Pre-feasibility Study: Development of Drainage Systems to Mitigate Floods in Isiolo

April 2021

“Develop Isiolo as a Centre of excellence and a major economic hub in Kenya with resilient and inclusive growth through the responsible use of its natural resources”

The Sustainable Urban Economic Development (SUED) programme is a £70M, five-year programme supported by the British government through the Foreign, Commonwealth and Development Office (FCDO). SUED provided support to Isiolo Municipality to develop an Urban Economic Plan (UEP) which outlines the economic vision for Isiolo.

The Isiolo UEP provides a development framework based on resilient urban development to realise that vision, focusing on:

- ***Effective Town Planning***, to make Isiolo town flood-resistant through river flow management and building of sustainable urban drainage systems.
- ***Robust Water Infrastructure*** that includes the construction of strategic water harvesting and storage systems.

To bring this plan to fruition, Isiolo Municipality, in conjunction with SUED, has embarked on an investment attraction process including prioritising and refining the projects under this development framework. This pre-feasibility study focuses on assessing the practicality, sustainability, and impact potential of the proposed sustainable urban drainage systems (SuDS), promoting climate-resilient infrastructure in Isiolo Municipality.

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Abbreviations and Acronyms

AfDB	African Development Bank
ASAL	Arid and Semi-Arid Land
CADP	County Annual Development Plan
CBD	Central Business District
CIDP	County Integrated Development Plan
DANIDA	Danish International Development Agency
EBA	Ecosystem- Based Approach
ENNDA	Ewaso Ng'iro North River Basin Development Authority
GCP	Gross County Product
IIDP	Investment Development Plan
IWASCO	Isiolo Water and Sewerage Company
KAA	Kenya Airport Authority
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KUSP	Kenya Urban Support Programme
LAPSSET	Lamu Port South Sudan Ethiopia Transport Corridor Development Authority
NCA	National Construction Agency
NEMA	National Environment Management Authority
NLC	National Land Commission
SuDS	Sustainable Drainage Systems
UEP	Urban Economic Plan
UNEP	United Nations Environment Program
WRA	Water Resources Authority

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1. Executive Summary

Isiolo Municipality serves as the main economic centre and transport gateway for northern counties but experiences annual floods due to its topography, urban planning issues, and population pressure on the existing drainage systems. The municipality whose location on a low-lying flood plain characterised by steep gradients makes the Central Business District (CBD) vulnerable to the rapid flow of stormwater from the upstream catchment areas of Meru County and Mt. Kenya. The soil's high clay content and limited vegetation given the area's semi-arid nature also combine to minimise water retention and increase surface water run-off. The airport gabions and tarmac roads raised on bunds[i] exacerbate the situation by diverting stormwater from its natural path into residential and commercial spaces such as the open-air market. The rapid growth of the town population, from 40,000 people in 2009 to 80,000 currently, poses a further challenge in the form of informal settlements on riparian land and encroachment along road reserves, limiting the capacity of the existing drainage systems to adequately carry stormwater. Isiolo "town," which makes up most of Isiolo Municipality is the area most affected by floods.

The ensuing floods interfere with movement, residential, and commercial activities, and lead to the destruction of property and loss of life annually. Over the past decades, Isiolo County has experienced adverse climate change with the major floods recorded in 1982 that destroyed the Food and Agriculture Organisation (FAO) Irrigation Schemes.[1] More recently, floods caused 10 deaths in 2005, and in 2006 they caused 8 deaths and displaced 500 people. The recurrent floods further led to the displacement of over 1,320 households between 2009 and 2019 with the floods in 2015 destroying property worth KES 800 million and displaced about 349 households.[2,3] The residents living along the Isiolo-Moyale (A2) road and Marire River are at higher risk of displacement and loss of lives to floods because flood water often converges in these areas. According to the Urban Economic Plan (UEP) 50% (40,000 residents) of Isiolo Municipality's population are settled within the Marire River Basin.[4] The frequency of flood events is anticipated to increase with climate change and these vulnerabilities highlight the important role that the proposed Sustainable Drainage Systems (SuDS) project will play in anchoring resilient urban infrastructure and driving climate change adaptation.

Isiolo Municipality recognises the importance of a holistic approach to stormwater management spanning solutions in both CBD as well as its upstream catchment areas. The municipality has therefore engaged different stakeholders to assist with the development of drainage systems, but the collaborations are yet to result in any upgrades. The municipality has undertaken several efforts to start addressing this issue:

- In 2020, Isiolo Municipality worked with the World Bank, ENNDA and JICA to develop stormwater management designs, but are yet to implement these designs due to insufficient financing.
- Furthermore, in the same year, Isiolo Municipality also engaged the Kenya National Highway Authority to upgrade the drainage channels on the A2 highway but have not received any responses.
- Finally, while, the municipality engaged the Meru County government to set up dams in upstream catchment areas, but they could not agree on the sources of financing and on how to use the dams to benefit populations in both Meru and Isiolo counties.

While the municipality has come up with several drainage system designs, they are yet to construct any due to insufficient funding, poor stakeholder coordination between the municipality and key stakeholders, and an unharmonised approach to the management of shared catchment areas with Meru County. Nonetheless, managing floods in Isiolo Municipality remains a critical priority to reduce economic and social losses to floods.

1.1. Proposed Project

The drainage systems in Isiolo Municipality either have a low capacity to channel the amount of stormwater flowing in the area or are misaligned with the natural water path. As such, this report leverages existing sustainable drainage systems designs such as the Isiolo stormwater management plan prepared by ENNDA and the UEP to propose required developments and assess their feasibility and potential implementation timelines as follows:

- **Phase I (Starting October 2021):** Construction of 25km drainage channels around the airport and on feeder roads within the municipality, rehabilitation of drainage channels and the main culvert on the A2 road, and construction of two 3m by 2m culverts on the A2 road. The drainage channels and culverts will redirect stormwater away from residential, commercial, and academic spaces to the Marire river.
- **Phase II (Starting January 2022):** Expansion of the Marire River and resettlement of the households on riparian land and road reserves. The Marire river can only channel 25m^3/s of water compared to the 68m^3/s of

[i] A bund is defined as an embarkment used to control the flow of water.

stormwater that flows into it during floods. Expansion of the river will enable it to safely channel stormwater at the peak discharge and resettlement of the population on riparian land will minimise social and economic losses to floods.

- **Phase III (Starting July 2022):** Development of a semi-natural bio-park north of Isiolo town. The bio-park will allow the attenuation of 25% of the stormwater flowing in the municipality for productive use.
- **Phase IV (Starting October 2022):** Construction of four check dams[ii] in catchment areas within Meru County to reduce the volume and velocity of floodwater flowing to Isiolo Municipality.

1.1.1. Ease of Implementation

The proposed SuDS in this report align with prior designs from the UEP and the World Bank that the project sequencing proposed above is best suited for the project needs. The technical implementation (i.e., construction of the drainage system) of these works is not complex and can be delivered by several qualified firms who have completed similar projects in Kenya. For instance, KeNHA installed box culverts on the A2 – Isiolo Airport junction and the National Water Conservation and Pipeline Corporation constructed the Isiolo dam, which provides a base for the proposed SuDS project.

Following this study's analysis, the key challenges to implementation will be acquiring buy-in and resources e.g., land and financing required to resettle populations living and working on riparian land and road reserves to allow execution. Isiolo Municipality is aware of this challenge and will need to formulate a Resettlement Action Plan (RAP) that is based on the principles and procedures of the Resettlement Policy Framework (RPF) prepared for similar resettlement projects under the World Bank, for example, the Nairobi Metropolitan Services Improvement Project (NaMSIP). The main objective of the RAP will be to minimise the adverse impacts to project affected persons (PAPs) and enhance or at least restore their livelihood to match before displacement status. The RAP will include the institutional arrangements, schedules, and budgets to facilitate the resettlement process that will be necessitated because of this project. In addition to County Assembly approval, the RAP will also need to undergo public participation to provide PAPs and community members with information on resettlement options and grievance redress mechanisms. With upfront planning and coordination with key stakeholders such as the Kenya National Highways Authority (KeNHA), National Environment Management Authority (NEMA), Water Resources Authority (WRA), and the Isiolo County Land and Physical Planning Department, the municipality can demarcate the road reserves and riparian land, issue notices for relocation to populations illegally using the spaces and estimate the cost of compensation where required. The municipality will also need to ensure funds necessary for resettlement are budgeted into the project totals, which currently do not include this provision.

While Phase I could move forward without significant displacement of residents from their commercial and residential spaces, the project's success is dependent on executing all phases, so this study concludes that the RAP is a critical pre-requisite.[5,6]

1.1.2. Enabling Environment

The National Water Master Plan 2030 empowers county governments and municipal administrations to lead the implementation of the stormwater strategy in conjunction with the relevant regulatory bodies. Isiolo Municipality will need to engage the Kenya National Highway Authority (KeNHA) to approve and implement the proposed drainage infrastructure on the A2 road. The project will also benefit from having KeNHA provide technical advisory and quality assurance support. The municipality will also need to prepare a resettlement plan for people living on riparian land, then work with NEMA and WRA to de-clutter the riparian land of informal structures allowing for the development of public realm facilities as well as tree planting. For instance, after completion of the A2 road, the LAPSSET Corridor Development Authority plans to resettle 144 families north of the Isiolo town CBD for KES 1.5 million per acre to pave way for the construction of the resort city.[7] The existing County Government Procurement Regulations provide a clear framework for the municipality and county administrations to initiate and monitor the project contracting process. Isiolo County has also enacted the Water and Finance Bills that will further strengthen the institutional framework. The existing laws and bills create a conducive legal, regulatory and policy environment in governing the implementation of SuDS by the municipality.

Historical examples of resettlement and rehabilitation of riparian land have been lengthy and costly due to inadequate planning and stakeholder buy-in and coordination. The Nairobi river rehabilitation and resettlement of riparian residents took over a decade despite support from organisations such as the United Nations Environmental Program (UNEP) and the African Development Bank (AfDB). Some of the key challenges included the length of the river covered, lack of adequate involvement of the riparian residents in the rehabilitation plan, extensive and costly research processes, and insufficient political will to resettle the population and rehabilitate the riparian land. Nonetheless, in 2020, the national government through the Athi Water Service Board and the Nairobi City Water and

[ii] Check dam is a wall built across a waterway to reduce the velocity of run-off water.

Sewerage Company partnered with the AfDB to commission phase II of the Nairobi river rehabilitation in the Eastland neighbourhoods of Nairobi that will result in the resettlement of 834 households at an estimated cost of KES 538 million.[8] The budget was based on the value of assets owned by the riparian residents including land, houses, business structures, and crops. Given Isiolo Municipality's lower land values, the cost of resettlement per household is expected to be lower. However, the municipality must secure political and public buy-in for the resettlement process. Cognisant of this, the municipality manager initiated a technical resettlement committee in March 2021 that comprises key stakeholders including the Municipality Manager, the county executive committee, the assistant county commissioner, the land and physical planning department, WRA, and community elders. The committee will be responsible for communicating with the public on the resettlement plans, drafting the resettlement plan, and identifying land for resettlement.

1.1.3. Impact Assessments

Climate Change and Environmental Impact

Isiolo County is prone to prolonged droughts and increased flooding due to erratic and unpredictable rainfall worsened by climate change. The droughts often have devastating economic effects on the county's residents because 80% of the population rely on agricultural activities for their livelihood. The agricultural value chain products include camel meat and milk, goat meat, poultry, and green grams. The droughts reduce the yields from agricultural activities and have led to the rise of poverty levels to 72.6% with over 80,000 residents relying on food aid.[9] Additionally, during prolonged droughts, the water supply in the most vulnerable areas in the county can be as little as eight litres per person per day compared to the required 20 litres per day.[10] Flooding also disrupts movement, commercial, and residential activities, leading to damage to property and loss of lives. The worst floods occurred in 2006, displacing 500 people from the Bulla Pesa area in the municipality. The SuDS project will play an integral role in enhancing the municipality's climate resilience and create adaptation opportunities such as the storage of water for irrigation during extreme events.

Ecosystem-Based Adaptation Approach and other Environmental Benefits

The SuDS project will enhance adaptation against the impact of drought and the socio-economic losses to flooding. The SuDS project includes Ecosystem Based Adaptation (EBA) strategies such as the Isiolo Bio-Park, revegetating the Marire River, and planting trees in the upstream catchment areas to provide nature-based solutions to climate change. The features create sustainable biodiversity through conservation and restoration of the ecosystems increasing human resilience on climate adaptation. For instance, the proposed Isiolo Bio-Park, to be located on the undeveloped land north of the CBD, will incorporate features such as swamps with reedbeds vegetation, drought-resistant crops, and agricultural plots that will increase rainfall absorption and water supplies to the municipality while attenuating flood water for productive use. The vegetation will foster the control of the atmospheric carbon with the created shady green spaces lowering heat stress to the municipality's residents. The establishment of attenuation ponds and provision of plots for climate friendly agriculture at the bio-park not only reduces the emission of the greenhouse gas (GHG) but also enhances the plant and animal species and the recreational use of the landscape. Additionally, vegetating the Marire Riverbed will improve the riverine ecosystem by protecting the banks from erosion.

Economic Resilience

The SuDS components will improve the resilience of the municipality's economy by reducing the damage caused by floods to trade premises and residential properties. Floods in Isiolo County contribute to frequent destruction of property with losses estimated at KES 800 million incurred in 2015 alone.[11] The recurrent floods are estimated to destroy property worth KES 1.08 billion annually compared to Isiolo County's gross county product of KES 15.9 billion as of 2019.[12] Isiolo town's CBD consists of individual or family-owned retail shops and open-air markets that sell household items, food, and clothing. Some of these commercial premises are located near road reserves, and along the natural water paths rendering them vulnerable to the damage posed by stormwater and attendant disruption of operations. Isiolo Municipality also serves as a gateway to northern counties such as Marsabit, Turkana and Wajir hence flooding often interrupt both road and air transport and logistics services, for example by rendering the A2 highway impassable. The implementation of SuDS will reduce the flow of stormwater over roads and into commercial spaces, strengthening the resilience of the business environment to flooding and potentially underpinning more sustainable growth. Furthermore, the civil works involved in the development of the SuDS project components create the opportunity to source local materials and labour where possible, which will boost the local economy and upskill the workforce.

Gender and Social Inclusion

Floods in Isiolo Municipality often results in the displacement of populations from their residential spaces and loss of lives. The municipality residents living close to and relying on the Marire River are most vulnerable to the detrimental social effects of flooding. Currently, there are 25 informal settlements along the river, with the most

populous being the Bulla Pesa slum with 3,842 households that are at risk of displacement and loss of lives to floods that occur when the Marire riverbanks burst due to high volumes of stormwater from catchment areas.[13] In 2006, 500 households were displaced, and 8 people lost their lives.[14] To mitigate the social effects of floods and allow the expansion of the Marire river, the municipality needs to develop a resettlement plan for these populations that includes issuing relocation notices, estimating the costs of compensation where necessary, and raising capital for resettlement and compensation.

Women and people with disabilities in Isiolo Municipality are most vulnerable to floods due to social structures and limited economic empowerment opportunities highlighting the importance of resettling them. Women are consistently the largest recipients of aid to mitigate the loss of homes and commercial enterprises to flooding. During the 2018 floods, out of 349 households that were displaced and relying on aid for sustenance, 219 (63%) were women-led households.[15] People with disability, who make up 1.7% of the municipality population, are often rendered immobile as stormwater covers and damages roads and invades residential premises. They depend on their non-disabled family members for mobility and livelihood support during the floods.[16] Other vulnerable groups include children and the elderly who depend on women and youth for food and mobility during flooding. The proposed resettlement of these marginalised groups that have settled on riparian land and road reserves will play a critical role in addressing the gender and social inclusion challenges in Isiolo Municipality by reducing the risk of damage to their residential and commercial spaces empowering them to sustain their livelihoods and households. The drainage systems will also reduce the level of damage to the roads and pathways allowing people with disability, the elderly, and children to commute safely to and from their homes. Lastly, the implementation of the drainage systems provides an opportunity for vulnerable groups, particularly women and youth, to engage in construction and maintenance.

As noted in 1.2.1 above, any resettlement must be done with care, hence a clear framework and approach must be adopted for the long-term benefit of the community.

Project Budget and Financing

The SuDS project is estimated to cost KES 574 million, which includes a 25% contingency provision for any variation in costs due to unforeseen events. The project will be implemented in the four phases outlined above to accommodate the longer timelines attributable to the necessity of resettling residents from riparian land. The resettlement may further be delayed by lack of buy-in from political leaders in the lead-up to the upcoming general elections and the need to engage Meru County in the establishment of upstream catchment dams. The municipality will need to establish the number of residents to be resettled in order to inform the RAP budget. As no provision has been made for the resettlement exercise in the forthcoming budget cycle, financing may have to be sought from development partners such as the World Bank which could potentially delay the commencement of this exercise until after the General Election. The municipality will oversee the implementation of this project through engaging different actors such as KENHA, WRA and the county government to get approvals and coordinate outreach for project funding for both the resettlement costs and project phases. The municipality will also depend on the county government to set-up a procurement process with the pre-tendering phase and tendering phase estimated to take 20 weeks (5 months) and project management in the post-award phase for ~ 32 weeks (8months).[17] For the budget:

- Phase I, the construction of 25km drainage channels around the airport and on feeder roads within the municipality, rehabilitation of drainage channels for KES 117 million, and retrofit the main culvert on the A2 road, and construction of two 3m by 2m culverts on the A2 road at KES 2 million will have a total phase cost of KES 119 million.
- Phase II, expansion of the Marire river, will cost KES 98 million which includes KES 20 million for riparian land improvement and excludes resettlement costs to be determined as next steps.
- Phase III, construction of the bio-park, will cost KES 122 million with KES 6 million set for the acquisition of land and KES 116 million for the land upgrades such as land grading, decking, landscaping, and construction of pavements.
- Phase IV, the construction of four check dams in upstream catchment areas, will cost KES 95 million.

Other costs will include consultation fees for implementation and maintenance costs. Independent engineers and surveyors would be needed to provide technical advice during the project implementation, and this is estimated to cost KES 30 million. Annual maintenance costs to ensure proper environmental management are estimated at KES 2 million and are projected to cover culvert de-clogging, debris collection from drainage channels and bio-park maintenance.

Only the bio-park has income generating potential through tourism activities. The municipality can generate revenues by charging park entry fees. With peak domestic tourism and park entry fees as low as KES 50, the park can realise

revenues of KES 3 million per year with park maintenance fees estimated at KES 1.2 million hence generating net revenues of KES 702,800 from domestic tourism only.[iii]

To enable implementation, access to the right type of financing is key. Grant financing is needed for all phases of the projects, but the municipality can leverage the grants to crowd in private sector investment into the bio-park construction and operations. Therefore, the municipality could leverage the pre-feasibility study and investment attraction support to conduct funder outreach to seek financing from the various stakeholders. In partnership with the World Bank, the municipality has developed a stormwater management plan for Isiolo Municipality. The county funds the municipality through annual budgetary allocations with the current fiscal year (2020/2021) the county government allocated KES 22 million for urban development with to the additional grant from the World Bank of KES 93 million. In the financial year 2021/2022, the county has only allocated KES 24 million for urban development recurrent expenditures.[18,19] The provided funds are insufficient hence they are occasionally directed to routine maintenance of the existing drainage systems. With the SUED technical team's help, the municipality will engage other potential funders such as AfDB, World Bank, the county government, and private sector financiers to contribute to the project's cost. Given the significant positive impact of this project, and the success of similar projects being funded in Kenya, this study expects interest from potential funders, though government contribution may be expected.

1.2. Conclusion and Next Steps

1.2.1. Conclusion

Based on the analysis summarised above and shown in the body of this document, this project appears operationally feasible, with a significant positive impact, assuming the key risks around resident resettlement technical capacity, and environmental disruption are managed appropriately, and financing can be secured
The project will require a coordinated approach between the municipality and key stakeholders such as KeNHA, NEMA and WRA to fast-track implementation development of the necessary SuDS infrastructure. The successful implementation will also be contingent on the development and execution of a resettlement plan for people living on riparian land, acquisition land from private landowners for the bio-park, establishment of a stakeholder engagement framework for project financing and implementation, and procurement of contractors to implement the project.

1.2.1. Next Steps for Implementation

For the successful implementation of the SuDS project components, the municipality will need to:

1. **Coordinate with key stakeholders to develop a resettlement plan, starting March 2021**: The Marire river is the main outlet conveying stormwater from the municipality and will need to be expanded to accommodate the increased volume of water from the aligned and constructed drainage channels and culverts. This will require resettling populations that have settled on riparian land and road reserves, a process that appears manageable given resettlement exercises conducted elsewhere and approved by organisations such as the World Bank. The municipality will need to contract a consultant to formulate a Resettlement Action Plan (RAP) detailing the institutional arrangements and resources needed to facilitate this resettlement process. Based on consultations, it seems prepared to do so but timelines may be affected by limited political goodwill in the lead-up to the approaching General Election. This exercise will therefore likely be undertaken after the General Election slated for August 2022. The municipality can in the meantime formally engage WRA and NEMA to map the riparian land and KeNHA to demarcate the A2 road reserves, estimating the number of people and households within riparian land and road reserves and the final cost of compensation during resettlement. The county Land and Physical Planning Department would then be engaged to identify land for their resettlement, of which there appear to be many options. SUED will support the Municipality in developing an implementation plan detailing the steps required, stakeholders responsible for each step and the timelines for each activity.
2. **Hold public engagement and consultation forums starting July 2021**: After aligning with the county government on the project tendering process, the municipality administrator should ensure the appointed project implementation team and contractor engage the public in highlighting the importance of the SuDS project to garner community buy-in for the respective project components and develop a gender and social inclusion framework and strategy. They have already conducted two stakeholder engagement forums on stormwater management. SUED will support the Municipality prepare for the public participation sessions by developing presentation materials that will cover the social and economic challenges caused by flooding, and benefits that could arise from implementing the SuDS project.

[iii]The assumed domestic tourism rate is 2% of the municipality population, visiting the park up to 2 times a month, with a KES 50 entry fee each time they visit. The international tourist visitation rate is assumed as 0.5% of the 2 million international tourists that visit Kenya annually, visiting the park once a year with a KES 100 entry fee per visit.

3. **Engage key stakeholders to acquire approval of the SuDS components and to initiate procurement processes, starting October 2021:** The municipality administrator should engage the county infrastructure engineers to integrate a plan for construction of the drainage channels on feeder roads to enable the approvals from the national and county governments. Additionally, the municipality relies on the county for public procurement and tendering processes, and hence the Municipality Manager should appoint the project implementation team and work with the County Accounting Officer to publish an expression of interest notice for the project.
4. **Engage private landowners to acquire or lease land for the bio-park, starting March 2022:** The bio-park is to be located north of Isiolo CBD due to existing large tracts of undeveloped land. The land is, however, privately owned. In collaboration with the county Land and Physical Planning Department, the municipality can engage private landowners to acquire land to set up the bio-park. Alongside the acquisition process, SUED has proposed an operating model with accompanying financial projections and risk analyses to inform the municipality's evaluation of the bio-park decision.
5. **Conduct detailed climate change and GESI assessments:** This project provides a great opportunity to build the necessary resilient urban infrastructure to adapt to climate change as well as ensure the desired gender and social inclusion. Additional assessments will be conducted in these two areas during the due diligence stage to project outcomes across incomes, access, control, leadership, and other recommended empowerment indicators This will also increase funding opportunities for the project with possibilities to tap into climate funds and other impact investment funds.
6. **Funder outreach:** Determine potential government funding contribution to this effort and engage key potential funders such as the World Bank, AfDB, and JICA, among others, to understand fit within similar programs in Kenya, also to determine potential structure and timing for funding. SUED will also support the Municipality in identifying potential funders, preparing capital raise documentation, initiating the investment outreach process, and backstopping due diligence processes.

1.2.2. Key Risks and Mitigation Strategies

The table below outlines the key risks of the project and mitigation strategies that the municipality should undertake to successfully implement the SuDS project.

Risk description	Risk level	Mitigation strategies	Residual risk
Inability to obtain timely stakeholder buy-in due to the lack of an existing common framework on the construction of drainage systems	Severe	• The municipality will need to accelerate engagement with key stakeholder organisations and define the collaboration framework between the parties to fast track development of the SuDS	**Major**
Resettlement of affected residents may delay project implementation given that the municipality is yet to develop a Resettlement Action Plan (RAP) and lack of political will	Severe	• The municipality will need to collaborate with WRA and NEMA to map the riparian and then with the Lands and Physical Planning Department to resettle the affected residents. The municipality should further seek buy-in from the affected population, community elders, and the county government members. This will take place while other SuDS components such as retrofitting culvert on the A2 road are being implemented.	**Major**
Insufficient project financing may stall the phased implementation given that the municipal receives limited funds from the county	Severe	• The municipality will need to reach out to potential local funders such as the county government and KeNHA, and external funders to ensure the project components are adequately funded. Similar projects such as the rehabilitation of the Nairobi River and resettlement of riparian residents were financed by the African Development Bank.	**Major**

Dependence on the county government for procurement may be time-consuming and lead to mismanagement of project funds	**Major**	• The municipality will need to form a project implementation committee to partner with the County Procurement Unit in contracting and giving oversight to the project funds management.	**Minor**
Lack of technical capacity to oversee the design and construction of the drainage systems	**Major**	• The municipality will need to engage KeNHA and KeRRA to support in the identification of best-in-class contractors in addition to providing quality assurance through the implementation phase. • The municipality will need to liaise with KUSP to ensure the contracting of experts with the capacity to execute the project to best-practice standards and incorporate robust monitoring and evaluation elements to satisfy prior concerns about the quality of work undertaken.	**Minor**

2. Pre-feasibility Study Approach

2.1. Methodology

This study evaluates the feasibility of developing sustainable drainage systems (SuDS) in Isiolo Municipality against a set of technical, financial, socio-economic, and environmental assessment criteria.

The SUED investment attraction team conducted secondary research, consultations, site visits, and analysis to gather information needed to assess the project feasibility and recommend the steps necessary for project implementation. Publications by stakeholders such as the World Bank, ENNDA, and WRA provided context on the state of drainage systems in Isiolo Municipality and interventions done to-date. Consultations and site visits validated the information gathered through secondary research while providing a more nuanced context. Lastly, a thorough analysis of secondary and primary data informed the technical and financial requirements to execute the project, the potential socio-economic benefits of having the SuDS in place, and the steps required for project execution.

Open Capital, the lead SUED Investment Attraction Firm, and its consortium partners, ESF Consultants, and BE Associates, leveraged their technical expertise in investment, engineering, environmental, social and health advisory to conduct this pre-feasibility study.

Figure 1: Organisations involved in conducting the pre-feasibility study.

2.2. Structure

Following this section, this report is structured as follows:

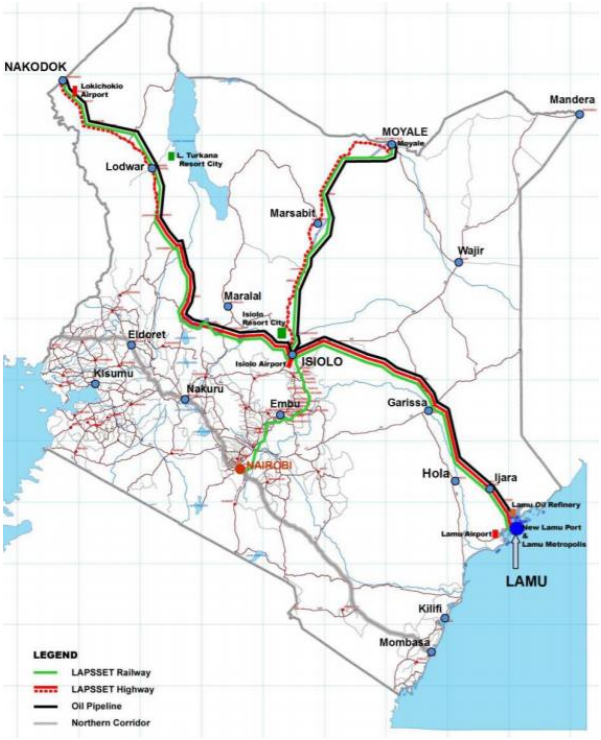
- **Section 3: Drainage Systems Context in Isiolo:** describes the existing drainage infrastructure in Isiolo.
- **Section 4: Proposed SuDS Project:** describes the proposed operations of the new drainage systems.
- **Section 5: Enabling Environment:** describes the stakeholder factors surrounding the project.
- **Section 6: Socio-economic Impact Assessment:** describes the socio-economic implications of the project.
- **Section 7: Gender and Social Inclusion Assessment**: described the implication of the project to women and other vulnerable groups.
- **Section 8: Environmental Impact Assessment:** describes the environmental implications of the project.
- **Section 9: Project budget and financing:** provides an analysis of the financial results of the project, highlighting the investment required, key cost drivers.
- **Appendices:** include the list of consultations and the financial model.
- **References:** includes the citations of the sources of information used throughout the study.

3. Drainage Systems in Isiolo

Isiolo Municipality within which the CBD lies is of strategic economic importance to Kenya's tourism, transport and logistics sectors given its significant role in the LAPSSET Corridor Project development, but flooding threatens its social, economic, and environmental structures. This section will provide context on Isiolo Municipality, causes of flooding, existing drainage systems, and flood mitigation strategies undertaken to date.

3.1. Overview of Isiolo Municipality

Figure 2: Isiolo's location within LAPSSET corridor



Isiolo Municipality is strategically positioned at the centre of Kenya, serving as a gateway to northern counties and Ethiopia. It lies on a low lying plain 1,067m above sea level, 285km north of Kenya's capital Nairobi.[20]

The municipality is integral to Kenya's growth plans and has developed rapidly in recent years because of the newly constructed transport and logistics infrastructure. For example, Isiolo International Airport was commissioned in 2013, and the Kenya Airports Authority (KAA) completed renovations in 2017 to provide more access to regional markets. The Kenya Rural Roads Authority (KeRRA) upgraded the Muriri Miciimikuru road for ease of access to and from the airport from Meru County.[21] Illustrating Isiolo County's integral role in connecting Kenya to neighbouring countries, President Uhuru Kenyatta commissioned the Lamu Port–South Sudan–Ethiopia-Transport (LAPSSET) corridor in 2017, which resulted in the Kenya National Highway Authority (KeNHA) constructing the A2 highway that passes through the municipality. As part of Vision 2030, the national government through the LAPSSET Corridor Development Authority is looking to construct a resort city near the municipality to enhance its tourism potential.[22] The municipality will, however, benefit from the construction of drainage systems alongside the developments to manage surface run-off water.

3.2. Causes of Floods in Isiolo Municipality

Isiolo Municipality faces a significant flooding challenge that affects current and planned developments. The municipality experiences flooding during the rainy seasons in March-May and October-December.[23] The floods disrupt economic activities especially in the open-air market, interrupt the movement of people and cargo across the A2 road, destroy property, and lead to the loss of at least one life each year.[24] Isiolo County has experienced adverse climate change with the major floods recorded in 1982 that destroyed the Food and Agriculture Organisation (FAO) Irrigation Schemes in Garfasa and Merti bordering Isiolo town.[25] In recent decades, floods caused 18 deaths in 2005 and 2006 and displaced over 500 people. Between 2009 and 2019, floods further led to the displacement of ~ 1,320 households.[26] The worst floods in history occurred in 2015, destroying property worthy KES 800 million belonging to the Isiolo Water and Sewerage Company (IWASCO).[27,28] Isiolo Municipality is prone to flooding due to the following factors:

- **Topographical factors** such as the gradient from the upstream catchment areas, the soil type, and the vegetative cover,
- **Urban planning and maintenance factors** such as structures that divert stormwater from the natural water paths, missing or small capacity culverts, and ill-maintained drainage channels and culverts,
- **Population factors** such as encroachment of Marire River and road reserves, and improper waste disposal clogging drainage channels.

Topographical Factors

Isiolo Municipality has a steep gradient that increases the velocity of surface run-off water, thereby intensifying flooding. Stormwater flows from high altitude areas in Meru County and the slopes of Mt. Kenya into the

low-lying Isiolo Municipality during rainy seasons. The differential between the geographical gradient (1:50) and the riverbed gradient (1:100) is a contributor to the increased velocity of stormwater resulting in rapid flooding.[iv,29]

The clay soil and limited vegetative cover hamper effective absorption of stormwater maintaining water at the ground surface and further increasing the flow of run-off water. Isiolo Municipality is located on arid and semiarid land (ASAL) in the Ewaso Ng'iro River basin, with the soil composition dominated by a high clay content along the river. Clay soil makes the region susceptible to floods due to its low water absorption rate, and renders roads impassable during rainy seasons, especially because 75% of roads in Isiolo CBD are earth roads with inadequate drainage systems.[30] The municipality's vegetative cover mostly comprising of shrubs, is also inadequate in reducing the speed of surface run-off water.[31]

Urban Planning and Maintenance Factors

Figure 3: Small diameter culverts on A2 road

Poor urban planning and maintenance of drainage systems have increased the risk of flooding. The A2 highway has one main culvert that directs stormwater to the Marire River, but it is not large enough to convey the volumes of water flowing during floods. The culvert can only convey 3m^3/s of water compared to the 25m^3/s of water flowing into it during floods. As a result, the water runs off on the surface of the road into the CBD's open-air market and residential spaces causing damage to property and loss of lives. The highway's design comprises drainage channels only on the eastern side with these channels also being too shallow to cope with the stormwater volumes. Irregular maintenance of culverts necessitates the need for cleaning to remove eroded sediments and debris. The shallow drains and clogged culverts further allow run-off water to flow on the road surface which often spills to the low-lying west side of the CBD.

The KAA has built gabions and embankment walls on the upper side of the Isiolo airport perimeter to prevent stormwater from its catchment basin from flowing into the airport grounds. The gabions divert water from the airport and their natural path into access roads and residential spaces with inadequate drainage systems and ultimately into the CBD. The paved airport surface, which is on a higher altitude than most of the municipality, further exacerbates the situation by reducing water infiltration and increasing surface run-off water that is released through flood gates to the earth roads near Isiolo Girls secondary school and Little Angels primary school.

Population Factors

Population growth has contributed to the encroachment of road reserves and riparian land, diminishing the capacity of roadside drainage systems and the Marire River to convey stormwater adequately. Isiolo Municipality has 80,000 residents that represent 50% of the Isiolo sub-county population. Consequently, the municipality has a relatively dense population of 45 persons per km^2 compared to the county's rural areas that have a density of 4 persons per km.[2,32] Additionally, population growth has resulted in encroachment onto the Marire River's riparian land as well as road reserves as residents seek space for economic activities and residential properties. For example, the Isiolo open-air market is on the edge of the A2 highway, and some sections are on the shallow drainage channels along the road. It is positioned on the path of stormwater flowing to the Marire River, causing economic losses and safety concerns when flooding occurs.

Figure 4: Waste disposal into Marire River

Encroachment of the riparian land has reduced the Marire River's capacity to convey water and increased the likelihood of flooding. Currently, 50% of the municipality's households are settled on the river basin, and they use the river for small scale farming and as a dumping site thereby reducing its flow capacity. Additionally, residents have blocked sections of the river using soil and rocks to create informal paths such as the one to and from the abattoir. The Isiolo prison irrigation activities along the Marire River have also blocked water flow, thereby increasing the river's chances of flooding.[33] As a result, the Marire River is currently approximately 5 meters wide and 0.5 – 1 meter deep, channelling only 4m^3/s of water compared to the five-year average flood discharge of 68m^3/s within the county.[34]

3.3. Flood Management Measures to date

[iv] Gradient estimates are read as 1m rise for every 100m covered horizontally for Marire River and 1m rise for every 50m covered horizontally for the airport, meaning that the slope from the airport is steeper.

Isiolo Municipality is responsible for overseeing the Isiolo town's drainage system implementation and maintenance. The municipality has worked with several other stakeholders including, the World Bank, Ewaso Ng'iro North Development Authority (ENNDA), the National Construction Agency (NCA), the Isiolo County government and the Meru County government, to design drainage systems that would mitigate flooding in the municipality. Currently, the drainage system plan is part of the Isiolo County Public Works Stormwater Management System Plan that the municipality is working on with the NCA to ensure alignment on approvals for structures.[35] The municipal council has, however, not been able to implement any of the drainage plans discussed with the different stakeholders for several reasons including:

- **Limited access to financing:** The county government and donors are the main financiers of the Isiolo Municipality. Isiolo County allocated KES 22 million in the 2020/2021 annual budget for urban development that includes the development of 1.5km of stormwater management systems, erecting 4 floodlights, and paving urban roads.[36] The World Bank allocation of KES 93 million, through the Kenya Urban Support Program (KUSP), was allocated to the urban development works, though the implementation is yet to commence because the financing was insufficient to cover the critical SuDS needs, but the municipality willing to channel the funds to support SuDS. The Isiolo County Integrated Development Plan (CIDP 2018-2022) has budgeted a total of KES 160 million to develop 10km of drainage systems and KES 300 million to upgrade 8km of municipal feeder roads.[37,38] However, the municipality reports delays and limited access to the financing attributable to bureaucracies faced by the county in securing its funding allocation from the national government. The municipality estimated the total costs of constructing SuDS at KES 376 million in the Isiolo Municipality Stormwater Drainage Works plan.[39] They are therefore seeking additional financing to meet the outstanding cost when the 93 million KUSP allocation is channelled to commence the construction of the SuDS. SUED will support the Municipality in raising the additional financing by identifying potential funders, preparing capital raise documentation, initiating the investment outreach process, and backstopping due diligence processes.
- **Limited stakeholder coordination:** Isiolo Municipality is integral to Kenya's Vision 2030. Consequently, the municipality benefits from the active, albeit disjointed, interventions of various national, regional, and local civic developmental organisations. For example, the municipal council is responsible for constructing drainage systems on the feeder roads, while KeNHA is responsible for building the drainage systems on the A2 road, and KeRRA on class C roads while the county government oversees earth feeder roads. This has resulted in partially built drainage systems that are inadequate to convey the volumes of stormwater flowing into the CBD. Additionally, due to the different jurisdictions, the drainage systems in Isiolo Municipality, such as drainage channels, culverts, and side ditches, do not work as a network, limiting their collective potential to manage the flow of stormwater. The municipal council has attempted to engage both KeNHA and KeRRA, to upgrade drainage systems, but due to lack of financing, and a common operational framework, both entities have not addressed the requests. SUED will support the municipality in preparing implementation plans for the SuDS project, detailing the required steps and highlighting the stakeholders responsible. The Municipality will leverage the implementation plans as a framework to engage different stakeholders.
- **Lack of consensus with Meru County:** The municipality engaged the Meru County government to develop four porous dams in Meru, where most floodwaters originate. The porous dams would collect surface run-off water before they flow into Isiolo Municipality and cause flooding. However, the Municipality and Meru County government could not agree on the source of financing and the use of the contained water to benefit the people in Isiolo Municipality. As a result, this initiative has seen limited progress. Given its potential to reduce the intensity of flooding in Isiolo Municipality, the SuDS component is prioritised for the medium to long-term to accommodate coordination between the Municipality and Meru County. SUED will support the Municipality in preparing a detailed implementation plan and help the municipality convene and advance conversations with the Meru County government.

The limited funding and stakeholder coordination result in the municipality only performing routine maintenances on the existing drainage systems. The drainage systems are, however, inadequate because they do not have the capacity to convey the volume of stormwater flowing in the municipality, and do not function as a network. Consequently, sustainable drainage systems in Isiolo Municipality remain a critical need that smart planning, access to financing, and stakeholder coordination will address.

4. Proposed Drainage System in Isiolo

The SuDS project outlined in this section was developed based on consultations, including those of potential implementers, as well as reviews of similar projects. They represent the author's best understanding of how this project may be developed but are a function of many assumptions which may shift and involve many stakeholders whose interests must be aligned during implementation. Sustainable Drainage Systems (SuDS) will play a critical role in mitigating the socio-economic and environmental effects of flooding in Isiolo Municipality. The current drainage systems are insufficient to redirect stormwater to catchment areas, outfalls, or the Marire River. The Isiolo Urban Economic Plan (UEP) provides an overview of potential climate-resilient infrastructure building on existing work and the Isiolo County Integrated Plans that further informs the approach undertaken for this project.

4.1. Overview of Proposed SuDS

Integrated drainage systems are necessary to address flooding in Isiolo Municipality. These systems will require stormwater management on three fronts including, managing flows along roads and the Marire River within Isiolo Municipality, redirecting the water to outfalls such as a bio-park or storage locations for productive use, and intercepting flows from the hinterland. This project proposes the implementation of the SuDS in the following order based on impact potential:

- **Phase I:** Construction and rehabilitation of drainage systems that include retrofitting the culverts on the A2 road and constructing drainage channels on feeder roads within the CBD and around the airport.
- **Phase II:** Expansion of the Marire River and resettlement of populations residing on riparian land.
- **Phase III:** Construction of the bio-park.
- **Phase IV:** Construction of check dams in catchment areas within Meru County.

Nonetheless, contingent on proper planning, adequate stakeholder coordination, and available financing, the phases can also be implemented concurrently.

4.1.1. Construction and Rehabilitation of Drainage Systems

Figure 5: Gabion along the airport fence

A 13km trapezoidal open drainage channel is needed around the airport perimeter to convey the water safely through the residential areas, across the A2 road and into Marire River. A trapezoidal channel offers significant cost savings – estimated at up to 11% - compared to a rectangular channel with the same capacity. The channels will convey water diverted from their natural path by the gabions along the airport perimeter wall into residential spaces. They will also address flooding caused by stormwater released at the airport floodgates into earth roads near Little Angels primary and Isiolo Girls secondary schools. The municipality will oversee the construction of these drainage channels and engage KAA to construct underground water storage facilities in the airport to capture some of the run-off water for recycling activities such as cleaning within the airport.

Three culverts are needed on the A2 road to enable stormwater flowing from Meru County to flow into the Marire River. While the current culvert is strategically positioned to convey water flowing from catchment areas and drainage channels into the Marire River, it has a small conveyance capacity. The culvert's cross-section area of 0.6m^2 allows it to convey only 3m^3 /s of water compared to 25m^3/s stormwater flow. As a result, the excess stormwater flows along the road surface into the low-lying areas such as the open-air market to the west of the A2 road. Changes will require replacing the existing circular culvert with two square culverts that are 5 meters wide by 2 meters long to accommodate the water flows. The A2 road further needs two more culverts that are 3 meters wide by 2 meters long (at location 0°21'0.70 "N 37°34'50.36 "E, and 0°21'56.66"N 37°34'59.24"E) to enable the flow of water from natural streams across the road to Marire River.

It will be necessary for the municipality to deepen the drainage channels and unclog culverts filled with debris and eroded topsoil to prevent run-off water from flowing on the road's surface. An additional challenge is posed by the ill-maintained and shallow drainage channels fitted on only one side of the A2 highway, therefore keeping flowing water at surface level. Boulevards and swales along the road would enhance the environmental impact and aesthetics of the municipality, but the municipality will need to resettle the populations encroaching the read reserve and to secure Way Leave approvals from KeNHA before engaging a contractor to construct the features.

4.1.2. Expansion of Marire River

Figure 6: Encroachment on Marire River

Marire River is 5 meters wide and approximately 0.5-1-meter deep channelling only 4m^3/s compared to the peak stormwater flow volume of 68m^3/s. Coupled with a steep topographical gradient, floodwaters arrive within a short timeframe hampering effective warnings and preparedness in the CBD. [40] The construction, retrofitting, and alignment of drainage channels and culverts along A2 will increase the volume of water channelled to the river to 54-68m^3/s during peak discharge. This will necessitate expansion of the Marire River in two sections: 2.5km upstream to accommodate the peak discharge of 54m^3/s and 3.5km downstream to accommodate the peak discharge of 68m^3/s. To protect the riverbanks from erosion and bursting, revegetation with shrubs and trees is also needed. Due to the encroachment of the riparian land, resettling people would require further intervention by the municipality and the Water Resources Management Authority (WARMA).

4.1.3. Construction of Isiolo Bio-park

Sustainable outfalls to collect floodwater for productive use would supplement the Marire River capacity to convey stormwater away from Isiolo Municipality. The Isiolo UEP proposes a bio-park north of the CBD to collect and attenuate the stormwater for productive use while enhancing the municipality's tourism potential. The bio-park will involve establishing a semi-natural park on the northern, open, and undeveloped land to provide green open spaces for both the locals and visitors to interact. Agricultural plots can also be established within the park's proximity to facilitate irrigation and livestock water source using the water collected. To create the park, the municipality will need to acquire land from the private owners by engaging with the Land and Physical Planning Department in mapping and transferring land ownership. The Municipality Manager indicates that the cost of the land in the target area is around KES 700,000 per acre and 46.7 acres as per the Isiolo UEP are needed to accommodate the floodwater volume flowing through the municipality. However, if only 25% of the floodwater is directed to the bio-park, and 75% to the Marire River, only 9 acres of land would be required for the park. The estimated cost of upgrading the land for the bio-park is KES 116 million with KES 6 million needed for land acquisition.[41] The municipality will also need to identify contractors that will grade the land, plant drought-resistant vegetation, create stormwater outfall dams/swamps with reedbeds, and construct footpaths within the bio-park.

4.1.4. Construction of Check Dams in Meru County

The hinterland approach focuses on intercepting floodwater from its source in Meru County and the Mt. Kenya slopes before it flows down into the municipality. The approach will involve building four check dams[v] along the Isiolo River tributaries such as Eastern and Western Marania to reduce the volume of water flowing into Isiolo Municipality and planting trees on hillsides to slow down the flow of water. Isiolo Municipality will need to partner with the Meru County government to identify appropriate locations, finance the check dams' cost, and compensate any individuals affected along the way. Isiolo Municipality had initiated conversations with the Meru County government but could not execute the project due to differing interests on how the water would benefit communities from each county. This component requires the municipality to align with the Meru County government on the design and location of the check dams, resettlement and compensation plan to landowners affected, the financing plan to build the dams, and how to use the dams to benefit residents from both Isiolo and Meru Counties. Recognising the time, it would take to align on each of these facets, the hinterland approach can be prioritised as a medium to long-term intervention.

4.2. Stakeholder Engagement

The construction of drainage systems in Kenya is decentralised to represent the various stakeholders' different roles. The key stakeholders carry out road construction, water resources management, environmental conservation, disaster management, and public works administration. The successful management of floods in Isiolo Municipality requires the various stakeholders' engagement in implementing the SuDS. The Isiolo County Water Bill 2019 outlines that the municipality administrator shall ensure that the stormwater management plan is developed and implemented through a consultative process.[42]

[v] Check dam is a wall built across a waterway to reduce the velocity of run-off water.

4.2.1. Road Construction Authorities

The Kenya Roads Act 2007 requires road authorities to construct any drainage structure or drain deemed necessary. Isiolo Municipality is served by four major highways and various feeder roads. The majority of murram roads in Isiolo are under the jurisdiction of the County Government of Isiolo.

The A2 highway is under the mandate of the KeNHA. Therefore, retrofitting drainage systems on the A2 will require Isiolo Municipality to engage KeNHA for approval and supervision. The municipality shared the master plan on upgrading the A2 road with KeNHA in 2019 to seek approval and financial support through the authority's corporate social responsibility kit but is yet to receive feedback. When approved, KeNHA can serve as a technical advisor and a quality assurance entity during the installation of drainage structures along the highway.

4.2.2. Environment and Water Management Authorities

The Water Resources Authority (WRA), previously WARMA, was founded under the Water Act (2016) to enforce water management and flood mitigation standards and regulations. To expand the Marire River width and banks, the municipality will work with the WRA and NEMA Isiolo office to map the encroached riparian land. The Water Act and the Environment Management and Coordination Act designates riparian land as the area lying 6 to 30 metres from the highest watermark. The municipality will need to seek early approval from the National Construction Authority for the proposed expansion of the Marire River. This will enable the municipality to engage the Land and Physical Planning Department to issue a relocation notice to the residents living and working on riparian land. The municipality is looking to undertake voluntary relocation given that occupation of riparian land is not legal and they, therefore, would not be obligated to compensate residents for the structures erected on riparian land. The resettlement plan will require the county government's involvement in holding public participation forums, issuing relocation notices, implementing compensation plans, where necessary, and enforce the removal of illegal structures along the riparian land.

4.2.3. Public Works and Other Administration Agencies

Isiolo Municipality is established under the County Government of Isiolo to enhance service delivery within Isiolo town. The municipality involves the county government in procurement processes for the identified projects. It will require support from the county government to secure encroached areas to implement the drainage systems. Other external stakeholders such as the World Bank through the Kenya Urban Support Programme, support the municipality in funding and implementing critical infrastructural projects in Isiolo Municipality. In the financial year 2019/2020, the World Bank provided KES 93 million to kick-start the implementation of drainage systems in Isiolo Municipality with KES 67 million funding expected for the 2020/2021 financial year.

4.3. Overview of the Public Procurement Processes

Once the Isiolo Municipality has secured the necessary approvals and support from the key stakeholders, they will need to engage contractors to execute the project. In 2013, the Public Procurement Regulatory Authority (PPRA) enacted the County Government Procurement Regulations (CGPP) to guide the county governments and their departments such as city and municipal councils on the procurement process concerning socio-economic developments. The regulations permit the county government to establish the tender and asset disposal committees. The tender committee awards, approves, and validates contracts, ensure availability of funds, and determines the procurement method. To openly procure services for the SuDS project, Isiolo Municipality will work closely with the county government as the governing body.

The Isiolo County government has established tender opening, evaluation, negotiation, acceptance, and inspection committees for greater certainty in the procurement process with the pre-tendering phase and tendering phase estimated to take 20 weeks (5 months) and post-award phase to be carried out for ~ 32 weeks (8months). The committees comprise of personnel with the relevant procurement expertise. However, the technologies in use are outdated and they often experience connectivity challenges to run the financial integrated management systems that captures procurement information, as a result, procurement processes are often delayed by 2-4 weeks. The table below outlines the phases, steps, timelines, and key stakeholders from the pre-tendering, tendering, and post-tender award phase.

Table 1: Municipality procurement process[43,44]

Step	Description	Time-taken (Weeks)[45]	Key stakeholders
Pre-Tendering Phase			
Planning and Budgeting	With the pre-feasibility study and EIA, the municipality will develop a procurement plan, strategy, and	6 – 8	Municipal Council

	budget to decide whether to engage one or multiple contractors		
Development of Contract Specifications	Development of the procurement plan enables the county tender committee to set an evaluation criterion	2 – 4	Municipality Council, Tender Committee, County Procurement Unit
Selection of Procurement Procedure	Tender committee to decide whether to offer an open tender or request for proposals/quotations	2 – 4	Tender Committee
Tendering Phase			
Advert/Tender Invitation	The county procurement unit will offer sufficient time for bidders to prepare and present proposals	6 – 8	County Procurement Unit
Bid Opening/Closing	Tender commit to open and sort all bids received within the set timelines	Same date	Tender Committee
Tender Evaluation and Report Submission	With the short-listed bids, the tender committee will evaluate the submission of the required documents, financial and technical capacity of the bidders to develop a report on the tenders received	2 – 4	Tender Committee
Contract Award	In partnership with the municipal council, the tendering committee will notify and issue the SuDS construction contract	1 – 2	Tender Committee, County Procurement Unit
Post-Award Phase			
Contract Management	The project implementation team and municipal council will oversee the cost time, quality, and resource control to ensure adherence to the project terms and conditions	12 – 32	Project Implementation Team, Municipal Council
Order and Payment	The municipal council and county accounting officer to streamline payments to the contractor according to the agreed terms	2 – 4	Municipal Council, County Accounting Officer

4.4. Operational Risks

The practical implementation of the SuDS in Isiolo Municipality depends on timely access to enough funds, upgrading and consolidating the urban drainage masterplans, and streamlining the procurement process. It will be essential to structure the funds to meet the immediate drainage systems gaps and encourage the Municipality to increase public finance management systems.

The municipality can manage the additional project operational risks by proactively following the steps identified below.

Table 2: Proposed SuDS operational risks

Risk description	Risk level	Mitigation strategies	Residual risk
Inability to obtain timely stakeholder buy-in due to the lack of an existing common framework on the construction of drainage systems	**Severe**	• The municipality will need to accelerate engagement with key stakeholder organisations and define the collaboration framework between the parties to fast track development of the SuDS	**Major**
Resettlement of affected residents may delay project implementation given that the municipality is yet to	**Severe**	• The municipality will need to collaborate with WRA and NEMA to map the riparian and then with the Lands and Physical Planning Department to resettle the affected	**Major**

develop a Resettlement Action Plan (RAP) and lack of political will		residents. The municipality should further seek buy-in from the affected population, community elders, and the county government members. This will take place while other SuDS components such as retrofitting culvert on the A2 road are being implemented.	
Insufficient project financing may stall the phased implementation given that the municipal receives limited funds from the county	**Severe**	• The municipality will need to reach out to potential local funders such as the county government and KeNHA, and external funders to ensure the project components are adequately funded. Similar projects such as the rehabilitation of the Nairobi River and resettlement of riparian residents were financed by the African Development Bank.	**Major**
Dependence on the county government for procurement may be time-consuming and lead to mismanagement of project funds	**Major**	• The municipality will need to form a project implementation committee to partner with the County Procurement Unit in contracting and giving oversight to the project funds management.	**Minor**
Lack of technical capacity to oversee the design and construction of the drainage systems	**Major**	• The municipality will need to engage KeNHA and KeRRA to support in the identification of best-in-class contractors in addition to providing quality assurance through the implementation phase • The municipality will need to liaise with KUSP to ensure the contracting of experts with the capacity to execute the project to best-practice standards and incorporate robust monitoring and evaluation elements to satisfy prior concerns about the quality of work undertaken	**Minor**

5. Enabling Environment Assessment

Stakeholder coordination and a conducive legal, regulatory, and policy environment are critical to implementing SuDS. The promulgation of the Kenya Constitution in 2010 established a devolved system of governance, with the national and county governments being distinct and interdependent. Isiolo Municipality was legally constituted in 2018 by the Isiolo County Assembly under the revised Urban Areas and Cities Act. In consultation with the county government, the municipality can enter partnerships with national or international stakeholders to provide social infrastructural services as a critical mandate. This section outlines the municipality's alignment to the legal and regulatory framework and coordination with the county government and other stakeholders to effectively implement the drainage systems.

5.1. Municipality Infrastructure Environment

Kenya's Vision 2030 economic blueprint emphasises the finalisation of the national urban development policy to strengthen urban planning and delivery of urban infrastructure investments such as drainage systems. This emphasis led to the development of the National Water Master Plan 2030 that prioritises floodwater management in the Ewaso Ng'iro North basin catchment area. The plan's approach is to mitigate property damage and loss of lives by implementing structural river features, such as increasing discharge flow and upgrading drainage systems in Isiolo Municipality. The master plan states that the implementation of drainage systems would be Isiolo County's and relevant local authority's responsibility.[46]

Furthermore, Isiolo County together with the other pilot counties of Garissa, Kitui, Makueni and Wajir has established a County Climate Change Fund (CCCF) that prioritises financing of climate resilience projects. The counties have committed 1-2% of their development budgets to fund climate infrastructure with Isiolo County spending KES 145 million between 2013-2016 financial years. The climate change skills and performance of Isiolo County staff and community members both individually and collectively need to be enhanced to ensure the delivery of the CCCF and that climate change is effectively embedded into County development processes and plans.

Additionally, the LAPSSET project, a key Vision 2030 infrastructural plan, recognises Isiolo town's strategic location and importance to the transport and logistics sectors. The LAPSSET Corridor Development Authority, through KeNHA and KAA, has completed the construction of the Isiolo-Moyale highway and the expansion of the Isiolo Airport, respectively, with plans underway to extend the oil pipeline from Lamu to Addis Ababa through Isiolo town.[47] The development of the A2 highway and the airport has led to an influx of people settling in Isiolo Municipality, overstretching the existing urban infrastructure. In partnership with the World Bank, Japan International Corporation Authority (JICA), and the Water Resources Authority, the municipality has developed its stormwater management framework detailing critical infrastructural gaps of drainage systems.

5.2. Laws, Policies, and Approvals

The national and county level legislations currently guide the implementation of the municipality's drainage systems. At the national level, the Kenya Constitution and Urban Areas and Cities Acts set out the municipality's functions in service delivery. Other Acts that influence the municipality's operations are the Roads, Water, Environment Management, and Land Acts. The Acts broadly outline the responsibility of the established authorities in implementing the drainage systems infrastructure. The table below summarises the requirements of the different legislations.

Table 3: Proposed SuDS legislation requirements

Legislation	Requirement
Urban Areas and Cities Act 2011	Enacts new legislation that promotes the establishment of the municipalities under the county governments. Further, it elaborates on the municipality's power and responsibilities in long-term urban planning for sustainable service delivery
Roads Act 2007	Provides a framework in which collective decisions about how construction, maintenance, and management of roads is undertaken by KeNHA. Includes the statutory authorities' engagement process with other stakeholders in altering existing road facilities (e.g., drainage systems)
Water Act 2016	Establishes the regulation, management, and development context for water resources and services. It creates a framework in the abstraction, obstruction, diversion, and development of rivers in partnership with the other state authorities

Environment Management and Coordination Act 2012 and amendment of 2015	Sets the standards and practices in delegating environmental protection and conservation through the provision of the Environmental Impact Assessment (EIA) licence
Resettlement Policy Framework 2011	Stipulates the resettlement and compensation principles for both physical and economic displacement to the affected residents due to project implementation

To reinforce the national acts, Isiolo County Assembly has developed legislation on finance, water, and climate change to govern the municipality's implementation of social infrastructure projects. The Isiolo County Finance Bill outlines the best practices to uphold and charge for various approvals and licences required for any construction. The Water Bill and Climate Change Fund Bill explains the systems and processes in stormwater management within Isiolo County. The Bills have been integrated into the County Development Plan 2018 – 2022 to enhance funds allocation for the county's stormwater management goals. To seamlessly construct and align drainage channels and culverts along the A2 highway, and expand the Marire River, the following licences/approvals will be required:

Table 4: List of licences and approvals

Licence/ Approval	Issuing Authority	Description	Cost (KES)
Building of culverts on A2 Road			
Way Leave Approval	KeNHA	Certifies the retrofitting of the drainage systems	Waived
Expansion of Marire River			
Construction and Acquisition of Riparian Land Permit	NEMA	Permit to map the riparian land and widening of the water resources	Waived
Construction of Isiolo Bio-Park			
Private Land Acquisition Approval	NLC	Framework to map and transfer private land for public use with resettlement action plans stated	Waived
All SuDS Components			
Environmental Impact Assessment (EIA)	NEMA	Assessment of the impact and suitability of the project on the environment and human settlements by outlining the compliance and mitigation mechanisms of any adverse effects	Waived
Construction Permit	NCA	Registration of the construction project and inspection of the upgrade site	Waived
Engineering Reports	Isiolo County	Assessment of construction designs and plans	7,500
Site Inspection	Isiolo County	Assessment report on of damages on existing buildings	7,500 per visit
Green Card	Isiolo County	Card required each time a county official visits the construction site	1,000 per visit
Supervision Fees	Isiolo County	Card required each time a county official visits the construction site	1,500 per visit
Construction Site Advert	Isiolo County	Permit to display a construction notice during drainage systems construction	10,000
Completion Certificate	Isiolo County	Compliance certificate that constructed drainage systems maintained all plans, designs, and mandatory standards	7,500

Historical examples of resettlement and rehabilitation of riparian land have been lengthy and costly due to inadequate planning and stakeholder buy-in and coordination. The Nairobi river rehabilitation and resettlement of riparian residents took over a decade despite support from organisations such as the United Nations Environmental Program (UNEP) and the African Development Bank (AfDB). Some of the key challenges included the length of the river covered, lack of adequate involvement of the riparian residents in the rehabilitation plan, extensive and costly research processes, and insufficient political will to resettle the population and rehabilitate the riparian land. Nonetheless, in 2020, the national government through the Athi Water Service Board and the Nairobi City Water and Sewerage Company partnered with the AfDB to commission phase II of the Nairobi river rehabilitation in the Eastland neighbourhoods of Nairobi that will result in the resettlement of 834 households at an estimated cost of KES 538 million.[48] The budget was based on the value of assets owned by the riparian residents including land, houses, business structures, and crops. Given that land costs in Isiolo Municipality are lower than in Nairobi, and most of the Marire river riparian residents fall in the low-income categories, the cost of resettlement in this project will be lower, but valuations are required to estimate the cost of assets affected. However, the municipality must secure political and public buy-in for the resettlement process. Based on consultations, the Municipality seems willing to initiate the resettlement process, but timelines may be prolonged due to limited political goodwill from the county government in the lead-up to the approaching General Election.

The Resettlement Policy Framework (RPF) outlines "all displaced persons regardless of the total number affected, the severity of the impact and whether or not they have legal title to the land when an involuntary land acquisition occurs must be resettled/compensated or both."[49] The expansion of the Marire River will require the municipality to inform the affected residents about their rights and consult on resettlement and compensation options. The municipality will then carry out socio-economic surveys on the affected families and develop a SuDS Resettlement Action Plan (RAP). In partnership with the affected residents, the municipality will oversee RAP implementation and evaluation. The eligible residents will be provided with adequate compensation at total replacement cost for any losses on assets. The resettlement includes the value of the land, private buildings/structures, trees/crops, public structures, provision for disturbance of the population and cost for monitoring and evaluation of the implementation of the RAP.[50,51] The municipality manager has initiated this process by setting up a technical resettlement committee that comprises the municipality, the county executive committee, the assistant county commissioner, the land and physical planning department, WRA, and community elders. Other SuDS project components such as retrofitting culverts on the A2 road, constructing drainage channels around and from the airport and on access roads, and rehabilitating drainage channels along the A2 road can be implemented without resettlement.

6. Socio-economic Impact Assessment

This section covers the socio-economic impact of flooding in Isiolo Municipality and the potential mitigation from the SuDS project.

6.1. Overview of the Economic Impact of Floods in Isiolo Municipality

The Isiolo County gross county product was KES 15.9 billion in 2019 with an estimated annual economic loss of one billion due to floods. The gross county product grew at 4.9% between 2013 and 2017 which was lower than the national average of 5.6%. This highlights the importance of infrastructural interventions such as SuDS to strengthen the resilience of the business environment.[52] In 2015 alone, the municipality incurred infrastructure losses of up to KES 800 million due to flooding.

Figure 7: Open-air market along A2 road

Regular commercial activities by the municipality residents are most vulnerable to losses due to flooding. The main economic activities in the municipality include transportation and logistics, tourism, trade, and agriculture. Overall, approximately 38% of the residents are employed while roughly 62% of the population relies on family businesses, farming, or other family members for their livelihood.[53] The latter 62% of the population is the most vulnerable to the adverse effects of floods. For example, the central business district is characterised by individual or family-owned small retail shops and open-air markets that sell household, food, and clothing items along the A2 road. Surface run-off water that flows on the road due to inadequate drainage systems often flows into the market and retail shops, damaging the structures and property stored within them, causing economic losses.[vi] Furthermore, the surface run-off water on the roads and flooding on the Marire River limit livestock farmers from accessing the meat processing plant and market in the CBD whereas the sale of livestock at the open-air market contributes KES 6 million in sales tax annually.[54] Lastly, transport and logistics activities along the A2 road come to a halt restricting movement to and from the northern counties.

The SuDS project will enhance the economic resilience of Isiolo Municipality by reducing the economic losses due to flooding. Retrofitting the main culvert on the A2 road, building additional culverts, and rehabilitating the drainage channels on the road will reduce the volume of water flowing over the road and into commercial spaces and therefore reduce damage to commercial property. Additionally, expansion of the Marire River will obligate livestock farmers to use designated roads to the meat processing plant. Lastly, the Isiolo bio-park construction will enable the collection and attenuation of stormwater for productive use such as irrigation or car wash while enhancing the municipality's aesthetic appeal.

6.2. Overview of the Social Impact of Floods

Isiolo Municipality initially grew due to an abundance of water resources that met pastoral communities' needs within the area. The municipality is located near the confluence of streams that flow into the Isiolo river, including the Marire River, the East Marania river, and the West Marania river. Over the years, the municipality has experienced population growth due to the development of key public infrastructure investments such as schools, markets, hospitals, and transport and logistics systems. The estimated population in the municipality is 80,000 people with a high density of 45 people/ km^2 compared to 4 people/ km^2 in rural areas. [55] Annual flooding in Isiolo Municipality poses a significant threat to the social environment of the residents, hence creates the need to implement the SuDS components.

A substantial proportion of the municipality population lives close to and relies on the Marire River increasing risks of damage to residential property and loss of lives. There are 25 informal settlements along the river, with the most populous being the Bulla Pesa slum with 3,842 households.[56] The residents rely on the river for water supply and small-scale irrigation and use it as a dumping site. Encroachment of the river's riparian land has reduced the river's capacity to convey stormwater and puts the residents' lives at risk as seen in 2006 when 500 households were displaced, and 8 people lost their lives. While the number of displaced households decreased in 2018 to 349, risks of displacement and loss of life are still prevalent. Displaced families within the municipality and neighbouring regions often seek shelter in mosques and schools in the municipality, resulting in overcrowding and exposure to hunger, air-borne diseases, waterborne diseases, and contaminated water. Some potential refuge centres such as Isiolo Girls

[vi] The economic losses to Isiolo County are estimated as the number of households affected by flooding in Isiolo County divided by the number of households affected by flooding nationally and multiplied by the national economic losses due to flooding.

secondary school are often rendered inaccessible due to flooding at the access roads, thereby putting children and staff lives at risk, interrupting learning and contributing to a worsening in educational outcomes.[57]

The SuDS project will increase the social resilience of Isiolo Municipality by reducing the chances of displacement and loss of lives due to flooding. Widening the Marire River will increase the river's capacity to convey stormwater without flooding and destroying residential homes and commercial spaces within the river's vicinity. Constructing drainage channels around the airport parameters will direct stormwater away from residential spaces outside the airport. Constructing drainage channels from the airport flood gates to Marire River will reduce flooding at Little Angels primary school and Isiolo Girls secondary school to allow academic activities and enhance student and staff members' safety. Safely channelled stormwater will lower waterborne diseases among the municipality residents caused by groundwater contamination.

6.3. Assessment of Social Acceptability of the Project

The increased risk of floods in Isiolo Municipality due to the poor state of existing drainage systems makes the SuDS project socially appealing to the residents. The SuDS project will reduce risks relating to damaged residential and commercial property, displacement, and loss of lives. They will also contribute to consistent income generation for the municipality residents because flooding would not interrupt their economic activities.

However, the rapid development of settlements along the Marire River and encroachment of the A2 road reserve by open-air market traders creates a risk of resistance to the implementation of SuDS due to displacement and potential economic loss for those affected. Currently, half of the households in Isiolo Municipality live along the Marire River basin albeit not all on the riparian zone. To mitigate this risk, the municipality will need to streamline stakeholder engagement by:

- Collaborating with NEMA, WRA, KeNHA and the Lands and Physical Planning Department in mapping the encroached areas, notifying the affected residents, and resettling any legitimate landowners.
- Engaging the existing community administration, such as village elders and religious leaders, to carry out public participation forums to sensitise the affected residents about the SuDS project.
- Partnering with the county government to develop the Resettlement Action Plan of the Project Affected and Interested Parties (PAIPs) such as traders in the open-air market and residents along the Marire River.

7. Gender and Social Inclusion Assessment

This section will highlight the impact of floods on women, people with disabilities, and other vulnerable groups in Isiolo town and opportunities to include them in the SuDS implementation process.

7.1. Overview of gender and social inclusion

Though flooding is a societal problem, it affects both individuals and groups differently because of their inherent vulnerability as expressed by women and youth in Isiolo town. The majority of Isiolo town's population are either from the Borana, Somali, or Turkana ethnic communities that are predominantly patriarchal societies. As such, men are primarily involved in paid employment or livestock rearing while women partake in domestic duties such as looking after the homestead, small scale farming, and trade. Women make up to 50% of the town's population and are disproportionately vulnerable to the impact of flooding. For instance, out of the 349 households displaced and depending on social assistance in the Isiolo sub-county due to the 2018 floods, 219 (63%) were women-led households.[58]

As per the human development index, Isiolo ranks amongst the lowest counties with a score of 0.4 compared to the national average of 0.6. In Isiolo County, the female population has a higher life expectancy of 61 years compared to the 54 years for the male population, but lag in the literacy and school enrolment levels by 5%. All the three key human development indicators are below the national average implying that the county's income levels are generally low exacerbated by high youth unemployment rates of 53%. The youth aged below 35 years make up to 70% of the population with the female population accounting for 49% of the youth population.[59,60] Despite the rapid urbanisation in Isiolo town, the unemployed youth are especially vulnerable to floods as it disrupts casual jobs. The male population are mainly involved in livestock activities and women carry out small scale farming and trading activities, hence floods worsen women's economic position.

Other vulnerable populations include children, people with physical disabilities, and the elderly, who cannot retreat to safety fast enough during flash floods. Children (6 -13 years), who account for 25% of Isiolo town's population, are most susceptible when accessing schools without the supervision of their parents or teachers. People with disabilities account for 1.7% of the population in Isiolo County, of which 0.5% have visual impairments, 0.4% have mobility difficulties, and the rest either have a hearing, cognition, communication, or self-care difficulties.[61] People with disabilities often rely on their family members for movement and financial support. As such, flooding heightens the risks of their immobility because the stormwater renders roads impassable.

The SuDS project will enhance the economic and social resilience of vulnerable groups to flooding. They will reduce the risk of damage to women and youth's residential and commercial spaces, especially those near road reserves and water paths, minimising interruption to their productive activities and allowing them to sustain their livelihoods and households. They will also reduce the level of damage to the roads allowing people with disability, the elderly, and children to commute safely to and from their homes.

7.2. Assessment of inclusivity of the project

The expansion of the Marire River will lead to the displacement of people, potentially leading to resettlement conflicts and negatively impacting the vulnerable groups. The municipality will ensure participation of the special interest groups in the construction process through capacity-building workshops and assigning specific project implementation tasks to be carried out by vulnerable groups. The monitoring and evaluation committee should address any potential conflicts arising from allocating resources and access to the constructed infrastructure, such as the community's bio-park.

Implementation of the SuDS project will provide opportunities for vulnerable groups to participate in construction and maintenance. For example, the municipality can employ women and youth to rehabilitate the existing drainage networks by deepening shallow drainage channels and unclogging sealed culverts. Contractors involved in the implementation of the SuDS could also leverage the local youth labour in the projects. Women could play a vital role in convincing and mobilising household members to relocate from high-flood risk areas such as riparian land, and the open-air market, in collaboration with the municipality. To ensure adequate coordination of efforts, social and political buy-in, the municipality should initiate the activities outlined in **Error! Reference source not found.**.

Table 5: Proposed SuDS GESI interventions

Stakeholder	Activity
Municipality, Contractor	Encourage the participation of women and youth in the SuDS construction and maintenance activities

Municipality, Local Administration Units	Ensure the participation of women and youth in the public meetings on the implementation of SuDS
Municipality, County Procurement Unit, Contractor	Facilitate the development of gender, age, and disabled persons' inclusive labour recruitment plan
Municipality, County Government	Mobilise able and disabled women and youth, vulnerable to floods, to identify low flood risk locations to set up residential and commercial areas

The construction of SuDS is physically demanding hence creates an occupational safety and health risk for the workers. The use of heavy machinery or equipment to reconstruct the tarmacked road sections and site clearing of the feeder roads presents safety hazards. The transportation of materials to the site and removing the waste materials by trucks can cause accidents. To ascertain the workers' safety, the contractor will provide protective equipment and ensure regular training before starting any workstream.

8. Environmental Impact Assessment

The SuDS project encompasses retrofitting of existing drainage systems such as culverts, expansion of the Marire River, construction of the Isiolo Bio-Park, and hinterland check dams. The project components seek to improve the town's environment by attenuating and treating stormwater and increasing the town's biodiversity by creating green spaces.

This section outlines the climate change and weather risks, highlights the resilience benefits on an ecosystem-based approach, livelihood, infrastructure, and health identifies the potential environmental risks and gives a summary of the subsections.

8.1. Climate Change and Weather Risks in Isiolo Municipality

Kenya is susceptible to climate-related hazards, with arid and semi-arid regions such as Isiolo County being significantly affected. Isiolo County receives rainfall in March-May and October-December, but the rains have increasingly become irregular and unpredictable, exposing the county to prolonged droughts. Furthermore, some areas of the county, such as Isiolo Municipality, are also susceptible to floods originating from high altitude areas in the neighbouring Meru county. 80% of the county population rely on agriculture for their livelihoods out of which 54% are livestock farmers with agricultural products including camel meat and milk, goat meat, poultry, and green grams. Prolonged droughts have increased the risks in realising low yields to the agricultural activities and therefore increasing poverty rates to 72.6% causing 80,000 to rely on food aid.[62] Floods disrupt economic activities and destroy infrastructure further straining the livelihoods of the county residents as outlined in section 6.

Clean and reliable water supply is scarce in the county and within Isiolo Municipality because of prolonged droughts and recurrent floods. Only 6% of the county population has access to piped water and 35% to portable water. The rest of the population relies on water pans and boreholes for domestic and livestock water supply. Frequent droughts exacerbate Isiolo County's water-stressed environment leaving the most vulnerable households with as little as eight litres of water per person per day. [63] Floods increase the risk of water contamination due to immediate inundation of the town whereby residents mainly use open latrines. The presence of open sewage treatment ponds at Isiolo Water and Sewerage Company (IWASCO) increases the risk of the floodwater mixing with contaminants, therefore increasing the risk of waterborne diseases in the residential areas.

The steep topography with minimal vegetation and high stormwater and wind velocity erodes the topsoil of pasturelands and farmlands in the municipality plains. Both stormwater and strong winds carry away the topsoil on the plains resulting in erosion and rendering the landless conducive for agriculture. Large volumes of stormwater flowing into the Marire river during peak discharge further erodes the river's banks and damages property on riparian land. The debris carried along the wind and water paths further pollute the municipality either by contaminating water sources or spreading litter.

The floods that occur in Isiolo town typically damage critical infrastructure, mainly roads and drainage channels. Floods create water paths on the feeder roads and corrode the existing culverts with a small cross-sectional area. For instance, stormwater from the airport floodgates near Little Angels primary school flows on the earth road towards the A2 section in Isiolo town due to the lack of adequate drainage channels and culverts to direct the floodwater flow. The stormwater has created temporary water paths and dips along the road, hence disrupting the road's use by students and residents. Furthermore, the eroded debris from the upstream catchment areas clogs and corrodes culverts on major roads redirecting the water along the raised road bunds into Isiolo town.

8.2. Resilience Benefits

The national government recognised climate change as a key risk and developed the National Climate Change Response Strategy (NCCRS) in 2010 that highlighted several adaptation strategies primarily relating to agricultural activities. The focus of the initiatives has been on a national level and is yet to trickle down to county-level policies. To position Isiolo town ahead of the curve, constructing the bio-park and revegetating Marire Riverbanks and planting trees has the potential to enhance the town's resilience and adaptation to climate change.[64]

The SuDS components such as the construction of the Isiolo Bio-Park, revegetating the Marire River, planting trees in the upstream catchment areas provide nature-based solutions to climate change for the Isiolo Municipality's residents and the urban environment aesthetics. The features conserve and restore the ecosystems increasing human resilience and enhance climate adaptation through reduced exposure to adverse climate conditions.

8.2.1. Ecosystem-Based Adaptation Approach for Isiolo Municipality SuDS

The SuDS project incorporates Ecosystem Based Adaptation (EBA) approach towards responding to the impacts of flooding due to the changing climate in Isiolo Municipality. The EBA is a nature-based solution that harnesses biodiversity and ecosystem services to reduce vulnerability and build resilience to climate change. Some of the components included in the SuDS project include revegetating the Marire riverbank and constructing a semi-natural bio-park.

Revegetating the Marire River and construction of the bio-park will increase the chances of rainfall in the town and its environs through evapotranspiration. Trees and bushes planted along the river and within the park will slow down the erosive force of the flowing stormwater, while releasing moisture into the atmosphere through natural transpiration processes. Scientifically, it is noted that approximately 40% of the precipitation in the atmosphere originates from evaporation and transpiration by plants. The precipitates would condense to form clouds and fall back on the ground in the form of rainfall. The Isiolo bio-park features such as swamps with reedbeds vegetation, drought-resistant crops, and agricultural plots will also increase rainfall absorption, reducing the flooding and recharging water supplies in Isiolo town.

Additionally, the vegetative cover along the river and in the park will also reduce extreme weather conditions such as intense heat and strong winds. Isiolo town is vulnerable to increasing temperatures because of its location. Shade from the vegetation would lower heat stress on the town's residents allowing them to continue in their commercial and residential activities in conducive environments. The branches and leaves would also serve as interceptors, slowing down strong winds and reducing their potential for soil erosion and property damage.

The ecosystem-based features will further enhance adaptation and resilience to mitigate climate change and encourage adaptation by populations in Isiolo Municipality. In addition to attracting rainfall, the bio-park will supply water resources needed for irrigation of farmlands and livestock watering points. These features will directly counter the effects of droughts on agricultural produce. However, the municipality could also encourage residents to pursue adaptation measures such as using the bio-park water supply to grow commercial drought-resistant crops such as green grams and cowpeas and to grow fodder instead of relying on pasture for livestock.

8.2.2. Resilience Benefits on Water, Health, Livelihoods, and Infrastructure

The SuDS project will also improve the Isiolo town's water quality by ensuring the stormwater's safe conveyance through the township area. The floods experienced in Isiolo town affect houses, infrastructure, businesses, and farmland. In the Isiolo sub-county, 45% (9,400) of households use shallow and uncovered pit latrines, while the surrounding villages have high open defection rates of up to 47%.[65] Farmers in catchment areas (Meru County) from where floodwaters in Isiolo town originate frequently use pesticides and fertilisers. During heavy rainfall, the high velocity of the stormwater flows over surfaces where chemicals, fuel, bacteria, and solid waste pollutants harmful to human health and the environment are found.

Additionally, the Isiolo Water and Sewerage Company (IWASCO) provides the town residents with water from 17 boreholes frequently affected by floods. [66] Therefore, implementing the SuDS components such as drainage channels helps redirect the stormwater from the residential places and other key development structures such as boreholes to ensure water safety, reducing the risk of frequent waterborne diseases. The inclusion of the vegetative cover enhances the absorption of the stormwater and filtration of pollutants carried by water.

The SUDS project integrates aspects of effective flood control that reduce the stormwater's risk of destruction of the urban structures. The retrofitting of culverts and construction of the drainage channels on A2 road enhance the stormwater's natural flow, reducing any eroded sediments' destruction of urban structures such as water pipes and sewage lines. The development of the Isiolo bio-park, a semi-natural park, improves urban design by creating green spaces and managing environmental risks by attenuating the stormwater and enhances the built environment by maximising biodiversity opportunities.

Isiolo County's fast urbanisation will contribute to the town's population of 80,000 to almost double (159,770) by 2030.[67] The implementation of SuDS ecosystem-based features improves the quality of surface runoff water, enhances recreational value, and protects the ecosystems for the town residents. Through regular upgrades and maintenance, the features will reduce the county's recurrent losses caused by floods on the residents especially in the CBD hence improving the trading environment and internal revenues. The features will further reduce the impact of adverse climate conditions on 80% of the population that enhancing their agricultural yields on livestock products and crops. Additionally, in the presence of the other structural drainage systems, the features will reduce the infections caused by contaminated groundwater, hence improving the residents.

8.3. Potential Environmental Effects and their Mitigants

During the construction of the SuDS, there will be environmental inconveniences such as exposed excavation trenches, increased solid waste generation, congestion, dust, noise, vibrations, and fumes. Isiolo town is densely populated with commercial, residential, and social premises. The intensity and extent of vibrations from compaction may cause agitation for both locals and livestock and pose a danger to the buildings along the road. Furthermore, the construction of drainage channels along the earth and gravel feeder roads could cause dust clouds disturbing the population and the environment. The construction activities could increase waste from packaging materials, residual road structure material, and dangerous oil spills from machines. Lastly, the construction activities will result in the disruption of traffic along the affected roads. To mitigate the above risks, the municipality will need to:

- Engage KeNHA, KeRRA and the contractor to issue a prior notice to the residents and itinerary on traffic diversion and provide alternative transport routes while fast-tracking the project implementation.
- Ensure that the contractor put up adequate signs and reflectors to demarcate the no-go-zone areas and the diversions.
- Leverage traffic police to direct traffic on a day-to-day basis to avoid congestion and road accidents in diversions.
- Ensure the project implementation team assesses the technical capacity of the contractor's equipment to ascertain they produce reduced noise, vibrations, and emissions.
- Provide measures for watering potential roads with dust incidences and use of dust binders near houses.
- Incorporate soil conservation measures and drainage systems for any effluent discharge during construction.

The phased approach in the construction of the SuDS may result in varied exposure of the residents to the damaging effects of floods. While prioritising construction of drainage channels and culverts on the A2 road, around the airport, and on feeder roads will mitigate the effects of flooding within CBD, populations on the Marire river riparian land will remain vulnerable because the river is the main discharge point of the stormwater. Cognisant of this challenge, the municipality has already convened a resettlement technical committee that comprises of community elders, WRA, the County Executive Committee, the assistant county commissioner, and a county representative from the Lands and Physical Planning Department to discuss and develop the resettlement plan.

Upon completion of the projects, it is key that the residents utilise and adequately maintain the SuDS. Part of the challenge with existing drainage systems is the disposal of waste materials and improper diversion of the Marire river water for irrigation, which increases the damaging effects of floods. The municipality should ensure continued stakeholder consultation with all Project Affected and Interested Parties (PAIP's). The stakeholder exercise will serve the purpose of enabling stakeholders to influence project design based on their indigenous knowledge thus creating a sense of project ownership, promote the dissemination of project information to allow stakeholders to comprehend the potential benefits and potential use of the proposed project as well as provide a platform for the timely identification of stakeholder grievances and concerns regarding the proposed SuDS project design and features.

8.4. Summary of Environment Impact

The successful implementation of the ecosystem-based SuDS contributes to the municipality's effective town planning and robust stormwater infrastructure. The features enhance the residents' adaptability to climate change through sustainable crop farming, livestock rearing and trading activities. Additionally, mitigating floods contribute to societal well-being through reduced health hazards and displacement effects.

Floods and droughts have heightened the risk of food shortage and variability of returns from the livestock activities that are the main source of income for 80% of the Isiolo County population. Unpredictable rainfall and prolonged dry spells have resulted in difficulties in livestock farmers reporting lower yield on meat and milk products due to insufficient pasture during droughts and low water supply. As a result, the food supply and household incomes for households in Isiolo County and Municipality are becoming unsustainable. The mitigation of the identified climate change and weather risks increases the internal revenues for both individuals and the county government through taxes collected.

The project resilience benefits outweigh the identified risks as the features will mitigate climate change and encourage adaptation by populations in Isiolo Municipality. In addition to attracting rainfall, the bio-park will supply water resources needed for irrigation of farmlands and livestock watering points. The project features will directly counter the effects of droughts on agricultural and livestock production. Furthermore, the municipality could also encourage residents to pursue adaptation measures such as using the bio-park water supply to grow commercial drought-resistant crops such as green grams and cowpeas and to grow fodder instead of relying on pasture for livestock.

The implementation of the project only poses temporary disruptions of the ecosystem during the construction phase with a high probability of risk mitigation. The municipality will proactively plan and engage the relevant stakeholders to enhance its technical capacity, funding, and multi-stakeholder buy-in.

9. Project Budget and Financing

The numbers and estimates outlined in this section are based on inputs from consultations and analysis and rely on numerous assumptions that may shift as project implementation occurs. This section intends to provide initial estimates to be further tested during the due diligence stage and highlights the potential funders for the project.

9.1. Overview of budget estimations

The implementation of all SuDS project components requires KES 574 million with a 109 million contingency provision. The project will be implemented in four phases as prioritised below (with potential timelines) based on the SuDS impact potential.

- **Phase I (Starting October 2021):** Retrofitting the culverts on the A2 road and constructing drainage channels on feeder roads within the CBD and around the airport at KES 119 million.
- **Phase II (Starting January 2022):** Expansion of the Marire River at KES 98 million and with resettlement cost of populations residing on riparian land to be determined.
- **Phase III (Starting July 2022):** Acquisition of land north of Isiolo town CBD and construction of the bio-park costing KES 122 million.
- **Phase IV (Starting October 2022):** Construction of check dams in catchment areas within Meru County for KES 95 million.

As noted earlier, the municipality faces limited budget allocations from the county government. The county government allocation of recurrent expenditures for the municipality to support urban development is averagely KES 23 million between 2018 - 2022. Most of the municipality funding totalling KES 135 million was by the World Bank through KUSP between 2017 - 2018.[68]

The construction of the check dams will be pursued in the long-term given that a portion of the proposed project site is in Meru County, and will need collaboration between the two counties. Therefore, the municipality will focus on implementing phase I and II with an estimated budget of KES 248 million. The two phases budget includes 119 million (50%) for the construction and alignment of drainage channels and culverts, and 98 million (41%) for the expansion of Marire River with KES 30 million provisions for consultancy and technical services. The table below shows the itemised costs of the SuDS components based on measurements done during site visits, geospatial analysis and unit costs obtained from the Institute of Quantity Surveyors of Kenya and the Kenya Builders and Concrete Company price list.

Table 6: Project budget (Details in Appendix)

SuDS Project Budget		
SuDS Component	**Item**	**Amount (KES)**
Phase I:		
A2 Road Culverts Retrofitting	Main culvert (Muimui)	901,600
	Culvert 1 (A2 road – Ruiri road junction)	596,600
	Culvert 2 (A2 road –Airport feeder road)	473,000
		1,971,200
Drainage Channels Excavation	Channel 1 (CBD Feeder roads 12Km)	12,980,100
	Channel 2 (Airport – A2 road 13Km)	21,840,000
	Channel lining (Concrete slabs)	82,500,000
		117,320,100
Phase II:		
Marire River Expansion	Section 1 (CBD Upstream 2.5Km)	12,096,250
	Section 2 (CBD Downstream 3.5Km)	21,273,000
	Riverbank gabion mattress lining	45,000,000
	Provision for riparian land improvement	20,000,000
		98,369,250
Phase III		

Bio-park construction	Land preparation including grading and decking, planting indigenous drought-resistant crops and construction of access roads, drop-off points, and parking	115,510,080
	Land acquisition (9 acres)	6,300,000
		121,810,080
Phase IV		
Check Dam Construction	Bulk excavation (4 Check dams)	90,000,000
	Community water point	120,000
	Cattle trough	769,920
	Spillway	3,247,000
	Silt trap	1,000,000
		95,136,920
Provisions		
Provision for contingency 25% of the overall cost		**108,651,887**
Provision for engineering consultancy services		**30,422,528**
Total project budget exclusive of resettlement costs		**573,681,966**

Of the SuDS, only the bio-park has revenue-generating potential from tourism and productive use activities. Parks in Kenya charge standard entry fees determined by the Ministry of Tourism. These charges are disaggregated based on the origin of the tourists with domestic tourists paying as low as KES 50 and international tourists paying from KES 100 to access public parks. With these charges, the municipality could generate revenues of up to KES 3 million per year where there are high visitation rates to the park from both international and domestic tourists as shown in Table 12.[vii] The projected impact of the COVID-19 pandemic is likely to result in subdued international arrivals in the medium term highlighting the importance of domestic tourists. Furthermore, the drawback of levying entry fees is the park is no longer an open, public good for all residents, and may be inaccessible to some due to price. However, assuming peak visitation rates, domestic tourism from municipality residents could be sufficient to generate revenues of up to KES 2 million per year. The park will also incur KES 1.2 million in maintenance costs generating approximately KES 700 thousand net revenues from domestic tourism only. Early investment by the public sector would help attract private sector investment as has been seen in similar projects e.g., Machakos People's Park where the original infrastructure was done by the public sector which in turn has attracted private sector investment in recreational facilities and other related businesses.

9.2. Bridging the Financing Gap

This project will require an investment of KES 573 million which the municipality will need to meet through several approaches to reduce the risk of a potential funding shortfall. First, the municipality aims to direct future grants from the World Bank funded Kenya Urban Support Programme (KUSP) to the project and are currently being assessed for KES 67M for the 2021/2022 financial year, but the financing is yet to be finalised. If the municipality can access this financing, the resultant financing gap will be KES 506 million, for which additional financing will be required. In addition, the municipality will use a phased implementation approach where Phase 1 can be funded from the municipality budget with the remaining project components being financed by development partners such as KUSP or the African Development Bank. The grant financing from these development partners will be critical to incentivising private sector investment into additional activities once the bio-park is completed like the Machakos People's Park.

9.3. Overview of potential investors

SuDS is a social infrastructure project with distinct interventions and will need a coordinated multi-stakeholder funding approach from local and international investors. The SuDS project will require an

[vii] The assumed domestic tourism rate is 2% of the municipality population, visiting the park up to 2 times a month, with a KES 50 entry fee each time they visit. The international tourist visitation rate is assumed as 0.5% of the 2 million international tourists that visit Kenya annually, visiting the park once a year with a KES 100 entry fee per visit.

investment of KES 574 million. In the financial year 2019/2020, the county government allocated KES 40 million to upgrade the drainage systems in Isiolo Municipality. For the 2020/2021 annual budget, the county has allocated KES 93 million from the World Bank for urban development including the construction of stormwater management systems. Consequently, the municipality needs an additional KES 155 million to implement the prioritised SuDS in phase I and II with a total budget of 248 million and KES 95 million to implement phase IV in the medium-long term. Public sector and international development grants are most suitable to fund these phases of the SuDS project. The table below outlines potential funders whose interests are aligned with the municipality's commitment to providing effective urban planning and development of climate-resilient infrastructure.

Table 7: List of potential funders

Investor	Avg. ticket size	Potential interest highlighted	Project suitability	Potential contribution
World Bank	N/A	Provides financing to urban institutions to strengthen the delivery of social infrastructure services through the Kenya Urban Support Program (KUSP)	High	KES 93 million based on historical grants
Africa Development Bank Group (AfDB)	N/A	Through the establishment of the Urban and Municipality Development Fund (UMDF), the Bank focuses on technical assistance financing of urban planning projects that impact the quality of life of urban dwellers	High	KES 300 - 400 million based on historical financing to large infrastructure projects such as the Nairobi river rehabilitation[69]
County Government of Isiolo	N/A	The county provides budgetary allocations for the upgrade of the feeder roads within the municipality	High	KES 22 -40 million based on historical budget allocations[70]
Kenya National Highway Authority	N/A	The maintenance of the A2 road is under the jurisdiction of KeNHA and annually allocates budgets from the Road Maintenance Levy Fund (RMLF) to upgrade major roads	High	KES 189 million based on 2021/2022 budget allocation for A2 road maintenance in from Lewa, to Isiolo town, to Marsabit[71]
DANIDA	N/A	Provides financing to water management projects aimed at increasing resilience of marginalised areas due to climate change hence supporting sustainable growth in the communities through the Danish Embassy	Med	KES 50- 200 million based on historical investments in water projects in Wajir, Garissa, Isiolo, Lamu, and Tana river[72]
African Water Facility	EUR 50,000 – 5 million	In partnership with AfDB, offers financing for flood management infrastructure in urban areas that affected by climate change	Med	KES 50 million within their ticket size range
Kenya Innovative Finance Facility for Water (KIFFWA)	€ 10 – 100 million	Provides early-stage financing to water initiatives to catalyse investments into the water sector. The Municipality could leverage this facility to finance the bio-park construction.	High	KES 50 million within their ticket size range
Adaptation Fund	Up to $10 million	Provides funding for climate change and adaptation projects with the focus of building resilience for the vulnerable communities	High	KES 100 million based on their 2018 – 2022 funding strategy[73]

10. Conclusion and Next Steps

10.1. Conclusion

Flooding in Isiolo Municipality is a critical challenge that causes adverse socio-economic losses to the residents. Movement and commercial activities come to a halt because stormwater renders roads impassable and causes the destruction of commercial and residential properties. The resultant frequent displacement of residents undermines sustainable economic recovery with the effects borne disproportionately by women, youth, people with disabilities, children, and the elderly.

To enhance the municipality's economic, social, and environmental resilience to flooding, it is necessary to implement integrated SuDS. The SuDS components are designed to direct stormwater away from commercial and residential spaces. This will reduce the risk of damage to commercial property and displacement due to flooding. Additionally, they will control the flow of surface run-off water, reducing erosion to existing infrastructure and contamination of water sources that the municipality residents rely on. Construction of the bio-park and revegetation of Marire River will not only improve the municipality's aesthetics but also attract rainfall and provide water supply for productive use such as irrigation. While the SuDS have several potential benefits, it was necessary to assess the feasibility of implementing them against several variables using information from consultations, site visits, secondary research, and project cost analysis.

The SuDS project is technically feasible in that the spaces for the SuDS are demarcated and there are clear next steps on how to acquire the spaces and construct the SuDS. However, its implementation will depend on acquiring technical expertise, obtaining support from the public and private sector actors as well as the successful resettling of residents who have encroached on riparian land.

10.2. Next Steps

For the successful implementation of the SuDS project components, the key next steps are:

Figure 8: Next steps for SuDS project

No.	Outstanding items	Status	Action needed and discussion areas	Responsible parties	Timeline
1	**Coordinate with key stakeholders to develop a resettlement plan**	• The municipality has engaged the Water Resources Authority on the need to expand the Marire River, but no formal action has been taken yet due to low political will.	• To develop the resettlement plan, the municipality should engage with WRA, NEMA, and KeNHA Isiolo office to conduct mapping of Marire River riparian land and A2 road reserves. • Based on the mapping, the municipality should conduct a survey to identify legitimate landowners and value their assets to estimate the cost of compensation. • The Municipality should also engage with the county Lands and Physical Planning Department to issue a relocation notice to residents living and working on riparian land illegally.	Municipal Administrator, WRA-Isiolo Basin office, KeNHA-Isiolo office, Isiolo County Lands and Physical Planning Department	**March 2021**
2	**Conduct coordinated public engagement and consultations**	• The municipality has conducted two stakeholder engagement forums on stormwater management. There is need for municipality to phase out the consultations for effective	• The municipality administrator to ensure the appointed project implementation team and contractor engage the public in developing a gender and social inclusion framework and strategy. This is after aligning with the county government on the project tendering process. • The municipality to develop a community participation forum to enhance communication and	Isiolo Municipality	**July 2021**

		implementation of feedback.	implementation of the project for the affected parties		
3	**Engage key stakeholders to acquire approval of the SuDS and to initiate procurement processes**	• The municipality depends on the county government for the issuance of tenders.	• The municipality should work with the county procurement unit under the county Finance CEC and work as part of the tender committee to issue a notice for interest on SuDS contractors. • They should also engage with the county infrastructure engineers to integrate a plan for the construction of the drainage channels on feeder roads under the county government to enable seeking approvals from the national and county governments. • Lastly, the municipality should also engage KeNHA to approve the proposed upgrades on the A2 road.	Municipal Administrator, Isiolo County Infrastructure Department, County Finance CEC, KeNHA	**October 2021**
4	**Engage private landowners to acquire or lease land for the bio-park:**	• The north of Isiolo town CBD is proposed as the location for the bio-park as it has vast undeveloped land, but it is not owned by the Municipality.	• In collaboration with the county Lands and Physical Planning Department, the municipality should engage private landowners to acquire the land to set up the bio-park.	Isiolo Municipality, Isiolo County Lands and Physical Planning Department	**March 2022**

To enable the implementation of the SuDS, access to the right type of financing is key. Grant financing is needed for phase I, II, and IV of the projects, while concessional debt is more fitting for phase III, which entails construction of a revenue generating bio-park. Therefore, the municipality could leverage the pre-feasibility study and investment attraction support to conduct funder outreach to seek financing from the various stakeholders. In partnership with the World Bank, the municipality has developed a stormwater management plan. With the SUED technical team's help, the municipality should engage other potential funders such as AfDB, World Bank, the county government, and private sector financiers to contribute to the project's cost.

11. Appendix

Figure 9: Interaction of proposed SuDS with discharge drainage areas

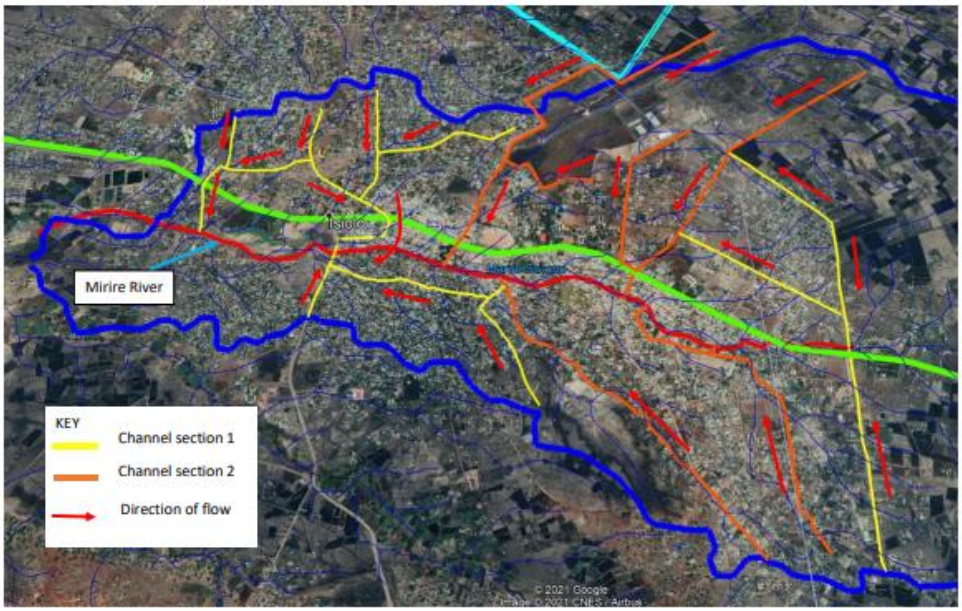


Table 8: Detailed costs of retrofitting culverts on A2 road

A2 road culverts

Main culvert

Proposed size	5m by 2m
Shape	Box
Number of culverts	2

Cost per culvert	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Steel reinforcement	Kg	970	140	135,800
Concrete	m	10	27,000	270,000
Formwork	m^2	100	450	45,000
Total cost				**450,800**
Cost of all culverts				**901,600**

Access culvert 1

Proposed size	3m by 2m
Shape	Box
Number of culverts	2

Cost per culvert	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Steel reinforcement	Kg	620	140	86,800
Concrete	m	10	18,000	180,000
Formwork	m^2	70	450	31,500
Total cost				**298,300**
Cost of all culverts				**596,600**

Access culvert 2

Proposed size	3m by 2m

Shape	Box
Number of culverts	2

Cost per culvert	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Steel reinforcement	Kg	500	140	70,000
Concrete	m	10	14,400	144,000
Formwork	m^2	50	450	22,500
Total cost				**236,500**
Cost of all culverts				**473,000**

Table 9: Detailed costs of constructing drainage channels within CBD and around the airport.

Drainage channel extension

Channel 1 (CBD feeder roads)

Distance	12,000 meters
Shape	Trapezoidal channel

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Excavation for topsoil to depths not exceeding 0.25m	m^3	7,230	450	3,253,500
Excavation in soft material to depths not exceeding 2.5m	m^3	14,964	650	9,726,600
Total				**12,980,100**

Channel 2 (Airport to A2 road)

Distance	13,000 meters
Shape	Trapezoidal channel

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Excavation for topsoil to depths not exceeding 0.25m	m^3	9,945	450	4,475,250
Excavation in soft material to depths not exceeding 2.5m	m^3	26,715	650	17,364,750
Total				**21,840,000**

Channel lining

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Concrete lining	m	25,000	3,300	82,500,000
Total				**82,500,000**

Table 10: Detail cost of Marire River expansion

Marire River expansion

CBD upstream

Distance	2,500 meters
Shape	Trapezoidal channel

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Excavation for topsoil to depths not exceeding 0.25m	m^3	2,975	450	1,338,750
Excavation in soft material to depths not exceeding 2.5m	m^3	16,550	650	10,757,500
Total				**12,096,250**

CBD downstream	
Distance	3,500 meters
Shape	Trapezoidal channel

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Excavation for topsoil to depths not exceeding 0.25m	m^3	4,655	450	2,094,750
Excavation in soft material to depths not exceeding 2.5m	m^3	29,505	650	19,178,250
Total				**21,273,000**

Gabion lining

Cost of lining	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Gabion lining	m	6,000	7,500	45,000,000
Total				**45,000,000**

Table 11: Detailed costs of the check dam construction

Check dam construction

Reservoir excavation

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Bulk excavation	m^3	50,000	450	22,500,000
Total				**22,500,000**

Cattle trough construction

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Cattle Trough	m^3	5	500	2,400
Concrete class 20/20	m^3	11	12,000	132,480
Water regulation chamber with self-regulatory water valves	No.	2	25,000	50,000
Provide for rip rap protection to the water trough of 2m around the troughs	m2	10	800	7,600
Total				**192,480**

Community watering point

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)

Provide all materials and construct a complete masonry community water point complete with two water taps mounted on risers of 1m above the concrete base of 1.5mx1mx0.03m	Lumpsum	1	30,000	30,000
Total				**30,000**

Spillway Earth works

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Bulk excavation	m3	1,350	500	675,000
Provide for concrete class 15/20 spillway sill 300mm thick (in-situ cast) across the channel not exceeding 10m depth	m3	9	10,750	96,750
Provide rip rap protection to spillway and outflow channel with hard core stone materials	m2	50	800	40,000
Total				**811,750**

Cost of excavation	Unit	Quantity	Cost per unit (KES)	Amount (KES)
Silt trap	m3	500	500	250,000
Total				**250,000**

Total cost per dam		23,784,230
Number of dams	4	**95,136,920**

Table 12: Detail cost of bio-park set up and potential revenue from operations.

Bio park construction		
Land acquisition cost		
Land size	9	Acres
Cost of land (KES)	700,000	per acre
Total cost of land (KES)	6,300,000	
Land upgrade costs (KES)	115,510,080	
Total cost for bio-park set up	**121,810,080**	
Domestic tourists in Isiolo town	1,601	Monthly
Number of visits per month	2	

Bio-park entry cost per domestic tourist	50	
Monthly revenue (KES)	160,100	
Annual revenue (KES)	1,921,200	
# of international tourists visiting Kenya	2,025,206	Annually
Percentage visiting Isiolo town	0.5%	
# of international tourists visiting Isiolo town	10,126	Annually
Bio-park entry cost per international tourist	100	
Annual revenue (KES)	**1,012,603**	
Total annual revenue from access to the bio-park	**2,933,803**	

Maintenance costs

Maintenance cycles	2	
Land for public realm	4.8	Acres

Phase I – Culverts and Channels

Description	Unit	Quantity	Cost per Unit (KES)	Amount (KES)
Channel's cleaning – manual	m	25,000	18	5,280
Culvert's cleaning – manual	m	12	220	880,000
Total				**885,280**

Phase III - Bio-Park

Description	Unit	Quantity	Cost per Unit (KES)	Amount (KES)
Landscape maintenance	m^2	4633	15	68,103
Pavement repairs	m^2	3861	34	131,264
Park administration – Manager	No	1	30,627/month	367,529
Park administration – Casual Labour	No	4	13,573/month	651,504
Total				**1,218,400**

Table 14: List of People and Organisations Consulted

	Organisation	Archetype	Name	Role
1	NEMA	Government Official	Andrew Nganga	Environmental Officer
2			Hunyu Murithi	Environmental Officer
3	IWASCO	County Official	Catherine Mwendwa	Internal Auditor
4	WRA	Government Official	Mercy Mbaya	Flood Management Officer
5	KeNHA	Government Official	Joshua Kapinua	Field Engineer
6	ENNDA	Government Official	Boru Konso	Regional Coordinator

7	Isiolo Municipality	Municipality Official	Halake Osman	Municipality Manager
8			Hassan Wakawario	Municipality Chairman
9			Harrison Thuranira	Municipal Town Planning
10			Augustine Gatebu	Municipal Accountant
11			David Guyo	Municipal Board Member
12			Sakina Adan	Municipal Board Member
13			Hussein Bonaya	Municipal Board Member
14			Anab Kassim	Municipal Board Member
15			Endia Molu	Municipal Board Member
16	Isiolo County Government	County Official	Hussein Olo	County Roads Engineer
17			Franklin Darwin	Member of County Assembly Bulla Pesa Ward
18			Abdi Duba	Member of County Assembly Wabera Ward
19			Idd Hassan	Bulla Pesa Ward Representative

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