Nauru Priority Water Sector Development and Funding Needs Report

DRAFT REPORT

NRW SPECIALISTS
Every drop counts

ABN 42 217 629825

Australia
P.O. Box 762, Sanctuary Cove,
QLD 4212, Australia
Ph. +61 (0)755 467 123
Fax. +61 (0)755 109 337
Email. info@nrwspecialists.com.au

Fiji Islands
49 Gladstone Road,
Suva, Fiji
Ph: +679 331 3388
Email. info@nrwmacallan.com.fj

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	Preliminary		Authors	David Cox
	Draft	X	Signature	
	Draft Final		Reviewer	S. Turvey
			Signature	S.T
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1 INTRODUCTION

The purpose of the report is to identify and prioritise water sector development needs for Nauru in a constructive manner that will assist donors in understanding both the current situation and the water sector needs of Nauru. In addition to the social need for an acceptable, modern, and healthy level of service for water and wastewater, it is important that that requests for donor participation are justifiable from an engineering and economic perspective.

As stated in the Nauru Economic Infrastructure Strategy and Investment Plan (NEISIP):

> "Nauru's development strategy for water is to provide a reliable, safe, affordable, secure and sustainable water supply to meet socio-economic development needs".

In order to develop a "roadmap" for Nauru for water supply and sewerage, a Consultant was appointed in 2015 to develop the ***Nauru Water And Sanitation Master Plan*** covering the planning period 2015 to 2035. This document was completed in October 2015 and is used as a key planning document for the water sector and is the base planning document for this report.

Although the report is from late 2015, the question was raised as to whether it was worth doing a review and full update of the Master Plan before proceeding further. As outlined in this report, the current water and sewerage situation on the island is an "emergency system" that requires immediate remedial works. As such it is considered urgent to proceed immediately rather than undertaking a full update of the Master Plan which is less than two years old. Typically, Master Plans are updated every five to ten years. In this report, the consultant has documented any significant changes that have occurred since the 2015 Master Plan and included these in the revised costings.

It is proposed that Phase 1 of the water and sewerage works as outlined proceed as soon as possible to address the current situation. It is acknowledged that water demands in 2017 may be slightly different to those adopted for the start of Phase 1 works however the water demands in any master plan are based on assumptions, and brackish water systems, like that recently constructed in Meneng, will have reduced water demand in that area. Accordingly it is proposed that Phase 1 of the Master Plan 2015 be implemented in its current form as soon as possible taking into account the findings in this report.

This report outlines the prioritised development needs (based on the Master Plan) that need to be addressed in order to achieve a reliable water supply and sewerage system to meet current needs and lead to significant health improvements.

2 EXISTING WATER SUPPLY AND SEWERAGE SYSTEMS

The existing water supply and sewerage systems are under significant duress and the bulk of water and sewerage related activities are based around emergency responses such as reactions to people running out of water, septic tanks overflowing, power outages affecting desalination units, or water tanker breakdowns. At present the system is in such a state of disrepair that proactive management and preventative maintenance are extremely difficult to undertake.

The following sections outline the current systems in more detail.

2.1 Water Supply

Households in Nauru receive their drinking water through rainwater harvesting, desalinated tanker delivery, bottled water, or groundwater that is boiled before drinking. In most cases, a rainwater tank outside of the dwellings receives the water which is then pumped into the domestic plumbing using a pressure pump.

A common example of household supply is shown in the diagram below:

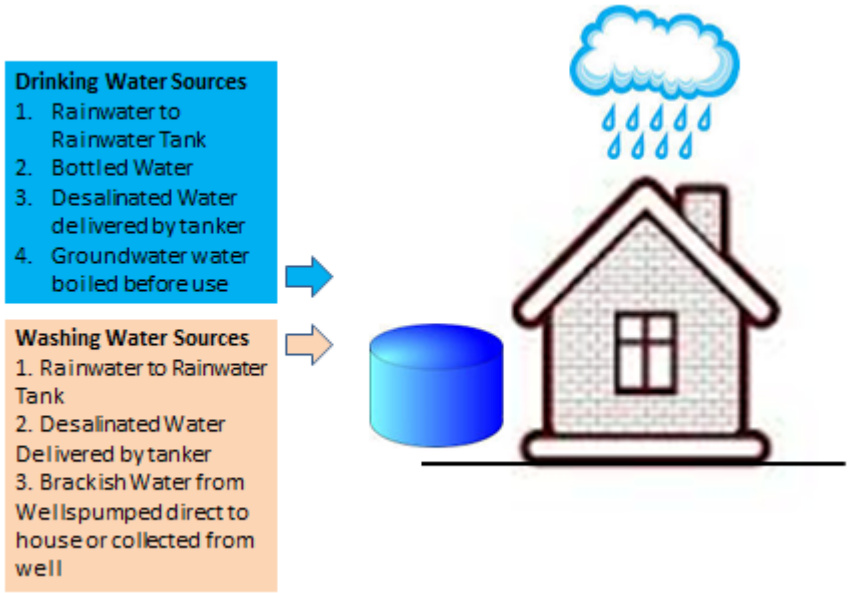

Figure 1. Water Sources Utilisation at Households

At present the vast majority of drinking water is supplied to residents using water tankers that fill up with desalinated water at the Nauru Utilities Corporation (NUC) tank "B13" and then deliver water as ordered by the customers. The NUC currently has a maximum desalination treatment capacity of approximately 2,110 kl/day (MLD), or 2.11 MLD due to the recent commissioning of 800kl/day additional desalination unit. It should be noted that this water treatment facility serves not only the citizens of Nauru but also the refugees being processed at the Refugee Processing Centres (RPCs).

The following schematic outlines the existing supply system.

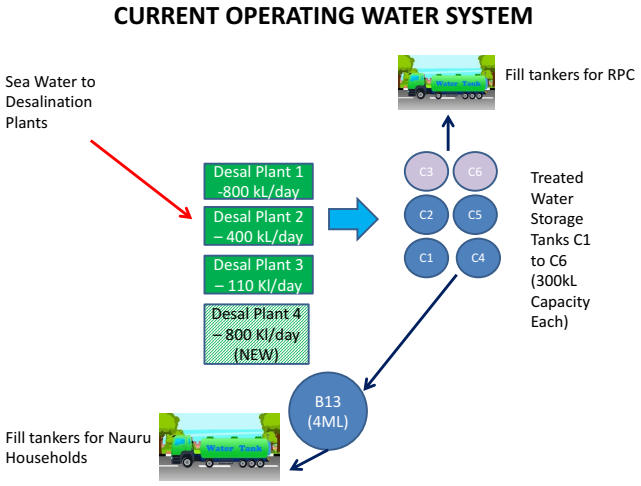

Figure 2. Current Water Supply System Operation

The existing system is considered to be an "emergency supply system" where tanker delivery of desalinated water to households is the norm rather than a permanent solution where water is delivered through a piped network on demand (supplementing rainwater harvesting).

The current system experiences difficulties related to:

- shortages of diesel to power the desalination units;
- electrical faults affecting supply;
- disruptions related to repairs or maintenance of desalination units;
- tanker breakdowns; and/or
- lack of water storage capacity to allow for the above factors.

A water reticulation network was previously installed for the Aiwo district however this system was abandoned many years ago. The reticulation network also consisted of Asbestos Cement and Galvanised Iron pipework which is reportedly more than fifty years old. Due to the nature of the pipework materials used, the old network is not considered to be salvageable as the galvanised iron pipework is most likely severely corroded and the Asbestos Cement pipework is likely to have suffered multiple fractures due to the roadwork upgrades in the old supply areas (Asbestos Cement piping is brittle and very prone to facture when road traffic loading). In addition, the undesirable health effects of working with Asbestos Cement pipework also led to the decision to not consider possible reinstatement of the old network. Pipe sizes in the old network were also, in many cases, less than the generally accepted minimum pipe diameter of 75DN to 100ND for reticulation mains.

2.2 Sewerage

The Nauru sewerage system simply consists of primary treatment in the form of septic tanks or cesspits provided to treat waste at all households.

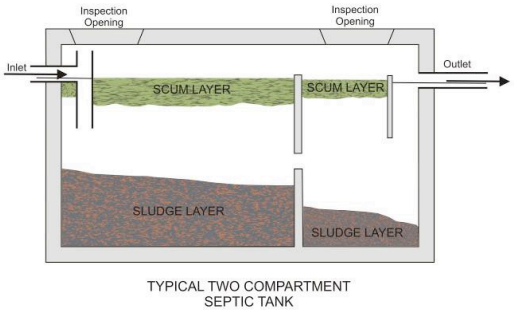

Figure 3. Typical Septic Tank

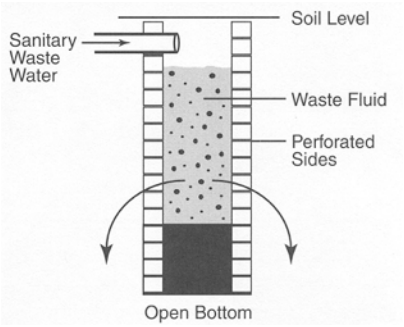

Figure 4. Typical Cesspit

As shown in the figures above, the fully enclosed septic tank provides an improved primary treatment to the cesspit before discharging the effluent to the seepage drains in the adjacent ground. Septic tank effluent will still contain approximately 40% of the pollutants and 25% of the pathogens in the raw sewage and therefore should not be discharged close to a water source being used where human contact is likely.

The cesspits discharge raw sewage directly to the adjacent ground through the open bottom and perforated sides of the units.

It is reported that a number of septic tanks are, however, also damaged and leaking which means that they are not functioning correctly and also discharging to the adjacent soil although it is likely that the bulk of the solids are still being retained. It is well documented in the previous studies that the widespread use of cesspits and poorly functioning septic tanks had led to severe contamination of groundwater. Due to the continued use of groundwater for toilet flushing plus washing, laundry and in some cases drinking, this clearly poses a significant health risk.

Figure 5. Sewage Ocean Outfall Structure

Until recently, when septic tanks and cesspits needed pumping out, the pumpout material was disposed of through the many ocean outfalls that exist on the island.

The RPC does have its own sewage treatment plants which treat the sewage generated at its facilities. The only municipal sewage treatment plant in Nauru is a small plant in Meneng at Nauru Primary School that was installed when the facility was the original RPC.

Figure 6. Sewage treatment Plant at Nauru Primary School with Effluent Dispersal Pit

Figure 7. New Sewage Plant for New School Building at Nauru Primary School

The existing "green" sewage treatment plant located adjacent to the Nauru Primary School has not been operating correctly for some time. The treatment plant was constructed as part of the original refugee centre on the island and originally operated as a biological filter plant.

The treatment plant tanks were then modified so that the flow from the tankered waste enters one of the two sedimentation tanks then flows through the second sedimentation tank into the first balance tanks, the clarifier, the chlorination tank and the second balance tank where it overflows into the newly constructed dispersal pit and percolates into the groundwater.

This system provides little or no effective treatment apart from acting as a series of septic tanks where the solids are captured but the polluted water, after some chlorination, will flow into the groundwater. The total capacity of the tanks used in this system is approximately 750,000L or assuming the current sludge tankers are of 4,000L capacity equal to around 200 tanker loads.

A recently installed "black tank" sewage treatment plant was installed for the new building at Nauru Primary School. At the time of the site visit, this plant was starting to overflow and all island septic tank pumpouts are reportedly also being directed to this plant now.

The facilities at the Nauru Primary School (after repairs) are suitable for the school's needs and are not suitable for use as a municipal treatment plant that can handle the entire island's needs.

The longer the current situation continues, the more severe the groundwater contamination will become and the more the public health risks will increase. If tankers continue to dump the sewage into the small plants, they are likely to completely fill up with sludge and overflow. This is already starting to happen on site.

The Master Plan report also provided a more detailed assessment and analysis of the current situation and highlighted the health risks associated with current practices.

2.3 Summary of Water Supply and Sewerage Situation

It is noted that past under-expenditure and minimal investment in the water sector over many decades has led to a situation where the water supply system is in a state of severe disrepair and groundwater contamination due to poorly functioning sewage disposal systems is rife. There are **very few countries in the world that do not have a reticulated water supply system at all** and where all supply is by water tanker or rainwater harvesting.

Similarly wastewater disposal is through cesspits or septic tanks, and apart from two minor plants designed to service one school, the country has no means to treat septic tank "pump outs" in a reliable way. Septic tank discharges pass directly to the soil, contaminating the groundwater which is used to supply houses with either washing water or in some cases even drinking water. The health risks of such practices are apparent.

3 MASTER PLAN (2015) PROPOSED WORKS

The *Water and Sanitation Master Plan* of 2015 provided a detailed assessment of the current situation on the island and undertook the detailed analysis and planning for the proposed future works to meet the 20 year needs until 2035.

The proposed works were split into two phases as follows:

- Phase 1 – planned works to be implemented immediately to cater until 2025
- Phase 2 to follow on from Phase 1 in 2025 to meet the needs until 2035

It is proposed that Phase 1 works be constructed as soon as possible. The following sections outline what was proposed in the Master Plan.

3.1 Water Supply Phase 1 (Up to 2025)

It is proposed to focus on the future delivery of improved water supply as outlined in the *Nauru Water Supply and Sanitation Master Plan*, Phase 1 as shown in the diagram below.

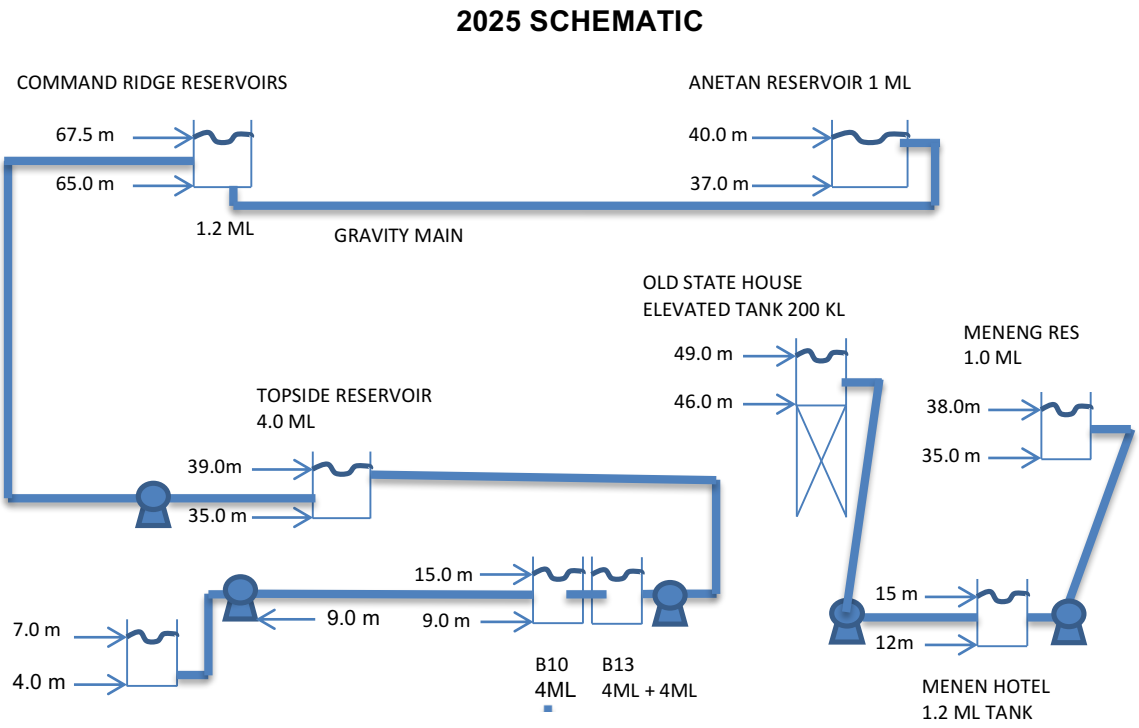

Figure 3 Water Supply Phase 1 Schematic

The budget for the proposed works is outlined in the table below:

Table 1. Table of Water Supply Capital Works Costs

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs
Water Treatment Works	1,515,000	1,365,000	2,880,000
Water Storage	2,400,000	2,200,000	4,600,000
Pump Stations	1,780,000	850,000	2,630,000
Additional Various System Pump Items	130,000	200,000	330,000
Water Reticulation	14,750,000	0	14,750,000
House Connections	1,200,000	330,000,	1,530,000
SCADA	500,000	200,000	700,000
Total	**22,275,000**	**4,815,000**	**27,420,000**

3.2 Sewerage Works Phase 1 (Up to 2025)

In a similar way to the water supply planning, the sewerage works were similarly split into two phases with Phase 1 catering until 2025 and Phase 2 catering until 2035.

The table below shows the estimated capital costs for the Phase 1 works.

Table 2. Table of Sewerage Capital Works Costs

Sewage Treatment Works	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand
Site Clearing, Preliminaries	120,000	60,000
Control Building/Office	180,000	36,000
Treatment Structures and Equipment	2,350,000	825,000
Control	823,000	248,000
Pipework	1,060,000	330,000
Electrical	1,530,000	495,000
Stormwater Management	80,000	40,000
Roadworks	120,000	60,000
Security Fencing etc	80,000	40,000
Sub Total	***6,343,000***	***2,134,000***
Engineering	1,268,000	427,000
Contingencies	1,521,000	512,000
Total	**9,132,000**	**3,073,000**

4 DEVELOPMENTS SINCE 2015 AFFECTING MASTER PLAN DETAILS

Since the *Water Supply and Sanitation Master Plan* was finalised in 2015, there have been a number of infrastructure works that have been commenced or planned works that have not been completed due to budget issues. This affects some of the planning items (and cost estimates) which were outlined in the *2015 Master Plan*.

It is therefore essential that the costs of the current Master Plan works are updated to reflect these changes prior to seeking donor participation.

4.1 New Nauru Port Design and its Effect on the Existing Seawater Pump Station

Discussions between Mr David Cox and Cardno, the consulting engineering company undertaking the new port design under ADB funding, took place on 16th May 2017. The earlier advice received from the Consultants in April 2017 was that the new port development was planned to be built over the existing sea water intake building. The later advice on 17th May 2017 was that the design was now being amended and this was no longer an issue for consideration.

During the site visit from 17 May to 26 May 2017, the seawater intake structure was however inspected to ascertain if there were any issues with the current intake arrangement. It was also noted that this is a shared intake facility – i.e. used for supply to the desalination units for both the Nauruan population and the Refugee Processing Centres (RPCs). As such it is a critical item of infrastructure and is the only seawater intake for the desalination units.

Inspection of the seawater intake on 19th May 2017 found that there was significant damage to concrete of the structure and the condition had worsened significantly since 2015. There was both internal and external damage with the internal damage appearing to be worse than the external damage.

Figure 8. Existing Seawater Intake Structure and Inlet Pipeline to Marker at Edge of Reef

Figure 9. External Concrete Damage to Structure with Steel Reinforcement Now Exposed

Figure 10. Concrete spalling and Steel Reinforcement Exposed on Internal Side Wall

Figure 11. Concrete damage and exposed Steel Reinforcement on Upper Floor Slab

It was noted that the pump station building does not appear to be leaking at all and that the concrete issues may be localised to the upper half of the building. It is possible that poor grade concrete and insufficient cover to steel was used on the upper portion of the structure and that the lower section of the structure was well-constructed.

A detailed inspection by a suitably qualified structural engineer is required to ascertain the extent of the damage and recommend appropriate remedial work. As such an amount has been included in the scope of works to undertake a structural inspection and facilitate repairs to the structure. It is possible that CIE may be able to procure funding from the Australian government for these works as they are a shared facility for both the RPC centres and the Nauruan population.

4.2 Current Desalination Production at Nauru

At the time of the Master plan report, the water production figures were known and the upgrade plans from Nauru Utilities Corporation (NUC) were incorporated into the Master Plan report.

The production figures as outlined in the Master Plan of 2015 were confirmed on 19th May 2017 during discussions with the CEO of NUC. As such no changes to the planning production figures are required to the Master Plan values.

4.3 Current Water Supply Upgrade Plans by Nauru Utilities Corporation (NUC)

The Consultant met with the CEO of NUC on 19th May 2017 and the current water supply plans of NUC were discussed.

NUC has the following plans for the next 12 to 24 months:

a) Construct new seawater pipeline from port wet well as an alternative (emergency) seawater supply – this would be an additional intake to the existing seawater intake structure. **An amount of AUD 300k funding is being sought through the Australian Border Force (ABF) for such works.**

b) Procure new 5000 litre water tanker – the new 12,000 litre tankers acquired under US Aid funding are very effective however some properties are difficult to access with a large tanker and so the smaller 5000 litre tanker is required for such instances.

c) Repair the 4ML "B13" Steel Tank – the condition assessment of the tank is currently in progress. The financial impact of proposed upgrading of Tank B13 is discussed in the following section of the report.

d) Start installing reticulation from tank "B13" towards Aiwo and RON hospital.

It is noted that these plans by NUC although constituting more "Emergency Relief" at the moment, do generally tie in with the Master plan.

At the moment, NUC has very few options and funding to substantially improve its situation however it is attempting to initiate a water reticulation system to provide less reliance on the current water tanker system and reduce operating costs.

There are factors outlined below that need to be taken into consideration by NUC with their proposed works so that it will integrate correctly with the Master Plan.

Proposed Supply to Aiwo and RON Hospital from B13 Tank

It is noted that the B13 tank is located at a similar ground level to the rest of Aiwo. As such under the Master Plan, the supply to AIWO was planned to be supplied not from B13 but from a tank located at a higher elevation up on the ridge adjacent to the Fuel Storage Tank Farm 'Topside". This was where approximately four large water tanks were located some years ago and their locations are described in the Master Plan.

The Master Plan outlines the levels of service required and providing a reticulation network from the B13 tank will not achieve this. As NUC is in such a dire situation regarding water supply the reticulation network could be installed as soon as possible to assist in reducing the dependence and costs of tankers and then connected up to the tank near the Fuel Tank Farm when this new tank is built under Phase 1.

It is clearly preferable if the reticulation is fully designed by engineers prior to any new section of pipework being laid, however the emergency situation of NUC is acknowledged and the reticulation that is proposed could be laid and then incorporated later into the design process providing that the reticulation meets minimum standards.

It is important that if NUC proceed with the proposed reticulation, that reticulation of suitable size and material is used so that it can be incorporated later into the planned reticulated supply system.

The Master Plan (section 5.1) outlines the "Water Supply Standards of Service and Design Criteria).

Accordingly if NUC proceed with the installation of any reticulation, it is requested that NUC provide the following:

a) Minimum size of DN90 of Polyethylene pipework (PE100 material) with PN 12.5 pressure rating.

b) Minimum DN75 for PVC Series 2 Rubber Ring Joint (RRJ) or Ductile Iron Pipework - minimum PN12 pressure rating.

All pipelines are to be professionally laid with a minimum of 600mm cover generally and a minimum of 900mm cover in trafficable areas.

If the above pipework is installed then the reticulation could be successfully incorporated into the planned Master Plan works.

4.4 Changes in Planned Water Storage Facilities

At the time that the Water Supply Master Plan was produced, the following water storage situation existed:

- Tank B13 was the main water storage facility on the island.
- A contract had been awarded to demolish Tank B10.
- The EU funding for the 4ML water storage tank to replace B13 on the existing B13 footing was no longer available.
- An additional 4ML water tank at the B10/B13 site was to be constructed using USAid funding. It is noted that the costs for this 4ML tank were not included in the Master Plan costing as this was to be covered under US Aid funding. **It is noted that this funding for the 4ML tank was later used for other water supply infrastructure (water tankers) and so the cost of the 4ML tank would now need to be added into any new budget**.

During the site visit from 17 to 26th May 2017 it was noted that:

> *Tank B13 was empty and was undergoing a condition assessment – a report will be produced (by others) which will outline proposed works. It was noted that although the roof of the tank showed severe corrosion, the side walls of the tank and floor were in relatively good condition and the tank should be able to offer long term service if a liner were installed (a detailed report will be produced to confirm these suggestions).*

Tank B10 had been completely demolished by May 2017.

Figure 12. Tanks B"13" and "B10" at time of Master Plan (2015)

Figure 13. Tank "B13" remaining – tank "B10" demolished (by May 2017)

Figure 14. View showing remaining base of "B10" and Upgraded Pump Station Building (Blue Building)

Figure 15. Pump Station Building Before (2015) and After Upgrade (May 2017)

At the time of writing this report, a small pump to pump water from B13 into the water tankers has not been commissioned and water is supplied under gravity from B13 into tankers.

The new pump station building also incorporates other NUC staff facilities and as such its functionality to be further upgraded as a pump station for the main pumping from B13 up to the proposed new tanks near the Fuel Tank Farm is uncertain. Accordingly the budget has not been adjusted for a reduction in the proposed pump station cost at this location and the budgeted figure in the 2015 Master Plan remains.

The following costs will need to be incorporated into the costing of the proposed works and the Master Plan Phase 1 costs will be adjusted to include:

1. Cost to upgrade tank B13 – this will be based on the assumption that it is economically viable to upgrade based on the condition assessment report (not yet available). As a minimum the roof will require replacement and it is likely that a liner would be recommended for installation within the tank.

2. Cost for new 4ML tank to provide for the tank that was intended to be funded under USAID.

3. Increased estimate for 4ML tanks in Nauru. The tender prices for the USAID funded 4ML tank at Nauru in 2016 exceeded the USAID budget and based on tender prices received, the cost estimates for constructing new 4ML tanks on the island would need to be increased for budgeting purposes. This has also been undertaken in the updated costings.

4.5 Meneng Brackish Water Reuse Project

It was noted during the May 2017 site visit that the Meneng brackish water scheme had been largely completed and will provide brackish water to some 400 people in the Meneng district for toilet flushing. This scheme is therefore effective in reducing the dependence on desalination water from NUC.

Figure 16. Water Storage Tanks for the Meneng Brackish Water Scheme

Figure 17. Pump Station for Brackish Water

It was noted that the pump station is located only some 50m from the sea which means that the water is likely to be of high salinity. Due to the health concerns raised in the Master Plan regarding the effluent discharges from the Nauru Primary School Sewage treatment plant to the Meneng groundwater, the distance between the pump station and the school is seen as positive.

Figure 18. Typical Brackish Water Service Connection in Meneng

The Meneng brackish water scheme was considered as part of the 2015 Master Plan and does not affect the planned water supply works so no budgetary adjustments are required as a result of this scheme.

4.6 Opportunities for Increased Rainwater Harvesting

In the Master Plan it was noted that there is increased opportunity for rainwater harvesting on the island especially taking into consideration the predicted increased rainfall in Nauru due to climate change.

As mentioned in the 2015 Master Plan, it is proposed that to make the water supply system sustainable (and lower cost) in Nauru, rainwater harvesting at a household level is to be considered to be the **primary source** of water. When the rainwater tank has water in it, then the typical household would draw its water from the tank in the usual manner. When the rainwater tank is running low, then the household would open the valve of its future water service connection from the NUC reticulation network and top the rainwater tank up again and then close the valve.

In this manner, households will be aware that:

a) **Rainwater is the primary source and is free.**

b) **Reticulated water is a backup and comes at a cost.**

As part of the 2011 Census, it was also noted that a number of houses do not utilize rainwater harvesting for reasons that include:

- There is no rainwater tank.
- The rainwater tank is not physically connected to the roof downpipes.
- The low retail cost of water means that the community acquires the desalinated water at a low cost and this does not drive the need to harvest rainwater more efficiently.

There are currently partially complete rainwater tank installation projects on the island. What is essential however is that each and every household (and business) has a working rainwater tank that is connected to the guttering and provides a meaningful amount of storage so that it can become the primary water source at that location.

Based on discussions held in Nauru in May 2017, the 18,500 litre rainwater tanks on a concrete slab are locally recommended as a suitable, practical size tank to be installed that can provide meaningful storage capacity.

At present it is unclear of how many households still require rainwater tanks or how many households have tanks but are not connected to the roof downpipes etc. A survey of all household regarding rainwater tanks is therefore required. It is also recommended that this data be captured on GIS so that it can be suitably tracked and monitored by NUC or some other agreed party.

As rainwater harvesting underpins the sustainability of the water supply system and may also lead to deferred capital expenditure on Phase 2 of the Master Plan - i.e. if rainwater harvesting works out to be very effective in reducing overall water use, then the Phase 1 development outlined in the Master Plan may meet demand for more than ten years as originally proposed.

Accordingly an estimate of approximately 200 rainwater tank installations (to be confirmed the proposed field survey) has been included in the cost estimates.

Budget Impact

Based on discussions with NUC staff in May 2017 and considering quotations received as part of their rainwater tendering activities to date, an amount of AUD 15,000 has been allowed per 18,500 litre tank with concrete base installed on the island. With an estimated 200 tanks this amounts to AUD 3 million. An amount of AUD 75,000 has been allowed for the field survey of all of the households for rainwater tanks on the island including updating the results into GIS and producing location plans showing the locations of tanks and status (connected/not connected/other).

The total estimate for rainwater tanks would therefore be **AUD 3,075,000**.

4.7 Sewerage Related Changes

In the Water Supply Master Plan it was noted that the sewerage disposal on the island is of major concern due to the fact that there is no municipal Sewage Treatment Plant (STP) on the island. Up to the end of 2015, all septic tank pump outs were disposed of by tankers discharging into the Nauru Primary School sewage treatment plant. Due to issues with the school's sewage disposal, the school was discharging into an adjacent cess pit while the island's pump outs were going into its treatment plant.

The following changes have occurred since 2015:

1. The use of the cesspit by the Nauru Primary School has reportedly been discontinued with sewage from the main school buildings being directed to the original "green" treatment plant system. It was not possible to confirm the cesspit operation due to the densely overgrown site as this location and the consultant relied on the school maintenance manager's report;

2. The original sewage "green" treatment plant is in use with a minor repair attempt having been attempted since 2015. One of the treatment tanks has been replaced and there has been an attempt to recommission electrical supply to pump(s). The final stage of the treatment facility (filters) are overgrown with vegetation and do not appear to be functional.

3. The site of the original treatment plant is heavily overgrown and the security fence has been removed which poses a health risk to children at the school.

4. A new school building has been constructed and a new Sewage Treatment Plant has been constructed for this new extension.

5. The STP for the new school building is now being used as the discharge location for the island's septic tank pump outs. At the time of the site visit on 19th May 2017, these tanks were starting to overflow and this STP is similarly not capable of treating all of the island's sewage.

6. RON Hospital has constructed a new Sewage Treatment Plan as part of its upgrades.

Figure 19. New School Building At Nauru Primary School

Figure 20. New Sewage Treatment Plant for New Building at Nauru Primary School

Figure 21. The older "Green" Sewage Treatment Plant at Nauru Primary School

Figure 22. A replacement tank has been installed at the plant

The RON Hospital as part of its recent upgrade works has constructed a new sewage tanks. The RON Hospital has a planned sewage treatment plant under the Hospital planning in 2015 and it was proposed to treat hospital waste separate to domestic sewage. It appears that this has been implemented and will not change the proposed works under the 2015 Master Plan.

Figure 23. RON Hospital with Black Sewage Tanks (Right Hand Side)

In summary, the 2015 recommendations are still valid that a CED sewerage system with a Municipal Treatment Plant capable of handling the islands sewage should be provided. In addition, minor works should be carried out to bring the sewage treatment plant at Nauru Primary School up to successful operation.

4.8 Land Ownership

During the Master Plan study it was noted that that land ownership would be an issue for consideration prior to project implementation. This is considered to be more of an issue with the sewerage system than the water supply system.

The proposed reservoir locations for the water supply system were discussed with the Survey Department in Nauru and sites were strategically chosen on land that already has infrastructure located on it and should be easily accessed from an infrastructure development perspective. Similarly water supply pipelines would generally follow the roads and water supply connections would be provided from the water reticulation mains (in the street) up to either the customer's boundary or to their rainwater tank. As such, the water supply is likely to have few land ownership issues.

The sewerage system will however have land ownership matters to resolve before implementation and CIE will need to consider an approach as the funding application progresses. In particular, there will need to be an assessment of the condition of septic tanks on customers' property together with small diameter pipelines laid from customers' septic tanks to sewer reticulation mains and/or sewage pump stations. Access to properties will be a key factor.

The location of the sewage treatment plant will also need to be finalised prior to design/implementation and possible land ownership matters resolved.

While land ownership can be a challenge, CIE will be able to develop a consultation strategy in the interim period to develop an approach in the interim period that will assist in addressing land ownership.

5 PROPOSED WORKS FOR FUNDING

Phase 1 of the Water and Sanitation Master Plan will be the key works to be implemented. Where necessary, the original cost estimates have been revised to reflect the current situation and changes since the report was produced – changes that have occurred since 2015 were discussed in section 5 of the report and the cost implications are addressed in the following sections.

5.1 Water Supply Phase 1

The following works were proposed for Phase 1 as shown in the schematic below.

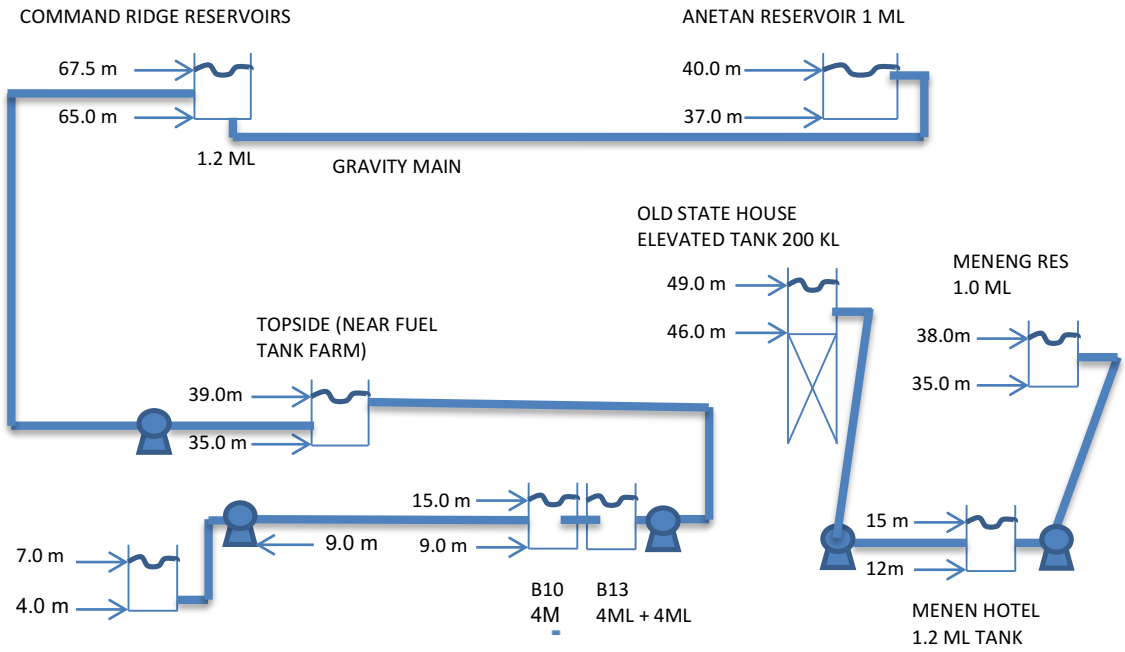

Figure 24. Phase 1 Water Supply Schematic.

The estimated costs for Phase 1 (and phase 2) are shown in the tables below.

Table 3. Water Production Proposed Augmentations (Desalination Plants)

Location	Maximum Production (MLD)	Rated Daily Production (MLD)	Year of Augmentation	Phase 1	Phase 2
NUC Location	0.8	0.6	2016 (commissioned)	$0 – already commissioned	
Meneng (at Menen Hotel)	0.6	0.45	As of May 2017 - purchased by NUC but awaiting installation	$0 – already purchased	
NUC (Aiwo) Location	0.7	0.525	2016	1,515,000	
NUC (Aiwo) Location	0.6	0.45	2025		1,365,000
TOTAL	2.7	**2.025**	**Total Cost (AUD)**	**1,515,000**	**1,365,000**

Table 4. Water Storage Proposed Augmentations

Location	Storage Delineation (Ground / Elevated)	Proposed Augmentations (ML)	Year of Augmentation	Phase 1	Phase 2
B10 and B13 Tank Site – new 4ML tank – *build on B10 site*	G	4 ML	2016	**1,300,000*	
B10 and B13 Tank Site – *Repair tank B13*	G	4ML	2018	*500,000*	
B10 and B13 Tank Site – new 4ML tank – *next to B13 and B10*	G	4 ML	2016	**1,300,000*	
B10 and B13 site – replace tank B13 (if necessary)	G	4 ML	2025		**1,300,000*
Topside (near Fuel Tank Farm) Reservoir	G	4 ML	2016	**1,300,000*	
Topside (near Fuel Tank Farm) Reservoir	G	4 ML	2025		**1,300,000*
Command Ridge (upgrade existing tanks)	G	1.2 ML	2016	200,000	
Command Ridge (new tank)	G	1 ML	2025		300,000
Anetan Reservoir	G	1 ML	2016	300,000	
Anetan Reservoir	G	1 ML	2025		300,000
Meneng New Reservoir	G	1 ML	2016	300,000	
Meneng New Reservoir	G	0.5 ML	2025		200,000
Meneng "Old State House" Elevated Tank	E	0.2 ML	2016	200,000	
Rainwater tanks (200 No of 18,500 litre)	G	3.7ML	2018	**3,075,000*	
			Total	**8,400,000**	**3,400,000**

**Notes:*

(1) Reservoir costs for 4ML tanks increased from 700k to 1.3Million based on past Nauru tenders and other more recent pacific island tenders. With RON Rehab having acquired crushers from the RPC centres, costs may come down from these values due to ability to produce quality fill for foundations locally. (2) Rainwater costs include for survey to determine exact number of tanks required.

Table 5. Phase 1: Pump Station Costs

Pump Station	Civil KW	Rate	M&E KW	Rate	Total
Aiwo Desal to B13	13	186,684	11	130,000	316,684
B13 to Topside	42	465,123	32	260,000	725,123
Topside (near Fuel Tank Farm) to Command Ridge	15	215,405	11	130,000	345,405
Menen Tank to Meneng Res	9	174,565	6	100,000	274,565
Menen Tank to Old State House	2	49,382	1	70,000	119,382
				Total	**1,781,159**

Table 6. Phase 2: Pump Station Costs

Pump Station	Civil KW	Rate	M&E KW	Rate	Total
Aiwo Desal to B13	13	18,668	13	128,824	147,492
B13 to Topside (near Fuel Tank Farm)	42	46,512	42	297,224	343,737
Topside (near Fuel Tank Farm) to Command Ridge	15	21,540	15	148,643	170,183
Menen Tank to Meneng Res	9	17,456	9	128,435	145,892
Menen Tank to Old State House	2	4,938	2	36,332	41,271
				Total	**848,575**

Table 7. Bulk Supply and Reticulation Water Pipeline Costs (Phase 1)

Item	Diameter	Material	Length	Rate	Amount
1	75	DICL	323	150	48,450
2	90	PE	24,330	200	4,866,000
3	100	DICL	84	230	19,320
4	125	PE	3,201	260	832,260
5	150	DICL	624	317	197,808
6	160	PE	24,494	300	7,348,200
7	180	PE	2,096	330	691,680
8	250	DICL	641	479	307,039
9	315	PE	722	600	433,200
					14,743,957

Table 8. Additional System Pump Stations Costs

Location	No	Rate	Phase 1	Phase 2
Ijuw High Elevation – minor of main storage, mini pump station and mini elevated tank	2	50,000	100,000	
Aiwo High Elevation	1	30,000	30,000	
Upgrade Pumping Facilities at Sea Water Intake Pump Station	1	As shown	**1,000,000*	200,000
		Total	**1,130,000**	**200,000**

**Notes:*

(1) The concrete rehabilitation at the intake structure may be specialist work at higher cost. Also includes for structural assessment by structural engineer. (2) In addition, the pumps will need to be upgraded as additional desalination plants are commissioned.(3) As this is a shared facility with the RPCs, it is likely that funding contribution will be provided by Australia.

Table 9. House Connection and Water Meter Costs

Description	Number	Rate	Phase 1	Phase 2
Water connections (including water meter)	2,396	500	1,198,000	
Water Connections (including water meter)	666	500		333,000
TOTAL			**1,198,000**	**333,000**

The revised costs are summarised in the table below.

Table 10. Summary of Proposed Water Supply Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs
Water Treatment Works	1,515,000	1,365,000	2,880,000
Water Storage	*8,400,000	*3,400,000	*11,800,000
Pump Stations	1,780,000	850,000	2,630,000
Additional Various System Pump Items	*1,130,000	200,000	1,330,000
Water Reticulation	14,750,000	0	14,750,000
House Connections	1,200,000	330,000,	1,530,000
SCADA	500,000	200,000	700,000
Total	**29,275,000**	**6,345,000**	**35,620,000**

*Notes:

Items with * indicate values that have changed since 2015 Master Plan taking into account subsequent developments.

As the costs were estimated in 2015 for implementation in 2016, it is necessary to adjust the cost estimate for Phase 1 from 2015 to 2017 with planning for implementation in 2018. Specific increases in pricing for some items have already been taken into account where known.

The table below reflects the costs adjusted at 3% per annum to cater for inflation related increases. Although some costs outlined in preceding tables are more recent than the 2015 original estimates, they are a small percentage of the overall costs and it is also noted that all the design and construction costs are unlikely to be incurred in one year and will be subject to some additional increases. Therefore all costs estimates from the preceding table have been upwards adjusted to 2017 values with the view for 2018 implementation.

Table 11. Proposed Phase 1 Water Supply Works – Cost Adjusted to 2017

Description	Phase 1 Year 2015 costs	Phase 1 Adjusted Costs to 2017
Water Treatment Works	1,515,000	1,610,000
Water Storage	8,400,000	8,910,000
Pump Stations	1,780,000	1,890,000
Additional Various System Pump Items	1,130,000	1,200,000
Water Reticulation	14,750,000	15,650,000
House Connections	1,200,000	1,270,000
SCADA	500,000	530,000
Total	**29,275,000**	**31,060,000**

5.2 Sewerage Phase 1

The following tables were presented in the Master Plan and the work scope associated with the Phase 1 works remains unchanged.

The following costs estimates are therefore provided for the new Sewage Treatment Plant:

Table 12. Sewage Treatment Works Rates

Sewage Treatment Works	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand
Site Clearing, Preliminaries	120,000	60,000
Control Building/Office	180,000	36,000
Treatment Structures and Equipment	2,350,000	825,000
Control	823,000	248,000
Pipework	1,060,000	330,000
Electrical	1,530,000	495,000
Stormwater Management	80,000	40,000
Roadworks	120,000	60,000
Security Fencing etc.	80,000	40,000
Sub Total	***6,343,000***	***2,134,000***
Engineering	1,268,000	427,000
Contingencies	1,521,000	512,000
Total	**9,132,000**	**3,073,000**

The proposed plant would be constructed close to the main facilities and a suitable site for the new plant is considered to be “Location” which is in proximity to large demand areas and also has the advantage of being located close to Aiwo NUC offices where power supply can be provided to pump treated effluent up to the Rubbish Dump site for irrigation of reclaimed phosphate mining areas.

Table 13. Sewerage Reticulation, Septic Tanks, Access Chambers, Pump Stations & Septic Tanks

Location	No	Rate	Phase 1	Phase 2
Households	2,396	5,000	11,980,000	
Households	666	5,000		3,330,000
New Septic Tanks	1,678	4,000	6,712,000	
New Septic tanks	666	4,000		2,664,000
		Total	**18,692,000**	**5,994,000**

Table 14. Summary of Proposed Sewerage Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs
Immediate Repairs to STP at Nauru Primary School	75,000		75,000
New Sewage Treatment Plant	9,130,000	3,075,000	12,205,000
Upgrade sea outfall structure for STP	200,000		200,000
Sewer Reticulation, Septic Tanks, Pump Stations etc.	18,690,000	5,990,000	24,680,000
Total	**28,095,000**	**9,065,000**	**37,160,000**

As outlined for the Water Supply Costs estimates, it is necessary to update the cost estimates developed in 2015 to 2017 values. Therefore all costs estimates from the preceding table have been upwards adjusted to 2017 values with the view for 2018 implementation. In a similar manner to the Water Supply cost estimate adjustments, the Sewerage Cost estimates have been updated at 3% per annum as per the table below.

Table 15. Summary of Proposed Sewerage Works- Cost Adjusted to 2017

Description	Phase 1 Year 2015 Costs	Phase 1 Adjusted Costs to Year 2017
Immediate Repairs to STP at Nauru Primary School	75,000	80,000
New Sewage Treatment Plant	9,130,000	9,690,000
Upgrade sea outfall structure for STP	200,000	210,000
Sewer Reticulation, Septic Tanks, Pump Stations etc.	18,690,000	19,830,000
Total	**28,095,000**	**29,810,000**

5.3 Institutional Support for NUC for Phase 1 Water and Sewerage

In terms of operating the new system, NUC will require additional staffing and skills to manage the new assets effectively.

Taking into account similar scale utilities operating in remote areas, the following organisational structure for the proposed Water and Sewerage Section at NUC in Nauru was presented in the Master Plan report.

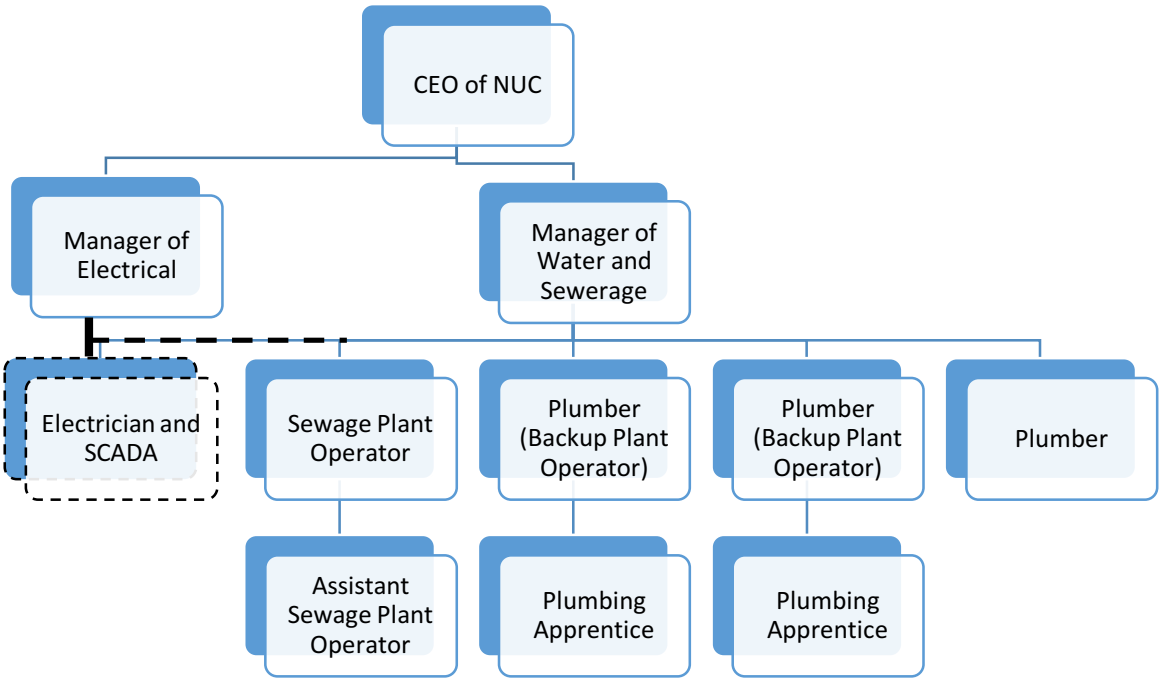

Figure 25. Indicative Organisational Structure for NUC Water and Sewerage Section

The above diagram represents a starting point for internal discussion at NUC with the proposed structure generally in line with similar utilities in remote areas.

The following Operation and Maintenance Costs were derived based on discussions with NUC and using typical infrastructure Operation and Maintenance estimates based on an annual percentage of infrastructure asset value.

Table 16. Estimate of Annual Operation and Maintenance Costs (AUD)

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand
Annual Staffing Costs as per Structure shown in Section 9.3	240,000	240,000
Allocation of 50% of total Electrical, Water and SCADA costs as per NUC discussions	180,000	180,000
Water Maintenance/parts/repairs based on percentage of installed asset value	335,000	410,000
Sewerage Maintenance/parts/repairs based on percentage of installed asset value	420,000	560,000
Total (AUD/year)	**1,175,000**	**1,390,000**

It is therefore necessary to also adjust the annual costs to 2017 values as per the table below. Similarly a rate of 3% per annum to cater for inflation has been adopted.

Table 17. Estimate of Phase 1 Annual Operation and Maintenance Costs – Cost Adjusted to 2017

Description	Phase 1 Year 2015 Costs	Phase 1 Year 2017 Costs
Annual Staffing Costs as per Structure shown in Section 9.3	240,000	255,000
Allocation of 50% of total Electrical, Water and SCADA costs as per NUC discussions	180,000	190,000
Water Maintenance/parts/repairs based on percentage of installed asset value	335,000	375,000
Sewerage Maintenance/parts/repairs based on percentage of installed asset value	420,000	445,000
Total (AUD/year)	**1,175,000**	***1,390,000**

*This coincidentally works out at the same value as the unadjusted Phase 2 annual cost.

It is noted that although NUC has significant power-related experience and in-house expertise related to power supply, it has very little in-house expertise in managing large scale water and sewerage projects like that which is required to be delivered in Nauru. It is therefore proposed that an experienced water/sewerage engineer (minimum 10 to 15 years international water/sewerage experience) be located in Nauru for a minimum period of three years to assist NUC with the contractor liaison and Client representation during the implementation phase of the water and sewerage projects.

It is recommended that a sum of $1 million be allocated for project implementation engineering support for NUC Client for these projects – this sum can be spread out annually as part of O&M costs or included under a donor's capital sum.

6 SUMMARY OF PROJECT FUNDING REQUIREMENTS

In summary, it is noted that donor participation should be sought for the following items.

6.1 Water Supply Phase 1 Funding Requirement

The table below summarises the water supply cost estimates to implement the project in 2018. In addition to such cost estimates, it is typical to allow for a contingency for unforeseen events that can negatively impact upon the project such as encountering large quantities of rock that could cause construction costs to rise.

The table below therefore outlines the recommended funding level to deliver Phase 1 of the Master Plan.

Table 18. Summary of Proposed Phase 1 Water Supply Funding Needs

Description	Phase 1 Adjusted Costs to 2017 - AUD
Water Treatment Works	1,610,000
Water Storage	8,910,000
Pump Stations	1,890,000
Additional Various System Pump Items	1,200,000
Water Reticulation	15,650,000
House Connections	1,270,000
SCADA	530,000
Total	**31,060,000**
Contingency – approx.. 10%	**3,110,000**
Total (AUD)	**34,170,00 = Approx. 34 million**

6.2 Sewerage Phase 1 Funding Requirement

Similarly for sewerage Phase 1 implementation the funding requirements are outlined in the table below. The table below also allows for a contingency for unforeseen events that can negatively impact upon the project such as encountering large quantities of rock that could cause construction costs to rise.

Table 19. Summary of Proposed Sewerage Works- Cost Adjusted to 2017

Description	Phase 1 Adjusted Costs to Year 2017 - AUD
Immediate Repairs to STP at Nauru Primary School	80,000
New Sewage Treatment Plant	9,690,000
Upgrade sea outfall structure for STP	210,000
Sewer Reticulation, Septic Tanks, Pump Stations etc	19,830,000
Total	**29,810,000**
Contingency – Approx 10%	**2,980,000**
Total (AUD)	**32,790,000 = Approx. 33 million**

6.3 Institutional Support and Operational Phase 1 Funding Requirement

As shown in section 5.3 of the report, NUC will require water and sewerage staff to perform the operation and maintenance delivery requirements of the new water and sewerage systems.

Table 20. Estimate of Phase 1 Annual Operation and Maintenance Costs – Cost Adjusted to 2017

Description	Phase 1 Year 2017 Costs
Annual Staffing Costs as per Structure shown in Section 9.3	255,000
Allocation of 50% of total Electrical, Water & SCADA costs as per NUC discussions	190,000
Water Maintenance/parts/repairs based on percentage of installed asset value	375,000
Sewerage Maintenance/parts/repairs based on percentage of installed asset value	445,000
Total (AUD/year)	**1,390,000**

In addition to the above annual requirement it is recommended as per section 5.3 of the report that a senior water/sewerage engineer be assigned to NUC during project implementation to assist in Client management of the works as well as capacity building and skills transfer to NUC Water and Sewerage staff. It is recommended that a sum of **AUD 1 million** be requested for funding of the individual to cover their input over a three to four year period.

7 SUMMARY OF FUNDING NEEDS

The current water and sewerage situation in Nauru is at an emergency level and has been operating at that level for many years. Decades of under-investment in water and sewerage infrastructure have left a water supply and sewerage system that is barely functional and poses a significant health risk to people.

Water Supply

Nauru's water supply system consists of desalination to a deteriorating steel tank (Tank "B13") from where water is supplied to customers via water tankers. This mode of operation places high reliability of supply risks due to the following factors:

- Power outages affecting water production
- Inadequate water storage facilities to cater for intermittent production
- Deteriorating critical assets - the only water storage tank in operation ("B13") is in poor condition and the seawater intake structure is showing extreme concrete damage – these assets place the entire island's water supply at risk
- Water tanker breakdowns and the unavailability of spare parts (delays in importing spares) affect supply
- Water quality issues
- High cost of running water tanker system compared with a reticulation system;
- No reticulation system at all - entirely water tanker supply.

The points above outline some of the key factors affecting the current water crisis on the island. As such it is recommended to proceed with the implementation of Phase 1 works as soon as possible.

Some of the benefits of Phase 1 water supply works would be as follows:

- Repairs to critical assets to ensure their reliability
- Increases in production and water storage leading to reliable water supply
- Chlorination at various points ensuring safe drinking water to customers
- Water reticulation network leading to use of water tankers for emergency purposes only
- Providing level of service to customers that is in line with modern expectations
- Providing a water supply system that will utilise rainwater harvesting as a key element of supply leading to sustainability
- Health benefits to those who currently need to carry water in buckets from communal water tanks to flush their toilets at their houses.

The Phase 1 water supply works will make a significant difference to the quality of life to the people of Nauru and provide a reliable and safe water drinking system that will also encourage and utilise sustainable rainwater harvesting.

Sewerage System

The people of Nauru are dependent on cesspits and septic tank systems at a household level for sewage disposal. Each of these systems leads to groundwater contamination and the high incidence of groundwater contamination is well documented from past studies in Nauru. In particular, a number of septic tanks are reported to be damaged and leaking which exacerbates the issue.

Due to the current water supply system, households have attempted to become self-sufficient as far as possible and many families pump groundwater to the house for toilet flushing, washing, and other purposes. In some cases, groundwater is also used for drinking water. The use of contaminated groundwater is a significant health risk for families.

The other key issue lies in the disposal of septic tank pump outs when the sludge builds up in the septic tanks over many years. At present all septic tank pump outs are discharged into the Nauru Primary School Treatment plants. These treatment plants are designed for the school, and are unable to cope with the loading from the entire country. **As such, these plants at the Nauru Primary School overflow, which is a risk for school children.**

As stated in the Master Plan, a municipal treatment plant and sewerage system is urgently required to address the current emergency situation. It is therefore recommended that Phase 1 of the Sewerage works as outlined in the Master Plan proceed as soon as possible.

Some of the benefits of Phase 1 sewerage works would be:

- Reduction in health risk at household level.
- Reduction in health risk at Nauru Primary School.
- Gradual improvements to groundwater quality as new septic tanks provided and septage discharged to sewerage system instead of groundwater.
- The potential use of sludge from sewage treatment plant mixed with soil for rehabilitated mining areas.
- The potential reuse of treated effluent for sewage treatment plant to irrigate rehabilitated mining areas.

The water and sewerage systems on the island are failing and are operated in an emergency status. In both the water and sewerage systems, the proposed planned works have adopted tried and tested technologies that are relatively easy to maintain and do not call for advanced operating skills.

The current needs and the significant health and other benefits of the proposed works have been outlined in the report. Urgent funding is required to address these issues.