Climate and Disaster Risk Screening Report for Coastal Flood Protection Project in Samoa: Hypothetical Coastal Flood Protection Project[1]

[1] This is the output report from applying the World Bank Group's Climate and Disaster Risk Screening Project Level Tool (Global website: climatescreeningtools.worldbank.org; World Bank users: wbclimatescreeningtools.worldbank.org). The findings, interpretations, and conclusions expressed from applying this tool are those of the individual that applied the tool and should be in no way attributed to the World Bank, to its affiliated institutions, to the Executive Directors of The World Bank or the governments they represent. The World Bank does not guarantee the accuracy of the information included in the screening and this associated output report and accepts no liability for any consequence of its use.

1. Introduction

Building resilience to climate and geophysical hazards is a vital step in the fight against poverty and for sustainable development. Screening for risks from these hazards improves the likelihood and longevity of a project's success. The project level **Climate and Disaster Risks Screening Tool** provides early stage due diligence on climate and disaster risks at the concept stage of project development. The tool uses an **exposure - sensitivity - adaptive capacity framework** to consider and characterize risks from climate and geophysical hazards, based on key components of a project and its broader development context (Annex 1).

This report summarizes the results of the screening process for the Hypothetical Coastal Flood Protection Project/Samoa.
The potential risks flagged in this report were identified through four screening stages by connecting information on climate and geophysical hazards exposure with the user’s subject matter expertise and understanding of the project components and sensitivity to rate the impacts. The tool does not provide detailed risk assessments, rather it flags risks to inform consultations, enhance dialogue with local and other experts, and define further analytical work at the project location.

This early stage due diligence can be used to strengthen the consideration of climate and disaster considerations in key components of the project design, including the physical (e.g., flood defenses and coastal infrastructure, etc.) and non-physical aspects (e.g., capacity building and training to help prepare for and cope with hazards or build longer-term resilience, institutional strengthening at the community level, early warning systems, etc.). The broader sectoral (e.g., broader land-use planning and zoning laws, etc.) and development context conditions (e.g., access to technology, climate-related early warning systems, etc.) could help modulate the risks to the delivery of the outcome/service level.

The results of the screening are presented below, with supporting narrative to guide their interpretation.

2. Climate and Disaster Risk Screening Results Summary

2.1 Project Information Summary

Table 1 below provides key project information including the location and key project development objectives. This information is provided by the task team. The activities within the components are important as their sensitivity to the climate and geophysical hazards will determine the level of potential impact from these hazards.

Table 1: Project Information

Project Information	
Title	Hypothetical Coastal Flood Protection Project
Number	Hypothetical
Region	East Asia and Pacific
Country	Samoa
Type of Assessment	Coastal Flood Protection Projects
Funding Source	IDA
Keywords	Flood Defenses, Storm Surge Protection, Land Use Management
Location	Coastal communities and mangroves
GPS Coordinates	This is optional information which may be useful when searching for geospatial climate and hazard information from data sources. It is not directly used in the screening process.
Built Infrastructure	The project will rehabilitate and improve polders (protected low-lying areas). Specifically, investments include slope protection, increasing embankment height, repairing and upgrading drainage systems and design of new hydrological management infrastructure as needed.
Coastal Ecosystem	The coastline is dominated by beaches and sand dunes. Certain parts of the coast also feature mangroves. There are no coral reefs near the project location. The project is investing in reforestation and preservation of mangroves. Specific species have not been selected at this time.
Outcome / Service Delivery	The project aims to provide direct protection to approximately 1 million people living within polder boundaries. It will do so by upgrading the existing embankments and drainage systems. The level of protection to be provided is intended to be enough to withstand 25-year return period storm surges for the lifetime of the project (up to year 2050).

* Please note that this is based on user inputs and the coverage may not be comprehensive.

2.2 Summary of Exposure to Climate and Geophysical Hazards

Table 2 presents a summary description of exposure to climate and geophysical hazards at the project location for the Historical/Current and Future time frames[1]. Exposure to climate hazards is evaluated in two timeframes, because past records are not necessarily indicative of future conditions.

The descriptions provide a summary of the key characteristics and some indication of the trends in exposure from each hazard, drawing on global, quality controlled data sets from the Climate Change Knowledge Portal (CCKP). It is useful, for example to understand the temperature range and the rate of annual or decadal increase in a region; or precipitation patterns for historical and future time frames and seasonality shifts. Understanding the trends of hazards is important as they act individually and collectively on components/sub-sectors of the project. Because geophysical hazards (such as earthquakes, tsunamis, landslides, and volcano eruptions) do not have associated future projections, exposure for those hazards is assessed only in the Historical/Current time frame.

Table 2: Summary of Exposure to Climate and Geophysical Hazards at Project Location

Hazard	Time Frame	Description of hazards for your location
Extreme Temperature	Current	Mean annual temperature has increased by 0.59°C, with the minimum and maximum temperature increasing by 0.67°C and 0.18°C respectively. Meteorological data of Samoa collected over 101 years indicates mean, maximum and minimum temperature increase and a trend decrease in precipitation by 49.28 mm over the same period. The numbers of hot days and hot nights have increased significantly across the Pacific.
	Future	Temperatures in the Pacific are projected to increase between 1.4 and 3.1°C.
Extreme Precipitation and Flooding	Current	As of yet, it is not possible to get a clear picture for precipitation change, due to large model uncertainties. While average annual and monthly rainfall changes are inconsistent across this region of the Pacific, recent evidence and model simulations point to a more frequent occurrence of El Nino weather patterns, bringing an increase in drought conditions along this region.
	Future	The future of rainfall patterns across the Pacific region is a subject of continued debate, with models projecting +/-25% changes in rainfall. More frequent El Nino events could also increase the intensity of tropical cyclones along the Pacific, with important implications for disaster management and response.
Sea Level Rise	Current	Satellite measurements in this area of the Pacific estimate sea-level increases of 8-10 mm/year, approximately three times the global average rate of increase.
	Future	Sea levels are projected to rise by the end of the century by 0.35 m (0.23 to 0.47 m) although the spatial manifestation of this rise will not be uniform due to circulation changes and ocean density.

[1]The Future time frame is based on changes projected to occur between the 1980-1999 average and a future average. This future average is most likely the 2040-2059 average (i.e., the default in the Climate Change Knowledge Portal - CCKP). Users can choose to select another time frame, or choose to use national/local data sets, but if so, this should be reflected in the notes section of the tool (and summarized in Annex 2). The CCKP draws on global, quality-controlled datasets and is continually updated as new data become available. In some cases, the CCKP is supplemented with other sources of information. For more detail on the data used in this step, please refer to the Data Annex. Climate Change Knowledge Portal (http://climateknowledgeportal.worldbank.org).

Hazard	Time Frame	Description of hazards for your location
Storm Surge	Current	The number of category 4 and 5 storms in the Pacific region has more than doubled in comparison to their frequency and occurrences between 1975- 1989 and 1990-2004, increasing damages due to severe storm surges on coastal areas.
	Future	Storm surge height is expected to increase, but estimates are highly uncertain
Strong Winds	Current	Tropical cyclones: increase in frequency of tropical depressions, gale winds forces and tropical cyclones during the cyclone season (December–February).
	Future	The maximum wind speed from tropical cyclones is expected to increase, but estimates are highly uncertain
Earthquake	Current	Samoa is in an area of high techtonic activity.
Tsunami	Current	Samoa is in an area of high techtonic activity and has experienced 115 tsunamis since 1900, 22 of which led to significant damage.

Insufficient Understanding	Not Exposed No Potential Impact No Risk	Slightly Exposed Low Potential Impact Low Risk	Moderately Exposed Moderate Potential Impact Moderate Risk	Highly Exposed High Potential Impact High Risk

Please note that the colors shown in Table 2 are only for exposure at the project's location. Overall risk to project's outcome/service delivery, taking into account sensitivity of physical investments and adaptive capacity(non-physical components and development context), is depicted in Tables 3A and 3B.

2.3 Summary of Overall Project Risk

Tables 3A and 3B present the same results, with Table 3A highlighting the impact ratings on the project's component/subsectors, and the overall risk of the outcome/service level for both Historical/Current and Future time frames. Table 3B draws attention to how the climate impacts and risks shift from the Historical/Current to the Future time frame.

The ratings are derived on the basis of the hazard information, subject matter expertise, contextual understanding of the project, and modulated on the basis of adaptive capacity and the larger development context of the country, as well as coastal flood protection. The results indicate what components are most at risk. The actual ratings themselves, while instructive, should inform further consultations, dialogue, and future planning processes. Keep in mind that the greatest value of the tool is that it provides a structured and systematic process for understanding climate and disaster risks.

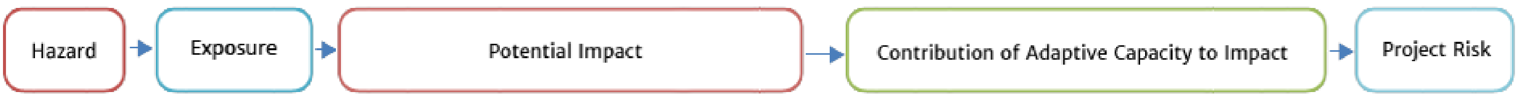
2.3.1 Results Summary - by Component / Subsector

Table 3A provides a characterization of risks due to climate and geophysical hazard on project subsector/components for both Historical/Current and Future time frames

The results indicate where risks may exist within one or multiple components and where further work may be required to reduce or manage these climate and geophysical risks. An ongoing process of monitoring risks, refining climate and other information, and regular impact assessment may also be appropriate.

The potential impact on key components due to exposure from hazards is modulated by the project's non-physical components (enabling and capacity building activities). The right kind of capacity building measures could increase preparedness and longer-term resilience and reduce the risks. An understanding of the larger sector and development context with respect to key modulating factors helps to assess the climate risks in terms of adaptive capacity. For example, certain zoning policies may help reduce risks to coastal flooding; while population growth and poorly regulated coastal development may aggravate the risks.

Table 3A: Results Summary - by Component / Subsector



Hazard	Project Components								Development Context		Outcome / Service Delivery	
	Location		Built Infrastructure		Coastal Ecosystem		Non-Physical Components (Overall)					
Time Frame	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Extreme Temperature	[yellow]	[orange]	[green]	[yellow]	[green]	[yellow]	Emergency planning: Significantly Reduces Impact; Capacity Building, Training and Outreach: Slightly Reduces Impact; Overall: Significantly Reduces Impact		Population growth: Slightly Increases Impact; Land ownership issues: Slightly Increases Impact; Overall: Slightly Increases Impact		[yellow]	[yellow]
Extreme Precipitation and Riverine Flooding	[yellow]	[orange]	[yellow]	[orange]	[orange]	[orange]					[orange]	[orange]
Sea Level Rise	[orange]	[red]	[orange]	[red]	[orange]	[red]					[orange]	[red]
Storm Surge	[orange]	[red]	[red]	[red]	[red]	[red]					[red]	[red]
Strong Winds	[orange]	[red]	[orange]	[red]	[orange]	[red]					[orange]	[red]
Earthquake	[yellow]	X	[orange]	X	[yellow]	X					[yellow]	X
Tsunami	[orange]	X	[orange]	X	[orange]	X					[orange]	X

2.3.2 Results Summary - by Time Frame

The results in Table 3B display the results by time frame. Potential impacts to the components are evaluated separately for the Historical/Current and Future time frames to capture changes in the exposure from climate hazards over time. For example, the height of embankments may be traditionally based on a calculated period of recurrence of a certain storm surge height, based on historical records. But, further adjustments to embankments would need to take the likelihood of increased future storm surge potential into consideration during the design and building of these embankments.

For investments with long operational lifetimes, such as physical infrastructure, considering future climate variability and change is critical to avoid "locking in" designs and features that are only suited to current climate. For example, the effectiveness of a sea wall may be greatly reduced by sea level rise over time.

Table 3B: Results Summary - by Time Frame

Time Frame	Current						Future					
	Project Context				Development Context (Overall)	OUTCOME/ Service Delivery	Project Context				Development Context (Overall)	Outcome/ Service Delivery
Hazard	Location	Built Infrastructure	Coastal Ecosystem	Non-Physical Components (Overall)			Location	Built Infrastructure	Coastal Ecosystem	Non-Physical Components (Overall)		
Extreme Temperature				Emergency planning Significantly Reduces Impact Capacity Building, Training and Outreach Slightly Reduces Impact Overall Significantly Reduces Impact	Population growth Slightly Increases Impact Land ownership issues Slightly Increases Impact Overall Slightly Increases Impact					Emergency planning Significantly Reduces Impact Capacity Building, Training and Outreach Slightly Reduces Impact Overall Significantly Reduces Impact	Population growth Slightly Increases Impact Land ownership issues Slightly Increases Impact Overall Slightly Increases Impact	
Extreme Precipitation and Riverine Flooding												
Sea Level Rise												
Storm Surge												
Strong Winds												
Earthquake							X	X	X			X
Tsunami							X	X	X			X

Insufficient Understanding	Not Exposed No Potential Impact No Risk	Slightly Exposed Low Potential Impact Low Risk	Moderately Exposed Moderate Potential Impact Moderate Risk	Highly Exposed High Potential Impact High Risk

2.4 Key Drivers of Risks

Based on the results above, Table 4 highlights the key drivers of risk for each project component/subsector ratings, in terms of hazards that are likely to pose the greatest challenge.

The ratings for the potential impact for each component/subsector reflect the aggregate rating across multiple hazards, drawing on all of the exposure information and their own expert judgment. For example, the height of sea walls and embankments is an important indicator of sensitivity to sea level rise and storm surge. However, sensitivity to earthquakes is a very different problem, because ground shaking challenges the integrity of structures differently than pressure from high waves.

Specific consideration should be given to those hazards which have high ratings, or are moving from moderate to high ratings over time. For example, sea-level rise may not be a key risk driver in the Historical/Current time frame; but may emerge as a key driver across multiple sectors in the future time frame. Understanding which hazards are key drivers may help flag follow-on work to manage climate risks within the design and delivery of the project.

Table 4: Key Drivers of Risk

	Historical/Current Drivers	Future Drivers
Hazards and Location	Sea Level Rise (Moderate) Storm Surge (Moderate) Strong Winds (Moderate) Tsunami (Moderate)	Extreme Temperature (Moderate) Extreme Precipitation and Flooding (Moderate) Sea Level Rise (High) Storm Surge (High) Strong Winds (High)
Physical Components	Extreme Precipitation and Flooding - Coastal Ecosystem (Moderate) Sea Level Rise - Built Infrastructure (Moderate) Strong Winds - Coastal Ecosystem (Moderate) Sea Level Rise - Coastal Ecosystem (Moderate) Strong Winds - Built Infrastructure (Moderate) Earthquake - Built Infrastructure (Moderate) Tsunami - Built Infrastructure (Moderate) Tsunami -Coastal Ecosystem (Moderate) Storm Surge - Coastal Ecosystem (High) Storm Surge - Built Infrastructure (High)	Extreme Precipitation and Flooding - Built Infrastructure (Moderate) Extreme Precipitation and Flooding - Coastal Ecosystem (Moderate) Strong Winds - Built Infrastructure (High) Storm Surge - Coastal Ecosystem (High) Storm Surge - Built Infrastructure (High) Sea Level Rise - Coastal Ecosystem (High) Sea Level Rise - Built Infrastructure (High) Strong Winds - Coastal Ecosystem (High)
Outcome / Service Delivery	Extreme Precipitation and Flooding (Moderate) Sea Level Rise (Moderate) Strong Winds (Moderate) Tsunami (Moderate) Storm Surge (High)	Extreme Precipitation and Flooding (Moderate) Sea Level Rise (High) Storm Surge (High) Strong Winds (High)

Key: High Risk | Moderate Risk

* If a cell is blank it implies there is 'No high or moderate risks' identified for this aspect of the project.

- Overall, the Non-physical Components : **Significantly Reduces Impact**
- Overall, the Broader Development Context : **Slightly Increases Impact**

3. Next Steps

By understanding which of your coastal flood protection project components is most at risk from climate change and other natural hazards, the design of the project that you are applying the screening tool can begin to take measures to avoid their impacts by:

- Enhancing the consideration of climate and disaster risks early in the design stage of the project.
- Using your risk screening analysis to inform follow-up feasibility studies and technical assessments.
- Encourage local stakeholder consultations and dialogues to enhance resilience measures and overall success of the project.

Table 5A provides some general guidance based on the risk ratings for the Outcome/Service Delivery, and Table 5B lists some climate risk management measures for your consideration. Visit the "Next steps" page of the tool on the website for guidance and a list of useful resources.

Note: Please recall that that this is a high-level due diligence tool, and the characterization of risks should be complemented with more detailed work.

Table 5A: General Guidance Based on Risk Ratings for Outcome/Service Delivery

Insufficient Understanding	Gather more information to improve your understanding of climate and geophysical hazards and their relationship to your project.
No Risk	If you are confident that climate and geophysical hazards pose no risk to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented.
Low Risk	If you are confident that climate and geophysical hazards pose low risk to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented. You may also consider gathering additional information to increase your level of confidence in your rating.
Moderate Risk	For areas of Moderate Risk, you are encouraged to build on this screening through additional studies, consultation, and dialogue. This initial screening may be supplemented with a more detailed risk assessment to better understand the nature of the risk to the project.
High Risk	For areas of High Risk, you are strongly encouraged to conduct a more detailed risk assessment and to explore measures to manage or reduce those risks.

Table 5B: Types of Climate Risk Management Measures for Typical Coastal Flood Protection Projects

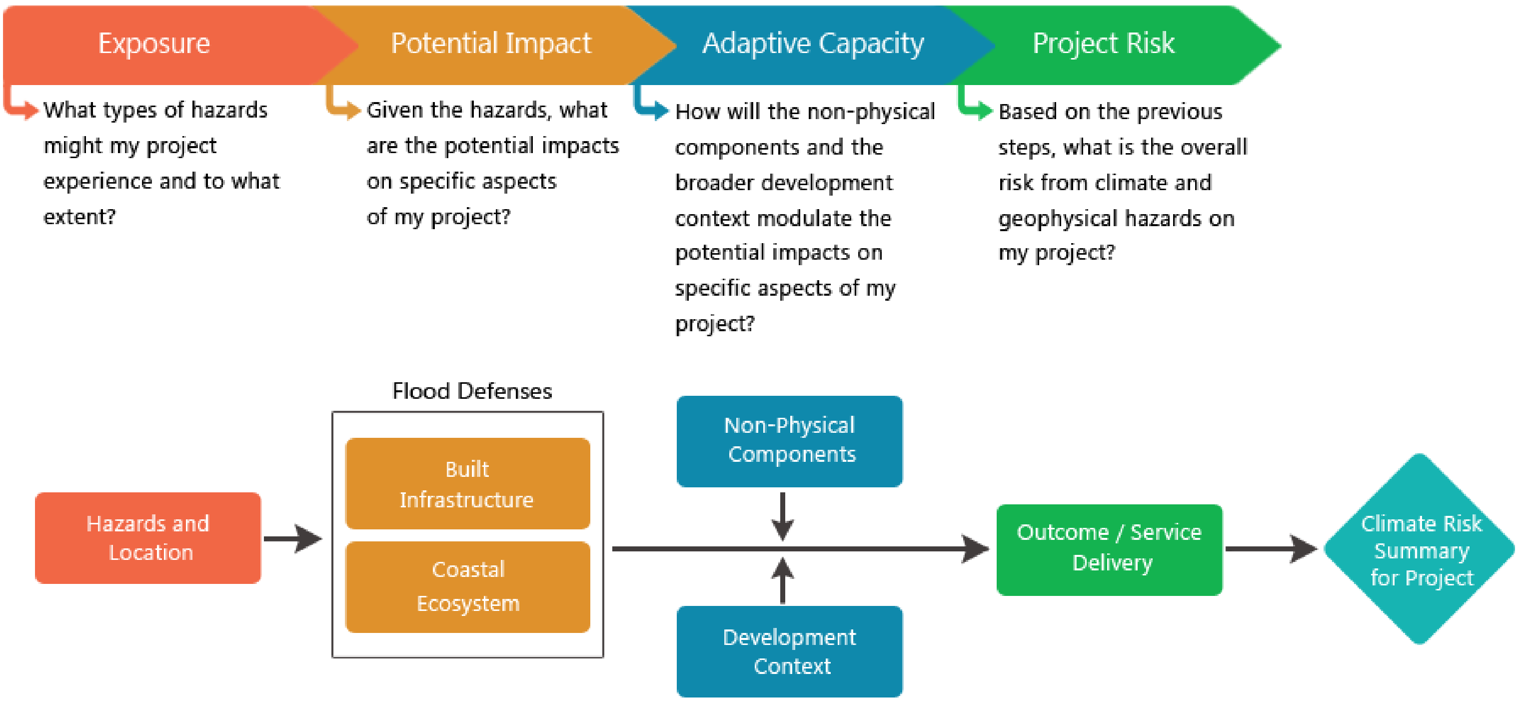
CATEGORY	PROS	CONS	Examples
Accommodate and Manage	• Flexible • Typically low-cost • Useful when risk is low, but projected to rise in the future	• Temporary solution • Can be insufficient in preventing losses	• Increasing repair and maintenance budgets • Instituting policies for proactive rerouting during severe weather
Protect and Harden	• Can be used for existing and new assets • Responds to immediate risks	• High cost • Inflexible • Effectiveness may decrease over time	• Elevating a roadway • Expanding buffer zones • Designing roads with larger drainage systems • Engineering bridges with elements of seismic-resistant design
Retreat and Relocate	• Long-term solution • Responds to immediate risk	• High cost • Inflexible	• Moving a road alignment away from a river • Moving infrastructure further inland or onto higher ground

Annex 1: Tool Approach

Tool Approach

The framework below describes the approach taken to screen the project. Climate and natural hazards information used to screen the project is obtained from the World Bank's Climate Change Knowledge Portal, which houses numerous global data sets with historical records and future projections as well as country-specific adaptation profiles.

Figure A1: Project Level Climate and Disaster Risk Screening Tool: Approach for Coastal Flood Protection projects



Annex 2: Notes

Table A2-1 summarizes the sub-national locations of high risk noted during the assessment, if the user entered these sub-national locations. Table A2-2 summarizes all the notes entered by user for each section while completing the assessment, if the user elected to enter notes. These notes can help shed light on specific ratings as well as considerations and limitations of the user's expertise.

Table A2-2 Summary of Comments by Section

Section	Notes