



WESTERN AREA PENINSULA WATER FUND

ASSESSING THE RETURN ON INVESTMENT FOR
NATURE-BASED SOLUTIONS FOR THE WESTERN
AREA PENINSULA AND FREETOWN, SIERRA LEONE

FINAL BUSINESS CASE: MARCH 2021



Disclaimer

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CONTENTS

Acknowledgements	ii
Abbreviations.....	iii
Glossary	v
Executive Summary	1
Demand Outstripping Supply	1
The Importance of Ecological Infrastructure.....	1
Return on Investment in Conservation.....	1
Conclusion.....	2
Introduction	4
Water Security.....	4
The Role of a Water Fund	5
Vision & Mission for the Water Fund	6
The Business Case.....	6
The Water Supply System.....	6
The Western Area Peninsula Water Supply System	7
Ecological & Built Infrastructure.....	7
Deforestation: Causes & Consequences	8
Evaluating the Impact & Cost Effectiveness of a Water Fund	12
The Case for Conservation.....	14
Water Fund Conservation Interventions	16
Likely Impacts of Water Fund Activities.....	21
Additional Benefits of Conservation	23
Stakeholders Engaged	26
Limitations of the Study	28
Next Steps	28
Conclusion	29
Appendix.....	31
Endnotes.....	32

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ABBREVIATIONS

ANR	Assisted Natural Regeneration
BAU	Business-as-Usual
CAP	Catchment Area Platforms
CBA	Cost-Benefit Analysis
CBD	Convention on Biological Diversity
CCC	Convention on Climate Change
CDMC	Community Disaster Management Committees
CRS	Catholic Relief Services
CTFA	Conservation Trust Fund Act
DFID	Department for International Development
EAL	Expected Annual Losses
EPA	Environment Protection Agency
EWRC	Electricity and Water Regulatory Commission
FAO	The Food and Agriculture Organization of the United Nations
FCC	Freetown City Council
GEF	Global Environment Facility
GFCC	Global Forest Cover Change
GVWC	Guma Valley Water Company
ICT	Information and Communication Technology
MAFFS	Ministry of Agriculture, Forestry and Food Security
MLHCP	Ministry of Lands, Housing and Country Planning
MoENV	Ministry of Environment
MoIA	Ministry of Internal Affairs
MoU	Memorandum of Understanding
MoWR	Ministry of Water Resources
NGO	Non-Governmental Organisation
NPAA	National Protected Area Authority
NPV	Net Present Value
NWRMA	National Water Resources Management Agency
ONS	Office of National Security

PES	Payments for Ecosystem Services
RAIN	Replenish Africa Initiative
REDD+	Reducing Emissions from Deforestation and Degradation
ROI	Return on Investment
SCC	Social Cost of Carbon
SDG	Sustainable Development Goals
SSL	Statistics Sierra Leone
SLL	Sierra Leonean Leone
SLURC	Sierra Leone Urban Research Center
SWAT	Soil Water Assessment Tool
TCCF	The Coca Cola Foundation
TNC	The Nature Conservancy
USD	United States Dollar
UN	United Nations
WAPNP	Western Area Peninsula National Park
WARD-C	Western Area Rural District Council
WACDRMP	Western Area Community Disaster Risk Management Platform
WASH	Water, Sanitation and Hygiene

GLOSSARY

Adaptive Management

Adaptive management is a systematic approach to learning and managing protected areas and natural resources that allows managers to make decisions despite uncertainty.¹ It is an iterative process with six stages: problem assessment, experimental design, implementation, monitoring results of experiment, evaluation of results, and management adjustment.

Business-As-Usual Scenario

The Business-as-Usual (BAU) Scenario assumes management of the Western Area Peninsula Water Supply System continues as it is currently being implemented with no significant new investments in forest protection or restoration and that unmanaged urban and agricultural expansion continues.

Carbon Sequestration

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. Natural carbon sequestration processes can be supported through changes in land use and agricultural practices, including forest restoration and the conversion of annual cropping systems and livestock grazing land into agroforestry systems.

Conservation Scenario

The Conservation Scenario assumes significant investments in interventions aimed at halting and reversing the deforestation that has taken place in the WAPNP, as well as to preserve and restore forest areas in the riparian zones of the urbanized areas below the Park. It also assumes substantial investments in a suite of enabling interventions that seek to enhance the impact of the interventions directly aimed at forest conservation and restoration.

Currency

All monetary values are expressed in United States Dollars (USD). All estimates were calculated using the exchange rate of USD 1 = SLL 9,840.

Catchment

A catchment is an area where water is collected by the natural landscape. Precipitation that falls in a catchment runs downhill into creeks, rivers, lakes, oceans, or into built infrastructure, such as reservoirs. In this document, the terms catchment and watershed are used interchangeably.

Cost Benefit Analysis

Cost-benefit analysis is a conceptual framework and tool used to evaluate the viability and desirability of projects or policies based on their costs and benefits over time. It involves the adjustment of future values to their present value equivalent by discounting at a rate which reflects the potential rate of return on alternative investments or the rate of time preference.

Discount Rate

Refers to the interest rate used in discounted cash flow analysis to determine the present value of future cash flows.

Ecological Infrastructure

Ecological infrastructure is the nature-based equivalent of grey or engineered infrastructure. It forms and supports a network of interconnected structural elements such as catchments, rivers, riparian areas and natural corridors supporting habitats and movement of animals and plants.

Ecological Restoration

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Active restoration involves the planting of seedlings, direct seeding, and/or the manipulation of disturbance regimes, such as fire, to encourage faster recovery.² In contrast, natural regeneration is a biological process whereby new forest establishes itself and recovers some or all of its ecological functions. Passive regeneration occurs spontaneously without any human intervention, whereas in assisted natural regeneration (ANR), humans employ a set of interventions, such as fencing to control grazing or fire prevention, to accelerate the natural regeneration of forests.³

Ecosystem Services

Ecosystem services are the benefits people obtain from the Earth's many life-support systems. The Millennium Ecosystem Assessment defines four categories of ecosystem services: provisioning, regulating, cultural, and supporting services.

Nature-Based Solutions

Nature-based solutions are actions taken to protect, sustainably manage, and restore ecosystems to effectively address societal challenges, such

as climate change, food and water security, and disaster risk reduction. Nature-based solutions simultaneously improve ecosystem health and functioning to the benefit of human and non-human nature.

Net Present Value

Net present value (NPV) is a calculation used to estimate the value — or net benefit — over the lifetime of a particular project. NPV allows decision makers to compare various alternatives on a similar time scale by converting all options to current dollar figures. A project is deemed acceptable if the net present value is positive over the expected lifetime of the project.

Return on Investment

Return on investment (ROI) is a simple ratio of the gain from an investment relative to the amount invested. ROI is calculated by dividing net profit (current value of investment — cost of investment) by the cost of investment.

Water Fund

A Water Fund is a funding and governance mechanism that enables water users to provide financial and technical support collectively in catchment restoration alongside upstream communities.

Water Security

Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods, human wellbeing, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters and for the preservation of ecosystems in a climate of peace and political stability.⁴

Western Area Peninsula Water Supply System

The Western Area Peninsula Water Supply System is all of the ecological and built infrastructure, which together supply water to meet the needs of the population of the Western Area Peninsula, including the city of Freetown.

EXECUTIVE SUMMARY

Nature-based solutions represent an effective and financially sound means to address the growing water security challenges facing Sierra Leone's capital of Freetown and the surrounding Western Area Peninsula region. This document makes the Business Case for creating the Western Area Peninsula Water Fund to convene and coordinate stakeholders and facilitate the necessary investments to protect and restore the ecological infrastructure that supplies water to nearly two million people.

The Western Area Peninsula Water Fund is a priority for the city of Freetown as it provides a long-term solution to an age-old problem that many of our residents face — severe water shortage each dry season despite torrential rainfall every rainy season.

— Yvonne Aki-Sawyerr, Mayor of Freetown

DEMAND OUTSTRIPPING SUPPLY

Over the past 50 years, Freetown's population has increased nearly 10-fold and natural forest cover on the Western Area Peninsula has declined by about 70%.⁵ By 2028, the city's population is expected to increase by some 535,000 people, while during the same timeframe the forested ecosystem that already struggles to supply Freetown with water may lose some 1,400 hectares (more than 8%) of its remaining trees.

Even at current population density levels, the Western Area Peninsula Water Supply System cannot deliver sufficient, safe water to the region's population. The average daily output of Guma Valley Water Company (GVWC), a government-owned entity that provides water supply services to the city of Freetown, is approximately 70,000 m³ per day, just over half of the estimated average daily demand of 130,000 m³ per day.⁶

The insufficient supply of water requires rationing to many areas in the city, and almost no customers receive guaranteed supply 24-hours per day.⁷ Freetown's poorest and most densely populated urban and peri-urban areas often receive water just once a week or not at all. Moreover, only 3% of Freetown's residents have access to piped indoor

water, 39% of households rely on public taps, and 25% of the city's people do not have any access to an improved water source.⁸ In peri-urban and rural areas of the peninsula, most people rely on streams, rivers and unprotected wells for their water.

THE IMPORTANCE OF ECOLOGICAL INFRASTRUCTURE

The Western Area Peninsula's forests play an essential role in supplying water and in maintaining water quality. Forests serve as natural water collection, filtration, and delivery systems. Forested catchments in the Western Area Peninsula National Park (WAPNP) provide about 90% of Freetown's water supply. The Peninsula's forests also mitigate landslides by stabilizing soil and provide flood control services by absorbing and holding vast amounts of water from major rain events, such as those increasingly seen with climate change.

Investments in engineered infrastructure solutions to combat water scarcity are important.⁹ However, without investments in ecological infrastructure to secure and augment water supply, even the best built infrastructure will not have enough water to store and transport. Between 2000 to 2015, 10,587 hectares of the WAPNP's forest experienced some thinning or loss of canopy cover, and by 2050, a third of the Park's remaining forest may be lost if nothing is done. Without these forests, Freetown and the rest of the Peninsula will experience dire water insecurity and more landslides.

RETURN ON INVESTMENT IN CONSERVATION

The Business Case analysis demonstrates that a USD 20 million investment in the protection and restoration of critical ecological infrastructure will generate a return of USD 55 million in economic benefits over a 30-year timeframe. In other words, every USD 1 invested by the Western Area Peninsula Water Fund is expected to generate at least USD 2.70 worth of benefits to stakeholders.

The considerable benefits to the people and biodiversity of the Western Area Peninsula include:

- 11,000 m³ more water will be available to households during the dry season months, with an annual cost saving to poor households of USD 436,941;
- Sediment entering the rivers of the Western Area Peninsula will be cut in half, and the lifetime of the Guma Reservoir will be extended by 60%;
- Average annual flood damages across Freetown's seven urban watersheds will be reduced by USD 2.05 million;
- 12.13 million more tons of carbon will be sequestered, leading to the avoidance of USD 1.08 billion worth of global, and USD 240,000 of national, climate related damages every year;
- Ecological restoration projects, agroforestry and nature-based tourism will bring significant employment and livelihood opportunities to thousands of households; and,
- Protection of the WAPNP will help conserve the invaluable biodiversity of one of the last strongholds of primordial forest in Sierra Leone, as well as a significant portion of the remaining forest cover in the Guinean Forests of the West Africa Biodiversity Hotspot.

CONCLUSION

Water is essential for life, and forests are essential for water. The results of the Business Case demonstrate a clear economic basis for the establishment of a water fund to restore the watersheds within the WAPNP so that they can supply the quantity and quality of water needed for all users in the Greater Freetown Area while improving the livelihoods and resilience of the people in the watersheds and conserving the area's rich biodiversity. Now, transforming the shared vision for the Western Area Peninsula Water Fund into reality requires the continued dedication of members of the Inter-Ministerial Task Force on the Protection of Western Area Catchments and the emerging Water Fund Advisory Committee. It also depends on expanding public and private support from all the stakeholders who rely on the forest and the essential ecosystem services it delivers.¹⁰



Guma Valley Dam located at Mile 13



Sierra Leone is located in West Africa, and Freetown sits on the northernmost tip of the country's Western Area Peninsula.

INTRODUCTION

Water security is a major concern for many of the world's rapidly expanding cities, which struggle to meet the water demands of their populations amid mounting challenges associated with environmental degradation and climate change.

Freetown, the capital and largest city of Sierra Leone, is among the cities where water security is a major concern. The city, designed for only 400,000 inhabitants, is now home to more than 1.2 million people and it is expected to add 535,000 more residents by 2028.¹² Urbanization and agricultural expansion associated with the growth of Freetown have led to extensive encroachment into Western Area Peninsula National Park (WAPNP). Degradation of the Park's forests threatens the watersheds that provide about 90% of Freetown's water supply, increases the risks of floods and landslides, and destroys critical habitat for wildlife, such as the endangered Western Chimpanzee, which was recently named Sierra Leone's national animal following a visit by Dr. Jane Goodall DBE, the world's foremost expert on chimpanzees.

During the past two years, Catholic Relief Services (CRS) and The Nature Conservancy (TNC) have been working with more than a dozen local and national partners to lay the groundwork for the Western Area Peninsula Water Fund, which will facilitate investments in nature-based solutions for the protection and restoration of the WAPNP, ensuring sustainability of the Western Area Peninsula's water supply for future generations.¹³ Development of the Water Fund Business Case would not have been possible without this broad stakeholder support for nature-based solutions.

Additionally, this process has benefited from CRS's almost six decades of experience implementing multi-stakeholder initiatives in Sierra Leone, including water security, sustainable agriculture, and flood mitigation and response programming in Freetown and the Western Area Peninsula. This process has also drawn extensively from TNC's experience addressing similar issues in Kenya with the Upper Tana-Nairobi Water Fund and in South Africa with the Greater Cape Town Water Fund, as well as in North and South America, where over 30 water funds are either underway or

WATER SECURITY

The United Nations defines water security as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods, human wellbeing, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters and for the preservation of ecosystems in a climate of peace and political stability".¹¹

There are four core elements within this definition:

- People have access to safe adequate quantities of acceptable quality drinking water for sustaining livelihoods, human well-being, and socio-economic development. Water supply needs to be adequate and reliable, and typically piped to people's homes and places of work;
- Water is available for economic activities and development, energy production, industry and transport as required, and people's livelihoods are not affected by unreliable water supplies;
- Ecosystems are preserved such that they deliver water-related ecosystem services. This includes protection of freshwater resources, and the aesthetic and recreational opportunities associated with aquatic ecosystems and human-made reservoirs; and,
- Climate related water hazards, such as floods and droughts, and the risks associated with these, are effectively managed.

in development. The experiences of these water funds have demonstrated that significant ecological infrastructure benefits can be achieved by targeting conservation on a small fraction of the source watershed area.

The Business Case was developed as part of the Replenish Africa Initiative (RAIN) Project, which



Mayor Yvonne Aki-Sawyerr OBE (Freetown City Council), Fredrick Kihara (TNC), Jean-Philippe Debus (CRS) and Paul Emes (CRS) at the RAIN project launch event

CRS implemented from April 2019 to September 2020 in the Western Area Peninsula on behalf of the Coca-Cola Foundation (TCCF) and the Global Environment and Technology Foundation (GETF). RAIN is TCCF's flagship program contributing to helping Africa achieve the United Nation's Sustainable Development Goals on clean water and sanitation access. The development of the Business Case has thus also benefitted from inputs and support from the RAIN Project Technical Committee and one of its key members, the National Water Resources Management Agency (NWRMA).

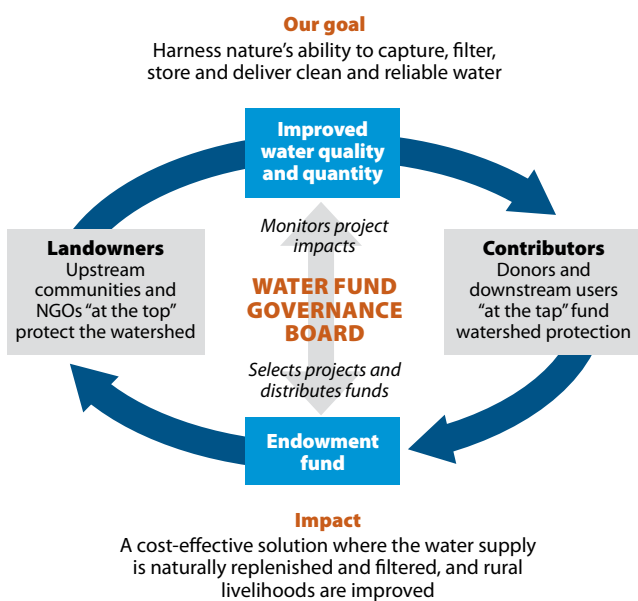


Illustration of how a water fund works

THE ROLE OF A WATER FUND

A healthy, functioning watershed has been shown to reduce water treatment costs and improve water regulation for people reliant on the watershed.¹⁴ Investment in **green infrastructure** using natural systems to trap sediment and regulate water often provides a more **cost-effective approach** than relying solely on grey infrastructure such as reservoirs and treatment systems.

A water fund usually involves a **public-private partnership** and a financing mechanism to invest in **watershed conservation**. The watershed conservation measures are strategically designed to protect the quality and/or quantity of water available for multiple water users and the environment. Thus, a water fund brings together public and private downstream users (e.g., water utilities and major private users), upstream watershed stewards (e.g., agricultural landholders), and other interested stakeholders (e.g., development organisations) to participate in and contribute to the fund, given their shared stake in a healthy water future.

The **water fund concept** is founded on the principle that it is cheaper to **prevent water problems at the source** than it is to address them later. The financial support of the water fund is used to promote sustainable management practices in lands upstream that filter and regulate water supply, such as forest restoration and agroforestry. Funding is also used to support economic opportunities that **enhance livelihoods** and the quality of life for upstream communities, including agroforestry and nature-based tourism that can boost incomes while contributing to conservation. A water fund can also enhance communities' ability to **adapt to climate change**, by building in resilience across green and grey infrastructure approaches.

VISION & MISSION FOR THE WATER FUND

The vision for the Western Area Peninsula Water Fund is a restored WAPNP that provides biodiversity and clean water benefits to the Greater Freetown Area. The Water Fund's mission is to restore the watersheds within the WAPNP so that they can supply the quantity and quality of water needed for all users in the Greater Freetown Area while improving the livelihoods of the people in the watershed, conserving the area's rich biodiversity, and building resilience to acute shocks — in the context of a changing climate.

The Water Fund will support and align with existing government initiatives and act as a catalyst for systemic change in catchment management by cost effective use of on-the-ground resources, strengthened capacity, and robust monitoring and evaluation. In addition, the Water Fund will stimulate funding and implementation of catchment restoration efforts and, in the process, create jobs and momentum to protect globally important biodiversity and build more resilient communities in the face of climate change. The conservation activities promoted by the Water Fund will also make meaningful contributions to a number of the United Nation's (UN) Sustainable Development Goals (SDGs), including SDG 6, 11, 13 and 15, as well as the Convention of Biological Diversity (CBD) and the UN Convention on Climate Change (CCC).

THE BUSINESS CASE

This document presents the Business Case for the creation of the Water Fund to help protect and restore the quality and supply of water to Freetown and the Western Area Peninsula, as well as other important ecological services. It draws from a study undertaken to determine the economic value of the difference in priority ecosystem services flows between a Business-as-Usual (BAU) Scenario and a Conservation Scenario.¹⁵ The BAU Scenario assumes the management of the Western Peninsula Area Water Supply System continues as it is currently being implemented with no significant new investments in the protection of existing forests or forest restoration. On the other hand, the Conservation Scenario anticipates considerable investments, which are facilitated by the Water Fund, in both active and enabling interventions

THE WATER SUPPLY SYSTEM

A water system is made up of both ecological and built infrastructure, which together supply water for our needs. Water enters the system as precipitation falling on catchments, where it collects and runs downhill into creeks, rivers, lakes, oceans, or into built infrastructure, such as reservoirs. The highest elevations of the catchment mark its outside edges. Some water also infiltrates below ground where it is stored in the soil or in the space between rocks. This is called groundwater. Often, water supply systems also include various built infrastructure components, such as pump stations, pipes, and sewers to move water through the system, as well as treatment facilities to make it safe for human consumption and to treat wastewater before release to the environment or reuse.

aimed at halting deforestation and restoring forests in and around the WAPNP.

The economic study analyses these benefits in relation to the costs of implementation to determine the net present value (NPV), return on investment (ROI), and cost-effectiveness of the Conservation Scenario. The economic modelling is based on a 2019 assessment of the catchments that feed the Western Area Peninsula, and on extensive hydrologic, hydraulic, and morphologic modelling undertaken to assess the relative impact of land management decisions on a variety of water quality and quantity parameters and to assess water security and the related issues of urban flooding and reservoir sedimentation.¹⁶

The Business Case demonstrates the potential economic impact and expected benefits of a water fund supporting land conservation measures in and around the WAPNP. The results present a case for the creation of a water fund to:

- Protect and restore forest resources where Freetown's fresh water supply originates;
- Extend the life of the Guma and Congo Reservoirs that provide Freetown with water during the dry season;

- Engage communities and other stakeholders to ensure buy-in and create alternative livelihood opportunities, such as nature-based tourism and agroforestry, that enhance the impact of conservation measures;
- Reduce the risk of natural disasters, including floods and landslides, that threaten the population of Freetown and surrounding settlements; and,
- Contribute to climate change mitigation through the sequestration of carbon with increased forest cover.

The Business Case for the Western Area Peninsula Water Fund is meant to inform and encourage private and public sector stakeholders to engage in a collaborative process to create a structure that will design — guided by further stakeholder input — and promote financial and governance mechanisms, articulating public, private and civil society stakeholders with the goal of contributing to water security and the sustainable management of the watersheds within the WAPNP.

THE WESTERN AREA PENINSULA WATER SUPPLY SYSTEM

Freetown and the Western Area Peninsula face myriad water security challenges, including water shortages and flooding, which will grow worse if definitive action is not taken to mitigate threats to the ecological and built infrastructure that make up the Peninsula’s water supply system.

ECOLOGICAL & BUILT INFRASTRUCTURE

The WAPNP provides critical ecological services for the Western Area Peninsula. While the Park covers less than a third of the Peninsula’s total land area, it protects most of the Western Area Peninsula Water Supply System’s ecological and built infrastructure. More than 90% of the Peninsula’s major river catchments, as well as the two reservoirs they feed, originate in the WAPNP. Freshwater for the city of



Young girl fetching water from a water point rehabilitated as part of the RAIN Project

Freetown comes primarily from the Guma Reservoir, which supplies 1.5 million people, and the Congo Reservoir, which supplies 300,000 people.¹⁷ These reservoirs are especially important during the period from December to April every year, when just 11 to 17% of the annual river discharge occurs.

Even at current population density levels, the Western Area Peninsula Water Supply System fails to adequately supply sufficient, safe water to the region's population. The average daily output of Guma Valley Water Company (GVWC), a government-owned entity that provides water supply services to the city of Freetown, is approximately 70,000m³ per day, just over half of the estimated average daily demand of 130,000m³ per day.¹⁸

The insufficient supply of water requires rationing to many areas in the city, and almost no customers receive guaranteed supply 24-hours per day.¹⁹ Freetown's poorest and most densely populated urban and peri-urban areas often receive water just once a week or not at all. Moreover, only 55% of the Western Area Peninsula's urban residents have access to piped drinking water or public taps.²⁰ The rest of the city's people obtain their water from wells, both protected and unprotected, from open water sources, such as rivers and streams, and/or from venders.²¹ In rural areas of the Peninsula, many more people rely on streams, rivers and unprotected wells for their water, and are forced to buy water from venders during the dry season.

This lack of access to safe water has far ranging socio-economic consequences. Globally, the opportunity costs and lost wages associated with searching for water amounts to hundreds of billions of dollars.²² While this affects the entire economy, low-income communities suffer the most. Those who can least afford this lost time and wages must spend hours, often multiple times per day, waiting in long lines at community water kiosks or walking to distant rivers or other water sources to meet their basic water needs. Also, a clean, adequate water supply is crucial to health. People become ill more frequently when they do not have access to safe water for drinking and hygiene. According to the World Health Organization (WHO), every USD 1 invested in water and sanitation provides a USD 4 economic return from lower health costs, more productivity and fewer premature deaths.²³

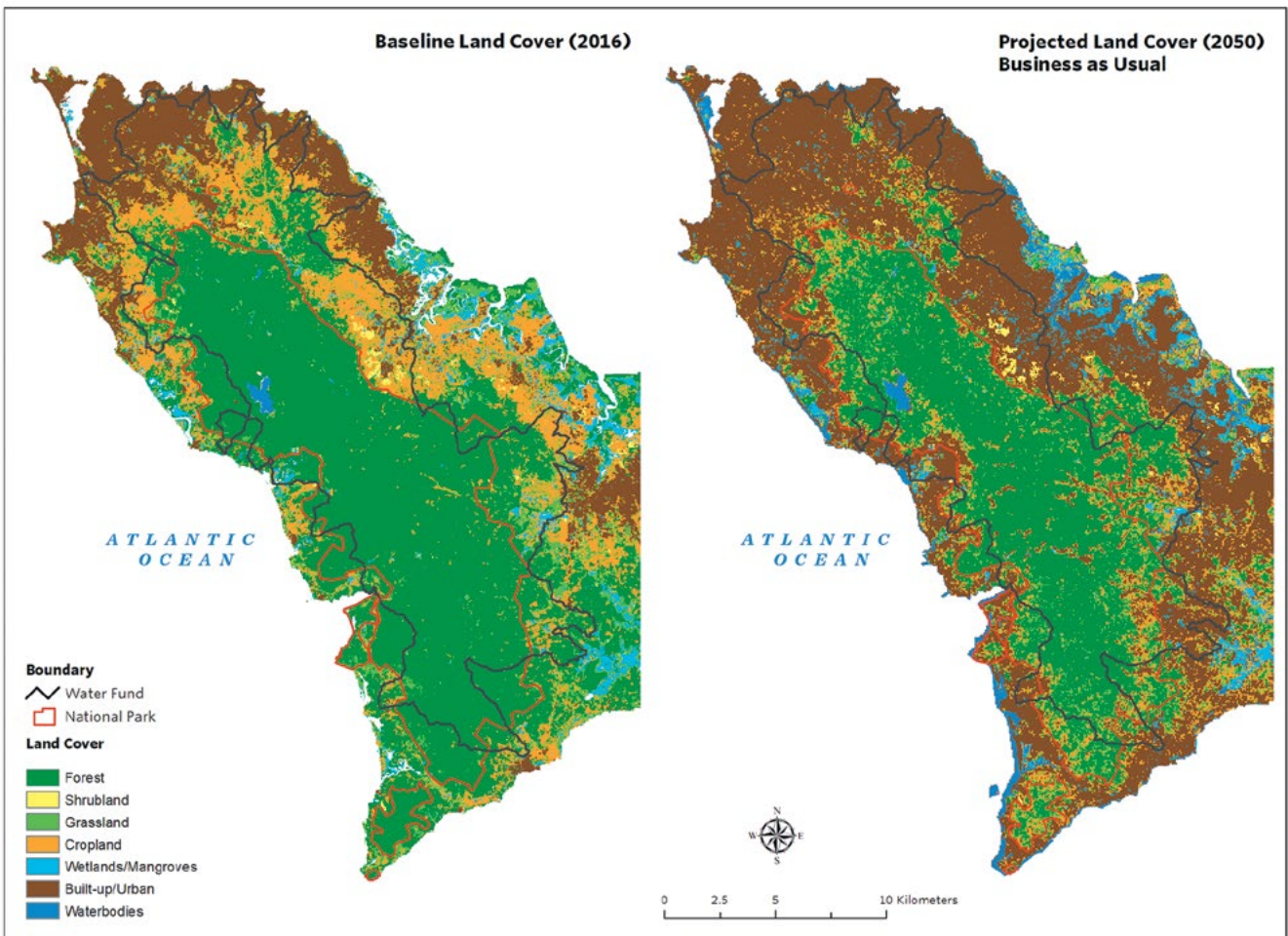
DEFORESTATION: CAUSES & CONSEQUENCES

Over the past several decades, there has been significant deforestation in the WAPNP, causing severe damage to the ecosystem, which ultimately threatens the Peninsula's water supply system. Analysis of the Global Forest Cover Change (GFCC) Tree Cover dataset shows that from 2000 to 2015, 10,587 hectares of forest experienced some thinning or loss of canopy cover, equating to an overall loss of 2,103 hectares during the 15-year period. This is an average loss of 140 hectares per year. By 2050, it is estimated that an additional 5,115 hectares of forest within the WAPNP will be lost if nothing is done. This represents almost a third of the current forest cover.

Urban expansion is the most serious driver of forest loss within the WAPNP. By 2011, human settlements that housed some 100,000 people had encroached on 3,200 hectares of land. Moreover, under the BAU Scenario, urban expansion is predicted to increase by 197% between 2015 and 2050, which would result in significant additional encroachment into the WAPNP.

When people build settlements at the forest frontier, they not only clear land to build homes and roads, many of them also cut down and burn forests to make room for economic activities. A 2019 assessment of 38 areas within the Peninsula's main catchments identified 147 hectares of illegal agriculture, including production of charcoal, marijuana and other crops within the WAPNP. Additionally, illegal logging, fuelwood harvesting, and stone quarrying have been identified as causes of deforestation and degradation in the WAPNP.

Illegal activity within the WAPNP continues because of weak enforcement, which is rooted in weak policies and institutions, ministerial mandate overlap, corruption, weak monitoring, and an absence of inter-sectorial coordination among government agencies.^{24,25} The effective enforcement of environmental laws and regulations is closely linked with the overall quality of governance.²⁶ Fortunately, there is growing awareness of the urgency to protect the WAPNP, and nature-based solutions are gaining support among policy makers. Indeed, stakeholders from across the spectrum see the



Baseline land cover (2016) and projected land cover (2050) for the Western Area Peninsula. The 2050 land cover projection was used for the BAU Scenario.



Urban expansion and illegal activities threaten to reduce the WAPNP's remaining forest by a third over the next 30 years.

protection of the WAPNP as a priority because it contributes to so many national, regional and city-level goals.

“My own dream is to ensure that we conserve Western Area Peninsula catchment areas to make sure we get water from those sources that do not require much treatment as compared to water from the rivers. The government is serious about conserving this forest reserve because they see the importance of conserving it for reasons of providing water to its people as well as for touristic purposes and to prevent disasters like the landslide that happened a few years ago”.

— Eng. Philip K. Lansana, Minister for Water Resources

In July 2020, an Inter-ministerial Task Force on the Protection of Western Area Catchments was established. Overseen by the Vice-President, the Task Force is composed of five Ministries: the Ministry of Water Resources (MoWR), the Ministry of Lands, Housing and Country Planning (MLHCP), the Ministry of Environment (MoENV), the Ministry of Internal Affairs (MIA), and the Ministry of Agriculture, Forestry and Food Security (MAFFS). The members of the Task Force have entered into a Memorandum of Understanding (MoU), which endorses nature-based solutions and identifies the establishment of the Water Fund as a priority area of collaboration.²⁷

The consequences of deforestation include reduced water flow, soil erosion and reservoir sedimentation, flooding and landslides, and biodiversity loss. Collectively these present a grave threat to Freetown and the Western Area Peninsula. Moreover, these threats cascade because of the interdependencies between the Peninsula’s natural and socio-economic systems, resulting in damaging feedback loops that can be difficult to stop if not addressed early. Failure to mitigate deforestation now threatens the region’s water supply, increases the possibility of ecosystem collapse, and leads to greater likelihood of environmental disasters, all of which exacerbate water insecurity. This in turn leads to human deprivation, ill health and diminished sustainable livelihood opportunities, forcing people to engage in negative coping mechanisms that further degrade the ecosystem. Urgent, coordinated action is needed to stop this downward spiral.

REDUCED WATER FLOW

Natural ecosystems slow down and reduce the magnitude of water flows in the wet season, and by facilitating infiltration of rainfall into the ground, they contribute to maintaining river flows during the dry season. Thus, deforestation negatively impacts the ecosystem’s ability to regulate water flow.

In the Western Area Peninsula, many low-income residents rely directly on rivers and streams and unprotected wells for their daily water needs. Even in Freetown, 25% of the city’s inhabitants do not have access to an improved water source.²⁸ Also, in some areas where access to protected water sources is available, people continue to use water from rivers and streams because of the ease of access, lower cost and cultural preference.²⁹

Already in the dry season months from December to April, demand for water can exceed supply and residents must find alternative sources. More often than not, they purchase water at water stands or from informal vendors selling bottled water or water in plastic sachets. Continued deforestation of the catchments in the WAPNP is likely to further impact the availability of water to these residents. Also, deforestation degrades filtration capacity and causes increased erosion, which leads to increased turbidity and suspended solids in the water that so many people depend upon. Water sediment concentration is correlated with bacterial pathogen content, and, therefore, declining water quality is likely to have significant health consequences for the people who rely on untreated surface water sources.

SOIL EROSION & RESERVOIR SEDIMENTATION

The forests of the WAPNP are important for controlling soil erosion, trapping sediments and preventing them from entering the Guma and Congo water supply reservoirs that are situated within the WAPNP. Morphological modelling used to quantify the rate at which sediments would accumulate in the Guma and Congo Reservoirs showed that deforestation under the BAU Scenario would have a significant impact on water supply through the reduction in the lifespan of these reservoirs. Conversely, modelling results indicate that under the Conservation Scenario there would be a 60% annual decrease in the percentage of sediment contained within the Guma Reservoir.



2017 landslide site on Mount Sugarloaf located at Motomeh

FLOODING & LANDSLIDES

Due in part to its steep topography, Freetown and the Western Area Peninsula face serious flood and landslide hazards. These occur frequently during the rainy season between the months of May and October. In 2017, Freetown experienced the worst disaster in recent history. Extraordinary precipitation levels, 300% higher than normal, resulted in landslides and flooding that killed 1,141 people and destroyed 3,000 homes.³⁰ A rapid damage and loss assessment carried out by the World Bank estimated the total damages to be in the order of USD 31.65 million.³¹

Deforestation in the WAPNP reduces the ecosystem's capacity to mitigate flood risk. Intact forests reduce flood peaks and lengthen the flood period at a lower level. Deforestation results in increased sediment loads and increased sediment deposition into the Peninsula's estuaries, which may cause further increases in flood levels and consequently increased inundation of buildings. Deforestation also increases landslide hazard. Trees help prevent landslides by reinforcing and drying soils.

While much of the problem is rooted in deforestation, unplanned development in natural waterways and solid waste clogging Freetown's drainage system are also major concerns.

Approximately 38% of expansion outside the city's planned development has taken place in either medium or high-risk areas.³² The city's poorest people are typically those who live in these risky areas. For example, Kroo Bay, an impoverished coastal neighbourhood surrounded by eroded hills, has flooded every year since 2008. Likewise, the landslide hazard is concentrated in the steep hills around Freetown in the areas of Regent, Goderich and Tacugama.³³

BIODIVERSITY LOSS

Globally, more than 120,000 animal, fungus and plant species are known to be threatened, and more than 32,000 species face possible extinction,



including 41% of amphibians, 34% of conifers, 33% of reef building corals, 26% of mammals and 14% of birds.³⁴ This devastating loss of biodiversity has become known as the Anthropocene extinction because of humanity's role in causing it. Today's extinction rate is estimated to be 1,000 times higher than natural background rates, and it is feared that unless dramatic action is taken, the extinction rate could increase to 10,000 times the background rate.³⁵

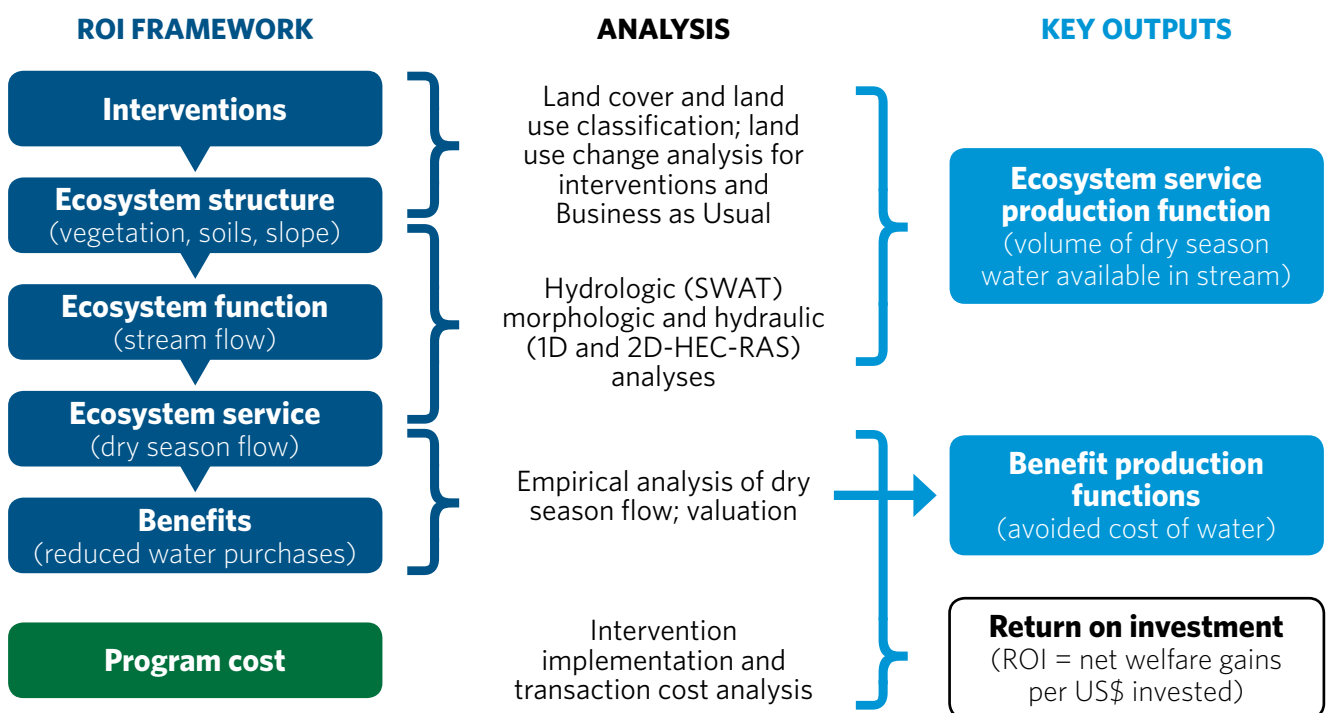
The WAPNP protects the largest remaining moist closed forest in western Sierra Leone and is the western-most remnant of Upper Guinean forest.³⁶ It also provides important habitat for some 400 bird and 50 mammal species, including endangered species such as the Western Chimpanzee and the Jentink's Duiker.³⁷ Deforestation within the WAPNP and urbanization of the land surrounding it shrinks the habitat of these species, increases the potential for human-wildlife conflict, and makes it easier for poachers to access the Park. In the northern sections of the Park, poachers frequently blanket the forest floor with snares, trapping and killing everything that falls into them. Under the BAU Scenario, almost a third of the Park's current forest cover is projected to be lost by 2050, which will undoubtedly undermine the chances of survival for

the species that depend on it. Additionally, the loss of biodiversity will negatively impact nature-based tourism, the development of which is a national priority for the Government of Sierra Leone.

EVALUATING THE IMPACT & COST EFFECTIVENESS OF A WATER FUND

Mobilizing stakeholders to establish a water fund requires a predictable positive impact and a strong financial case for making substantial investments to achieve it. For the Western Area Peninsula, the Business Case depends on how the cost of conservation and restoration of forests in and around the WAPNP, referred to as the Conservation Scenario, compares to the no-action alternative, or the Business-as-Usual (BAU) Scenario.

To this end, in response to a request from the Water Fund Advisory Committee of key stakeholders from across the Western Area Peninsula, CRS and TNC undertook a study to determine the economic value of the difference in priority ecosystem services flows between a BAU Scenario and a Conservation Scenario and analysed the potential benefits of the



The process for estimating the cost competitiveness and ROI of catchment restoration

Conservation Scenario in relation to the costs of implementation to determine the net present value (NPV), return on investment (ROI), and overall cost-effectiveness.

The Business Case analysis is based on the results of hydrologic, hydraulic, and morphologic modelling of the impacts under the BAU and Conservation Scenarios. Using the Soil and Water Assessment Tool (SWAT) hydrologic model along with the best available data sets, an assessment was carried out of the relative impact of land management decisions on a variety of water quality and quantity parameters. Outputs from this model were used as inputs to hydraulic and morphologic models to assess water security issues, including flooding and reservoir sedimentation, in the Western Area Peninsula and Freetown.

The development of the Business Case also considered an assessment, undertaken by NWRMA

in 2019, of 38 catchments found on the Western Area Peninsula, as well as extensive scenario analysis of potential forest restoration interventions, based on studies conducted elsewhere in the region (and globally), to get a better understanding of the factors affecting their success in different socio-ecological contexts.

The economic analysis was conducted in two steps. First, the long-term benefits of conservation interventions were identified. This involved comparing the difference in benefits under a landscape with fully implemented conservation investments (the Conservation Scenario) versus one that lacks those investments (the BAU Scenario). Second, the realisation of benefits over time was considered over a 30-year time horizon. The 30-year time period is used to allow sufficient time for measures, such as soil retention, to realise their full impact on flood attenuation and reservoir sedimentation, as well as the realisation of economic



Congo water supply dam which serves Freetown. The forest canopy is still intact but is threatened by rapid deforestation. If the trend continues, existing and future water supplies for hundreds of thousands are in jeopardy.

returns from nature-based tourism and damage loss avoidance from carbon sequestration. None of the benefits are immediate and the analysis involved estimating the time taken for the conservation interventions to generate meaningful impacts. For example, the benefits of active forest restoration started only in year seven and tourism benefits started in year two, rising gradually to reach the target value in 2050. Also, a 30-year time horizon is conservative, in that many interventions will continue to produce benefits beyond that period if properly maintained.

THE CASE FOR CONSERVATION

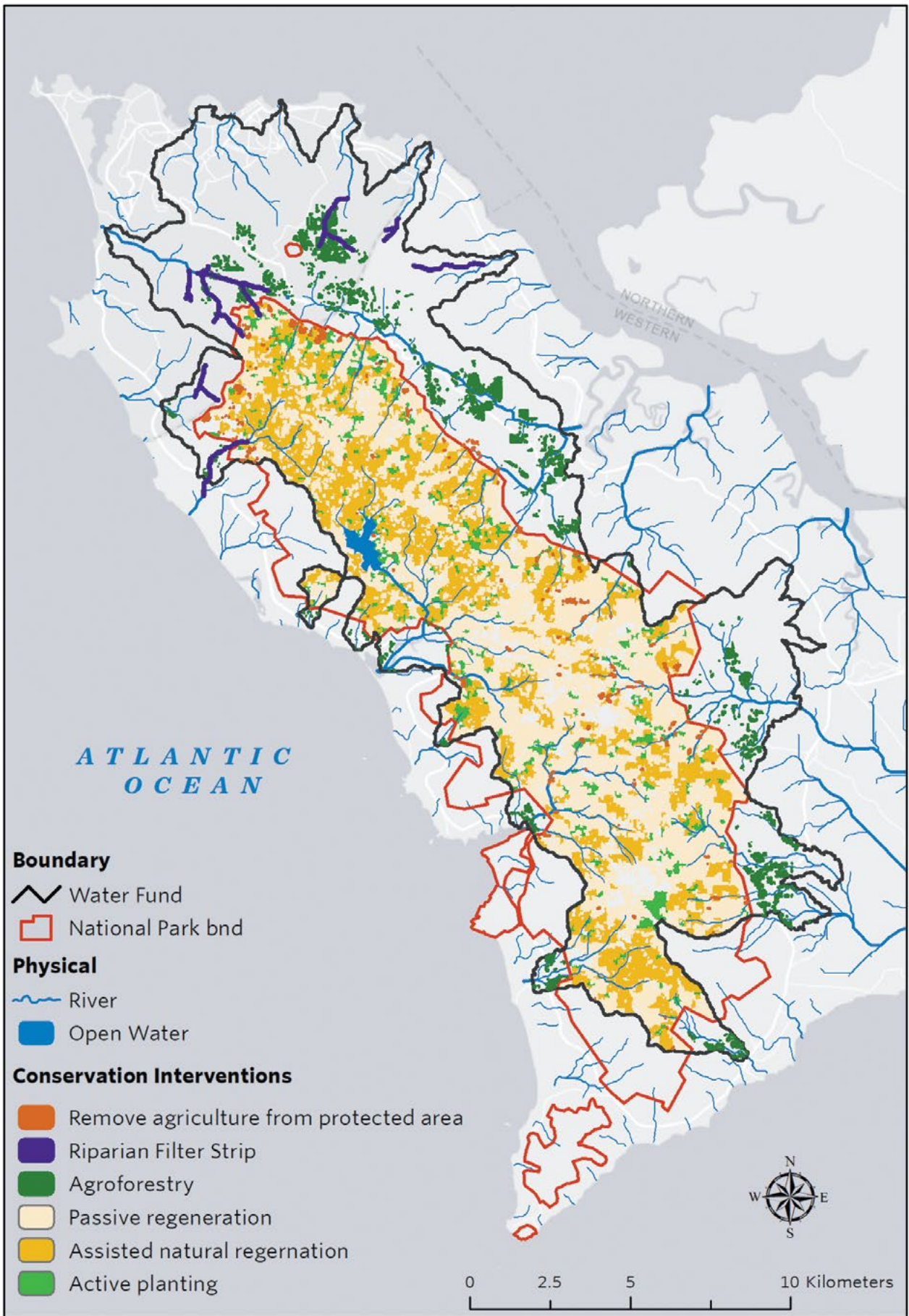
The results of the Business Case analysis demonstrate that a well implemented Water Fund will produce benefits that outweigh their costs under a variety of assumptions. The NPV over

30 years is estimated to be USD 34.76 million, with a ROI of 2.7. In other words, a USD 1 investment by the Water Fund will generate USD 2.70 of benefits to stakeholders. The results presented here include the avoided national costs in terms of carbon storage and not the avoided global costs, which are orders of magnitude greater. Including the global cost savings in the cost-benefit analysis would result in an NPV in the order of USD 13 billion.

Additionally, a sensitivity analysis was carried out, using discount rates of 6% and 9%, to assess the impact of specific uncertainties on the overall viability of the Business Case. The results from the sensitivity analysis indicate that even under lower benefit and higher cost streams, as well as varying timing and discount rates, economic viability can still be maintained and restoration interventions in and around the WAPNP can be justified in economic terms when enabling conditions are in place to ensure their success.

	Present value (US\$ millions)
Costs	
Conservation scenario	
Improved management of WAPNP	2.94
Active planting (restoration) in WAPNP	5.12
Assisted natural forest regeneration in WAPNP	3.72
Passive forest regeneration in WAPNP	6.17
Agroforestry PES	0.29
Fencing	1.54
Riparian buffer zones	0.17
Total present value of costs	19.96
Benefits	
Erosion control	12.30
Flood attenuation	24.69
Flow regulation	5.27
Carbon retention and gains relative to BAU (savings to Sierra Leone	2.81
Nature-based tourism	9.50
Agroforestry gains from tree introductions	0.15
Total present value of benefits	54.72
Net present value	34.76
ROI	2.7

NPV and ROI of the interventions proposed under the Conservation Scenario



The estimated locations of the spatial interventions for the Conservation Scenario

WATER FUND CONSERVATION INTERVENTIONS

The Business Case analysis considered a variety of conservation interventions that could be implemented by the Water Fund under the Conservation Scenario. These include investments in interventions aimed at halting and reversing the deforestation that has taken place in the WAPNP, as well as interventions to preserve and restore forest areas in the riparian zones of the urbanized areas below the Park. The analysis also considered enabling interventions that can enhance the impact of the interventions directly aimed at forest conservation and restoration. **TNC's experiences with water funds in Cape Town, Nairobi, and elsewhere demonstrate that success depends on the intelligent combination of direct conservation and restoration actions supported by effective stakeholder engagement, cooperative landscape management, policy reform, and sustainable financing.**

EFFECTIVE PROTECTION

Protected areas are the cornerstone of biodiversity protection and a central component of conservation strategies. There is ample evidence proving that

protected areas can slow or stop deforestation compared to unprotected areas. However, their efficacy depends on the extent and intensity of nearby development, the density and capacity of park guards, and the effectiveness of management.

Situated on the edge of the city of Freetown and surrounded by urban and peri-urban communities, the WAPNP is easily accessible and faces constant encroachment. In this context, effective protection requires a smart approach that engages communities in conservation and makes use of intelligence and technology to maximize finite resources. Adaptive management has been used effectively for managing natural resources for decades, and it is ideally suited to the challenging context of the WAPNP.³⁸ When coupled with powerful information and communication technology (ICT), adaptive management allows managers to evaluate patrol performance, make decisions about where to apply resources and alter tactics and strategies in response to evolving threats. Additionally, because adaptive management is based on a continuous monitoring, feedback and improvement loop, it enables managers to recognize which activities, both protection and conservation, are working and which ones need modification



Tacugama rangers patrolling the Western Area Peninsula National Park

or restructuring.³⁹ This is critical because it allows activities to proceed despite uncertainty, and the learning that takes place leads to better management and quicker resolution of problems.

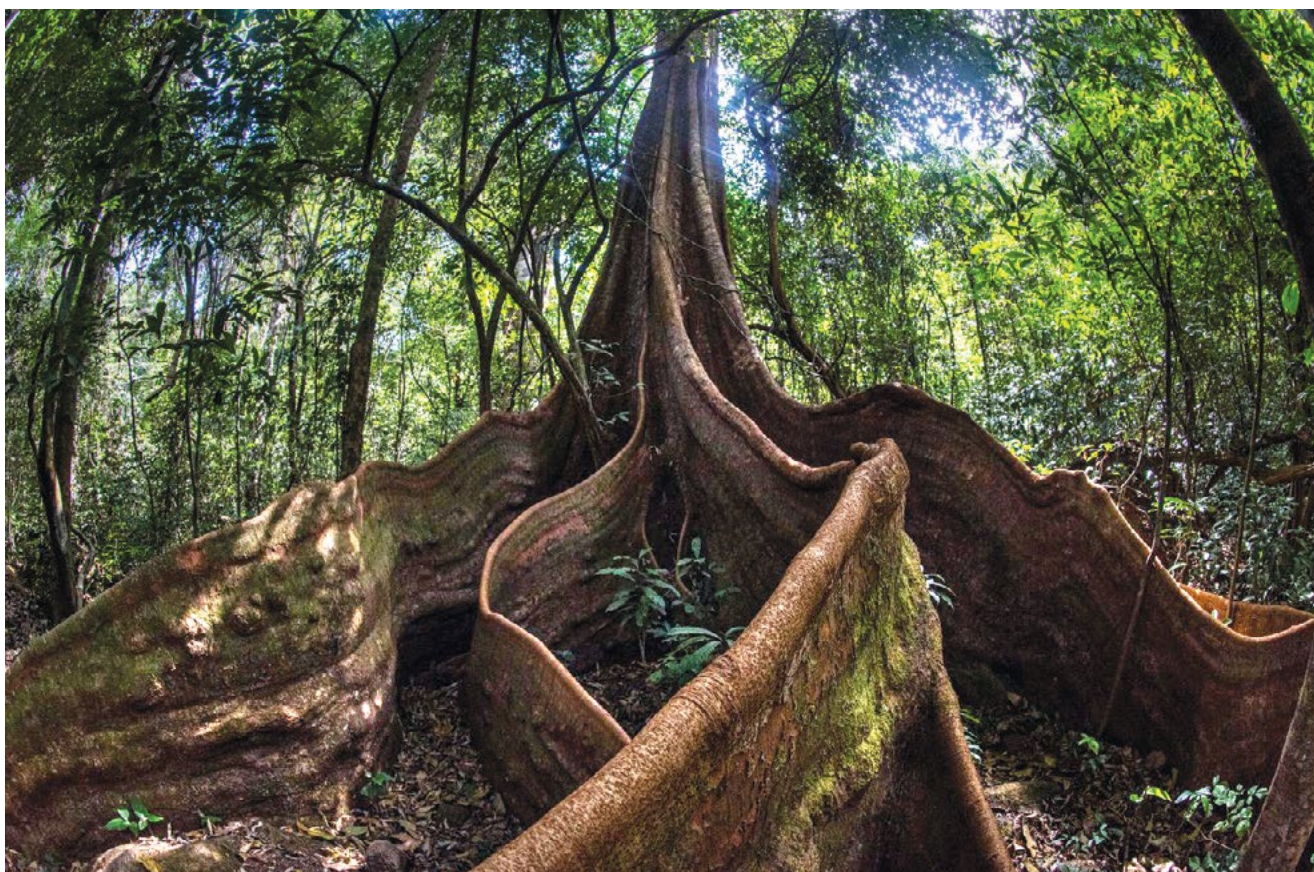
Under the Conservation Scenario, the Water Fund would ensure there are enough guards to adequately patrol the WAPNP, invest in training and equipping these guards, as well as Park management, and fence the Park's entire perimeter.

The estimated cost is based on the highly effective African Parks model, which employs an adaptive management style approach and uses the latest ICT solutions to improve enforcement outcomes. African Parks is currently managing 19 parks, covering over 14.2 million hectares across the continent, at a cost of about USD 10 per hectare. At this rate, effective protection of the WAPNP's 17,000 hectares could be achieved for USD 170,000 annually. Fencing the WAPNP's 90-kilometer perimeter would cost an additional USD 855,000 initially, and USD 44,100 annually thereafter to inspect and maintain it. Together, these measures could dramatically decrease deforestation from encroachment and illegal activities, such as charcoal production and logging.

FOREST RESTORATION

Over the past 20 years, there have been major advancements in the science and practice of restoration ecology. Thousands of ecological restoration initiatives have been completed, demonstrating that ecological restoration can significantly increase biodiversity and ecosystem services over degraded, unrestored ecosystems. This success, together with the growing recognition of the dire state of the natural world that humanity depends on, has led to a surge in interest and policy initiatives, such as the Bonn Challenge and New York Declaration on Forests, to scale up ecological restoration to some 350 million hectares of forest landscape by 2030.⁴⁰

The ecological restoration of WAPNP is critical for improving water supply, retaining sediments and mitigating the effects of flooding and landslides on the peninsula. It will have far-reaching benefits for the residents of Freetown and also for those peri-urban and rural communities of the Western Area Peninsula. Under the Conservation Scenario, the Water Fund would invest in the restoration of deforested areas of the WAPNP as well as forest areas that have been substantially degraded, with the goal of accelerating recovery of forest structure, biodiversity, and



ecological functioning toward the pre-disturbance state. Forest restoration would be achieved through active restoration, involving planting or seeding, through assisted natural regeneration (ANR), which involves interventions such as weeding, fire prevention, attracting seed dispersal, and fencing to control disturbances, and through passive regeneration which occurs naturally through protection against disturbances. ANR is more feasible at scale and is more cost-effective.⁴¹ However, some active restoration will be necessary, such as in severely degraded areas around the edges of the WAPNP or in areas where illegal agriculture has cleared the forest. For example, when Tacugama Chimpanzee Sanctuary was founded 25 years ago, the area between the Sanctuary and the main road had been completely logged out and was covered in charcoal pits. After 25 years of protection, it is now covered in dense forest. Passive regeneration covers the greatest area and involves, through protection, the natural restoration of canopy density.

Based on spatial data on the extent of deforestation and degradation, the Business Case analysis estimates 12,556 hectares of forest restoration will cost USD 5,947,050:

- Active restoration: 1,489 hectares at a cost of approximately USD 2,000/hectare initially, or USD 2,978,000, plus 6 years of maintenance to ensure success at a cost of USD 446,700. Total: USD 3,424,700;
- Assisted natural regeneration of 3,938 hectares at cost of USD 550/hectare, or USD 2,165,900, plus 6 years of maintenance to ensure success at USD 324,885. Total: USD 2,490,785; and,
- Passive regeneration of 7,129 hectares at a cost of USD 50/hectare per year. Total: USD 356,450.

AGROFORESTRY BUFFER ZONES

The delineation of buffer zones around core forest areas can be an important tool in both conserving areas of ecological importance and in achieving development objectives.⁴² Multi-use buffer zones surrounding a protected area serve the purpose of protecting forest resources by providing ecological buffering functions while also providing resources, such as fuelwood and areas for agricultural activities. Buffer zones function as physical barriers to human encroachment, reduce edge effects and enhance ecosystem services provided by the protected area.^{43,44}

Under the Conservation Scenario, Payments for Ecosystem Services (PES) would be used to promote agroforestry species on 1,152 hectares within the designated buffer zones around the WAPNP. To increase the effectiveness of this intervention, the Water Fund would target areas where illegal activity is highest and ensure that ownership vests with those who purchase plots within the buffer zones. Ownership encourages self-enforcement of good land use management practices, as well as the sustainable harvesting of wood commodities. The agroforestry zones would be based on the intentional integration of environmentally suitable trees and shrubs into crop farming for the purpose of providing fruit, fuelwood, fodder, and timber, among other services.⁴⁵ A benefit of agroforestry is that it can be undertaken at various scales, from small household gardens which are less than a hectare in size to larger landscape levels covering hundreds of hectares. It is also suitable for implementation in both rural and peri-urban environments.

Agroforestry is an alternative livelihood activity ideally suited for the buffer zone around the WAPNP. In contrast to the slash and burn agriculture that is currently practiced by many people living along the Park boundary, which tends to damage and simplify ecosystems, agroforestry can play a role in conserving and even restoring biodiversity and ecosystem functions.^{46,47} Agroforestry practices also provide opportunities for landowners to diversify and strengthen the resilience of their production systems, which can help them improve food security, reduce poverty and lessen the impact of climate change.^{48,49,50}

The REDD+ project currently underway in the Gola Rainforest National Park, as well as a number of large, ongoing agroforestry zones in Sierra Leone could inform and substantially increase the success of the proposed agroforestry buffer zones. The estimated cost per hectare for establishing agroforestry PES is USD 150 per hectare, with an annual incentive payment of USD 10 per hectare afterwards for 15 years. Thus, the total cost for the agroforestry PES intervention is projected to be USD 345,600. The Business Case does not estimate the cost of a more comprehensive agriculture program in the buffer zones. However, if the Water Fund invests in such a program, the evidence indicates that the rural livelihood gains will more than offset the cost of agriculture extension services and other support provided to farmers.



RIPARIAN BUFFER ZONES

Riparian buffer zones are natural or semi-natural vegetated areas along rivers and streams that contribute to water security by intercepting sediments, nutrients, pesticides, and litter in unchanneled surface runoff, thereby reducing the amount of pollutants entering rivers and streams. They can also help to reduce floods by slowing water entering streams. Assuming appropriate vegetation types, riparian buffers can also be important for reducing streambank erosion and providing stabilisation, both by reducing the velocity of water running off from adjacent areas and by anchoring the soil. They also provide habitat and linear wildlife corridors through the landscape — increasingly important functions as adjacent areas are sterilised by urban development.

Under the Conservation Scenario, the Business Case analysis considered the rehabilitation and enhancement of 53 hectares of riparian buffer zones in areas of Western Area Peninsula where there are sections of river that are severely degraded. These riparian buffer zones are situated in the upper catchment areas of the northern peak section of the Peninsula, above the largest urban areas. Riparian buffer areas, extending 30 meters from either side of the main river or stream channel, would be rehabilitated using a combination of grading,

landscaping, and seeding to restore vegetative cover. The cost of rehabilitation can vary greatly depending on specific site conditions and the level of degradation. Based on the cost of similar projects carried out elsewhere, the Business Case projects an average cost of USD 2,350 per hectare, or USD 124,550 for all 53 hectares.

ENABLING INTERVENTIONS

The success of the proposed conservation interventions depends on the Water Fund's ability to mobilize stakeholders at all levels. It is critical to enlist the support of communities as stewards and frontline defenders of their natural resources, yet they cannot effectively perform this role without reliable, effective support from park guards and other local law enforcement. Likewise, those charged with environmental law enforcement depend on authorities to develop and promote the implementation of environmental policies and regulations capable of achieving the Water Fund's protection, conservation and restoration goals.

The process of establishing this enabling context is already underway. In 2020, with support from the RAIN project, CRS facilitated the creation of a RAIN Technical Committee comprised of key stakeholders. This committee was the driving force behind the commissioning of this Business Case



Students visiting the Tacugama Chimpanzee Sanctuary

analysis. Additionally, an Inter-ministerial Task Force on the Protection of Western Area Catchments has been established. Under the Conservation Scenario, the Water Fund will continue to work to harmonize interests and priorities of these and other stakeholders. It will also advocate for policies to incentivize the conservation and protection of the ecological infrastructure the people of the Western Area Peninsula depend on. For example, the Water Fund could advocate for policies that promote more sustainable land uses, such as agroforestry around the WAPNP, formal physical planning and curb illegal issuing of land titles.

Additionally, because community buy-in and participation are essential to the protection and conservation of the Western Area Peninsula's ecological infrastructure, the Business Case envisions a broad and sustained campaign to raise awareness about key issues and to engage the peninsula's water users. This includes investment in a multimedia campaign to disseminate messages about the purpose of the Water Fund, the importance of the Western Area Peninsula's forests and the associated economic value of the forest in terms of the ecosystem goods and services,

especially water security, that they provide to the people of Freetown and the greater peninsula.

The Business Case is also based on the premise that the Water Fund will seek broad and sustained community engagement. Due to their proximity to the WAPNP, surrounding communities are situated to either participate in activities that degrade the forest or to work with the authorities to detect, report and prevent illicit activities that damage the ecological infrastructure and to contribute to its conservation and restoration through changes in the ways they interact with the forest ecosystem. Successful water funds involve community-level stakeholders, such as water user associations, in the decision-making structure through their representation on the steering committees and through participatory assessment, planning and monitoring processes. The Water Fund stakeholder engagement effort will benefit from CRS' nearly 60 years of experience working with communities on the peninsula, which includes numerous Community Disaster Management Committees (CDMC) and two multi-stakeholder Catchment Area Platforms (CAP) created during the RAIN project in 2019.

CO-FINANCING THROUGH CARBON CREDITS

In addition to the standard funding mechanism of public-private partnership, the Water Fund will seek to develop mechanisms for co-financing. In particular, there is significant potential to fund conservation efforts through the sale of carbon credits through programs such as the Reducing Emissions from Deforestation and Forest Degradation (REDD+).

In Africa, the average carbon offset price in 2018 was recorded as USD 4.20 per metric ton of Carbon Dioxide Equivalent (tCO₂e).⁵¹ Preliminary findings from the “Conservation of the Western Area Peninsula Forest Reserve and its Watersheds” REDD+ Project suggested a mitigation potential that ranged from 57,000 tCO₂e to 124,000 tCO₂e per year. Based on the average price of USD 4.20 this equates to a total potential revenue from the sale of carbon credits of USD 239,400 to USD 520,800 per year.

LIKELY IMPACTS OF WATER FUND ACTIVITIES

The Business Case analysis demonstrates that the activities proposed under the Conservation Scenario are likely to significantly improve water security and mitigate flood hazards for the population of Freetown and the Western Area Peninsula. The Water Fund would directly contribute to achieving targets under the Mayor’s Transform Freetown resilience cluster and Goal 3 of the NWRMA’s 2019-2023 strategic plan, which states that ‘watersheds and catchments are protected against deforestation and other environmental problems’

IMPROVED WATER SECURITY

Water security will be improved through better flow regulation, erosion control, and reduced sedimentation of water supply reservoirs.

The Business Case evaluated flow regulation services in terms of water availability during the dry season, measured as the value of avoided costs in purchasing water from vendors in months where instream yields fall short of demand. Under the Conservation Scenario, dry season flows increased by approximately 11,000 m³, amounting to an estimated annual cost saving to poor households of USD 436,941 per year. The benefits were highest in the urban sub-catchments in the north of the peninsula where demand was estimated to be highest. In the

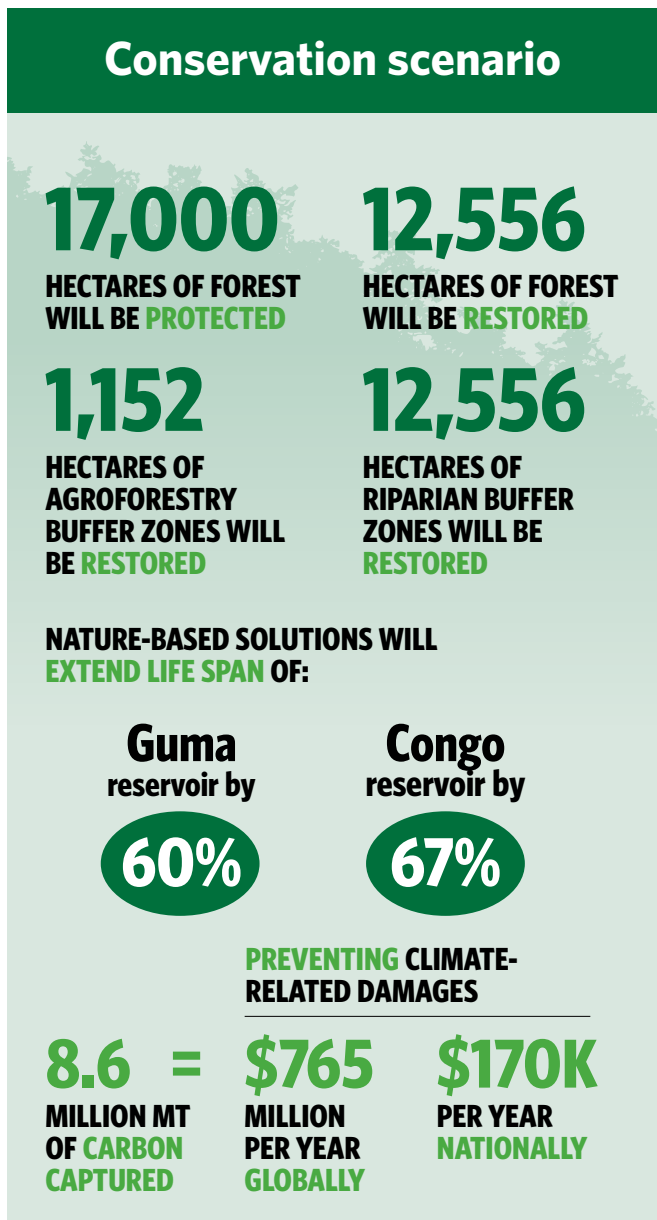
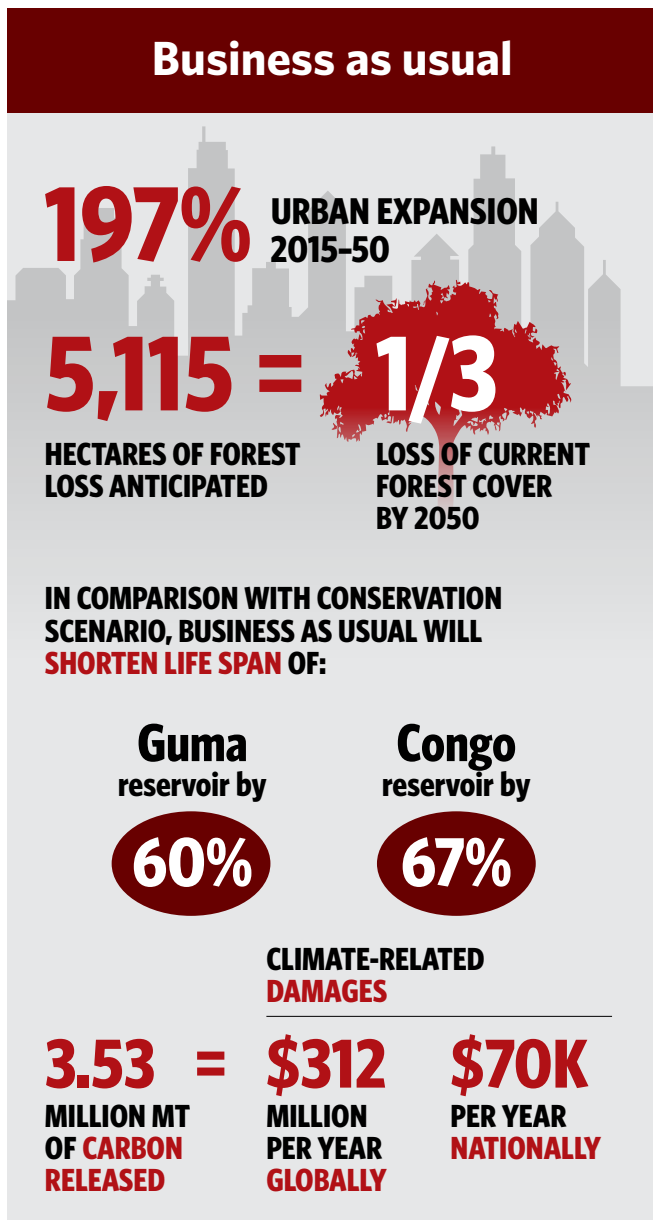
rural areas of the peninsula the overall number of households was lower and therefore, even though reliance on rivers and streams was higher, total demand was low, resulting in a minimal impact in the sub-catchments further south of the peninsula.

In addition to helping to ensure the availability of water for those who obtain it directly from the peninsula’s rivers, streams and springs, conservation and restoration activities will contribute to improved water quality for those whose drinking water originates in the catchment areas of the WAPNP. This is critical because turbidity and suspended solids have been shown to be correlated with bacterial pathogen content in a number of studies. It is likely that a reduction in sediment being carried into streams will have some positive effect on health outcomes, most likely in terms of reduced incidence of diarrhoea, which can be both costly and deadly when adequate treatment is unavailable.

The erosion control benefit was quantified as the amount of soil loss avoided per year in the catchments of the Guma and Congo Reservoirs, as well as the amount of soil loss avoided per year to downstream aquatic environments. Conservation and restoration activities in and around WAPNP are projected to reduce the amount of sediment entering the Guma Reservoir by 60% per year, relative to BAU conditions. A total of 4,347 tonnes of sediment would be abated each year relative to the BAU for Guma alone. The avoided sedimentation of the two reservoirs was valued using the avoided damage costs of dredging, which included the costs of mechanical dredging and the cost of removing dredge spoil off site. The cost savings total USD 842,500 (USD 531,500 for Guma and USD 311,000 for Congo) per year, and the ROI of investment in conservation and restoration is nearly ten times higher than if the problem were solved by dredging. Most importantly, the reduced sedimentation anticipated under the Conservation Scenario would increase the lifespan of the Guma Reservoir by a minimum of 60%.

MITIGATION OF FLOODS & LANDSLIDES

The Business Case calculated the value of reduced floods based on flood damage avoided in the main urban area of Freetown. The analysis focuses on direct market losses in the form of damage to buildings, because they can be estimated using observable data, rather than non-market losses and



Likely impacts of BAU versus the Conservation scenario

indirect losses, which are more difficult to quantify. Additionally, it is important to note that due to extremely high rainfall, widespread building in floodplains and a lack of stormwater infrastructure, forest conservation and restoration activities alone will not be sufficient to mitigate flooding in the lower parts of the city.

Areas of flooding were mapped based on streamflow generated under the BAU and Conservation Scenarios. This information was used to estimate the impacts on buildings in the flooded areas in each of the seven urban watersheds in Freetown where flooding is a major problem. The difference in the number of buildings affected

between the BAU and Conservation Scenarios represents the flood attenuation service provided by conserved and restored forests and riparian buffer zones. The damage costs avoided were converted into expected annual losses (EAL) by considering the probability that a given storm will occur.

The Conservation Scenario would reduce the expected annual damage costs from flooding across all seven urban watersheds by some USD 2.05 million, with an average of 74 fewer buildings being inundated compared to the BAU Scenario. This results in a ROI of USD 1.65 for every USD 1 invested in restoration activities.



While the impact of deforestation on landslides was not modelled during the Business Case analysis, the results of a 2018 World Bank landslide risk and hazard assessment of Freetown provide estimates of the average annualised landslide risk and associated average annual losses.⁵² This data highlights the current situation and potential future impacts under the BAU Scenario. Using the mean estimate, average annual direct market losses in the form of damage to buildings and roads are projected to be USD 360,000. The upper estimates indicate that direct market losses could reach as much as USD 710,000 per year.

ADDITIONAL BENEFITS OF CONSERVATION

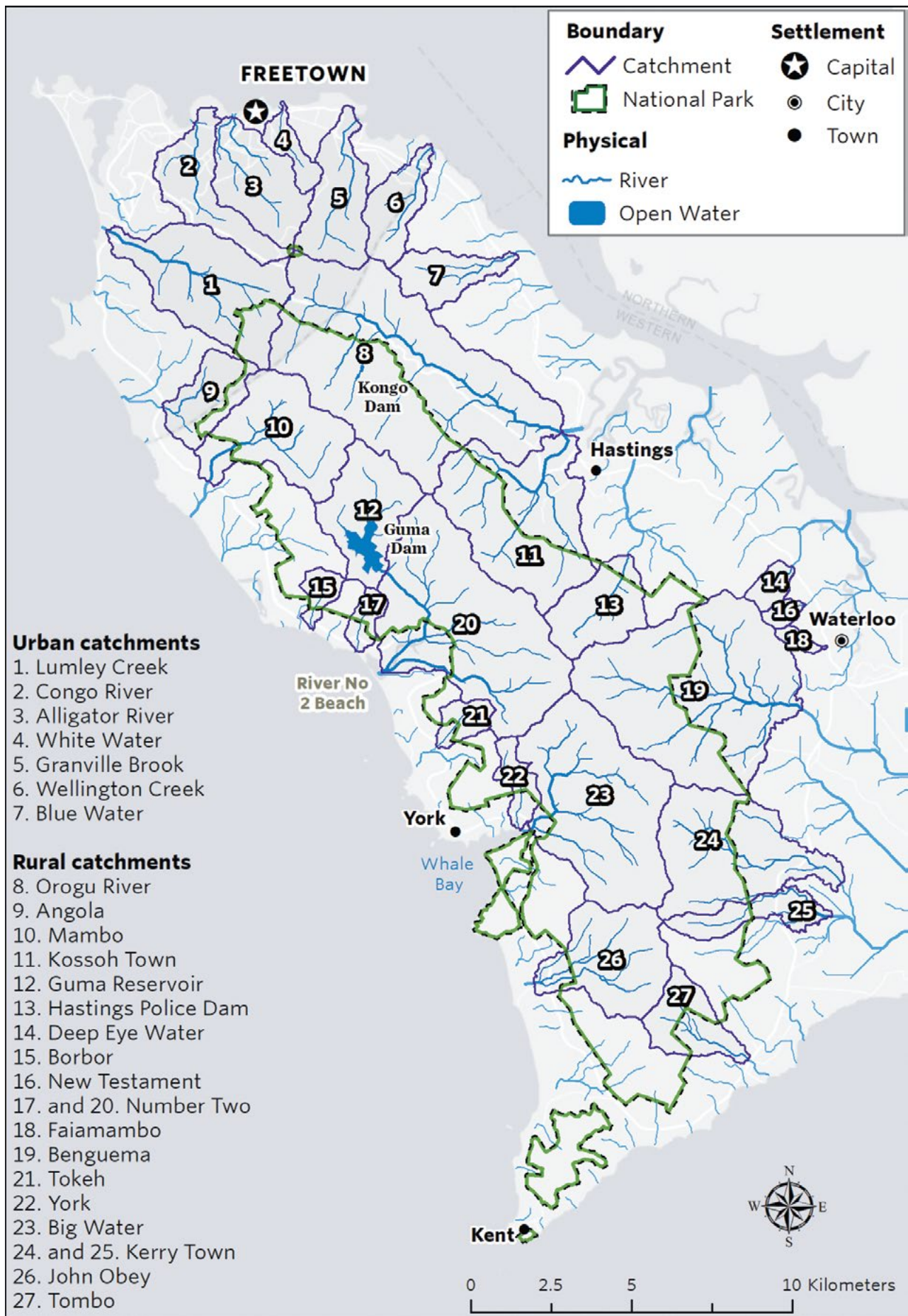
SUSTAINABLE RURAL LIVELIHOODS

The conservation and restoration activities considered by the Business Case analysis present multiple sustainable livelihood alternatives for the populations living in the vicinity of the WAPNP. Active planting and ANR activities inside the WAPNP and in riparian buffer zones require intensive labour, and with large areas of forest targeted for restoration with maintenance and monitoring occurring over a six-year period, a dedicated restoration team would need to be employed, providing employment opportunities for unskilled labourers. Additionally, the Water Fund investments in substantial agroforestry buffer zones would provide substantial livelihood benefits to hundreds more households.

While livelihood opportunities associated with the active restoration and ANR activities will mostly end after six years, the livelihood benefits of agroforestry will continue indefinitely because of the participatory capacity building program envisioned by the Water Fund. There are four main pathways through which agroforestry contributes to livelihoods: food production, health and nutrition, provision of fuel wood, and income generation.⁵³ Agroforestry enhances livelihoods by allowing farmers to produce food, fodder for livestock, medicines, fuelwood, as well as myriad other timber and non-timber forest products (NTFPs) that can be directly consumed or sold on the market to generate income to pay expenses related to other priority needs, such as housing and education.⁵⁴ Agroforestry is an inherently sustainable livelihood activity because it diversifies income and food sources, thereby increasing people's resilience to shocks, such as food price hikes, and it also helps regenerate the natural resource base upon which people depend, thus improving farm resilience and productivity for future generations.

Most poor African households already pursue livelihood diversification as a strategy for coping with economic and environmental shocks and as a means of enhancing income.⁵⁵ However, the majority of households, especially in rural areas, receive more than 75% of their income from a single source, and this source is most often agricultural income.⁵⁶ For households already engaged in farming in forest ecosystem, such as the region around the WAPNP, agroforestry represents a viable livelihood option that can diversify both farm and nonfarm activities to help households deal





Urban and rural catchments on the Western Area Peninsula

with recurrent shocks and lean periods and make livelihoods more sustainable.

A number of recent studies demonstrate the important contribution agroforestry can make to household income in sub-Saharan Africa. In Ethiopia, Malawi, Nigeria, Tanzania and Uganda, a third of households engage in agroforestry, and trees and tree crops account for an average of 17% of the total annual gross income for tree-growing households.⁵⁷ Researchers found fruit trees and cash crop trees to be the two most popular types of trees. Growing trees for timber and fuelwood is much less prevalent, but not insignificant. In Burkina Faso, Mali and Senegal, close to half of households obtain income from agroforestry, with fuelwood, fodder and fruit contributing between 10% and 24% of the total household income.⁵⁸ Finally, research in neighbouring Liberia provides compelling evidence that adoption of agroforestry practices can benefit households through enhanced crop yields, additional food sources, and income diversification.⁵⁹ Households practicing agroforestry reported significantly greater food security and incomes than households that engaged in monoculture agriculture.

NATURE-BASED TOURISM

In 2019, tourism generated USD 156.8 million in Sierra Leone, or 4% of the country's total economic output. It is estimated that only USD 500,000 of this revenue resulted from visits to WAPNP. This is not surprising given that tourism opportunities in the WAPNP are currently limited to the Tacugama Chimpanzee Sanctuary, which is open to tourists and provides accommodation in six small eco-lodges. Nevertheless, given WAPNP's wealth of biodiversity and natural beauty and its proximity to Freetown, it is well positioned to attract tourists.



Tacugama Ecolodge

To protect this sensitive ecosystem, high-value, low-volume ecotourism would be most appropriate and through careful planning and development could generate significant revenues. Under the Conservation Scenario, which estimates a tourism growth rate of 7% per year, tourism in the WAPNP could generate USD 3.92 million annually by 2050.

CARBON STORAGE

Natural ecosystems make a significant contribution to global climate regulation through the sequestration and storage of carbon. Tropical forests, such as those protected by the WAPNP, play an especially critical role in the global carbon cycle.^{60,61} Under the Conservation Scenario, the protection of the WAPNP would stop the loss of 5,115 hectares of forest, avoiding the release of 3.53 million tons of carbon that if released would result in global climate-related damages of USD 312 million per year and national damages of USD 70,000 per year. Additionally, the strict protection and restoration of 12,556 hectares of forest would ensure the sequestration and storage of over 8.6 million tonnes of carbon annually, thus avoiding global and national damage costs of USD 765 million and USD 170,000 per year, respectively.

BIODIVERSITY CONSERVATION

Placing an economic value on the services that ecosystems provide for human benefit is a useful tool for decision makers. It makes these benefits



explicit, which allows policy makers to consider trade-offs and various alternatives.⁶² However, nature also has intrinsic value — a value in its own right, independent of human uses. Economists sometimes attempt to quantify the intrinsic value of nature, which they conceptualize as its non-use value and seek to describe in monetary terms the worth that people ascribe to ecosystem services that they do not directly or indirectly use yet view as affecting their wellbeing.⁶³

Indeed, the conservation of the WAPNP would contribute to multiple non-use values, including the existence value of endangered species, such as the Western Chimpanzee; the habitat preservation value for the hundreds of species that live in the Park; and the bequest value of preserving one of the most significant remnants of Upper Guinean forest. The protection of the tremendous biodiversity in the WAPNP is also important for Sierra Leone to meet its obligations under the Convention of Biological Diversity.

The Business Case analysis did not attempt to estimate non-use values under the Conservation Scenario, yet there are significant benefits that should be acknowledged. Moreover, economic and

intrinsic valuation need not be mutually exclusive.⁶⁴ When we humans view our species as being part of the environment rather than separate from it, the benefits of conservation become plain to see. This worldview values the provisioning, regulating and supporting services that are vitally important to human and non-human life; embraces the cultural services (aesthetic, physical and mental health, recreation, and spiritual benefits) that are often overlooked even though they too are essential to human wellbeing; and acknowledges that non-human life, in all its myriad forms, has a right to exist and thrive alongside humanity.

STAKEHOLDERS ENGAGED

The Western Area Peninsula Water Fund's success depends on the creation of a broad base of support from across the Western Area Peninsula and beyond. As a key step towards establishing the Water Fund, CRS has conducted deep and meaningful engagements with a range of key institutional stakeholders. CRS has worked closely with the Ministry of Water Resources (MoWR) to promote nature-based solutions as the appropriate



Engineer Phillip K. Lansana, Minister of Water Resources (center), Dr. Dennis Sandy, former Minister of Lands, Housing and Country Planning (left), and Professor Foday Jaward, Minister of the Environment (right) at a meeting of the Inter-ministerial Task Force on the Protection of Western Area Catchment.

remedy for the growing water security challenges facing the Western Area Peninsula, and MoWR was consulted as part of the development of this Business Case. The National Water Resources Management Agency (NWRMA) also provided significant input and support for this process.

The RAIN Technical Committee served as an effective platform for multi-stakeholder and multi-sectoral coordination. It could be re-activated and leveraged in the next phase of the Water Fund. Key members of the RAIN Project Technical Committee include:

- Ministry of Water Resources (MoWR);
- Ministry of Agriculture, Forestry and Food Security (MAFFS);
- Ministry of Environment (MoENV);
- Ministry of Lands, Housing and Country Planning (MLHCP);
- Ministry of Local Government (MoLG);
- National Water Resources Management Agency (NWRMA);
- National Protected Area Authority (NPAA);
- Environment Protection Agency (EPA);

- Freetown City Council (FCC);
- Western Area Rural District Council (WARD-C);
- Guma Valley Water Company (GVWC);
- Sierra Leone Electricity and Water Regulatory Commission (EWRC);
- Sierra Leone Urban Research Center (SLURC); and
- Water Sanitation & Hygiene Network (WASH-Net).

As a result of this outreach and collaboration, the recently established Inter-ministerial Task Force on the Protection of Western Area Catchments has endorsed nature-based solutions and prioritised the establishment of the Water Fund. It has also pledged to support the establishment of the Water Fund.

Based on their active and effective participation in both the RAIN Technical Committee and Inter-Ministerial Task Force, CRS and TNC trust that these organisations will continue to play an important role in this initiative as a water fund steering committee is developed.

Additionally, other important stakeholders that were involved in the RAIN Project are expected to

participate in the design and implementation of the Water Fund. These include community-based organizations such as the research and academic institutions, Western Area Community Disaster Risk Management Platform (WACDRMP), two multi-stakeholder Catchment Area Platforms (CAP), and 30 Community Disaster Management Committees (CDMCs) that were established and strengthened as part of RAIN. By partnering with organisations such as the Centre of Dialogue on Human Settlement and Poverty Alleviation (CODOHSAPA)/ Federation of Urban and Rural Poor (FEDURP), CRS was able to secure community buy-in and effectively establish and strengthen CDMCs, as part of RAIN. These entities fill an important role in the Western Area Peninsula's disaster preparedness and response capacity and could be great allies in the important step of engaging communities and water users in the Water Fund.

LIMITATIONS OF THE STUDY

Several challenges presented themselves when carrying out technical analyses for the Business Case. Physical models, such as those used for the hydraulic, hydrologic, and morphologic modelling, require field measurements over time for variables such as rainfall, streamflow, soil erosion, and changing reservoir volume, among others. This data was unavailable, which required researchers to rely heavily on satellite-derived datasets. Satellite data sets selected for use in this study are those routinely used in physical models globally and that have been vetted by the scientific community. However, they are not field measurements, and, therefore, may present information in a more generalized way.

The suspension of most international travel and social distancing rules implemented due to the COVID-19 pandemic presented additional barriers to data collection. It was impossible to implement field campaigns, local interviews with experts and workshops that would normally be undertaken as part of a study of this kind to improve satellite products or to verify physical modelling assumptions and results. While researchers communicated regularly through virtual meetings, more extensive joint field campaigns involving local experts and modelers are generally required to achieve the best results in data scarce regions.

Similarly, the pandemic's travel and meeting restrictions significantly limited stakeholder engagement. This resulted in a focus on more broad landscape scale interventions and less emphasis on interventions to benefit smaller outlying communities that require more locally designed or specialized interventions.

Once field engagements are permitted, researchers will refine the analyses to include field verification and more in-depth sensitivity analyses of the various models and tools used in this Business Case. Such activities are important before diving more deeply into other complex modelling activities involving climate change and landslide modelling.

The purpose of the Business Case report is to establish and quantify links between the proposed Water Fund interventions in the watershed and specific outcomes that generate benefits for individual investors, thereby demonstrating the value of establishing a Water Fund. The Business Case is not intended to provide detailed analysis of how the proposed interventions will be rolled out and how they will impact specific stakeholders on the ground. This analysis requires additional research and stakeholder engagement, which will be done as part of the development of a detailed implementation plan in the next phase of the Water Fund's establishment.

NEXT STEPS

The Business Case analysis is an initial step in the creation of the Water Fund. The Advisory Committee, with support from CRS and TNC, will use this document and the relationships that have been fostered during its creation to establish a robust and transparent public-private governance body — the Water Fund Steering Committee. An immediate next step for CRS and TNC will thus be to cement ties with members of the RAIN Project Technical Committee and Inter-Ministerial Task Force on the Protection of Western Area Catchments and form new alliances across a broad spectrum of key stakeholders. It is anticipated that the Ministry of Tourism and Cultural Affairs, Sierra Leone Breweries, Tacugama Chimpanzee Sanctuary, Conservation Africa, as well as water user association and local communities within the catchment areas will be key additional

stakeholders in the next phase of creating the Water Fund. Furthermore, CRS with support from TNC will broaden and intensify engagements with government stakeholders at all levels, development partners, the private sector, civil society organisations, as well as research and academic institutions with an eye towards socialising interventions proposed in the Business Case and catalysing resource mobilisation efforts for their effective implementation.

In the coming years, based on the experience of Water Funds around the world including those in Cape Town and Nairobi, the Water Fund will work with stakeholders to create a long-term (e.g., five years) ecological infrastructure strategic plan for the Western Area Peninsula. This strategic plan will be designed to set near-term and long-term objectives, create clarity, focus, and a shared roadmap for action at scale. The Water Fund will use the strategic plan to guide implementation and associated monitoring and evaluation, in partnership with the management of the WAPNP and landowners around WAPNP. Putting the strategic plan in place will include building the institutional capacity of the Water Fund to lead or support restoration efforts and creating mechanisms to help ensure sustained funding. Over time, it is expected that the Water Fund will evolve into a stand-alone organisation with a board of trustees that manages sinking and endowment funds to ensure lasting impact at the scale of the Western Area Peninsula.

In parallel to developing the WAPNP strategic plan and mobilising resources for its implementation, urgent conservation interventions (such as fencing the WAPNP's 90-kilometer perimeter) and demonstration projects will be identified and prioritised for implementation as early as 2021, depending on available funding. On-the-ground demonstration of which interventions could be scaled effectively in the Western Area Peninsula will be useful in mobilising partners and capital for the Water Fund. Robust monitoring and evaluation, in collaboration with academic and other scientific partners, will also be critical to demonstrate impact against agreed-upon restoration and water yield targets, as well as clarifying ecological and socio-economic uncertainties that have been highlighted through the development of this Business Case.

CONCLUSION

The forests of the Western Area Peninsula and their wildlife are under increasing pressure. Urban expansion and unsustainable land-use practices are impacting both the quality and quantity of water supply to one of Sierra Leone's most important economic regions, including the capital Freetown. Changes to the way in which the watershed is valued and managed will not happen unless a new approach is taken which includes strict protection of remaining forests and restoration of those that have been degraded. This requires a long-term commitment to investment in green infrastructure and the enabling environment required to ensure they succeed.

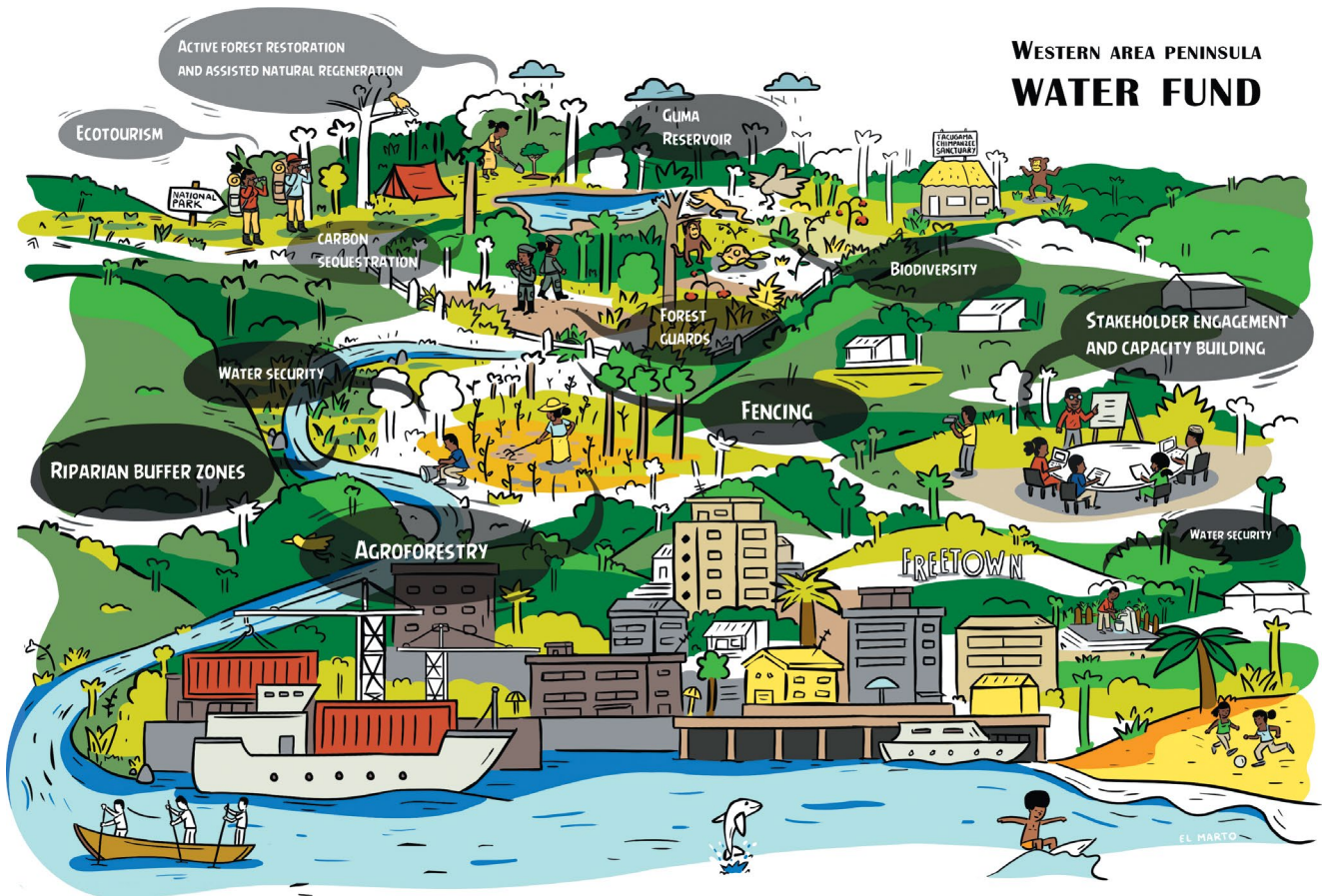
The results of the Business Case demonstrate a clear economic basis for the establishment of the Water Fund. A USD 20 million investment in Water Fund interventions is likely to return USD 55 million in economic benefits over a 30-year timeframe. In other words, for every USD 1 invested by the Water Fund, stakeholders on the peninsula will see at least USD 2.70 worth of benefits accrued.

Given the scarcity of data, the calculation of benefits was conservative. Where uncertainty existed, benefit streams were scaled down to avoid overestimation, and sensitivity analysis shows that costs could be increased and benefits reduced further while still maintaining economic viability. When less conservative but highly plausible benefits are included, such as the global costs avoided through carbon storage, the returns of the fund increase rapidly, even while several potentially important benefit streams remain non-monetised.

Making the shared vision for the Water Fund into a reality will require the continued dedication of the members of the Advisory Committee and support from new public and private stakeholders, including the population of the peninsula. Funding and operational support for the Water Fund has primarily been through CRS, TNC and donors such as TCCF to date. CRS and TNC will continue to act as a catalyst for the Water Fund as it transitions to an independent organisation, yet the Water Fund's success as an independent entity will depend on expanding public and private financial support. That support is anticipated to be a mix of funding

from major Western Area Peninsula water users, who recognise the clear Business Case behind this effort, and from generous donors with interests in the environment and development sectors given the clear value of the Water Fund to both.

If the Water Fund receives this support, it can be an effective mechanism for mainstreaming and scaling the nature-based solutions needed to protect and restore the Western Area Peninsula for people and nature. A monitoring and evaluation system will be established and progress tracked after the start of implementation.



Artist's depiction of the Conservation Scenario implemented by the Western Area Peninsula Water Fund

APPENDIX

This Business Case document distils a great deal of technical work which could not be given adequate attention in the above text. Interested readers will find three appendices available as electronic supplements at <https://www.crs.org/stories/freetown-water-fund-business-case-technical-reports>, each detailing key technical aspects of the study:

URBAN AND RURAL MORPHOLOGICAL MODELLING METHODOLOGY AND RESULTS

https://www.crs.org/sites/default/files/urban_and_rural_morphological_modeling_methodology_and_results_swat_update.pdf

SWAT (SOIL AND WATER ASSESSMENT TOOL) SIMULATION OF FOREST INTERVENTIONS ON STREAM DISCHARGE AND SEDIMENT YIELD IN THE WESTERN AREA PENINSULA, SIERRA LEONE

https://www.crs.org/sites/default/files/wapwf_swat_report_0.pdf

REPORT ON STAKEHOLDER ASSESSMENT OF THE WESTERN AREA WATER CATCHMENT AREAS

https://www.crs.org/sites/default/files/final_report_wa_catchment_assessment_report_part_1_0.pdf

ENDNOTES

- 1 Allen, C.R., Fontaine, J.J., Pope, K.L., & Garmestani, A.S. (2011). Adaptive Management for a Turbulent Future. *Journal of Environmental Management* 92:1339-1345.
- 2 Crouzeilles, R., Ferreira, M.S., Chazdon, R.L., Lindenmayer, D.B., Sansevero, J.B.B., Monteiro, L., Iribarrem, A., Latawiec, A.E. & Strassburg, B.B.N. (2017). Ecological restoration success is higher for natural regeneration than for active restoration in tropical forests. *Sci. Adv.* 3, 1-8.
- 3 *Ibid.*
- 4 Soto Rios, P.C., Deen, T.A., Nagabhatla, N., & Ayala, G. (2018). Explaining Water Pricing through a Water Security Lens. *Water* 10(9): 1173.
- 5 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.
- 6 African Water Facility, African Development Bank. (2018). Greater Freetown Water Supply and Sanitation Master Plan and Investment Studies — Project Appraisal Report.
- 7 African Water Facility, African Development Bank. (2018). Greater Freetown Water Supply and Sanitation Master Plan and Investment Studies — Project Appraisal Report.
- 8 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.
- 9 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.
- 10 Please see the Stakeholder section on page 25 for a list of the task force and committee members contributing to the conservation and restoration of the peninsula's forest and water resources.
- 11 Soto Rios, P.C., Deen, T.A., Nagabhatla, N., & Ayala, G. (2018). Explaining Water Pricing through a Water Security Lens. *Water* 10(9): 1173.
- 12 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.
- 13 Funding for the Business Case was provided in part by the Replenish Africa Initiative (RAIN) funded by the Coca Cola Foundation (TCCF) through the Global Environment and Technology Foundation (GETF). RAIN is TCCF's flagship African program contributing to helping Africa achieve the United Nation's Sustainable Development Goals on clean water and sanitation access. It aims to improve the lives of six million people in Africa through WASH and other water-based initiatives.
- 14 Postel, S. L. & B. H. Thompson. (2005). Watershed protection: Capturing the benefits of nature's water supply services. *Natural Resources Forum* 29(2): 98-108.
- 15 Letley, G. & Turpie, J. (2020). Business Case Development for the Western Area Peninsular Water Fund, Sierra Leone. Anchor Environmental Consultants (Pty) Ltd.
- 16 These three technical studies are attached as appendices: National Water Resources Management Agency. (2020). Report on Stakeholder Assessment of The Western Area Water Catchment Areas; Baker, T., Srinivasan, R., & Apse, C. (2020) SWAT (Soil and Water Assessment Tool) Simulation of Forest Interventions on Stream Discharge and Sediment Yield in the Western Area Peninsula, Sierra Leone. The Nature Conservancy; and, Smith, V., Cotugno, A., & Shugart-Schmidt, W. (2020). Urban and Rural Morphological Modelling Methodology and Results. Villanova University Center for Resilient Water Systems.
- 17 Guma Valley Water Company. (2008). Water supply improvement plan. As part of the Strategic Water Supply and Sanitation Framework. Freetown, Sierra Leone.
- 18 African Water Facility, African Development Bank. (2018). Greater Freetown Water Supply and Sanitation Master Plan and Investment Studies — Project Appraisal Report.
- 19 *Ibid.*
- 20 Statistics Sierra Leone. (2015). 2015 Population and Housing Census. Summary of Final Results. Planning a Better Future.
- 21 *Ibid.*
- 22 World Bank. (2013). WB Confronts US\$260 Billion a Year in Global Economic Losses from Lack of Sanitation. Available from <https://www.worldbank.org/en/news/press-release/2013/04/19/wb-confronts-us-260-billion-a-year-in-global-economic-losses-from-lack-of-sanitation>
- 23 World Health Organization. (2014). Investing in Water and Sanitation: Increasing Access, Reducing Inequalities. UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water.
- 24 Fayiah, M., Otesile, A.A. & Mattia, S.B. (2018b). Review of challenges confronting the implementation and enforcement of environmental policies and regulations in Sierra Leone. *Int. J. Adv. Res.* 6, 530-541.
- 25 NPA. (2017). Status Report on the Western Area Peninsula National Park (WAPNP). National Protected Area Authority: Freetown, Sierra Leone.
- 26 Biggs, D., Cooney, R., Roe, D., Dublin, H.T., Allan, J.R., Challender, D.W.S., & Skinner, D. 2017. Developing a Theory of Change for a Community-Based Response to Illegal Wildlife Trade. *Conservation Biology* 31(1):5-12.
- 27 Memorandum of Understanding for the management and protection of the Western Area Catchments.
- 28 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.
- 29 Harris, D., Kooy, M. & Jalloh, G. (2012). The political economy of the urban water-pricing regime in Freetown, Sierra Leone. London ODI.
- 30 World Bank. (2017). Sierra Leone: Rapid Damage and Loss Assessment of August 14, 2017 Landslides and Floods in the Western Area. Washington D.C.
- 31 *Ibid.*
- 32 World Bank Group. (2018). Freetown: Options for Growth and Resilience. World Bank, Washington, DC.

- 33 World Bank. (2017). Sierra Leone: Rapid Damage and Loss Assessment of August 14, 2017 Landslides and Floods in the Western Area. Washington D.C.
- 34 International Union for Conservation of Nature's Red List of Threatened Species. 2020. <https://www.iucnredlist.org>
- 35 De Vos, J.M., Joppa, L.N., Gittleman, J.L., Stephens, P.R., & Pimm, S.L. (2015). Estimating the Normal Background Rate of Species Extinction. *Conservation Biology* 29(2): 452-462.
- 36 Brncic, T.M., Amarasekaran, B. & McKenna, A. (2010). Sierra Leone National Chimpanzee Census. Freetown, Sierra Leone.
- 37 *Ibid.*
- 38 Allen, C.R., Fontaine, J.J., Pope, K.L., & Garmestani, A.S. (2011). Adaptive Management for a Turbulent Future. *Journal of Environmental Management* 92:1339-1345.
- 39 *Ibid.*
- 40 Perring, M.P., Erickson, T.E., & Brancalion, P.H.S. (2018). Rocketing restoration: enabling the upscaling of ecological restoration in the Anthropocene. *Restoration Ecology* 26(6): 1017-1023.
- 41 FAO. (2019). Restoring forest landscapes through assisted natural regeneration (ANR) — A practical manual. Bangkok: Food and Agriculture Organisation of the United Nations.
- 42 Atsri, K.H., Abotsi, K.E., Kokou, K., Dendi, D., Segniagbeto, G.H., Fa, J.E. & Luiselli, L. (2019). Ecological challenges for the buffer zone management of a West African National Park. *J. Environ. Plan. Manag.* 63, 689-709.
- 43 *Ibid.*
- 44 Robinson, E.J.Z., Albers, H.J. & Busby, G.M. (2013). The impact of buffer zone size and management on illegal extraction, park protection, and enforcement. *Ecol. Econ.* 92, 96-103.
- 45 Alavalapati, J.R.R. & Mercer, D.E. (2005). Valuing Agroforestry Systems: Methods and Applications. *Valuing Agrofor. Syst.* Dordrecht: Kluwer Academic Publishers.
- 46 Altieri, M.A. (1999). The Ecological Role of Biodiversity in Agroecosystems. *Agriculture, Ecosystems and Environment* 74:19-31.
- 47 Liere, H., Jha, S. & Philpott, S.M. 2017. Intersection Between Biodiversity Conservation, Agroecology, and Ecosystem Services. *Agroecology and Sustainable Food Systems* 41(7):723-760.
- 48 Ajayi, O.C., Akinnifesi, F.K., Sileshi, G. & Kanjipite, W. (2009). Labour inputs and financial profitability of conventional and agroforestry-based soil fertility management practices in Zambia. *Agrekon* 48, 276-292.
- 49 Alavalapati, J.R.R. & Mercer, D.E. (2005). Valuing Agroforestry Systems: Methods and Applications. *Valuing Agrofor. Syst.* Dordrecht: Kluwer Academic Publishers.
- 50 Ahmad, F. & Goparaju, L. (2017). Geospatial Approach for Agroforestry Suitability Mapping: to Enhance Livelihood and Reduce Poverty, FAO Based Documented Procedure. Case Study of Dumka District, Jharkhand, India). *Biosci Biotech Res Asia*: 14(2).
- 51 Hamrick, K. & Gallant, M. (2018). Voluntary Carbon Markets Insights: 2018 Outlook and First-Quarter Trends. Forest Trends Ecosystem Marketplace.
- 52 World Bank. (2018). The World Bank Sierra Leone Multi-City Hazard Review and Risk Assessment. Washington D.C.
- 53 Kuyah, S., Sileshi, G. W., Luedeling, E., Akinnifesi, F. K., Whitney, C.W., Bayala, J., Kuntashula, E., Dimobe, K., & Mafongoya, P.L. (2020). Potential of Agroforestry to Enhance Livelihood Security in Africa. In: Jagdish Chander Dagar, J.C., Teketay, D., & Gupta, S.R., editors. *Agroforestry for Degraded Landscapes: Recent Advances and Emerging Challenges*, Volume 1, First Edition. Springer Singapore.
- 54 *Ibid.*
- 55 Sarah Aloba Loison. (2015). Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review, *The Journal of Development Studies*, 51:9, 1125-1138,
- 56 Kuyah, S., Sileshi, G. W., Luedeling, E., Akinnifesi, F. K., Whitney, C.W., Bayala, J., Kuntashula, E., Dimobe, K., & Mafongoya, P.L. (2020). Potential of Agroforestry to Enhance Livelihood Security in Africa. In: Jagdish Chander Dagar, J.C., Teketay, D., & Gupta, S.R., editors. *Agroforestry for Degraded Landscapes: Recent Advances and Emerging Challenges*, Volume 1, First Edition. Springer Singapore.
- 57 Miller D.C., Muñoz-Mora J.C., Christiaensen, L. (2017). Prevalence, economic contribution, and determinants of trees on farms across sub-Saharan Africa. *Forest Policy and Economics* 84:47-61.
- 58 Binam, J.N., Place, F., Kalinganire, A., Hamade, S., Boureima, M., Tougiani, A., Dakouo, J., Mounkoro, B., Diaminatou, S., Badji, M., Diop, M., Babou, A.B., & Haglund, E. (2015). Effects of farmer managed natural regeneration on livelihoods in semi-arid West Africa. *Environ Econ Policy Stud* (2015) 17:543-575.
- 59 Fouladbash, L. & Currie, W.S. (2015). Agroforestry in Liberia: household practices, perceptions and livelihood benefits. *Agroforestry Systems* 89:247-266.
- 60 Glenday, J. (2006). Carbon storage and emissions offset potential in an East African tropical rainforest. *For. Ecol. Manage.* 235, 72-83.
- 61 Lewis, S.L. (2006). Tropical forests and the changing earth system. *Philos. Trans. R. Soc. B Biol. Sci.* 361, 195-210.
- 62 Costanza, R., De Groot, R., Sutton, P. Van der Ploeg, S., Anderson S.J., Kubiszewski, I., Farber S., & Turner, R.K. (2014). Changes in the Global Value of Ecosystem Services. *Global Environmental Change* 26: 152-158.
- 63 Rea, A.W. & Munns, W.R. (2017). The Value of Nature: Economic, Intrinsic, or Both? *Integrated Environmental Assessment and Management*. 13(5): 953-955.
- 64 *Ibid.*



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