E1844 v4

Hawassa Storm Water Treatment Project

Environmental Impact Assessment Report

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Acronyms

BMP	Best Management Plan
CSE	Conservation Strategy of Ethiopia
EELPC	Ethiopian Electric light Power Corporation
EFB	Eastern Fault Belt
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EPA	Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
EWNHS	Ethiopian Wildlife and Natural History Society
FDRE	Federal Democratic Republic of Ethiopia
FEPA	Federal Environmental Protection Authority
IEC	Information, Education and Communication
ITCZ	Inter- Tropical Convergence Zone
MERV	Main Ethiopian Rift Valley
NBP	National Biodiversity Policy
NGO	Non Governmental Organization
RIAM	Rapid Impact Assessment Matrix
SNNPRS	Southern Nation Nationality People of Regional State
ULD	Urban Local Government
ULGDP	Urban Local Government Development Project

Executive Summary

Background and Project justification

Urbanization, like many other places, in Hawassa brought the impetus for a substantial investment on basic infrastructures of the city. With the expansion of urban infrastructures the urbanization process resulted in major changes in the natural conditions of the urban (Hawassa) watershed. With construction of residential and other buildings to accommodate the increasing population (both private and governmental), road rehabilitation and upgrading works, etc the main features of the natural areas are modified in Hawassa. Generally the urbanization process influences the natural surface detention, the infiltration characteristics and the drainage pattern formed by the natural flow paths.

Objectives of the proposed development project

The greater objectives of the project relate to complying with the ideals of the Ethiopian Environmental Protection Authority's requirement to minimize or reduce the environmental externalities of anthropogenic activities (e.g. urbanization and its effects) by exercising greener thinking and implementing greener technical decisions.

Project Description

Project location

The wetland Rehabilitation Project is found in Hawassa City, Sidama Zone, of Southern Nation Nationalities and peoples' (SNNP) Region. The project areas are situated at the City of Hawassa, which is the capital of SNNP Region and Sidama Zone. In addition, the project areas are located between latitude of 6°45'00" to 7°05'00" N and longitudes of 38°25'00" to 38°30'46" E.

Description of the proposed Wetland Development project

The construction of Wetland is offer a suitable combination of physical, chemical and biological factors for the removal of pathogenic organisms. The physical factors include mechanical filtration exposure to ultraviolet radiation and sedimentation. Chemical factors include oxidation, exposure to biocides excreted by some wetland plants and absorption by organic matter. Biological removal mechanisms include antibiosis, predation by nematodes and protists, attack by lytic bacteria and viruses.

Alternatives Analysis of Storm Water treatment

Among examination of the different storm water treatment Dry ponds, wet ponds and swales were taken out of the comparison at the beginning. Swales are hardly end of pipe management options and their use is best suited upstream in the catchment. The pond systems can be considered as end of pipe management option but their use is very much suited to flow attenuation and are limited in dealing with storm-water constituents. Three main options remain: infiltration units, bio-retention units and wetlands. While having great potential for pollutant removal the use of infiltration units and bio-retention units as an end of pipe management options is questionable given the size of the catchment and the extremely sediment laden nature of the storm-water in Hawassa and the shallow ground water table at the sites. However, these treatment units can be integrated within the upstream urban catchment as a mechanism to reduce the treatment load on end of pipe storm-water treatment options. In the light of the technical and practical issues considered we recommend wetlands (sub-surface) – as in a treatment train - as storm-water management system for the city of Hawassa.

Environmental Impacts identification, prediction and analysis

Positive Impacts of the Wetland Project

Purification of water and Reduce the velocity of the storm water

Hawassa Wetland is kind of man-made ponds specially designed for the storage and treatment of storm water runoff. These ponds continually hold a certain volume of water. As storm water is held in the wetland particles settle to the bottom and nutrients are taken up by wetland vegetation. Over the long-term, microorganisms breakdown petroleum hydrocarbons and wetland vegetation takes up metals that have settled out into the sediment. Therefore, the Hawassa wetland project would ensure compliance with Ethiopian Environmental Legislations objectives by ensuring that potentially compromised storm-water does not reach the lake, thereby protecting water quality in the Awassa Lake.

Increased Aesthetic Value of the city

Perhaps one of the major anticipated positive significant impacts of the proposed development project is increase current attractive aesthetic scene of Lake Awassa. The project will boost the image of the city as a green city and the introduction of the green storm-water treatment methods like wetland will have an overarching educational significance intern of environmental awareness and can serve both to local and other residents

Increased Jobs opportunity

Special consideration is given to enhancement of the positive effects of the project by maximizing the distribution of this employment related project benefits. Hiring professionals and service providers will be based on merits and yet on competitive base in order to get quality technical workers.

Negative Impacts of the Wetland Project

Accumulation of coarse sediments on the a gross pollutant trap

The wetland system proposed as an end of pipe management system of storm water to provide treatment of storm-water to best practice standard through screening, sedimentation, filtration and through plant uptake. As The wetland will have the screening process of coarse sediments by gross pollutant trap components.

The largest and heaviest particles with pre-dominantly settle out in the inlet open water zone while slightly smaller and lighter particles may only settle out after flowing into wetland vegetation.

Air pollution, noise nuisance and vibration impacts

Air pollution and noise nuisance are predicted to occure during construction phases of the project. The sources of air pollution and noise nuisance during the construction phase is essentially going to emerge from the construction activity and its machineries. The vehicles and construction machines that will be used for excavations, for carting away the excavated materials, and delivery of other construction materials will release roaring noises and create dusts in the project area.

Soil erosion

Soil erosion and landslide effects due to excavations undertaken by the project may transport soil and rock material in to the lake and the surrounding recreational sites of the lake shore and cause siltation. Construction activities should be planned during the dry seasons to minimize entry of excavated material and wastes in to the water body.

Construction waste disposal

Solid waste generated during site preparation and construction work would include cut vegetation and typical construction waste (e.g. wasted concrete, steel, wooden scaffolding and forms, bags, waste earth materials, etc.). This waste would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite.

Impact Mitigation Measures

Mitigation Measures for impact on Accumulation of coarse sediments on the a gross pollutant trap

Deposited sediments and gross pollutants stored around grating installed in the drainage canals and at the gross pollutant trap should be removed regularly. High specific gravity materials silting in the gross pollutant trap should be removed before the onset of the rainy season and the gross- pollutant trap should be checked regularly during the rainy season. Removal should be scheduled in the drier seasons before the onset of every rainy season. Generally, sediment removed from the sedimentation basin is not polluted and can be managed by disposing to sanitary landfill or can be used for landscaping purposes.

Mitigation Measures for impact on Air pollution, noise nuisance

The dust and noise nuisances predicted to occur in the construction and operation sites will be mitigated by applying the following measures.

Re-suspension of dust in the construction sites will be prevented by frequent sprinkling of water. This will be specially applied during the carting away operations of the foundation excavation material.

Mitigation measures for impacts on soil Erosion

Topsoil and cover will be installed as soon as possible after proposed site development is completed. This measure will alleviate the potential erosion of the proposed site to a significant level either during or after preliminary construction. In the long term, soil erosion will be minimized through site grading and land leveling as well as seeding of runoff ditches.

Mitigation measures for impacts on Construction Waste disposal

It has been shown in the impact analysis sections that inappropriate disposal of construction waste generated during the foundation excavation activities of the development project will be one aspect that will potentially affect the environment. The project management and the contractor will ensure that the construction waste to be generated during excavations and related activities will be disposed in officially permitted places.

CHAPTER ONE: INTRODUCTION

Any project has unintended environmental consequences which warrant the need for a detailed environmental impact assessment to ascertain development will not become a self defeating process by tampering with the environment. Development activities bring changes on natural environment, socio-economic environment as well as to the socio-cultural environment of mankind. Accordingly, the Ethiopian Environmental Legislations require an assessment of the environmental pros and cons of development projects as well as placement of measures to safeguard against potential side effects. The Hawassa City Administration required the development of a storm-water treatment system to safeguard potential pollution of the lake. A system of storm-water wetlands is envisaged. In order to realize the benefits that can be derived from wetlands, and to avoid, mitigate or compensate adverse impacts upon and from them, it is imperative that Environmental Impact Assessments (EIAs) are undertaken. Environmental Impact Assessment (EIA) study is one of the several components of the design work specified in the terms of reference (TOR). This EIA report is prepared in line with the requirements of the terms of reference. The study is carried out to get a clear picture of the Environmental component expected to be affected by the project activities and thereafter to recommend and propose the appropriate mitigation measures so as to alleviate the adverse effects and enhance the positive ones.

While undertaking this ESIA study due considerations were given to the ESMF, RPF and relevant national and regional requirements. Chapter one to three of the ESIA study report presents information that introduces the proposed development project, its objectives and key components. The baseline data reflecting the current status of the physical and social environments of the project area iof Hawassa is outlined in chapter six. Whereas identification and

analysis of all potential environmental and social impacts are thoroughly discussed in chapter eight, the proposed mitigation measures for the major and significant adverse impacts followed by the Environmental and Social Management plan are presented in the succeeding chapters.

CHAPTER TWO: BACKGROUND AND PROJECT JUSTIFICATION

Hawassa City located 275 km south from the Nation's capital Addis Ababa is the seat of the Southern Nations and Nationalities Regional State Government and an Administrative center. The city is located on the international road connecting Ethiopia and Kenya and other African countries. The city can be regarded as one of the fastest growing cities in Ethiopia Lake Hawassa is the major icon of the city and the reason behind the latest mushrooming of the hotel industry and the preference of the city as a popular destination for recreation. The multi faceted growth of the city across different economic sectors, the noticeable migration from nearby rural corners and the introduction of major university in the city has made Hawassa a major population center with an over 100% increase in the size of the population within decade. Consequently the city has seen a substantial physical expansion and urbanization visible with enormous urban sprawls in almost every corners of the city in general (i.e. especially in the south and south east portion of the city).

Urbanization, like many other places, in Hawassa brought the impetus for a substantial investment on basic infrastructures of the city. With the expansion of urban infrastructures the urbanization process resulted in major changes in the natural conditions of the urban (Hawassa) watershed. With construction of residential and other buildings to accommodate the increasing population (both private and governmental), road rehabilitation and upgrading works, etc the main features of the natural areas are modified in Hawassa. Generally the urbanization process influences the natural surface detention, the infiltration characteristics and the drainage pattern formed by the natural flow paths. In tandem with coverage of the natural surfaces with houses and other paved surfaces (increasing the degree of imperviousness and consequently the runoff coefficient), the increase in the speed of runoff and the increase in catchment response time to critical rainfall events as an after effects of the process of

urbanization in Hawassa resulted in a concomitant increase in the quantity of storm water requiring management and lead to a decrease in the quality of the storm water.

However, the unintended side effects of the increasing urbanization in Hawassa City and the improvement in the storm-water collection efficiency puts a multi-dimensional challenge on Lake Hawassa as it is an end to the runoff generated on the urban landscape. Given the economic, recreational, ecological and environmental significance of the lake to Hawassa and its environs and to attend to the Ethiopian Environmental Legislative demand of greener development sustainable solutions are required to systematically address storm water management problems in the city. Specifically, there is an urgent need to protect Lake Hawassa from pollution ensuing from the urban landscape. The project specifically endeavors to develop a greener alternative to polish the increased storm water flow from the currently refurbished Hawassa city storm water drainage system before final discharge to the ecologically and economically important "lake Hawassa". Towards this end, the City Administration appointed MS-CONSULTANCY to undertake the study, design, and construction supervision of the Hawassa Storm Water Treatment Project, and signed the Contract Agreement on 22nd of August, 2011. This document presents the storm drainage study in general and the detail design and implementation plan of the part of the city cortically affected in particular.

2.1. Objectives of the proposed development project

The greater objectives of the project relate to complying with the ideals of the Ethiopian Environmental Protection Authority's requirement to minimize or reduce the environmental externalities of anthropogenic activities (e.g. urbanization and its effects) by exercising greener thinking and implementing greener technical decisions. By looking for the state of the art, contextually

relevant, technically competent and easily manageable storm water treatment and final management alternative, the project specifically intends to protect Lake Hawassa from point and diffuse pollution potentially arising from the city storm water drainage system Specifically, by minimizing and/or averting the pollution of lake Hawassa the project ensures the continuity of the lake as an economic driver in the city, help to maintain its recreational value, helps to keep its ecological integrity and avert potential ill effects (e.g. contacting disease by direct contact with the lake water, heavy metal threats, odor related nuisance) of lake pollution on the residents Hawassa city. By minimizing the sediment load on the lake the project also contributes to the greater objective of reducing flooding problems in Hawassa and its surrounding.

2.2 Objective of the EIA Study

The objectives of the environmental impact assessment of this project are to assess and identify potential environmental impacts that may occur as the result of the Hawassa Wetland Rehabilitation Project, screen and scope the impacts, analyze the potential impacts, propose mitigation measures for the potential negative impacts at different phases of the project implementation and recommend environmental mitigation plan and monitoring program. In general the EIA Study will be conducted in the following manner:-

- Gather and analyze the base line data of the existing environmental situation.
- Evaluate the policy, legislative and institutional frame works with in which the project work shall operate.
- Identify environmental components that would be significantly affected by the project work.
- Analyze potential positive and /or adverse impacts of the project
- Propose possible mitigation measures to the adverse impacts
- Propose Environmental management plan and Monitoring

CHAPTER THREE: PROJECT DESCRIPTION

3.1. Project location

The wetland Rehabilitation Project is found in Hawassa City, Sidama Zone, of Southern Nation Nationalities and peoples' (SNNP) Region. The project areas are situated at the City of Hawassa, which is the capital of SNNP Region and Sidama Zone. In addition, the project areas are located between latitude of 6°45'00" to 7°05'00" N and longitudes of 38°25'00" to 38°30'46" E.

This report is limited to the study of wetland as an end of pipe management systems to the storm water management problems in Hawassa City. However the issue of the huge silt accumulation in Awassa Lake, which is primarily caused as the result of the farming practice in its catchments, is an issue, which the Client may have to deal within a similar occasion.

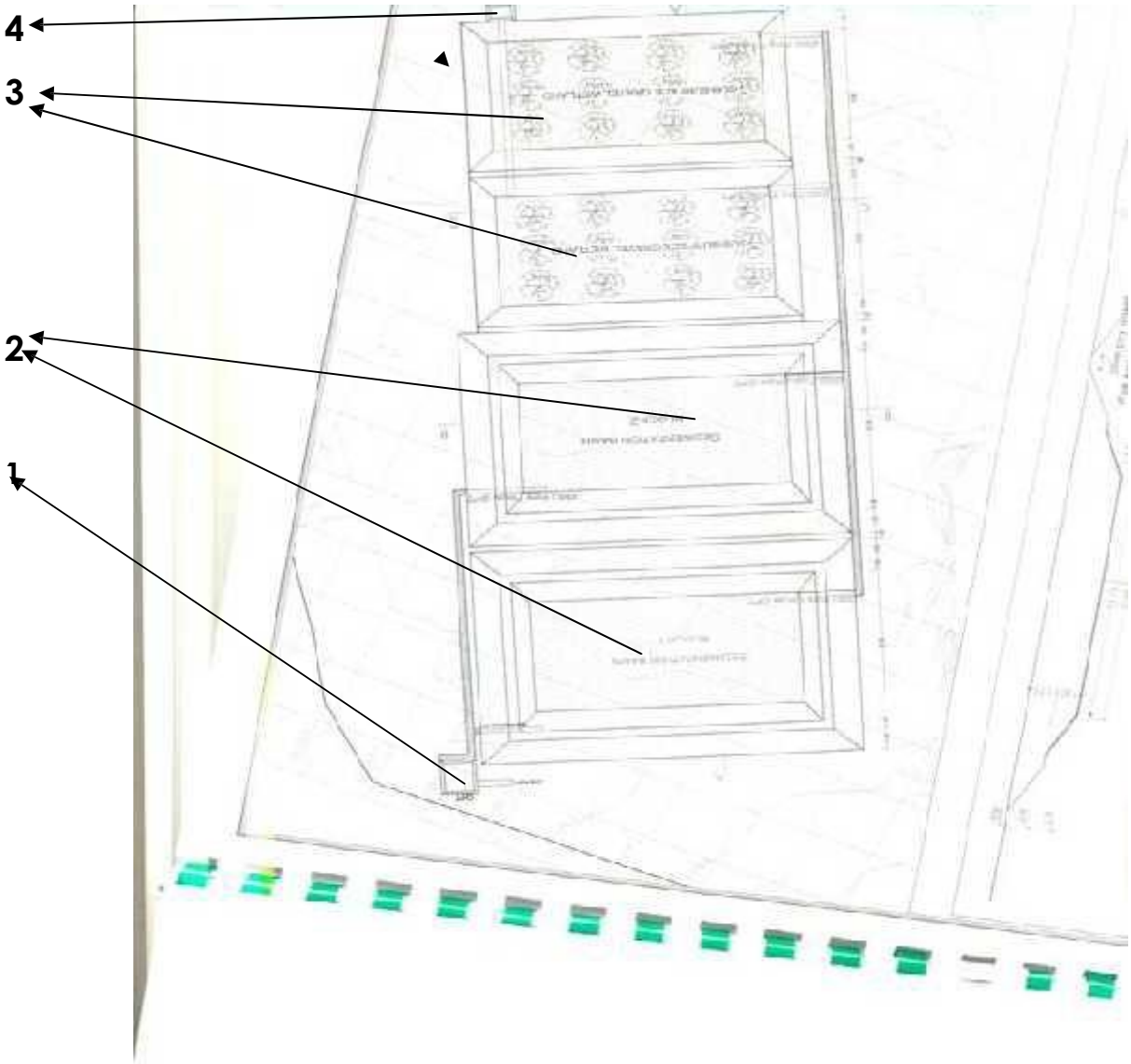
3.2. Description of the proposed Wetland Development project

The Hawassa wetland construction consists of Gross pollutant trap, two blocks of Sedimentation basin, two blocks of sub-surface Gravel wetland and outlet/ over Flow Lake. These different components of the wetland are interconnected with each other in a manner that facilitates a good process flow for quality water to Lake Awassa.

The wetland will be constructed in three different sites that are around Chambelala Hotel, Amora-Gedel and referral Hospital. The first two blocks is intended to serve similar purposes and the other / second two blocks have similar function but intended to serve different purposes from the first two blocks. The Wetland development project will be lying on an area of 11,040 square meters. Each block of wetland project will be lying on an area of 920 square meters.

The construction of Wetland is offer a suitable combination of physical, chemical and biological factors for the removal of phathogenic organisms. The physical factors include mechanical filtration exposure to ultraviolet radiation and sedimentation. Chemical factors include oxidation, exposure to biocides excreted by some wetland plants and absorption by organic matter. Biological removal mechanisms include antibiosis, predation by nematodes and protists, attack by lytic bacteria and viruses.

Figure 1: Proposed wetland construction Site and Land Scape Plan



The first block of wetland construction is gross pollutant trap (Designated number 1 in the sit plan) The mechanical system proposed as an inlet of pipe management system of storm water is intended to provide treatment of storm-water to best practice standard through screening very coarse and large sediment material before entering to the Sedimentation basin.

Inlets, control structures should be inspected and maintained regularly. This may include removing gravel, debris, grass clippings, and trash. Trash rocks (located in the canals and around gross pollutant traps) should be inspected and cleaned on a regular basis, particularly during the rainy season.

The second block is Sedimentation basin (Designated number 2 in the sit plan) of a shallow basin or sequence of basins containing 30-50 cm of rooting of soil with a water depth of 100-150 cm. These two blocks are intended to serve similar purposes to remove suspended matter and attached nutrients within a sub-surface horizontal flow gravel wetland system to remove nutrients and metals and biological threats through physical training and sorption mechanism.

The third blocks are sub-surface Gravel wetland (Designated number 3 in the sit plan) these two blocks also have similar function but intended to serve different purposes from the first two blocks. This sub-surface wetland constructed with emergent Macrophytes similar to the first two blocks is a shallow sealed basin or sequence of basins containing 30-50 cm of rooting of soil with a water depth of 100-150 cm. Dense emergent vegetation covers significant fraction of the surface usually more than 50% planted Macrophytes and naturally occurring species may be present. The natural plant should be selected the indigenous species.

The main purpose of dense emergent vegetation covers over the sub-surface Gravel wetland is provides sustainable removal of Nitrogen, phosphorus and other elements. Nitrogen, phosphorus and other elements removal in the system occurs from adsorption, absorption, complexation and precipitation.

The fourth block is the outlet (Designated number 4 in the sit plan) of the quality water and joins to the Lake Awassa.

CHAPTER FOUR: NATIONAL POLICIES AND REGULATORY FRAMEWORK

4.1 Policy framework

4.1.1 Constitution of the Federal Democratic Republic of Ethiopia

The Constitution is the supreme law of the country, whose provisions must be complied with by all other policies, regulations and institutional frameworks. The Constitution of the FDRE (Proclamation No. 1/1995 as amended) is the foundation for human rights, and natural resources and environmental management.

The concepts of sustainable development and environmental rights are enshrined in the Constitution of the FDRE through articles 43 and 44, which states among others the right to development and right to live in clean and healthy environment. Article 44(2) of the Constitution states that all persons who have been displaced, or whose livelihood has been adversely affected as a result of state programmes have the right to commensurate monetary or alternative means of compensation including relocation with adequate State assistance . The government shall pay fair compensation for property found on the land but the amount of compensation shall not take into account the value of land. Moreover the Constitution states that, without prejudice to the right to private property, the government may expropriate private property for public purposes subject to payment in advance of compensation commensurate to the value of the property (Article 40(8). Moreover, Article 43 (2) dealing with the rights to development states that nationals have the right to participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community.

Economic objectives of the Constitution states that Government has the duty to hold, on behalf of the people, land and other natural resources and to deploy

them for their common benefits & development. Government shall all the time promote the participation of the people in the formulation of national development policies and programmes; it shall also have the duty to support the initiatives of the people in their development endeavors (Article 89 5&6).

Article 92 of the Constitution states that the design and implementation of any program and development projects shall not damage or destroy the environment, and people have the right to be fully consulted and express their views in planning and implementation of environmental policies and project.

4.1.2 National and Regional Conservation Strategy

Since the early 1990s, the Federal Government of Ethiopia has undertaken a number of initiatives that aims to develop regional, national and sectoral strategies to conserve and protect the environment. Paramount amongst these was the conservation strategy of Ethiopia (CSE, 1996). This document provides a strategic framework for integrating environment into new and existing policies, programs and projects. It is also an important policy document, which views environmental management as an important component of development. It recognizes the importance of incorporating environmental factors into development activities from the outset.

The major environmental and natural resources management issues facing Ethiopia are well documented in the CSE (FDRE, 1997). The CSE sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sectoral as well as cross-sectoral interventions for the management of Ethiopia's natural, man-made and cultural resources. The most important areas that are addressed by the CSE include the following:

- Management of forest and woodland resources.
- Land resource use policy and strategies; physical land use planning.

- Integration of social, cultural and gender issues in sustainable resources and environmental management.
- Promotion of participation in sustainable development of natural, artificial and cultural resources, and environmental protection.
- Development of environmental education, public awareness and human resources.

4.1.3 Environmental Policy of Ethiopia

The Environmental Policy of Ethiopia (EPE) was issued in April 1997. The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and promote sustainable social and economic development through sound management and use of natural, human-made and cultural resources and their environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. The policy consists mainly of guiding principles and various sectoral and cross-sectoral policies for sustainable environmental management.

The policy seeks to ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities, raise public awareness and promote understanding of the essential linkage between environment and development. In addition to its guiding principles, the policy addresses sectoral and cross sectoral environmental issues.

Environmental Impact Assessment (EIA) policies are included in the cross sectoral environmental policies. The EIA policy emphasizes the early recognition of environmental issues in project planning at all levels of administration. The principal features of the Environmental Policy in this area are:

- Provides for protection of human and natural environments.
- Provides for an early consideration of environmental impacts in projects and program design.

- Recognizes public consultation.
- Includes mitigation plans and contingency plans.
- Provides for monitoring and auditing
- Establishes legally binding requirements
- Institutionalizes policy implementation

The policy establishes the Federal Environmental Protection authority (FEPA) to harmonize sectoral development plans and implement environmental management programs for the country.

4.1.4 National Health Policy

Ethiopia had a low level of health coverage even in comparison with other Sub-Saharan countries. This is largely related to low levels of income and widespread poverty, low levels of education, nutritional deficiencies, poor environmental conditions, and inadequate access to health services. The government has therefore assigned a very high priority to significantly improving health care and, in 1998, issued a health policy based on the following main principles:

- Promotion of disease preventive components.
- Ensuring accessibility to health care for the whole population.
- Development of appropriate capacity based on needs assessment.
- Promotion of private sector and NGO participation in the provision of health care.
- Promotion and strengthening of inter-sectoral activities through a national self-reliance program.
- Democratization and decentralization of the health care system

Health Sector Development Plans and Strategies have been designed to implement the stated health principles within a defined period of time. The strategies include raising the awareness of personal and environmental health care and sanitation through information, education and communication (IEC);

control of disease; and promotion of primary health care through community participation.

4.1.5 Land Tenure Policy

The Constitution of the Federal Democratic Republic of Ethiopia (FDRE) states that the right to ownership of rural and urban land, as well as all natural resources, is exclusively vested in the State and People of Ethiopia. Article 40 of the Constitution indicates that land is a common property of the Nations, Nationalities and the People of Ethiopia, and shall not be subjected to sale or to other means of transfer.

The Constitution of FDRE retained land under the control of the people and government of Ethiopia thus, prohibiting its buying and selling. Also article 4(5) of the Proclamation 94/1994 deals with provision of land for the conservation, development and utilization of state forests or protected areas. However, this can be effective only after the consultation and consent of the peasantry and subject to the assurance of their benefits.

In general, all legal provisions cited above, make rural and urban lands the property of the People and Government of Ethiopia, and buying and selling of land is prohibited but leasing rights is allowed. Moreover, it is the right for existing land owner to be compensated fully and satisfactorily if land is expropriated by the state.

The Land Policy of Ethiopia strongly support that project plans must include attractive and sustainable resettlement strategies to the people who are going to be displaced as a result of the development plan, and they have to be fully convinced, compensated and have to participate in all phases of the project implementation.

4.1.6 National Biodiversity Policy

The National Biodiversity Policy (NBP) was established in 1998 based on a holistic ecosystem approach to conserve, develop and utilize the country's biodiversity resources. The policy provides for guidance towards effective conservation, rational development and sustainable utilization of the country's biodiversity, and contains comprehensive policy provisions for the conservation and sustainable utilization of biodiversity. Integration of biodiversity conservation and development in federal and regional sectoral development initiatives, and mobilization of international cooperation and assistance, have been identified as the principal strategies for implementation of the policy.

Wetlands are considered among the most productive type of ecosystem in the world, providing benefits far in excess of those obtained from alternative uses to which they are subjected. Ethiopia is endowed with vast wetlands, however, efforts towards their conservation and sustainable utilization are very limited, and no clear policy and legislative framework have been designed. The EPA and Ethiopian Wildlife & Natural History Society (EWNHS), in collaboration with Ramsar Bureau and other funding organizations, are focusing efforts in this direction, and have conducted successful workshops and awareness raising programs.

4.2 Legislative Framework

4.2.1. Establishment of Environmental Protection Organs (proclamation No.295/2002)

This law clarifies the institutional mandate and responsibilities of the Environmental Protection Authority (EPA) and aims to integrate environmental considerations into the policies and decision-making of sectoral agencies through such means as the establishment of environmental units in these

agencies at the federal level and the creation of independent environmental agencies at the regional level.

This law also re-established the Environmental Protection Council, a cross-sectoral co-coordinating body that advises the federal EPA and supervises its activities. The mandate of the Council includes: (i) reviewing environmental policies, strategies and laws proposed by the EPA and issuing recommendations to government; (ii) providing appropriate advice on the implementation of the Environmental Protection Policy of Ethiopia; and (iii) reviewing and approving directives, guidelines, and environmental standards prepared by the EPA.

4.2.2. Environmental Impact Assessment (proclamation No.299/2002)

This Proclamation (No 299/2002) aims primarily at making the EIA mandatory for categories of projects specified under a directive issued by the EPA. The law specifies the projects and activities that will require an environmental impact assessment (EIA). The proponent of the project must prepare the EIA following the format specified in the legislation. The EPA will then review the EIA and either approve the project (with or without conditions) or reject it. The Proclamation requires, among other things:

- Specified categories of projects to be subjected to an EIA and receive an authorization from the EPA or the relevant regional environmental agency prior to commencing implementation of the project.
- Licensing agencies to ensure that the requisite authorization has been duly received prior to issuing an investment permit, a trade or operating license or a work permit to a business organization.
- The EPA or the relevant regional environmental agencies may issue an exemption from carrying out an EIA in projects supposed to have an insignificant environmental impact.

- A licensing agency may suspend or cancel a license that has already been issued where the EPA or the relevant regional environmental agency suspends or cancels environmental authorization.

Procedures that need to be followed in the process of conducting an environmental impact assessment are described in the Proclamation. Thus a project developer is expected to act as follows:

- Undertake a timely environmental impact assessment, identifying the likely adverse impacts, incorporating the means of their prevention, and submitting the environmental impact study report accompanied by the necessary documents to the EPA or the relevant regional environmental agency.
- Submit an environmental impact study report to the EPA or the relevant regional environmental agency for review.

Environmental guidelines are among the tools for facilitating the consideration of environmental issues and principles of sustainable development and their inclusion in development proposals. To put this Proclamation into effect the EPA issued guideline documents, which provide details of the EIA process and its requirements. According to this EIA guideline projects are categorized into three schedules:

Schedule 1: Projects which may have adverse and significant environmental impacts thus requiring a full Environmental Impact Assessment

Schedule 2: Projects whose type, scale or other relevant characteristics have potential to cause some significant environmental impacts but are not likely to warrant a full EIA study

Schedule 3: Projects which would have no impact and do not require an EIA

However, projects situated in an environmentally sensitive areas such as land prone to erosion; desertification; areas of historic or archaeological interest; important landscape; religiously important area, etc. will fall under category 1 irrespective of the nature of the project.

According to this guideline all project proponents and executing bodies (agencies) in the country should operate in close cooperation with the EPA to ensure that proper mitigating measures are designed and implemented, especially for projects with an adverse effect on the environment. This in effect means that an Environmental Impact Statement (EIS) should be prepared by project proponents and be examined, commented and approved by the EPA.

4.2.3. Environmental Pollution control (proclamation No.300/2002)

Proclamation No. 300/2002 on Environmental Pollution Control primarily aims to ensure the right of citizens to a healthy environment and to impose obligations to protect the environment of the country. The law addresses the management of hazardous waste, municipal waste, the establishment of environmental quality standards for air, water and soil; and monitoring of pollution. The proclamation also addresses noise as one source of environmental pollution and it seeks for standards and limits for noise providing for the maximum allowable noise level taking into account the settlement patterns. In general, the Proclamation provides a basis from which the relevant environmental standards applicable to Ethiopia can be developed, while sanctioning violation of these standards as criminally punishable offences.

Furthermore, it empowers the Federal Environmental Protection Authority or the Regional Environmental Authority to assign environmental inspectors with the duties and responsibilities of controlling environmental pollution. In order to ensure implementation of environmental standards and related requirements, inspectors belonging to the EPA or the relevant regional environmental agency

are empowered by the Proclamation to enter, without prior notice or court order, any land or premises at any time, at their discretion. Such wide powers derive from Ethiopia's serious concern and commitment to protecting the environment from pollution.

4.2.4. National rural Land Administration and Use (Proclamation No.456/2005)

The Rural Land Administration and Use Proclamation (Proclamation No. 456/2005) defines the state ownership of rural land and the tenure rights of the land occupant, including rights to "property produced on his land", rights of inter-generational tenure transfer, and rights of exchange land and limited leasing rights. Provisions are made for the registration and certification of tenure rights. Part Three of the Proclamation presents regulations relating to the use of rural land, particularly as it relates to soil and water conservation and watershed management. The rural land administration and land use laws are to be implemented by the regional states.

Land holding right gives the right to use the land for agricultural purposes as well as to lease it and, while the right remains in effect, hand down it to family members, as well as the right to acquire property thereon, by labour or capital, and to sell, exchange and bequeath the same. The Proclamation also addresses environmental concerns, including non-compliance with directives on environmental protection.

Article 7(3) of the Proclamation reinforces the rights of land users to compensation for the development they have made on the land. It also states that when the land holder is evicted by federal government, the rate of compensation would be determined based on the federal land administration law. When the rural land holder is evicted by regional governments, the rate of compensation would be determined based on the rural land administration laws of regions.

It is envisaged that the Proclamation will create a sense of ownership among the vast majority of the rural population and enable them to take initiatives and collectively engage in environmental management activities.

4.3 Institutional Framework

4.3.1 The Environmental Protection Organs

Environnemental Protection Proclamation (Proc. 295/2002) is aimed to assign the responsibilities for environmental management to various entities in order to ensure sustainable use of environmental resources, thereby avoiding possible conflicts of interest and duplication of efforts. It is also intended to establish a system that fosters coordinated but differentiated responsibilities among environmental protection offices at a federal and regional level.

At the federal level the Environmental Protection Authority is in charge of formulating policies, laws, regulations and standards. Enforcing the laws and policies including EIAs and environmental monitoring, for all projects or activities that falls under the control of the Federal Government also falls within the responsibilities of the EPA.

Each of the main federal institutions active in the construction of infrastructure, or economic development is required by law to have its own environmental unit. The Ministry of Urban Development and Construction have an Environment Desk under its Urban Development and Capacity Building Office.

According to the Environmental Protection Organs Proclamation, the regional states are required to create their own regional environmental agencies. These institutions are to deal, among others, with EIAs for regionally managed infrastructures or development activities. Most of the regional states have already established their own Regional Environment Protection offices. The

Environment Protection, Land Administration and Utilization Authority is such an institution established by the SNNP Regional State.

4.3.2 Federal Environmental Protection Authority (EPA)

The EPA is an independent authority, acting outside the main ministerial structures and reporting directly to the prime minister. The federal EPA is the key national level environmental agency, with a mandate to address environmental issues. The environmental legislation gives the EPA powers to fulfill its role, support all federal agencies in establishing environmental units, and develop skills in strategic environmental analysis of policies and public instruments. The EPA is involved in the development of environmental policy and legislation, setting environmental quality standards for air, water and soils, monitoring pollution, establishing EIA procedures and an environmental information system, and undertaking capacity development in relevant agencies to ensure the integration of environmental management in policy development and decision making.

The mandate and duties of the EPA were subsequently clarified in the Establishment of Environmental Protection Organs Proclamation (Proclamation No. 295/2002). The federal EPA is responsible for:

- Establishment of a system for environmental assessment of public and private sector projects, as well as social and economic development policies, strategies, laws, and programs of federal level functions.
- Review, decision-making and follow-up implementation of environmental impact study reports for projects, as well as social and economic development programs or plans where they are subject to federal licensing, execution or supervision; also proposed activities subject to execution by a federal agency, likely to entail inter- or trans-regional and international impacts.

- Notification of its decision to the concerned licensing agency at or before the time specified in the appropriate law or directives.
- Auditing and regulation of implementation of the conditions attached to the decision.
- Making its decisions and the EIA report available to the public.
- Resolution of complaints and grievances in good faith and at the appropriate time.
- Development of incentives or disincentive structures required for compliance with regional environmental agency requirements.

4.4 Summary of the World Bank's safeguard policies and their relevance to this project

OP/BP 4.01 Environmental Assessment

The objective of this policy is to ensure that Bank-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. This policy is triggered if a project is likely to have potential (adverse) environmental risks and impacts on its area of influence. OP 4.01 covers impacts on the natural environment (air, water and land); human health and safety; physical cultural resources; and Trans-boundary and global environment concerns.

The Bank undertakes environmental screening for each proposed projects to determine the appropriate extent and type of Environmental Assessment. It classifies a proposed project into one of the Categories, depending on the type, location, sensitivity and scale of the project and the nature and magnitude of its potential environmental impacts:

Category A: Proposed project is classified as category "A" if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. The present wetland development project was screened by the Hawassa city administration ULGDP project office and it was finally concluded that it falls under category-"A".

Category B: Proposed project is classified as category "B" if it's potential adverse environmental impacts on human population or environmentally important areas-including wetlands, forests, grasslands and other natural habitats –are less adverse than those of Category "A" projects. The present wetland development project was screened by the Hawassa city administration ULGDP project office and it was finally concluded that it falls under category-"B".These projects are site specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category "A" Projects.

Category C: a proposed Project is classified as category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a category C Projects.

Disclosure: OP 4.01 also requires that EIA reports are (I) reviewed and cleared by the responsible national agencies and the Bank and (II) made available by the government in the publicly accessible places in the country as well as the Banks Info shop. This report should also be made available to the project affected groups and local NGOs. If the borrower objects to the Bank's release an EIA report through the World Bank Info shop , Bank staff (a) do not continue processing the project or (b) or submit the issue for further process to the Executive Directors of the Bank.

OP/BP 4.04 Natural Habitat

This policy recognizes that the conservation of natural habitats is essential to safeguard their unique biodiversity and to maintain environmental services and products for human society and for long-term sustainable development. The Bank therefore supports the protection, management, and restoration of natural habitats in its project financing, as well as policy dialogue and economic and sector work. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and most native species.

In line with the anticipations of the ESMF, which has indicated that most ULG projects may not trigger OP 4.04, the present project will not trigger OP 4.04. This is mainly because the proposed wetland construction by itself is an environmental protection scheme.

OP/BP 4.36 Forests

The objective of this policy is to assist borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development and protect the vital local and global environmental services and values of forests. Where forest restoration and plantation development are necessary to meet these objectives, the Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank assists borrowers with the establishment of environmentally appropriate, socially beneficial and

economically viable forest plantations to help meet growing demands for forest goods and services.

There is no forest land that will be adversely affected as a result of implementing this project. This policy under the present sub-project will not therefore be triggered to ensure project sustainability.

OP/BP 4.11 Physical Cultural Resources

The objective of this policy is to assist countries to avoid or mitigate adverse impacts of development projects on physical cultural resources. For purposes of this policy, "physical cultural resources" are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The cultural interest may be at the local, provincial or national level, or within the international community.

Therefore, in this case there is no historical and religious sites of importance in Hawassa city, it is anticipated that the activities and operations of the proposed project will not have negative impacts on them. This policy will not be triggered under the Wetland Construction project.

CHAPTER FIVE : METHODOLOGY AND APPROACH OF THE STUDY

The EIA Study has been carried out by analyzing the potential impacts on the Hawassa Storm Water Treatment Project area and its peripheries by using the available information and recommending mitigation measures for the potential negative impacts as well as giving insights on environmental mitigation plan and monitoring programme to the client and the residents.

The task of the Environmental Impact Assessment study is carried out by using the methodology that includes the collection of baseline information and data, document review, field survey and consultation with residents around the periphery of the project area. Data from secondary sources were also collected and documents obtained from the city administration (Municipality) and other applicable documents from the city Department of Design and Construction office, were also reviewed. Moreover, the World Bank Guideline, the Ethiopian Environmental Impact Assessment (EIA) Guideline and Rapid Impact Assessment Matrix (RIAM) introduced by K.Jenson (1998) are used for screening, scoping and full analysis of the potential environmental impacts of the Hawassa Wetland construction project.

CHAPTER SIX: DESCRIPTION OF THE BASE LINE ENVIRONMENT

6.1 Physical environment

6.1.1 Topography

The Hawassa City Drainage Rehabilitation Project is found in Hawassa City, Sidama Zone, of Southern Nation Nationalities and peoples'(SNNP) Region. The project areas are situated at the City of Hawassa which is the capital of SNNP Region and Sidama Zone. Besides, the project areas are located between latitude of 6°45'00" to 7°05'00" N and longitudes of 38°25'00" to 38°30'46" E. The maximum and the minimum elevations including the adjacent areas are 1930 and 1680 meters above sea level having diversified topographic features and they are parts of Eastern Fault Belt (EFB) of the central part of the Main Ethiopian Rift valley (MERV) in large volcanic-tectonic collapse.

6.1.2. Climate

The project region- the city of Hawassa including the Hawassa Zuria Woreda in which the project is situated is one of the places affected by the ITCZ (Inter Tropical Convergence Zone) almost throughout the year. The project area is situated in worm temperate climatic zone with a mean annual precipitation of 956 mm whereas the mean minimum precipitation is 17 mm in the month of January during the dry season and the mean maximum precipitation is 126 mm in the month of September during the rainy season. Temperatures vary between 10°C in Kiremt (long rainy season from June to September) and 30°C in Bega (long dry season). Including the project area it is estimated that there is a potential evapo-transpiration of 1255 mm [according to the estimate made by CESEN and ANSALDO (1987)] with minimum of 81 mm in the month of July and maximum of 135 mm in the month of January.

Table 1: annual rain fall by season (1999-2001)

Year	Feb,Mar,Ap,May (Belg)	JJAS (Kiremt)	ONDJ (Bega)	Ann. Rain Fall [mm]
1999	375.9	601.3	240.8	1218.0
2000	251.6	488.8	58.4	798.8
2001	223.7	384.5	175.5	783.3

6.1.3 Vegetation

The City of Awassa including the Hawassa Zuria Woreda has an evergreen woodland and other vegetation cover. The vegetation coverage shows grass land of 30.7% and forest/bush land of 12.7% from the total surface area. Arable land in Hawassa Zuria Woreda is some 32.5% of the total surface area. The Woreda has some 24.04% of the degraded, rock-out-crop, water bodies, built-up areas and settlement areas from the total surface area.

The area has indigenous trees such as Ficus sur, Ficus vasta, Carissa edulis, Croton macrostachys, Olea africana, Millettia ferruginea, Acacia mellifera, Rubus apetalus, Coffea arabica, Carica papaya, Cordia africana, Phytolacca dodecandra and others. There indigenous grasses such as Hyparrhenia rufa, Strychnos innocua, Lippia Abyssinia, Festuca elatior, Brucea antidysenterica, and others.

6.1.4. Wildlife and Avifauna

The wild animals around the project areas are Bushbuck, Dikdik, Hyaena, Monkey , Baboon, Colobus, Leopard, Snake, Python Snake, Scorpion, Porcupine, Mole-rats, Rat and Mice, Warthog, Waterbuck, Bush pig, Wild Cat, Fox, Civet, Lizard, Chameleon, Spider, Hippopotamus, Lion, Cheetah, Crocodile, Hare, Fishes of various types (such as Tilapia, Catfish and others), etc

The Avifauna around the project area are Bush-Crow, Bat, Bitter, Wattled Ibis, Kite, Eagle, Owl, Woodpecker, Sunbird, African Pitta, Duck Pochard, Dove, Goose, Francolin, Guinea Fowl, Parrot, Sparrow, Waldrap, Vulture, Ostrich, Bat and the like.

6.1.5 Water Resource and Aquatic Life

The Hawassa Zuria Woreda has major water resources such as surface water from rivers and lakes, deep groundwater and groundwater as springs. There are rivers such as Kedo, Boga, Afina and Abosa rivers in Awassa Zuria Woreda. In one way or the other, all these rivers drain into Awassa lake basin. In addition, there is mineral water potential in this Woreda. There are also other rivers such as Walmole and Gidabo rivers outside the Hawassa lake catchment's which have been considered as the water supply source for the city of Hawassa.

Rivers and lakes in Hawassa Zuria Woreda have a potential of fishery, irrigation, tourism and recreational uses. And also there are aquatic animals such as Hippopotamus, Crocodile, Frog, Fish, Tortoise, Water flea, Water flies and other benthic organisms in these rivers and lakes.

6.1.6 Soil and Mineral Resources and Geologic Formation

The City of Hawassa is located in the central part of the Main Ethiopian Rift Valley with a volcano-tectonic collapse. The Geology of the areas comprises of pyroclastic deposits, trachyte, lacustrine and alluvial deposits, unsorted gravels, sandy gravel, clay and underlain basaltic rocks. Pyroclastic deposits are made up of ignimbrites, volcanic ash, tuff and rhyolites which are considered to be part of the Nazareth series. The underlying basalt probably belongs to the Dino formation which erupted following fissuring of the uplifted landmass.

The distribution of soil in Hawassa Zuria Woreda is 40% black cotton, 30% red clay, 20% sandy soil and 10% silty soil which are derived from weathering of the basaltic lavas. Colloidal soils are present in the valley sides and bottom lands generally comprising of gravel and cobble in a matrix of clayey silty sand with occasional pockets of silty clay.

6.2. Socio-Economic Environment

6.2.1. Population and settlement

As per the 1994 projection of the Population and Housing Census, the population of the city of Hawassa in the year 2000 is estimated to reach 107,700 having a growth rate of 4.11% per annum. The average household size is about 4.9. Some 70% of the households own the houses they live in. Regarding migration patterns, some 44% of the population is immigrants from rural parts of Hawassa Zuria Woreda and other areas. In recent years students enrolled to Southern University and to the other Colleges in the City contributed a lot to the surprising increment of immigrant numbers in Hawassa.

The major nationalities in the city of Hawassa are Amhara (31.4%), Wolayta (24.9%), Oromo (11.5%), Sidama (10.2%), Guraghe (5.4%), Kembata (4.9%), Tigray (4.6%), Siltie (2.2%), Hadiya (1.6%), and others (3.3%).

The majority of the people in the Woreda are Christians [Orthodox, Protestant, and Catholic (95.2%)], Muslims (4.1%). Also, there are some (0.7%) of the Woreda people who worship in other and traditional religions.

6.2.2. Social services

6.2.2.1. Education

As reported by the city administration, in 2009/10, there are 181 educational institutions from kindergarten (KG) up to secondary schools. The number of schools, enrollment by cycle and sex distribution is shown on Table below:

Table 2: Hawassa - Number of Schools and Enrollment 2009/10

Type of schools	Number of school	enrollment	Students		Ownership	
			Male	female	Government	Private
KG	66	7716	3990	3726	-	-
1st cycle(1-4)	95	37260	17875	18385	34	61
2nd Cycle(4-8)		32489	15511	16978	-	-
1st cycle(9-10)	20	13487	6919	6568	5	15
2nd Cycle(11-12)		4114	2520	1594	-	-
Total	181	58463	28784	29679	39	76

Out of the total number of schools in the town 22% were government schools with remaining owned by private owners and NGOs. Males account for 49% and female for 51% of total enrollment of 58,463 in the year.

In addition a total of 27 TVETs and colleges were found operating in the city in 2003.The total number of students registered in private colleges is reported as 25,203 with 263 teachers. The Hawassa TVET has 1000 students with 184 students.

6.2.2.2. Health Situation

The Hawassa Zuria Woreda including Hawassa city has 2 hospitals (1 is a referral hospital) three health centers (two governmental and one non-governmental), 27 clinics (six governmental, four non-governmental and seventeen private) and 11 pharmacies (three governmental, one non-governmental and seven private). The health coverage in the city is 100%.

Table 3: Health Institutions and Potential Health Service Coverage 2001

	Population	Number of hospitals	Ratio%	Number of health center	Ratio	Number of health post	Ratio
Region	15856781	21	7555085	673	23561	3340	4748
Hawassa city	280059	2	140030	8	35007	10	28006
% share	2%	10%	2%	1%	149%	0%	590%

The ten top diseases in the city and its surroundings are malaria, intestinal parasites including giardia, pneumonia, upper respiratory tract disease, gastritis, skin disease, diarrhea, all other parasites, disease of unknown origin and amoebiasis.

6.3. Economic Activities

6.3.1. Sources of Income and Employment

The City of Hawassa is the capital of SNNP Region and can be characterized as the administrative center rather than the commercial or trade center. According to the 1994 Population and Housing Census, 46.5% of the adult population is economically active whereas 19.3% of the adults are unemployed.

Almost 40% of the households in the city are earning their incomes from government employment (principal occupation). The main income source of the second largest group (about 24%) is a pension. Seasonal labor, artisans and business employees have income sources share of 9.3%, 7.3% and 7.3% respectively.

Moreover, Hawassa has some industries such as sisal processing factory, ceramic factory, floor mill, agricultural development factory (oil production), cement products factory, textile factory (1&2), soft drink factory, tobacco and matches factory, etc. The economic base of Awassa Zuria Woreda is crop farming and livestock rearing.

6.3.2. Industry

Hawassa has some industries such as sisal processing factory, ceramic factory, floor mill, agricultural development factory (oil production), cement products factory, textile factory (1&2), soft drink factory, tobacco and matches factory, etc. The economic base of Hawassa Zuria Woreda is crop farming and livestock rearing. These provide gainful employment to the population of Hawassa.

In addition 193 micro enterprise cooperative associations established since 1998 EC engage 1640 youth 1132 of which are male and 508 female in various activities ranging from livestock and agricultural trading, to retail of various textile and other manufactured goods to catering services.

6.3.3. Tourism

The SNNPRs range of altitude and varied climatic types and agro ecological zones that support immense varieties of fauna and flora have made tourism a major business activity for Hawassa. The city of Hawassa is within easy reach of many hot and cold springs and mineral waters, natural forests different kinds of

wild life varieties, and the famous rift valley lakes, which are rich in aquatic life in their surrounding and also inhabited by various kinds of endemic animals & used for recreational purposes. Above all there are 5 national parks, 16 controlled hunting areas & wild life reserves in the region. Provided with 24 hours electric supply, branches of all the major banks and modern hotels with internet and other communication facilities, Hawassa has become a major tourist attraction.

The regional income from tourism has increased rapidly in recent years as can be seen from the following table:

Table 4: Annual Tourist Arrivals and Revenue to the Region

years	Ethiopia	Foreigners	Total visitors	Total income
2003/4	157,187	31,225	188,412	8,663,101
2004/5	200,000	38,814	238,814	12,260,000
2005/6	338,915	32,215	371,130	13,778,443
2006/7	336,185	57,347	393,532	23,852,410
2007/8	257,489	75,375	332,864	26,379,639

Tourist income for the region both from nationals and foreigners increased from Nr 8.7 million in 2004/05 to Br 26.4 millions in 2008/09. With its flourishing hotels and resorts and better financial, communication and financial services, Hawassa's share can be expected to be quite significant.

Table 5: Hawassa Hotels and Resorts 2008/09

No	Bed Number	Number of hotels
1	0-10	-
2	10-20	12
3	20-30	10
4	30-40	8
5	40-50	3
6	Over 50	2

There are 35 hotels, pensions and resorts with a total of 975 rooms providing hotel and room services in Hawassa. In addition to the services they provide to tourists they have been source of employment and income to residents of the city.

6.3.4. Trade and Commerce

Trading and commercial activities are growing as important source of income and employment as indicated by the licensing activities of the city. In fiscal year 2002 active business licenses increased to 4,891 from its level of 4,458 in 2001. The increase is in all sectors of trade save for wholesale and industry. This can be seen from the following table:

Table 6: Hawassa Active Business Licenses 2001-2002 EC

	2001	2002
wholesalers	419	325
Retailers	2060	2419
Services	1425	1724
Industry	549	406
Agriculture	5	17
Total	4458	4891

The city trade promotion report for the last six months of the current fiscal year shows the following picture:

Table 7: Hawassa Town: Business Registration and revenue for 2003

	Businesses	Number	Value(Br)
1	Newly registered	562	59572
2	Newly Licensed	563	59678
3	Registration renewal	3734	321124
4	Licensed renewal	3364	289304
5	Total	8223	729678

A total of 8223 businesses underwent registration, licensing and renewal activities in the six months providing the city with total revenue of Br 729,678. These indicate the growing business activities in the city.

6.4. Social and Physical Infrastructure

6.4.1 Housing Condition

The city of Hawassa is known to have, as indicated from a recent survey, about 14,150 housing units, 177 shops/businesses, 72 hotels, 1 University, 2 Colleges, 16 schools, 20 kindergartens. There are also other infrastructures such as health centers, clinics, pharmacies, private offices, a market square, asphalt road crossing Hawassa city (main road from Hawassa to Dilla and other southern parts of Ethiopia), gravel roads, drainage system, water supply, power supply, play grounds, commercial vehicles(buses, taxis and bicycles for rent), horse carts or Garis and abattoirs.

Nearly 99% of the houses in the city of Hawassa are non high story ground building blocks. Most houses have corrugated iron sheet roofing whereas some poor households at the periphery of the city have houses with thatched roofs. According to the 1994 Population and Housing Census report, the average household size is 4.9 whereas the latest other studies claim to be significantly higher than this figure. About 34.6% of the households own the houses they are living in whereas the rest 65.4% live in rental houses from government or private owners. The following table shows length and condition of roads, drainage and lighting in the city of Hawassa:

Table 8: Hawassa roads, drainage and street lighting

Roads		
Asphalt	47.3	3km slight deterioration
Gravel	66.7	10km moderate deterioration
Red Ash	40	20km slight deterioration
Earth	161.1	30 km slight deterioration
Cobblestone	10	0.5 km slight deterioration
Side walk (Asphalt)	26	0.5 km slight deterioration
Side walk (Cobblestone)	3000m2	
Drainage		
Masonry drainage not covered	36	3 km slight deterioration
Earth drain	100	50 km slight deterioration
Covered drain	48	5 km slight deterioration
Street lighting		
Street Lights (Sodium Lights	1200	200 lamps to be replaced
Street Lights (fluorescent Lights	1500	500 lamps to be replaced

The light is provided by 24 hrs Electric supply by the Ethiopian Electric Light and Power Corporation (EELPC), some 95.2% of the total households in the city of Hawassa have electricity through shared or private meters.

6.4.2 .Water Supply Facilities

The city of Hawassa gets its water supply from Kodo water treatment station by treating Kodo River at about 11 km south of the city at an elevation of 1811 masl. Water from Kodo River is abstracted by tyrdean weir and the water is conveyed through PVC pipe to an adjacent well with a capacity of 15.63 m^3. The existing water treatment plant was constructed some years back and comprises of operation building with chemical dosing system, sedimentation units, rapid sand filters, a balancing chamber, clear water reservoir and service water tank. Water production from Kodo water treatment plant is 3360m^3/day.

6.4.3 .Sanitation Condition

Safe and appropriate sanitation coverage of residents with toilets in the city of Hawassa is about 90% whereas the remaining 10% are residents without suitabletoilet facilities. According to the 1999 Household Survey report, only 20% of the households in Hawassa city have proper bath facilities whereas most of the household use buckets for bath.

CHAPTER 7: ALTERNATIVE ANALYSIS OF STORM WATER TREATMENT

7.1 Dry Ponds

A dry detention or extended dry detention basin is a surface storage basin or facility designed essentially to provide water quantity control through detention and/or extended detention of storm water runoff. These facilities temporarily detain storm-water runoff, releasing the flow over a period of time. They are designed to completely drain following a storm event and are normally dry between rain events. Both dry ponds and extended dry ponds basins provide very limited pollutant removal benefits. However, a very noted physical improvement in storm water quality can be anticipated due to the sedimentation process in the pond. In a treatment train approach dry ponds can be used with other structural measures. Otherwise they cannot seriously be taken as storm water treatment methods.

7.2. Wet-ponds

Wet ponds are modifications of dry ponds. Unlike the dry system these are not designed to dry between rain events and maintain a permanent pool of water. Runoff from each event is detained and treated in the pool primarily through settling and biological uptake mechanism. The permanent pool also serves to protect deposited sediments from re-suspension. Wet-ponds are among the most cost effective and widely used storm water practices. Water quality improvement is afforded by a combination of physical, chemical and biological processes. Primarily pollutant removal is induced through settling as the storm water resides in the pond. Parts of particulate materials, organic matter, metals, bacteria, and organics are sorted in this process. Uptake by algae and wetland plants is the removal mechanism for nutrients. With the detention of storm water

volatilization and chemical activity also work to breakdown and eliminate a number of a storm water contaminant.

Wet ponds are relatively moderately efficient system of polishing storm water. Up to 80% removal in suspended solids, 30-65% reduction in nitrogen, phosphorous, metals, hydrocarbons and over 65% reduction in bacterial threat is anticipated. Wet ponds are more of end of pipe storm water management alternatives. However, amenity value can be fetched through careful design practices. The major disadvantage of wet ponds consist the minimum areal need for maintaining the pool (which at times may require a costly exercise of reconfiguring the drainage system), mosquito and midge breeding which makes it a nuisance in built in environment.

7.3. Bio-retention System

Bio-retention system use vegetation and engineered soils as a treatment area to accept runoff from impervious surfaces. Storm water flows into the bioretention area, ponds on the surface, and gradually infiltrates into the engineered soil layer. Bioretention systems mimic the stable hydrologic functions of a native ecosystem. The combined effect of soil and plant matter in bio-retention basins removes pollutants through a variety of physical, chemical, and biological processes occurring in the upper engineered soil layer and the underlying native soils. System performance is heavily reliant on the design. Some of the major processes that occur in a bio-retention system include: interception, infiltration, settling, evapo-transpiration, filtration, absorption, thermal attenuation, and biological degradation/decomposition. Filtered storm water can either be in to the underlying soil or as a ground water recharge exercise or can be collected and stored and managed sensibly afterwards. In this regard the selection of the right kind of vegetation is important. A very interesting feature of bioretention

basins as management option is the flexibility afforded in using them. They can be easily scaled to fit in to existing urban areas.

Bioretention is an excellent storm water treatment practice due to a variety of pollutant removal mechanisms. A bioretention system essentially consists an engineered soil layer; plant material and mulch layer each performing a specific function. The engineered soil provides filtration and holds water and nutrients for the plants, enhances biological activity, encourages root growth, and provides storage of storm water through the voids within the soil particles. The plant material evapo-transpires storm water, creates pathways for infiltration through the plant roots, improves soil structure, improves aesthetics, and reinforces long-term performance of subsurface infiltration. The mulch layer acts as a filter for pollutants in runoff, protects underlying soil from drying and eroding, and provides an environment for microorganisms to degrade organic pollutants. It also provides a medium for biological growth, decomposition of organic material, and adsorption and bonding of heavy metals. Bioretention system can induce an 80% removal of total suspended solids, 65-85 removal of total phosphorous, 50% reduction of total nitrogen, 70- 80% reduction of pathogens and 40-45% removal of heavy metals from the run-off from the catchments.

As a system often designed to deal with suspended and dissolved elements in storm runoff bioretention systems are likely to chock due to gross pollutants in storm runoff. A more efficient use of bioretention basins as a storm water management requires introduction of management practices in the urban watershed or just before the retention basins. Filter strips, vegetated swales, gross pollutant traps sedimentation basins can be combined with bioretention system depending on the intended use of the bioretention system for a more efficient performance. Unlike wetland, mosquitoes are not a problem in bioretention systems because bioretention areas and rain gardens do not retain standing

water long enough for mosquito reproduction. As a system which can be easily retrofitted within the urban watershed as well as serving as an end management practice bioretention system appears to be a compelling alternative for managing the storm water generated in Hawassa.

7.4. Constructed Wetlands

Wetlands are a common treatment measure used to treat storm water runoff in temperate climates. Constructed wetland systems are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from storm water. There are two major kinds of storm water wetland system depending on the way storm water flow within the wetland. Surface water wetlands (SF) most closely mimic natural wetland hydrology and are designed to provide high quality wetland habitat. Surface water wetlands are open systems where water flows through the wetland above the soil surface as sheet flow through vegetation. Configuration is variable from site to site but they generally consist of an inlet zone (sedimentation basin to remove coarse sediments), a macrophyte zone (to remove fine particulates and uptake soluble pollutants) and a high-flow bypass channel (to protect the macrophyte zone from scour and damage). In sub-surface wetlands (SSF) water passes horizontally or vertically through a media bed planted with macrophytes. The media and plant root provide attachment sites for the microbial community.

The operation of constructed wetlands involves the interaction between storm water runoff, vegetation and hydraulic structures and the successful implementation of constructed wetlands requires appropriate integration into the landscape design. Therefore, water quality, ecology and amenity are integrated in using wetlands as end of pipe storm water management ends.

A properly functioning wetland system will induce a close to 90% reduction in suspended solids and over 60% reduction of major pollutants such as nitrogen and phosphorous. However, integration of wetlands in an already established urban system is a very sensitive engineering practice. Wetlands (especially surface wetlands) require the presence a minimum water level for proper functioning of treatment within the macrophyte zone. In dry/wet tropical climates there is either has to be a very large contributing catchment or a supply from ground water. As a relatively shallow system – surface - wetland requires larger area. Wetlands create standing water bodies which are potential breeding grounds for mosquitoes. However, the later can be tackled with subsurface wetland systems or an environmental design practice to discourage mosquito breeding.

7.5. Treatment System Selection

In the selection of the treatment system we considered:

- the performance of the system in-terms of pollutant removal properties
- quantity of storm water anticipated at the final storm water outlets;
- quality of the storm water (specifically the sediment load);
- storm water drainage- lake connection;
- socio-economic condition at the storm water outlets;
- potential of contact between the treatment system and the public;
- land size needed to achieve anticipated treatment levels;
- the ease of integration with the existing landscape;
- odor issues;
- potential for mosquito breeding;
- potential for encouraging malpractices;
- potential for public danger;
- the pros and cons of different storm-water treatment options ; and
- Operational and maintenance requirements.

An examination of the aforementioned treatment units were performed based on the criteria listed above. Dry ponds, wet ponds and swales were taken out of the comparison at the beginning. Swales are hardly end of pipe management options and their use is best suited upstream in the catchment. The pond systems can be considered as end of pipe management option but their use is very much suited to flow attenuation and are limited in dealing with storm-water constituents. Three main options remain: infiltration units, bio-retention units and wetlands. While having great potential for pollutant removal the use of infiltration units and bio-retention units as an end of pipe management options is questionable given the size of the catchment and the extremely sediment laden nature of the storm-water in Hawassa and the shallow ground water table at the sites. However, these treatment units can be integrated within the upstream urban catchment as a mechanism to reduce the treatment load on end of pipe storm-water treatment options. In the light of the technical and practical issues considered we recommend wetlands (sub-surface) – as in a treatment train - as storm-water management system for the city of Hawassa.

CHAPTER EIGHT: ENVIRONMENTAL IMPACTS IDENTIFICATION, PREDICTION AND ANALYSIS

Development projects and programmes such as the implementation of wetland projects are planned for the socio-economic development of a nation to bring about improved life style of the community. However, these developments might have impacts which are of negative or positive nature.

In the process of executing development activities, natural resources are definitely needed and are consumed, disrupted and damaged. The extent of disruption and damage to the natural, economic and cultural resource base depends on the planning and design of the project. What need to be indemnified are significant changes or impacts, particularly those of negative nature. The environmental analysis, therefore, attempts to screen out the significant ones and bring the crucial elements only to the attention of decision makers.

The planning and design of a project should consider environmental issues and environmental concerns to avoid and/or to minimize the damages to be caused due to the programme implementation. It is, therefore, important to identify the environmental components that are likely to be affected by the project right in advance. For the purpose of this assessment, impacts and/or consequences mostly occurring during the construction and future operational phases will be considered.

8.2. Positive Impacts of the wetland Project

8.2.1. Purification of water and Reduce the velocity of the storm water

Hawassa Wetland is kind of man-made ponds specially designed for the storage and treatment of storm water runoff. These ponds continually hold a certain

volume of water. As storm water is held in the wetland particles settle to the bottom and nutrients are taken up by wetland vegetation. Over the long-term, microorganisms breakdown petroleum hydrocarbons and wetland vegetation takes up metals that have settled out into the sediment. When storm water enters the wetland, it displaces a portion of the existing water, which flows out to a storm water drainage system or receiving waterway. Wetland are typically lined or sited in areas with impermeable soils and therefore do not infiltrate storm water into the ground as groundwater. Therefore, the Hawassa wetland project would ensure compliance with Ethiopian Environmental Legislations objectives by ensuring that potentially compromised storm-water does not reach the lake, thereby protecting water quality in the Awassa Lake.

8.2.2. Safeguards deposition of potentially toxic heavy metals

A properly functioning wetland system will induce a close to 90% reduction in suspended solids and over 60% reduction of major pollutants such as nitrogen and phosphorous. The construction of wetlands is used to stop the pollutants from entering into the receiving water body (Lake Awassa) by limiting them at sedimentation basin and sub-surface gravel wetland. Nutrients and suspended solids are major pollutants present in storm water runoff. Phosphorus is typically the most common limiting nutrient in receiving waters. High phosphorus concentrations in storm water runoff degrade the water quality of lakes and streams through eutrophication. Different forms of phosphorus also attach to the sediment at the bottom of the pond through the adsorption process.

8.2.3. Increased Aesthetic Value of the city

Perhaps one of the major anticipated positive significant impacts of the proposed development project is increase current attractive aesthetic scene of lake Awassa. The project will boost the image of the city as a green city and

the introduction of the green storm-water treatment methods like wetland will have an overarching educational significance intern of environmental awareness and can serve both to local and other residents

8.2.4. Increased Jobs opportunity

Special consideration is given to enhancement of the positive effects of the project by maximizing the distribution of this employment related project benefits. Hiring professionals and service providers will be based on merits and yet on competitive base in order to get quality technical workers. However, the project will provide priority to the local community while hiring for those positions that do not requiring especial skill.

As there will be high demand for daily laborers, especially during construction and maintenance phase of the project, it will be two fold advantages to hire laborers from local people. First, the project managers will reduce time of searching for laborers and save the money that is needed for transportation of these laborers to project site and second, it will enhance social acceptability of the project in general.

8.3. Negative Impacts of the Wetland Project

8.3.1. Accumulation of coarse sediments on the a gross pollutant trap

The wetland system proposed as an end of pipe management system of storm water to provide treatment of storm-water to best practice standard through screening, sedimentation, filtration and through plant uptake. As The wetland will have the screening process of coarse sediments by gross pollutant trap components.

The largest and heaviest particles with pre-dominantly settle out in the inlet open water zone while slightly smaller and lighter particles may only settle out after

flowing into wetland vegetation. These promote and enhance sedimentation of terrible organs around the homestead and create ouder and Air pollution. Even when the inlet open water zone of gross pollutant trap is block by the largest and heaviest particles, it would create flooding and inundation of the surrounding area.

The surface water constructed wetland with emergent Macrophyts function as land intensive biological treatment system trapped solids removal is usually a rapid physical process and need of maintained every time and checked the inlet open water zone.

8.3.2 Air pollution, noise nuisance and vibration impacts

Air pollution and noise nuisance are predicted to occure during construction phases of the project. The sources of air pollution and noise nuisance during the construction phase is essentially going to emerge from the construction activity and its machineries. The vehicles and construction machines that will be used for excavations, for carting away the excavated materials, and delivery of other construction materials will release roaring noises and create dusts in the project area. The dust release is expected to be significant during the dry season. The neighbourhood of the project site is a densely populated area where residential houses, hotel, restaurants,Hospital, cafes and shops are found. As a result the likely receipents of the dust and noise will be those living in the neighboirhood and those poeple working and using the nearby shops and cafes. The presence of receptors of the dust and noise pollution in the immediate neighbourhood to the project site makes its impact to be of significance. The dust released will affect not only the health of the community in the neighbourhood but also negatively influence the daily activities and buisnesses in the neighbourhood. Unless prevented, it can cause the petaints in the hospital, deterioration of services in the hotel and merchandises sold in the shops, e.t.c of the area.

The time of the day during which the noise is released will also be a factor in impacting the neighbourhoods. This is because noise released during night time when the majority of the neighbourhood go to sleep will have more sever nuisance impact than that during normal working hours of the day. According to the draft emission limit standards of the Federal EPA, the permissible noise limits differ based on the dominant functions of the areas under consideration and the time of the day. Table 9 below shows the permissible limit values for noise.

Table 9: Draft Noise emission standards of FEPA

		Limits in dB (A) Leq	
Area Code	**Category of area**	**Day time**[Note 1]	**Night time**[Note 2]
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

Note-1: Day time reckoned in between 6.00 am to 9.00p.m
Note- 2: Night time reckoned in between 9.00p.m. to 6.00am

Project implementation activities that will be undertaken during the construction phase are then likely to cause localized impacts to the neighbourhood of the project site through the release of dust and noise nuisance.

8.3.3. Loss of terrestrial habitat and biodiversity

The clearing and removal of trees and vegetation during construction and the development of the wetland will result in the loss of a significant part of the existing trees and, as a consequence, a reduction of arboreal habitat for epiphytes, lizards, tree frogs, and birds including endemic species. Noise, vibrations, and intrusive activities related to construction works also will tend to scare away any animals remaining on the site after vegetation clearance. This is the environmental trade off for the expansion of tourism birds and plant.

8.3.4. Soil Erosion

Soil erosion and landslide effects due to excavations undertaken by the project may transport soil and rock material in to the lake and the surrounding recreational sites of the lake shore and cause siltation. Construction activities should be planned during the dry seasons to minimize entry of excavated material and wastes in to the water body.

Vegetation clearance, road construction and excavation works related to construction of the wetland and buildings will expose soils in the affected areas leaving them vulnerable to erosion by surface run-off and ultimately threaten adjacent lake waters with high sediment deposition which is a negative consequence. The flat topography of the site would tend to reduce erosive surface flows and the threat of turbidity should exist only for the duration of construction works before landscaping and drainage works are put in place that would reduce the susceptibility to soil erosion.

8.3.5. Materials Transportation

The various materials required for construction wetland (e.g. steel, blocks, lumber, etc.) will be obtained from sources elsewhere and transported to the site. Transportation of these materials, typically in over-laden and sometimes uncovered trucks, usually results in undue road wear-and-tear.

In the case of fine earth materials, dusting and spillages occur on the roadways between source and site. Dusting degrades local air quality and material spillages worsen driving conditions and increase the risk of road accidents. These occurrences represent indirect, short-term, reversible, negative impacts on public health and safety.

8.3.6. Materials storage

The improper sitting of stockpiles and storage of sand, gravel, cement, etc., at the construction sites could lead to fine materials being washed away, during heavy rainfall events, into the drainage system and ultimately into the adjacent lake environment. This would not only represent a waste of materials but would also contribute to sedimentation with consequent negative impacts on Awassa lake water quality Hazardous and flammable materials (e.g. paints, thinner, solvents, etc.) improperly stored and handled on the site are potential health hazards for construction workers and spilled chemicals would have the potential to contaminate soil and inhibit plant growth in localized areas. It is anticipated that refueling or maintenance of large vehicles will take place on the construction site and therefore there will be a requirement to store fuel and lubricants in a safe manner on the site.

8.3.7. Construction Waste Disposal

Solid waste generated during site preparation and construction work would include cut vegetation and typical construction waste (e.g. wasted concrete, steel, wooden scaffolding and forms, bags, waste earth materials, etc.). This waste would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite.

Cleared vegetation burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. Vegetation and solid waste, if allowed to accumulate in drainage ways, could cause localized pooling and flooding. Pooling of water, in turn, would create conditions conducive to the breeding of nuisance and health-threatening pests such as mosquitoes. Poor construction waste management constitutes a short-term, possibly long-term, negative impact.

8.3.8. Sewage and litter management

Inadequate provision of toilets for use by workers can lead to adhoc defecation in secluded areas on the site, thus creating of unsanitary conditions and sources of fly infestation. Improper disposal of food cartons and other domestic forms of construction camp garbage could lead to littering of the site and pollution of adjacent lake waters.

CHAPTER NINE: IMPACT MITIGATION MEASURES

9.1. Mitigation Measures for impact on Accumulation of coarse sediments on the a gross pollutant trap

Deposited sediments and gross pollutants stored around grating installed in the drainage canals and at the gross pollutant trap should be removed regularly. High specific gravity materials silting in the gross pollutant trap should be removed before the onset of the rainy season and the gross- pollutant trap should be checked regularly during the rainy season. Removal should be scheduled in the drier seasons before the onset of every rainy season. Generally, sediment removed from the sedimentation basin is not polluted and can be managed by disposing to sanitary landfill or can be used for landscaping purposes.

Inlets, outlets, control structures should be inspected and maintained regularly. This may include removing gravel, debris, grass clippings, and trash. Trash racks (located in the canals and around gross pollutant traps) should be inspected and cleaned on a regular basis, particularly during the rainy season.

9.2. **Mitigation Measures for impact on Air pollution, noise nuisance**

The dust and noise nuisances predicted to occur in the construction and operation sites will be mitigated by applying the following measures.

i. Re-suspension of dust in the construction sites will be prevented by frequent sprinkling of water. This will be specially applied during the carting away operations of the foundation excavation material.
ii. During construction, earth moving equipments, trucks and machineries will have their normal muffler intact in their smoke exhaust pipe. The contractor

will be advised to repair it when broken to avoid unnecessary release of noise during operation in the site.

iii. Construction activities will be restricted to work in the late night time to avoid nuisance during sleeping hours.

9.3. Mitigation Measures for impact on terrestrial habitat and biodiversity

Impact mitigation here seeks to retain and restore as much of the original and natural forested condition of the site.

- Replanting or plants are to be placed and maintained on site. These activities should be guided by an appropriate and approved management plan.
- Site clearance should be carried out in a manner that retains the large trees while the building footprints are pegged out.
- Construction of the internal roads and placement of the wetland should be carried out after identifying and locating all the mature and ecologically valuable trees to save the trees.

9.4. Mitigation measures for impacts on soil Erosion

Topsoil and cover will be installed as soon as possible after proposed site development is completed. This measure will alleviate the potential erosion of the proposed site to a significant level either during or after preliminary construction. In the long term, soil erosion will be minimized through site grading and land leveling as well as seeding of runoff ditches.

Topsoil will be salvaged from disturbed areas, stored in stockpiles and used for site landscaping upon completion of construction. The loss of the limited soil will be partially offset by topsoil salvage and re-vegetation. Therefore, the residual impacts are rated low.

9.5. Mitigation Measures for impact on Materials transportation

All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting. Trucks used for that purpose should be fitted with tailgates that close properly and with tarpaulins to cover the materials. The cleanup of spilled earth and construction material on the main roads should be the responsibility of the Contractor and should be done in a timely manner so as not to inconvenience or endanger other road users. These requirements should be included as clauses within the contracts.

9.6. Mitigation Measures for impact on Materials storage

The stockpiling of construction materials should be properly controlled and managed. Fine grained materials (sand, marl, etc.) should be stockpiled away from surface drainage channels and features.

- Low berms should be placed around the piles and/or tarpaulin used to cover open piles of stored materials to prevent them from being washed away during rainfall.
- Safe storage areas should be identified and retaining structures put in place prior to the arrival and placement of material.
- Hazardous chemicals (e.g. fuels) should be properly stored in appropriate containers and these should be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities.

9.7. Mitigation measures for impacts on Construction waste disposal

It has been shown in the impact analysis sections that inappropriate disposal of construction waste generated during the foundation excavation activities of the development project will be one aspect that will potentially affect the environment. The project management and the contractor will ensure that the

construction waste to be generated during excavations and related activities will be disposed in officially permitted places. The project management and contractor will facilitate for obtaining permission to access such tipping site which shall be designated by the municipality of Hawassa city for this purpose. The designated site should be an eroded or degraded land which can be rehabilitated and remedied by filling it back with soil and earth material. It would have been advantageous to keep the top soil which is also the fertile soil aside in a separate place during excavation, so that it will be placed back at the top during backfill, but due to the nature of the construction the backfill will be done with other select material and thus it will be carted away together with the rest of excavation material to an officially permitted disposal place. If there is absence of an officially designated site for disposal of construction waste in the city, the project management and the contractor will ensure that a degraded land that can be rehabilitated by tipping soil and other earth material is selected and used.

9.8. Mitigation measures for impacts on Sewage and litter management

It was discussed in the impact analysis section that improper management of Solid waste generated in the wetland construction will have the potential of polluting important environmental media lake Awassa and soil found in the area. Thus it is essential to set up solid waste collection and disposal system for temporary to prevent environmental damages.

Proper solid waste receptacles and storage containers should be provided in sufficient numbers, construct temporary toilet for workers, so as to prevent littering and solid waste of the site.

Table 10: show for summarizing Impact Mitigation Measures

Project Stage	Project activity	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibilities	Cost Estimates
Construction Phase	Excavation and cart away	Improper disposal of construction waste will affect the environment	• Dispose the construction waste in officially permitted place. The designated place should be a degraded site to be remedied by tipping excavation soil waste.	Contractor	No cost incurred, it included in the project cost
Construction Phase	The use of heavy equipment during site clearance and Excavation	Noise and dust releases	• *Construction activities that will generate disturbing sounds should be restricted to normal working hours.* • *Local residents should be given notice of intended noisy activities so as to reduce the degree of annoyances.* • *Workers operating equipment that generates noise should be equipped with noise protection gear.* • Stockpiles of fine materials should be wetted or covered with tarpaulin during windy conditions.	Contractor	No cost incurred, it included in the project cost
Construction Phase	Materials transportation	fine earth materials, dusting and spillages occur on the roadways between source and site.	• *The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.* • *As far as possible, transport of construction materials should be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.* • *Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the Bahia Hotel property.* • *Flagmen should be employed to control traffic and assist construction vehicles as they attempt to enter*	Contractor	No cost incurred, it included in the project cost

			and exit the project site.		
Construction Phase	Vegetation clearance and site excavation	Soil erosion	• *To the greatest extent possible, phase site clearance so as to minimize the area of exposed soil at any given time.* • *Re-cover exposed soils with grass and other appropriate species as soon as possible.*	Contractor	No cost incurred, it included in the project cost
Construction phase	site preparation and construction work	Solid waste	• *A site waste management plan should be prepared by the contractor prior to commencement of building.* • *Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction. To reduce organic waste, softer vegetation may be composted onsite and used for soil amendment during landscaping.* • *Vegetation and combustible waste must not be burned on the site.* • *Reusable inorganic waste (e.g. excavated sand) should be stockpiled away from drainage features and used for in filling where necessary.* • *Unusable construction waste, such as damaged pipes, formwork and other construction material, must be disposed of at an approved dumpsite.*	Contractor	No cost incurred, it included in the project cost
Operation and maintenance phase		Accumulation of coarse sediments on the a gross pollutant trap	• Deposited sediments and gross pollutants should be removed regularly around the gross pollutant trap • The sediment removed from the sedimentation basin should be disposing to sanitary landfill • Inlets, outlets, control structures should be inspected and maintained regularly.	Hawassa city administration	216,000 Eth.Birr

CHAPTER TEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The Environmental management plan gives the mitigating measures, monitoring requirements and it identifies the organizations assigned to implement them. Mitigating measures for the impacts that are likely to arise from implementing the project are outlined in the previous chapter and here it will be correlated with the responsible organs for implementation and estimated budget requirements.

10.1. Structural Best Management Plans

The Engineering systems that are used to treat the storm water at either the point of generation or the point of discharge to either the storm sewer system or to receiving waters (e.g. detention ponds or constructed wetlands).

No single BMP can address all storm water problems. Each type has certain limitations based on drainage area served, available land space, cost, and pollutant removal efficiency; as well as a variety of site-specific factors such as soil types, slopes, depth of groundwater table, etc. Careful consideration of the factors is necessary both to select the right kind of best management practices as well as to harness the synergy which can be fetched by integrating them in a unit. Regardless of the type, storm water BMPs will be most effective when implemented as part of a comprehensive storm water management program that includes proper selection, design, construction, inspection, and maintenance.

In Hawassa given the increasing urbanization and the associated increase in the quantity of storm water requiring management and the potential increase in storm-water quality challenges with urbanization, the lake as a main

management end to the city's storm water and the environmental urge to protect the lake from the pollution and the relatively limited nature of the lake side to embrace physical measures perpetually sustainable solution in Hawassa requires working on the attitude of the residents to change their view of the draianage system as solid and liquid waste management option, to establish the relationship between household waste management and the lake health, keeping the streets clean, control of illegal connection, introducing measures to reduce quantity of storm-water requiring management and working on polishing the quality of stormwater within the urban catchment and developing a mechanism to bring the treatment issue within the urban catchment. The sustainability of the infrastructure provisions as an end of pipe management option by the lake side can be achieved if the City can align the goals of the storm-water management in terms of reduction of runoff volume from urbanizing areas and pollutant removal and pollutant source reductions

10.1.1. Reduce Quantity of Runoff Generated

The principle of runoff reduction begins by recognizing that developing or redeveloping land within a watershed inherently increases the imperviousness of the areas and therefore the volume and rate of runoff and the associated pollutant load; and outlines various approaches to reduce or minimize this impact through planning and design techniques. The extent of impervious land covering the landscape is an important indicator of storm water quantity and quality and the health of urban watersheds.

Rainwater is prevented from filtering into the soil, adversely affecting groundwater recharge, and reducing base stream flows. Because it cannot filter into the soil, more rainwater runs off, and runs off more quickly; causing increased flow volumes, accelerating erosion in natural channels, and reducing habitat and other stream values. Flooding and channel destabilization often

require further intervention. As a result, riparian corridors are lost to channelization, further reducing habitat values.

Pollutants that settle on the impervious pavements and rooftops are washed untreated into storm sewers and nearby stream channels, increasing pollution in receiving water bodies.

Impervious surfaces retain and reflect heat, increasing ambient air and water temperatures. Increased water temperature negatively impacts aquatic life and reduces the oxygen content of nearby water bodies.

- Techniques for reducing runoff are;
- Manage watershed impervious area
- Minimize directly connected impervious areas
- Incorporate reduced discharge areas
- Include self-treatment areas

10.1.2. Manage Watershed Impervious Area.

Land use planning on the watershed scale is a powerful tool to manage the extent of impervious land coverage. This planning has two elements. First, identify open space and sensitive resource areas at the regional scale and target growth to areas that are best suited to development; and second, plan development that is compact to reduce overall land conversion to impervious surfaces and reliance on land-intensive streets and parking systems.

Impervious land coverage is a practical measure of environmental quality because:

- It is quantifiable, meaning that it can be easily recognized and calculated.

- It is integrative, meaning that it can estimate or predict cumulative water resource impacts independent of specific factors, helping to simplify the intimidating complexity surrounding non-point source pollution.
- It is conceptual, meaning that water resource scientists, municipal planners, landscape architects, developers, policy makers, and citizens can easily understand it.

10.1.3. Minimize Directly Connected Impervious Areas (DCIA).

Any impervious surface that drains into a catch basin, area drain, or other conveyance structure is a "*directly connected impervious area*." As storm water runoff flows across parking lots, roadways, and paved areas, the oils, sediments, metals and other pollutants are collected and concentrated. If this runoff is collected by a drainage system and carried directly along impervious gutters, into surface or curb intake openings, or in closed underground pipes; it has no opportunity for filtering by plant or infiltration into the soil. It also increases in speed (reducing the runoff time of concentration) and volume, which may cause higher peak flows downstream, and may require larger capacity storm drain systems, and increasing flood and erosion potential.

Minimizing directly connected impervious areas can be achieved in two ways:

- Limiting overall impervious land coverage
- Directing runoff from impervious areas to pervious areas for infiltration, detention, or filtration

Strategies for reducing impervious land coverage include:

- Cluster rather than sprawl development
- Taller narrower buildings rather than lower spreading ones
- Sod or vegetative "green roofs" rather than conventional roofing materials
- Narrower streets rather than wider ones
- Pervious pavement for light duty roads, parking lots and pathways

Example strategies for infiltration, retention/detention, and bio-filtration include:

- Vegetated swales
- Vegetated basins (ephemeral – seasonally wet)
- Constructed ponds and lakes (permanent- always wet)
- Crushed stone reservoir base rock under pavements or in sumps
- Infiltration trenches
- Infiltration basins
- Bio retention areas and rain gardens

Unlike conventional storm drain systems that convey water beneath the surface and work independently of surface topography, a drainage system for storm water infiltration can work with natural landforms and land uses to become a major design element of a site plan. Solutions that reduce DCIA prevent runoff, detain or retain surface water, attenuate peak runoff rates, benefit water quality and convey storm water. Site plans that apply storm water management techniques use the natural topography to suggest the drainage system, pathway alignments, and optimum locations for parks and play areas, and the most advantageous locations for building sites. In this way, the natural landforms help to generate an aesthetically pleasing urban form integrated with the natural features of the site. This planning approach is often referred to as the "better site design" methodology.

10.1.4. Incorporate Reduced Discharge Areas.

An area within a development project can be designed to infiltrate, retain, or detain the volume of runoff requiring treatment from that area. The term "reduced discharge" in this philosophy applies at storm water treatment design storm volumes. For example, consider an area that functionally captures and then infiltrates the 80th percentile storm volume. If permits require treatment of the 80th percentile storm volume, the area generates no treatment-required runoff.

Site design techniques available for designing areas that could produce no treatment-required runoff include:

- Retention/detention ponds
- Wet ponds
- Infiltration areas
- Large fountains
- Retention rooftops
- Green roofs (roofs that incorporate vegetation)

Infiltration areas, ponds, fountains, and green roofs can provide dual functionality as storm water retention measures and development amenities. Detention ponds and infiltration areas can double as playing fields or parks. Wet ponds and infiltration areas can serve dual roles when meeting landscaping requirements. When several reduced discharge areas are incorporated into a development design, significant reductions in volumes requiring treatment may be realized. The reduced discharge area-designed tract represents a design to infiltrate (i.e., achieve reduced discharge from) a portion of the tract's runoff, reducing total runoff from the tract. The application of reduced discharge methodology in site design requires a careful consideration of the overall site characteristics, local jurisdiction planning and design requirements, and overall acceptance of the site features and individual BMPs by the residents in the development.

10.1.5. Self-treatment Areas.

Developed areas may provide self-treatment of runoff if properly designed and drained. Self-treating site design techniques include:

- Conserved natural spaces
- Large landscaped areas (including parks and lawns)
- Grass/vegetated swales
- Turf block paving areas

The infiltration and bio-treatment inherent to such areas may provide the treatment control necessary. These areas therefore act as their own BMP, and no additional BMPs to treat runoff should be required. Site drainage designs direct runoff from self-treating areas away from other areas of the site that require treatment of runoff. Otherwise, the volume from the self-treating area will only add to the volume requiring treatment from the impervious area. Likewise, under this philosophy, self-treating areas receiving runoff from treatment-required areas would no longer be considered self-treating, but rather would be considered as the BMP in place to treat that runoff. These areas could remain self-treating or partially self-treating areas, if adequately sized to handle the excess runoff addition.

10.1.6. Improving the Quality of the Storm Water Quality

Reduction of the pollutant loads of the storm-water reaching the treatment plants is the best way to maintain the treatment efficiency of the designed systems in concert (or alone where volume reduction is not possible) with other measures. A number of structural and non structural measures can e integrated to achieve this in Hawassa.

10.2. Non- Structural Controls

10.2.1. Education, recycling, and source controls

Public education can be an effective means of reducing the amounts of point and non-point source pollutants entering the storm water conveyance system. The public is often unaware that the combined effects of their actions can cause significant source pollution problems. Proper education on day-to-day activities such as recycling of used automotive fluids, household chemical and fertilizer use, animal waste control, and other activities can significantly reduce

non-point source pollutant loadings to urban streams. The main components of a public education program include:

- Commercial and retail space good housekeeping
- General community outreach
- Industrial good housekeeping
- Pesticide/herbicide use
- Fertilizer use
- Household hazardous material disposal
- Lawn debris management
- Pet waste disposal
- Illicit discharge detection and elimination

10.2.2. Maintenance practices

Maintenance programs are important in order to reduce the pollutant contribution from the urban landscape and to ensure that storm water collection and treatment systems are operating as designed. Major maintenance practices that can be used include:

- Catch basin cleaning
- Street and parking lot sweeping
- Road and ditch maintenance
- Limited road salting and sanding
- Sediment and floatable removal from BMPs
- Vegetation maintenance
- General BMP maintenance

CHAPTER ELEVEN: ENVIRONMENTAL AND SOCIAL MONITORING

Environmental monitoring is very essential part of the project implementation. It helps to follow up the implementation of the proposed mitigation measures and to capture unforeseen environmental impacts of the project.

It is necessary to establish and maintain environmental monitoring system to assess the efficiency of different mitigation measures, to perceive possible environmental hazards or to detect unpredicted impacts in time. Monitoring of environmental parameters will timely signal potential problems and will allow for prompt implementation of effective corrective measures.

Due to capacity and resource limitations monitoring should be scoped to those indicators that are most relevant for evaluation of the performance of the environmental mitigating measures. The selection of the issues to be monitored must be based on the severity, extent and intensity of the impacts.

For this particular project the proposed environmental and social monitoring indicators, frequency of measurement and reporting requirement are indicated in table below.

Table 11 : Summarizing Monitoring Requirement

	ASPECTS TO BE MONITORED	HOW TO BE MONITORED	LOCATION	FREQUENCY	RESPONSIBILITY	Cost
Construction phase	Accumulation of sediment in runoff/Excavation and Clearance	Visual monitoring of sediment load	construction site	Regularly through site visits	Construction supervisor	No need cost
	Dust	Visual monitoring dust level	construction site	Regularly through site visits	Construction supervisor	No need cost
	Collection and disposal of solid wastes	Visual monitoring	construction site	Regularly through site visits	Construction supervisor	No need cost
	Restoration of lands damaged by excavation	Visual monitoring	construction site	At the completion of construction	Construction supervisor/city administration	No need cost
	Protection of habitats	Visual monitoring	construction site	monthly	Construction supervisor/city administration	No need cost
	Noise	Portable noise meters	construction site	Regularly through site visits	Construction supervisor	No need cost
Operation and Maintenance phase	Accumulation of gravel, debris, grass clippings, and trash	Visual monitoring	Gross pollutant trap	Regularly through site visits	city administration REPA	200,000 to employed daily sweepers
	Accumulation of gravel, debris, grass clippings, and trash	Visual monitoring	City's drainage	Regularly through site visits	city administration REPA	200,000 to employed daily sweepers
	Damage of hydraulic performance of inlet and outlet	Visual monitoring	The inlet and outlet structures system of the wetland.	Regularly through site visits	city administration	24, 000 to employed technician

CHAPTER TWELVE: CONCLUSION AND RECOMMENDATIONS

12.1. Conclusion

This document generally attempts to show the environmental impacts and the controlling measures of the Hawassa city Administration wetland construction Project to be implemented around Lake Hawassa. Remedial measures to control significant environmental impacts associated with the construction of wetland processes are also suggested.

The implementation of the project will bring several beneficial impacts including Protecting the Lake from Sediment loading which is the most predominant pollutant associated with storm-water runoff pollution, creating job opportunity and reducing poverty, contributing to sustainable development of the nation by playing a role in improving the tourism industry supplying the necessary input in making Lake Hawassa aesthetically beautiful to attract tourist in different part of the world

The EIA conducted on the project wetland construction comply the legislation of the Ethiopian Environmental protect and World Bank safeguard policy and will also manage adverse environmental impacts which pose during the construction and operation phase. Construction of wetland is by itself environmental protection mechanism of the lake water in Hawassa. Those impacts related to the construction and operation phase will be mitigated with e respective to EIA reports including proper policy, planning, public relations, and good construction and supervision practices.

Those negative impacts can be reduced to an acceptable level through a holistic planning and implementation of the environmental management plan. Thus, it can be concluded that the project benefits by-far outweighs its adverse

socio-economic and socio-ecological impacts as these two can be mitigated by proper utilizations of the suggested mitigation measures.

12.2 Recommendation

To enhance the potential benefits and social acceptability of the project, avoid or minimize the adverse impacts of the project and reduce the impacts of the existing environmental conditions on the project, it is recommended that the proposed mitigating measures are properly implemented at the right time. To ensure its proper implementation regular environmental monitoring and audit are also recommended.

In addition, the City should create harmonious relationship between the local community and the project by holding regular discussions with local elders so as to develop strong linkages with and avoid adverse environmental pollutant of the Lake.

Furthermore, Public education is another ways that can be an effective means of reducing the amounts of point and non-point source pollutants entering the storm water conveyance system. The public should often aware that the combined effects of their actions can cause significant source pollution problems. Proper education on day-to-day activities such as recycling of used automotive fluids, household chemical and fertilizer use, animal waste control, and other activities can significantly reduce non-point source pollutant loadings to urban streams.

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LEGEND

- MAJOR CONTURE
- MINOR CONTURE
- FENCE
- BLOCK
- PARCEL
- EX.RECTANGULAR CULVERT
- BOUNDARY

CLIENT:

FEDERALDEMOCRATICREPUBLICOFETHIOPIA,
SOUTHERNNATIONSANDPEOPLE'SREGION(SNNPR),
HAWASSACITYADMINSTRATION

PROJECTTITLE

HAWASSACITYSTORMWATERWETLAND
SYSTEMDESIGNPROJECT

DRAWINGTITLE:	STATUS:
AMORA-GEDELWETLANDSITEPLAN	FINAL

DRAWINGNUMBER:	SCALE:	DATE:
HWAGS-11	1:500	MARCH,2012

DESIGNEDBY:	MSConsultancy
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APPROVEDBY:	MSConsultancy

CONSULTANT:

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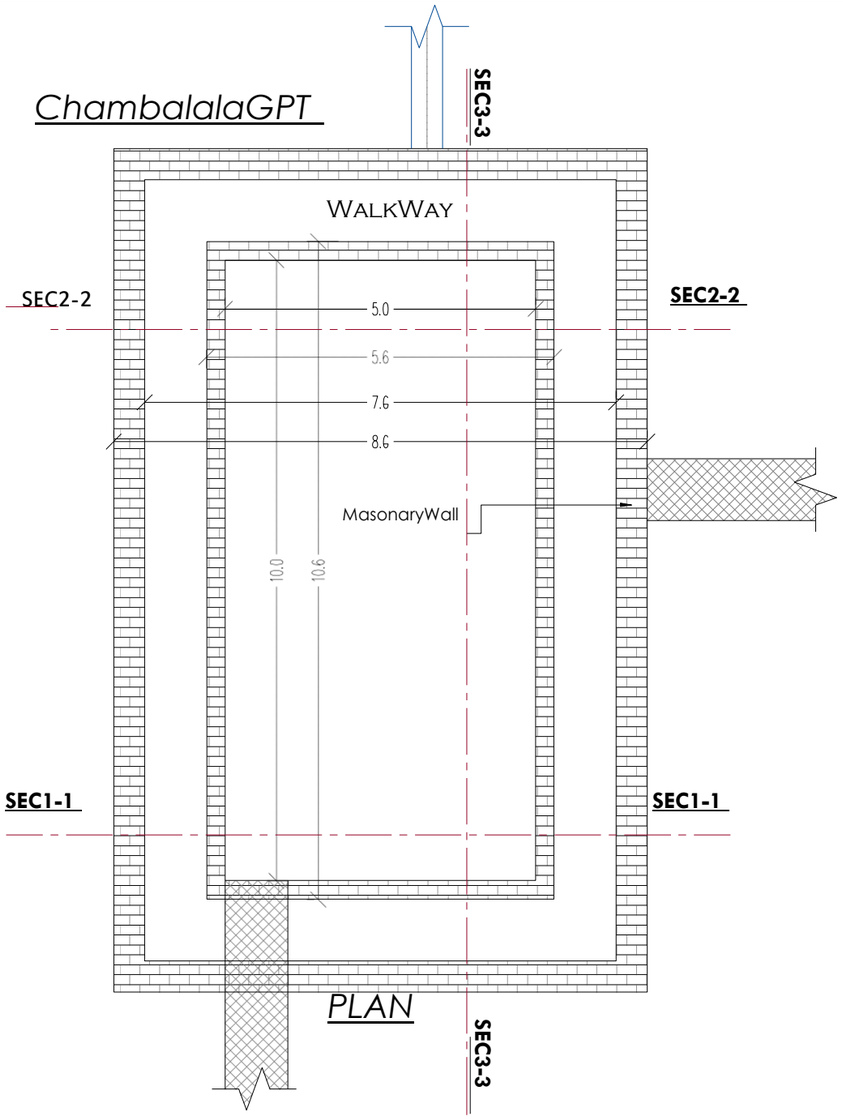
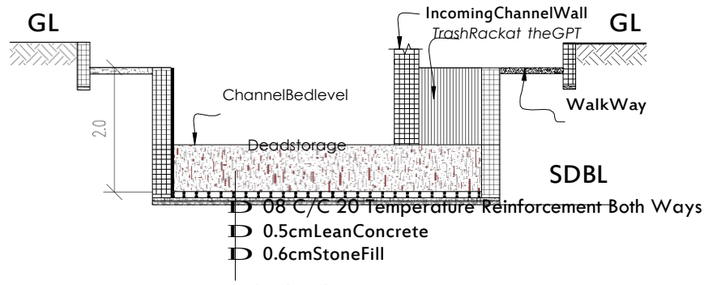
ChambalalaGPT



PLAN



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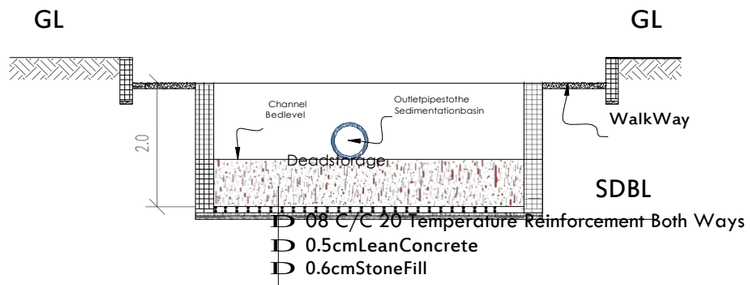

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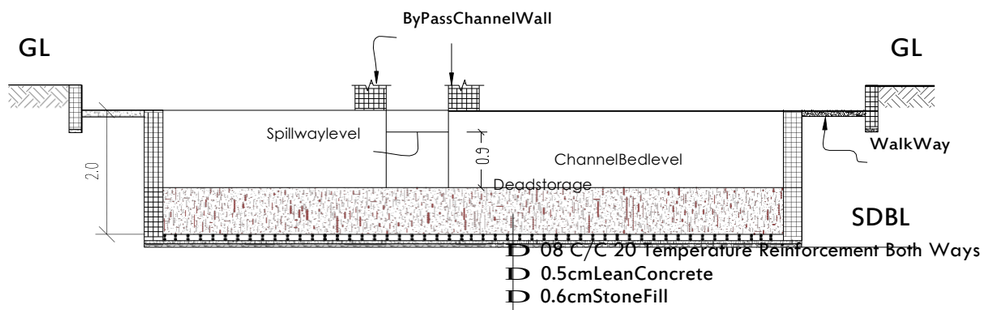

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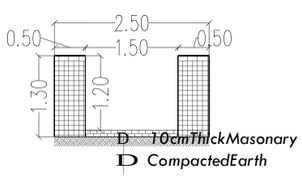
ChembelalaChannel Section



CLIENT:

FEDERALDEMOCRATICREPUBLICOFETHIOPIA, SOUTHERNNATIONSANDPEOPLE'SREGION(SNNPR), HAWASSACITYADMINSTRATION

PROJECTTITLE

HAWASSACITYSTORMWATERWETLAND SYSTEMDESIGNPROJECT

DRAWINGTITLE:	STATUS:
ChembelalaGPTPlanandSection,Channel Section,TypicalWalkAwayDetail	FINAL

DRAWINGNUMBER:	SCALE:	DATE:
HWCGP-11	1:100	MARCH,2012

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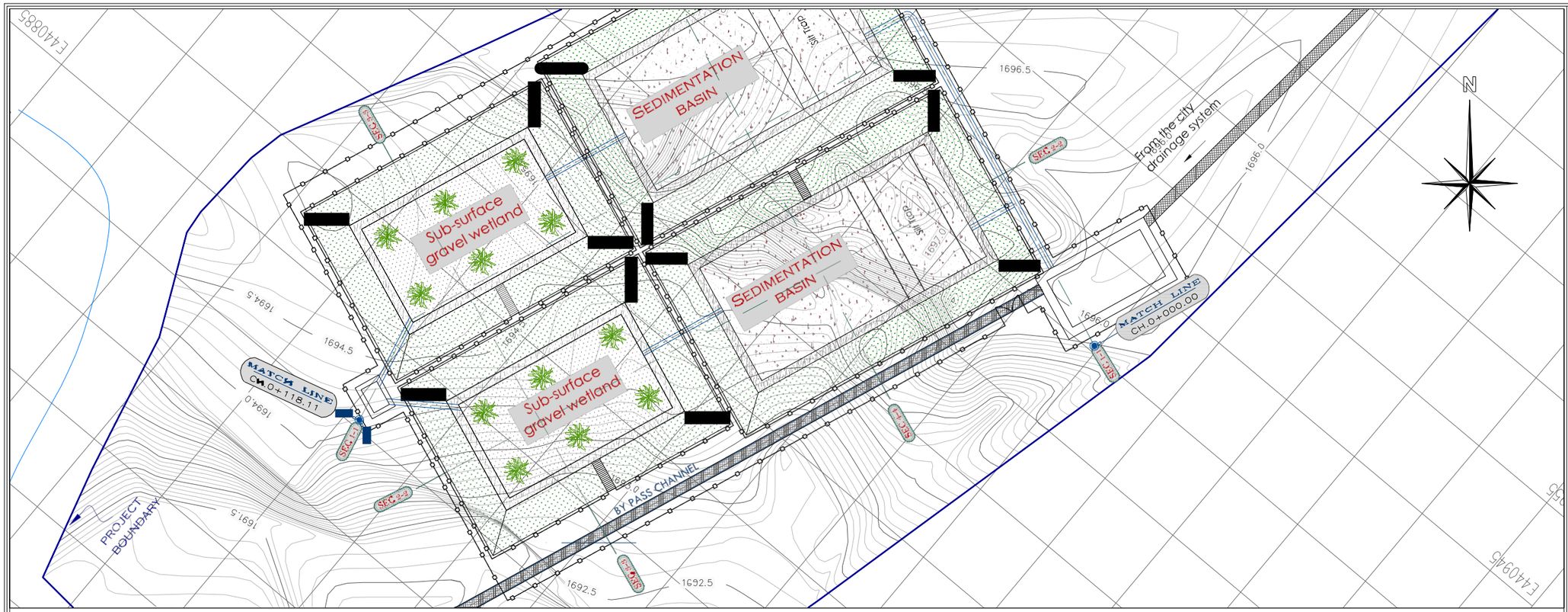

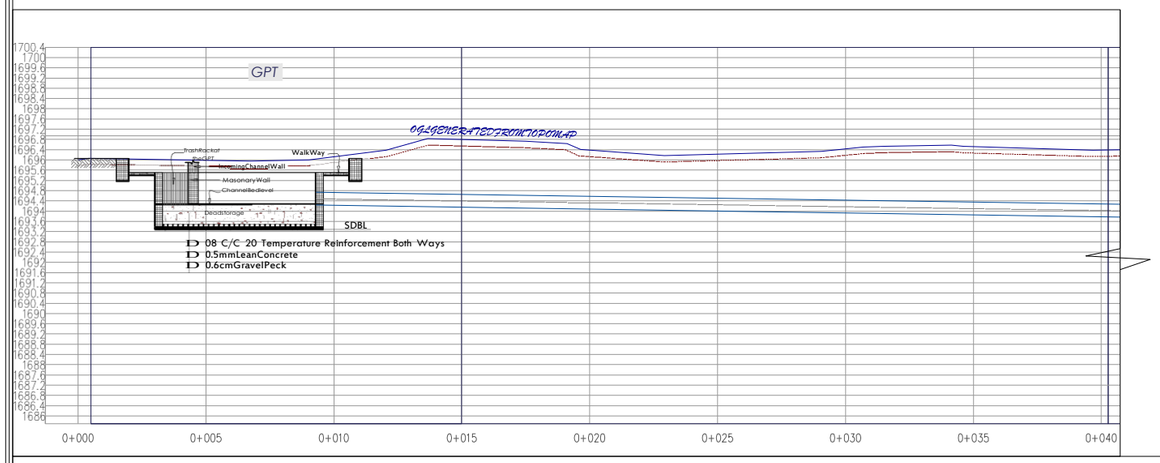

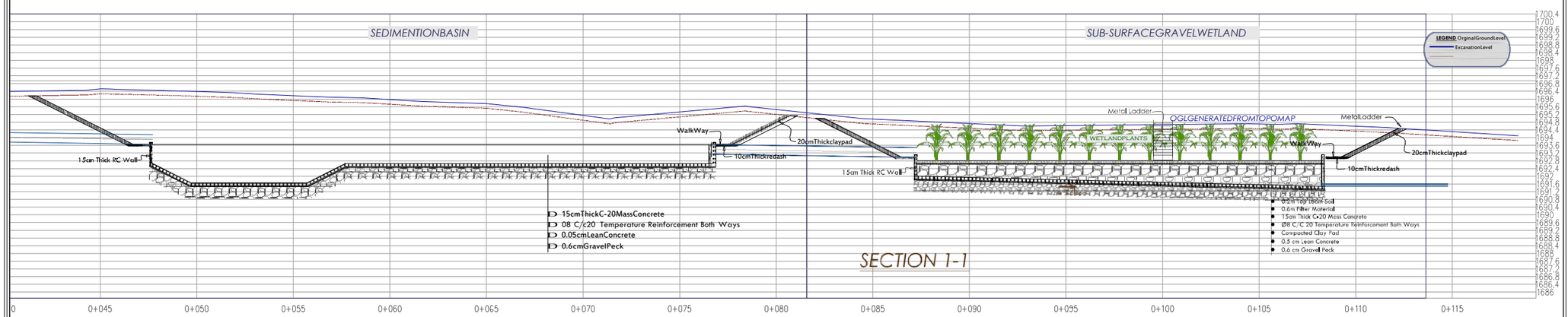

CLIENT:

FEDERALDEMOCRATICREPUBLICOFETHIOPIA, SOUTHERNNATIONSANDPEOPLE'SREGION(SNNPR), AWASSACITYADMINSTRATION

PROJECTTITLE

HAWASSACITYSTORMWATERWETLAND SYSTEMDESIGNPROJECT

DRAWINGTITLE:	STATUS:
ReferalWetLandSection1-1	FINAL

DRAWINGNUMBER:	SCALE:	DATE:
HWRS-13	NTS	MARCH,2012

DESIGNEDBY:	MsConsultancy
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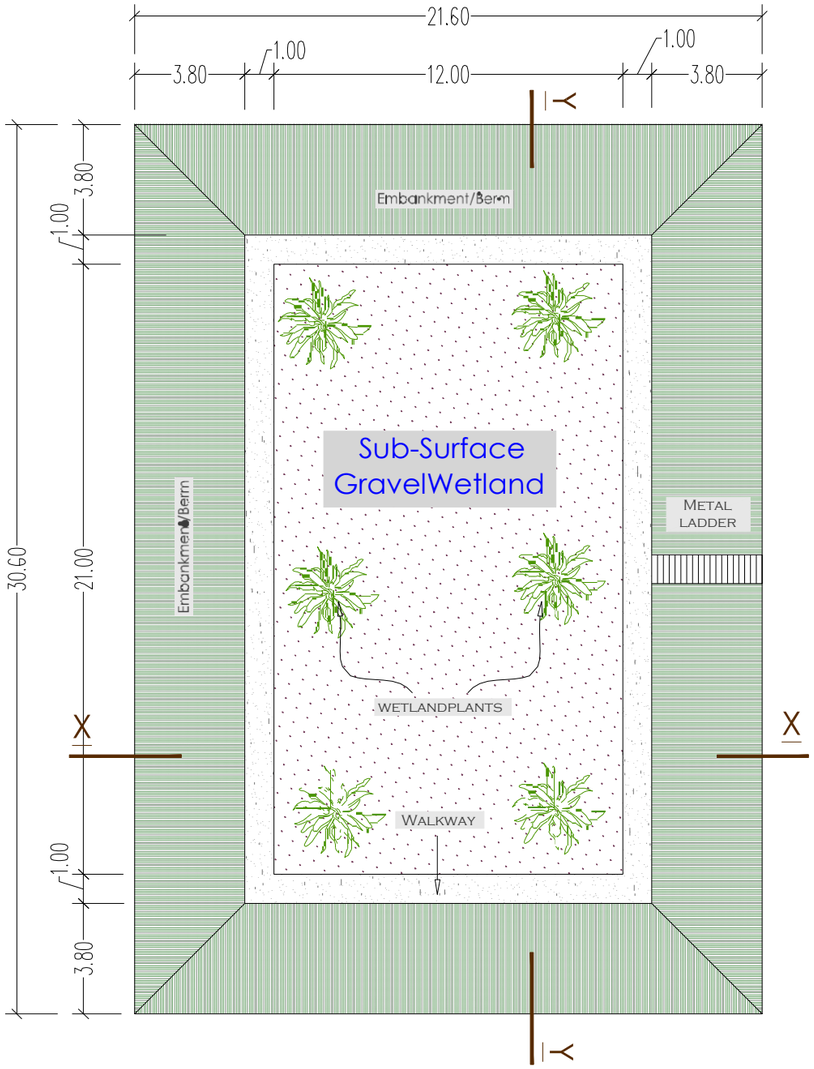
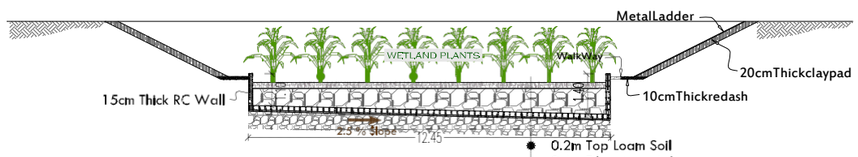
CONSULTANT:

MSCONSULTANCY

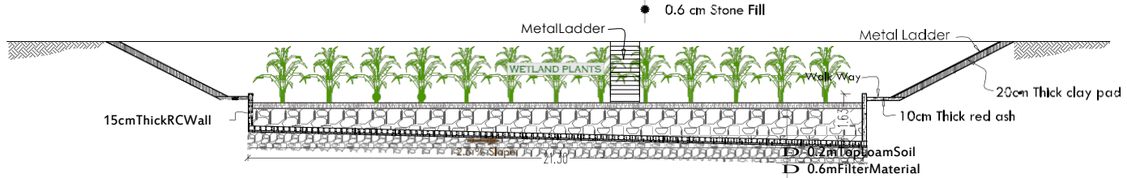
Referal Sub-SurfaceGravelWetland





SECTIONX-X

- 0.2m Top Loam Soil
- 0.6m Filter Material
- 15cm Thick C•20 Mass Concrete
- Ø8 C/C 20 Temperature Reinforcement Both Ways
- Compacted Clay Pad
- 0.5 cm Lean Concrete
- 0.6 cm Stone Fill



SECTIONY-Y

- 0.2m TopLoamSoil
- 0.6mFilterMaterial
- 15cmThickC-20MassConcrete
- 08 C/C 20 Temperature Reinforcement Both Ways
- CompactedClayPad
- 0.5cmLeanConcrete
- 0.6cmStoneFill

CLIENT:

FEDERALDEMOCRATICREPUBLICOFETHIOPIA,
SOUTHERNNATIONSANDPEOPLE'SREGION(SNNPR),
AWASSACITYADMINSTRATION

PROJECTTITLE

HAWASSACITYSTORMWATERWETLAND
SYSTEMDESIGNPROJECT

DRAWINGTITLE:	STATUS:
ReferalSub-SurfaceGravelWetlandPlan andSection	FINAL

DRAWINGNUMBER:	SCALE:	DATE:
HWRSSG-11	1:200	MARCH,2012

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