**GEF-6 PROJECT IDENTIFICATION FORM (PIF)**

**Project Type: Full-sized project**

**Type of Trust Fund:** **GEF Trust Fund**

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# **PART I: Project Information**

|  |  |
| --- | --- |
| Project Title: | **Managing Coastal Aquifers in Selected Pacific SIDS** |
| Country(ies): | Republic of Palau, Republic of Marshall Islands (RMI); Tuvalu | GEF Project ID:  | 10041 |
| GEF Agency(ies): | UNDP | GEF Agency Project ID: | 6196 |
| Other Executing Partner(s): | SPC; National Government Agencies in Palau, RMI and Tuvalu | Submission Date:Resubmission Date: | 6 March 201812 April 2018 |
| GEF Focal Area(s): | Multi-focal area  | Project Duration (Months) | 48 |
| Integrated Approach Pilot | IAP-Cities [ ]  IAP-Commodities [ ]  IAP-Food Security [ ]  | Corporate Program: SGP [ ]  |
| Name of parent program: | N/A | Agency Fee ($) | 499,829 |

## A. Indicative [Focal Area Strategy Framework and Other Program Strategies](https://www.thegef.org/gef/sites/thegef.org/files/documents/document/GEF6%20Results%20Framework%20for%20GEFTF%20and%20LDCF.SCCF_.pdf)[[1]](#footnote-1)

|  |  |  |
| --- | --- | --- |
| **Objectives/Programs** (Focal Areas, Integrated Approach Pilot, Corporate Programs) | **Trust Fund** | **(in $)** |
| **GEF Project Financing** | **Co-financing** |
| **IW-2**: Balance Competing Water-uses in the Management of Surface & Groundwater; **Program 3**: Advance Conjunctive Management of Surface& Groundwater Systems  | GEF TF | 3,237,469 | 8,107,171 |
| **LD-3**: Integrated Landscapes:Reduce pressures on natural resources from competing land uses in the wider landscape; **Program 4:** Scaling-up sustainable land management through the Landscape Approach  | GEF TF | 2,023,887 | 6,331,045 |
| **Total Project Cost** |  | **5,261,356** | **14,438,216** |

## B. Indicative project description summary

|  |
| --- |
| Project Objective: To improve the understanding, use, management and protection of coastal aquifers in Republic of Palau, Tuvalu and the Republic of Marshall Islands towards enhanced water security within the context of a changing climate |
| Project Components | Financing Type[[2]](#footnote-2) | Project Outcomes | Project Outputs | Trust Fund | (in $) |
| GEF Project Financing | Co-financing |
| 1. Improved knowledge of coastal aquifers. | TA | 1.1 Enhanced understanding on the locations of the major coastal aquifers, their current quantitative and qualitative status and the human dependency on these aquifers.1.2 Enhanced understanding of long-running and climate-related threats to these aquifers as source of water for domestic use. | 1.1.1 Multidisciplinary coastal aquifer assessment:- Hydrogeological: delineation, quantification and quality assessment of fresh groundwater bodies. - Environmental: identification of relevant pollution sources.- Assessment of vulnerability to wave overtopping events through the use of land surveying methods (incl. drones) for the production of digital elevation models.- Assessment of land-uses over aquifers to determine impacts on groundwater quality and recharge- Socio-economic: assessment of human dependency on identified coastal aquifers.1.2.1 Development of monitoring borehole networks in selected aquifers to monitor the response of coastal aquifers to external influences such as climate, natural/anthropogenic pollution and groundwater abstraction. | TF | 2,500,000 | 2,617,000 |
| 2. Adaptive land and groundwater management. | TA | 2.1 Improved management and protection of coastal aquifers. | 2.1.1 Review of existing groundwater public water supply and monitoring infrastructures:- Establish status and trends from existing available data pertaining to aquifer health under varying climatic and abstraction scenarios.- Explore gaps and establish mechanisms to improve aquifer management.2.1.2 Instrumentation and monitoring towards management: - Installation of automatic rain stations at representative locationsfor assessment and monitoring of climatic factors.- Installation of groundwater salinity loggers to assist in early warning for the prevention of salinization of coastal aquifers due to climatic (thinning of freshwater lens due to droughts) or anthropogenic (over-abstraction) influences.- Piloting of crowd-sourced monitoring during dry conditions on selected islands for extended monitoring capacity and improved real-time monitoring using mobile technology). 2.1.3 Development of groundwater numerical models to better understand the behavior of coastal aquifers against climatic influences and to inform the design of sustainable groundwater abstraction schemes.2.1.4 Improved management of catchments through land restorations to protect aquifers2.1.5 Development of aquifer protection management plans identifying major climatic and anthropogenic threats and options to mitigate or manage the risks | TF | 1,799,999 | 10,551,741 |
| 3. Strengthened island-based water governance towards improved national scale governance. | TA | 3.1 Improved water governance at the community and national levels.3.2 Knowledge platform put in place. | 3.1.1 Community and relevant stakeholders’ engagement before and after the aquifer assessments to inform on the objectives and outcomes; participatory management of aquifers with direct involvement of communities and relevant authorities and governmental bodies.3.1.2 Strengthened capacity and reporting mechanisms in outer islands to support the collection of water resource information and reporting at the national level. Development of data monitoring guidelines for island-based technicians.3.1.3 Policy implications of results incorporated into applicable national water policies, including on IWRM in the respective countries3.2.1 Island briefs produced with relevant statistics on water use and reliance for each water source, and the groundwater potential. These briefs will help translate the project results into more easily digestible products to be used for awareness raising and decision-making.3.2.2 Accessible project website with project developed datasets 3.2.3 Contribution to IWLEARN activities, including sharing of results globally focusing on SIDS, amounting to 1% of the IW funds. | TF | 711,000 | 761,685 |
| Subtotal |  | 5,010,999 | 13,930,426 |
| Project Management Cost (PMC)[[3]](#footnote-3) | TF | 250,357 | 507,790 |
| Total Project Cost | TF | 5,261,356 | 14,438,216 |

For multi-trust fund projects, provide the total amount of PMC in Table B, and indicate the split of PMC among the different trust funds here.

## C. Indicative sources of [Co-financing](http://www.thegef.org/gef/policy/co-financing) for the project by name and by type, if available

|  |  |  |  |
| --- | --- | --- | --- |
| Sources of Co-financing  | Name of Co-financier | Type of Cofinancing | Amount ($) |
| National governments | Palau, RMI. Tuvalu | In-kind | 6,347,376 |
| Local governments | Palau, RMI, Tuvalu | In-kind | 2,653,840 |
| NGOs | International Red Cross, Tuvalu Red Cross, RMI Red Cross, Palau Red Cross | In-kind | 20,000 |
| Multilateral Agencies | SPC (various projects) | In-kind | 1,917,000 |
| GCF | UNDP – RMI GCF Water Security Project  | Grant | 3,500,000 |
| Total Co-financing |  |  | 14,438,216 |

## D. Indicative Trust Fund Resources Requested by Agency(ies), Country(ies), Focal Area and the Programming of Funds a)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GEF Agency | Trust Fund | Country/Regional/ Global | Focal Area | Programming of Funds | (in $) |
| GEF Project Financing (a) | Agency Fee (b)b) | Total(c)=a+b |
| UNDP | GEF TF | Palau | Land Degradation |  | 655,443 | 62,267 | 717,710 |
| UNDP | GEF TF | RMI | Land Degradation |  | 1,018,447 | 96,752 | 1,115,199 |
| UNDP | GEF TF | Tuvalu | Land Degradation |  | 349,997 | 33,250 | 383,247 |
| UNDP | GEF TF | Regional  | International Waters |  | 3,237,469 | 307,560 | 3,545,029 |
| Total GEF Resources | 5,261,356 | 499,829 | 5,761,185 |

1. Refer to the [Fee Policy for GEF Partner Agencies](http://www.thegef.org/gef/sites/thegef.org/files/documents/document/gef-fee-policy.pdf).

## E. Project preparation grant (PPG)[[4]](#footnote-4)

Is Project Preparation Grant requested? Yes [x]  No [ ]  If no, skip item E.

**PPG Amount requested by agency(ies), Trust Fund, country(ies) and the Programming of funds**

|  |
| --- |
| Project Preparation Grant amount requested: $  |
| GEF Agency | Trust Fund | Country/ Regional/Global  | Focal Area | Programming of Funds | (in $) |
| PPG (a) | AgencyFee[[5]](#footnote-5) (b) | Totalc = a + b |
| UNDP | GEF TF | Palau | Land Degradation |  | 28,653  |  2,722  | 31,375 |
| UNDP | GEF TF | RMI | Land Degradation |  | 44,521  | 4,230  | 48,751 |
| UNDP | GEF TF | Tuvalu | Land Degradation |  | 15,300  | 1,454  | 16,754 |
| UNDP | GEF TF | Regional  | International Waters |  | 141,526 | 13,445 | 154,971 |
| Total PPG Amount | 230,000 | 21,851 | 251,851 |

## F. Project’s Target Contributions to Global Environmental Benefits[[6]](#footnote-6)

Provide the expected project targets as appropriate.

|  |  |  |
| --- | --- | --- |
| Corporate Results | Replenishment Targets | Project Targets |
| Maintain globally significant biodiversity and the ecosystem goods and services that it provides to society | Improved management of landscapes and seascapes covering 300 million hectares  | *Hectares* |
| Sustainable land management in production systems (agriculture, rangelands, and forest landscapes) | 120 million hectares under sustainable land management | *1,500 Hectares*    |
| Promotion of collective management of transboundary water systems and implementation of the full range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services | Water-food-ecosystems security and conjunctive management of surface and groundwater in at least 10 freshwater basins;  |  *Number of freshwater basins*  |
| 20% of globally over-exploited fisheries (by volume) moved to more sustainable levels | *Percent of fisheries, by volume*  |
| 4. Support to transformational shifts towards a low-emission and resilient development path | 750 million tons of CO2e  mitigated (include both direct and indirect) | *metric tons* |
| Increase in phase-out, disposal and reduction of releases of POPs, ODS, mercury and other chemicals of global concern | Disposal of 80,000 tons of POPs (PCB, obsolete pesticides)  | *metric tons* |
| Reduction of 1000 tons of Mercury | *metric tons* |
| Phase-out of 303.44 tons of ODP (HCFC) | *ODP tons* |
| Enhance capacity of countries to implement MEAs (multilateral environmental agreements) and mainstream into national and sub-national policy, planning financial and legal frameworks  | Development and sectoral planning frameworks integrate measurable targets drawn from the MEAs in at least 10 countries | *Number of Countries:*  |
| Functional environmental information systems are established to support decision-making in at least 10 countries | *Number of Countries:*  |

# **Part II: Project Justification**

## 1. Project Description (global environmental and/or adaptation problems, root causes and barriers that need to be addressed)

SIDS rely on small coastal aquifers that are fragile thin freshwater lenses that *float* on the underlying denser seawater and are recharged by rainfall. These coastal aquifers are at higher risk of impact to water quality deterioration from threats including saltwater contamination from sea level rise, pumping, wave overtopping, loss of aquifer area through coastal erosion, and other impacts on water quality from inappropriate land-use activities.([GRAPHIC, 2015](http://unesdoc.unesco.org/images/0023/002357/235713e.pdf)a; [GRAPHIC, 2015b](http://unesdoc.unesco.org/images/0024/002428/242861e.pdf)). Climate change exacerbates these long-running threats to coastal aquifers through increased climate variability and climate extremes. The sensitive nature of coastal fresh groundwater systems necessitates careful management and protection to ensure their long-term integrity and their role in climate change adaptation strategies.

Dixon-Jain et al (2014) have undertaken a first-pass regional assessment of relative potential vulnerability of groundwater on islands of the Pacific region (covering 15 Pacific Island countries and territories) to the impacts of (i) lowest mean annual rainfall during ENSO phases and (ii) mean sea-level rise (SLR) in two projection periods (2050 and 2085). The vulnerability of the assumed principal aquifer on each island to current and future climate was assessed through a groundwater vulnerability framework, which considered the components of sensitivity, exposure, and adaptability of the groundwater system. The study found that the majority of assessed low-lying carbonate islands in the Pacific region have higher relative vulnerability. Tuvalu, Palau and the Republic of Marshall Islands were ranked particularly high in terms of groundwater vulnerability due to the large number of low-lying carbonate islands.

The high risks associated with groundwater availability and natural/anthropogenic pollution in low-lying SIDS were also identified by the GEF-funded Transboundary Waters Assessment Programme (UNESCO-IHP and UNEP, 2016). The global assessment performed for the groundwater systems in SIDS highlighted how these risks are particularly exacerbated when human groundwater dependence for its potable and domestic freshwater needs is high, as this is the case in many Pacific low-lying SIDS.

Climate and rainfall variability is a direct threat to the population of RMI, Palau and Tuvalu which relies mainly on rainwater harvesting for their potable needs. Surviving droughts requires the identification of alternate and drought- resilient water sources. Fresh groundwater occurs naturally in many of the islands of these three SIDS, existing as a freshwater lens which floats on top of the denser seawater. These limited but important freshwater sources are very sensitive to external influences requiring informed decision making to manage and maintain their integrity. Site-specific information on the aquifer locations and extents, the natural and anthropogenic sources of pollution, and on risks from other threats such as overtopping, and over abstraction, is necessary to achieve sustainable coastal aquifer protection and development. To obtain this knowledge, geophysical and land-use assessments need to be conducted, monitoring networks need to be established and, ultimately, water budget and numerical models need to be developed. The spatial and temporal variability of rainfall needs to be available to ensure reliable model output as a basis for sustainable management, necessitating the collection of island level daily rainfall records.

In most cases, human-induced pollution of groundwater in small islands relates to the absence of sewage treatment systems and to the percolation of the effluents from septic tanks or pit latrines into the groundwater. Agriculture and animal farming are in most cases performed at subsistence level and may be responsible for localized contamination of groundwater. There are a few cases of more intensive agriculture which may cause more significant contamination.

In Funafuti, the capital of Tuvalu, groundwater is exposed to natural and anthropogenic contamination, including salinity, leaving the population solely dependent on rainwater for potable purposes (Baarsch and Berg, 2015). Variations in precipitation patterns, however, can make rainwater access unreliable. The Government of Tuvalu recommends that groundwater in Funafuti should only be used for secondary purposes, as it is contaminated by leaking septic tanks, animal waste, heavy metals, and saltwater intrusion. As the islets of Funafuti atoll are considered to consist mainly of coarse grain sediments, the potential for the development of a freshwater lens is reduced and pollutants can more easily percolate in the shallow and permeable groundwater system.

Groundwater contamination in RMI has been observed in Laura (Majuro atoll) and in Kwajalein, where groundwater has been recognized as an important water source, particularly during periods of low rainfall. Contamination in Laura has been observed in the shallower monitoring boreholes and private wells, predominantly in the form of E. coli bacteria. In Kwajalein, microbial oxidation of organic matter as indicated by low dissolved oxygen, and the elevated concentration of nutrients near the top of the water indicated sites contaminated by petroleum hydrocarbons.

Saltwater intrusion has been observed in the island of Peleliu, Palau, where one of the country’s main freshwater lens aquifers exists. This resulted in the shutdown of a number of wells located close to the shoreline. Bacteriological contamination from septic tanks has been identified as a threat in the islands of Kayangel, Peleliu and Angaur (IWRM hot spot analysis, 2007). It is estimated that 4% of the national land area and 9% of the total population are affected by saltwater intrusion of aquifers (IWRM hot spot analysis, 2007). In 2013, the freshwater lens aquifer of Kayangel suffered extended salinization due to Super Typhoon Haiyan passing within 7 miles of the island. The levels of groundwater salinity increased due to this wave overtopping event to prohibitive levels for potable purposes.

In 2011, the Government of Tuvalu declared a state of emergency due to drought (Sinclair et al, 2012). This followed the declaration of national crises on two atolls (the capital Funafuti and the southern island of Nukulaelae) requiring emergency measures to provide sufficient safe water for the populations living on these two islands. In 2016 a state of emergency was declared by the President of the Republic of Marshall Islands due to the severe drought conditions affecting the country (Sinclair, 2017). Assistance was sought by the RMI government to help determine the impact of the drought and pumping on the fresh groundwater and to provide advice regarding management and operational options available to RMI. Similarly, in the same year also Palau declared a state of emergency and water rationing was introduced with residents only able to use taps for six hours a day. These examples illustrate the high frequency of drought-related disasters in the region and the particular vulnerability of the three countries and their water supplies.

White and Falkland (2010) stated that despite their vulnerability, Pacific island countries do not know the full extent and quality of their water resources – information that is needed for sustainable development, management and protection of these valuable freshwater resources. This calls for a comprehensive assessment to help guide SIDS in meeting their development challenges in the future.

The lack of country capacity in undertaking consistent water resources assessment and monitoring was identified during the Pacific HYCOS programme (SOPAC, 2010). It was concluded that most countries, by the end of the project had not achieved an acceptable level of sustainability in terms of being able to provide reliable, consistent, and timely data for water resource assessment and monitoring. It was recommended that capacity building should be part of a structured long term programme in order to be successful. A programme of support that is able to address each countries’ needs and priorities is required.

With regards to enhancing groundwater system integrity in vulnerable areas Dixon-Jain et al (2014) recommended the following: developing informed and ongoing groundwater monitoring networks; ensuring sustainable extraction strategies; developing sub-regional groundwater management strategies for countries with similar island type distributions; developing coordinated best-practice guidelines, policies and programs to underpin the above activities. Adaptation capacity can further be increased by: improving in-country technical knowledge of groundwater systems; ensuring sufficient resources are available to carry out the adaptation activities; mentoring of water management agencies; and increasing community participation in water resources management, including sustainable groundwater management.

## 2. Baseline scenario and associated baseline projects

*Tuvalu*

To this day, limited groundwater investigations have been carried out in Tuvalu. A rapid assessment of the hydrogeology for the islands of Tuvalu was undertaken by Van Putten (1988) as part of a UNDP project. While point source resistivity measurements were used to determine the groundwater potential of many of the islands, survey time was very limited, and the assessments were incomplete restricting their usefulness for groundwater resource delineation and identifying optimal development options. Most of the outer islands have available groundwater though its quality is largely unknown (R2R Tuvalu National Programme Document).

More comprehensive groundwater investigations have been performed on the island of Vaitupu under the EU-funded CAIA project (Sinclair, 2017). Geophysical survey techniques, including electromagnetics and resistivity, were undertaken to delineate and locate the size and extent of the freshwater lens in Vaitupu and to identify potential groundwater development sites that could be used by the community as a drought reserve. It was concluded that the usable freshwater lens is restricted to the northwestern area of the island, considerably less than proposed by Van Putten.

**Table 1. Summary of existing knowledge on groundwater resources in Tuvalu (estimated aquifer areas by Van Putten 1988).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Atoll/Island** | **Characteristics of Aquifer** | **Households /Population Served** | **Estimated aquifer area (km2)** |
| Nanumea | Shallow freshwater lens potential in Nanumea is indicated to be limited. A small number of shallow wells are constructed for households and community use. During drought salinity of groundwater has been observed to be brackish but is relied upon for purposes such as washing and livestock. | 205/764 | Main village: 0.1Matagi: 0.63Lakena: 0.53 |
| Niutao | The groundwater potential for Niutao while less known is indicated to be limited. Shallow wells located within the community indicate brackish water while wells further away are believed fresher. A potential drought water supply could be developed further away from the village where it is indicated that fresher groundwater potential exists.  | 169/759 | Eastern half: 0.81 |
| Nanumanga | The fresh groundwater potential for Nanumanga is thought to be low based on rapid assessment during 2011 drought (Sinclair et al), in which groundwater measured in available wells was saline. | 251/674 | Majority: 0.9 |
| Nui | The use and reliance on groundwater for domestic needs is high, with a large number of household and community wells present. | 203/609 | Fenua Tapu: 0.08Meang: 0.15 |
| Vaitupu | Fresh groundwater has been identified as a shallow freshwater lens in the northern part of the island. The community has indicated their support to develop this resource for use during extended dry periods including infrastructure to make the groundwater more accessible. | 321/1600 | Northern: 0.94Motufua: 0.34 |
| Nukufetau | Fresh groundwater potential from a shallow aquifer is indicated to be quite high for Nukufetau. Previous investigations indicate the potential for groundwater for domestic purposes with some areas being more resilient to drought. | 130/568 | Fale: 0.21 |
| Funafuti | Fresh groundwater resources of Funafuti are considered to be limited. Groundwater is relied upon at the household level during extended dry periods to provide water for domestic needs. | 789/5300 |  |
| Nukulaelae | The fresh groundwater potential of Nukulaelae is expected to be limited with indications that during extended dry periods the existing groundwater becomes saline. | 121/333 | Fagaua: 0.03Fenualago central: 0.02Tefakai Northern: 0.02 |
| Niulakita | Fresh groundwater potential is unknown for Niulakita however given the size of island fresh groundwater is considered limited. | 35 | Western half: 0.15 |

*Republic of Marshall Islands*

Extensive coastal aquifer assessment and development work in the Republic of Marshall Island has been made since the 1980’s in response to the vulnerability of limited freshwater resources, the increasing drinking water demand and chronic water shortages experienced during after the El-Nino driven droughts of 1983, 1987, 1992, 1998 and 2015. The Outer Island Water Resources Planning and Development (OIWRPD) project focused on the water resources assessment of ten atolls (Table 3) and aimed at (1) evaluating the existing sources of water supply around these atolls to determine the conditions of existing infrastructure and facilities and to identify the necessary improvement works necessary and (2) assessing the groundwater resources underlying these islands with regards to the location and thickness of any exploitable freshwater lenses and the water quality to support the water supply needs for the islands.

Groundwater assessment work in Majuro, being the most populated atoll, has primarily been focussed on the Laura lens, located on the western end of the Majuro Atoll and serving water supply for the Dalap-Uliga-Darrit areas in the east, where the most population is concentrated. A series of aquifer assessment and characterisation works have been undertaken as part of disaster responses to several severe drought events, such as those recorded in 1998 and 2016, to determine the status of the lens in light of the reduced rainfall conditions and in conjunction with the need for continued abstraction to serve the public needs. Historical groundwater assessment around the Kwajalein atoll, being a US military base, focused on the recognition that groundwater was an important water source, particularly during periods of low rainfall and accounting for 33% of the 1140 m3/day daily demand for water supply with the remaining 66% provided by rainwater harvesting (Tribble, 1997).

**Table 2. Groundwater summary with some basic hydrogeological information from selected islands, RMI**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Atoll** | **Site** | **Sustainable yield (m3/day)** | **Maximum lens thickness (m)** | **Lens width (m)** | **Number of monitoring bores** |
| Majuro1 | Laura | 1514 | 14 | no data  | 36 |
| Kwajalein2 | Kwajalein | no data  | 12 | no data  | 51 |
| Kwajalein2 | Roi-Namur | no data  | 7 | no data  | 55 |
| Bikini3 | Bikini | no data  | 2 | 700 | no data  |
| Bikini3 | Eneu | no data  | 5 | 500 | no data  |
| Enewetak3 | Enjebi | no data  | 2 | 986 | no data  |

**1** Hamlin and Anthony, 1987 and Sinclair et.al., 2017

**2** Tribble, 1991 and Gingerich, 1996

**3** Barkey and Bailey, 2017

**Table 3. Groundwater summary with some basic hydrogeological information from selected islands, RMI (Goodwin et.al. 2000).**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Atoll** | **Site** | **Number of houses** | **Number of wells** | **Percentage wells with freshwater (%)** | **Lens area (km2)** | **Maximum lens thickness (m)** | **Safe yield under average rainfall (m3/day)** | **Safe yield under drought (m3/day)** |
| Jaluit | Jabor | 54 | 20 | 0 | 0.34 | 2.62 | 592.04 | 330.98 |
| Jaluit | 19 | 4 | 40 | 0.02 | 1.77 | 6.37 | 3.57 |
| Imrodj | 15 | 11 | 9 | 0.01 | 1.46 | 20.48 | 11.44 |
| Maloelap | Taroa | 24 | 26 | 72 | 0.86 | 2.44 | 988.00 | 278.16 |
| Airok | 22 | 20 | 86 | 0.43 | 3.75 | 492.48 | 134.90 |
| Jang | 15 | 15 | 70 | 0.17 | 2.32 | 193.80 | 53.20 |
| Wotje | Wotje | 64 | 56 | 90 | 1.71 | 2.56 | 2068.34 | 541.88 |
| Wormej | 17 | 15 | 50 | 0.32 | 2.62 | 387.22 | 101.46 |
| Namu | Majkin | 33 | 19 | 95 | 0.40 | 5.21 | 280.44 | 164.54 |
| Namu | 22 | 14 | 43 | 0.35 | 5.21 | 236.36 | 145.16 |
| Mae | 15 | 11 | 9 | 0.08 | 1.77 | 55.86 | 32.68 |
| Ailinglaplap | Airuk | 37 | 10 | 20 | 0.53 | 3.63 | 411.54 | 256.12 |
| Buoj | 28 | 12 | 25 | 0.39 | 2.38 | 149.34 | 92.72 |
| Woja | 28 | 16 | 44 | 0.56 | 12.31 | 435.86 | 271.32 |
| Ebon | Ebon | 49 | 35 | 97 | n.d | 18.07 | 1761.30 | 948.48 |
| Toka | 30 | 25 | 100 | n.d | 6.10 | 983.06 | 529.34 |
| Lae | Lae | 23 | 23 | 65 | 0.62 | 2.32 | 426.74 | 254.98 |
| Ujae | Ujae | 40 | 38 | 100 | 0.38 | 2.74 | 261.44 | 156.18 |
| Mejit | Mejit | 55 | 45 | 62 | 0.81 | 6.04 | 972.80 | 254.60 |
| Majuro | Ron Ron | 3 | 11 | 67 | 0.18 | 2.19 | 282.34 | 86.26 |

*Palau*

The limestone atolls of Peleliu and Angaur and the coral atoll of Kayangel rely on freshwater lens aquifers as a water source for their public water supply systems. Also on the main island of Babeldoab, the public water supply systems of Ngiwal and parts of Ngaraard states rely on limestone aquifers which overlay the volcanic bedrock. According to Winzler (1996), drilled test wells also exist in the other states of Babeldoab. During dry periods, the Palau Public Utilities Company (PPUC) has attempted to augment the supply of Koror, the main urban centre, by reactivating a network of existing wells. Although this has not led to large quantities of extra water, this trial has also given useful information on estimated groundwater availability for future development (de Bruijn at al 2016).

Historically the community of Kayangel relied upon shallow household wells and household rainwater harvesting systems for their water needs. Between 2003 and 2006 a reticulated water supply system was designed and installed using an infiltration gallery to provide up to 50-75 m3/day with tablet chlorination for disinfection. The 2005 census suggests that prior to this reticulated system the majority of households relied upon a rainwater harvesting system for their potable water needs.

Over 95% of households in Angaur have access to reticulated water (ROP Yearbook, 2012). The water is provided untreated from two wells accessing the shallow groundwater. Information on the construction, location and abstraction from the wells is limited. According to the 2005 census, the reliance on the reticulated system is for purposes other than cooking or drinking. Rainwater is indicated as the dominant potable water source. It is reported in a note following a USEPA and EQPB inspection (December, 2011) that the reticulated water suffers from hydrogen sulfide smell which affects its palatability (source wells A & B). Recommendations from this letter report suggest a combination of super chlorination and aeration to improve its palatability. The EPA letter report suggests that if the treatment options are not effective abandoning the current well/s and constructing a new well may be an economical option. Angaur State Government has recently purchased a solar powered reverse osmosis unit (Progretti Plant) which has been installed at the community centre. This Unit is producing palatable water stored and accessed only at the community centre. The Koska Well was also recently rehabilitated as an emergency water supply (EU-SPC GCCA project) to serve Angaur’s northern population, as it is a closer water source than the community centre.

Peleliu has the largest freshwater lens, which is in the south part of the island. It has been estimated to be capable of yielding 3785 m3 of fresh water per day (Barret 1986). Over 97% of households in Peleliu are indicated to have access to reticulated water from a groundwater source in addition to individual rainfall catchments (ROP Yearbook, 2012). Information on the construction, location and abstraction from the wells is currently unknown. The census 2005 suggests that only 20% of households rely on the reticulated groundwater for cooking, with 0% of households reporting reliance for drinking water needs. Rainwater is indicated to be the dominant water source relied upon for cooking and drinking. Completed in March 2014 was a solar powered reverse osmosis desalination plant under the Pacific Islands Forum Pacific Environment Community project. The plant is capable of providing up to 150 m3/day of desalinated water to improve the water security needs of the Peleliu community. The water used for the desalination plant is sourced from an existing groundwater well.

**Table 4. Groundwater summary with some basic hydrogeological information from selected islands (Winzler 1996, EQPB 2014)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Island/location** | **Site** | **Groundwater salinity (μS/cm)** | **Aquifer yield (m3/day)** | **Existing public water supply system** |
| Kayangel | North | 400-1250 | 55-75 | 1 infiltration gallery |
| Angaur | Central | 670-850 | 135-165 | 2 shallow wells |
| Peleliu | South | 500 | 270-330 | 2 infiltration galleries |

*Links to other projects*

Projects that have recently been completed and will facilitate or directly contribute to the development of the proposed activities include (but are not limited to):

1. **Climate and Abstraction Impacts in Atoll Environments (CAIA)** – This project included the groundwater assessment of Vaitupu islands, Tuvalu, and was completed in 2017 by SPC under the EU-funded CAIA project. Specifically these results can be used to inform the drilling of a groundwater monitoring network for the purposes of improved aquifer protection actions under the CAP project.
2. **Global Climate Change Alliance: Pacific Small Island States (GCCA: PSIS)** – During this project, water improvement measurements were implemented in the islands of Palau according to each island’s needs. This included the refurbishment of groundwater wells to ensure backup water supplies during natural disasters and the reparation on leaks in the existing water distribution system.

Projects for potential co-financing which have commenced and which will include activities which are expected to directly support CAP objectives includes:

1. **KfW funded response to Tropical Cyclone Pam** **recovery –** Field work in partnership with the Tuvalu Lands and Survey Department and the UK Hydrographic Office Tuvalu, initiated in 2017 for multi hazard mapping and inundation forecasting to inform improved resilience of coastal communities in Tuvalu is expected to be completed in 2018. The resulting data sets will include valuable land based topographical surveys and an assessment approach for providing insight into the probable risk of coastal inundation wave and water level events for selected islands. Specific outcomes identified include inundation hazard maps which are expected to be able to be directly used as inputs for the assessment of the aquifer vulnerability to wave overtopping in the selected islands in Tuvalu.
2. **Strengthening Water Security in Vulnerable Island states** - Installation of eight rain gauges is planned for Tuvalu in early 2018, one on each island (Vaitupu already has one) through the project, funded by MFAT New Zealand. SPC is currently providing training to governmental staff on installation, maintenance and logging procedures. These rain gauges will be used to monitor inputs into the aquifer systems throughout the duration of the CAP project. The project is also planning for late 2018 – early 2019 to install rain gauges in those islands of RMI which do not have any. Finally, a groundwater assessment mission will be undertaken by SPC during the second half of 2018 on Wotje island in RMI, however no drilling is currently envisaged. It is proposed to include Wotje in the scope of the CAP project and make use of the knowledge obtained during the mission to drive the drilling of monitoring boreholes.
3. **Readiness for El Nino -** EU funded project 11th EDF includes drought preparedness in 6 selected outer islands of RMI including Ailut, Wotho, Mejit, Utrik, Santo-Kwajelein, and Enewetak. While the focus of the work is on food security there are clear links in regards to the application of water resources for domestic and agricultural purposes where by the coordination of activities would be considered and developed during the project proposal stage.
4. **Green Climate Fund – RMI – water security**. RMI Government has requested UNDP to support their efforts in developing a proposal to the Green Climate Fund (GCF). The proposed scope includes hard infrastructure investments in rainwater harvesting and protection of groundwater wells to supply the minimum requirement of 20 liters per capita per day. Institutional and policy strengthening in the area of disaster response is also proposed. The focus is on the 23 outer islands and atolls with the exclusion of the two urban centres of Majuro and Ebeye. There are clear linkages of this Aquifers proposal to the GCF proposal but will be further explored during the PPG.

## 3. Proposed alternative scenario and GEF focal area strategies (brief description of expected outcomes and components of the project)

The overall objective of this project is “to improve the understanding, use, and protection of coastal aquifers towards enhanced water security within the context of a changing climate”. Specifically this project proposes to identify the extent, threats and the development potential of groundwater resources across the islands of Tuvalu, Palau and RMI through geophysical and land-use assessments, establishing monitoring networks, and working with individual communities and national government to provide options for improved access to groundwater and develop aquifer protection management plans. These management plans will be presented as suggested policy measures and investments to protect the coastal aquifers from over-abstraction, contamination and salt-water intrusion. The project scope will particularly contribute to Program 3 on “advancing conjunctive management of surface and groundwater through effective institutional, legal, and policy measures” of the GEF IW Objective 2. At present, lack of sound understanding on the location, extent, quality, and development potential of coastal aquifers in the three countries hamper conjunctive groundwater management.

The project will focus specifically on the protection of coastal aquifers from identified anthropogenic and climatic threats. Climatic threats consist of droughts, sea level rise and wave overtopping events whereas anthropogenic threats consist of unsustainable groundwater abstraction and land-based contaminating activities arising from land-uses and economic activities. The interventions to mitigate anthropogenic factors would likely involve restoration of degraded catchments (LD-3).

At the moment, groundwater abstraction for public water supply is only performed in the islands of Kayangel, Angaur and Peleliu of Palau and in the Laura freshwater lens in Majuro, RMI. The current state of abstraction (infrastructure, abstraction rates, and current water demand) will be assessed in relation to aquifer health and vulnerability to disasters and climate change and recommendations will be given in terms of management and expansion of production and monitoring infrastructure. In the rest of the islands in RMI and Tuvalu, groundwater abstraction occurs mainly at household level through shallow private wells. This level of abstraction does not present a direct threat to coastal aquifers as the abstraction rates are small. The exploitation potential of coastal aquifers in these islands will however be assessed and recommendations will be given on exploitable freshwater volumes, optimal locations for abstraction galleries and monitoring boreholes and sustainable yields. These recommendations will be part of the developed aquifer protection plans, which will consider sustainable abstraction as a management strategy and sustainable land management to tackle the climatic threats mentioned above (especially droughts).

To assist in determining the prioritization and selection of islands in both Tuvalu and RMI for further groundwater investigation, a selection criteria matrix will be developed in consultation with the relevant country representatives and in coordination with other projects to identify islands for further investigation. The selection process will consider population size, water demand especially during drought, indicated groundwater potential from existing investigations and observations, and other relevant parameters. It is anticipated that two to three islands in Tuvalu and five islands in RMI may be selected for further detailed groundwater investigations which will allow for both identification of specific groundwater resources potential and consideration of coastal aquifer protection measures.

The outcomes from this project will provide the evidence based information necessary for communities and governments alike to make informed decisions about the current and future reliance and use of available groundwater resources. The knowledge gained from the specific investigations and ongoing data sets will be used to guide future investments in groundwater within the context of water security and a changing climate, environmental and social conditions.

**Component 1.** Improved knowledge of coastal aquifers

**Outcome 1.1.** Enhanced understanding on the locations of the major coastal aquifers, their current quantitative and qualitative status and the human dependency on these aquifers

It is proposed to apply a methodology to assess small island groundwater resources with a multidisciplinary approach covering hydrogeological, socio-economic and environmental aspects. The methodology will build on the experience gained in the last 10 years by relevant projects in the Pacific (Pacific HYCOS, PASSAP, KIRIWATSAN, BIVA, CAIA, IWRM) and will incorporate a number of novel components that can link to existing global monitoring processes (SDGs) and new monitoring technologies (mobile applications). The assessment is carried out in cooperation with local partners (government, user associations) and external partners and is in alignment with existing projects (Atoll Water Security, Ridge 2 Reef). The aquifer assessment work will comprise of a hydrogeological, environmental, and socio-economic assessment.

*Hydrogeological and land-use assessments*

In order to identify the location and the lateral and vertical extent of coastal aquifers and to quantify the exploitable groundwater resource, a detailed assessment is required. Geophysics can accurately provide an image of the electrical resistivity/conductivity of subsurface materials, effectively indicating the presence of fresh groundwater. The geophysics will be used to quantify the freshwater supplies and to identify the areas of greatest thickness of the freshwater lens to guide resource development and water security planning. The results obtained from the geophysical surveys will also be used to identify suitable locations for the drilling of monitoring boreholes. Monitoring boreholes will allow for a complete aquifer assessment as well as for the monitoring of temporal changes in aquifer thickness (depth to fresh/saltwater interface) due to climatic and anthropogenic influences and environmental impacts.

Land-use assessments focusing on areas above the lens will be done to determine the sources of pollution and impacts on the freshwater lens. Due to the highly permeable soil of the atolls and islands, pollution from the surface are quickly leached into the groundwater.

*Environmental assessment*

A GIS study using satellite images will initially be conducted to map the locations of settlements and land-use activities which may act as pollution sources (e.g. locations of swamp taro pits). This information will be ground verifications during the assessment missions where household surveys will additionally be performed. The purpose of these surveys will be to capture the location and the groundwater quality of private wells, the quality of well construction, and the presence of pigs and pit latrines near the wells. The surveys will further capture socio-economic aspects such as groundwater use (see socio-economic assessment). Household surveys developed during the KIRIWATSAN project will be adapted to meet the needs of this project. The environmental information will contribute to the identification of water supply and monitoring boreholes locations.

The identification and mapping of potential pollution sources in combination with the geophysical and land-use assessments will help in defining potential groundwater protection zones for designation by the local community or national government. These zones are usually defined in areas where the freshwater lens is thicker where the groundwater development potential is greater. Other factors such as land ownership issues and existing land use activities will be an important consideration in the development of any groundwater resource or designation of any groundwater protection zone. Ultimately, it is foreseen that groundwater protection will be decided at the island and national level and incorporated into the existing bylaws, legislation, and regulations of the specific island and any appropriate national protocol and mandates, providing clear guidance for planning purposes at island and national levels (links to components 2 and 3).

*Vulnerability to overtopping*

The production of digital elevation models (DEMs) using advanced land surveying techniques will allow assessing the aquifer vulnerability to wave overtopping. Low-lying areas will be indicated as unsuitable for groundwater exploitation as more vulnerable to salinization in case of wave overtopping events. In addition, questionnaire surveys will be conducted to collect anecdotal information from the (older) population regarding historic large wave events and whether these resulted in island inundation. This will allow estimating the thresholds (tidal and wave conditions) above which inundation occurs and approximate the frequency of such events. For a number of islands, shallow bathymetry data of the reef zone are available. Combining this information with existing global wave models and with the detailed topographical information (DEMs) produced will allow for the development of models to simulate and assess the actual impact of potential overtopping events to coastal aquifers.

*Socio-economic assessment*

The human dependency and access to groundwater is a socio-economic indicator which may differ between islands, and varies spatially and temporally. Assessing the dependency on groundwater will help establish a reliable base line indicator for each island. This assessment will provide measurable insight on the needs and potential vulnerability of each island to water scarcity, groundwater potential and help prioritize the drilling component. Quantifying the indicator is done in collaboration with the local communities by means of census style surveys of water supply sources at the household level allowing for comparison between islands.

**Outcome 1.2.** Enhanced understanding of long-running and climate-related threats to these aquifers as source of water for domestic use

To confirm the thickness of the freshwater lens and better understand the dynamic behavior of the freshwater lens under different climate conditions requires monitoring boreholes. Geophysical models will be used to inform the drilling/construction of monitoring boreholes so that a representative monitoring network is installed in terms of borehole locations and depths. Moreover, information obtained from monitoring boreholes will be valuable for the development, calibration and validation of numerical models which will form an inherent component of aquifer management plans.

It is expected that the construction of 5-8 boreholes (each with four nested piezometers isolated at different depths) on each selected island will be required to allow for effective and ongoing monitoring of groundwater quantity and quality. It should be noted that, in freshwater lens systems, groundwater quantity is indirectly managed via salinity monitoring. Groundwater quality is therefore used to monitor groundwater quantity. Monitoring bores are critical to providing the community and government with the information to understand impacts and options for groundwater protection and sustainable development. As part of the construction of monitoring boreholes the determination of hydraulic information (hydraulic conductivity, transmissivity, porosity, etc.) via dedicated lab tests (grain size analysis) and field tests (slug tests, tidal wave propagation) will be undertaken contributing to the knowledge set for atolls. Once the boreholes are developed, monitoring schedules will be developed at the island level and linked to national protocols and mandates.

**Component 2.** Adaptive groundwater management

**Outcome 2.1.** Improved management and protection of coastal aquifers

The development of protection management plans is directly related to the development potential of the respective coastal aquifers. This is particularly relevant for the proposed islands of Palau where the public water supply relies on groundwater. Except Laura in Majuro atoll in RMI, no other aquifer in the three countries is currently being exploited for larger scale public water supply. A review of all existing infrastructures and operation will be essential to establish long-term term aquifer health and intermittent climate and abstraction impacts to guide improved management. Protection management plans will be developed providing recommendations regarding suitable areas for aquifer development in terms of groundwater potential and climatic/anthropogenic threats. These threats and the associated risks will be identified spatially and temporally. The plans will also provide recommendations on sustainable groundwater abstraction. The protection management plan which will be developed for Laura lens will be able to assess the possible impacts of abstraction and droughts more thoroughly and will be able to provide recommendations on how to optimize abstraction to achieve resilience against droughts.

Monitoring will be implemented under two overlapping schemes to achieve a more effective management of the groundwater resources. Once the monitoring boreholes are in place, periodic monitoring of groundwater salinity can be undertaken by trained community members, who will be supported with appropriate technologies and data-sharing platforms that can be more easily linked with island administrators and the national government. Considerations on resourcing the support for these community water officers in the intermediate and long-term, through an effective monitoring program, will be vital in the collection, storage and dissemination of reliable groundwater information.

Additionally the potential of crowd sourcing mechanisms will be explored to enable a community extension of the monitoring officer’s job in the existing private wells. The crowd-sourcing component will be demonstrated and implemented at an early stage (during the initial geophysical assessment) in a number of islands as a capacity development component to strengthen the capacity at community level and subsequently at national level (e.g. EPA for RMI).

The project will aim at equipping all priority islands with one automated rain station where needed, installed at a representative location, for a more complete understanding, assessment and monitoring of climatic inputs. It is especially important to be able to monitor the rainfall when it comes to groundwater management in relation to disaster risk reduction (droughts).

Data collection from the installed monitoring bores will be done manually. However, for selected islands the most representative boreholes will be equipped with salinity loggers to indicate the changes in the groundwater lens and act as an early warning system, triggering different alert levels which would translate into changes in groundwater management and operational responses and monitoring scheduling. Where practical, rainfall stations and monitoring boreholes will be telemetered to provide real time access to data.

As with all project components which require data collection, a main objective will be to strengthen the capacity within the island to manage its own water resources and improve its water security and disaster resilience. This is achieved by securing island-level ownership of data for operation and information access. Eventually, the strengthened capacity and bottom-up reporting mechanisms will form a centralized database capable of serving as the basis for the development of national groundwater protection and management plans.

Once the coastal aquifers are identified and the fresh groundwater is monitored and quantified, the influence of climatic threats and land-use will be assessed by means of scenario model simulations. A number of dedicated cross-sectional numerical models will be developed and possibly calibrated using salinity data obtained from existing and newly installed monitoring boreholes. The numerical model will allow simulation of the behavior of the island’s groundwater lens to external influences such as rainfall, pumping (relevant for Laura, RMI), tides and storm surges. Scenario simulations will help with visualizing and quantifying the damage to these coastal aquifers due to possible climatic threats and will allow for the development of informed protection plans that help minimize the impact (see Output 2.1.3). Ultimately, the purpose of such models would also be to better understand the behavior and recovery of the freshwater lens to drought, abstraction and overtopping pressures and demonstrate the replicability potential and application of results in similar island settings.

A dedicated modeling study will be performed for the Laura lens where long-term monitoring data have been obtained from the existing monitoring network installed by USGS in 1998. This model will become a valuable management tool facilitating the discussions between the Environmental Protection Agency (EPA) and the Majuro Water and Sewer Company (MWSC) regarding the use of this valuable coastal aquifer.

Two key outputs from this component is the development of implementation of management plans to mitigate the impacts of climate change and influences from land-use over the freshwater lenses. These plans will be implemented, including restoration of degraded lands and catchments to reduce groundwater pollution. Gender-related considerations and activities will be included in these plans.

**Component 3.** Strengthened island-based water governance towards improved national scale governance

**Outcome 3.1.** Improved water governance at the community and national levels

Understanding how communities in the outer islands address water governance issues in terms of (a) traditional ways of managing existing freshwater resources, (b) the use of local knowledge, coupled with tools or strategies that is usually activated (if this exists) when unplanned disruptions or damages occur, be it naturally-driven or human-induced, and (c) how water-related issues are resolved will be valuable information. The assessment will aim at characterizing traditional mechanisms of water resource management and look at ways of strengthening and/or improving these governance mechanisms towards an appropriate and systematic approach – this will require inclusive community engagements. This has been successfully trialed in Kiribati through the formation of village action groups who look after the routine maintenance and operation of water supply systems and linking these to the relevant use of village-by-laws to warrant the protection of water resources and infrastructures. These should in turn be linked to the island-level water supply management and protection strategy.

**Outcome 3.2.** Knowledge platform(s) put in place

Information sheets will be produced for each island with relevant statistics on water use and reliance for each water source, and the groundwater potential. Water resources maps will be produced indicating the areas of population density, the location of aquifers, potential pollution sources, overtopping vulnerability zones, indicative protection zones, etc. These briefs will help translate the project results into more easily digestible products which can be used for awareness raising, planning, and decision-making.

A dedicated project website will be developed allowing open access to produced documents and other relevant project products. The website will link to a knowledge database which will be a repository of information and temporal and spatial data sets generated during the project and build on the GEF Pacific R2R Programme Science and Technical Database developed under the GEF Pacific International Waters Project. The website will showcase the project results, highlight the replicability potential and will contribute in raising awareness.

## 4. [Incremental](http://www.thegef.org/gef/policy/incremental_costs)/[additional cost reasoning](http://www.thegef.org/gef/node/1325) and expected contributions from the baseline, the GEFTF, LDCF, SCCF, CBIT and [co-financing](http://www.thegef.org/gef/policy/co-financing)

Tuvalu, Palau and RMI are amongst the most vulnerable areas in terms of per capita fresh water availability, accessibility and usability against long-term climatic variabilities and improper anthropogenic interventions. This aquifer protection assessment and management support from the GEF will permit the systematic characterization and mapping of these limited resources, focusing on the identification of optimum fresh groundwater areas and with the guidance of communities and national authorities propose options and measures to maximize the benefits of using these resources and at the same time upholding the need for sustainable protection and management. This project will bring about common or shared environmental issues, such as human-induced and natural pollution, coastal inundation/erosion, and impacts of over-abstraction, which are pressing issues for both the countries in the context of sustainability and future development. Sustainable land management for areas above the lens will ensure a holistic approach in this project.

The suggested components are closely connected to regional and international agreements such as 1992 Rio Declaration on Environment and Development, the 2014 SIDS Accelerated Modalities of Action (SAMOA) pathway and the SENDAI framework. Relevant themes that are likely to be addressed under this project include (a) the recognition that sea-level rise and other adverse impacts of climate change will continue to pose significant risks to SIDS, (b) understanding threats or risks at local and national levels, (c) the conservation and management of resources through the protection and management of freshwater, (d) strengthening the role of women and youth in sustainable development, and (e) providing broad and more people-centered preventive plans to minimize disaster risks through multi-hazard, multi-sectoral, inclusive and accessible approaches. The project will encourage IWRM principles through its inclusive approach with government and the community, which will strengthen IWRM implementation and linkages at community-level, island-level, and national and regional levels. The proposed GEF TF resources will support the implementation and linkages of island-level and national goals to strengthen its adaptability and resilience to freshwater-related climate change threats.

The project will consolidate common knowledge base of coastal aquifers and will generate new and calibrated products to enhance groundwater protection and sustainable use. The project will be co-financed by a number of on-going regional projects such as the NZ government’s MFAT Water Security for Atoll Islands, which have planned activities for RMI and Tuvalu with the aim of integrating the activities and results to warrant holistic assessment and management of coastal aquifers and the planned Green Climate Funding proposal for RMI to address climate-induced water scarcity.

## 5. [Global environmental benefits](http://www.thegef.org/gef/GEB) (GEFTF) and/or [adaptation benefits](http://www.thegef.org/gef/sites/thegef.org/files/documents/GEF.R.5.12.Rev_.1.pdf) (LDCF/SCCF)

The protection of coastal aquifers is directly linked to the level of understanding and awareness on the behavior of these systems. An improved understanding of coastal aquifers and a strengthened in-country monitoring capacity will contribute to a more responsible and sustainable use and management of these freshwater resources and their accessibility and usefulness into the future. This will allow the countries to consider groundwater as an alternate freshwater resource, and incorporate into its water budgeting and management, especially during dry periods due its resilient nature. With respect to global environmental benefits, the project outcomes are expected to reduce the vulnerability of the three countries to climate variability and climate-related risks. Land degradation will also be addressed by instituting land-uses that will protect precious groundwater. Furthermore, the project outcomes are expected to protect and sustain the services these freshwater ecosystems provide, particularly the ones related to the provision of water supply.

## 6. Innovation, sustainability and potential for scaling up

Innovative approaches for the management and protection of coastal freshwater lenses in Kiribati have already commenced development through the BIVA and CAIA projects, funded by the Australian Government and the European Union, respectively. Calibrated and validated numerical models were developed under the aforementioned projects which simulate groundwater salinity changes based on climatic (rainfall) and anthropogenic (abstraction) influences proving invaluable for understanding of groundwater response and the development of pragmatic and innovative evidenced based management strategies. A number of key outcomes and lessons learnt from these projects will be replicated in the proposed components with particular attention to aquifer protection planning. Moreover, a number of innovations will be tested. These are particularly related to:

1. The advanced geophysical techniques using latest technology equipment (Electrical Resistivity Tomography using ABEM Terrameter LSII).
2. The installation of telemetered loggers for live and remote monitoring of climatic (rainfall) and anthropogenic (aquifer thickness due to abstraction, monitored through groundwater salinity) influences.
3. The testing of crowd-sourced salinity monitoring during dry conditions on selected islands to extend monitoring capacity and improve near-time monitoring and rapid assessment capability (mobile applications).

The active involvement of local personnel and communities in monitoring procedures aims at ensuring the long-term sustainability of project outcomes. Personnel will be supported with appropriate technologies and innovative data-sharing platforms that can more easily be linked with relevant island administrators and local or national government. This will support more consistent and homogeneous data collection throughout the country and consolidation into a centralized national database that can be used for targeting actions, identifying hot-spots, SDG achievement and other reporting purposes.

The improved understanding, management and protection of coastal aquifers attained by the project components described above will demonstrate the replicability potential to similar island settings, not only in the Pacific but globally. As the project will focus on selected islands identified by the governments in cooperation with the implementing agency, it is expected that the same strategies and developed technologies will be applicable to similar islands in the project countries as well as to other comparable countries outside of the current project scope.

[*Stakeholders*.](http://www.thegef.org/gef/sites/thegef.org/files/documents/document/Public_Involvement_Policy.Dec_1_2011_rev_PB.pdf) Will project design include the participation of relevant stakeholders from [civil society organizations](http://www.thegef.org/gef/csos) (yes [x]  /no[ ] ) and [indigenous peoples](http://www.thegef.org/gef/sites/thegef.org/files/publication/GEF%20IndigenousPeople_CRA_lores.pdf) (yes [ ]  /no[x] )? If yes, identify key stakeholders and briefly describe how they will be engaged in project preparation.

|  |  |
| --- | --- |
| **Agency** | **Role** |
| RMI Environmental Protection Agency, EPA | Coordination and National archive for groundwater monitoring data and support for water resource assessments  |
| RMI Ministry of Health and Human Services | Capacity building of water quality testing at national and island level |
| RMI Weather Service Office, WSO | Installation, calibration of rain gauges and overall responsibility for archive and dissemination of rainfall data  |
| RMI National Disaster Management Office, NDMO | Ensure the relevant coordination with regard to linking with existing efforts in disaster coordination and drought management |
| RMI Majuro Water & Sewer Company, Inc. | Support in groundwater supply operational management |
| RMI Red Cross Society | Red Cross volunteers will be engaged and trained in the use of crowd sourcing technologies for the rapid assessment of drought or overtopping impacts |
| RMI Coastal Management Advisory Council, CMAC | Ensure relevant community participation and engagement for community-based management plans in the outer islands  |
| Office of Environmental Planning and Policy Coordination OEPPC | Assist with project coordination with existing projects in RMI for the protection of the environment and human health  |
| Tuvalu Public Works Department, PWD | Support for survey of groundwater assessment, management of National groundwater data  |
| Tuvalu Meteorological Service, TMS | Installation, calibration of rain gauges and overall responsibility for archive and dissemination of rainfall data  |
| Tuvalu Ministry of Health | Capacity building of water quality testing at national and island level |
| Tuvalu Department of Rural Development | Coordination with Island council (Kaupule) and community consultation |
| Tuvalu Office of Lands and Survey | Surveying support for DEM  |
| International Federation of Red Cross and Country National and branch offices, RMI and Tuvalu | Collaboration on rapid assessment of groundwater conditions in household wells and other water sources |
| Tuvalu Department of Environment | GEF Focal point – coordination with other projects including NAPA2 |
| Tuvalu National Disaster Management Unit, Office of the Prime Minister | Alignment of activities to link with other existing projects |
| Red Cross Society for Tuvalu | Red Cross volunteers will be engaged and trained in the use of crowd sourcing technologies for the rapid assessment of drought or overtopping impacts |
| Palau Public Utility Company, PPUC | Responsible for supplying power and safe drinking water to the population |
| Palau Bureau of Land and Survey, BLS | Responsible for surveying land and identifying official recognized boundaries, including those of protected areas. |
| Palau Office of Environmental Response and Coordination, OERC | Responsible for ensuring compliance with Palau’s obligations under the UN conventions on climate change |
| Environmental Quality Protection Board, EQPB | Responsible for regulating environmental impact statements (EIS), marine and freshwater quality, air quality, public water systems, solid waste management, toilet facilities and pesticides |
| Palau Red Cross Society | Red Cross volunteers will be engaged and trained in the use of crowd sourcing technologies for the rapid assessment of drought or overtopping impacts |
| Office of Palau Automated Land and Resource Information System (PALARIS) | Responsible for the digitizing information for land-use and coastal aquifers building on existing databases |

*3. Gender Equality and Women’s Empowerment.* Are issues on [gender equality](http://www.thegef.org/gef/policy/gender) and women’s empowerment taken into account? (yes [x]  /no[ ] ). If yes, briefly describe how it will be mainstreamed into project preparation (e.g. gender analysis), taking into account the differences, needs, roles and priorities of women and men.

The community engagement work will be particularly centered on strengthening the participation of women (and the youth) in water resources management. A gender analysis will be undertaken during the project preparation phase to identify needs and roles of women and men in water resources management. Traditional gender roles will be challenged by developing women’s skills and involvement in water management practices. Gender-related considerations will be explicitly incorporated in the formulation and implementation of management plans related to aquifers and land management (Output 2.14 and 2.1.5).

*4 Risks.* Indicate risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, propose measures that address these risks to be further developed during the project design (table format acceptable).

|  |  |  |
| --- | --- | --- |
|  **Risk** | **Rating** | **Mitigation** |
| Lack of national and local buy-in for the development and adoption of aquifer protection management plans  | Low | Communication with island councils and national agencies will be developed early in the project to ensure their cooperation through demonstrated value of aquifer protection management plans. National and local governments have identified risks to groundwater and salinization potential as a major concern and addressing these risks by the project have direct benefits to the communities. This project will address these concerns at the island level.  |
| Absorptive capacity for knowledge transfer at the sub-national governance level is inadequate and unsustainable | Moderate | Assess the absorptive capacity in the identified area before committing to any interventions; maximise opportunities to employ local staff in the activity.  |
| Available data is insufficient to undertake site specific numerical modelling. . | Moderate | Input parameters for numerical model development including rainfall, aquifer extents and abstraction will be collected as part of the field assessments. Where drilling can be undertaken and establishment of monitoring networks then the infrastructure will be in place for targeted and specific data collection allowing for groundwater model development. In the absence of drilling and/or geophysical results, shallow seismic reflection will be employed. |
| Skills for undertaking modelling | Low | Partnership with appropriate educational/research institution with long-established expertise will be sought. |
| Communication costs for telemetry are unreliable or unsustainable for application | Moderate | Technology for telemetry via mobile network or satellite is improving. Where communication options are unreliable alternate sustainable data transfer approaches will be developed in consultation with country and island. |
| Logistical challenges of implementing activities in outer islands becomes overwhelming | Moderate | Build on lessons learnt about scheduling and logistics from previous projects; adopt flexible and back-up planning approaches such that alternatives (e.g. moving activities to a different location) can be prioritised if and when necessary. |
| Unable to establish monitoring boreholes due to difficulties of mobilizing conventional drilling rigs to remote locations | Moderate | Options exist in regard to monitoring borehole construction and drill technology. Appropriate technology and construction techniques will be applied, albeit this may affect the number of monitoring bores that are able to be constructed. |

*5. Coordination.* Outline the coordination with other relevant GEF-financed and other initiatives.

Coordination with existing national R2R Projects in Tuvalu, Palau and RMI and at regional level (SPC-implemented) has commenced to identify existing and proposed activities. Proposed actions will both complement and extend on the existing R2R projects. The current UNDP GCF proposal for RMI will consider water security measures for outer islands, where SPC has been involved since its inception and linked to existing projects such as the New Zealand MFAT-funded Atoll Water Security project.

The EU-funded North Pacific Readiness for El Nino Impacts (RENI) project commencing 2017 will focus on food and water security in Palau and FSM. In RMI the focus will be specifically on agriculture and food security whereby information on water resources will be an important factor.

The EU funded Global Climate Change Alliance Plus – Scaling up Pacific Adaptation (GCCA+ SUPA) project’s overall objective is to enhance climate change adaptation and resilience of ten Pacific countries including RMI, Tuvalu, and Palau. The specific objective is increase resilience to climate related stresses and shocks and to strengthen the implementation of integrated sectoral based climate change adaptation and mitigation strategies.

*6. Consistency with National Priorities*. Is the project consistent with the National strategies and plans or reports and assessments under relevant conventions? (yes [x]  /no[ ]  ). If yes, which ones and how: NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, INDCs, etc.

The RMI “National Strategic Plan (NSP) 2015-2017” includes five sectors with development objectives aligned with ten long-standing National Development Themes originating from the broader “Strategic Development Plan Framework 2003-2018” (Vision 2018) published in 2001. The proposed project components are consistent with the following national goals and targets of the RMI National Strategic Plan 2015-2017:

1. Efficient use of water resources under National Development Theme 1 “Ensuring and applying the practice of good governance principles to achieve effective governance through community planning and developing effective linkages between local and national government”,
2. Water security and access to reliable infrastructure under National Development Theme 8 “Building a sound infrastructure that provides energy environmental, infrastructure, and transportation security for all atolls”,
3. Environmental and coastal security under National Development Theme 9 “Mitigating the impacts of climate change and creating awareness of the importance of environmental assets through community, national, regional and international approaches and specifically the implementation of the Majuro Declaration”,
4. Environmental and infrastructure security for outer island populations under National Development Theme 10 “Ensuring outer islands populations receive access to all necessary services allowing all RMI citizens to enjoy a high quality of life”.

Moreover, the project outcomes are expected to complement the monitoring of NSP implementation and progress with respect to:

1. The “Environment, Climate Change and Resiliency” NSP Sector, which is monitored, among others, through the following indicators:
	1. Saltwater intrusion to wells and crops,
	2. Drinking water quality,
	3. Maps and datasheets of natural resource and conservation targets and uses,
	4. Number of completed resource management assessments.
2. The “Infrastructure Development” NSP Sector, which is monitored, among others, through the following indicators:
	1. Reduction of gastroenteritis incidences by 50%,
	2. Degree of IWRM implementation,
	3. Improving access to water for disadvantaged households.

Within the context of extreme vulnerability to climate change impacts, the RMI has developed and formally endorsed in 2011 the National Climate Change Policy Framework, to provide a blueprint to build resilience in partnership with regional and global partners. The NCCPF identifies “Food and Water Security” among the nine national priority areas which need to be addressed via the following five strategic goals:

1. Strengthen the Enabling Environment for Climate Change Adaptation and Mitigation,
2. Adaptation and Reducing Risks for a Climate Resilient Future,
3. Energy Security and Low-Carbon Future,
4. Disaster Preparedness, Response and Recovery,
5. Building Education and Awareness, Community Mobilization, whilst being mindful of Culture, Gender and Youth.

Links to the Post Disaster Needs Assessment of the 2015-2016 Drought, Feb 2017. The PDNA document will form the basis for drought recovery by the Government of RMI and will be useful for considering the economic and social impacts of drought and potential mitigation measures that could have been trialed and may be considered, cost reduction mechanisms identified for future droughts, and recommendations from the lessons learnt that could be considered for inclusion.

The project components are also consistent with the Tuvalu “National Strategy for Sustainable Development 2016 to 2020 (Te Kakeega III)” as they complement:

1. Strategic Area 8 "Natural Resources" as key performance indicator "increase in farmer productivity" implies availability of water including groundwater,
2. Strategic Area 9 "Infrastructure and Support Services" as performance indicator "Enough water in storage to last all the islands through 6 months of drought" is also dependent on groundwater,
3. Strategic Area 10 "Environment" which aims at protecting, restoring and promoting the sustainable use of terrestrial ecosystems including aquifers.

The need for promotion and enhancement of sustainable use of natural resources including groundwater through awareness and conservation was also highlighted in Tuvalu’s National Adaptation Programme of Action (NAPA) in 2007.

The project objectives will help achieve the Palau 2020 National Master Development Plan (PNMDP) as they aim at developing and strengthening policy mechanisms, institutional capacity and data collection required for the protection of coastal aquifer systems and to ultimately enhance the natural environment. The project is also in line with the national strategies related to the conservation of environmental assets, which helped implementing the Economic Development Plan (EDP).

The Management Action Plan (MAP) for Palau, approved in 2001, calls for comprehensive watershed management planning to achieve excellent water quality and quantity for the people of Palau. This has resulted in the development of a number of watershed management plans in Palau. Even though not explicitly mentioned, groundwater constitutes an integral component of the water cycle in every watershed and its management and protection is critical in achieving the envisaged water security. In the absence of surface water, as it happens in the islands of Kayangel, Peleliu and Angaur, groundwater/aquifer management plans will be developed during this project.

This project will finally support the Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) providing high-level strategic guidance to different stakeholder groups on how to enhance resilience to climate change and disasters, in ways that contribute to and are embedded in sustainable development.

*7.* *Knowledge Management.* Outline the knowledge management approach for the project, including, if any, plans for the project to learn from other relevant projects and initiatives, to assess and document in a user-friendly form, and share these experiences and expertise with relevant stakeholders.

The multi-disciplinary assessment results will generate substantial information pertaining to the characterization, delineation, and modelling of coastal aquifers with appropriate protection measures from climatic and anthropogenic threats. These products will unavoidably have socio-economic and land-use implications for the target islands, necessitating well-planned community engagement processes including women, youth, religious groups and local administrators to ensure the knowledge is transferred, and successfully adopted into the community-level and island-level development plans. Planned workshops with relevant government authorities will be essential to strengthen the linkages between key government stakeholders and warrant the timely dissemination of assessment results, which, in turn, will have implications on the potential replication of the assessment approach around the country or scaling up in terms of recommending best practices for coastal aquifer protection that can guide national policies and aid the achievement of national development goals.

Packaging of assessment results in a robust, reliable and accessible formats, including island briefs, GIS-based datasets, web-site, and reports with linkages to the GEF Pacific R2R Programme Science and Technical Database developed under the GEF Pacific International Waters Project, will be critical to allow the storage and/or archiving of the produced information as well as for awareness raising and decision making purposes.

# **Part III: Approval/endorsement by GEF operational focal point(s) and GEF agency(ies)**

**A. Record of Endorsement[[7]](#footnote-7) of GEF Operational Focal Point (s) on Behalf of the Government(s):** (Please attach the [Operational Focal Point endorsement letter](https://www.thegef.org/gef/sites/thegef.org/files/webpage_attached/OFP%20Endorsement%20Letter%20Template-Dec2014.doc)(s) with this template. For SGP, use this [SGP OFP endorsement letter](https://www.thegef.org/gef/sites/thegef.org/files/webpage_attached/OFP%20Endorsement%20of%20STAR%20for%20SGP%20Dec2014.docx)).

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Position | Ministry | Date *(MM/dd/yyyy)* |
| Clarence SAMUEL | Director | Office of Environmental Planning and Policy Coordination, RMI | 12 April 2018  |
| Soseala TINILAU | Director | Department of Environment, Tuvalu | 12 April 2018  |
| King SAM | Special Assistant to the Minister | Ministry of Natural Resources, Environment and Tourism, Palau | 6 April 2018 |

**B. GEF Agency(ies) Certification**

|  |
| --- |
| **This request has been prepared in accordance with GEF policies[[8]](#footnote-8) and procedures and meets the GEF criteria for project identification and preparation under GEF-6.** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Agency Coordinator, Agency name | Signature | Date*(MM/dd/yyyy)* | Project Contact Person | Telephone | Email |
| Adriana DinuUNDP-GEF Executive Coordinator | Adriana_signature.png | 6 March 2018 | Jose Erezo Padilla |  | jose.padilla@undp.org |

**C. Additional GEF Project Agency Certification (Applicable Only to newly accredited GEF Project Agencies)**

For newly accredited GEF Project Agencies, please download and fill up the required [**GEF Project Agency Certification of Ceiling Information Template**](https://www.thegef.org/gef/sites/thegef.org/files/webpage_attached/GEF%20Project%20Agency%20Certification%20Template.docx) to be attached as an annex to the PIF.

1. When completing Table A, refer to the excerpts on [GEF 6 Results Frameworks for GETF, LDCF and SCCF](https://www.thegef.org/gef/sites/thegef.org/files/documents/document/GEF6%20Results%20Framework%20for%20GEFTF%20and%20LDCF.SCCF_.pdf) and [CBIT guidelines](https://www.thegef.org/gef/sites/thegef.org/files/documents/EN_GEF.C.50.05_CBIT_TF_Establishment_0.pdf). [↑](#footnote-ref-1)
2. Financing type can be either investment or technical assistance. [↑](#footnote-ref-2)
3. For GEF Project Financing up to $2 million, PMC could be up to 10% of the subtotal; above $2 million, PMC could be up to 5% of the subtotal. PMC should be charged proportionately to focal areas based on focal area project financing amount in Table D below.

 [↑](#footnote-ref-3)
4. PPG requested amount is determined by the size of the GEF Project Financing (PF) as follows: Up to $50k for PF up to$2m (for MSP); up to $100k for PF up to $3m; $150k for PF up to $6m; $200k for PF up to $10m; and $300k for PF above $10m. On an exceptional basis, PPG amount may differ upon detailed discussion and justification with the GEFSEC. [↑](#footnote-ref-4)
5. PPG fee percentage follows the percentage of the Agency fee over the GEF Project Financing amount requested. [↑](#footnote-ref-5)
6. Provide those indicator values in this table to the extent applicable to your proposed project. Progress in programming against these targets for the projects per the Corporate Results Framework in the [GEF-6 Programming Directions](http://www.thegef.org/gef/sites/thegef.org/files/documents/GEF.C.46.07.Rev_.01_Summary_of_the_Negotiations_of_the_Sixth_Replenishment_of_the_GEF_Trust_Fund_May_22_2014.pdf), will be aggregated and reported during mid-term and at the conclusion of the replenishment period. There is no need to complete this table for climate adaptation projects financed solely through LDCF, SCCF or CBIT. [↑](#footnote-ref-6)
7. For regional and/or global projects in which participating countries are identified, OFP endorsement letters from these countries are required even though there may not be a STAR allocation associated with the project. [↑](#footnote-ref-7)
8. GEF policies encompass all managed trust funds, namely: GEFTF, LDCF, SCCF and CBIT [↑](#footnote-ref-8)