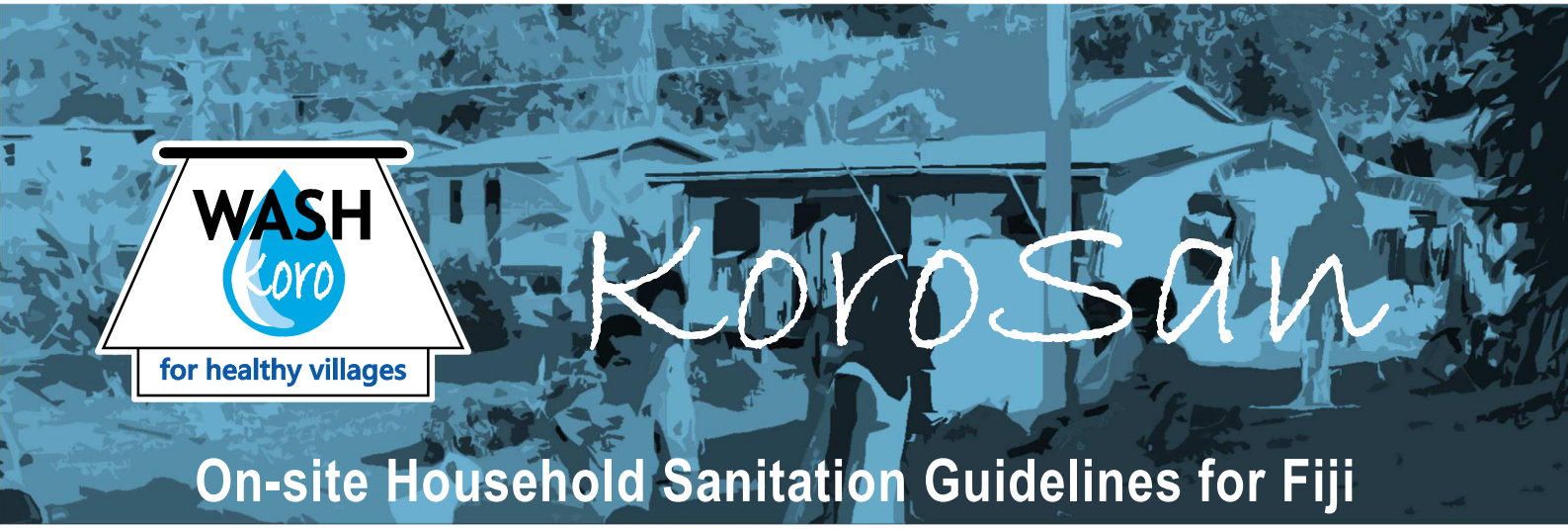


#2 SITE, SOIL AND WASTEWATER FLOW ASSESSMENT

1 PURPOSE

A safe, sustainable, effective and affordable sanitation system is an essential service for the health and wellbeing of all people. This guideline is aimed at rural areas in Fiji that are not serviced by a reticulated sewer service. There are a range of technical options for a sanitation service suitable for a rural dwelling, cluster of dwellings, school or community building(s). To work effectively, on-site systems need to be tailored to the local site characteristics.

This guideline provides generalized technical information and procedures for assessing the soils, and physical constraints and attributes of a village or property requiring an on-site wastewater management service (OWMS). This information is important for determining what sort of treatment system is appropriate, where it should best be sited, and what are the associated risks. It is essential for determining the type and area required for land application systems. For further information on choosing an appropriate village wastewater management service and what the components of such a service include, refer to KoroSan #1.

2 SITE ASSESSMENT

There are essentially two categories of waste product from domestic activities that need to be managed carefully to mitigate health and environmental risks:

- Wastewater; grey and black water (see KoroSan #1 for further information).
- Dry toilet waste product; faecal waste and urine.

This guideline deals with site assessment for wastewater management. Septic tank sludge management is dealt with in KoroSan #5.

2.1 GENERAL SITE ASSESSMENT

A site map provides a picture of the village identifying key issues and things that will assist with choosing an appropriate sanitation service. Table 1 lists the key information to include on a village map. Also, identify and record contact details for Turaga ni koro, Clan leaders, Water and Health Committee contacts, Provincial Council officers, and any other key people.

2.2 DETAILED SITE ASSESSMENT

Detailed assessment of wastewater sources, and soil and groundwater characteristics needs to be undertaken systematically with careful attention to detail.

Checklist templates are provided at the end of this guideline for:

- Preliminary rapid site assessment (Appendix A.)
- Full site assessment (Appendix B).

WASTEWATER SOURCE

The volume of wastewater to be managed will depend not only on the number of people living in the dwelling or dwellings, and their habits, but also on the types of household facilities such as whether or not there are flushing toilets and the type of flushing toilet (pour flush, single flush or dual flush), and if there are shower units, laundry facilities (washing machine). Wastewater management systems are generally designed on the basis of the maximum number of people likely to be using a dwelling, recognising that current usage may not reflect potential future use. Typical design volumes appropriate for Fiji villages are given in Table 2.

Table 1. Information to include on a village site map.

Information	Description
Location	Provide a locality map showing where the site is in relation to local towns and landmarks, and what provincial council area they belong to. GPS details or map references should also be provided if possible. Google Map or Google Earth are useful resources for showing the site location.
Buildings and other physical features	Identify existing dwellings and buildings, surface water bodies (rivers, streams, wetlands, coastlines), groundwater wells, roads and pathways, protected and special (cultural and sacred) areas, water source sites, bathing sites, food gathering sites, farming and gardening sites. Include village boundaries and land owner boundaries where possible. Using local knowledge (involving villagers, water and health committee's etc.,) will not only provide useful detail, but will also engage the local villages in the project.
Topography	On a site map indicate flat, gently sloping and steep areas.
Soils	On a site map, indicate the location of different soil types in the following categories: • Sandy free draining soils. • Moderately draining loamy soils • Poorly draining clay soils • Other soil/geological areas such as, stony/rocky, soap stone • Refer to Section 2.3 for information on soil assessment methods.
Drainage and flood risk	On a site map identify: • Dry and well drained areas • Low lying wet areas • Flood prone areas • Surface drainage – i.e., areas that convey surface waters after heavy rainfall.
Land holders	Identify the different land holder areas (with clan names) on a site map.
Water supply and wastewater infrastructure	On a site map, locate and describe water supply sources (roof rainwater, surface water and ground water [wells]) and show the location of water supply pipelines. Assess the incidence of leaking taps and pipes which will require remediation to avoid water wastage and overloading of wastewater management systems. Identify any existing wastewater systems within the village. Note types of toilets and disposal areas, and any problems with existing systems (e.g., overflows, wet patches, odours, polluted drains).
Groundwater	Identify on the site map areas where the groundwater level will be high and areas where the groundwater is relatively deep. If the groundwater levels vary throughout the year, it is important to use the highest groundwater level. Refer to Section 2.4
Flood risk	Identify on a site map, areas where flood waters and surface flooding occurs after heavy rainfall events.
Tidal surge and sea level rise risk	If there are areas in the village that are at risk from tidal surge or sea level rise, these should be identified on the site plan.
Number of houses and occupancy	The dwellings requiring a wastewater service need to be either listed or illustrated on the site map. For each dwelling requiring this service the following information is required: • Is there a reticulated water supply to the dwelling? • How reliable is this water supply (very reliable, unreliable, very unreliable)? • Number of bedrooms • Current occupancy • Current type of toilet - flush, pour flush, composting, pit…other • Type of toilet required - flush, pour flush, composting, ecoVIP2, …other • Is the proposed wastewater service required for blackwater only or blackwater and grey water? Provide details for type of wastewater producing facilities in each dwelling, existing and proposed– e.g., flush toilet, showers, bath, sinks, laundry.

Table 2. Design wastewater volumes for domestic dwellings in Fijian villages.

	Daily wastewater volumes allowances per occupant (L)[1]	
Blackwater	Flush toilet[2]	40
	Pour flush toilet	10
	Dry Toilets[3] Urine – 1.2 to 1.5L Raw faeces – 0.9L Bulking material – allow 0.3L	
Greywater	Shower	100
	Washing machine	20
	House sinks	20

1. When selecting a design daily wastewater volume, it is important to design for the maximum potential number of occupants in the building(s) rather than the actual number.
2. If low volume dual flush toilets are fitted in the house, the volume may be reduced to about 60% of the flush toilet volumes in this table.
3. The values given are approximate for raw fresh faecal solids, urine and bulking material. The liquid component from a composting toilet comprises leachate, mostly urine. In a composting toilet chamber and the ecoVIP2 toilet pit, the solids volume will reduce significantly over time as it bio degrades, possibly to as little as 20-30% of the original volume of faecal and bulking material.

Table 3. Soil drainage groups

Soil drainage group	Clean water infiltration rate	Soil Group
Free drainage	Greater than 30mm/hr	Sand and sandy loams
Moderate drainage	Between 30 mm/hr and 15 mm/hr	Loams
Poor drainage	Less than 15 mm/hr	Light clays and clays

Table 4. Interpretation of soil colours.

Soil colour/mottling	Drainage conditions
Warm colours, browns, reds and oranges	Good drainage
Pale yellowish, pale and dark greys with rusty orange and/or grey mottling within the waterlogged horizon; grey colours are common as well.	Drainage seasonally poor.
Pale, dark and bluish greys, or pale brownish yellows with rusty orange, brown or grey mottling within the topsoil.	Seasonally swampy soil.

2.3 SOIL ASSESSMENT

SOAKAGE TEST

The required dimension of the land application system receiving the septic effluent will depend primarily on the receiving soils drainage capacity, described as the drainage group in Table 3. This information is then used in the design of the land application system (refer to KoroSan #4 Section 4). To determine the sustainable application rate for particular soils at the site the following simplified soakage test is recommended:

Dig a hole (at least 60 cm x 60 cm) to the depth at which wastewater will be discharged (see Figure 1). At this depth dig a second hole (20 cm wide x 30 cm long x 20 cm deep). Fill this hole with 2 L of clean water and allow it to soak away completely. Add another 2 L of water, immediately and measure the depth (d) of water (in mm), then measure the time it takes for all water to drain from the whole (t, minutes). Using the following equation, calculate the soakage rate (the answer will be in mm/hour). Use Table 3 to determine soil drainage category.

$$\text{Soakage rate, S (mm/hr)} = [\text{d (mm)} / \text{t (mins)}] \times 60$$

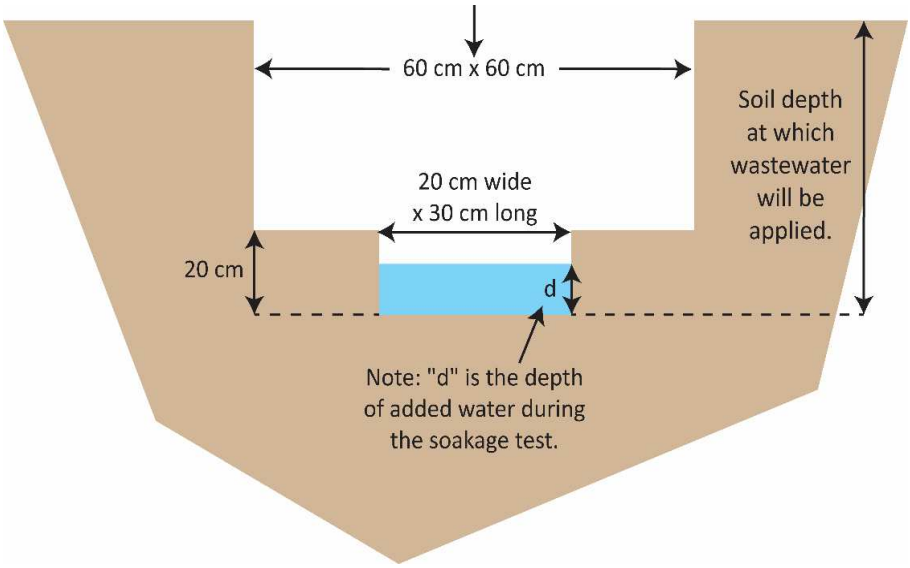
WORKED EXAMPLE

If d = 10mm and t = 45mins, then

S=10/45 x 60 = 13mm/hr

Soil drainage group would be poor drainage (see Table 3)

Figure 1: Soakage test soil pit dimensions. For pre-soaking, add 2 L of water and allow to drain away completely. Add another 2 L and measure the starting water depth, then measure the time for all the water to drain.



2.4 GROUNDWATER ASSESSMENT

It is important to determine the distance below ground level to which the groundwater can rise. The distance between the point where the septic tank effluent is applied to the ground and the average groundwater level, is to be no less than 1.5 m and no less than 1 m when the groundwater is at its highest level. The following are recommendation for determining the highest groundwater table levels, typically expressed as depth below ground level to the groundwater:

1. Talk to local villagers, gardeners and farmers and ask if they have knowledge of the highest level below ground level that groundwater can rise to.

2. Dig a 2m deep soil pit or auger hole. Observe changes in soil colour (Table 4; Fig 2). Rusty red coloured mottles (soil blotches) can be an indication of saturated soils and highest groundwater level. Cover the pit/hole securely and observe over several weeks how groundwater depth varies. If close to a coastline or lagoon be sure to note any tidal influence on groundwater depth.

3. If there are nearby wells, there may be groundwater depth data available.

4. Consult with local well driller or Mineral Resources Department (MRD). They may be able to provide information of groundwater depth.

5. Water level in nearby surface water bodies (river, stream, pond, lagoon, wetland) may provide an estimate of average and highest groundwater depth.

6. If these methods fail to provide reliable groundwater depth information seek specialist advice.

Figure 2: Photos of soil mottling.

3 REFERENCES

AS/NZS 1547:2012. On-site domestic wastewater management. https://www.standards.govt.nz/

4 APPENDIX A. RAPID ASSESSMENT TEMPLATE

Date of initial visit:.....

	Name of assessor
	Name of village
	Name and contact details of village contact
1	GPS waypoint of site
2	No. of houses
3	Typical no. of occupants in the houses
4	Describe existing toilet(s)
5	What is the water supply and how reliable is it? Note the location of wells and surface water supplies
6	Do they want dry toilet (composting, ecoVIP2), pour flush of flush toilets?
7	Is village topography flat or hilly?
8	What are the soil types - clay, sand .....?
9	How high can ground rise below GL?
10	Does the village/site flood?
11	If septic tank effluent has to be pumped to higher land, are they able to fund the ongoing power and pump maintenance costs?
12	Does village have an active and committed water committee?
13	Does village have active and committed health committee?
14	Are they willing to implement good hygiene practices?
15	Are village Chief, elders and Pastors supportive?
16	Take photos of key features of village layout and existing water and wastewater facilities

5 APPENDIX B: OWMS FULL SITE ASSESSMENT TEMPLATE

Use this form for a substantive upgrade or new village wastewater service.

Date:.....

Project manager and contact details	
Funding source	
Village location/ address	
Village contact name and contact details	
List Matagali potentially affected	
Sanitation service configuration required	Wastewater service for individual houses - Y/N
	Wastewater service for cluster of houses within the village - Y/N
	Combination of individual house and house cluster wastewater services – Y/N
	Reticulated wastewater service for whole village - Y/N
	Other
Brief description of existing sanitation service(s). Include number of houses serviced.	
Description of preferred OWMS	Specify type of toilets (flush, pour flush, dry)
	For blackwater only – Y/N
	For greywater only – Y/N
	For blackwater and greywater - Y/N
	For composting toilet Y/N
	Improved pit toilet (ecoVIP2) - Y/N
	For flush toilet and pour flush toilets describe:
	Type of treatment unit
	Type of land application system
	State total number of houses to be serviced
	Other

Describe any alternative options to be considered.	
Description of existing water supply service	To include details of: Description of water source Daily volume available at source Reliability of supply over a year period Water quality (include any water quality test data) Total volume of water storage available Note location of water supply bores and surface water supplies.
Description of water supply upgrade, if proposed.	
Describe proposed process of villager engagement proposed	
Summary of key findings of site and soil assessment (where applicable)	To include description of: Wastewater volumes – provide details design loads in L/day and method of determination Describe measures adopted to reduce water consumption wastage. Describe measures proposed to reduce stormwater and groundwater inflow and infiltration. Soil profile description and drainage Groundwater depth and variation Topography Proximity of surface fresh and marine waters (rivers, streams, drains, wetlands, lagoons, coast line….) Proximity to water supply wells Surface and subsurface drainage patterns Proximity to food gathering areas and food gardens/farms Proximity to village amenity areas Special cultural areas and/or features requiring protection

Governance and financing	Describe village governance structure that will sustain the wastewater service.
	Provide details of funding source(s) for full capital costs for; design, compliance, technologies, health and safety, training, awareness raising, installation, construction and commissioning.
	Provide details of funding source(s) for all annual operating costs; management, servicing, power, ongoing training, health and safety and monitoring.
Risk assessment and risk mitigation: Public health, environment and amenity.	For the following hazards (if applicable), provide results of risks assessment that has been carried out and, where appropriate, risk mitigation measures proposed.
	Risk of inadequate water supply
	Mitigation measures proposed
	Landowner resistance
	Mitigation measures proposed
	Health risk to villagers
	Mitigation measures proposed
	Risk of mosquito breeding
	Mitigation measures proposed
	Risk of contamination of drinking water sources
	Mitigation measures proposed
	Risk of odours
	Mitigation measures proposed
	Risk of vermin and other pests
	Mitigation measures proposed
	Contamination risks to water bodies (streams, lagoons, wetlands, coastal waters, groundwater)
	Mitigation measures proposed
	Flood and tidal surge risks
	Mitigation measures proposed
	Risk to special cultural areas and/or features requiring protection
	Mitigation measures proposed
	Other risks (state)
	Mitigation measures proposed

Risk assessment and risk mitigation: Governance, financing, management and servicing	Risk of failure of village governance structure and procedures
	Mitigation measures proposed
	Risk of insufficient capital for installation and construction
	Mitigation measures proposed
	Risk of loss of village capability to manage and service the service
	Mitigation measures proposed

Other Notes:

Signed: Date:

This guideline was produced in consultation with the Fiji Department of Water and Sewage and the Ministry of Health as part of the WASH Koro Project led by the National Institute of Water and Atmospheric Research (NIWA). The project was supported by the New Zealand Aid Programme through the Partnerships for International Development Fund of the Ministry of Foreign Affairs and Trade. Care has been taken to make sure the information provided is correct and fit-for-purpose, but we accept no liability for any errors or omissions, or the consequences of their use or misuse. The views expressed in these guidelines do not necessarily reflect those of the New Zealand or Fiji Governments.

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For more information contact:

The Department of Water and Sewage.
The Ministry of Health, or your local
Provincial Council

KoroSan Guidelines

The WASH w project has produced the following series of technical and participatory guidelines to help mobilise villages and settlements to improve their water supply, sanitation and hygiene. These guidelines may be freely disseminated provided the source is acknowledged.

KoroSan #	Title
1	Choosing a village wastewater management service
2	Site, soil and wastewater flow assessment
3	Septic tank construction using concrete blocks.
4	Land application systems
5	Maintaining your septic tank and land application system
6	Water-less ecoVIP2 toilet
7	Greywater management
8	Village participation in water and sanitation actions

KoroSan – for healthy villages