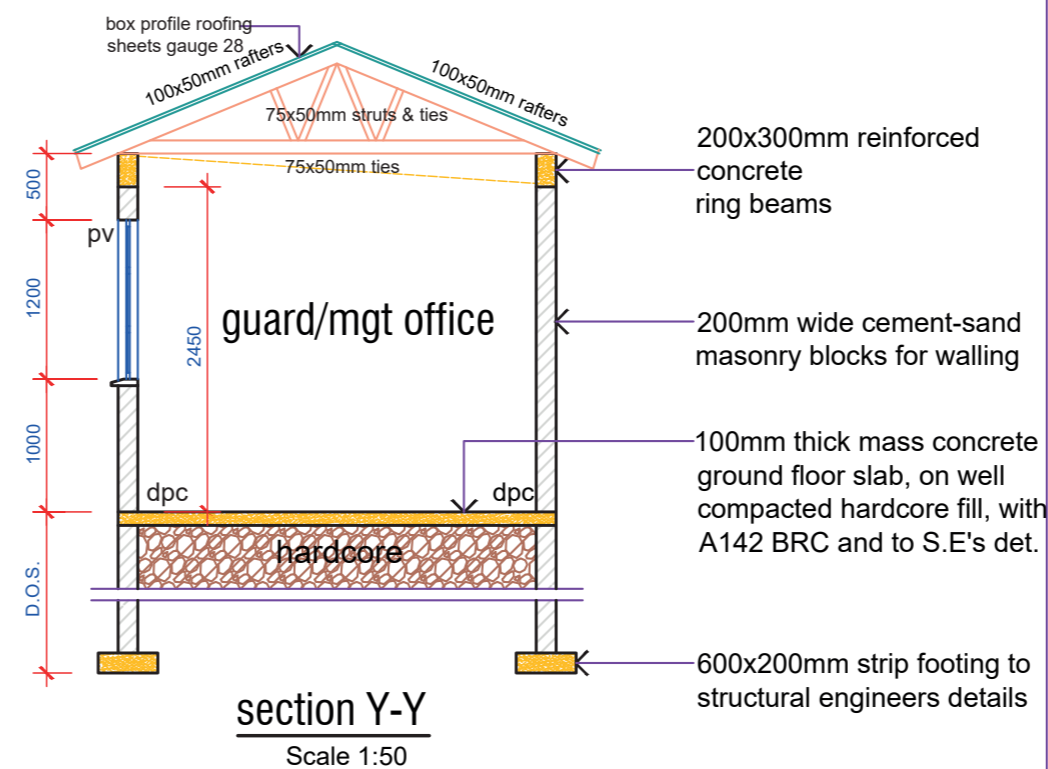
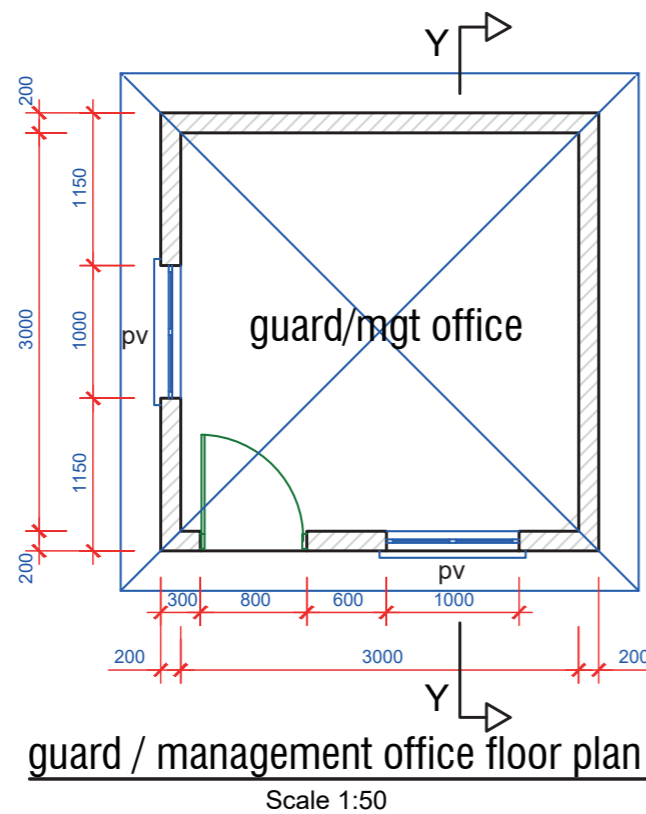
200 households with an average of 6 members.

8.03.3 Bill of Quantities for the proposed work in Kailo spring

REHABILITATION OF KALO SPRING IN KATHIANI, MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the spring	PS	1	150,000.00	150,000.00	1,465.07
1.2.	Allow for Security Costs	PS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 1				480,000.00	4,688.23
2.0. Masonry works						
2.1.	Provision for rehabilitation works of springs, sump and Pump house	LS	1.0	250,000.00	250,000.00	2,441.79
2.3.	Provision for reconnection of 3-phase power installation	LS	1.0	2,400,000.00	2,400,000.00	23,441.16
2.4.	Allow for purchase, installation and testing of Solar Panels and its accessories	LS	1.0	7,000,000.00	7,000,000.00	68,370.06
	Sub-Total Carried to Summary - Element 2				9,650,000.00	94,253.01
3.0. Pumping unit and Accessories						
3.1.	Allow for installation of submersible pump	NO	2.0	1,000,000.00	2,000,000.00	19,534.30
3.2.	Starter/control panel for 20HP motor	NO	2.0	400,000.00	800,000.00	7,813.72
3.3.	Provision for installations and testing of the pumping units and its accessories	LS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				2,950,000.00	28,813.10
4.0. Pipework						
4.1.	Clearing of pipeline site	LS	1.0	180,000.00	180,000.00	1,758.09
4.2.	Excavation and laying of pipes of channel for laying pipes	LM	2,500.0	450.00	1,125,000.00	10,988.05
4.4.	4" Rising Mains From Kalo Sump to the existing ground Masonry Tank	LS	1.0	1,000,000.00	1,000,000.00	9,767.15
	Sub-Total Carried to Summary - Element 4				2,305,000.00	22,513.28
5.0. Perimeter Fence, Guard house/shop						
5.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	250.0	600.00	150,000.00	1,465.07
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 5				170,000.00	1,660.42
6.0. Environmental Conservation						
6.1.	Allow for planting of indigineous trees upstream and downstream of the spring	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 6				250,000.00	2,441.79
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				480,000.00	4,688.23
	ELEMENT 2 - REHABILITATION WORK				9,650,000.00	94,253.01
	ELEMENT 3 - PUMPING UNIT				2,950,000.00	28,813.10
	ELEMENT 4 - PIPEWORK				2,305,000.00	22,513.28
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				170,000.00	1,660.42
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				250,000.00	2,441.79
	ALL ELEMENTS TOTAL				15,805,000.00	154,369.82
	Allow of 5% for supervision				790,250.00	7,718.49
	Grand Total				16,595,250.00	162,088.31

8.03.4 Engineering Drawing for the proposed work in Kailo spring



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
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7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
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Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS
Drawn: SN
Checked: JS
Date: 23 SEP 2018
Scale: as shown

Sheet

05

8.04 Description of Muooni water pan in Kathiani Sub-County, Machakos County

Muooni water pan is located in Kathiani Sub-county of Machakos County. The volume of the water pan was estimated at 122,193 m³. The water pan is currently used for domestic water supply and municipal water supply. The water from this water pan is treated and supplied to Kathiani town and its surroundings. However, there is no adequate means of treatment of water in the site due to one failed Composite Filtration Unit (CFU). Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to slow and filter direct runoff into the pan. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. One CFU will be constructed in the site. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 1,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

Machakos Water and Sewerage Company will be responsible for the day-to-day management of the water pan as they are currently do. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used form operation and maintenance of the project to enhance it sustainability. The company handles sanitation issues in Kathiani town however, various homesteads that benefit from the water supply outside the town will be handled sanitation at household level.

8.04.1 Figures showing the characteristics of Muooni water pan



Figure 83: Google image showing the location of Muooni water pan and its surroundings



Figure 84: A view of Muooni water pan



Figure 85: A leaking CFU in Muooni water pan proposed for rehabilitation

8.04.2 Beneficiaries of Muooni water pan

1,000 Households with an average of 6 members.

8.04.3 Bill of Quantities for the proposed rehabilitation work in Muooni water pan

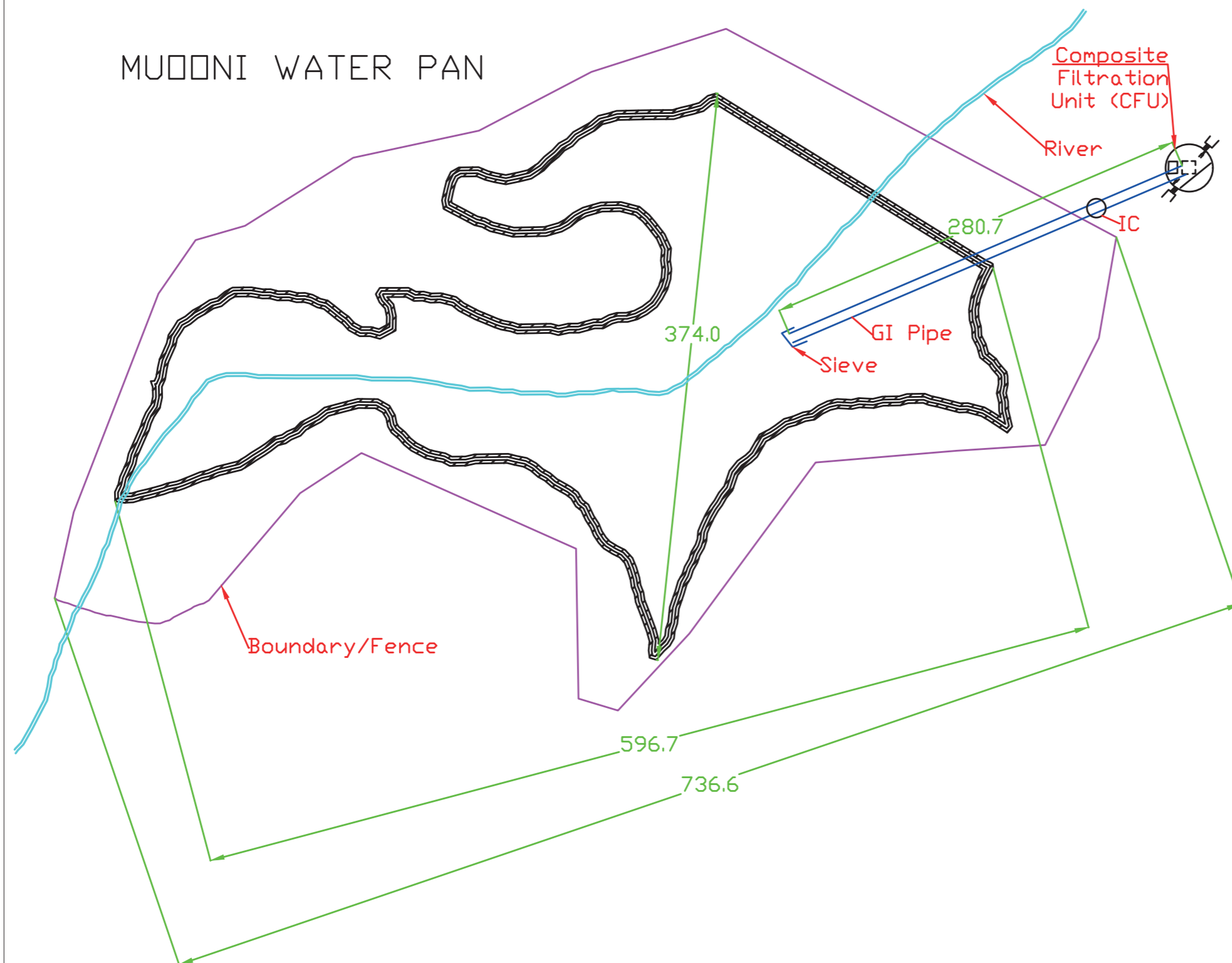
REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey, dam wall integrity assessment and water quality analysis	PS	1	850,000.00	850,000.00	8,302.08
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,500,000.00	14,650.73
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	100,000	3.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 2				300,000.00	2,930.15
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88
4	Perimeter Fence, Guard house/shop					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	3,000.0	400.00	1,200,000.00	11,720.58
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	3.0	20,000.00	60,000.00	586.03
	Sub-Total Carried to Summary - Element 4				1,260,000.00	12,306.61

REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
5.0.	<u>Treatment works</u>					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	1.0	2,000,000.00	2,000,000.00	19,534.30
	Sub-Total Carried to Summary - Element 2				2,000,000.00	19,534.30
6.0.	<u>Cattle Trough Construction</u>					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	1,000	250.00	250,000.00	2,441.79
	Sub-Total Carried to Summary - Element 7				300,000.00	2,930.15
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,500,000.00	14,650.73
	ELEMENT 2 - EARTHWORKS				300,000.00	2,930.15
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				1,260,000.00	12,306.61
	ELEMENT 5 - TREATMENT WORKS				2,000,000.00	19,534.30
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				300,000.00	2,930.15
	ALL ELEMENTS TOTAL				6,418,850.00	62,693.88
	Allow of 5% for supervision				320,942.50	3,134.69
	Grand Total				6,739,792.50	65,828.57

8.04.4 Engineering Drawing for the proposed rehabilitation work in Muooni water pan



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
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Lead Experts, GIS
Experts, Water
Resource
Professionals.
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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

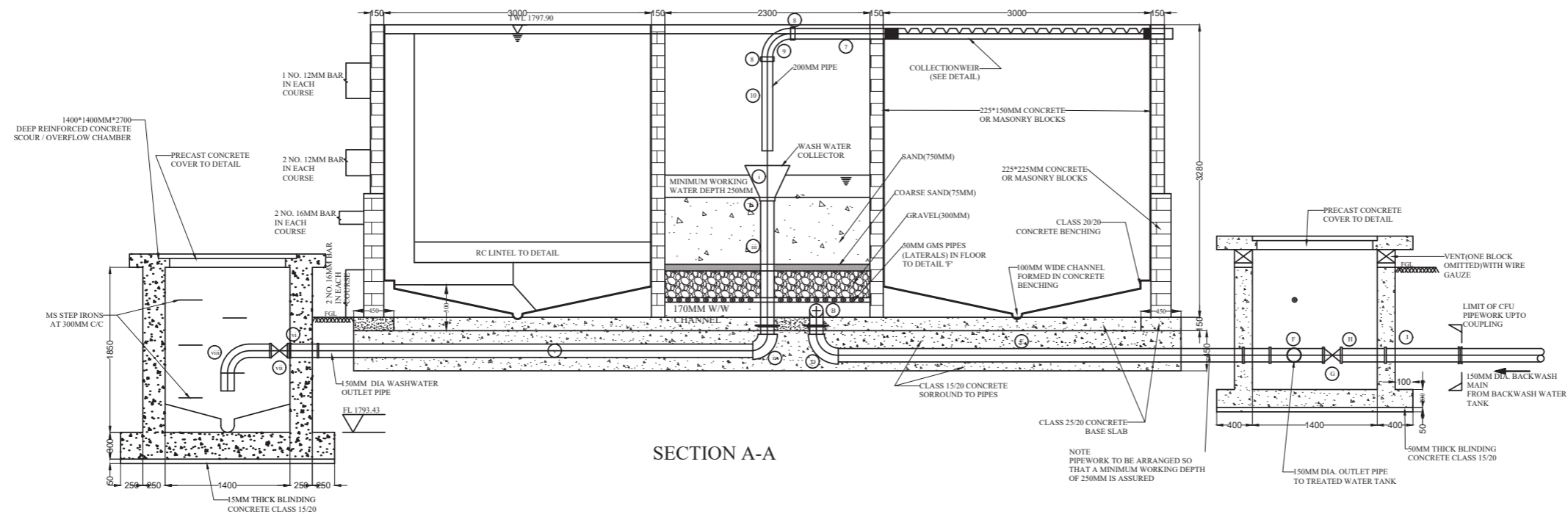
Checked : SN

Date : 23 sep 2018

Scale : 1: 1

Sheet

01



SECTION A-A

FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

Notes General

- All dimensions are in meters unless otherwise stated.
- All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
- Reinforcement bars are mild ferrous round bars to B.S 4449
- All pipework indicated diameters are nominal sizes.
- In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
- Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
- Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
- The lapping length of bars will be 50 x bar diameter
- Trenches shall be dug to the invert levels, graded and compacted to approval
- Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



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Experts, Water Resource
Professionals.
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Client:



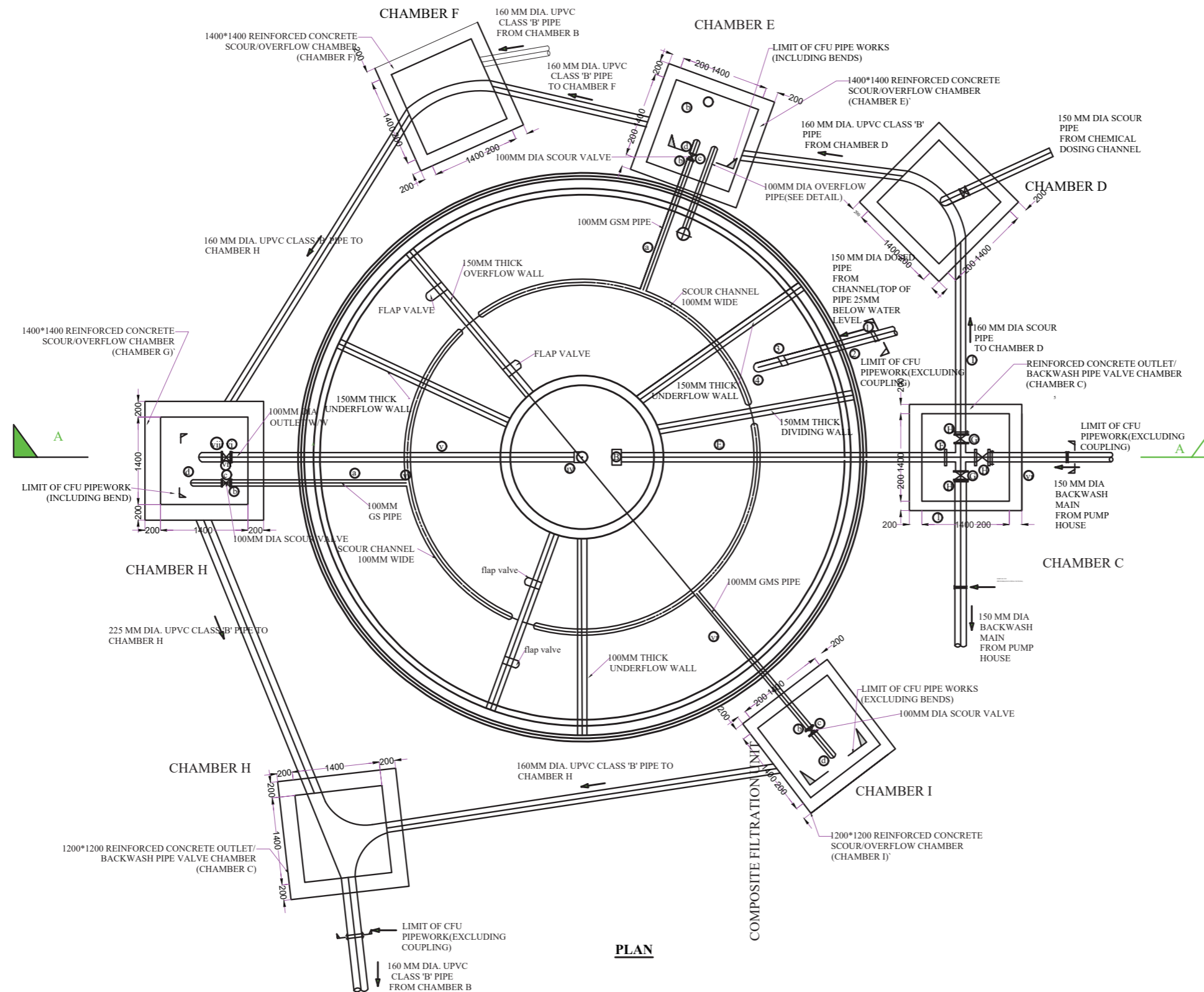
Project
Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - Section
A-A

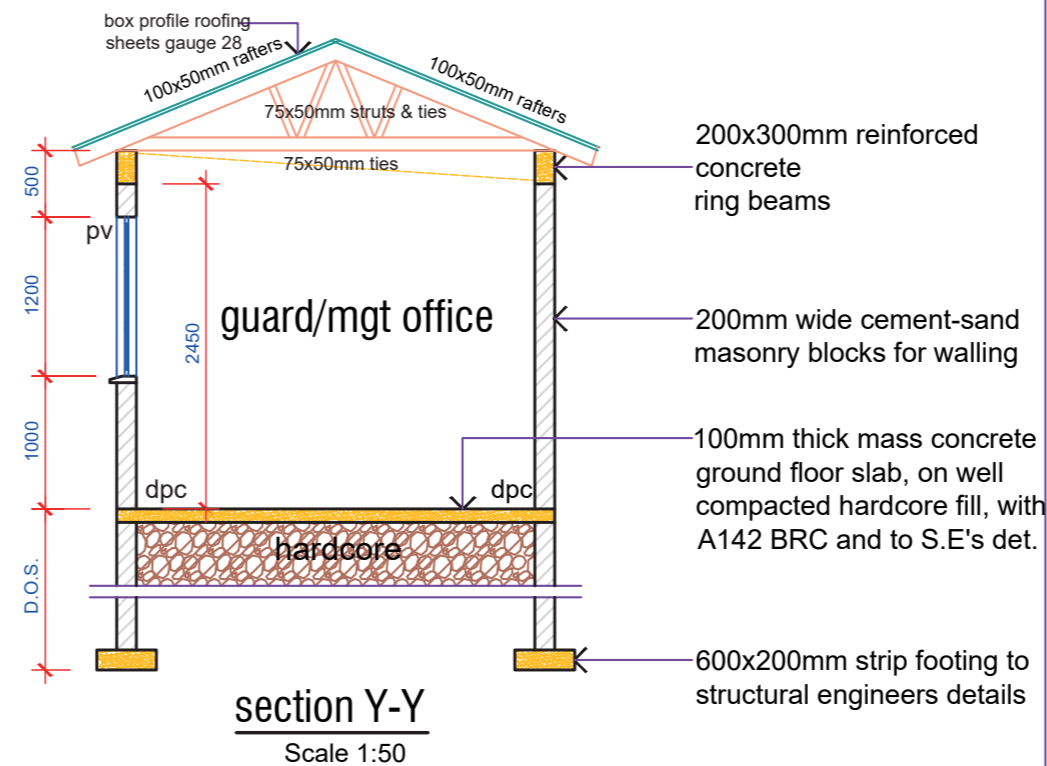
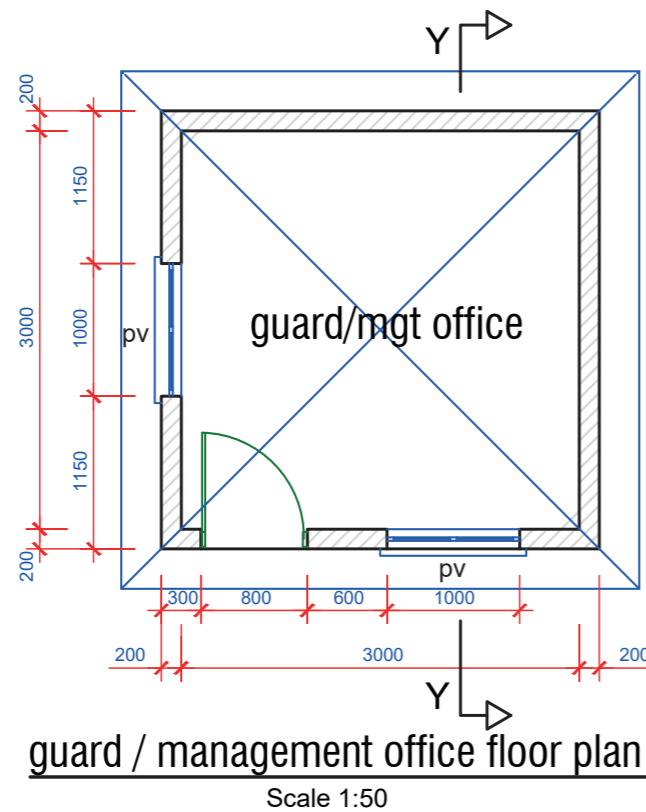
Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

Sheet
01



PLAN

Notes General	
<ol style="list-style-type: none"> All dimensions are in meters unless otherwise stated. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works. Reinforcement bars are mild ferrous round bars to B.S 4449. All pipework diameters indicated are nominal sizes. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm) The lapping length of bars will be 50 x bar diameter Trenches shall be dug to the invert levels, graded and compacted to approval Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval 	
Abbreviations	
WW - wash water GMS - Galvanized Mild Ferrous FFL - Finished floor level	
Consultant:	
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Client:	
	
Project	
Rehabilitation of water structures in Machakos county	
Drawing Title	
Composite Filtration Unit - PLAN	
Designed: JS	Sheet <div>01</div>
Drawn : SN	
Checked : JS	
Date : 22 Oct 2018	
Scale : As Shown	



Notes General

1. All dimensions are in mm unless otherwise stated.
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3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.05 Description of Mithatini borehole in Kathiani Sub-County, Machakos County

The proposed Mithatini borehole will be a solar powered and meant to augment domestic water supply in Kathiani sub-county of Machakos County. Some of the proposed preliminaries activities to develop this borehole includes hydrological survey, and Environmental and Socio Impact Assessment (ESIA). Drilling works will also involve preventing collapse in collapsible zones using suitable casing, which is provide for in the BOQ.

Once drilling is completed and the borehole appropriately cased a 24-hour test pumping will be carried out to determine its yield. Laboratory analysis will be carried to ascertain the suitability of the water for domestic use. Finally, solar panels, pumps, storage tanks and reticulations to point of use will be installed. The water will be supplied and will rely on existing sanitation service provided by Machakos Water & Sewerage Company Limited or existing stand-alone systems at home. The company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 300 indigenous trees in borehole sites and its surrounding area.

8.05.1 Figure showing the location of proposed Mithatini borehole



Figure 86: Google image showing the proposed location of Mithatini borehole

8.05.2 Beneficiaries of Mithatini borehole

3,000 Households with an average of 6 members.

8.05.3 Bill of Quantities for the proposed development of Mithatini borehole

DRILLING OF MITHATINI COMMUNITY BOREHOLE IN MUTWANI, MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0. Preliminaries						
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.2.	Provisional amount for hydrogeological sites to identify drilling sites.	PS	1.0	100,000.00	100,000.00	976.72
1.3.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
1.4.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				540,000.00	5,274.26
2.0. Drilling works						
2.1.	Drilling 203 mm diameter Borehole from 0-200 m depth	LM	200.0	7,500.00	1,500,000.00	14,650.73
2.2.	Additional Provisional costs in case of borehole collapse in collapsible zone. Installation of Non- Removable 8" Surface casings in the event of Borehole Collapse in the collapse zone	LM	50.0	7,000.00	350,000.00	3,418.50
2.3.	Supply of water used during drilling & development and for campsite use	CM	0.9	45,000.00	40,500.00	395.57
2.4.	6 Inch (153mm) diameter STEEL casings pipe	LM	200.0	4,000.00	800,000.00	7,813.72
2.5.	6 Inch (153mm) STEEL screens in Plasma Slots	LM	50.0	4,500.00	225,000.00	2,197.61
2.6.	Supply & filling of Gravel pack(2- 4mm)	KG	20,000.0	45.00	900,000.00	8,790.44
2.7.	Borehole development work/FLASHING using compressed air injected in to the borehole	HR	2.0	5,000.00	10,000.00	97.67
2.8.	24 Hours Test pumping Calibration, step test, and discharge test, recovery test after test pumping	LS	1.0	100,000.00	100,000.00	976.72
2.9.	Construction of concrete slab with well cap	NO	1.0	2,500.00	2,500.00	24.42
2.10.	Provisional amount for tanks and reticulations to point of use	PS	1.0	2,000,000.00	2,000,000.00	19,534.30
	Sub-Total Carried to Summary - Element 2				5,928,000.00	57,899.67
3.0. Laboratory analysis and completion reports						
3.1.	Allow for water analysis test - Bacteriological, chemical and physical tests to WHO standards	LS	1.0	20,000.00	20,000.00	195.34
3.2.	Allow for borehole completion report	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				30,000.00	293.01
4.0. Pumping and storages						
4.1.	Provisional sum for installing tanks, steel stand and solar pumping unit	PS	1.0	2,500,000.00	2,500,000.00	24,417.88
4.2.	Provision sum for reticulation of water to the point of use	PS	1.0	1,000,000.00	1,000,000.00	9,767.15
	Sub-Total Carried to Summary - Element 3				3,500,000.00	34,185.03
5.0. Perimeter Fence, Guard house/shop						
5.1	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	50.0	600.00	30,000.00	293.01
5.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
5.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 5				350,000.00	3,418.50
6.0. Environmental Conservation						
6.1.	Allow for planting of indigineous trees upstream and downstream of the spring	No	300	250.00	75,000.00	732.54
	Sub-Total Carried to Summary - Element 6				75,000.00	732.54
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				540,000.00	5,274.26
	ELEMENT 2 - DRILLING WORK				5,928,000.00	57,899.67
	ELEMENT 3 - LAB ANALYSIS AND COMPLETION REPORT				30,000.00	293.01
	ELEMENT 4 - PUMPING AND STORAGE				3,500,000.00	34,185.03
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				350,000.00	3,418.50
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				75,000.00	732.54
	ALL ELEMENTS TOTAL				10,423,000.00	101,803.02
	Allow of 5% for supervision				521,150.00	5,090.15
	Grand Total				10,944,150.00	106,893.17

8.05.4 Engineering Drawing for the proposed development of Mithatini borehole



MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

- ## Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



Registered Engineers,
EIA/EA Lead Experts, GIS
Experts, Water Resource
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Client



Project
Rehabilitation of water structures in
Machakos county

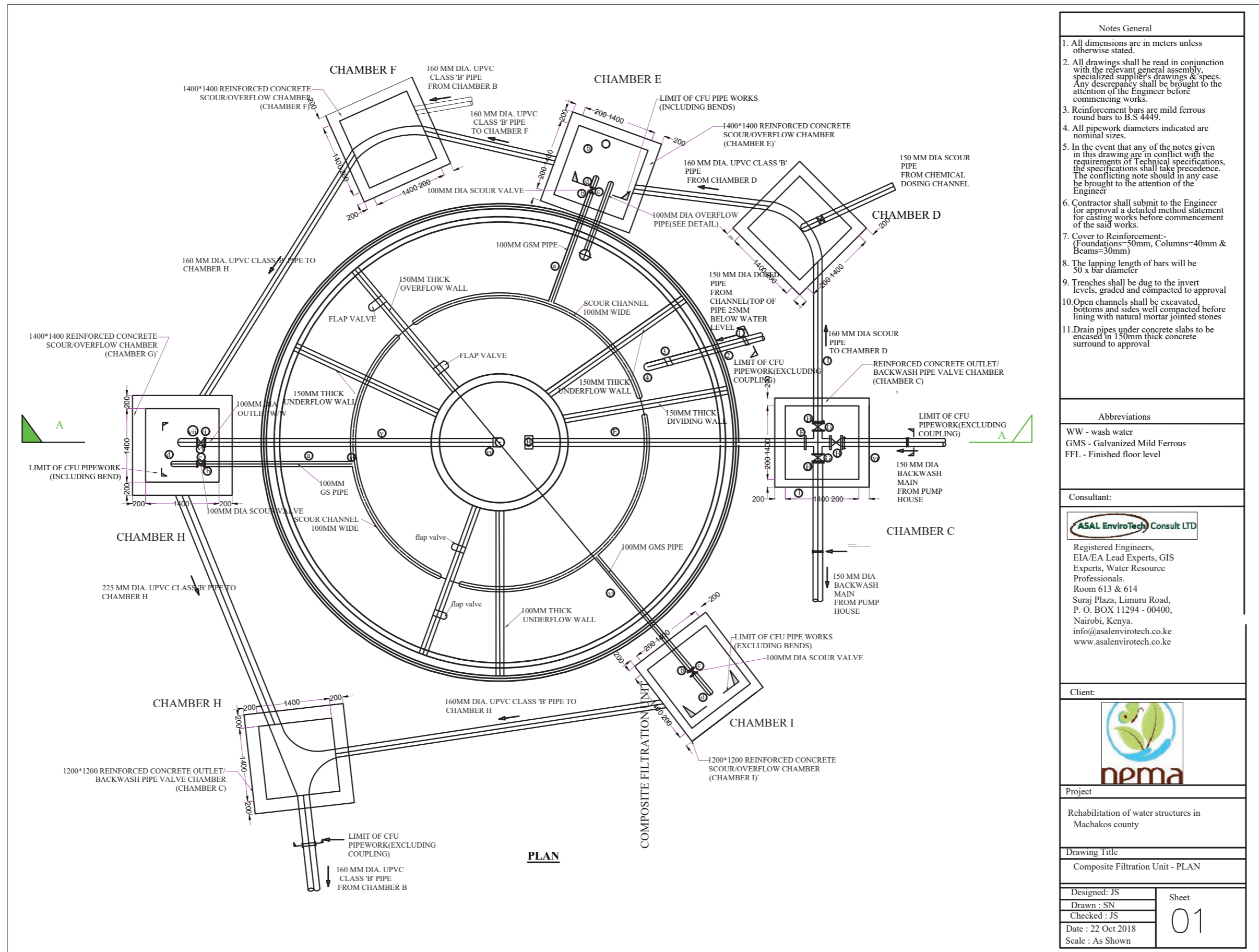
Drawing Title

Composite Filtration Unit - Section
A-A

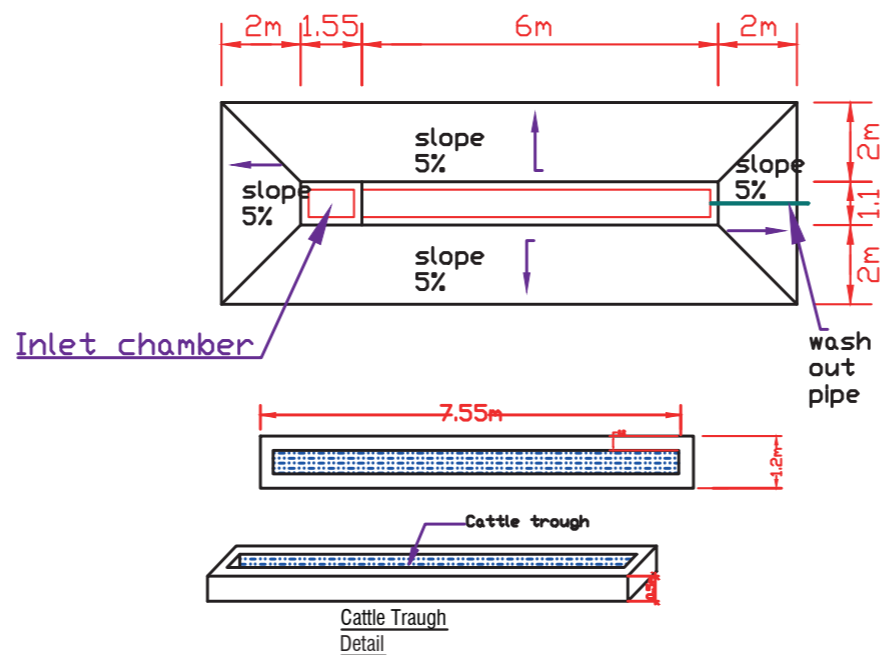
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 Checked : SN
 Date : 22 Oct 19
 Scale : 1/50

Sheet

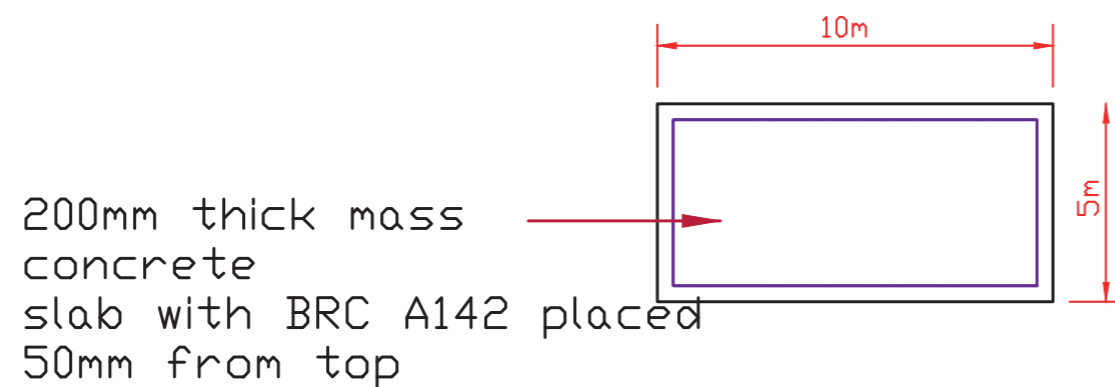
01



Notes General	
<ol style="list-style-type: none"> All dimensions are in meters unless otherwise stated. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works. Reinforcement bars are mild ferrous round bars to B.S 4449. All pipework diameters indicated are nominal sizes. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm) The lapping length of bars will be 50 x bar diameter Trenches shall be dug to the invert levels, graded and compacted to approval Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval 	
Abbreviations	
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Consultant:	
 Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Suraj Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke	
Client:	
	
Project	
Rehabilitation of water structures in Machakos county	
Drawing Title	
Composite Filtration Unit - PLAN	
Designed: JS	Sheet <div style="font-size: 2em; font-weight: bold; text-align: center;">01</div>
Drawn : SN	
Checked : JS	
Date : 22 Oct 2018	
Scale : As Shown	



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
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Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



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Lead Experts, GIS
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00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

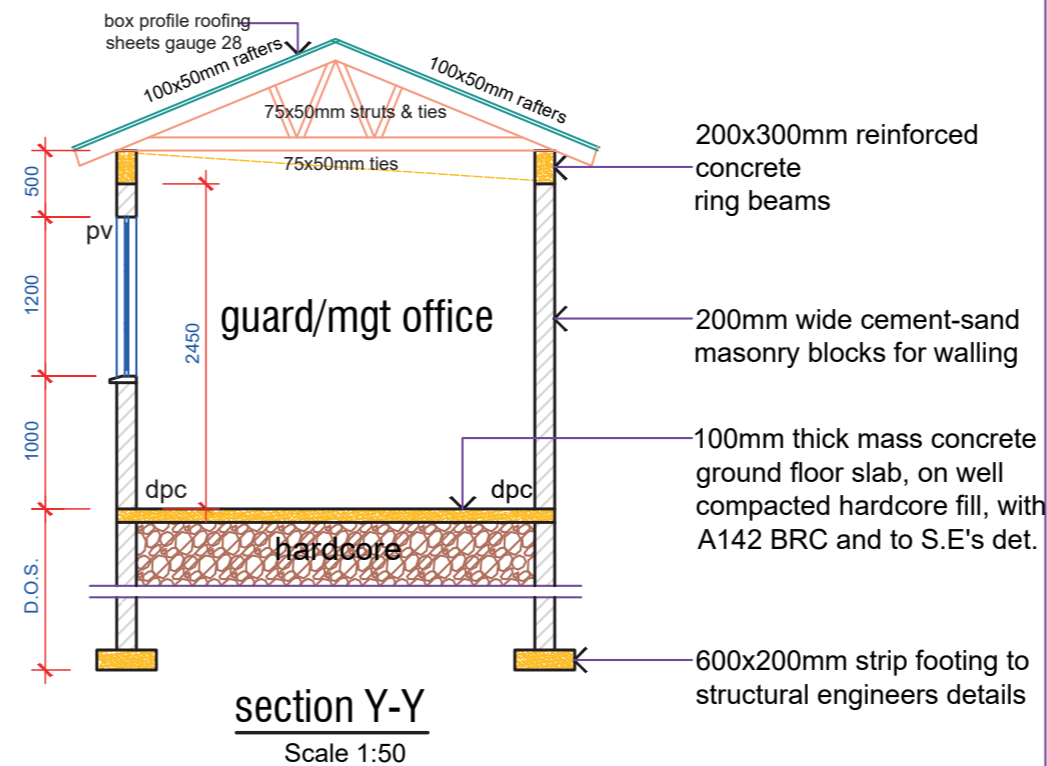
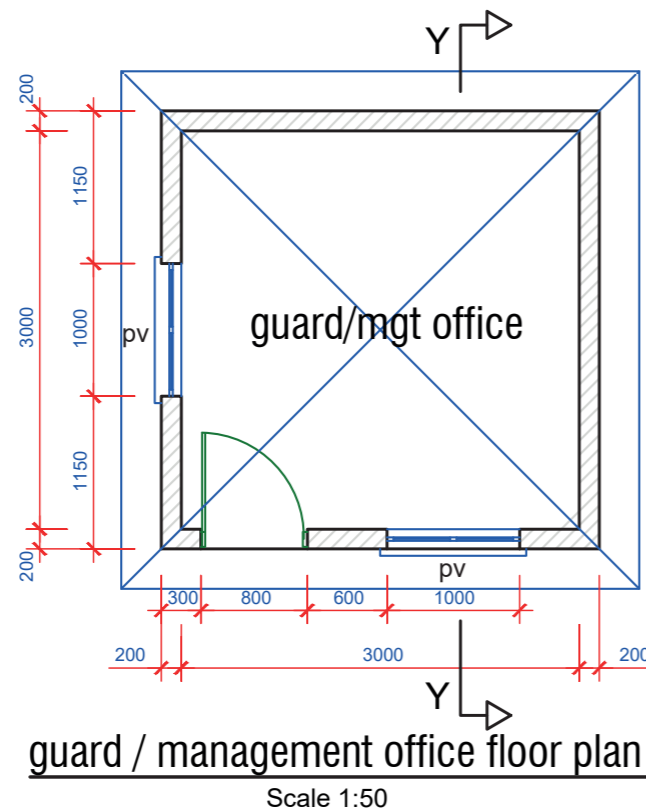
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
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Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.06 Description of providing dispensary with water tanks in Machakos County

To enhance rainwater harvesting and provide water to local dispensaries. It was proposed that 160 water tanks of 10 m³ each be availed to Machakos county. Each of the 80 dispensaries will benefit from two water tanks. Plastics gutter will be installed to collect rainwater to one tank, after which a solar pump will elevate the water to a second tank elevated using still tanks. From the second tank water will flow by gravity to the point of use within the Hospital.

The health centres are distributed across the counties and serve a number of people who need medical attention. Based on this it was not only estimated that the availability of the water will serve the dispensaries but also over 20,000 beneficiaries who rely on the health centres for their medical care. The health Centres committee will be in charge of operation and maintenance of the system and they will also take care of sanitation issues on site.

8.06.1 Beneficiaries of water tanks

20,000 Households with an average of 6 members.

8.06.2 Bill of Quantities for providing water tanks dispensaries

PROVISION OF RAINWATER HARVESTING TANKS IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	80.0	40,000.00	3,200,000.00	31,254.88
	Sub-Total Carried to Summary - Element 1				3,200,000.00	31,254.88
2.0.	Provision of Tanks					
2.1.	Provision for Procuring and distribution of 10m3 plastic water tanks per health facility in the county	NO	160	120,000.00	19,200,000.00	187,529.30
2.2.	Provision for fabrication and installation of cutters and stands	No	80	55,000.00	4,400,000.00	42,975.46
2.3.	Provision for solar pumping to elevated tank	No	80.0	160,000.00	12,800,000.00	125,019.53
	Sub-Total Carried to Summary - Element 2				36,400,000.00	355,524.30
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				3,200,000.00	31,254.88
	ELEMENT 2 - PROVISION OF WATER TANKS				36,400,000.00	355,524.30
	ALL ELEMENTS TOTAL				39,600,000.00	386,779.18
	Allow of 5% for supervision				1,980,000.00	19,338.96
	Grand Total				41,580,000.00	406,118.14

8.07 Description of Muthutheni water pan in Mwala Sub-County, Machakos County

Muthutheni water pan is located in Mwala Sub-county of Machakos County. The volume of the water pan was estimated at 24,740 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.07.1 Figure showing the location of the Mutheteni water pan



Figure 87: Google image showing the location of Mutheteni water pan and its surroundings

8.07.2 Beneficiaries of Muthuteni water pan

2500 households with an average of 6 members.

8.07.3 Bill of Quantities for the proposed rehabilitation work in Muthuteni water pan

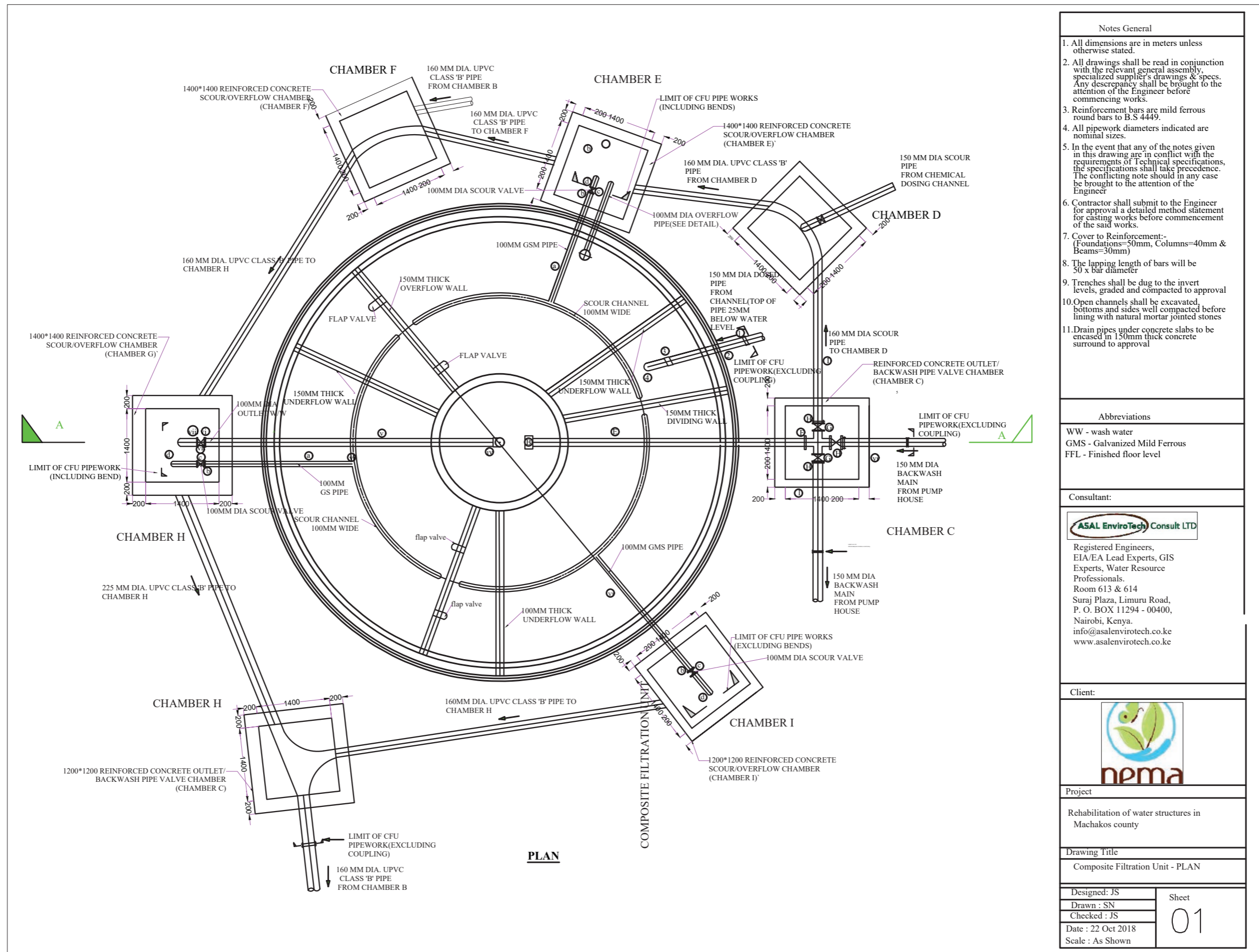
REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey, embankment assessment and water quality analysis	PS	1	850,000.00	850,000.00	8,302.08
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,500,000.00	14,650.73
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	33,600	450.00	15,120,000.00	147,679.32
	Sub-Total Carried to Summary - Element 2				15,270,000.00	149,144.40
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.7.	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:-</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88

REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
4.0.	<u>Perimeter Fence, Guard house/shop</u>					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	2,400.0	400.00	960,000.00	9,376.47
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	130,000.00	130,000.00	1,269.73
Sub-Total Carried to Summary - Element 4					1,110,000.00	10,841.54
5.0.	<u>Treatment works</u>					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	2.0	2,000,000.00	4,000,000.00	39,068.60
5.2.	Allow for auxillaries connections and other structures	PS	1.0	400,000.00	400,000.00	3,906.86
Sub-Total Carried to Summary - Element 5					4,400,000.00	42,975.46
6.0.	<u>Cattle Trough Construction</u>					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
Sub-Total Carried to Summary - Element 6					150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigineous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
Sub-Total Carried to Summary - Element 7					550,000.00	5,371.93
GRAND SUMMARY						
ELEMENT 1 - PRELIMINARIES					1,500,000.00	14,650.73
ELEMENT 2 - EARTHWORKS					15,270,000.00	149,144.40
ELEMENT 3 - AUXILIARY STRUCTURES					908,850.00	8,876.88
ELEMENT 4 - PERIMETER FENCE					1,110,000.00	10,841.54
ELEMENT 5 - TREATMENT WORKS					4,400,000.00	42,975.46
ELEMENT 6 - CATTLE TROUGH					150,000.00	1,465.07
ELEMENT 7 - ENVIRONMENTAL CONSERVATION					550,000.00	5,371.93
ALL ELEMENTS TOTAL					23,888,850.00	233,326.01
Allow of 5% for supervision					1,194,442.50	11,666.30
Grand Total					25,083,292.50	244,992.31

8.07.4 Engineering Drawing for the proposed rehabilitation work in Muthuteni water pan



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. Reinforcement bars are mild ferrous round bars to B.S 4449.
4. All pipework diameters indicated are nominal sizes.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

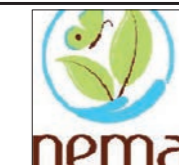
WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



Registered Engineers,
EIA/EA Lead Experts, GIS
Experts, Water Resource
Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - PLAN

Designed: JS

Drawn : SN

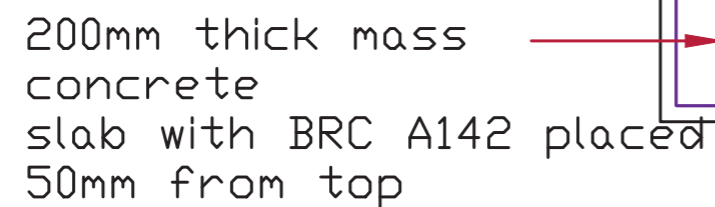
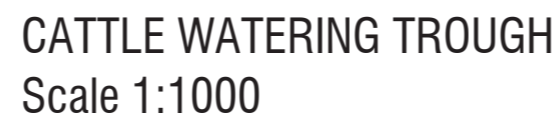
Checked : JS

Date : 22 Oct 2018

Scale : As Shown

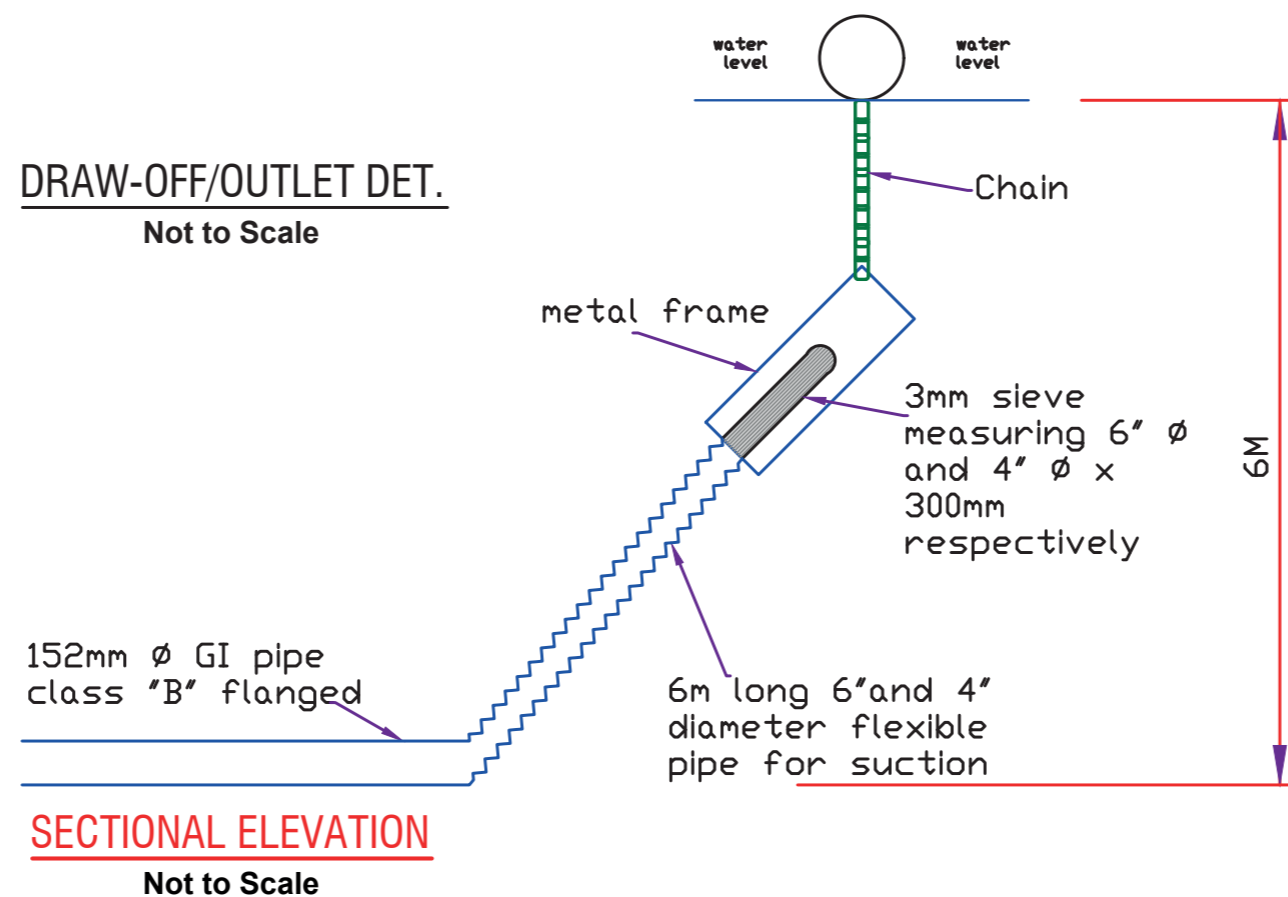
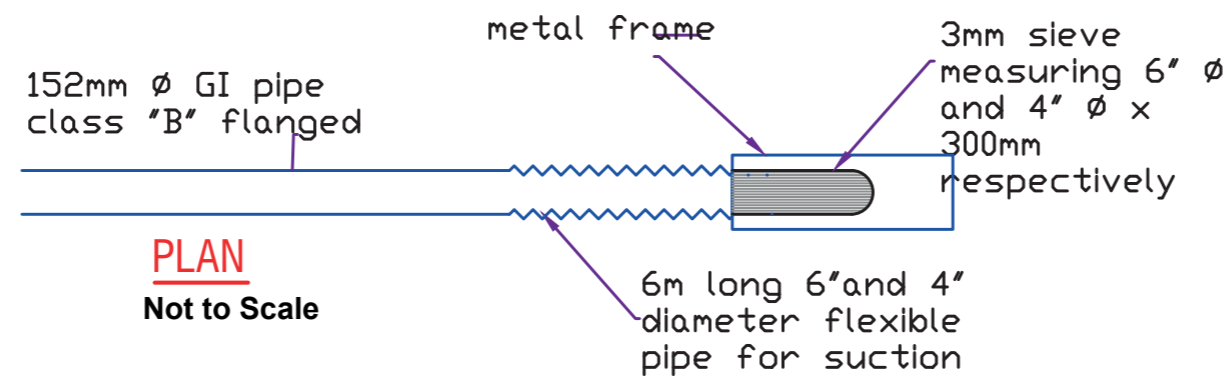
Sheet

01



- Sheet
03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert level, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
Sura J Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

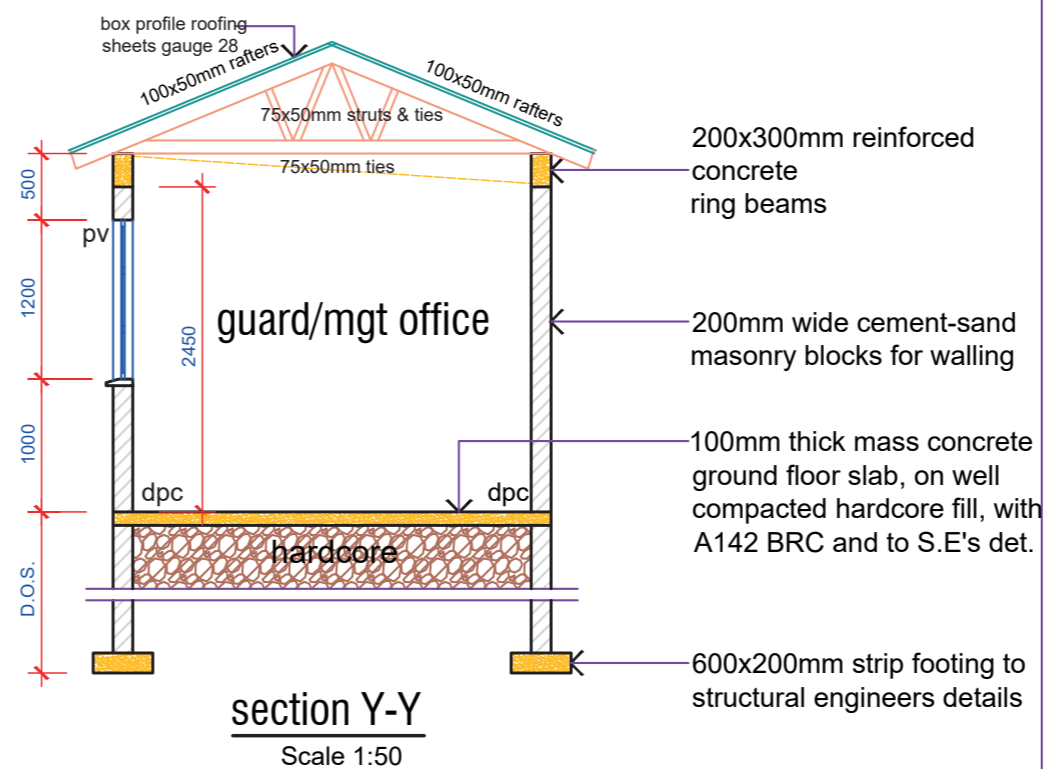
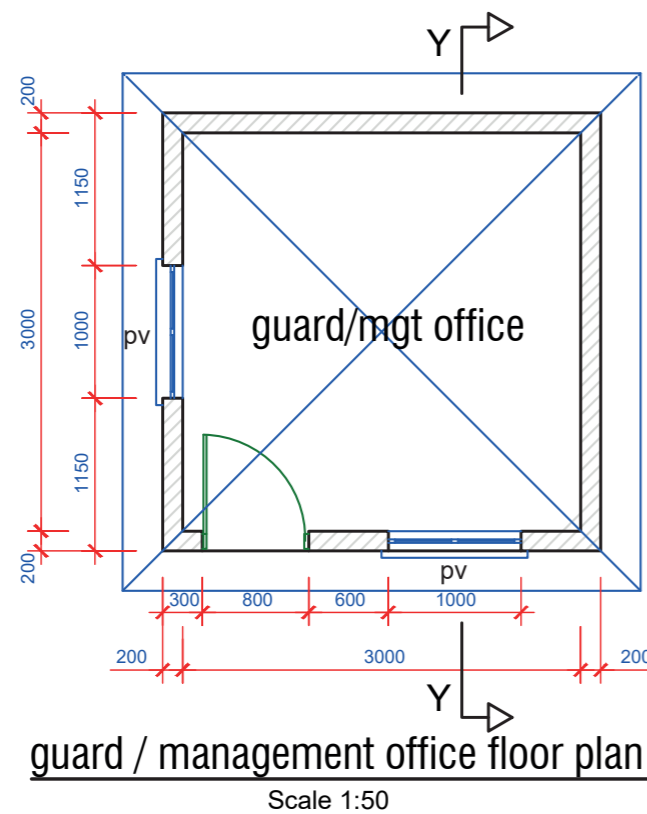
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.08 Description of Kwa Katheke water pan in Machakos Central Sub-County, Machakos County

Kwa Katheke water pan is located in Machakos Central Sub-county of Machakos County. The volume of the water pan was estimated at 96,560 m³. The water pan is currently used for domestic water supply and livestock watering. Despite its importance there is significant siltation in this pan.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan and act as a potential pollutant filter. The water pan will also be excavated to remove deposited silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings..

As a contribution to environmental conservation the site management committee will be expected to plant at least 5,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day

management of the water pan. The various users of water and other services from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.08.1 Figures showing characteristics of Kwa Katheke water pan



Figure 88: Google image showing the location of Kwa Katheke water pan and its surroundings



Figure 89: A view of Kwa Kitheke water pan



Figure 90: Oxen cart use to fetch water from Kwa Kitheke water pan

8.08.2 Beneficiaries of Kwa Kitheke water pan

1500 households with an average of 6 members.

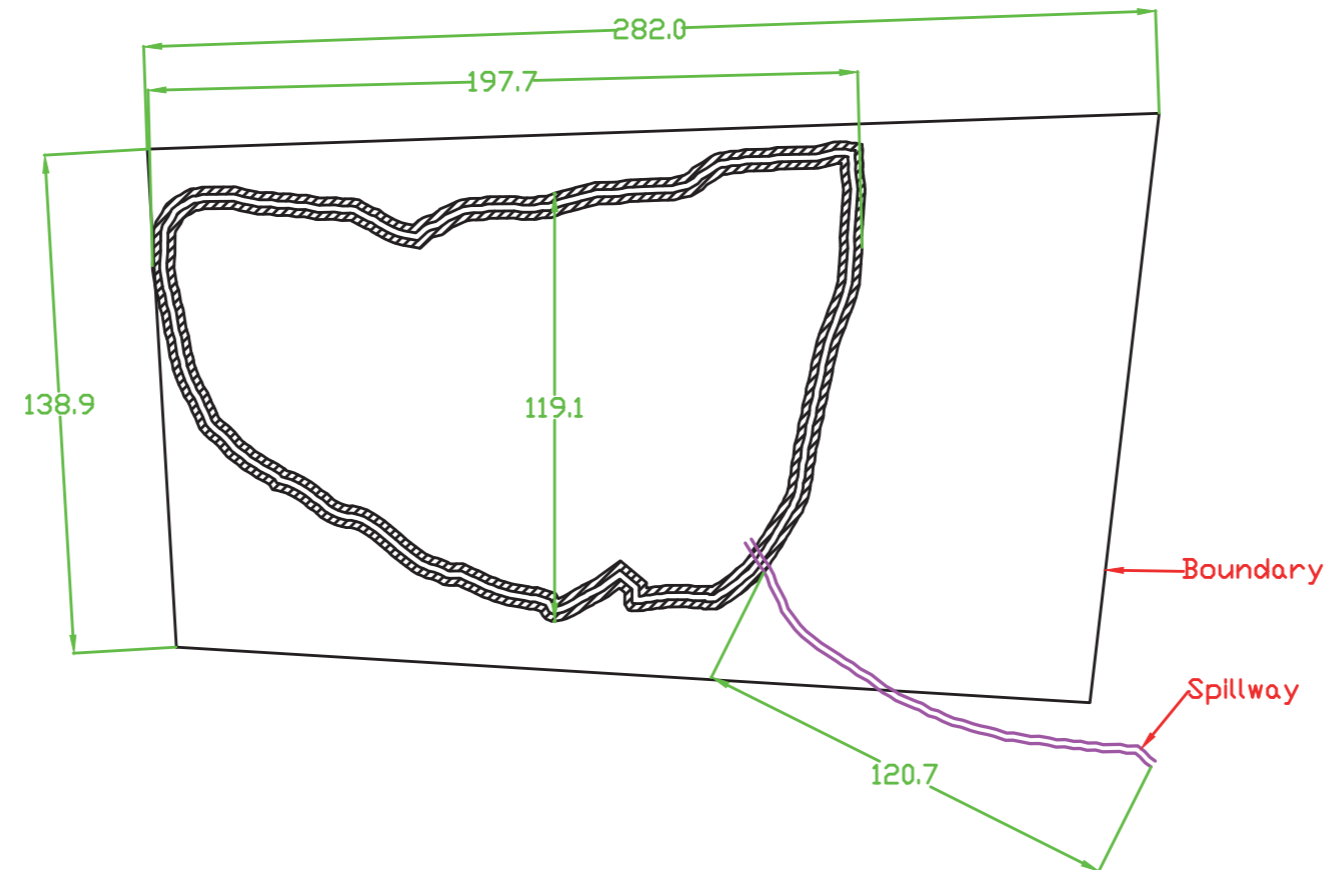
8.08.3 Bill of Quantities for proposed rehabilitation works in Kwa Kitheke water pan

REHABILITATION OF KWA KITHEKE WATERPAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	100,000.00	100,000.00	976.72
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the Waterpan	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				550,000.00	5,371.93
2.0.	Earthworks					
2.1.	Clear the waterpan site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	17,299	3.00	51,897.00	506.89
2.2.	Complete desilting of the waterpan, remove from site and dispose as directed by the Engineer	CM	14,000	450.00	6,300,000.00	61,533.05
2.3.	Allow for construction of silt trap	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 2				6,851,897.00	66,923.51
3	Perimeter Fence, Guard house					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	600.0	400.00	240,000.00	2,344.12
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
	Sub-Total Carried to Summary - Element 4				260,000.00	2,539.46
6.0.	Cattle Trough Construction					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	Environmental Conservation					
7.1.	Allow for planting of indigineous trees upstream and downstream of the dam	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 7				125,000.00	1,220.89
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				550,000.00	5,371.93
	ELEMENT 2 - EARTHWORKS				6,851,897.00	66,923.51
	ELEMENT 4 - PERIMETER FENCE				260,000.00	2,539.46
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				125,000.00	1,220.89
	ALL ELEMENTS TOTAL				7,936,897.00	77,520.87
	Allow of 5% for supervision				396,844.85	3,876.04
	Grand Total				8,333,741.85	81,396.92

8.08.4 Engineering Drawing for proposed rehabilitation works in Kwa Kitheke water pan

KWA KATHEKE WATER PAN



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
Sura J Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

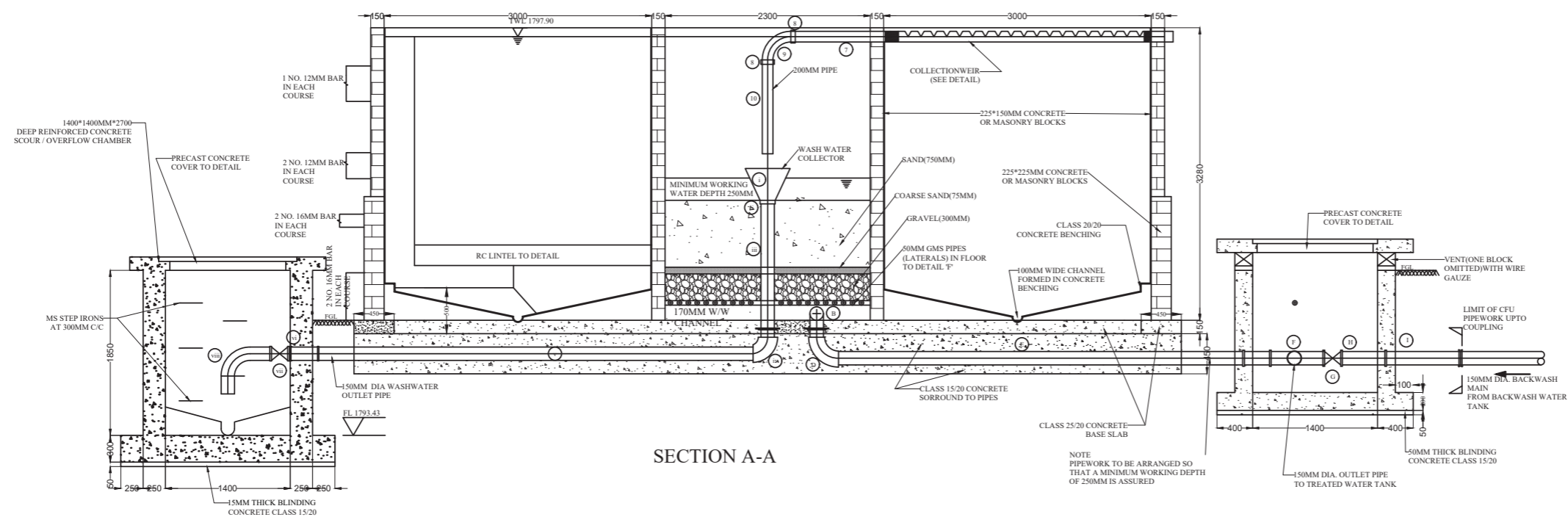
Checked : SN

Date : 23 sep 2018

Scale : 1: 1

Sheet

01



FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

- ### Notes General
1. All dimensions are in meters unless otherwise stated.
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 3. Reinforcement bars are mild ferrous round bars to B.S 4449
 4. All pipework indicated diameters are nominal sizes.
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 6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
 7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
 8. The lapping length of bars will be 50 x bar diameter
 9. Trenches shall be dug to the invert levels, graded and compacted to approval
 10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
 11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

ASAL EnviroTech Consult LTD

Client:



Drawing Title

Composite Filtration Unit - Section A-A

Designed: JS

Drawn : SN

Checked : SN

Date : 22 Oct 2024

Sheet

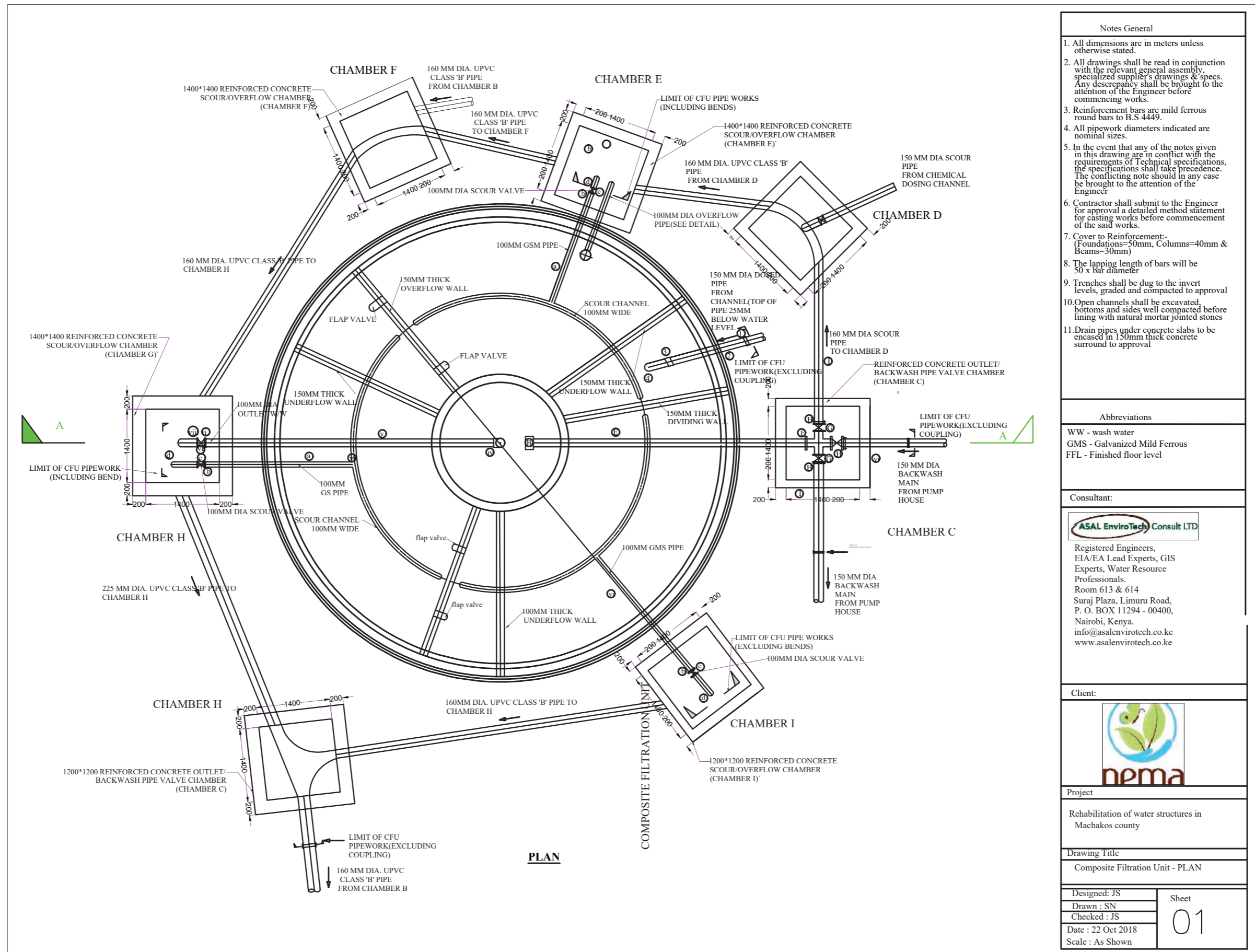
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Notes General	
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Abbreviations	
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GMS - Galvanized Mild Ferrous	
FFL - Finished floor level	

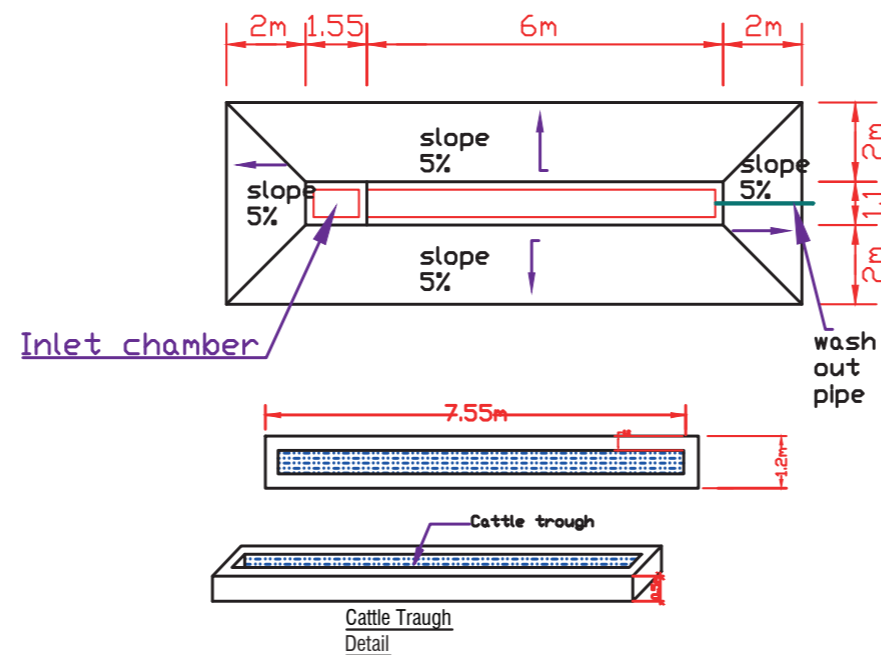
Consultant:	
 Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals. Room 613 & 614 Suraj Plaza, Limuru Road, P. O. BOX 11294 - 00400, Nairobi, Kenya. info@asalenvirotech.co.ke www.asalenvirotech.co.ke	

Client:	
	

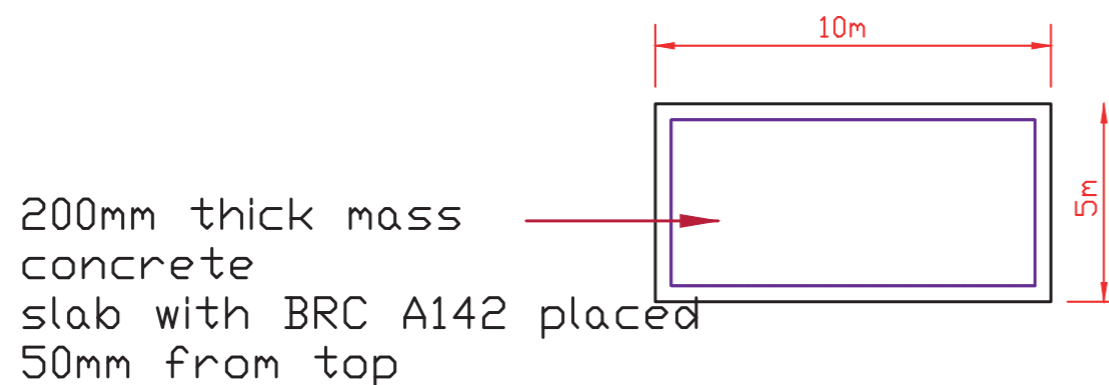
Project	
Rehabilitation of water structures in Machakos county	

Drawing Title	
Composite Filtration Unit - PLAN	

Designed: JS	<div>Sheet</div> <div style="font-size: 2em; font-weight: bold;">01</div>
Drawn : SN	
Checked : JS	
Date : 22 Oct 2018	
Scale : As Shown	



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

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Room 613 & 614 SuraJ Plaza, Limuru Road,
P. O. BOX 11294 - 00400, Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

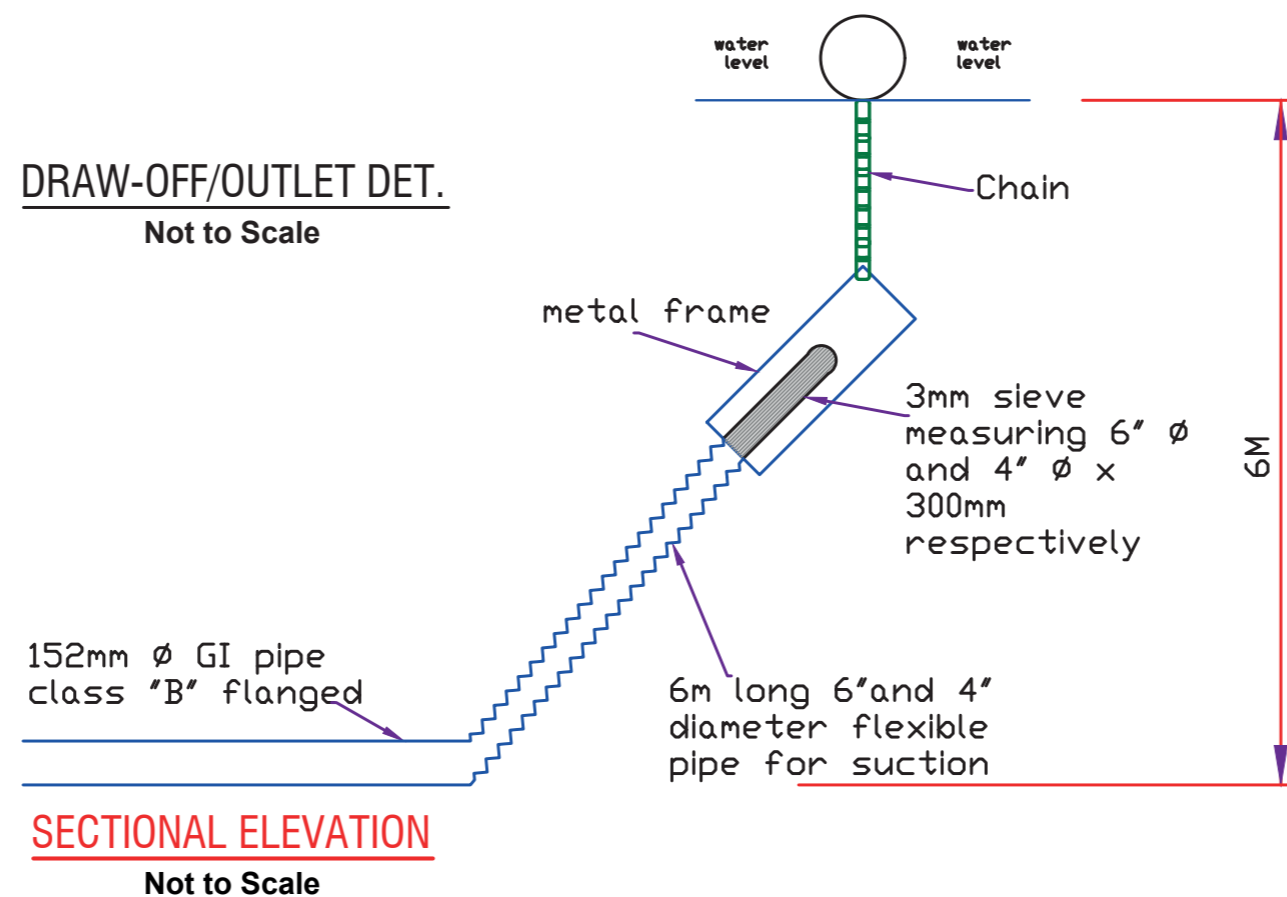
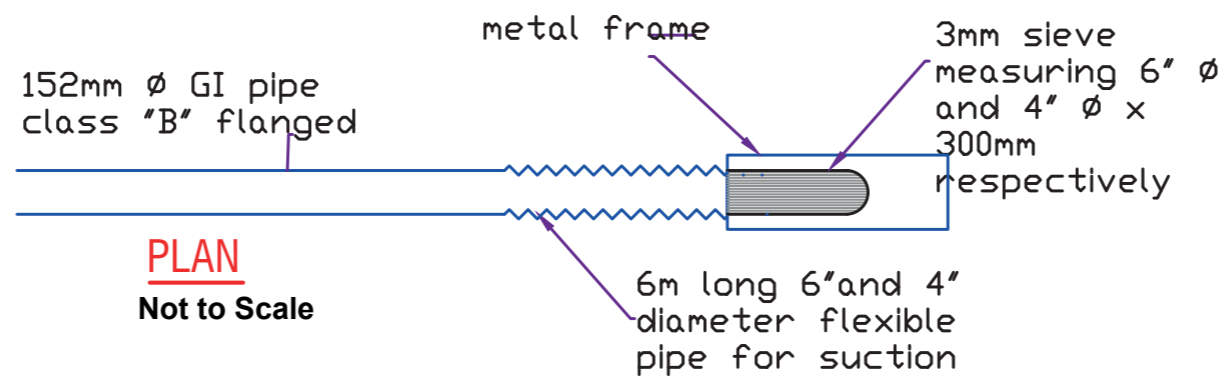
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn: SN

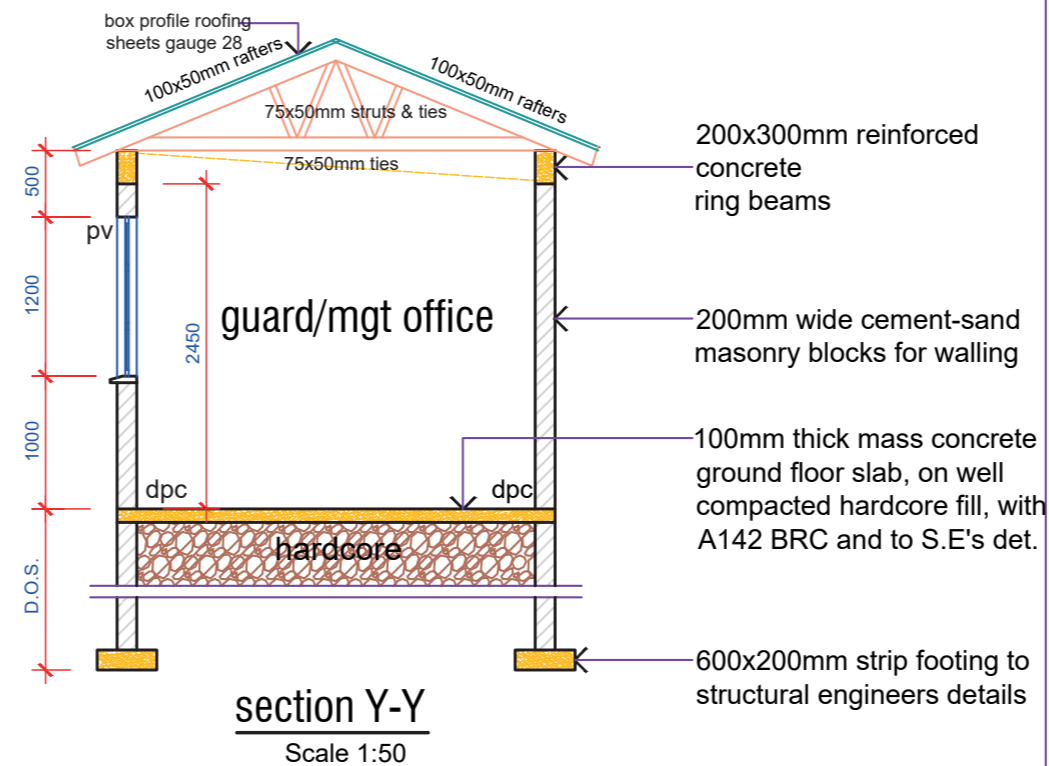
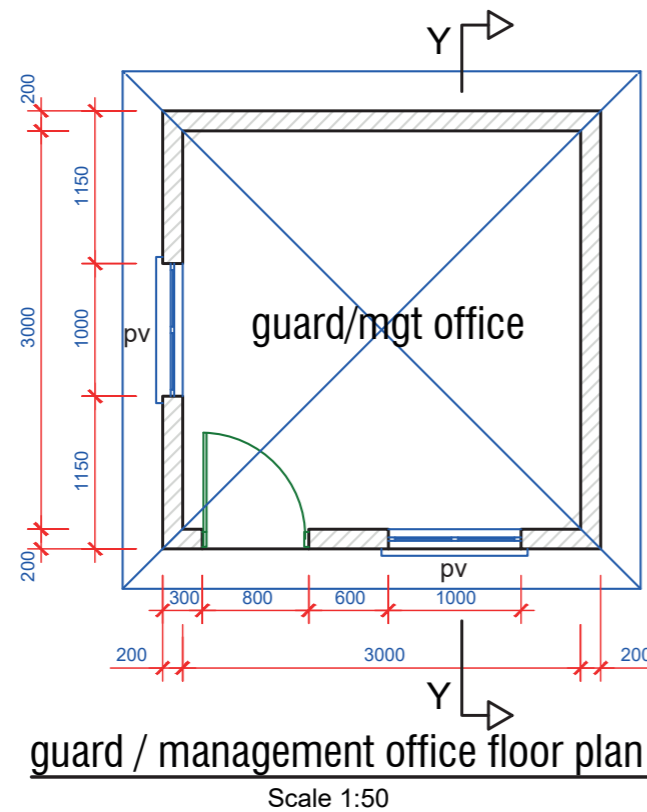
Checked: JS

Date: 12 sep 2018

Scale: as shown

Sheet

04



Notes General

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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.09 Description of Miwani water pan in Machakos Central Sub-County, Machakos County

Miwani water pan is located in Machakos Central Sub-county of Machakos County. The volume of the water pan was estimated at 95,660 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings..

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.09.1 Figures showing the characteristics of Miwani water pan



Figure 91: Google image showing the location of Miwani water pan and its surroundings beneficiaries



Figure 92: A view of Miwani water pan

8.09.2 Beneficiaries of Miwani water pan

1,500 Households with an average of 6 members.

8.09.3 Bill of Quantities for the proposed works in Miwani water pan

REHABILITATION OF MIWANI WATERPAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

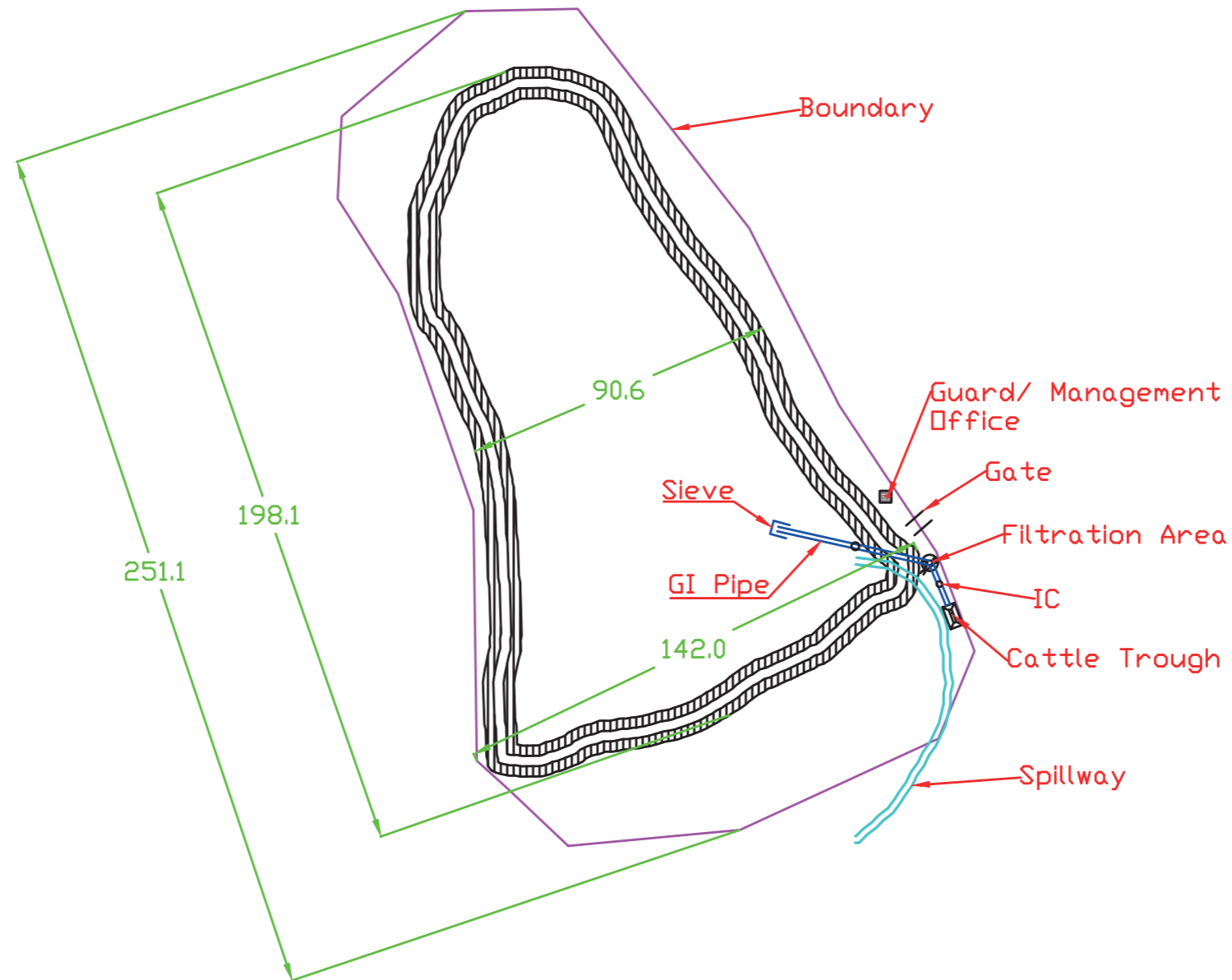
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				650,000.00	6,348.65
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	3,400	3.00	10,200.00	99.62
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	14,000	450.00	6,300,000.00	61,533.05
	Sub-Total Carried to Summary - Element 2				6,310,200.00	61,632.68
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88
4.0.	Perimeter Fence, Guard house/shop					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,000.0	400.00	400,000.00	3,906.86
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				550,000.00	5,371.93

REHABILITATION OF MIWANI WATERPAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
5.0.	Treatment works					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	1.0	2,000,000.00	2,000,000.00	19,534.30
5.2.	Allow for auxilliaries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 5				2,500,000.00	24,417.88
6.0.	Cattle Trough Construction					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 6				150,000.00	1,465.07
7.0.	Environmental Conservation					
7.2.	Allow for planting of indigeneous trees upstream and downstream of the Waterpan	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 7				125,000.00	1,220.89
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				650,000.00	6,348.65
	ELEMENT 2 - EARTHWORKS				6,310,200.00	61,632.68
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				550,000.00	5,371.93
	ELEMENT 5 - TREATMENT WORKS				2,500,000.00	24,417.88
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				125,000.00	1,220.89
	ALL ELEMENTS TOTAL				11,194,050.00	109,333.98
	Allow of 5% for supervision				559,702.50	5,466.70
	Grand Total				11,753,752.50	114,800.68

8.09.4 Engineering Drawing for the proposed works in Miwani water pan

MIWANI DAM



Notes General

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Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
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Professionals.
Room 613 & 614
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info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures in Machakos
County

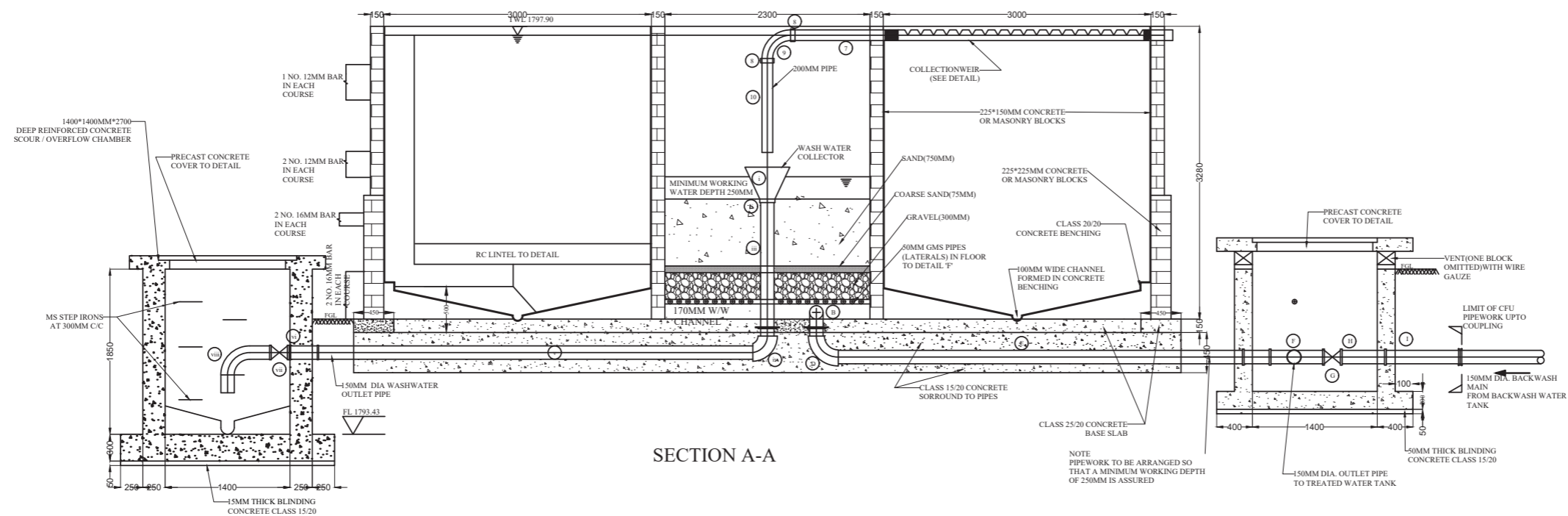
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1:1

Sheet

01



SECTION A-A

FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

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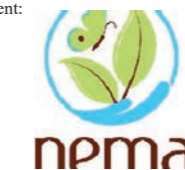
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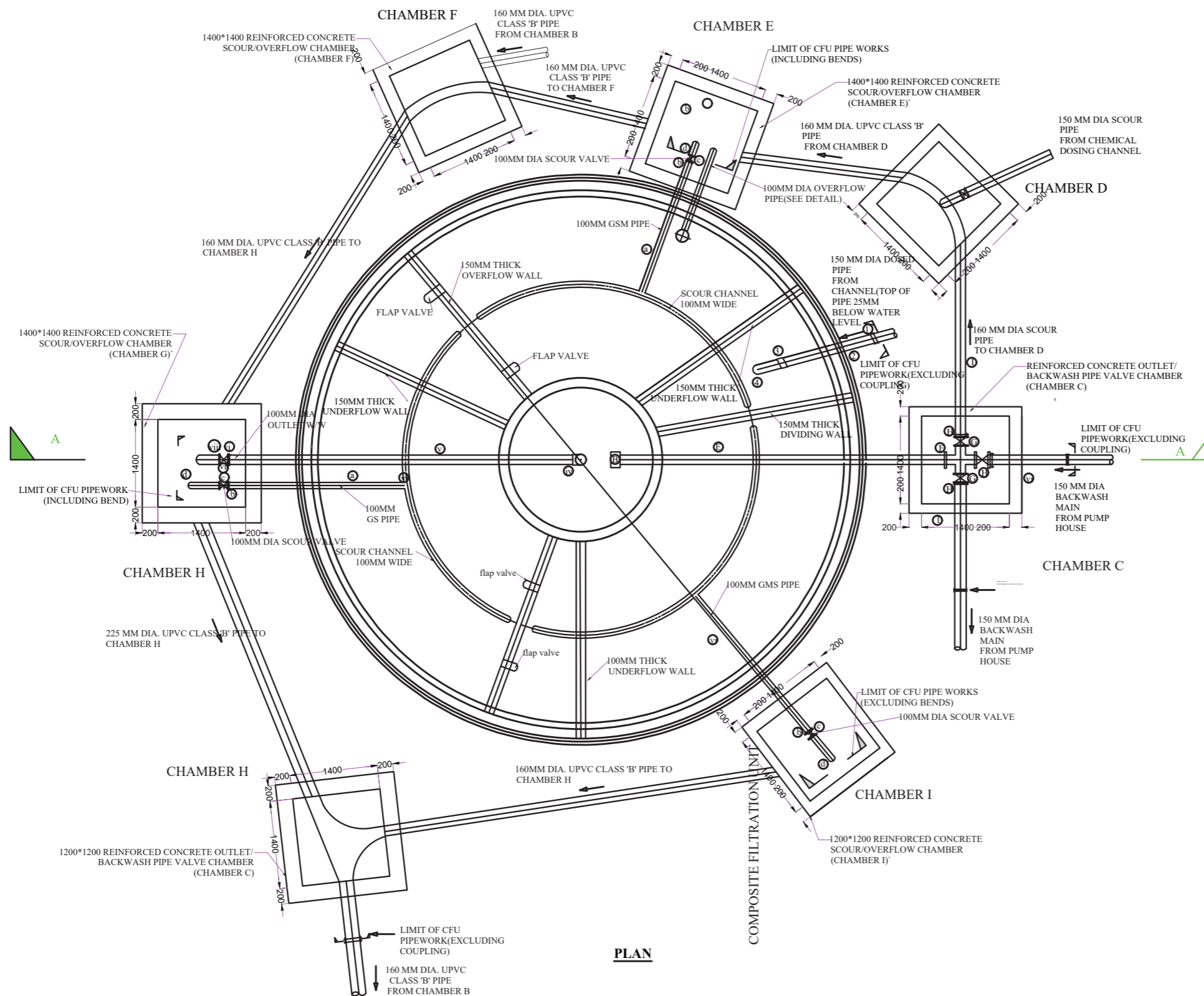
Project
Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - Section
A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

Sheet
01



Notes General

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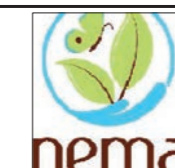
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www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - PLAN

Designed: JS

Drawn : SN

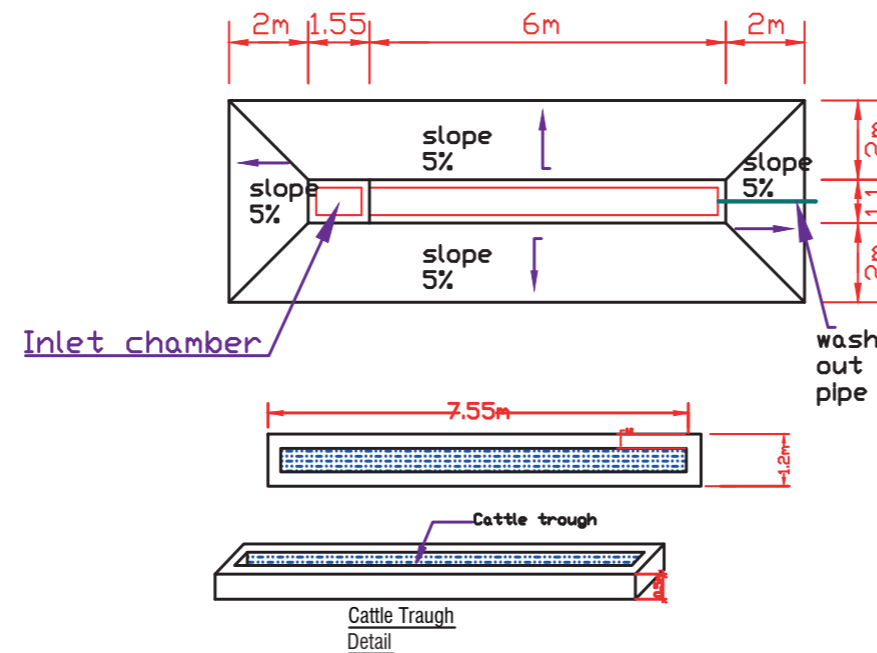
Checked : JS

Date : 22 Oct 2018

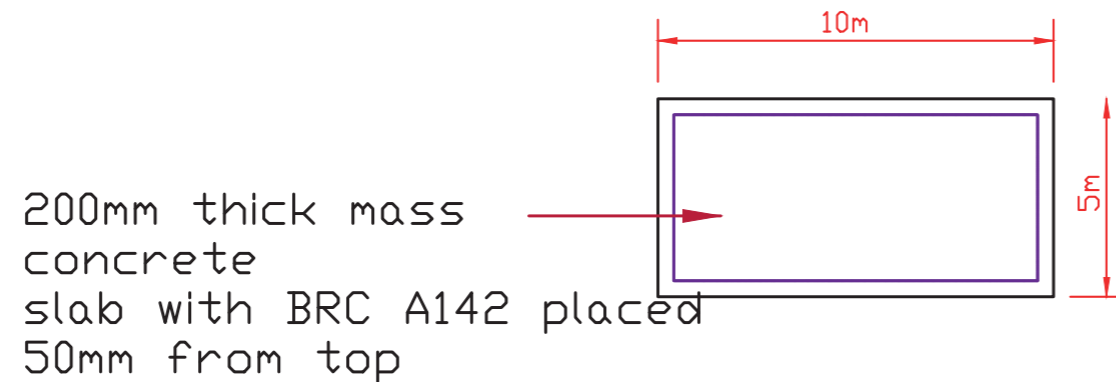
Scale : As Shown

Sheet

01



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
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Sura J Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

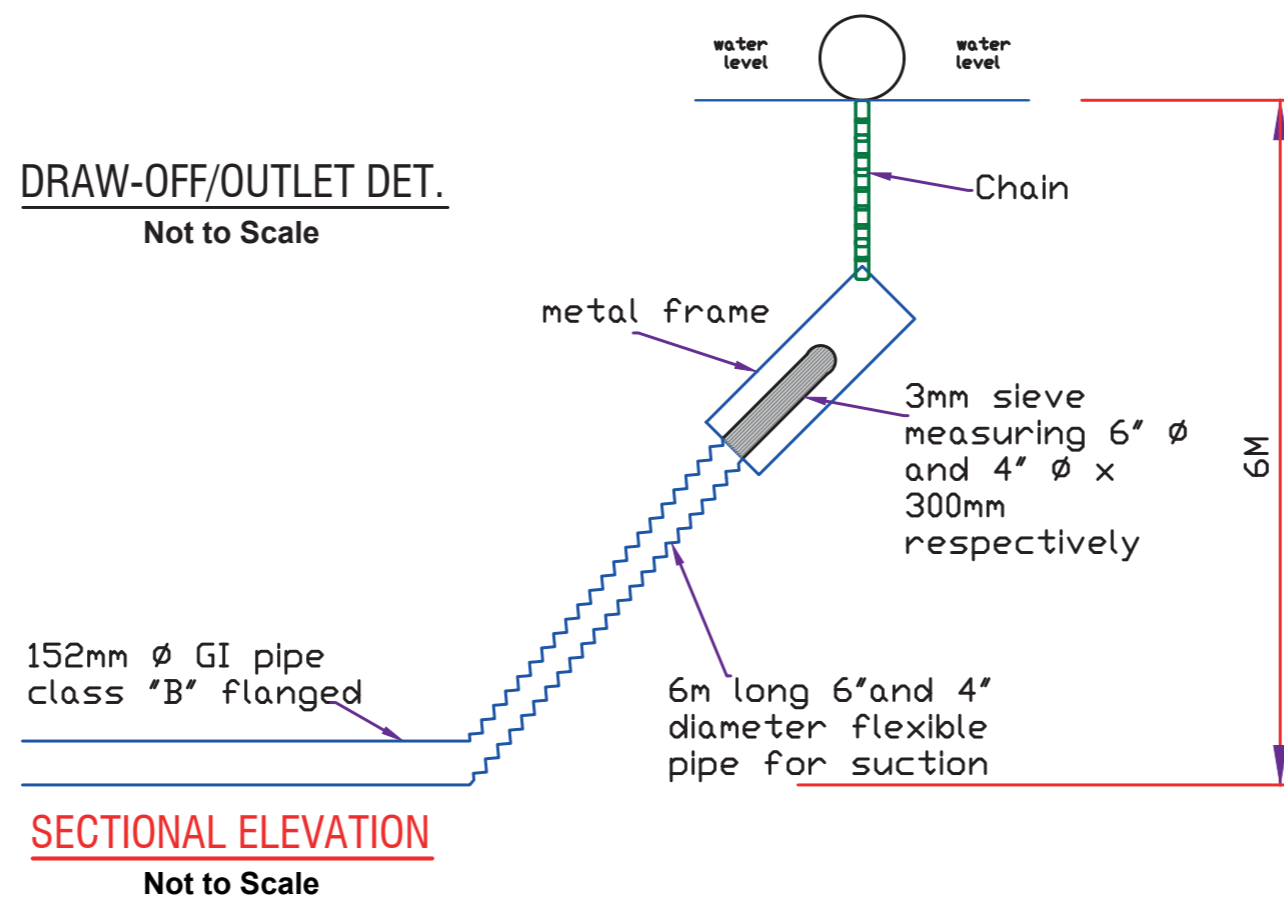
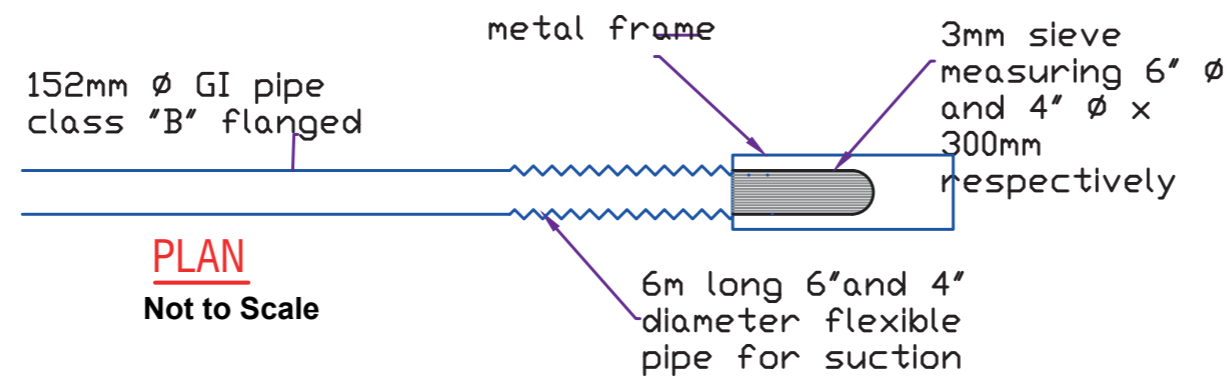
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

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Project

Rehabilitation of
water structures in
Nyandarua county

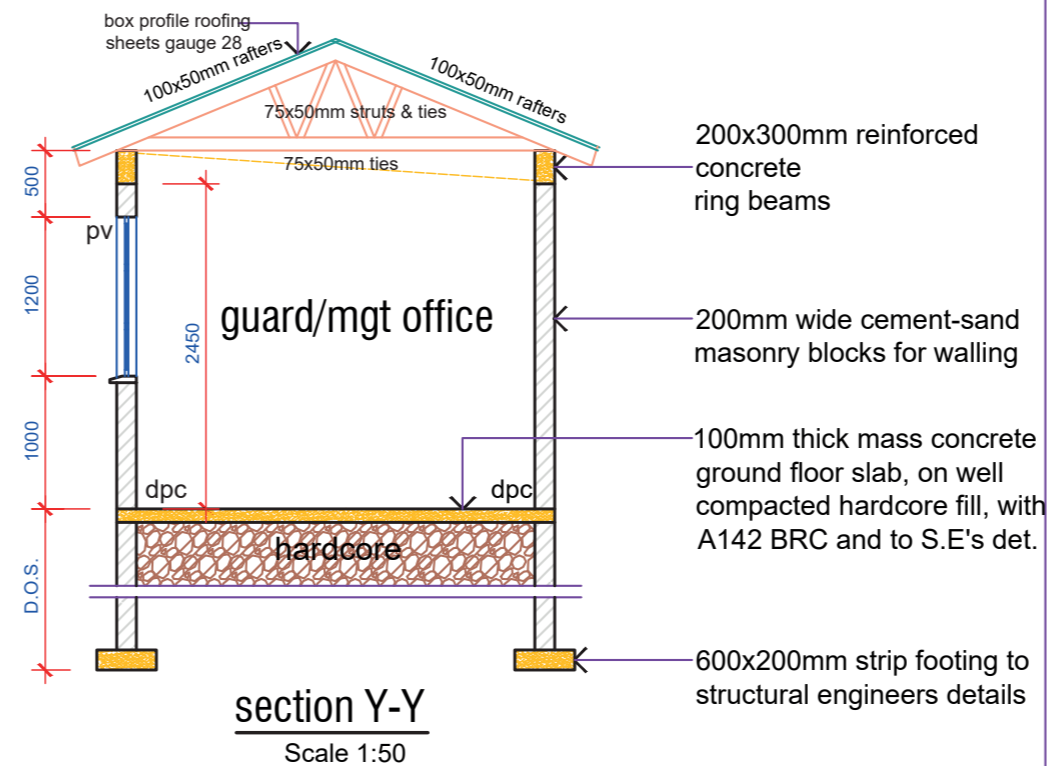
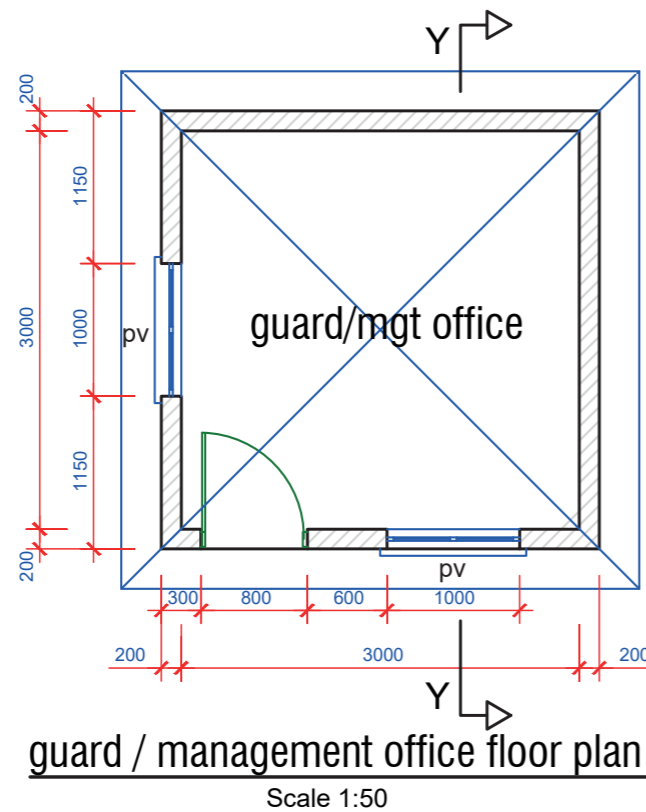
Drawing Title

Draw off/ Outlet

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

04



Notes General

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Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.10 Description of Muumandi water pan in Machakos Central Sub-County, Machakos County

Muumandi water pan is located in Machakos Central Sub-county of Machakos County. The volume of the water pan was estimated at 24,740 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings..

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.10.1 Figures showing the characteristics of Muumandi water pan



Figure 93: Google image showing the location of Muumandi water pan and its surroundings



Figure 94: A view of Muumandi water pan



Figure 95: a potential beneficiary irrigating vegetables with water from the Muumandi water pan



Figure 96: pumps used to supply irrigation water from Muumandi water pan

8.10.2 Beneficiaries of Muumandi water pan

1500 households with an average of 6 members.

8.10.3 Bill of Quantities of proposed rehabilitation work in Muumandi water pan

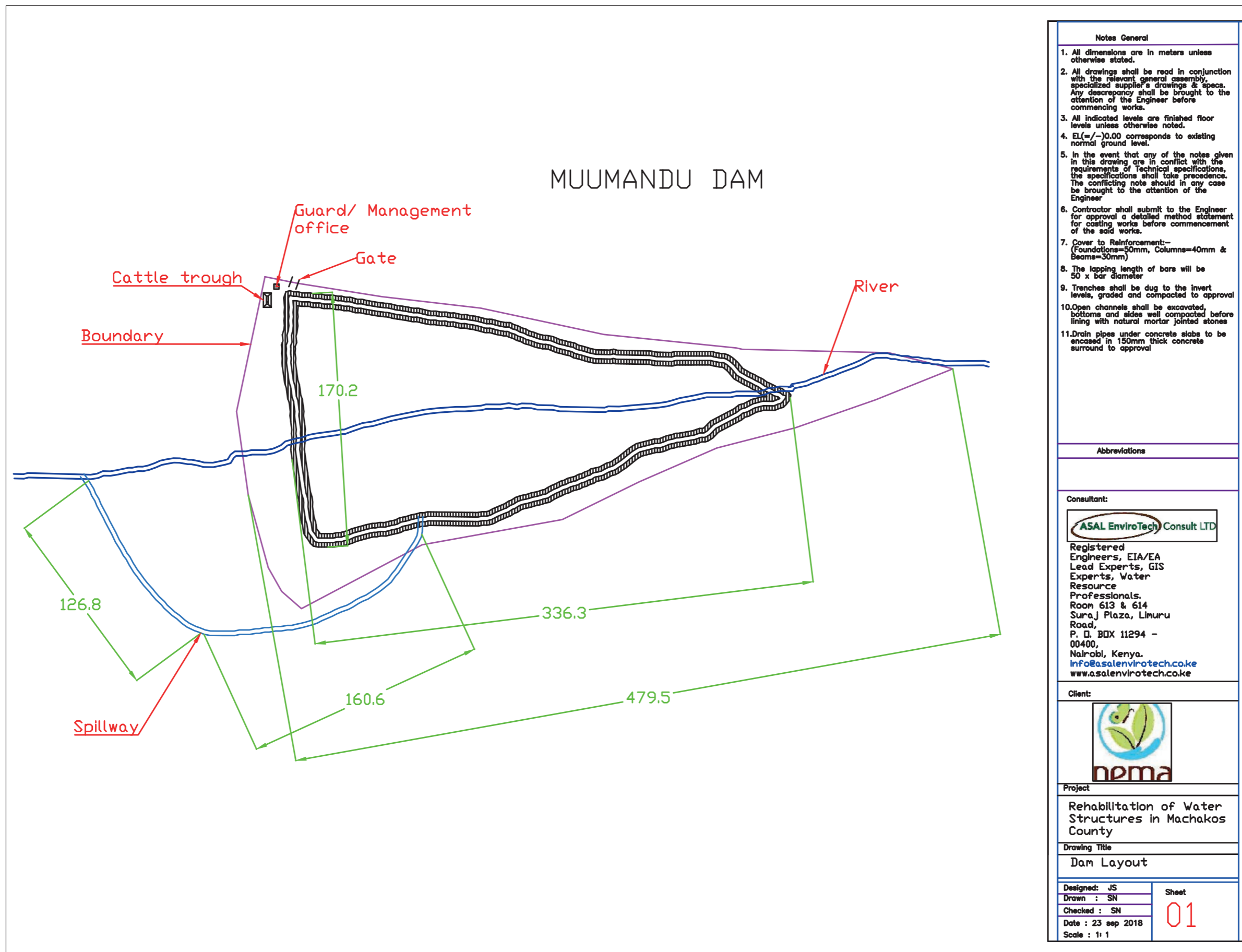
REHABILITATION OF MUUMANDU WATER PAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

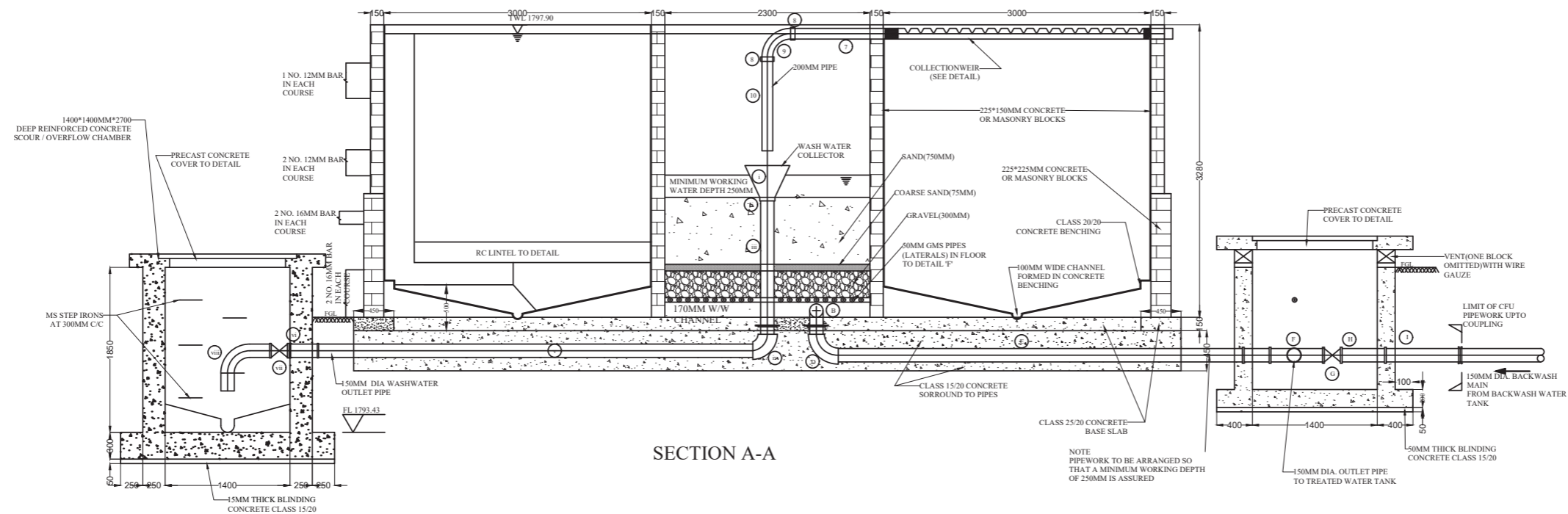
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey, embankment integrity assessment and water quality analysis	PS	1	850,000.00	850,000.00	8,302.08
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,500,000.00	14,650.73
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	3,400	3.00	10,200.00	99.62
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	14,000	450.00	6,300,000.00	61,533.05
	Sub-Total Carried to Summary - Element 2				6,310,200.00	61,632.68
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88

REHABILITATION OF MUUMANDU WATER PAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
4.0.	<u>Perimeter Fence, Guard house/shop</u>					-
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	2,400.0	400.00	960,000.00	9,376.47
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				1,110,000.00	10,841.54
5.0.	<u>Treatment works</u>					-
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	2.0	2,000,000.00	4,000,000.00	39,068.60
5.2.	Allow for auxillaries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 5				4,500,000.00	43,952.18
6.0.	<u>Cattle Trough Construction</u>					-
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 6				150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					-
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 7				550,000.00	5,371.93
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,500,000.00	14,650.73
	ELEMENT 2 - EARTHWORKS				6,310,200.00	61,632.68
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				1,110,000.00	10,841.54
	ELEMENT 5 - TREATMENT WORKS				4,500,000.00	43,952.18
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				550,000.00	5,371.93
	ALL ELEMENTS TOTAL				15,029,050.00	146,791.00
	Allow of 5% for supervision				751,452.50	7,339.55
	Grand Total				15,780,502.50	154,130.55

8.10.4 Engineering Drawing of proposed rehabilitation work in Muumandu water pan





FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

Notes General

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- Reinforcement bars are mild ferrous round bars to B.S 4449
- All pipework indicated diameters are nominal sizes.
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- Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



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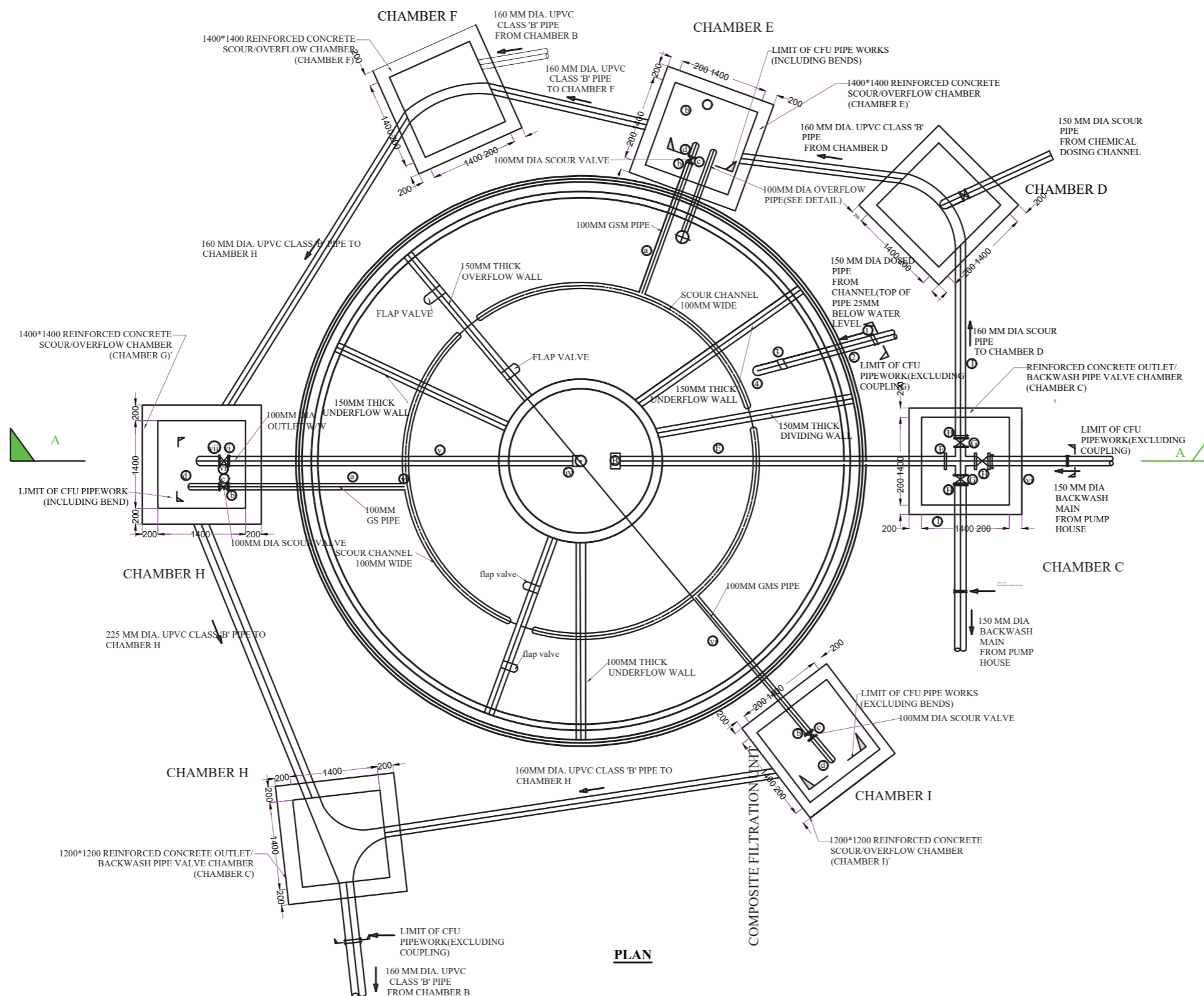
Project
Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - Section
A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

Sheet
01



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Client:



Project

Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - PLAN

Designed: JS

Drawn : SN

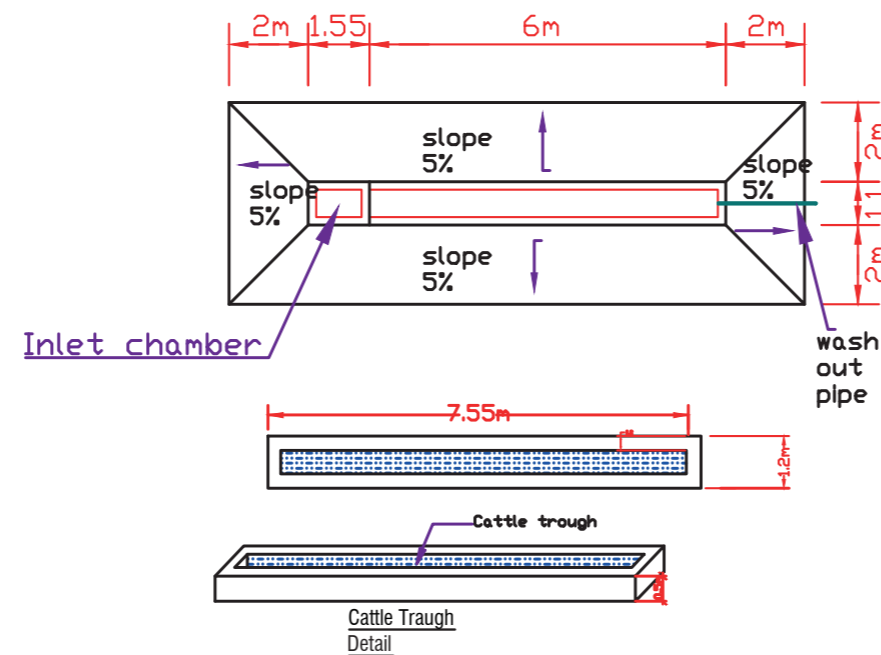
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Date : 22 Oct 2018

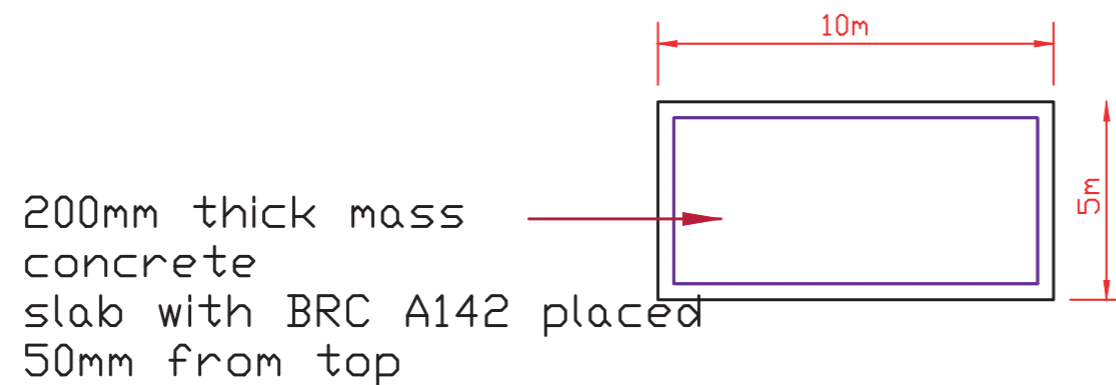
Scale : As Shown

Sheet

01



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

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Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

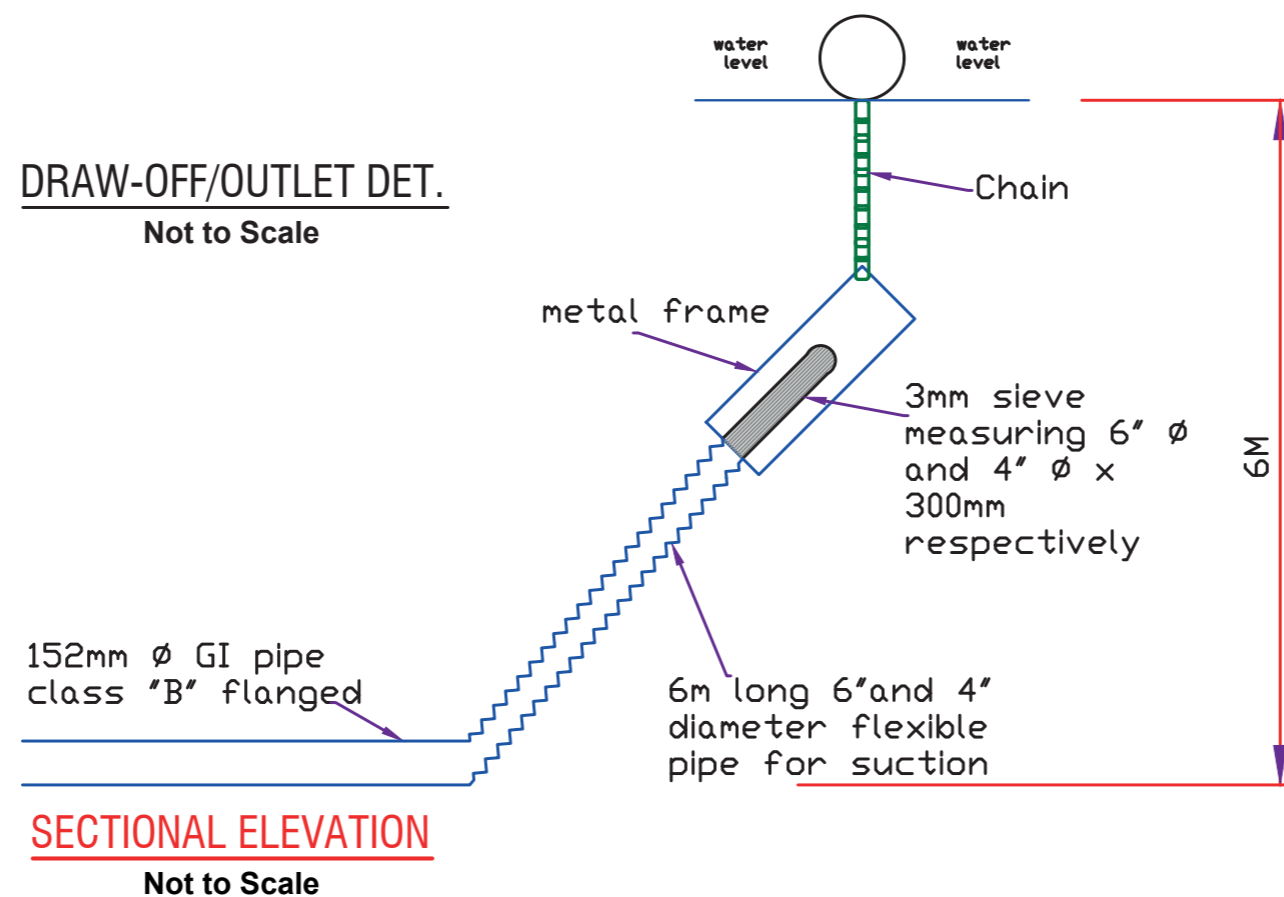
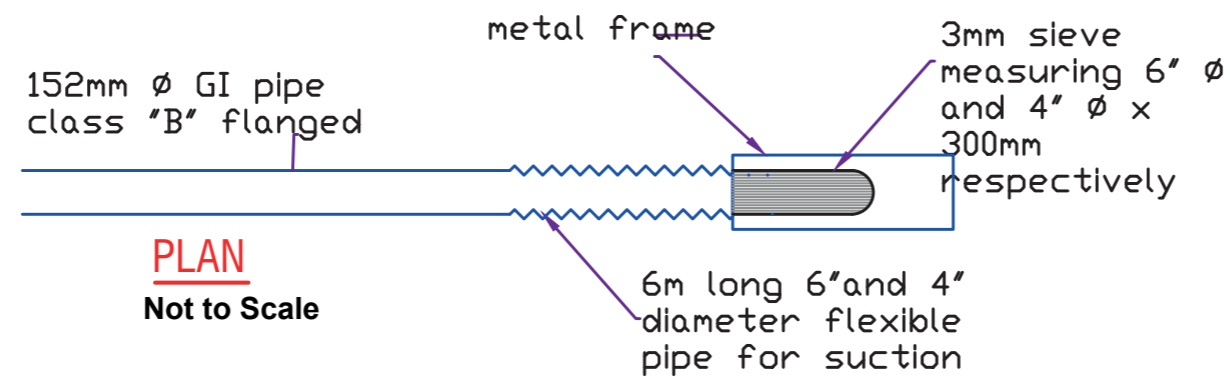
Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

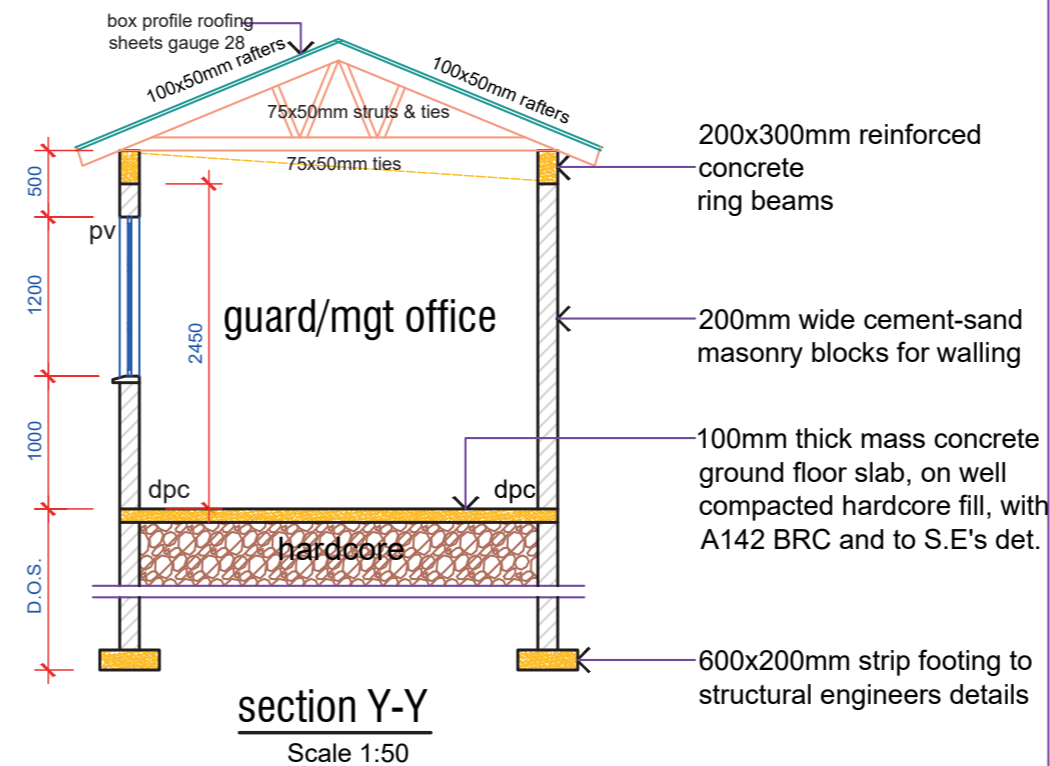
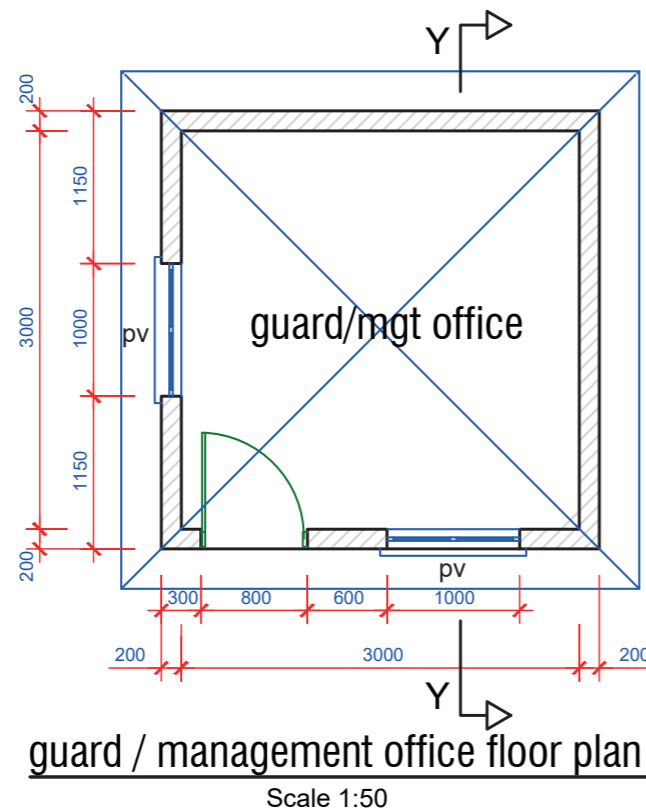
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

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Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.11 Description of Mekilingi water pan in Yatta Sub-County, Machakos County

Mekilingi water pan is located in Yatta Sub-county of Machakos County. The volume of the water pan was estimated at 24,740 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.11.1 Figure showing the location of Mekilingi Water pan

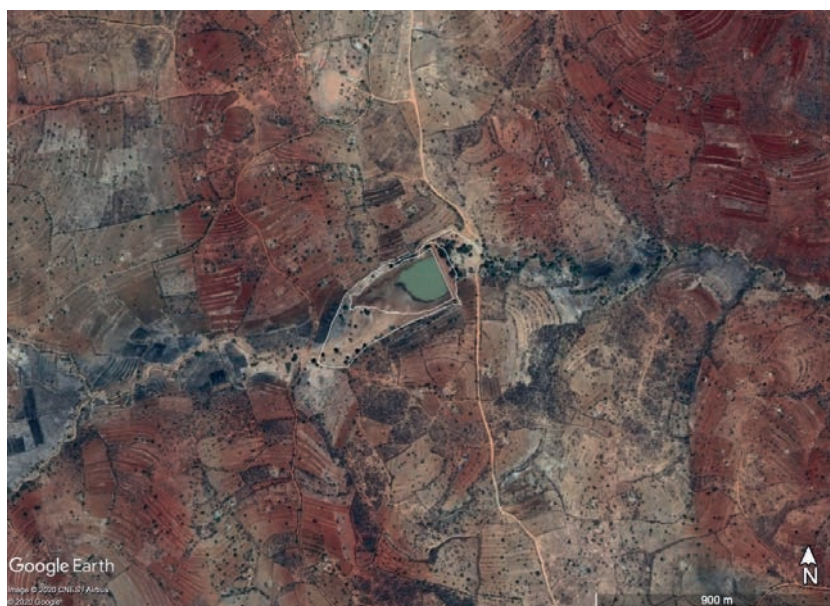


Figure 97: Google image showing the location of Mekilingi water pan and its surroundings

8.11.2 Beneficiaries of Mekilingi water pan

1500 households with an average of 6 members.

8.11.3 Bill of Quantities for proposed rehabilitation work in Mekilingi water pan

REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

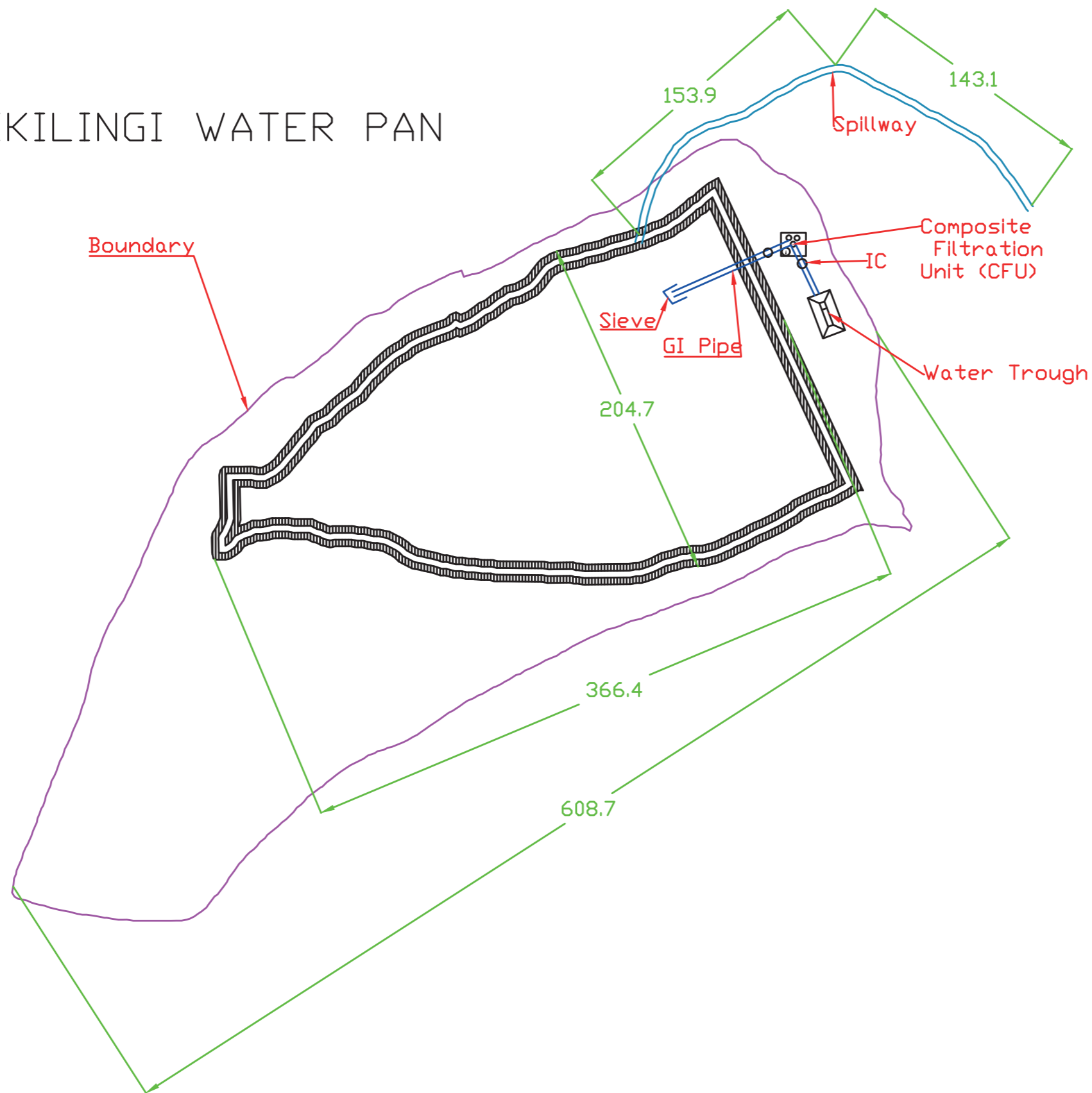
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey and water quality analysis	PS	1	550,000.00	550,000.00	5,371.93
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,200,000.00	11,720.58
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
2.2.	Excavate silt in the dam, remove from site and dispose as directed by the Engineer	CM	34,000	450.00	15,300,000.00	149,437.41
	Sub-Total Carried to Summary - Element 2				15,450,000.00	150,902.48
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.7.	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<i>Mass concrete as described in:-</i>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<i>Sawn formwork to:</i>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<i>Vibrated reinforced concrete as described in:-</i>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agleline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88
4.0.	Perimeter Fence, Guard house/shop					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,360.0	400.00	544,000.00	5,313.33
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				694,000.00	6,778.40
5.0.	Treatment works					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	2.0	2,000,000.00	4,000,000.00	39,068.60
5.2.	Allow for auxialleries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 2				4,500,000.00	43,952.18
6.0.	Cattle Trough Construction					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07

REHABILITATION OF KARIANI DAM IN NYANDARUA COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigineous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 7				550,000.00	5,371.93
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,200,000.00	11,720.58
	ELEMENT 2 - EARTHWORKS				15,450,000.00	150,902.48
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				694,000.00	6,778.40
	ELEMENT 5 - TREATMENT WORKS				4,500,000.00	43,952.18
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				550,000.00	5,371.93
	ALL ELEMENTS TOTAL				23,452,850.00	229,067.53
	Allow of 5% for supervision				1,172,642.50	11,453.38
	Grand Total				24,625,492.50	240,520.91

8.11.4 Engineering Drawing for proposed rehabilitation work in Mekilingi water pan

MEKILINGI WATER PAN



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized suppliers drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD
Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of Water
Structures In Machakos
County

Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : SN
Date : 23 sep 2018
Scale : 1:1

Sheet

01



MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

- ## Abbreviations

WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:



Registered Engineers,
EIA/EA Lead Experts, GIS
Experts, Water Resource
Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project
Rehabilitation of water structures in
Machakos county

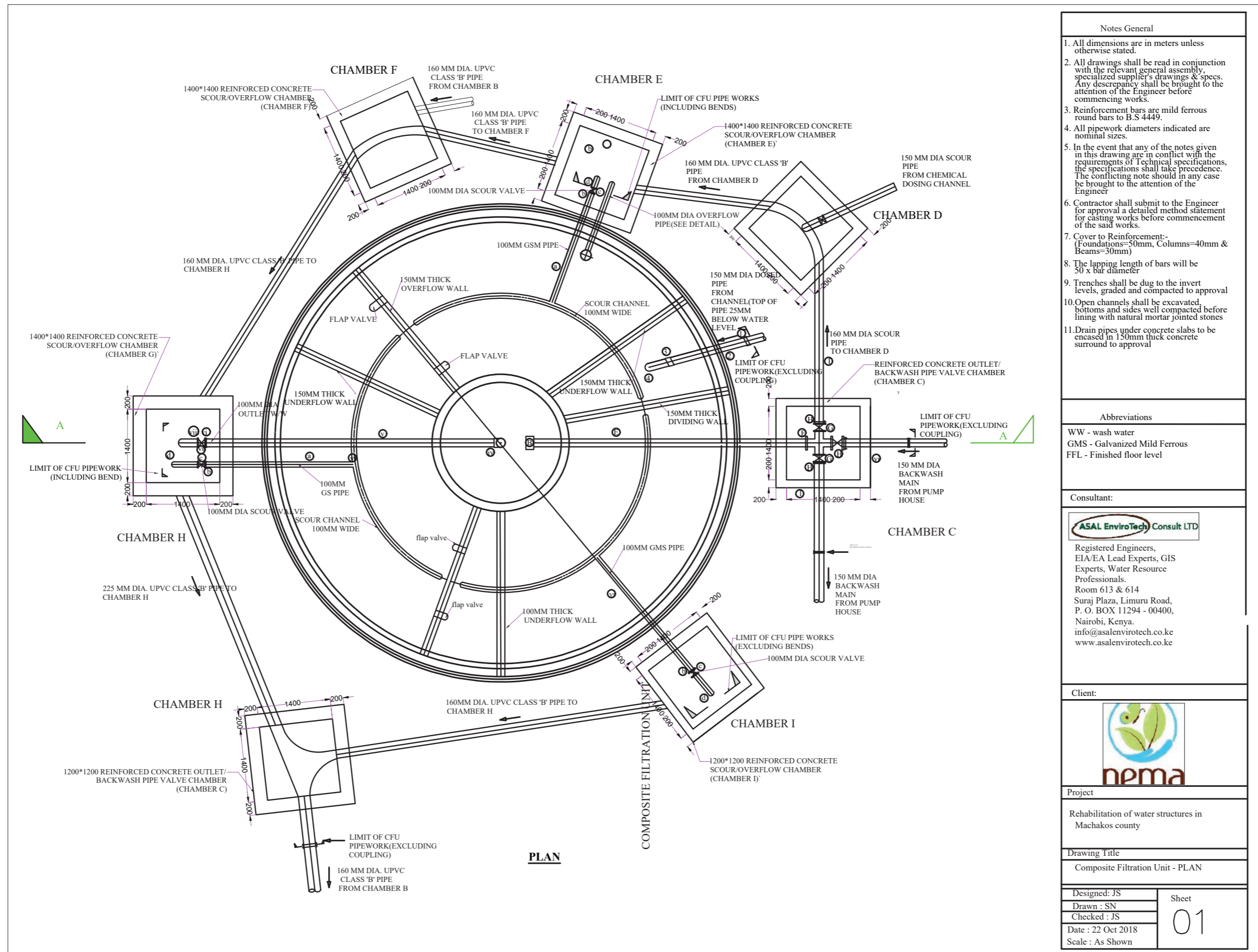
Drawing Title

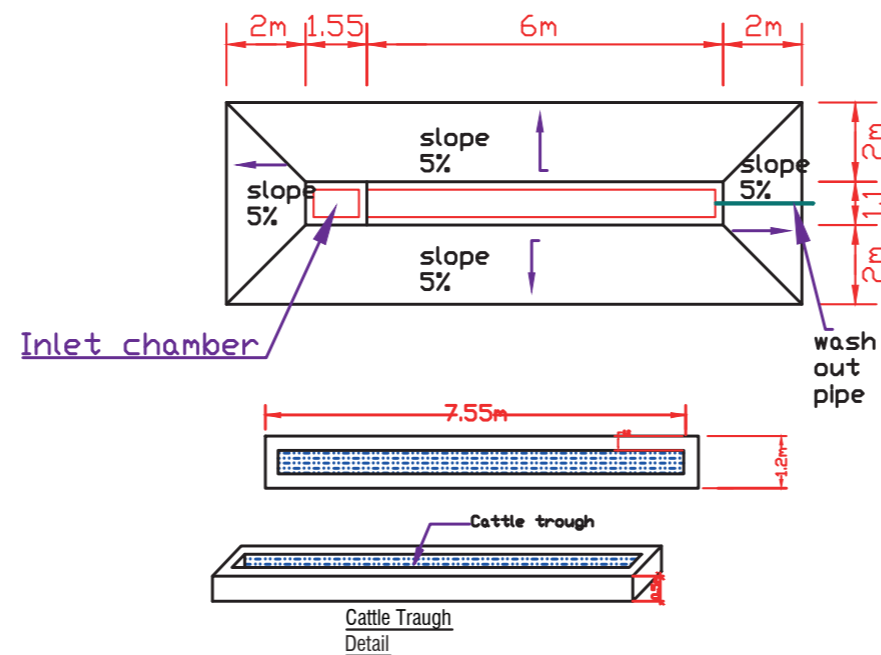
Composite Filtration Unit - Section A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 1
Scale : 1/50

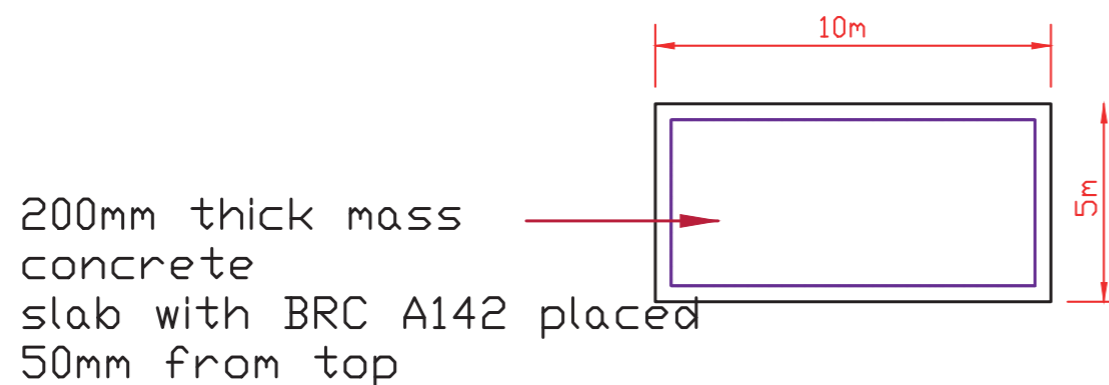
Sheet

01





CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
(Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614 SuraJ Plaza, Limuru Road,
P. O. BOX 11294 - 00400, Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of water structures in Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

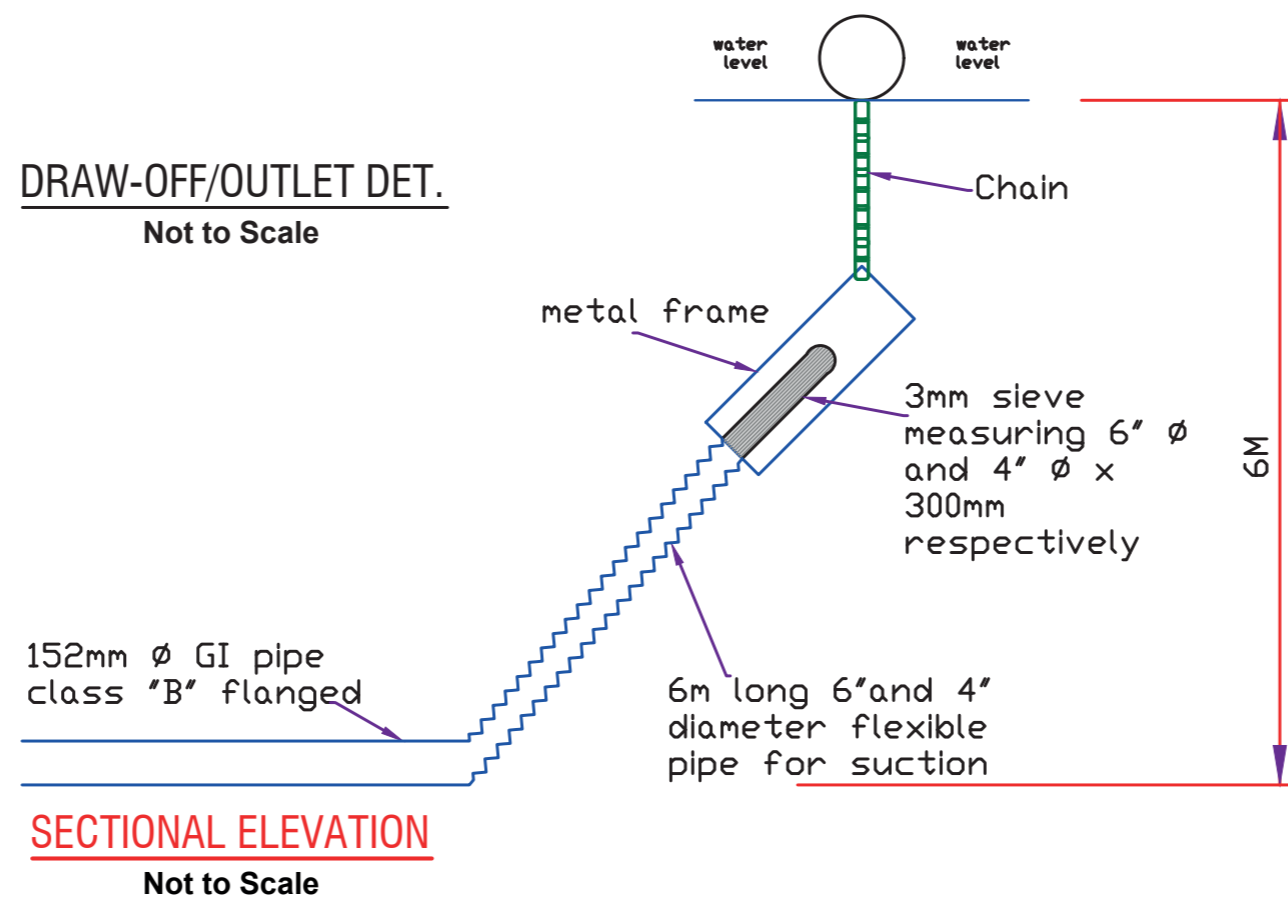
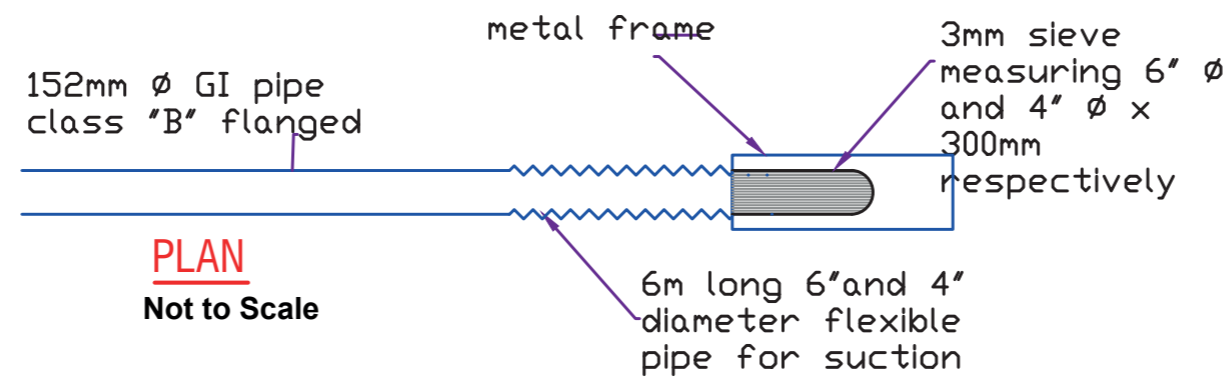
Date : 12 sep 2018

Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



Notes General

1. All dimensions are in meters unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer.
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:-
Foundations=50mm, Columns=40mm & Beams=30mm
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottom and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered
Engineers, EIA/EA
Lead Experts, GIS
Experts, Water
Resource
Professionals.
Room 613 & 614
SuraJ Plaza, Limuru
Road,
P. O. BOX 11294 -
00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Draw off/ Outlet

Designed: JS

Drawn : SN

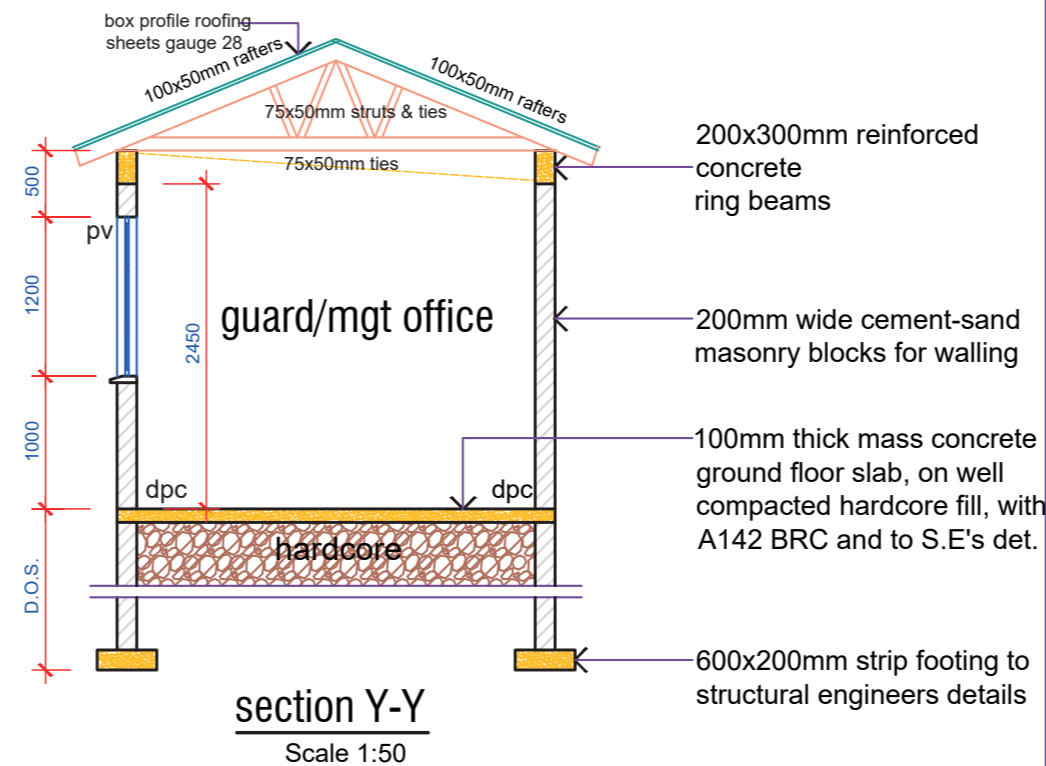
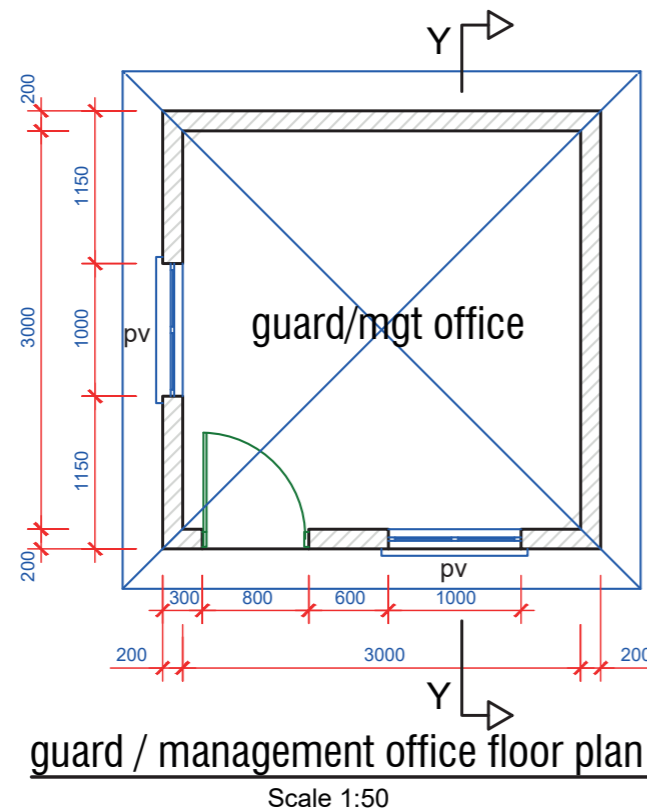
Checked : JS

Date : 12 sep 2018

Scale : as shown

Sheet

04



Notes General

1. All dimensions are in mm unless otherwise stated.
2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.12 Description of Ikombe Sand dam in Yatta Sub-County, Machakos County

Ikombe Sand dam is located in Yatta Sub-county of Machakos County. The sand dam is currently used for domestic water supply and livestock watering. The dam is currently the source of water for Ikombe sub location for both domestic and livestock. In this sand dam there is generator and cattle through on site. However, there is no means of treatment. Hence it was proposed for rehabilitation to increase its usefulness.

The sand dam was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the dam. Two composite filtration units will also be installed on site. A solar water pumping system will also be installed in the site to reduce the cost of operation in maintenance. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings..

As a contribution to environmental conservation the site management committee will be expected to plant at least 500 seedlings in the immediate surroundings of the dam and the riparian zones. To secure the dam and all the investment on site a perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the

water pan will be charged a reasonable fee. In turn the accrued income will be used form operation and maintenance of the project to enhance it sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.12.1 Figure showing location of Ikombe Sand dam

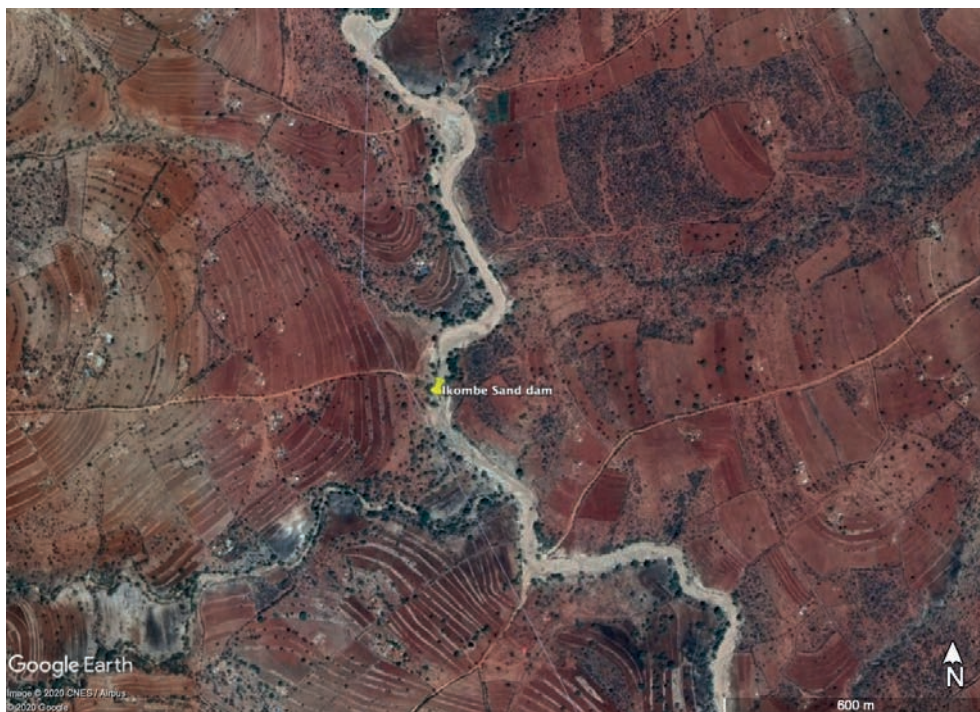


Figure 98: Google image showing the location of the Ikombe sand dam and its surroundings beneficiaries

8.12.2 Beneficiaries of Ikombe sand dam

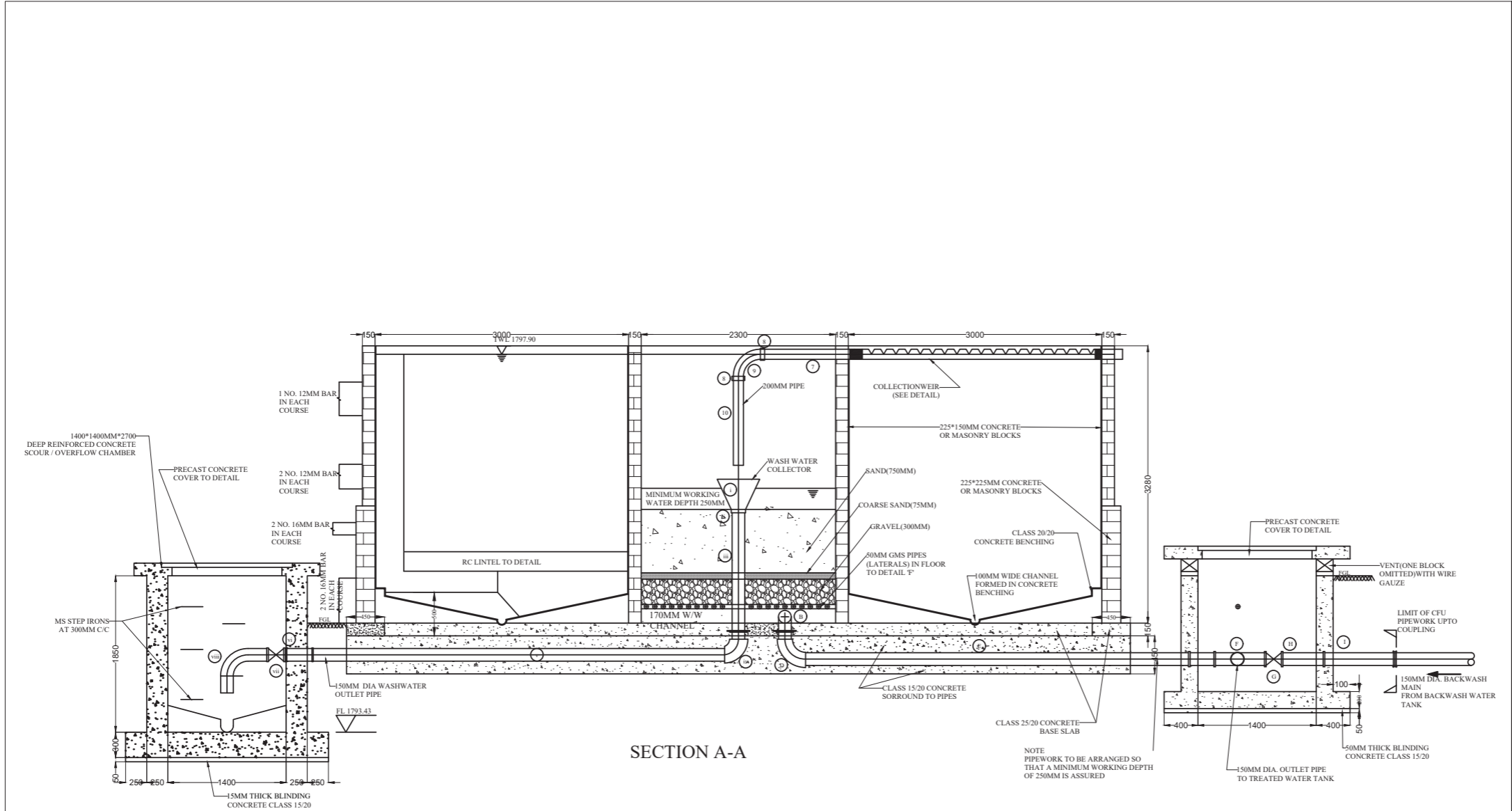
1,500 Households with an average of 6 members.

8.12.3 Bill of Quantities for proposed rehabilitation work in Ikombe Sand dam

REHABILITATION OF IKOMBE SAND DAM IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	200,000.00	200,000.00	1,953.43
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
	Sub-Total Carried to Summary - Element 1				500,000.00	4,883.58
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	3,400	3.00	10,200.00	99.62
	Sub-Total Carried to Summary - Element 2				10,200.00	99.62
3.0.	Auxiliary Structures					
3.1.	Allow for solar pumping	PS	1.0	5,000,000.00	5,000,000.00	48,835.76
	Sub-Total Carried to Summary - Element 3				5,000,000.00	48,835.76
4.0.	Perimeter Fence, Guard house/shop					
4.1.	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1,8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	1,000.0	400.00	400,000.00	3,906.86
4.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
4.3.	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				550,000.00	5,371.93
5.0.	Treatment works					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	1.0	2,000,000.00	2,000,000.00	19,534.30
5.2.	Allow for auxillaries connections and other structures	PS	1.0	500,000.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 5				2,500,000.00	24,417.88
6.0.	Cattle Trough Construction					
6.10.	Allow for construction a cattle trough 6 m long	Ls	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 6				150,000.00	1,465.07
7.0.	Environmental Conservation					
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	500	250.00	125,000.00	1,220.89
	Sub-Total Carried to Summary - Element 7				125,000.00	1,220.89
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				500,000.00	4,883.58
	ELEMENT 2 - EARTHWORKS				10,200.00	99.62
	ELEMENT 3 - AUXILIARY STRUCTURES				5,000,000.00	48,835.76
	ELEMENT 4 - PERIMETER FENCE				550,000.00	5,371.93
	ELEMENT 5 - TREATMENT WORKS				2,500,000.00	24,417.88
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				125,000.00	1,220.89
	ALL ELEMENTS TOTAL				8,835,200.00	86,294.73
	Allow of 5% for supervision				441,760.00	4,314.74
	Grand Total				9,276,960.00	90,609.47

8.12.4 Engineering Drawing for proposed rehabilitation work in Ikombe Sand dam



FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

- Notes General
1. All dimensions are in meters unless otherwise stated.
 2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
 3. Reinforcement bars are mild ferrous round bars to B.S 4449
 4. All pipework indicated diameters are nominal sizes
 5. In the event that any of the notes given in this drawing are in conflict with the requirements of Technical specifications, the specifications shall take precedence. The conflicting note should in any case be brought to the attention of the Engineer
 6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
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 10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
 11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

- Abbreviations
- WW - wash water
GMS - Galvanized Mild Ferrous
FFL - Finished floor level

Consultant:

ASAL EnviroTech Consult LTD

Registered Engineers,
EIA/EA Lead Experts, GIS
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Professionals.
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P. O. BOX 11294 - 00400,
Nairobi, Kenya.
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www.asalenvirotech.co.ke

Client:

nema

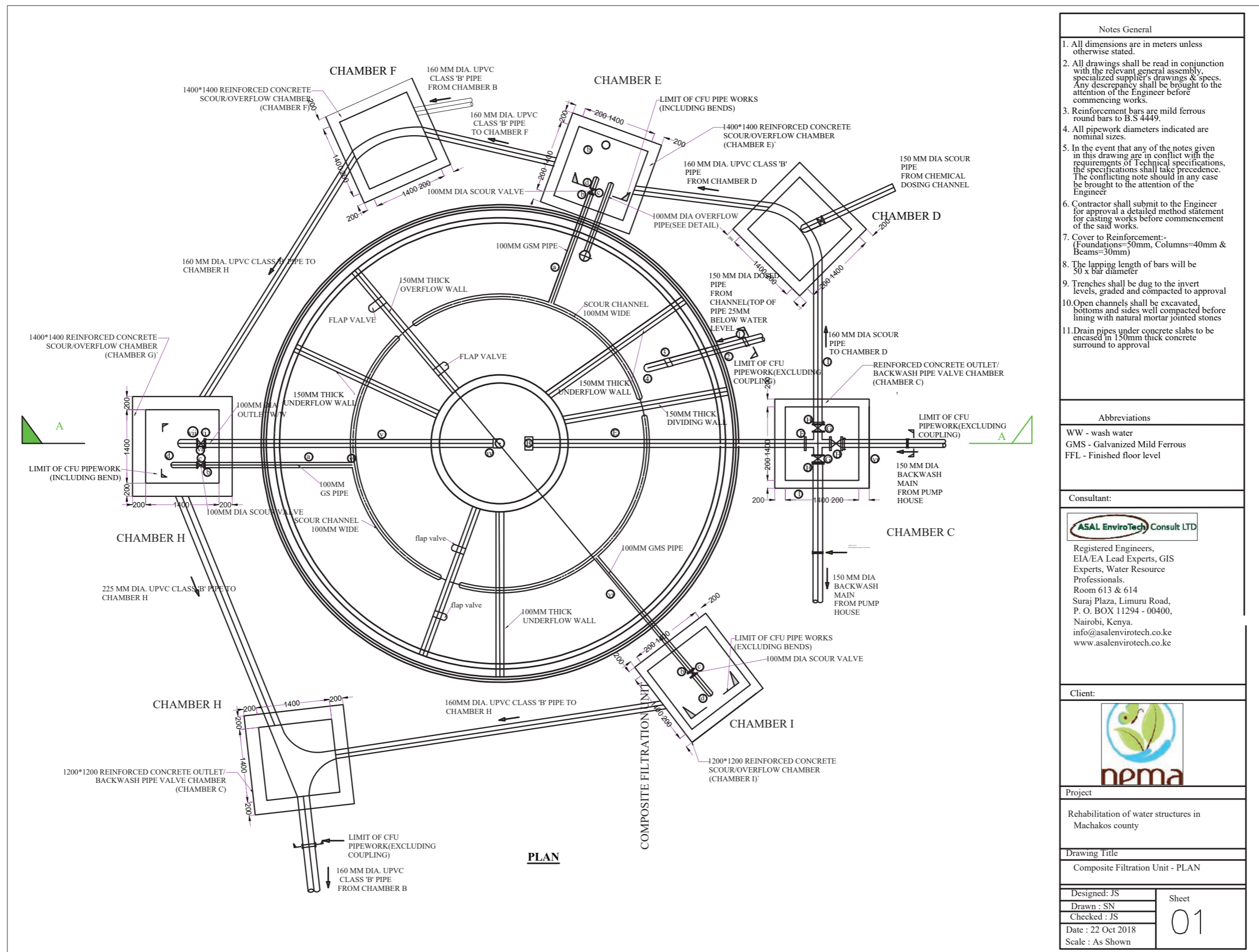
Project
Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - Section
A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

Sheet
01



Notes General

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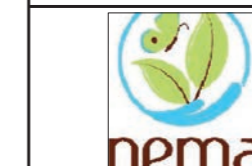
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Client:



Project

Rehabilitation of water structures in
Machakos county

Drawing Title

Composite Filtration Unit - PLAN

Designed: JS

Drawn : SN

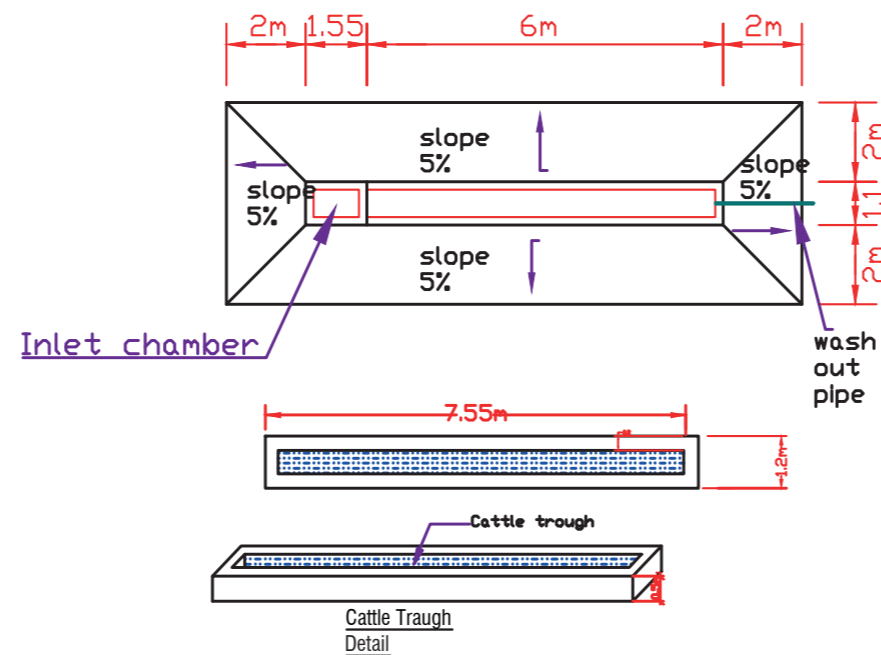
Checked : JS

Date : 22 Oct 2018

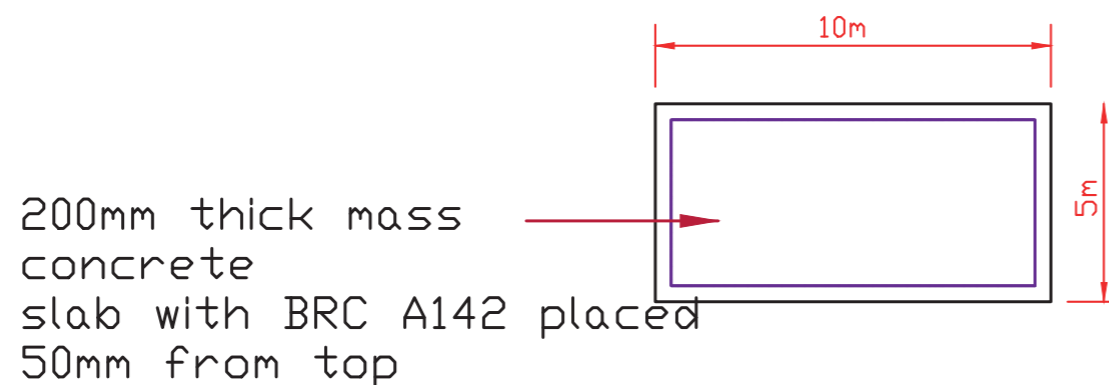
Scale : As Shown

Sheet

01



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

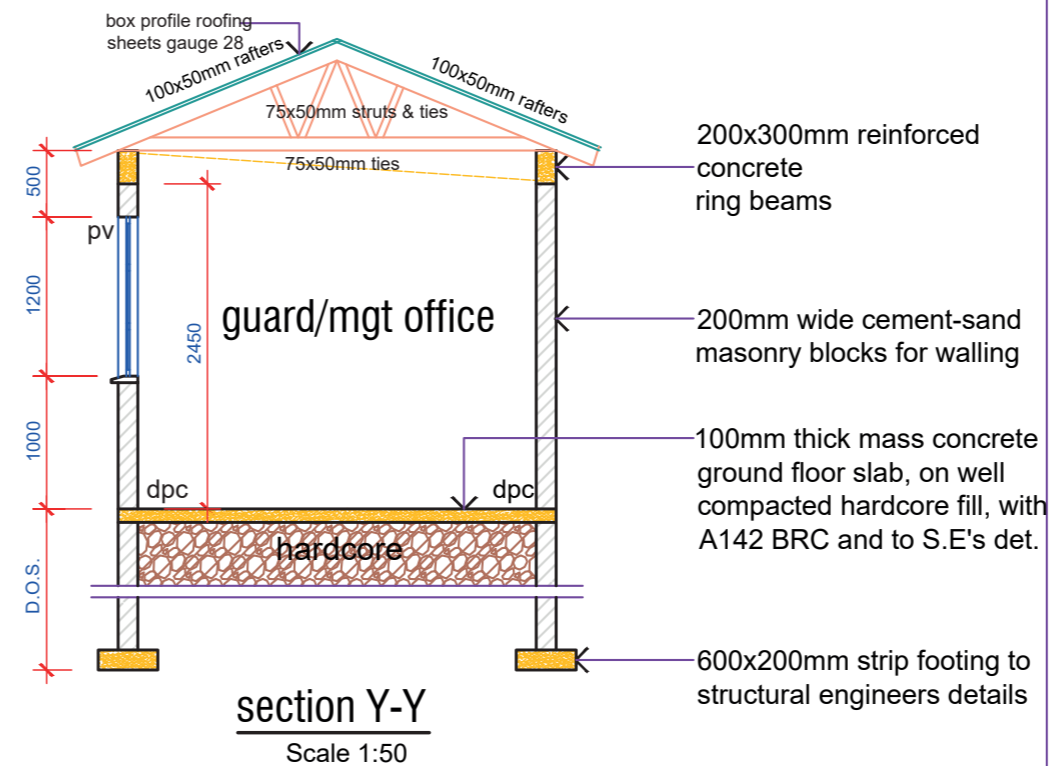
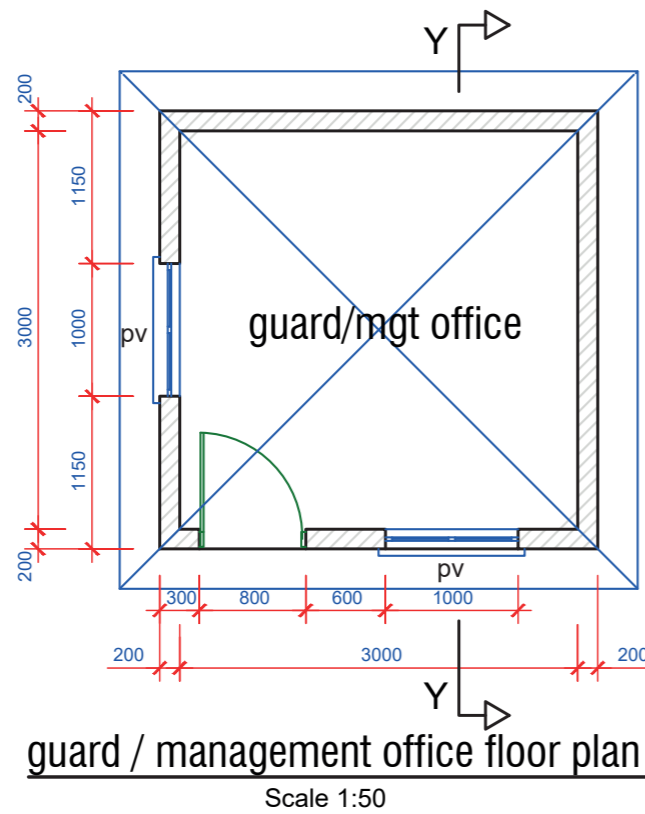
Drawing Title

Dam Layout

Designed: JS
Drawn : SN
Checked : JS
Date : 12 sep 2018
Scale : as shown

Sheet

03



Notes General

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Client:



Project

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

8.13 Description of Kwa Matinga water pan in Kangundo Sub-County, Machakos County

Kwa Matinga water pan is located in Kangundo Sub-county of Machakos County. The volume of the water pan was estimated at 1,718,542 m³. The water pan is currently used for domestic water supply and livestock watering. In this water pan there is an operational water kiosk and cattle through on site. However, there is no means of treatment. Despite its importance there is significant siltation and encroachment of water pan boundaries and riparian zones.

The water pan was proposed for rehabilitation to increase its usefulness in terms of volume and quality of the available water. Rehabilitation works will involve demarcating the official boundary of the water and fencing it to prevent further encroachment. Trees will be planted in the demarcated land to reduce direct runoff into the pan. The water pan will also be excavated to remove deposit silt and thus increase its current volume. To slow down the rate of siltation a silt trap will be introduced at the inlet channel. Two composite filtration units with a flexible draw off pipe will also be installed on site. The flexible draw off will be attached to a floating ball so that it constantly remains at 30 cm below the water surface. A solar water pumping system will also be installed in the site. A water trough will be rehabilitated, and its size increased as recommended in the engineering drawings.

As a contribution to environmental conservation a tree nursery will be established on site with a capacity to provide about 2,000 trees and fruits seedlings per year. However, at the onset of the project, the site management committee will be expected to plant at least 2,000 seedlings in the immediate surroundings of the water pan and the riparian zones. To secure the water pan and all the investment on site a

perimeter fence, a management committee office/guard's house will be established on site.

The management committee will be responsible for the day-to-day management of the water pan. The various users of water and other service from the water pan will be charged a reasonable fee. In turn the accrued income will be used for operation and maintenance of the project to enhance its sustainability. In this site, water is fetched and used at the various homesteads, hence issues related to sanitation will be handled at the household levels.

8.13.1 Figures showing the characteristic of Kwa Matinga water pan



Figure 99: Google image showing the location of Kwa Matinga water pan and its surroundings



Figure 100: A view of Kwa Matinga water pan



Figure 101: Kwa Matinga spillway proposed for rehabilitation



Figure 102: Storage to be connected to Kwa Matinga water supply for the surrounding villages

8.13.2 Beneficiaries of Kwa Matinga water pan

8,500 Households with an average of 6 members.

8.13.3 Bill of Quantities for proposed rehabilitation work in Kwa Matinga water pan

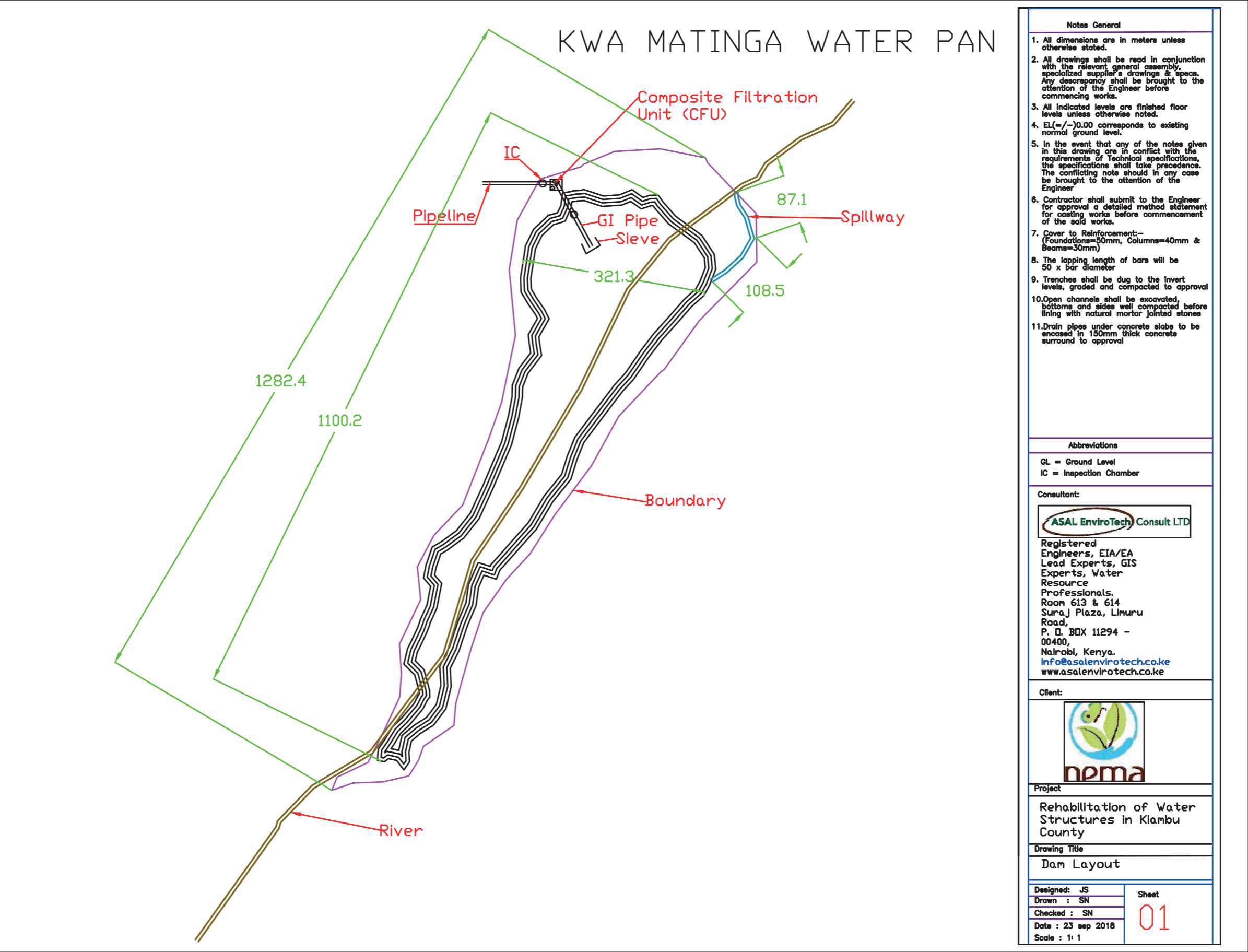
REHABILITATION OF KWA MATINGA WATER PAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

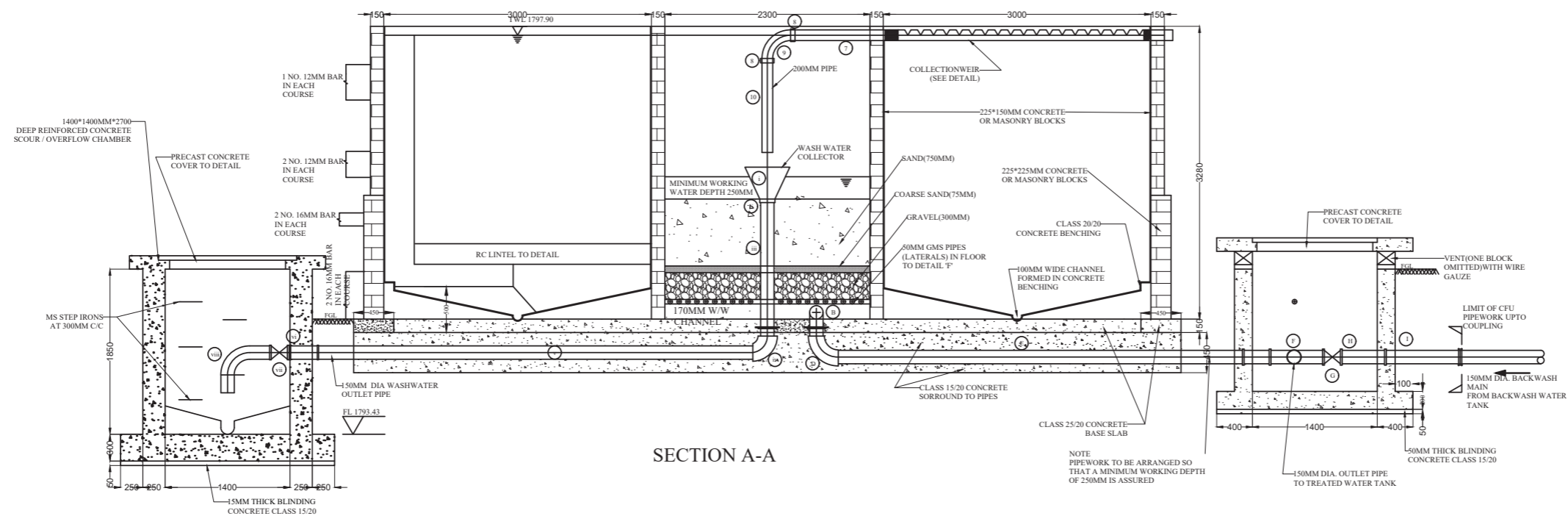
ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	LS	1.0	150,000.00	150,000.00	1,465.07
1.2.	Allow for Site survey to identify the official boundaries of the land set aside for the dam	PS	1	250,000.00	250,000.00	2,441.79
1.3.	Allow for Security Costs	PS	1	50,000.00	50,000.00	488.36
1.4.	Allow for bathymetric survey, embankment integrity assessment and water quality analysis	PS	1	850,000.00	850,000.00	8,302.08
1.5.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 1				1,450,000.00	14,162.37
2.0.	Earthworks					
2.1.	Clear the dam site of all bushes, shrubs, stumps and grub up roots and cart away as directed by the Engineer	SM	50,000	3.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 2				150,000.00	1,465.07
3.0.	Auxiliary Structures					
3.1.	Excavate soil at silt trap area and cart away and/or borrow as directed by the Engineer. Allow for the construction of the Silt traps	CM	1,200.0	200.00	240,000.00	2,344.12
3.2.	Excavate soil to create Overflow to outlet channel and cart away and/or borrow as directed by the Engineer.	CM	450.0	200.00	90,000.00	879.04
3.3.	Allow for the construction of the Overflow Channel	LS	1.0	60,000.00	60,000.00	586.03
3.4.	Excavate soil to clear inflow channel and cart away and/or borrow as directed by the Engineer.	CM	300.0	200.00	60,000.00	586.03
3.5.	Allow for the construction of riprap and sills for the Inlet Channel	LS	1.0	100,000.00	100,000.00	976.72
3.6.	Provide for riprap arrangement between the silt trap and the pan and also between the silt trap and the spillway to exceeding 6 m wide and 300 mm thick	SM	205.0	1,000.00	205,000.00	2,002.27
3.5	Cut trench for draw-off pipes 50 m long x 0.6m wide and 6.0 m average depth	CM	75	650.00	48,750.00	476.15
3.8.	Provide 152 mm Ø GI pipe flanged draw off pipe class "B", 152 mm Ø gate valve, lay, join to the storage tank and backfill as directed by the Engineer	NO	4	650.00	2,600.00	25.39
3.10.	Provide 100 mm Ø GI pipe class "B" flanged draw off pipe, 100 mm Ø gate valve, lay, join for cattle watering drawoff and backfill as directed by the Engineer	NO	15.0	650.00	9,750.00	95.23
3.11.	Provide 6 m long 152 mm Ø flexible Hose	NO	1.0	500.00	500.00	4.88
3.12.	Provide 6 m long 100 mm Ø flexible Hose	NO	1.0	450.00	450.00	4.40
3.13.	Provide for a 3 mm opening protecting screen floating ball and 300 mm long chain	NO	2.0	600.00	1,200.00	11.72
	<u>Mass concrete as described in:-</u>					
3.15	200 mm thick mass concrete floor slab with BRC mesh No. A142	CM	0.5	20,000.00	10,000.00	97.67
	<u>Sawn formwork to:</u>					
3.16	Sides of 200 mm thick Reinforced Concrete walls	SM	33.0	200.00	6,600.00	64.46
	<u>Vibrated reinforced concrete as described in:-</u>					
3.17	Reinforced Concrete 200 mm thick walls	CM	3.2	20,000.00	64,000.00	625.10
3.18	Provide and fix a lockable inspection chamber cover made from 4mm agline bars and 18mm metal sheets	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				908,850.00	8,876.88

REHABILITATION OF KWA MATINGA WATER PAN IN MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	Q'TY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
4	<u>Perimeter Fence, Guard house/shop</u>					
4.1	Provide and erect a perimeter fence with 4 mm thickness angleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1.8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	28,000.0	400.00	11,200,000.00	109,392.09
4.2	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	2.0	20,000.00	40,000.00	390.69
4.3	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	130,000.00	130,000.00	1,269.73
	Sub-Total Carried to Summary - Element 4				11,370,000.00	111,052.51
5.0.	<u>Treatment works</u>					
5.1.	Allows for construction of Composite Filtration Unit (CFU)	NO	3.0	2,000,000.00	6,000,000.00	58,602.91
5.2.	Allow for auxillaries connections and other structures	PS	1.0	800,000.00	800,000.00	7,813.72
	Sub-Total Carried to Summary - Element 2				6,800,000.00	66,416.63
6.0.	<u>Cattle Trough Construction</u>					
6.10.	Allow for construction a cattle trough 6 m long	LS	1.0	150,000.00	150,000.00	1,465.07
	Sub-Total Carried to Summary - Element 3				150,000.00	1,465.07
7.0.	<u>Environmental Conservation</u>					
7.1.	Allow for establishing of tree nursery on site	LS	1	50,000.00	50,000.00	488.36
7.2.	Allow for planting of indigeneous trees upstream and downstream of the dam	No	2,000	250.00	500,000.00	4,883.58
	Sub-Total Carried to Summary - Element 7				550,000.00	5,371.93
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				1,450,000.00	14,162.37
	ELEMENT 2 - EARTHWORKS				150,000.00	1,465.07
	ELEMENT 3 - AUXILIARY STRUCTURES				908,850.00	8,876.88
	ELEMENT 4 - PERIMETER FENCE				11,370,000.00	111,052.51
	ELEMENT 5 - TREATMENT WORKS				6,800,000.00	66,416.63
	ELEMENT 6 - CATTLE TROUGH				150,000.00	1,465.07
	ELEMENT 7 - ENVIRONMENTAL CONSERVATION				550,000.00	5,371.93
	ALL ELEMENTS TOTAL				21,378,850.00	208,810.46
	Allow of 5% for supervision				1,068,942.50	10,440.52
	Grand Total				22,447,792.50	219,250.98

8.13.4 Engineering Drawing for proposed rehabilitation work in Kwa Matinga water pan





SECTION A-A

FILTER MEDIA DETAILS

MATERIAL	DIAMETER (mm)	DEPTH (mm)	LOCATION
GRAVEL	38 - 20	75	BOTTOM
	20 - 12	75	-
	12 - 5	75	-
	5 - 2	75	-
COARSE SAND EFFECTIVE SIZE	1	75	MIDDLE
SAND EFFECTIVE SIZE	1/2		
UNIFORMITY COEFFICIENT	1 1/2	750	TOP
TOTAL THICKNESS OF FILTER BED		1125	

DETAILS OF LATERALS

50 mm G.M.S PIPES REQUIRED		
OVERALL LENGTH	NO. HOLES PER PIPES	NO. REQUIRED
900	5	4
1300	7	2
1700	9	2
2100	11	4

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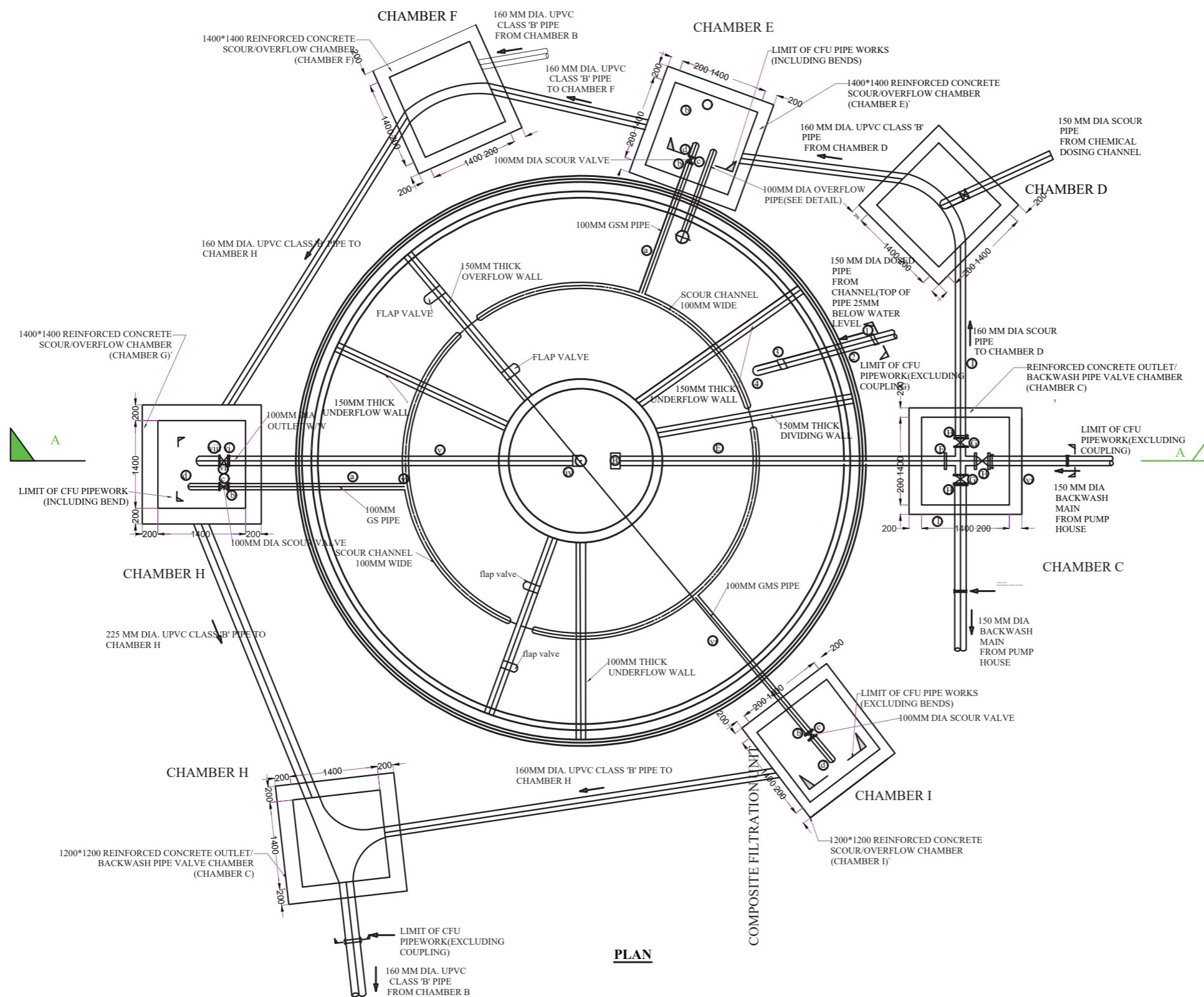
Project
Rehabilitation of water structures in
Machakos county



Drawing Title

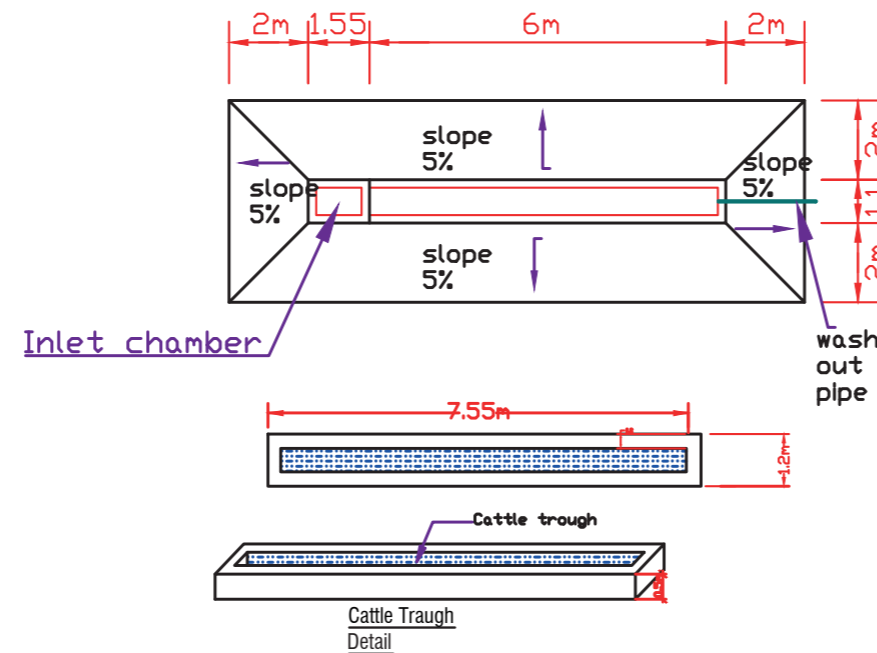
Composite Filtration Unit - Section
A-A

Designed: JS
Drawn : SN
Checked : SN
Date : 22 Oct 2018
Scale : 1/50

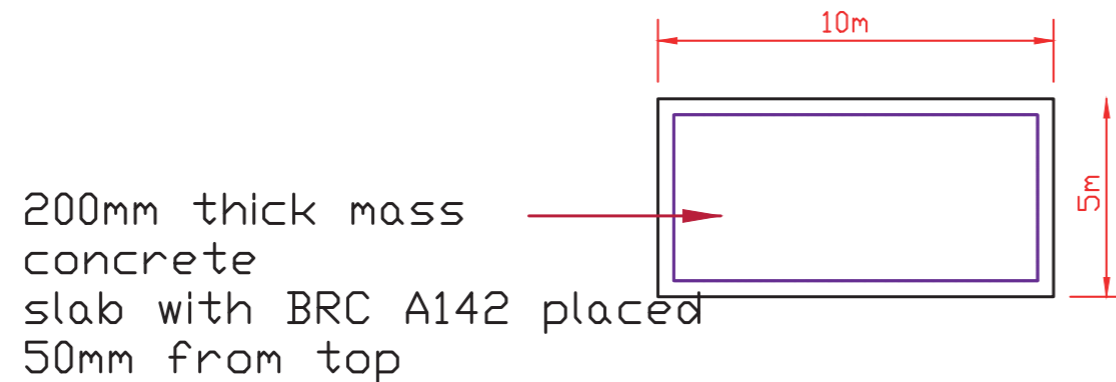
Sheet
01



Notes General	
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Client:	
	
Project	
Rehabilitation of water structures in Machakos county	
Drawing Title	
Composite Filtration Unit - PLAN	
Designed: JS	Sheet <div>01</div>
Drawn : SN	
Checked : JS	
Date : 22 Oct 2018	
Scale : As Shown	



CATTLE WATERING TROUGH
Scale 1:1000



WASHING SLAB PLAN
Scale 1: 1000

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Project

Rehabilitation of
water structures in
Nyandarua county

Drawing Title

Dam Layout

Designed: JS

Drawn : SN

Checked : JS

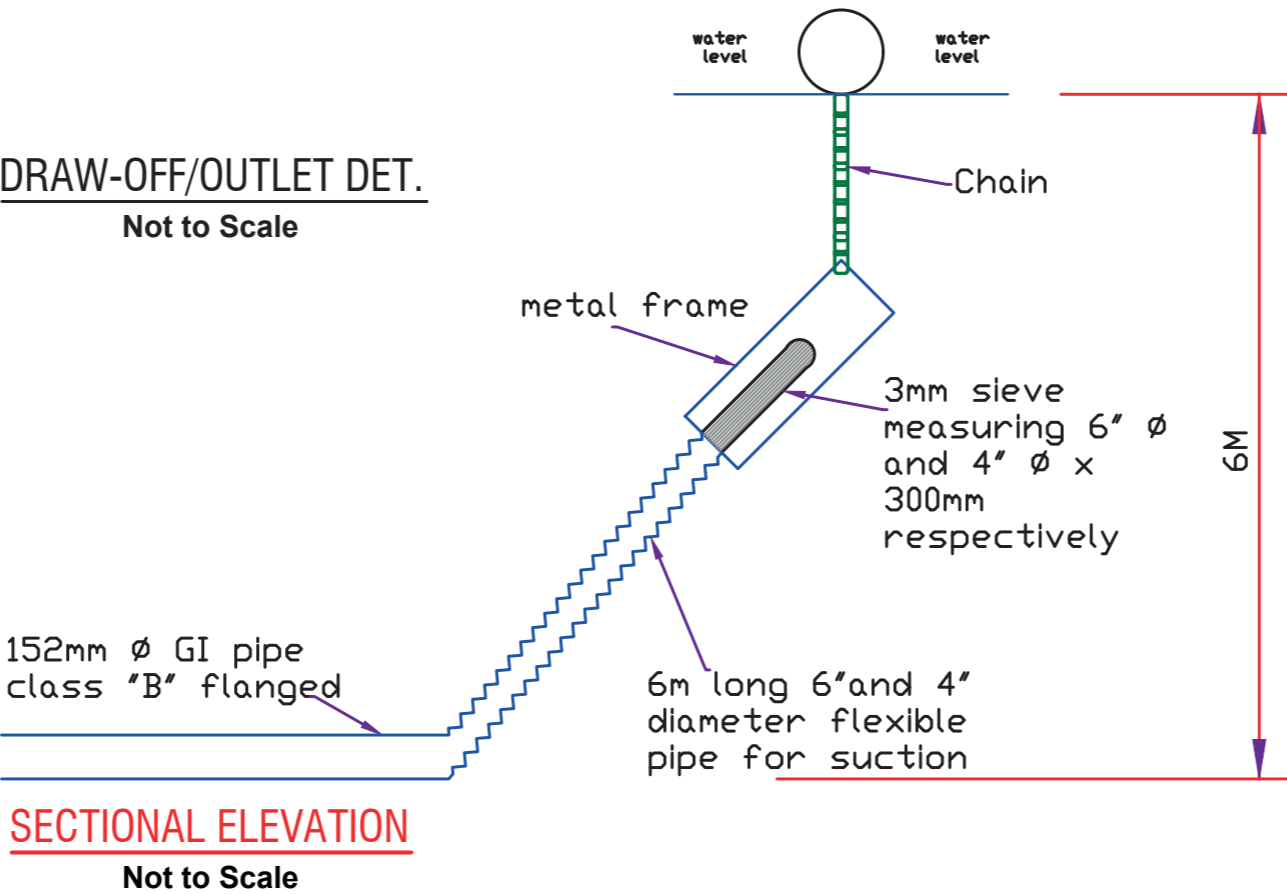
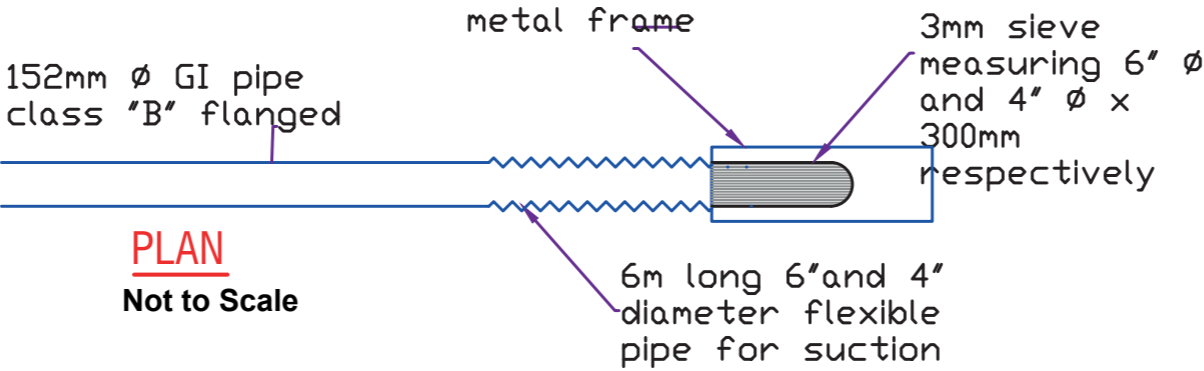
Date : 12 sep 2018

Scale : as shown

Sheet

03

DRAW-OFF/OUTLET



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Client:



Project

Rehabilitation of
water structures in
Nyandarua county

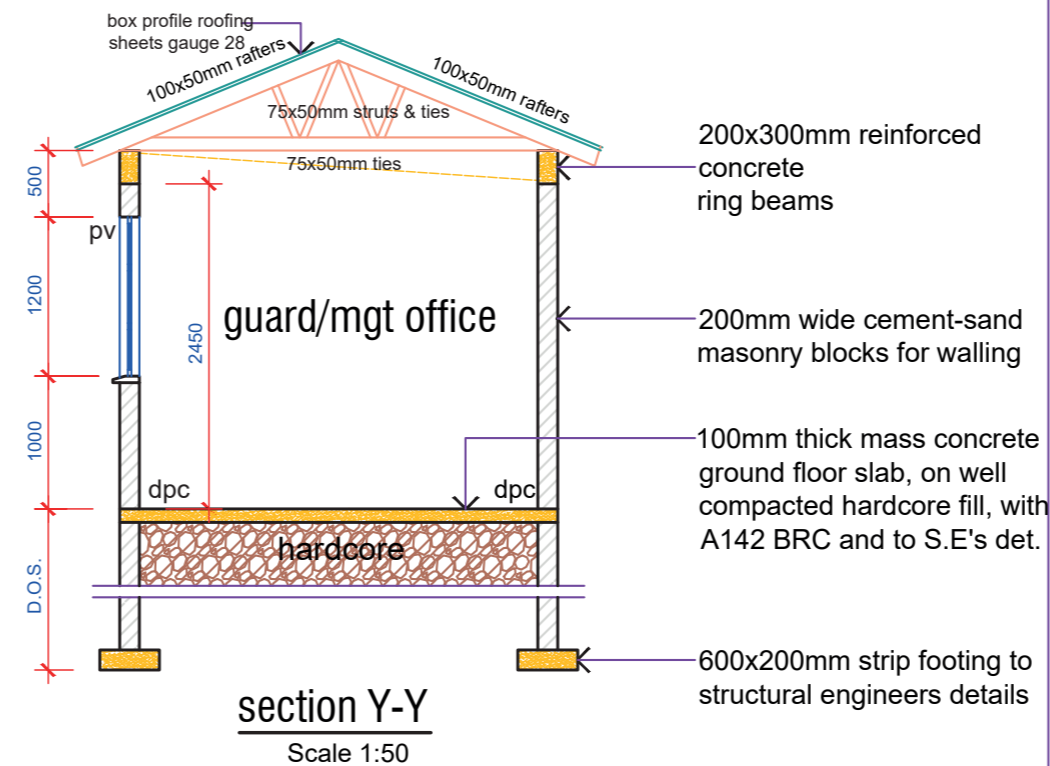
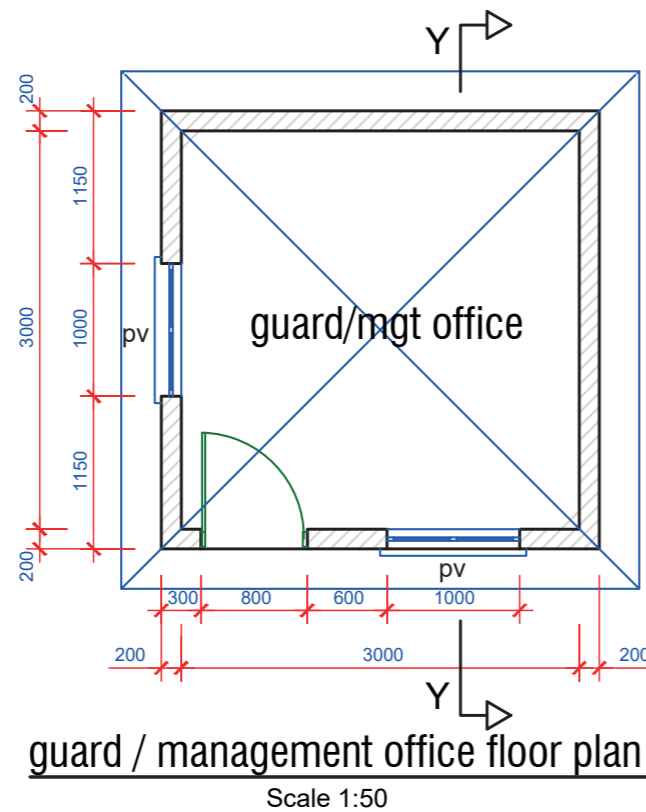
Drawing Title

Draw off/ Outlet

Designed: JS
Drawn: SN
Checked: JS
Date: 12 sep 2018
Scale: as shown

Sheet

04



Notes General

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2. All drawings shall be read in conjunction with the relevant general assembly, specialized supplier's drawings & specs. Any discrepancy shall be brought to the attention of the Engineer before commencing works.
3. All indicated levels are finished floor levels unless otherwise noted.
4. EL(=/-)0.00 corresponds to existing normal ground level.
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6. Contractor shall submit to the Engineer for approval a detailed method statement for casting works before commencement of the said works.
7. Cover to Reinforcement:- (Foundations=50mm, Columns=40mm & Beams=30mm)
8. The lapping length of bars will be 50 x bar diameter
9. Trenches shall be dug to the invert levels, graded and compacted to approval
10. Open channels shall be excavated, bottoms and sides well compacted before lining with natural mortar jointed stones
11. Drain pipes under concrete slabs to be encased in 150mm thick concrete surround to approval

Abbreviations

GL = Ground Level
IC = Inspection Chamber

Consultant:



Registered Engineers, EIA/EA Lead Experts, GIS Experts, Water Resource Professionals.
Room 613 & 614
Suraj Plaza, Limuru Road,
P. O. BOX 11294 - 00400,
Nairobi, Kenya.
info@asalenvirotech.co.ke
www.asalenvirotech.co.ke

Client:



Project:

Rehabilitation of Water Structures in
Nyandarua County

Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

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8.14 Description of Gimu borehole in Kathiani Sub-County, Machakos County

The proposed Gimu borehole will be a solar powered and meant to augment domestic water supply in Kathiani sub-county of Machakos County. Some of the proposed preliminaries activities to develop this borehole includes hydrological survey, and Environmental and Socio Impact Assessment (ESIA). Drilling works will also involve preventing collapse in collapsible zones using suitable casing, which is provided for in the BOQ.

Once drilling is completed and the borehole appropriately cased a 24-hour test pumping will be carried out to determine its yield. Finally, solar panels, pumps, storage tanks and reticulations to point of use will be installed. The water will be supplied and will rely on existing sanitation service provided by Mavoko Water and Sewerage Company limited (MAVWASCO) or existing stand-alone systems at home. The company will be in charge revenue collection and operation and maintenance of the system.

To support environmental conservation, this site will support establishment of green spaces with at least 300 indigenous trees in its peri-urban location. Further, a management office/guard's house/shop will be constructed on site. The shop is expected to serve the local community and provide alternative source of income to the management committee.



Figure 103: Location of Gimu Borehole in Athi River, Mavoko sub county, Machakos County

8.14.1 Beneficiaries of proposed Gimu borehole

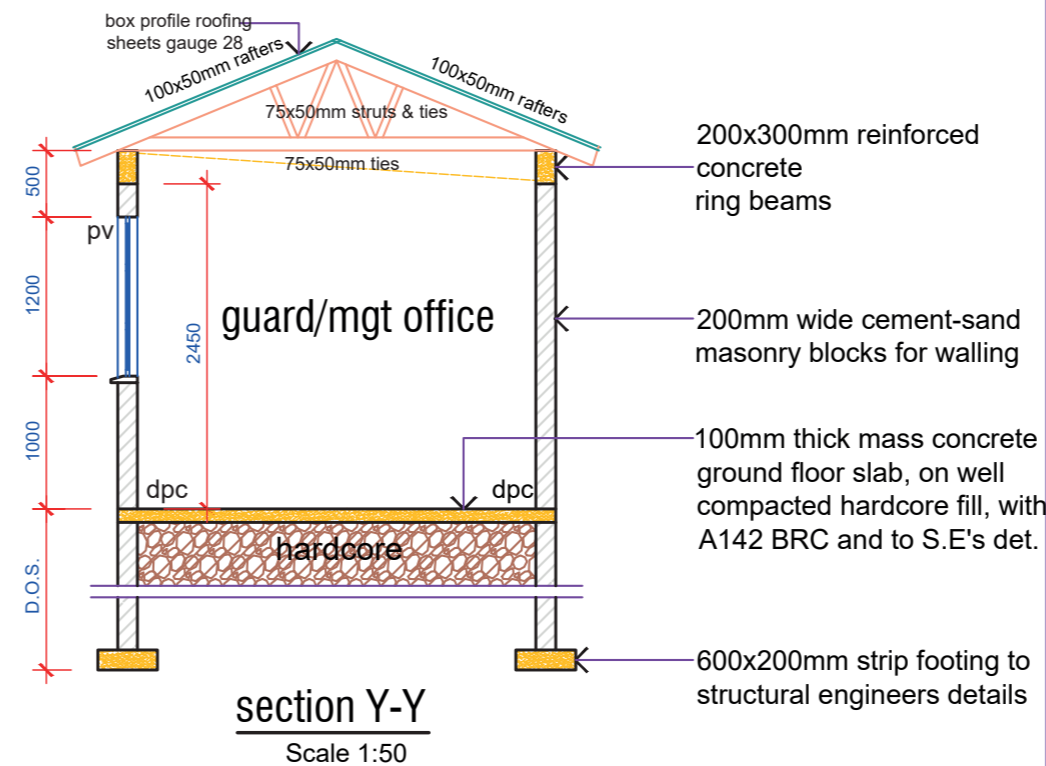
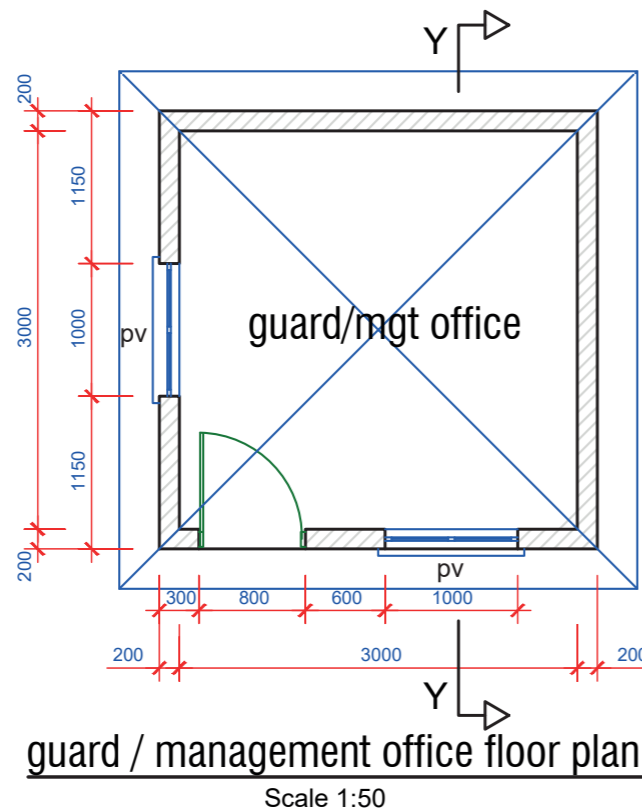
1,800 Households with an average of 6 members.

8.14.2 Bill of Quantities for proposed of Gimu borehole

DRILLING AND CONSERVATION ACTIVITIES IN GIMU COMMUNITY BOREHOLE IN ATHI RIVER, MACHAKOS COUNTY
BILL OF QUANTITIES (All Provisional)

ITEM	DESCRIPTION	UNIT	QTY	RATE (KES)	AMOUNT (KES)	AMOUNT (\$)
1.0.	Preliminaries					
1.1.	Provisional amount for mobilization of equipment to site, setting of camp and Demobilization on completion including tidying up the site. Allow for a Provisional Sum	PS	1.0	250,000.00	250,000.00	2,441.79
1.2.	Provisional amount for hydrogeological sites to identify drilling sites.	PS	1.0	100,000.00	100,000.00	976.72
1.3.	Provisional amount for Provision sum for ESIA and NEMA and WRA licenses	PS	1.0	120,000.00	120,000.00	1,172.06
1.4.	Provisional amount for security Costs	PS	1.0	70,000.00	70,000.00	683.70
	Sub-Total Carried to Summary - Element 1				540,000.00	5,274.26
2.0.	Drilling works					
2.1.	Drilling 203 mm diameter Borehole from 0-200 m depth	LM	200.0	7,500.00	1,500,000.00	14,650.73
2.2.	Additional Provisional costs in case of borehole collapse in collapsible zone. Installation of Non- Removable 8" Surface casings in the event of Borehole Collapse in the collapse zone	LM	50.0	7,000.00	350,000.00	3,418.50
2.3.	Supply of water used during drilling & development and for campsite use	CM	0.9	45,000.00	40,500.00	395.57
2.4.	6 Inch (153mm) diameter STEEL casings pipe	LM	200.0	4,000.00	800,000.00	7,813.72
2.5.	6 Inch (153mm) STEEL screens in Plasma Slots	LM	50.0	4,500.00	225,000.00	2,197.61
2.6.	Supply & filling of Gravel pack(2- 4mm)	KG	20,000.0	45.00	900,000.00	8,790.44
2.7.	Borehole development work/FLASHING using compressed air injected in to the borehole	HR	2.0	5,000.00	10,000.00	97.67
2.8.	24 Hours Test pumping Calibration, step test, and discharge test, recovery test after test pumping	LS	1.0	100,000.00	100,000.00	976.72
2.9.	Construction of concrete slab with well cap	NO	1.0	2,500.00	2,500.00	24.42
2.10.	Provisional amount for tanks and reticulations to point of use	PS	1.0	2,000,000.00	2,000,000.00	19,534.30
	Sub-Total Carried to Summary - Element 2				5,928,000.00	57,899.67
3.0.	Laboratory analysis and completion reports					
3.1.	Allow for water analysis test - Bacteriological, chemical and physical tests to WHO standards	LS	1.0	20,000.00	20,000.00	195.34
3.2.	Allow for borehole completion report	LS	1.0	10,000.00	10,000.00	97.67
	Sub-Total Carried to Summary - Element 3				30,000.00	293.01
4.0.	Pumping and storages					
4.1.	Provisional sum for installing tanks, steel stand and solar pumping unit	PS	1.0	2,500,000.00	2,500,000.00	24,417.88
4.2.	Provision sum for reticulation of water to the point of use	PS	1.0	1,000,000.00	1,000,000.00	9,767.15
	Sub-Total Carried to Summary - Element 3				3,500,000.00	34,185.03
5.0.	Perimeter Fence, Guard house/shop					
5.1.	Provide and erect a perimeter fence with 4mm thickness agleline metal bars spaced at 3 meters interval, 4 strands of 12.5 gauge barbed wire and 1.8 meters high class B galvanized steel chain link. All bindings to be done with galvanized binding wire.	LM	50.0	600.00	30,000.00	293.01
5.2.	Fabricate and fix lockable metallic weld meshed gate (4m x 1.8m high)	LS	1.0	20,000.00	20,000.00	195.34
5.3.	Construct a guard house/shop as per the technical drawings and as directed by the engineer	LS	1.0	300,000.00	300,000.00	2,930.15
	Sub-Total Carried to Summary - Element 5				350,000.00	3,418.50
6.0.	Environmental Conservation					
6.1.	Allow for planting of indigeneous trees upstream and downstream of the spring	No	300	250.00	75,000.00	732.54
	Sub-Total Carried to Summary - Element 6				75,000.00	732.54
	GRAND SUMMARY					
	ELEMENT 1 - PRELIMINARIES				540,000.00	5,274.26
	ELEMENT 2 - DRILLING WORK				5,928,000.00	57,899.67
	ELEMENT 3 - LAB ANALYSIS AND COMPLETION REPORT				30,000.00	293.01
	ELEMENT 4 - PUMPING AND STORAGE				3,500,000.00	34,185.03
	ELEMENT 5 - PERIMETER FENCE AND GUARD HOUSE				350,000.00	3,418.50
	ELEMENT 6 - ENVIRONMENTAL CONSERVATION				75,000.00	732.54
	ALL ELEMENTS TOTAL				10,423,000.00	101,803.02
	Allow of 5% for supervision				521,150.00	5,090.15
	Grand Total				10,944,150.00	106,893.17

8.14.4 Engineering Drawing for proposed of Gimu borehole



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Drawing Title:

Guard/Management office

Designed: JS

Drawn: SN

Checked: JS

Date: 23 SEP 2018

Scale: as shown

Sheet

05

Appendices

Appendix 1.1: County level stakeholder meetings attendees

Attendees of stakeholder meeting held on August 6th at the Royal Gardens Hotel, Olkalau Nyandarua County

No	Name	Organization
1	Joseph Sang	ASAL
2	Simon Mutie	ASAL
3	David Mutahi	County Government
4	Dorcas Kuria	County Government
5	Miriam Ngetho	County Government
6	Gerald Kinyua	Former Councillor
7	Benedict Kimani	Ministry of Water and Irrigation
8	Joseph Ndirangu	Ministry of Water and Irrigation
9	Lucy Gichuru	Ministry of Water and Irrigation
10	Mary Kamau	Ministry of Water and Irrigation
11	Mwanzia Kyambia	Ministry of Water and Irrigation
12	Silvester Karinge	Ministry of Water and Irrigation
13	Anne Gateru	National Environmental Management Authority
14	Harron Wanjohi	National Environmental Management Authority
15	Raynice Magak	National Environmental Management Authority
16	Wangare Karumba	National Environmental Management Authority
17	Stephen Simiyu	TUNAY
18	Mary Wambui	Water Resources Authority
19	Rahab Nyururu	Water Resources Authority
20	Geoffrey Kariuki	WRUA
21	Suleiman Ndungu	WRUA

Attendees to stakeholder meeting held on September 10th 2018 at the Phoenicians Hotel, Kiambu County.

No.	Name	Department
1	John Kariuki	Kiambu County Water and Sewerage Karuri Region
2	Joseph Mwangi W.	Kiambu County Water and Sewerage Githunguri Region
3	Jane Murage	Kiambu County Water and Sewerage Kikuyu Region
4	Allan Ngugi	Director ICT KEWSC
5	Joyce Maburi	Kabete Sub-county Kiambu County
6	Kellen Njoroge	Water Environment Energy and Natural Resources
7	Stephen Simiyu	TUNAY
8	Joseph Sang	ASAL
9	Kiai Caroline	ASAL
10	George Ngugi	Kiambu County
11	Stephen M. Muchunu	Kiambu County
12	Margaret W. Maina	KCWSC Limuru Region
13	Gerard Ngumbi	Env. Consultant
14	Simon M. Mwangi	KCWSC Ruiru Office
15	John K. Thukuo	C. GOK. Water and Sanitation
16	Boniface Mbuwa	KCWSC Kiambu Region
17	James G. Mwagwu	Kiambu County Government
18	Evans M. Kimari	Kiambu County Government-Juja
19	Samuel Wakangu	WEENR
20	Stephen Kimani	Kiambu County Water and Sewerage
21	Eng. Philip Gichuki	Kiambu County Water and Sewerage
22	Eng. John Kinuthia	Kiambu County Government
23	Dickson G. Njunge	Kiambu County Government

Attendees to stakeholder meeting held on September 17th at the Kyaka Hotel,
Machakos County

No.	Name	Department
1	Augustus Mboya	Water
2	Agnes Muteti	Water
3	Stella Ndwiga	Water Mavwasco
4	Moses Nzuki	MWASCO
5	Joseph Mutende	Machakos WSP
6	Michael Muthama	County Environmental Comm
7	Grace Kioko	Environment
8	Philip Kilonzo	MAVWASCO
9	Ndwiki S.M	Machakos Govt Water
10	Joseph M. Kimeu	WRUA
11	Francisca Mutinda	Environment
12	Dr. Jane Mutune	Environment
13	Thomas M. Kasoa	MAWASCO
14	Naomi Mutie	County Govt
15	Jackson	County Govt
16	Dinah Wanja	NEMA
17	Wangare Kirumba	NEMA
18	Anne Mumbi	NEMA
19	Oloo Vincent Ochieng	NEMA - Machakos
20	Jalubosco Madola	Water
21	Stephen Simiyu	TUNAY
22	Dr. Stephen Maelu	Machakos County Dept. Env.
23	Simon Mutie	ASAL
24	Daniel Kyalo	Machakos County Dept. Env.
25	Gideon Mutua	Machakos County Govt
26	William Makau	Machakos County Govt
27	Francis Musembi	NEMA-Machakos
28	Gerard Ngumbi	Environmental Consultant
29	Wanyohi Ha	NEMA

Appendix 1.2: Sites of the assess structures

No	Longitude	Latitude	Altitude	County	Name	Type
1	-0.871250000	36.598111111	2616	Nyandarua	Kariani	Water pan
2	-0.892111111	36.567444444	2683	Nyandarua	Githwe	Borehole
3	-0.865944444	36.560333333	2725	Nyandarua	Kahora	Water pan
4	-0.828250000	36.576527778	2681	Nyandarua	Mutonyora	Water pan
5	-0.786916667	36.559388889	2650	Nyandarua	Heni	Water pan
6	-0.699833333	36.548388889	2516	Nyandarua	Karanja Wanaina	Water pan
7	-0.717194444	36.573527778	2553	Nyandarua	Wanyeki	Water pan
8	-0.723777778	36.533138889	2524	Nyandarua	Koinange	Borehole
9	-0.754972222	36.641222222	2535	Nyandarua	Wachira Waheni	Water pan
10	-0.798305556	36.614694444	2622	Nyandarua	Mbiru	Water pan
11	-0.778000000	36.661472222	2504	Nyandarua	Kahungura	Spring
12	-0.728500000	36.671888889	2525	Nyandarua	Ebrahim Koikai	Water pan
13	-0.693527778	36.640972222	2597	Nyandarua	Kwa Musa	Water pan
14	-0.678000000	36.655166667	2703	Nyandarua	Gachuchu Spring	Spring
15	-0.714805556	36.629861111	2548	Nyandarua	Warungana	Water pan
16	-0.755444444	36.654972222	2523	Nyandarua	Churiri	Water pan
17	-1.183583333	36.753000000	1837	Kiambu	Kambara	Spring
18	-1.184305556	36.751083333	1838	Kiambu	Karia spring	Spring
19	-1.188888889	36.760388889	1810	Kiambu	Gathiri	Spring
20	-1.159888889	36.753944444	1939	Kiambu	Ite dam	Water pan
21	-1.065722222	36.649361111	2317	Kiambu	Romo	Borehole
22	-1.197916667	36.592250000	2094	Kiambu	Nguirubi	Borehole
23	-1.207555556	36.570194444	2035	Kiambu	Kiriri	Borehole
24	-1.142305556	36.785361111	1838	Kiambu	Riara	Catchment
25	-1.109944444	36.755250000		Kiambu	Kamiti	Water pan
26	-1.250138889	36.670722222	1969	Kiambu	Kikuyu	Spring
27	-1.243277778	36.669972222	1970	Kiambu	Rugita	Borehole
28	-1.242972222	36.670250000	1970	Kiambu	Rungiri	Water pan
29	-1.071102000	37.012097000		Kiambu	Ndarugu river	Catchment
30	-1.399305556	37.398055556	1480	Machakos	Musaalani	Water pan
31	-1.209666667	37.209138889	1496	Machakos	Kwale dam	Water pan
32	-1.465333333	37.285722222	1998	Machakos	Kailo spring	Spring
33	-1.434361111	37.319111111	1649	Machakos	Muooni Dam	Water pan
34	-1.407228000	37.170124000		Machakos	Mithatini Community Borehole	Borehole

No	Longitude	Latitude	Altitude	County	Name	Type
35	-1.517371000	37.264830000		Machakos	80 Health Centers	Tanks
36	-1.493138889	37.513500000	1258	Machakos	Muthutheni dam	Water pan
37	-1.602972222	37.237083333	1593	Machakos	Kwa Katheke	Water pan
38	-1.579388889	37.328583333	1448	Machakos	Miwani	Water pan
39	-1.657888889	37.270750000	1749	Machakos	Muumandu	Water pan
40	-1.388277778	37.756055556	1112	Machakos	Mekilingi Dam	Water pan
41	-1.270194444	37.697750000	1125	Machakos	Ikombe sand dam	Sand dam
42	-1.212111111	37.289166667	1461	Machakos	Kwa Matinga dam	Water pan
43	-1.436411000	36.994351000		Machakos	Gimu	Borehole

