Baring Head

Building Services Concept Report

21 December 2015

energy
environment
engineering

auckland office:

address
1 centre st
freemans bay
auckland 1010

postal
po box 91 675
victoria st west
auckland 1142

phone
64 9 303 0007

fax
64 9 303 0017

wellington office:

address
level 3
35 ghuznee st
wellington 6011

postal
po box 9585
wellington 6141

phone
64 4 384 6583

website
www.e3bw.co.nz

email
enquiries@e3bw.co.nz

TABLE OF CONTENTS

Document Control:

Rev No.	Date	Revision Details	Compiler	Author	Verified	Approved
A	13/08/15	DRAFT Concept	JN	JN	VE	
B	25/08/15	Concept	VE	VE		
C	21/12/15	Update Client Comments	VE	VE	PJA	

Print on totally chlorine free 100% recycled paper and use a re-useable fastener.
eCubed Ltd: 'Seeking better and cleaner ways of doing business'

1 SUMMARY

The Baring Head Lighthouse Compound is in a remote location on the south eastern side of the Wellington harbour entrance. The site consists of various buildings and structures with historic significance, in particular the light house, two keeper's houses and the power house. The site is popular local tramping destination.

In approx. 1996, the lighthouse keepers left the site and the houses have remained unused since.

It is now proposed to develop the site for commercial and recreational use. The keeper's houses are proposed to be refurbished to allow for short term accommodation and the power house to be used as Visitor Information Centre and Shelter.

This concept report provides information on the existing infrastructure services. It describes a scheme for new infrastructure services, like power supply, drainage and water, and proposed services for the houses. Where possible, options are discussed.

The report can be used by the stakeholders to proceed with initial budgeting and to review potential options where discussed.

A summary of our recommendations are below:

- Space heating is to be provided by radiant wall panel heaters
- Hot water is to be provided by an electric hot water cylinder
- Photovoltaic system to generate electricity and offset demand from local grid
- Appliances are to be energy efficient
- Tapware, sanitary fixtures, and appliances are to be low water use
- Onsite waste water treatment plant
- Rainwater Harvesting with regular top ups by tanker
- Lighting is high efficiency LED lights

2 INFRASTRUCTURE SERVICES

2.1 Power Supply

The site is provided with overhead mains power. A pole mounted 30kVa transformer is located at the site boundary. A below ground cable is then run from the transformer to service the keeper's houses with a fuse box in front of the Power House. The transformer also services the police radio mast, lighthouse and NIWA station.

The available free capacity for the houses is unknown. However, we have contacted Wellington Electricity and based on their information sufficient capacity should be available. The proposed systems for heating, hot water heating, general lighting and power is similar to the previous use. If the power usage of other facilities on or near the site (NIWA, Police) hasn't significantly changed since 1996, it is assumed sufficient power is available to services the keeper's and power house with electricity. Based on the proposed scheme, as described in this report, a power demand of approx. 24kW is estimated.

The power supply to all houses is currently disconnected. To re-establish power to each house, the existing below ground cable will need to be tested and, depending on the results of the test, may need to be replaced. We would suggest engaging an electrician for capacity and cable testing prior to the next design stage.

New cables can be run within a new common trench for water and drainage services between the houses (refer to sketch drawing at the back of this report).

Pole with transformer in background. In ground cable manhole in front

30kVA pole mounted transfomer

Fuse box in front of Power House

2.2 Water Services

The site has no mains water connection. The keeper's houses were previously serviced with collected rainwater which was stored in below ground tanks outside each house. Booster pumps drew water out of the tanks and supplied the houses. Access to the tanks was not possible during our site visit, therefore the condition and size of the tank is not known. The booster pumps have been removed and the pump enclosures are either removed or in bad condition.

We recommend that a new 30,000l plastic water tank be installed to capture the rainwater from all three house roofs. The Baring head weather data shows that rainfall is considerably less than Wellington. As a result, the water tank may require tanker refills during dry periods depending on the occupant's water consumption and the amount of rain. From our simulation, based on 10 people using the houses for three days per week and Baring Head rain data, we would anticipate that the water tank would require four to five 10,000l tanker top ups annually. As the neighbouring farm has a similar set up, tanker access is expected to be possible.

To allow for gravity feed from the roof gutters, the top of the tank has to be below the roof inlets. We would suggest partially burying the tank (approx. 1m deep). This will also reduce the visual impact. The tank is proposed to be located within the native garden where trees and bushes can provide additional visual protection.

From the water tank, the water would be filtered and pumped to where required. The pump and filters would require an enclosure for weather protection. We suggest positioning this enclosure right next to the tank. The water filtration system would consist of particulate filter, carbon filter and ultraviolet treatment.

Figure 1 - Typical 30,000l Rainwater Tank

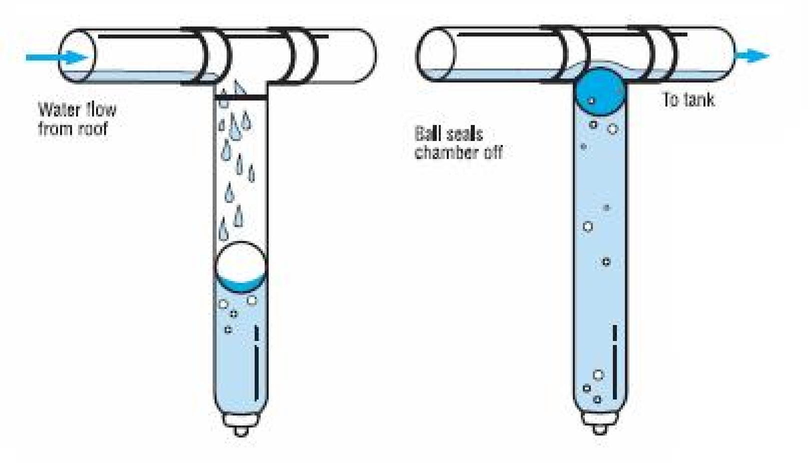


Figure 2 - First Flush Principle

A first flush diverter (Figure 2) would be installed, either at each house, or a larger first flush diverter at the tank. This is required to minimise roof contaminants entering the drinking water.

It is understood that the existing roofs are asbestos. To collect rain water, any asbestos roofs need to be replaced. It is also recommended that the roof and spouting are thoroughly cleaned on a regular basis (e.g. yearly depending on leaves, pollen, bird droppings, and other dirt collected on the roof) so that all potential rainwater can be collected and contaminants are minimised.

Alternative options investigated:

<u>Below ground tank</u>
An alternative option is to use a tank of similar size which is completely below ground. Because of structural requirements, these tanks are typical larger in footprint but shallower and typically more expensive.

<u>Reinstating existing tanks</u>
A further option is to reinstate the existing water tanks. However, access to the tanks was not possible during our site visit and their condition is unclear. The storage capacity of the tanks is also not known but appears to be smaller than that discussed above. As there are existing tanks for each house, this system would require two pumps and filtration sets.

<u>New individual tanks for each house</u>
Instead of one large 30,000l rainwater tank as proposed above, each house could be provided with an individual rainwater tank of approx. 10,000l to 15,000 which could again be an above ground or in-ground type. The roof of each house would charge its dedicated rainwater tank. The advantage of this would be a reduction of below ground stormwater piping compared to the described system above with a common larger tank. This option would require each house to have its own pump set, and the total costs for the tanks is likely to be higher than for one larger tank.

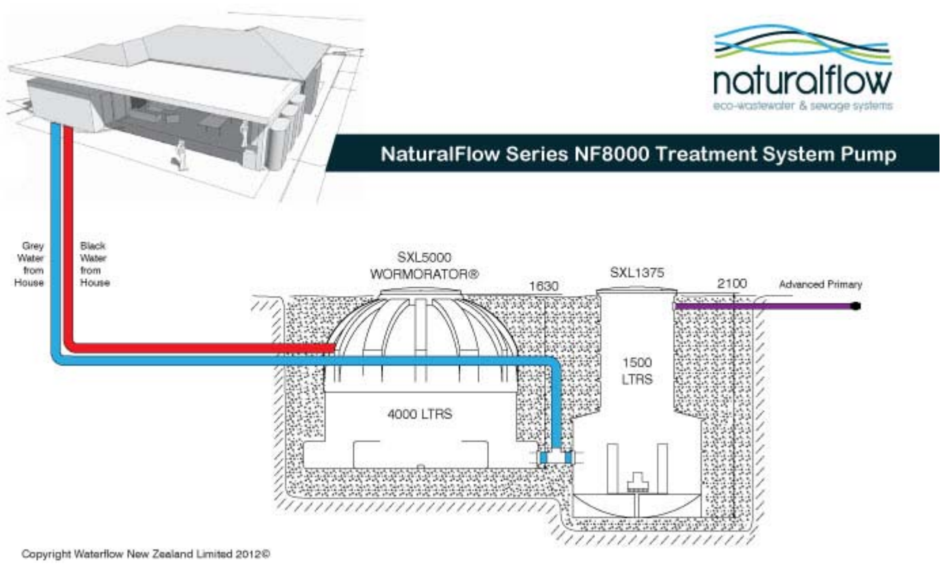
Our investigation has shown that costs for tanks increase only marginally with larger volume (e.g Devan Tanks 1 x 30,000l is advertised at approx. $3500, while 2 x 10,000l is approx $4500, or 2x15,000l is approx $5,000, all plus installation costs). Splitting the tanks also has the disadvantage that the rainwater harvest will be split. In a situation where one house is used more often than the other, a water shortage might occur for one house while the other tank would have still rainwater available. This is particularly critical due to the limited rainfall. It should also be noted that a 10,000 litre storage tank has dimensions of approx. 2.5m diameter and 2.6m height which will impact on the visual appearance of the houses.

2.3 Drainage Services

The existing drainage from the houses is currently discharged untreated over the cliffs edge, and an old septic tank from the Barracks has collapsed and cannot be reused. Therefore a new sanitary treatment plant is required.

For the on-site waste treatment plant, possible solutions include textile-based multi-pass treatment (Innoflow) or worm based (NaturalFlow) digestion systems which have a lower environmental impact compared to standard aerated systems. Due its organic and/or micro-organism processes, power demand on pumps, etc. is significantly lower and regular pump outs are typically not required. Maintenance is therefore limited to one or two annual checks. These systems are suitable for intermittent use.

The discharge from the treatment plant will then be dispersed using a subsoil sandbed irrigation field, approx. 70m^2, to the surrounding grassed area.



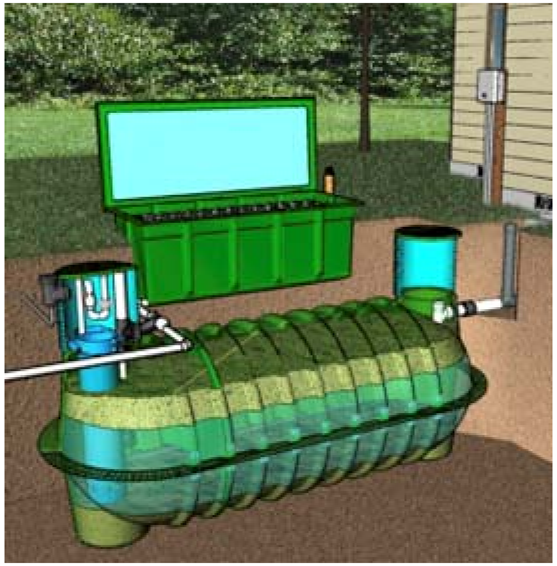


Figure 3 - Potential Sanitary Treatment Plant

3 BUILDING SERVICES

3.1 Heating

The table below provides a comparison of the different heating options available for the site. The limited power supply to the site may require the use of heatpumps to heat the houses. This will need to be investigated within the next project stage. Typically heat pumps provide up to four units of heat for every unit of electricity consumed, whereas resistive electric heaters only provide one unit of heat for every unit of electricity consumed. The drawback of heat pumps is their high capital cost, and low life expectancy due to the coastal environment in which they are to be installed. If heat pumps are to be used then additional corrosion protection would be required to the outdoor unit and coils.

The heat pump option could be either a single ducted unit per house or individual high walls or floor consoles per room. In the case of the ducted heatpump option, the unit would be mounted in the roof cavity and air would be supplied to each bedroom and living room.

Table 1 - Heating Comparison Table

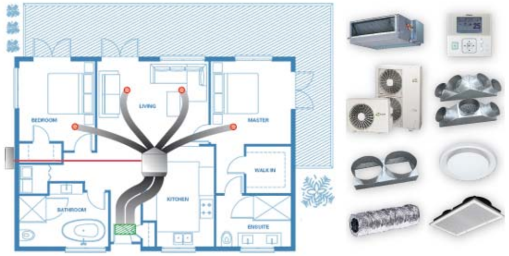
Heating Type	Capital Cost	Running Cost / Electrical Load	Plant Size	Comfort	Life	Operation	Comments
Heatpump- Ducted System	high	low	Medium	medium	Low-Medium	Moderate	Ducted system would provide tempered air to all bedrooms and living rooms at set temperature, variable room temperatures might occur.
Heatpumps- individual highwall	Medium/high	low	Medium	medium	Low-Medium	Moderate	Domestic Heatpump, would be required to each room, hence multiple units per house. Or one unit in living space heat transfer via open doors or heat transfer system
Electric Radiant Ceiling Panels	low	high	Small	low	Medium	Simple	Spare Electrical Capacity TBC - if incoming main needs to be increased, capital cost would be higher
Electric Wall Heater	low	high	Small	high	Medium	Simple	Spare Electrical Capacity TBC - if incoming main needs to be increased, capital cost would be higher

Because the usage of the houses is sporadic in nature, the impact of capital cost versus running cost has greater bearing, therefore electric wall heaters would be more favourable. Convection type wall heaters, as shown on Image 6, below are recommended above Econo panel heaters. Convection type wall type heaters are available with higher heating capacities (1000, 1500 and 2000W) while Econo panel heaters are available as 400 and 600W models only at similar cost. A higher capacity will provide faster heat up of the space before the in-built thermostat turns of the heater once the room has achieved its set point temperature.

To minimise the heat requirements for the houses it is recommended to insulate the building envelope, where possible, and to seal gaps to stop drafts. From our site visit, it is understood thermal insulation could be provided to the underfloor and to the ceiling (both accessible). Existing walls might be difficult to insulate unless wall linings are taken off. Any insulation should exceed building code requirements.

To stop drafts, seals should be provided to doors and windows. Any other fabric openings should be treated to prevent drafts and reduce infiltration.

Table 2 - Heating Option Pictures

 **1 – Typical Heat Pump Ducted unit**	 **2 – Typical Heat Pump Hi-wall unit**
 **3 – Typical Heat Pump Floor Mounted Console**	 **4 – Typical Large Heat Pump Outdoor unit (10-18kW)**
 **5 – Electric Radiant Ceiling Panel**	 **6 – Electric Panel Wall Heater**

3.2 Ventilation

Ventilation for the houses will be provided by natural ventilation via occupant openable windows. The bathrooms could be provided with a mechanical exhaust which would be interlocked with the light switch and with a run on timer, this would expel the moisture if the occupants didn't open the windows and thus minimise mould and mildew.

3.3 Hot and Cold Water Services

Filtered water is to be pumped from the water tank to each of the houses, with an isolation toby valve to each house. Hot water would be provided by either a hot water cylinder or an instantaneous electric heater. The main issue with instantaneous electric for this site is the limited power supply; typically instantaneous electric water heaters use 18kW or more of power where hot water cylinders are only 2-3kW. Turning off the hot water cylinder outside occupied hours, e.g. during the week, might be an option, however heating up the cylinder will take approx. 4 to 5 hours. A time clock could be used if occupancy occurs on a regular basis but would not work for irregular use, e.g. visits during the week.

The hot water cylinder could be connected via a load shedding device, so that it was switched off during peak times (e.g. while the oven/cooktop is used). Please refer to the table below for a comparison between a hot water cylinder and instantaneous water heaters.

Using bottled LPG for hot water heating has been discounted due to the regular refilling required, the difficult access to the site, and having the electrical infrastructure already onsite. If it is determined that the electrical supply is too limited then LPG may become viable.

Table 3 - Hot Water Heating Comparison Table

Heating Type	Capital Cost	Peak Electric Load	Plant Size	Comfort	Life	Comments
240 l Hot Water Cylinder	Low	Medium	Medium	High	high	Mains or low pressure HWC
Electric Instantaneous Water Heater - low capacity	high	Medium	Small	Low	Medium	Spare Electrical Capacity TBC - if incoming main needs to be increased, capital cost would be higher
Electric Instantaneous Water Heater - high capacity	high	high	Small	Medium	Medium	Spare Electrical Capacity TBC - if incoming main needs to be increased, capital cost would be higher
LPG Instantaneous Water Heater	Medium	Low/Zero	Small	High	Medium	LPG typically more expansive than electric plus hassle of gas bottle refill. Back up option in case of restricted power capacities.

Given the comparison table above we recommend hot water cylinders are installed in each house, and are located in a cupboard between the kitchen and bathroom.

We also recommend that all tapware, appliances and fixtures are low water flow, with at least a 5 star WELS rating (3 star for showers), and that landscape watering be minimised.

Figure 2 – Electric Hot Water Cylinder and an Instantaneous Electric Hot Water Heater

3.3.1 Solar Powered Hot Water Heating

There are two ways of using solar power for domestic hot water heating. This could be either via thermal solar collectors, circulation water through the collector to heat it up or via photovoltaic panels which produce power and drive an electric heating element with the hot water cylinder.

<u>Thermal solar collector</u>

A typical domestic installation, as required for the proposed houses, consists of approx. 4m^2 of thermal solar collectors, a 240 to 300l hot water cylinder and circulation pipework between the collector and cylinder.

The hot water cylinder will require an electric heating element as back up to cover periods of no or only limited sunshine, and therefore the hot water cylinder will be similar or slightly larger than a standard electric hot water cylinder installation as discussed above.

The cost of a thermal solar collector system installation is approx. $5,000, excluding the hot water cylinder. A thermal solar system would provide around 50 to 60% of the annual hot water heating demand.

Based on an estimate occupation of 150 nights / five people and 30 litres of hot water per person, a total of approx. 22,500 litres of hot water is required through a year which equates to approx. 1,300 kWh per year or around $400 of power.

A thermal solar system could provide savings of approx $200 to $250 per year. This results in a payback of 20 to 25years which is actually higher than the typical life expectancy of collectors and hot water cylinders.

From a financial perspective, thermal solar heating is therefore not recommended.

Environmentally, a thermal solar system can provided a reduction of approx. 100kg of CO_2 emissions per year.

Photovoltaic

The advantage of using photovoltaic compared to thermal solar collectors is the ability to use generated solar power not only for water heating but also for any other electrical appliances. Solar power can also be fed back into the grid during periods when solar power generation is higher than on-site consumption.

A typical photovoltaic installation for the Baring Head site would be a 2kWp system, comprising of approx. 16m^2 photovoltaic panels and an inverter. Installation costs are approx. $7,000 to 8,000. The system would be installed on the roof of one of the houses, orientated north.

A system like this can produce around 2,000 to 2,500kWh of electricity per year in Wellington's weather.

The system would feed into the on-site network, allowing generated solar power to be used in any of the buildings.

Electricity consumption at the Baring Head site will be predominately for hot water heating, lighting and cooking. Lighting and cooking are expected to occur predominately in the evening/nights outside the periods of solar power generation. Hot water heating can be controlled to occur during the day, however it is most likely that the peak hot water demand will be in the evening when people arrive on site or return from daytrips. A time-controlled hot water system might result in limited hot water availability in the morning.

It is therefore estimated that approximately 50% of the produced electricity can be used directly/instantly with the rest being fed back into the grid and refunded by the utility provider. This results in power savings of approx. $375 (1,250 kWh @ 30c/kWh) and a refund of approx. $100 (1,250kWh @ 8c/kWh - Meridian Energy). This results in a payback of approx. 14 to 17 years which is slightly below the typical life expectancy of 20 years.

From a financial perspective, a photovoltaic system is likely to be cost neutral. When we also consider a reduction of approx. 400kg of CO_2 emissions per year, the installation of a photovoltaic system is recommended.

Battery systems, e.g. like the Tesla Powerwall are in the market but not readily available in NZ yet. A system like this might increase the cost efficiency of a PV system further. We recommend to monitor the developments and once available and costs for this system are known.

3.4 Drainage Services

The sanitary drainage from the houses will be gravity systems flowing to the onsite sanitary treatment plant, as detailed in the Section 2.3 above. Depending on the waste treatment plant selected, a separate grey and black water drainage pipe may be required.

3.5 Power Services

Existing services within the buildings are outdated and do not comply with current legislation. The harsh winds and marine environment on site has also contributed to significant wear and tear on electrical equipment and wiring. As power was turned off for almost 20 years, any safe use for life and property can no longer be expected.

It is proposed to provide new electrical distribution boards within each house, with residual current protection to all power outlets. All wiring (incoming mains and distribution) will be replaced.

Double point power outlets will be provided throughout the houses for the connection of small appliances like TV, radio, mobile device charger, laptops, hair dryers, etc. The kitchen will be provided with power points for various kitchen appliances. The kitchen hobs are to be electric, as LPG hobs could pose a safety issue along with regular refilling required, the difficult access to the site, and having the electrical infrastructure already onsite.

Figure 3 - Load Shedding Device

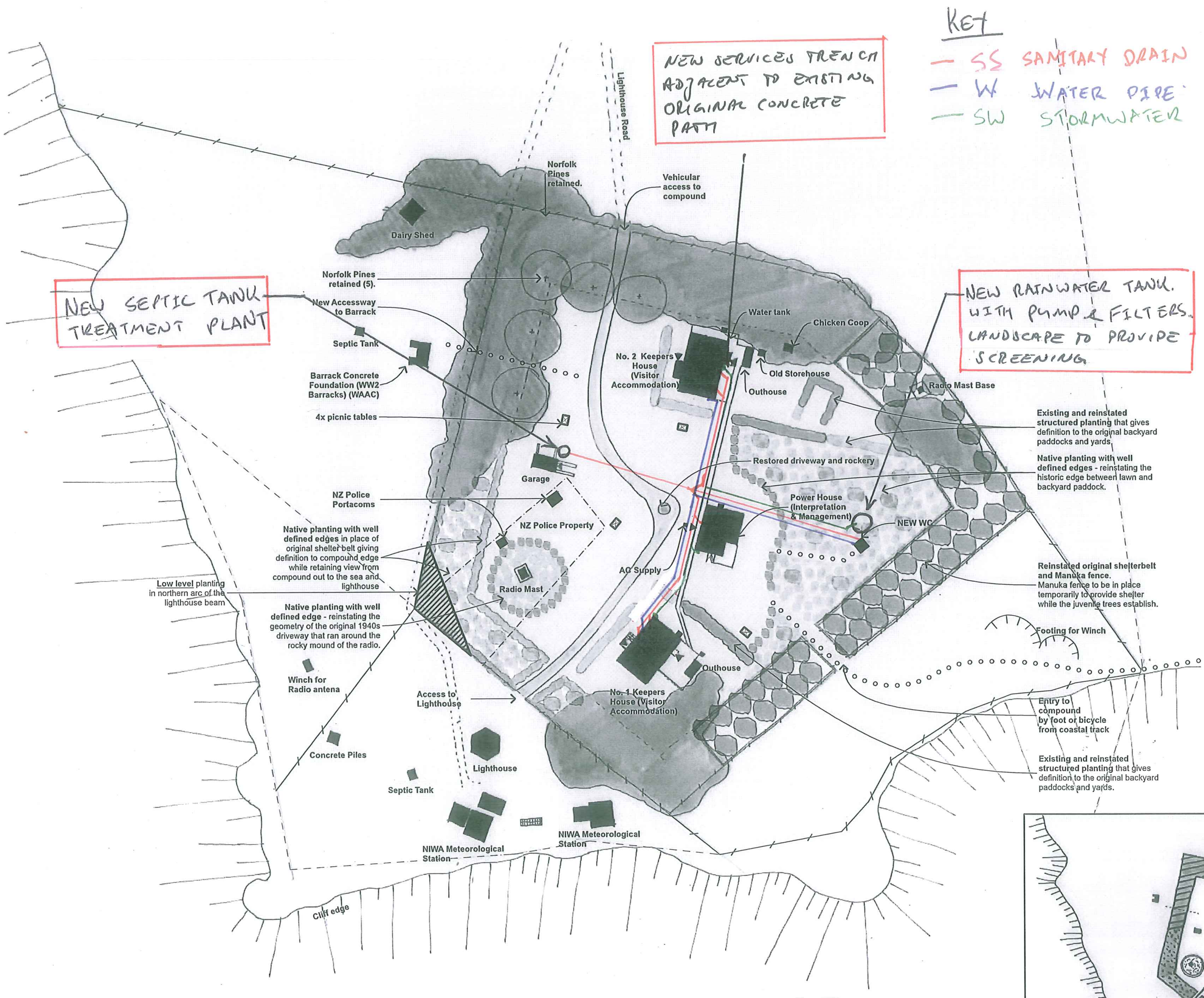
Note all electrical appliances should be selected for their energy performance ratings.

Due to the limited power supply to the site, we would recommend having load shedding during high demand. With load shedding control, when the power demand is exceeded the hot water heating, space heating, and cooktop/oven can be switched off in a cascading configuration for each house.

If a photovoltaic system as described above is installed, this will be integrated within the on-site power network. An import/export meter will allow to charge surplus solar power back into the grid.

3.6 Lighting Services

It is proposed to use highly efficient LED and fluorescent lighting inside and outside the building. We suggest providing external lighting with motion sensors. The extent of external lighting needs to be confirmed along with any requirements to have lighting on for safety or security reasons.



N

eCubed

Indicative Site Services Layout

13/08/2015 - JN

Design Aims:

A) Redefine the definition of the Compound. Re-establishing the shelterbelt to the North and Eastern boundaries. Plant low-level native species to the Southern and Western boundaries in place of the original shelterbelt to re-establish site definition while maintaining views from within the compound out to the sea and the lighthouse.

B) Enhance the unique contrast between the wild natural environment (as evidenced in weather and hardy wind blown plants) and the domestic scale site layout that was once established on site. Reinstate elements such as picket fences, rockery garden, structured lines of planting, lawn and specimen trees.

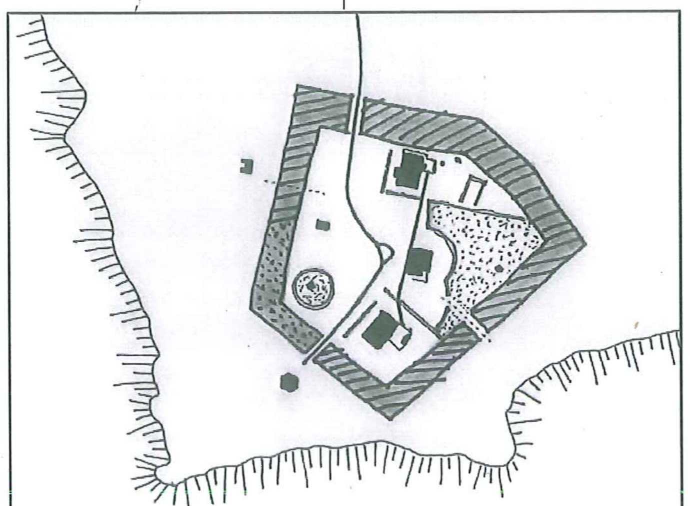
C) Tidy up and better define all entrances to the compound.

D)Provide way-finding signage and labels e.g. for Number One Keeper's House, access way to barracks, & lighthouse etc...

E) Integrate into the landscape design, reference to and enhancement of, the relationship to nearby historic elements such as the light house, barracks, observation posts etc... This may be achieved through the use of view shafts, clearings, structural planting, additional pathways etc...

F) Re-establish original structural plantings to illustrate earlier site definition of front and back yards to Light House Keeper's houses.

G) Discuss and organise an overall master plan to guide the location/ parameters for future development of the site ie, placement of equipment from NIWA, Police, Maritime NZ. Coordinate with the landscape design.



Concept Diagram

FINAL CONCEPT

KEY:

- ○ ○ ○ Pathway
- Entry
- Boundary
- Fence
- Picnic table

studiopacificarchitecture
Architects
Urban Designers
Interior Designers
Level 2
74 Cuba St
P.O. Box 11-517
Wellington, NZ
TEL: 64 4 802 5444
FAX: 64 4 802 5446
www.studiopacific.co.nz
email: architects@studiopacific.co.nz

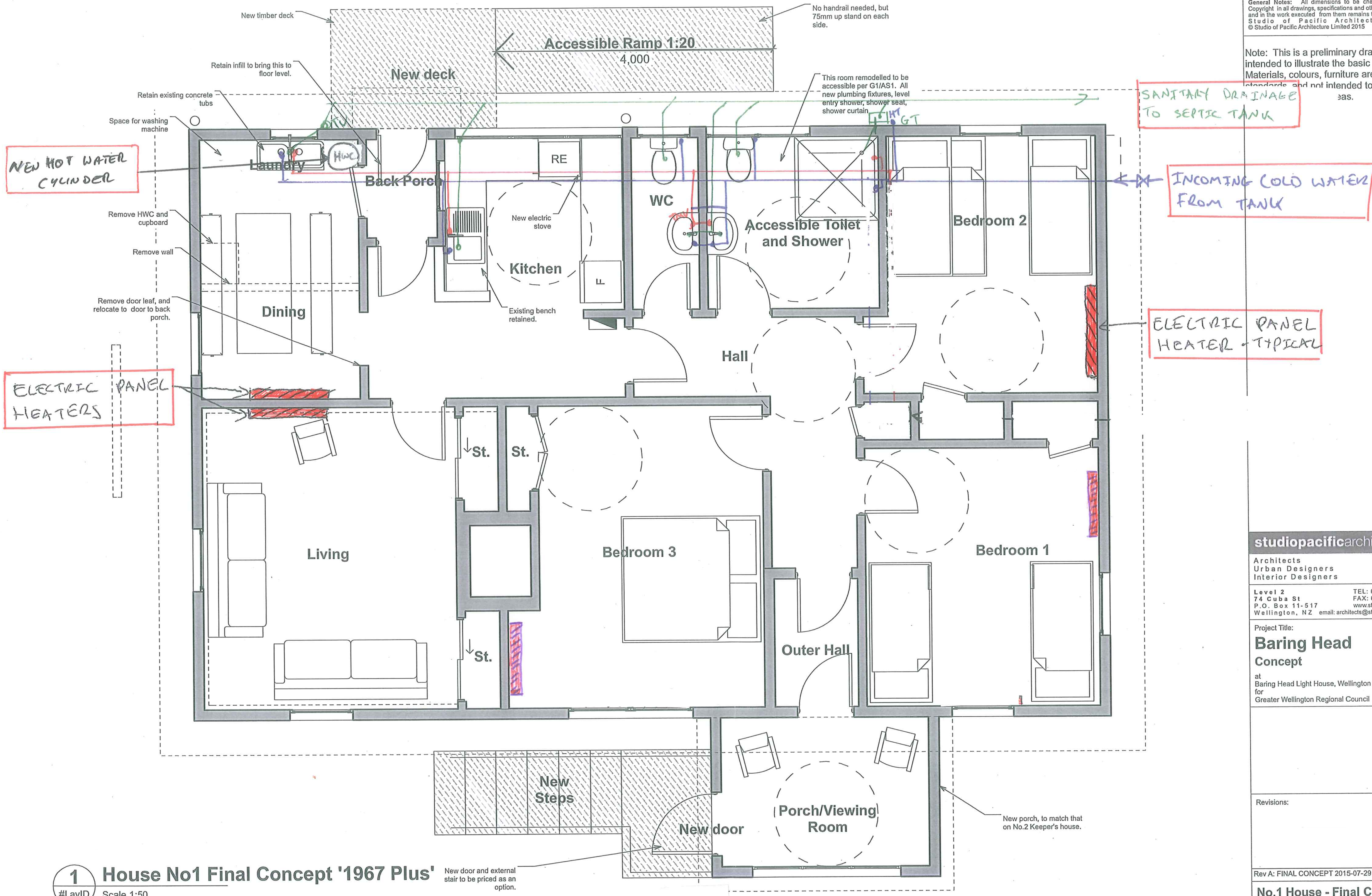
Project Title:
Baring Head
Concept
at
Baring Head Light House, Wellington Region
for
Greater Wellington Regional Council

Revisions:
A: FINAL CONCEPT DESIGN 2015-05-27
B: FINAL CONCEPT DESIGN 2015-07-30

Site Plan - Concept Design

Scale: 1:1000, 1:3260.6440 Orig. Size: A3
Drawing No. **SK-402** Job No.: **2096**
Revision: **B**

Printed: 30/07/15,9:45 AM CAD Ref.2096 current.pln



1 #LayID **House No1 Final Concept '1967 Plus'** Scale 1:50

New door and external stair to be priced as an option.

eCubed

Indicative Building Services Layout

13/08/2015 - JN

Note: This is a preliminary drawing intended to illustrate the basic layout. Materials, colours, furniture are

studiopacificarchitecture
Architects
Urban Designers
Interior Designers
Level 2
74 Cuba St
P.O. Box 11-517
Wellington, NZ
TEL: 64 4 802 5444
FAX: 64 4 802 5446
www.studiopacific.co.nz
email: architects@studiopacific.co.nz

Project Title:
Baring Head
Concept
at
Baring Head Light House, Wellington Region
for
Greater Wellington Regional Council

Revisions:

Rev A: FINAL CONCEPT 2015-07-29

No.1 House - Final Concept '1967 Plus'

Scale: 1:50 Orig. Size: A3

Drawing No. **SK-125** Job No.: 2096 Revision: A

Printed: 29/07/15,4:09 pm CAD Ref:2096 current.pln

FINAL CONCEPT