8 Water

Prepared by: Ricardo Serpell, September 2018.

8.1 Availability

The lack of a permanent surface water network makes water supply in Rapa Nui highly vulnerable due to its dependence on precipitation levels. The craters of Ranu Kao and Rano Raraku volcanoes provide a natural lasting reservoir for rain water. However, accessibility of the former is difficult due to its steep inner slopes and water level, quality and availability in both vary according to precipitation history.

Evidence suggests that throughout the period of human occupation predating European contact, the island had experienced several climatic phases and landscape shifts that affected the availability of water for human consumption. According to Rull et al. [1], even if a direct cause-effect relationship cannot be stablished with available evidence, changing water availability probably affected the cultural development of Rapanui civilization at different stages. The role of these climatic changes on human-resource interactions on Easter Island is still under exploration [2]. Nevertheless, archaeological research has already shown that rain water collection and management appears to have been a common practice at some point in the ancient history of the island [3–7]. Water reservoirs built along ephemeral streams and collectors carved on basaltic stones called *taheta* are found throughout the island (Figure 8.1). A network of man-made wells along the coast of the island, called *puna* (Rapanui word for spring), enabled catchment of a mixture of fresh and saline water (brackish water) in places where underground water flowing from the inner part of the island discharges just above the sea level. Some of this natural springs are still in use today to access water for livestock (Figure 8.2).

a  ***b*** 

Figure 8.1 ***a***: Ancient water reservoir (Vogt). ***b***: *Taheta* carved on a stone to collect water (from [7]).

a  b 

Figure 8.2 ***a***: *puna* in the La Perouse bay area, consisting of an open pit and stone lined wall (from [7]), ***b***: active well perched on top of a *puna* (from [8]).

8.2 Potable water supply

Today, almost all the potable water is sourced from a relatively shallow aquifer that is replenished by infiltration of precipitation through the highly pervious volcanic soil. Despite the small size of the island, average annual precipitation ranges from about 1,000 mm to over 1,500 mm at different locations [9]. Infiltrated groundwater migrates through the permeable volcanic layers of the aquifer and discharges in the sea, mainly through submarine springs and occasionally above the sea level. Considerable mixture of saline and fresh water occurs naturally in the aquifer, particularly near the coast (Figure 8.3).

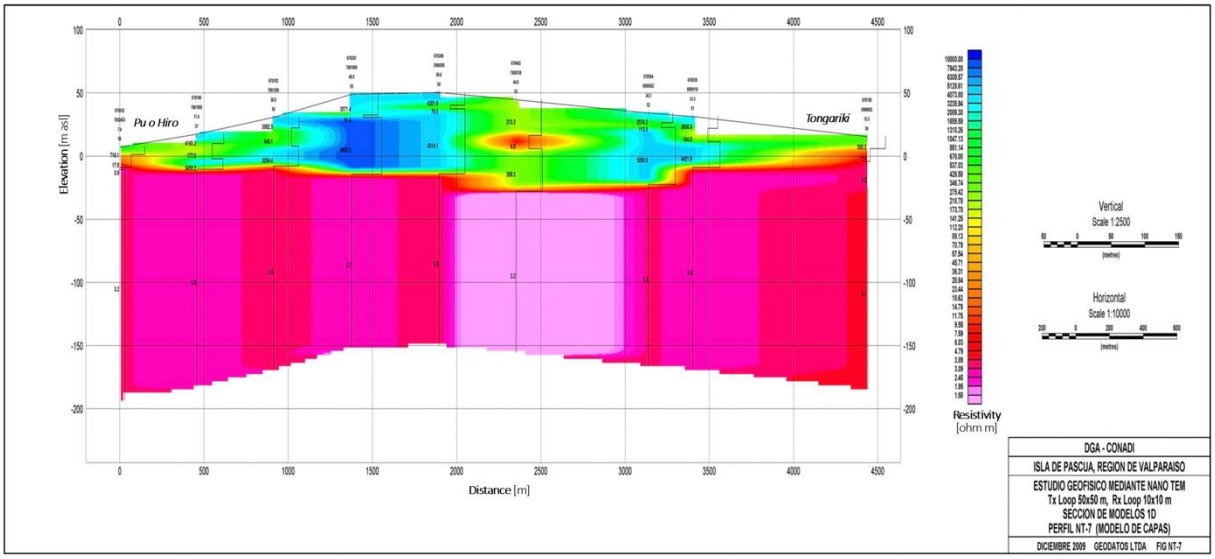

Figure 8.3 Resistivity from TEM data showing fresh/saline water boundary in the north-eastern part of the island (from [10]).

Water for domestic consumption is extracted from 6 wells located in the outskirts of Hanga Roa. Extraction and treatment is carried out by the state-managed company SASIPA SpA (Spanish acronym for *Sociedad Agricola y Servicios Isla de Pascua*, lit.: Easter Island Agricultural and Services Society). In

2011 the average rate of extraction was 33 l/s [11]. After treatment for disinfection according to local sanitary standards (chlorination) water is pumped to 6 accumulation tanks located around the city, two in RanoKau (350 and 500 m^3 capacity), two in Arapiki (250 m^3 each), one in Puna Pau (100 m^3) and one in Vaitea (250 m^3) to supply the adjacent rural area [12]. Distribution is by gravity, through a 70 km long network of mostly PVC pipes. Production has been constantly increasing to cope with increasing potable water demand, from 90,000 m^3/month in 2012 [13] to almost 130,000 m^3/month in 2017 [14]. Consumption in 2017 reached 80,000 m^3/month. The production-consumption difference is due to water losses that, despite recent efforts by the company, still take over 38% of the production [14].

8.3 Potable water quality

Water availability is not yet a concern, but rather the quality of the water due to potential contamination from leachates infiltrating the aquifer and to eventual increase of its natural salinity. According to Campbell [15], contamination of island's drinking water supply is already an environmental threat. Main causes are the percolation of wastes from the Orito dump (sitting directly on top of a ground water divide connected to the Hanga Roa aquifer) and the potential percolation of sewage due to the lack of centralized sceptic waste treatment and widespread use of simple pit latrines.

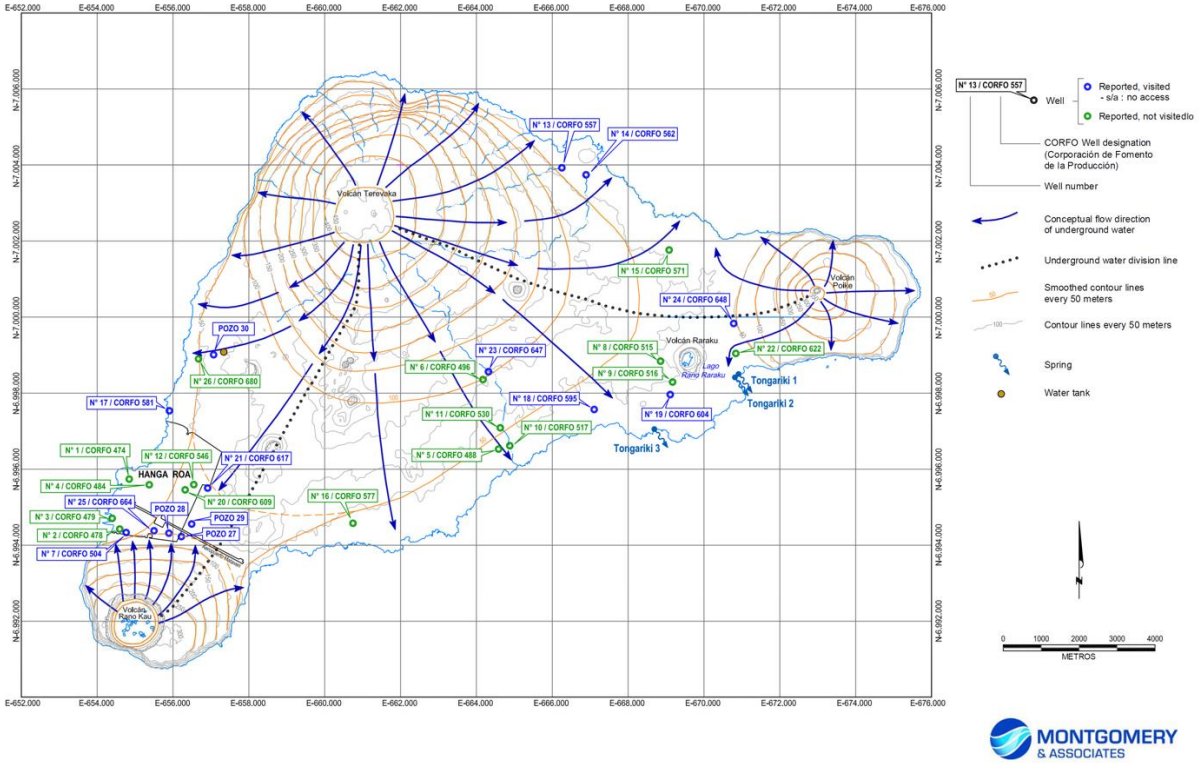

Figure 8.4 Location of wells and estimated underground water flow patterns (from [11]).

Comparative chemical analysis of rain, surface and subsurface water performed between 2002 and 2003 already showed possible anthropogenic contamination consisting of high nitrate content and Ammonia in samples obtained from boreholes at inhabited areas [16]. Several abandoned old wells

exist around Hanga Roa that also pose a risk for contamination of the aquifer (Figure 8.4). Another source of concern is the rate of extraction on the working wells. If the rate increases it can cause uplifting of saline water in the area of the well, increasing salinity of the extracted water. If the drinking water supply becomes irreversibly polluted, implementing an alternative source is not possible without significant social and economic damage to the island.

8.4 Waste water treatment

The city of Hanga Roa is not equipped with a sewage network and there is no sewage treatment plant on the island. Most households deal with septic wastes using simple pit latrines, covered with stones. Although since 2005 local regulations mandate the installation of septic tanks in new buildings, no treatment process is available on the island to deal with material from full septic tanks [17]. Currently, approximately 5% of households have sceptic tanks. A private operator collects the sludge from the tanks but disposes of it by dumping it into the environment [18]. The high density of latrine and septic tanks combined with the high permeability of volcanic soil and the shallow level of the water table make groundwater supply highly vulnerable to septic contamination.

A study commissioned by SASIPA in 2012 concluded that the individual solutions should be replaced by a central treatment process [12]. It recommends the collection of sewage and the construction of a septic treatment plant in the Vaitea estate. The location was proposed due to the availability of space, the safe distance from Hanga Roa and the possibility of using recovered water for agriculture/forestry on-site. Technical alternatives considered were activated sludges and vermifiltration.

The solution should mitigate the risk of vector spreading, protect the natural resources, including the acquirer, and warrant a sustainable service. A new study from 2017 compared three alternatives for sanitation: a) replacement of pit latrines exclusively with sceptic tanks in all households, b) conventional sewage in the central part of Hanga Roa (connected to a primary treatment plant and marine discharge) and use of sceptic tanks in the periphery, and c) sceptic tanks in all households connected at a later stage to swage of small diameter [19]. The study recommended continuing with the installation of individual sceptic tanks (alternative a), eventually implementing a small diameter sewage network to collect residual water from the tanks in the central part of Hanga Roa (as in alternative c) when the city reaches a higher population density.

8.5 Storm water

Hanga Roa has a significant deficit of storm water management infrastructure. Water frequently flows over the main streets towards or in the general direction of the sea and some areas of the city experience frequent flooding episodes [12]. The city surface presents lower retention capacity compared to the natural terrain. As a consequence, a larger proportion of sediment is discharged to the sea in front of the city. In its central part some streets have open channels running beside them and there is one collector of 400 mm diameter in Simon Paoa street. Studies carried out for the development of the new Urban Planning instrument for Hanga Roa (including Stream Power Index, Topographic Wetness Index and Transport Capacity Index), show the water collects in 5 main streams and discharges to the sea at 4 points [20].

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