Waterwork.nz Ltd
14 Onekaka Iron Works Road, Onekaka 7182
info@waterwork.nz
[redacted]

Camp Iona Charitable Trust
Camp Iona
35 Tulliemet Road
Herbert 9495

Friday 29th September 2023

Re. Summary of investigations and preliminary proposal for the upgrade of the existing wastewater treatment and disposal system at Camp Iona, Herbert.

To the Members of the Camp Iona Charitable Trust and the Otago Foundation Trust,

Please find below our summary of the previous and current investigations into the upgrade of the existing on-site wastewater treatment and disposal system at Camp Iona including our preliminary design proposal.

<u>Previous investigations</u>

Environment Technology (ET), the NZ supplier of the Advanced Enviro-Septic (AES) system, was engaged by Ross Milmine, Secretary and Treasurer of the Camp Iona Charitable Trust (CICT), in 2014 to visit the Camp Iona site and assess the site's suitability for an upgrade of the existing primary treatment and disposal systems to an AES secondary treatment and disposal system. Directors, Hazel Pearson and Dick Lamb visited the site in February and determined the receiving soils to be Category 4-Clay Loam to Category 5-Light Clay, resulting in low permeability. The poor permeability of the receiving soils meant a significant disposal area would be required to manage peak flows. A summary of their investigation was submitted to the CICT in July 2014, as per *Appendix A*. This summary included options for the sizing and configuration of the AES system but did not identify an appropriate area for disposal on-site as this assessment was not made during the initial site visit. Please note that ET provided updated guidelines for the sizing and configuration of the AES system in July 2021, as per *Appendix B*.

Tim McLeod, Civil Engineer of Eliot Sinclair & Partners Ltd, was engaged by Ken Mcleod of the CICT in 2016 and submitted a preliminary 'proposed sewer layout' in August of that year showing 0.10 ha of disposal area on the Camp Iona site and 0.18 ha of disposal area on an adjacent property managed by the Department of Conservation (DoC), as per *Appendix C*. An application for concession to dispose of treated wastewater in the proposed area was submitted to the DoC and was approved to be granted in September 2017 subject to agreement with the terms of the Concession Permit. However, agreement to all of the terms could not be made by the Otago Foundation Trust (OFT), Registered Owners of 35 Tullimet Road, and therefore, the concession for disposal was not granted.

We have also been informed that following this came a chance to purchase 1 acre of nearby land that could have potentially been used as a disposal area. However, the purchase was not successful and no further opportunities have presented themselves.

<u>Current Investigation</u>

<u>Camp Iona Site Assessment</u>

In September 2022, Ross Milmine engaged Waterwork.nz Ltd (Waterwork) to conduct a site assessment at Camp Iona to determine an appropriate area for the installation of an AES secondary treatment and disposal system based on the sizing and configuration guidelines submitted by ET in 2021.

Director, Dick Lamb visited the site with Shane Carter, Director of Laser Plumbing Oamaru, on 11th September 2022. His assessment found that the total disposal area required for the AES system on-site could not be met due to the poor soil conditions observed. Underlying soils across the site were found to consist of hard-packed gravels with very low permeability increasing the risk of surface breakout after periods of rain or during peak flows. The primary and secondary treatment components of the system, however, could be accommodated on-site.

As the first application for the concession to dispose of secondary treated wastewater from the Camp Iona site onto the Glencoe Domain was approved to be granted by the DoC, it was agreed that this option should be revisited. Rob Henry, Factor of the OFT, emailed Waterwork on 17/10/2022 with clarification as to why the OFT could not agree to the terms of the first Concession Permit and with a potential solution for the intended second application in that:

> '*…if DOC was prepared to accept that the campsite committee be held responsible for the insurance provision and the Trust Board was specifically excluded from this requirement and it was clearly noted in the agreement that the Campsite Committee was the authority responsible for the day-to-day operations associated with the campsite and, therefore legally responsible entirely, then this could be a way forward.'*

Waterwork has received confirmation from the CICT that this would be an acceptable solution and <u>is awaiting confirmation from the DOC.</u>

As per the investigation summary submitted by ET to CICT in 2014 in relation to the Camp Iona site:

> *'Evidence from the soil profile visible in the road cutting below the camp suggests that the free-draining gravels are several metres below ground level'*.

Therefore, Waterwork proposed that a site and soil assessment be conducted in the Glencoe Domain and Reserve in order to find a potential disposal area into such receiving soils. Access to more permeable soils would significantly reduce the size of the disposal area required as well as the risk of surface breakout.

<u>Glencoe Domain and Reserve Site & Soil Assessment</u>

The proposed soil assessment involved the excavation of multiple test pits on the Glencoe site, an activity that requires a temporary concession permit from the DoC.

The application for this concession called for details on the proposed activity including the location of the intended test areas. Through consultation with Ross Milmine and a desktop study of the aerial imagery over the site, three potential disposal areas were identified. As there is currently no available topographic map of this area showing contour intervals of 5 metres and less, Waterwork engaged Shane Carter to visit the site and visually assess the potential disposal areas for their suitability, as well as to check for any other potential disposal areas.

Shane visited the site with Ross on 29th November 2022 and found two of the three potential disposal areas to be suitable for further investigation and testing. Ross requested that a section of the 1.8 ha disposal area proposed by Eliot Sinclair in 2016 also be included in the investigation. See *Appendix D* for the location of the three potential disposal areas identified as suitable for further investigation and testing, labelled Test Area 1, Test Area 2 and Test Area 3.

The necessary application was made, and a temporary Concession Permit to excavate test pits in the three proposed areas was issued by the DoC on the 10th February 2023. The site and soil assessment was conducted by Dick Lamb of Waterwork on the 21st April 2023, with the excavation of the test pits carried out by Les Ballantyne and Bevan Smith of Laser Plumbing Oamaru.

Of the three test areas, only Test Area 3 was found to contain free-draining soils suitable for a disposal bed requiring a significantly smaller footprint than that of the disposal system proposed by Eliot Sinclair in 2016. Test Area 1 was observed to be a poorly draining site containing soils of low permeability with an increased risk of surface run-off, furthermore, a gully was observed nearby creating the potential for any surface run-off to find its way to the natural drainage path and flow into downstream waterways. Test Area 2 was also found to contain soils of low permeability and the steep topography of the area makes it an impractical site for the installation of a disposal bed system.

Sizing of Disposal Bed System and Reserve Area in Test Area 3

Multiple test pits were excavated across Test Area 3 to determine the uniformity of the soil profile throughout. Each test pit revealed a profile of approximately 200mm of topsoil followed by 1000-1300mm of Category 2-Sandy Loam soils with coarse fragments making up 20-30% of the overall composition. See *Appendix E* for photos taken of Test Area 3.

Due to the abundance of coarse fragments in the receiving soil, a conservative Design Loading Rate (DLR) of 30mm of secondary treated effluent per m^2 of disposal area per day is recommended as per *Table L1* in the *AS/NZ Standard 1547:2012* for the disposal of secondary treated effluent through trenches or beds.

A Design Flow Rate (DFR) of 8,151 litres of secondary treated effluent per day has been determined. Therefore, the total Land Application Area (LAA) required for a disposal bed or trench is 272m^2 (DFR / DLR = LAA). Note that the LAA i.e., the disposal area requires protection from public and vehicular access. See *Figure 1* for the proposed location of LAA, approximately L 44m x W 6.2m (273m^2).

In addition, a reserve area equal to 50% of the LAA is required i.e., 136 m^2. The purpose of setting aside a reserve area is to allow a factor of safety against unforeseen malfunction or failure, perhaps following increased occupancy of the camp or inadvertent misuse of the system. This ensures it is possible to extend the disposal system if appropriate. Note that the reserve area requires protection from any development that would prevent it from being used in the future. See *Figure 1* for the proposed location of the reserve area, approximately L 42.5m x W 3.2m.

Refer to *Appendix F* for the information and calculations used to determine the requirements of the disposal system.

Assessment of Environmental Effects (AEE) relating to the Proposed LAA

Following the identification of an appropriate Land Application Area, an assessment of environmental effects was made in accordance with the *AS/NZ Standard 1547:2012* and the *Otago Regional Council Land & Water Plan* as summarised below:

Assessment Criteria	**Assessment**	**Level of Constraint**
Potential for groundwater contamination	The proposed LAA is elevated many metres above the groundwater table. No evidence of a perched water table has been observed in the vicinity of the proposed LAA. The test pits were excavated to 1.5m and no water table was encountered. Furthermore, it is proposed that the wastewater is treated to a secondary level prior to disposal.	Low
Potential for surface water contamination	The proposed LAA is approximately 41m (horizontal) from the Waianakarua River. Due to the secondary level of treatment prior to disposal and the permeability of the receiving soils, effluent break-out leading to surface run-off and potential contamination of waterways is unlikely. It is more likely that the treated effluent will travel vertically through the permeable soils rather than horizontally. There is no other surface water within the vicinity of the proposed LAA.	Low
Potential for off-site export of effluent	As mentioned above, it is unlikely that effluent break-out leading to surface run-off will occur, however, the design will specify a minimum 1.5m setback from the LAA to property boundaries as recommended in the *AS/NZ Standard 1547:2012*.	Low
Potential for slope erosion leading to instability	The proposed LAA is on a site with a gentle gradient. There is a steep slope between the LAA and the Waianakarua River, however, no existing slope instability was observed during the site assessment and the slope is well-vegetated reducing the risk of potential soil erosion. Furthermore, the proposed disposal system has been sized to	Low

	accommodate the Camp at peak occupancy per week when in reality it will have regular rest periods of low to no flow. This can be seen by looking at the *Camp Iona Accommodation Statistics* from 2015 to 2023.	
Proximity to te nohoanga site	The proposed LAA is downslope of te nohoanga site and is at least 20m (horizontal). Due to the secondary level of treatment prior to disposal and the permeability of the receiving soils, effluent break-out leading to surface run-off and the potential contamination of te nohoanga site is highly unlikely. It is more likely that the treated effluent will travel vertically through the permeable soils rather than horizontally.	Low
Clearing of native plants/bush for the disposal area	The proposed LAA is covered with grass, weeds and blackberry with no native plants or bush observed.	Low

The site and soil assessment conducted by Waterwork shows that the proposed LAA is a suitable area for the disposal of secondary treated wastewater that poses little risk to the environment and areas of cultural significance.

Assessment of Existing Wastewater Treatment and Disposal System at Camp Iona

As per the information provided by Ross Milmine, the current treatment and disposal system at Camp Iona consists of four separate primary 'septic tank to soak-hole' systems, one of which includes a grease trap. The location and capacity of the septic tanks and grease trap have been provided to Camp Iona by S J Allen Ltd, providers of septic tank maintenance, servicing and de-sludging, as per *Appendix G*.

With regards to the treatment component of the existing system, our assessment finds that the existing septic tanks and grease trap are in good working order and can be further utilised, however, their combined capacity of approximately 11,700 litres does not meet the current standard.

With regards to the disposal component of the existing system, our assessment finds that the existing soak-holes do not meet the current standard and should therefore be decommissioned and replaced.

Proposed Wastewater Treatment and Disposal System for Camp Iona

Following our assessment of the existing primary wastewater treatment and disposal system at Camp Iona and the identification of a suitable Land Application Area/disposal area on the Glencoe Domain and Reserve site, Waterwork proposes that the existing system is upgraded to a secondary treatment and disposal system and configured as follows:

1. Decommission of Soak-Holes & Re-direction of Outlets to Main Wastewater Line
   Existing soak-holes to be decommissioned. Outlet from existing septic tanks to be re-directed to one main wastewater line leading to an additional septic tank as shown in *Figure 1* and as detailed below.

2. Upgrade of Primary Treatment – Additional 3,000L Septic Tank
   As stated above, the existing septic tanks and grease trap can be utilised for this stage. Considering a pump-out/de-sludging frequency of 5 years, a minimum total working capacity of 14,000 litres is required - see XX for calculations. In addition to the existing septic tanks with a combined capacity of 11,715 litres, a new septic tank with a working capacity of at least 3,000 litres is proposed.

3. Addition of Secondary Treatment – Lined AES Treatment Bed
   In order to improve the quality of treated effluent prior to disposal and thereby reduce the total disposal area required, a secondary level of treatment following primary treatment is proposed.

   The AES secondary treatment system is an ideal solution for this site as it is a passive system with minimal maintenance and servicing requirements and has a quick 'start-up' following periods of little-to-no use. The AES system has been installed on a number of campgrounds around NZ for these reasons.

It is proposed that a lined AES treatment bed of L 21.06m x W 4.05m is installed after the additional septic tank on the Camp Iona property as shown in *Figure 1*. Note that the dimensions of the AES bed could change during the final design stage.

4. Gravity Conveyance of Secondary Treated Effluent from Camp Iona Site to Glencoe Site for Disposal
   As concluded in the site and soil assessment, there is no suitable area for the disposal of treated wastewater on the Camp Iona site. Therefore, it is proposed that disposal takes place on the neighbouring property, Glencoe Domain & Reserve. Due to the drop in elevation from the proposed AES treatment bed to the proposed LAA, conveyance by way of gravity is possible. Therefore, a passive Flout dosing system is proposed to transport secondary treated effluent from the Camp Iona site to the Glencoe Site, as shown in *Figure 1*.

5. Disposal through Beds using LPED Distribution Lines
   A disposal bed is proposed, using LPED distribution lines to ensure even distribution of treated effluent along the length of the bed. The preliminary design for the disposal bed is L 44m x W 6.2m providing a total LAA of 272.8m^2, as shown in *Figure 1*. Note that the dimensions of the disposal bed may change during the final design stage.

Next Steps

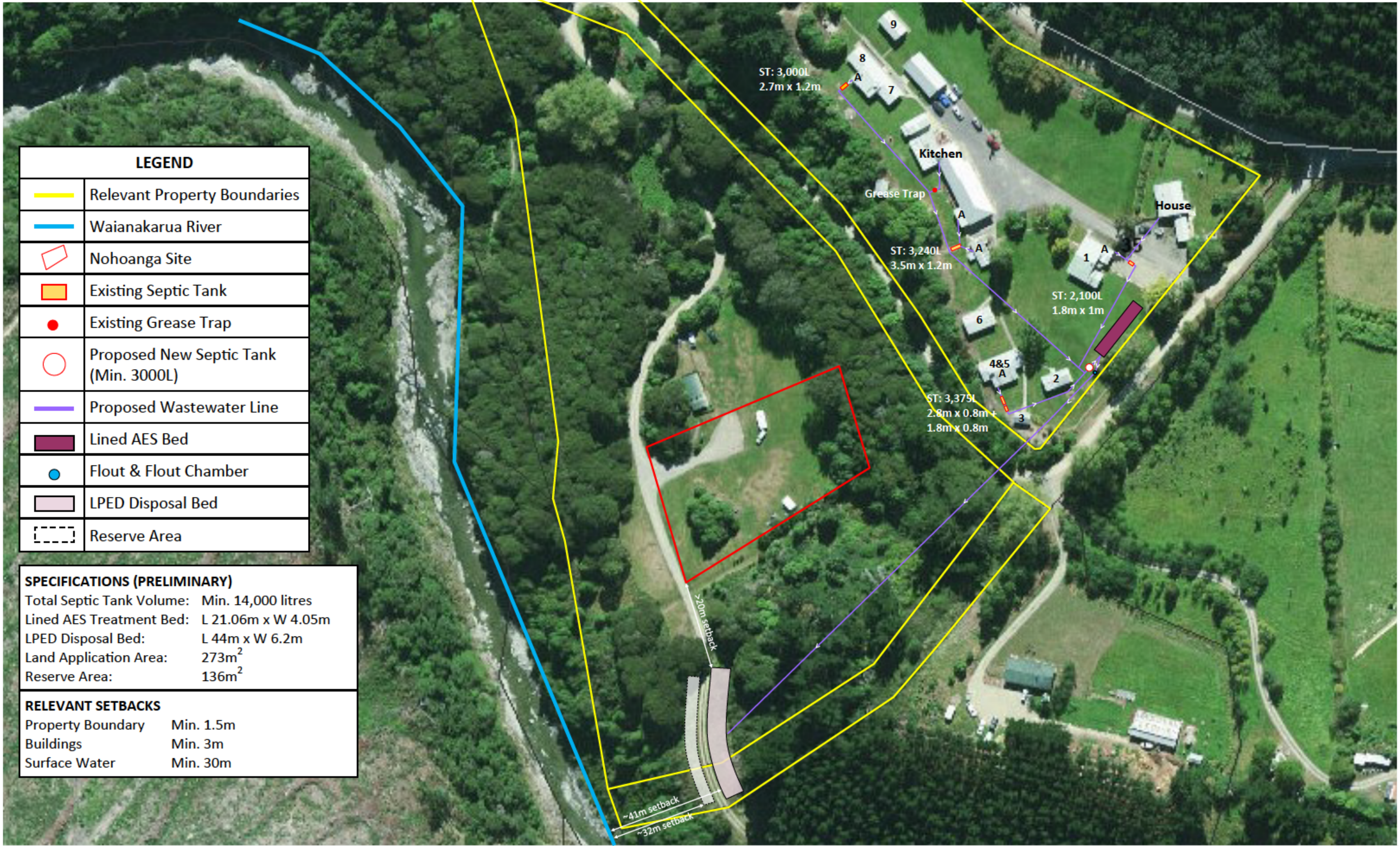
Below is a summary of the proposed next steps in this project. Please review and let me know if you have any questions.

1. Approval of proposal required from Camp Iona Trust and Otago Foundation Trust that Waterwork may proceed with the application for Concession with the Department of Conservation.
2. Invoice for works completed thus far i.e., site visits and provision of proposal report as per Terms of Engagement.
3. Application for Concession to be submitted.
4. Should the Concession be granted, the following will be needed in order to finalise the wastewater system design:
   a) Confirmation as to what consent is required for the installation of a wastewater pipeline underneath the road between the Camp Iona site and the Glencoe site. *Note: This may require a telephone meeting with a Council Planner.*
   b) Surveyance of the Camp Iona and Glencoe site and procurement of topographical map with contour intervals at 0.5m – 1m in order to finalise system design. *Note: I received a quote for $1,200 +gst from Waitaki Survey for this to be completed, but this may have expired by the time a Concession is granted.*
   c) Confirmation of various levels at the lowest installed septic tank and the proposed site of the additional septic tank and lined AES treatment bed. *Note: This could be completed by Laser Plumbing, Oamaru or possibly by Waitaki Survey.*

Kind Regards

Rowena Dixon
Waterwork.nz Ltd

[redacted]



LEGEND	
Yellow line	Relevant Property Boundaries
Blue line	Waianakarua River
Red outline	Nohoanga Site
Orange rectangle	Existing Septic Tank
Red dot	Existing Grease Trap
Red circle	Proposed New Septic Tank (Min. 3000L)
Purple line	Proposed Wastewater Line
Purple rectangle	Lined AES Bed
Blue dot	Flout & Flout Chamber
Pink rectangle	LPED Disposal Bed
Dashed rectangle	Reserve Area

SPECIFICATIONS (PRELIMINARY)

Total Septic Tank Volume:	Min. 14,000 litres
Lined AES Treatment Bed:	L 21.06m x W 4.05m
LPED Disposal Bed:	L 44m x W 6.2m
Land Application Area:	273m^2
Reserve Area:	136m^2

RELEVANT SETBACKS

Property Boundary	Min. 1.5m
Buildings	Min. 3m
Surface Water	Min. 30m

Waterwork.nz
14 Onekaka Iron Works Road, Takaka
[redacted]
info@waterwork.nz

Drawing Title:	Figure 1 - Preliminary WW Proposal	Date:	29/09/2023	Drawing No.:	01
Job Title:	Camp Iona & Glencoe Domain & Reserve, Herbert, Milmine			Job No.:	WW
Drawn By:	Rowena Dixon	N	Metres 0 15 30 45 60 90		
Reviewed By:	-				

Appendices

Appendix A – Environment Technology's Investigation of Camp Iona wastewater system upgrade, 17th July 2014

Environment Technology Ltd
[redacted]
www.et.kiwi.nz – info@et.kiwi.nz – 03 970 7979

17 July 2014

To the Camp Iona committee

RE: Investigation of Camp Iona wastewater system upgrade

To an AES (Advanced Enviro-septic) wastewater treatment system.

Dick Lamb and I visited Camp Iona in February this year, with regard to assessing the suitability of the site for upgrading the existing wastewater system to an AES system. The AES system is comprised of a standard septic tank followed by 300mm diameter AES pipes installed in a sand bed. Both secondary treatment and dispersal takes place in this bed. Evidence from the soil profile visible in the road cutting below the camp suggests that the free-draining gravels are several metres below ground level. Tests on the soil taken at the cutting revealed a category 4-5 soil; clay loam or light clay. The size and depth of an AES bed would depend on soil tests being done at the proposed site of the disposal bed, or beds. The figures below are based on a worst case situation regarding the size of the bed – sized as for light clay soils which gives an overall footprint of 750m^2. If the base of the bed was in free-draining gravels the size of the bed would be 150m^2. The amount of AES components required would stay the same regardless of soil type, as this is sized for the daily wastewater flow, which would remain unchanged. Earthmoving costs and sand quantities for the bed would reduce if the overall size of the bed is reduced.

A water meter installed since our visit has measured the average daily allowance per person as 104.7 L/day. This is in line with the current standard for onsite wastewater disposal AS/NZS1547:2012, which estimates 100-130 L/p/d.
If peak occupancy is 100 people, then

Peak flow = 10,500 L/d

averaged over a week (5/7 x 10,500) = 7,500 L/d.

For this amount of wastewater about 100 AES pipes would be required. The AES pipes come in 3m lengths.
If you load the base of the bed at a rate of
- DLR 10mm/d (worst case, for light clay soil) you would need 240m3 of sand, and a basal area of 750m2

- If DLR 50mm/d (for free-draining gravels, but unlikely to be cost effective to dig down this far) you would need 150m3 of sand and a basal area of 167m2.

Costing estimates follow for the 10mm/d (worst case) option above:

AES Pipes, couplings and offset adaptors [redacted]
Sand @ $55/m^3 delivered
2x 9000L septic tanks

($[redacted])

In conversation with Les Ballantyne [redacted] was added for installation (earthworks, connecting pipework to and from septic tanks, and between each row of AES pipes), and summed up as 'all in the ground for under [redacted]'

Since the conversation with Les in June I have thought more about the possible design, and think that a 'combination' bed could be possible whereby most of the bed is dosed at 10mm/d, with a 1m wide perimeter of the bed dug down into the free-draining gravels and dosed at 50mm/day. This would also allow an exit route for rainwater to drain to when it's been raining for four weeks. Some consideration would also have to be given to disposing of any spoil from the excavations, either onsite or off site.

I am also looking into actual costs (not estimates) for septic tanks from Burford Tanks, and Oamaru Shingle Supplies are sending sand samples to us for testing and so we will be able to be more precise on these costs. Please could you let me know of other tank and sand suppliers in the area if you know of any. The septic tanks may have to be sized for the daily peak flow amount rather than the daily flow averaged over a week, if so more capacity may be required (up to 2-3x the daily flow). I will let you know this more accurate pricing information as it comes to hand, and will ask Dick to estimate a cost for the earthworks and installation.

Please contact us if you have any questions or comments.

Regards

Hazel

[redacted]

Hazel Pearson
Director

Appendix B – Environment Technology's Camp Iona AES bed sizing guidelines, 25th July 2021

Environmenttechnology
Sustainable Wastewater Treatment
[redacted]
03 970 7979 | info@et.nz | www.et.nz

"Always the first option in wastewater treatment"

Camp Iona AES bed sizing guidelines 25 July 2021
This is a discussion document prepared for the wastewater system designer and the owners.

Sizing of AES beds takes into consideration two things.

1. How many AES pipes are required to treat any estimated design flow volume. This takes into consideration flow characteristics such as intermittent use and resting periods through the year.

2. The long-term acceptance rate of the soil, and therefore the infiltration area required for disposal of the treated wastewater.

Number of AES 3m length pipes required

The standard AES pipe loading rate is 38 l/m AES pipe. This is used for the daily flow averaged over a week, for single dwellings. Single dwellings frequently have fluctuating flow volumes, and the peak daily flow can be greater than twice the average daily flow.
The AES system tested in OSET-NTP Trial 12

- Used the standard AES pipe loading rate of 38 L/m (actually 37.04 L/m due to a whole number of AES pipes being used)
- Received the average daily flow every day for 10 months
- Received twice the average daily flow for 5 days in a row without treatment quality being significantly affected.

The design flow rate for Camp Iona can differ from the peak flow, and will consider:

- The peak daily flow volume can be calculated from the maximum possible occupancy, which unlike a dwelling (or the OSET-NTP Trial) will never double.
- The intermittent charactistic of the occupancy – the low winter season, and the large groups staying 4 nights/ 5 days of any week.
- Unlike many campgrounds January is relatively quiet as the large school groups visit during term time.
- Large groups when the camp is near capacity currently are infrequent:
  In the last 6 years the camp was more than two thirds full (70+ people) for 22 nights (6% of the year) in the busiest year. The camp was more than half full for 50 days (13.8% of the year).

In 2014 we wrote 'A water meter installed since our visit has measured the average daily allowance per person as 104.7 L/day. This is in line with the current standard for onsite wastewater disposal AS/NZS1547:2012, which estimates 100-130 L/p/d' for fully serviced campgrounds.

Example:
Peak flow rate

106 beds x 105L/d per person	11,130L/d
Caretaker's house (3 bdrm)	1,000L/d
Total Peak flow	**12,130L/d**

Average daily flow

11,130L/d x 5/7 days	7,950L/d
Caretaker's house (3 bdrm)	1,000L/d
Total average daily flow	**8,950L/d**

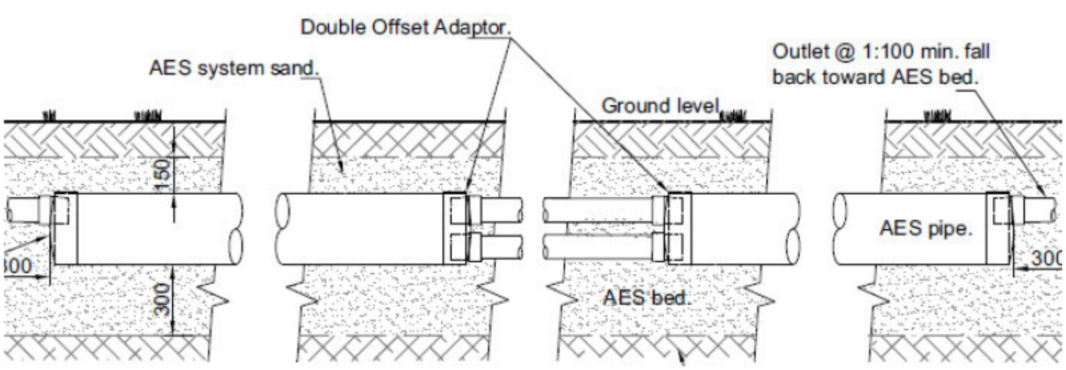
The table below shows two different AES pipe loading rates.
These can be compared to the OSET-NTP tested rate –
Average daily flow 37L/m AES pipe
Peak flow 74L/m AES pipe

Camp Iona differs to the OSET-NTP Trials in that there is both intermittent use and variable flow volumes. In these circumstances higher pipe loading rates can be used as the rest periods mitigate against too much biofilm build-up.

Table 1. Two options for number of AES pipes required. Other pipe loading rates may be chosen by the designer.

	AES pipe loading rate if 90 AES pipes used	AES pipe loading rate if 60 AES pipes used
Weekly Av. flow 8950L/d	38 L/m AES pipe	50 L/m AES pipe
Peak flow 12,130L/d	52 L/m AES pipe	68 L/m AES pipe
Conservative peak flow 14,780L/d (106 campers x 130L/d + 1 house x 1000L/d)	66 L/m AES pipe	83 L/m AES pipe

Increasing the AES pipe loading rate means fewer AES pipes to place in the bed. Rows can be extended using double offset adaptors to spread the effluent more evenly along the bed:



Size of AES bed area (infiltration area)

The wastewater flow characteristics of Camp Iona are similar to those of a marae. There are three ways that bed have been used for AES systems for marae.

Table 2. Three options for sizing of AES bed area

	Advantage	Comment
1. Bed area based on peak flows	Simple. Often suitable/ cost effective where there are sandy soils with high permeability	Can use a big area in clay soils
2. Allow for storage of effluent within the AES bed sand media. The bottom 150mm of the AES bed can be used for short term storage - weeks rather than months.	AES bed area can be smaller	Groundwater interceptor drain/s at perimeter or upslope of bed could possibly be a secondary overflow pathway for excess liquid – from rainwater or effluent – to access the free draining soil lower down.
3. Install holding tanks to store the short duration high flows, timer pump smaller volumes during the low flow period following a high flow period.	AES bed can be relatively small. Less area required and potentially lower installation cost as fewer pipes and less sand required. Could have dual system – gravity system for groups less than a certain number – holding tank system for groups over a certain number.	Involves at least one pump and timer control.

To give an idea of size as a starting point, and keeping in mind that actual dimensions can be easily changed to fit the shape of the area available at the site, below is an example of possible dimensions for an AES bed using 60 pipes, sized for 8950L/d with soil loading DLR of 8mm/d (taken from a trial Design Calculator, more information from this calculator is on the next page):

AES bed/s	AES pipe bed	AES bed extension/s		Total per bed	Number of beds	Total AES bed area
Length (m)	18.60	3.65	3.65	**25.90**		
Width (m)	1.35	3.65	3.65	**8.65**		
Sand depth (m)	0.75	0.15				
Area (m^2)	25.11	198.64		**223.75**	**5**	**1118.75**
Summary:	**This AES system has a total infiltration area of 1118.75m2, made up of 5x 223.75m2 AES beds, each 25.9m x 8.65m.**					

Some storage for peak flows would be required, and/or overflow options. Based on 30% pore space in the sand 50,343L storage is already available in the bottom 150mm of the example bed. (1118.75m2 x .15m x .3 = 50,343)
The conservative peak flow of 14,780L/d is 5,830L/d more than the 8950L used in this sizing example. 50,343 divided by 5,830 = 8.6 days of storage in the bed.

Next steps:
- Estimate appropriate DLR for sizing of bed area, guided by a percolation test and soil investigation.
- Decide what area/s are available for disposal of effluent at Camp Iona, and give measurements.

This will inform which of the three options in Table 2 is most appropriate – or perhaps a fourth option will become apparent. An overflow to a shallow trench or drippers where vegetation can access the liquid would be a good use of the nitrogen in the effluent. AES is good at nitrification – making nitrate which is readily accessible to plants.

3. Design flow

Number of bedrooms		Calculated daily design flow is	0	..... or enter daily flow as a lump sum	8,950 L/d
Number of people		Split flow entering AES bed/s into	5	subsystems	**Total daily design flow** **8,950 L/d**
Daily design flow per person (L/d)					**5 subsystems of 1790 L/d**

4. Relevant site conditions at disposal area

Site and soil assessment is the responsibility of the designer and addressed in a separate report.

Disposal method: (●) AES bed ( ) Remote - dripperlines ( ) Remote - bed/trench

DLR for the receiving soil below the proposed AES bed.

AS/NZS 1547 Category 5 soil - Light clay | Soil structure | **Design Loading Rate (DLR)** 8 **mm/d**

roundwater level (below original GL) 6000 mm | If AES bed is raised - depth of base of AES bed below original ground level ___ mm

☐ Disposal site sloping

Minimum infiltration area 1,118.8 m²

5. AES bed/s - AES pipes

AES pipes are supplied in 3m lengths and can be cut to length on site. Row refers to a linear line of AES pipe.

Standard AES Bed Design a portion of a row separated by raised connectors - a section can be a whole r Maximum 10 pipes/section (30m/section).

AES pipe loading rate (L/m AES	50.00	Justify non-standard rate in notes below.	**Total number of AES pipes** **60.00 lengths**
Total number of parallel rows	10	2 rows per subsystem ☐ Use cut pipes	**Number of AES pipes per row** **6.00 lengths**
Number of beds	5	2 rows of 6 AES pipes per bed	**Number of AES pipes per bed** **12.00 lengths**

If one row bed/s choose layout option

( ) NA for this design ( ) One row fed in the middle with a distribution box; two sections (default) ( ) One row fed from one end; two sections separated by an in-line raised connector (●) One row fed from one end; one section

6. AES bed - dimensions

AES sand depth beneath AES pipes (mm) 300 Total expected FC reduction through AES system in this design: 3.5Log**

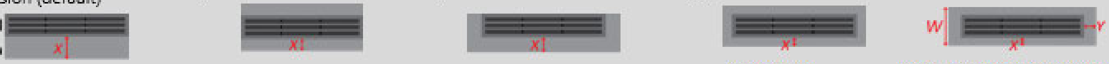
dard sand depth is 300mm. OSET-NTP Trial 12 standard depth achieved 3.5Log reduction for FC***; sand depth can be increased to further reduce FC.

AES bed extension position

AES bed extension required - choose extension position. Extension width/s will be added to AES pipe bed dimensions belo

( ) Extension on 1 side, or no extension (default) ( ) Extension on 2 sides ( ) Extension on 3 sides (●) Extension on 4 sides ( ) Irregular extension

AES pipe bed
Bed extension
Plan views



x =3.65 m Irregular extension width W ___ m

7. AES system additional details

☐ New septic tank/s Septic tank/s working volume (L) ___

☐ Effluent pumped to bed/s Max. dose/bed is 12L/m AES pipe.

Maximum flow rate into a bed is 151 L/min.

bution box/es. If used, number of distribution boxes 1

Number of subsystems per distribution box 5

AES bed venting. Min. 1 air inlet (low) vent and 1 air outlet (high) vent. Beds can share vents; at least 1x 100mm vent for up to 300m AES pipe

☐ Septic tank outlet tee capped to isolate AES bed venting

☐ 88 degree bend on inlet inside distribution box forms water trap preventing airflow between AES bed/s and septic tank

☐ One distribution box port is used for low vent

High vent diameter: ( ) 65mm ( ) 80mm (●) 100mm ( ) Other (mm): ___

Total number of: Low vents 5; High vents 1

☐ Sampling of effluent required ☐ Designer is installer of this job

AES bed/s	pipe bed	AES bed extension/s		Total per bed	Number of beds	Total AES bed area
Length (m)	18.60	3.65	3.65	**25.90**		
Width (m)	1.35	3.65	3.65	**8.65**		
Sand depth (m	0.75	0.15				
Area (m²)	25.11	198.64		**223.75**	**5**	**1118.75**

Summary: **This AES system has a total infiltration area of 1118.75m2, made up of 5x 223.75m2 AES beds, each 25.9m x 8.65m.**

8. Designer's notes

Include information about non-standard design flow characteristics or AES pipe loading rates, other site constraints, traffic loading of AES bed/s etc

AES pipe loading rate of 50L/m justified as camp occupancy above 50% occurs rarely - 10% of the year. The bed will be rested/ receive very low flows over winter.

9. Schedule of Materials

	1 bed	**All 5 beds**
AES pipes required (3m lengths)	12	60
AES couplings required	10	50
AES offset adaptors (end caps)	4	20
100mm vent cap for low vent	1	5
100mm vent cowl for high vent	-	1
100mm pipe for raised connectors (m)	0.4	2
88° bends, approximately	7	35
11° bends, approximately	0	0
Distribution box, min. 6 ports	1	1
Sample port kit	0	0
Bed liner, for base, walls and top of bed (m2	0	0
Pea metal (m3)	0	0.0
AES System Sand (in place, guide only)(m³)	50	248

(= total bed volume - volume of AES pipes + 1:2 slope from pipe bed to extension)

10. Signature box- Environment Technology (Et) use only

Digital signature confirms Design Calculator & construction drawings approved by Et.

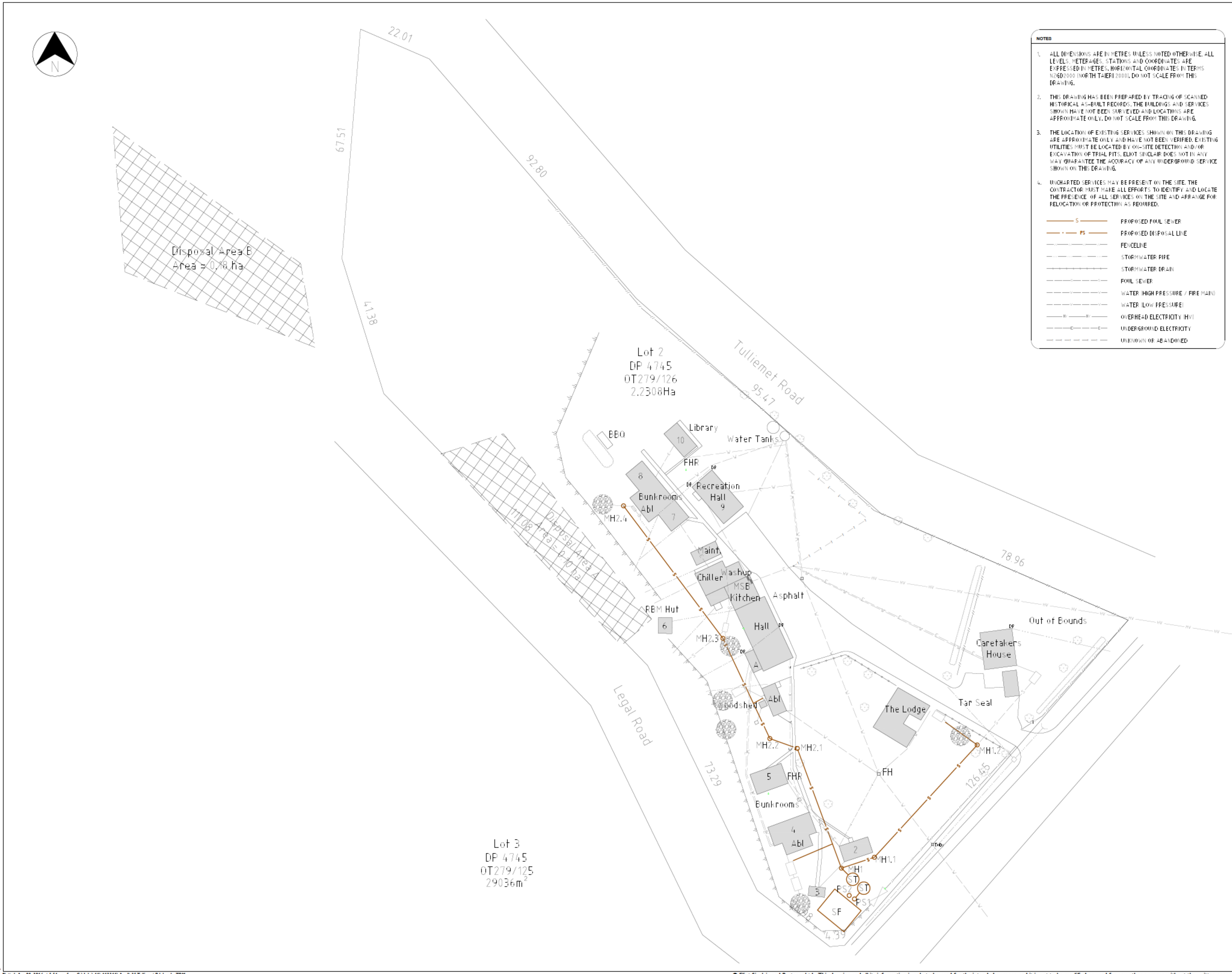
Reviewed by:		Job #	J1358	25-07-21 18:32

Open PDF in Adobe Acrobat; hover over signature for document status.

www.securedsigning.com/products/signature-verification-service

* Residential effluent has ≤300mg/L BOD; ≤250mg/L TSS ... or a combined BOD + TSS total of 550mg/L prior to entering the septic tank, a combined

Appendix C – Eliot Sinclair's Preliminary Proposed Sewer Layout, 8th August 2016



PRELIMINARY

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE. ALL LEVELS, METERAGES, STATIONS AND COORDINATES ARE EXPRESSED IN METRES. HORIZONTAL COORDINATES IN TERMS NZGD2000 (NORTH TAIERI 2000). DO NOT SCALE FROM THIS DRAWING.
2. THIS DRAWING HAS BEEN PREPARED BY TRACING OF SCANNED HISTORICAL AS-BUILT RECORDS. THE BUILDINGS AND SERVICES SHOWN HAVE NOT BEEN SURVEYED AND LOCATIONS ARE APPROXIMATE ONLY. DO NOT SCALE FROM THIS DRAWING.
3. THE LOCATION OF EXISTING SERVICES SHOWN ON THIS DRAWING ARE APPROXIMATE ONLY AND HAVE NOT BEEN VERIFIED. EXISTING UTILITIES MUST BE LOCATED BY ON-SITE DETECTION AND/OR EXCAVATION OF TRIAL PITS. ELIOT SINCLAIR DOES NOT IN ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERVICE SHOWN ON THIS DRAWING.
4. UNCHARTED SERVICES MAY BE PRESENT ON THE SITE. THE CONTRACTOR MUST MAKE ALL EFFORTS TO IDENTIFY AND LOCATE THE PRESENCE OF ALL SERVICES ON THE SITE AND ARRANGE FOR RELOCATION OR PROTECTION AS REQUIRED.

Symbol	Legend
S	PROPOSED FOUL SEWER
PS	PROPOSED DISPOSAL LINE
	FENCELINE
	STORMWATER PIPE
	STORMWATER DRAIN
S	FOUL SEWER
W	WATER (HIGH PRESSURE / FIRE MAIN)
W	WATER (LOW PRESSURE)
HV	OVERHEAD ELECTRICITY (HV)
E	UNDERGROUND ELECTRICITY
	UNKNOWN OR ABANDONED

no.	amendment	initial	date
A	PRELIMINARY ISSUE	TMcL	08.08.16

designed	T MCLEOD	surveyed	
manager	T MCLEOD		
drawn	B STEWART	surv.date	
checked	.		

origin of levels

datum NZGD2000 North Taieri 2000

PROPOSED SEWER LAYOUT - CAMP IONA
35 TULLIEMET ROAD, HERBERT
FOR OTAGO FOUNDATION TRUST

Scale: 1:500 [A1] 1:1000 [A3]

0 5 10 20

Date Created: 8.08.2016

Drawing Set 412341 E1

Sheet 5

Rev. A

Eliot Sinclair
surveyors | engineers | planners

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Appendix D – Location of Test Areas as per Temporary Concession Permit granted on 10th February 2023

SCHEDULE 4

1a – Testing areas 1, 2, and 3

Appendix E - Waterwork's Photos of Test Area 3 and Proposed Disposal Area, 21st April 2023

Drone Photo of Test Area 3 / Proposed Disposal Area

Photos from Two Test Pits in Test Area 3 / Proposed Disposal Area

Appendix F - Calculations for Camp Iona Wastewater System

Calculations for Camp Iona Wastewater System
29/09/2023

Wastewater Flow

			Notes
			Water meter attached to inlet of water tanks at time of readings in 2014
Water meter readings from 25/02/2014 to:			
10/03/2014	77490	litres	
17/03/2014	30460	litres	
24/03/2014	16980	litres	
31/03/2014	17200	litres	
7/04/2014	28690	litres	
14/04/2014	16210	litres	
Total water use	187030	litres	
Total no. of days measured	48		
Total occupancy over measured period - camp	1786		
Total occupancy over measured period - caretaker's cottage	72		*(approx. 1.5 persons per day to account for days where 2 people stayed at the cottage)*
Average flow per person per day	**101**	**litres**	

Design Flow

Camp

Max. Occupancy	106	people	
Design Flow per person	101	litres	
Peak Daily Flow of Camp	10706	litres	
Average Weekly Flow of Camp	53530	litres	*(camp is rarely at full occupancy 7/7 days of the week, a more realistic calculation is full occupancy 5/7 days of the week)*
Average Daily Flow of Camp	7647	litres	

Caretaker's Cottage

No. Bedrooms	3		
Max. Occupancy	5	people	
Design Flow per person	101	litres	
Total Design Flow of Caretaker's cottage	504	litres	
Total Daily Design Flow	**8151**	**litres**	

Septic Tank

Average sludge build-up /person /year	80	litres	*all waste*
Max. no. of guests in 1 year between 2015 & 2021	5346		
Estimated sludge build-up per year	1172		
Pump out frequency	5	years	
Sludge build up after 5 years	5859		
Emergency storage volume	8151		
Min. septic tank working volume required	14010	litres	
Existing total septic tank working volume	11715	litres	
Additional min. septic tank working volume required	2295	litres	
Additional min. septic tank working volume recommended	**3000**	**litres**	

Lined AES Secondary Treatment Bed

AES Pipe Loading Rate	48.5	litres/m	*AES pipe loading rate is increased from 38 litres/m as occupancy of camp will never double and there is sufficient rest periods to mitigate against any excess build-up of bio-film. - Camp Iona AES bed sizing guidelines 25 July 2021*
AES Pipe Length	3	m	
No. AES Pipes Required (3m lengths)	56	pipes	
No. Subsystems	4		
No. Pipes per Subsystem	14		
Flow per Subsystem	2037	litres	*Max. flow of 2500 litres per subsystem*
No. Rows per Subsystem	2		
Total No. Rows	8		
No. Pipes per row	7		
Length	**21.6**	**m**	
Width	**4.05**	**m**	

Land Application Area / Disposal Area

Soil Category at Point of Discharge	2 - Sandy Loam		
% Coarse Fragments	>20	%	
Change to Soil Category	Yes		
Recommended Daily Loading Rate (DLR)	30	mm	*As per Table L1 - Recommended Design Loading Rates for Trenches and Beds, AS/NZS 1547:2012*
LAA Required	272	m2	

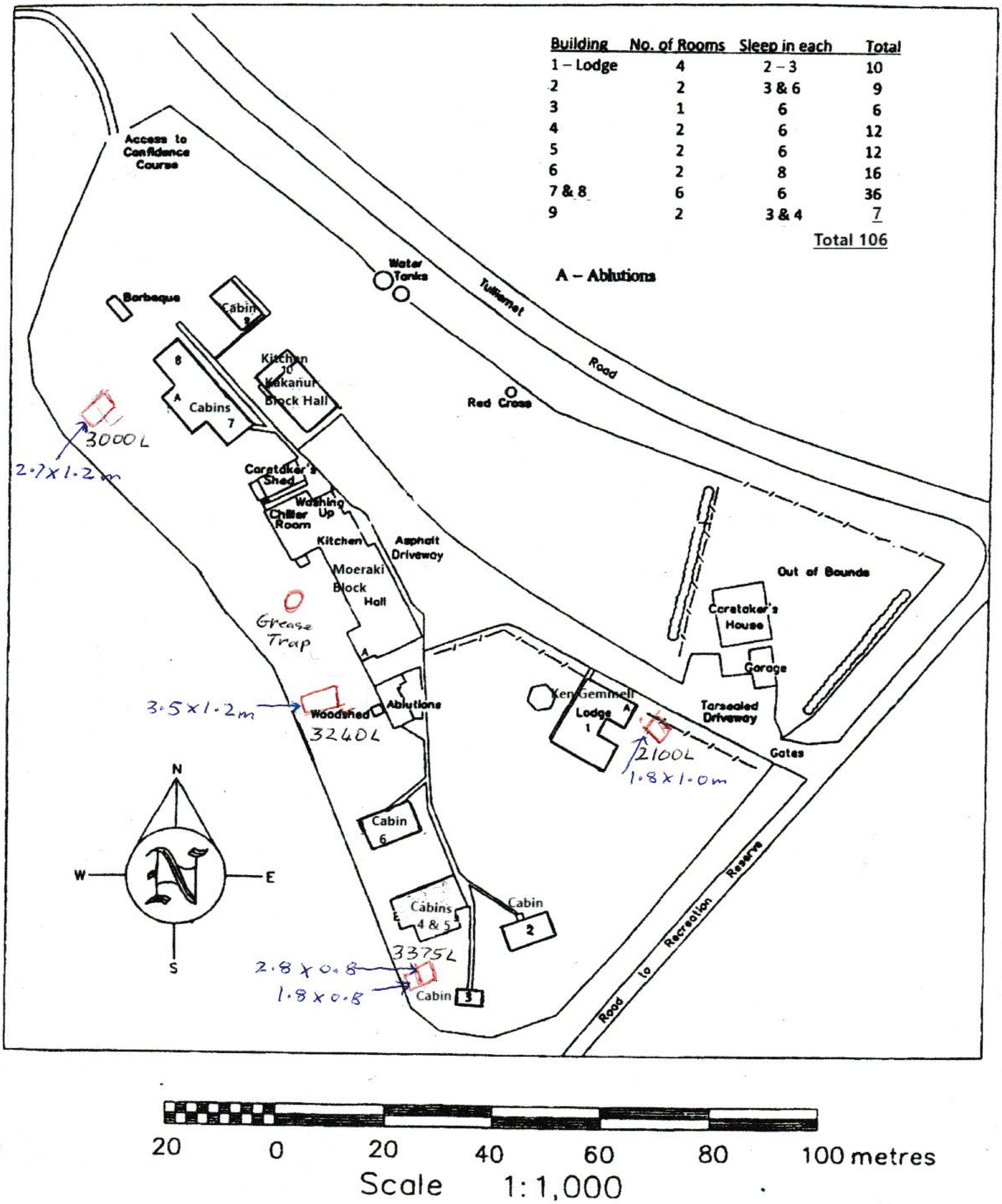
Low Pressure Effluent Distribution Disposal Bed

Length of Bed	44	m
Width of Bed	6.2	m
Total Disposal Area	**272.8**	**m2**

Appendix G – Location and Capacity of Existing Septic Tanks and Grease Trap based on information from S J Allen Ltd

Septic Tanks (SJ Allen info)

Camp Iona Site Plan



Building	No. of Rooms	Sleep in each	Total
1 – Lodge	4	2 – 3	10
2	2	3 & 6	9
3	1	6	6
4	2	6	12
5	2	6	12
6	2	8	16
7 & 8	6	6	36
9	2	3 & 4	7
			Total 106