Year 3 Climate and Water Resource Addendum Report Summary

The Water Pillar Team have continued to monitor surface water levels, stream flow and groundwater levels in key water catchments across the island. The team have also continued to collected climate data from the Automatic Weather Stations (AWS) and installed a new AWS in 2023 at The Depot.

Climate Data

Climate data shows that at Bottom Woods Met Station, total rainfall was 2% less than the 20 year average. June 2023 was the wettest month (72.8mm) which is 22% higher than the monthly average. The highest temperature recorded in 2023 was 25.8°C in March, 1.9°C higher than the previous highest temperature for that month. The overall average max daily temperature for 2023 was 1% below the 20-year average. The lowest temperature recorded was 12.3°C in August, 1.5°C warmer than the lowest recoded temperature for that month. The overall average minimum daily temperature was 1% above that of the 20-year average.

A new mist monitoring location was installed at The Depot in July 2023. Total recorded mist averaged 3,184mm across the monitoring network. Monthly mist ranged between 125mm and 534mm (excluding The Depot). Studies of cloud forest mist capture across the world have reported mist contribution between 20mm/a and 1,990mm/a, with mist contributing between 5% and 75% of total catchment runoff.

Based on water supply data provided by Connect, surface water abstractions accounted for 83% of total raw water abstracted for island water supply in 2022 and 69% of total raw water abstracted for the island water supply in 2023.

For the purposes of the catchment water balances, it has been assumed that 1000mm of the 2023 average mist is available for recharge to streams and groundwater, with the remaining mist evaporated from the cloud forest canopy (2,184mm). Based on this assumption, mist is estimated to contribute between 51% and 75% of water available for stream flow or as groundwater in 2023 (average 57%). Mist contributes to the island water supply from land above 690m elevation contour, emphasising the importance of the cloud forest for the islands water supply.

Water Balance Data

The Year 3 water balance used data collected during 2023 which has been refined through the subdivision of each catchment into three zones by elevation:

- **Zone 1**. Land above the 690m contour (where previous studies have indicated mist interception in the cloud forest occurs alongside rainfall recharge).
- **Zone 2**. Land between the 500m and 690m contours (where rainfall recharge is believed to occur; and
- **Zone 3**. Land below the 500m contour (where PE is believed to be greater than rainfall e.g. no rainfall recharge occurs).

The 2023 water balance for the island has calculated a surplus of 3.04 Million m^3/a. It should be noted that much of this surplus water recharges deep groundwater aquifers which flow out to the ocean, many of which are not accessible for water supply.

Climate Change

Using current data, a climate change assessment using climate model data for the period 2040 to 2060 indicates that the islands water supply will reduce by 3%.

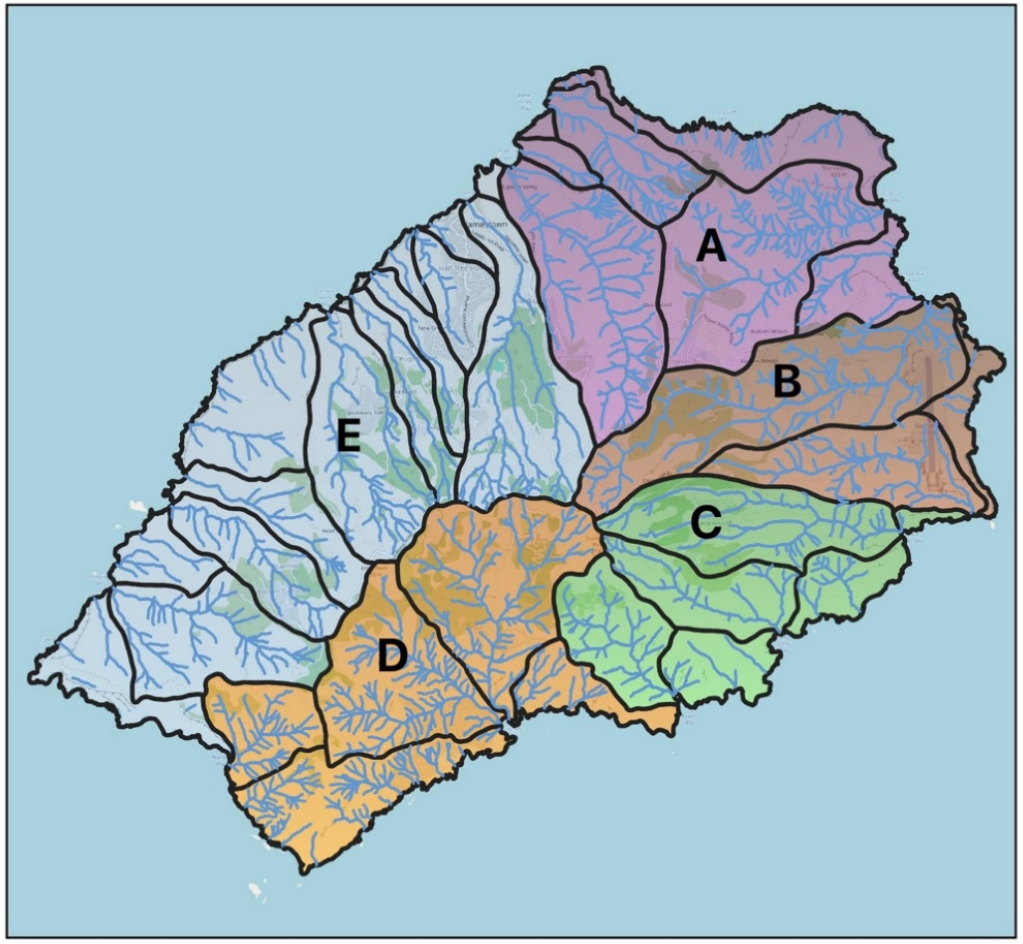
Based on the current monthly water balance data, St Helena should prepare for a 3% decrease in available rainfall recharge for water supply between 2040 and 2060. The islands water network will need to plan for a climate change reduction in water supply for the months of February, May and June. Longer term water resource monitoring will support more accurate assessments of the climate change impacts on the islands water supply.

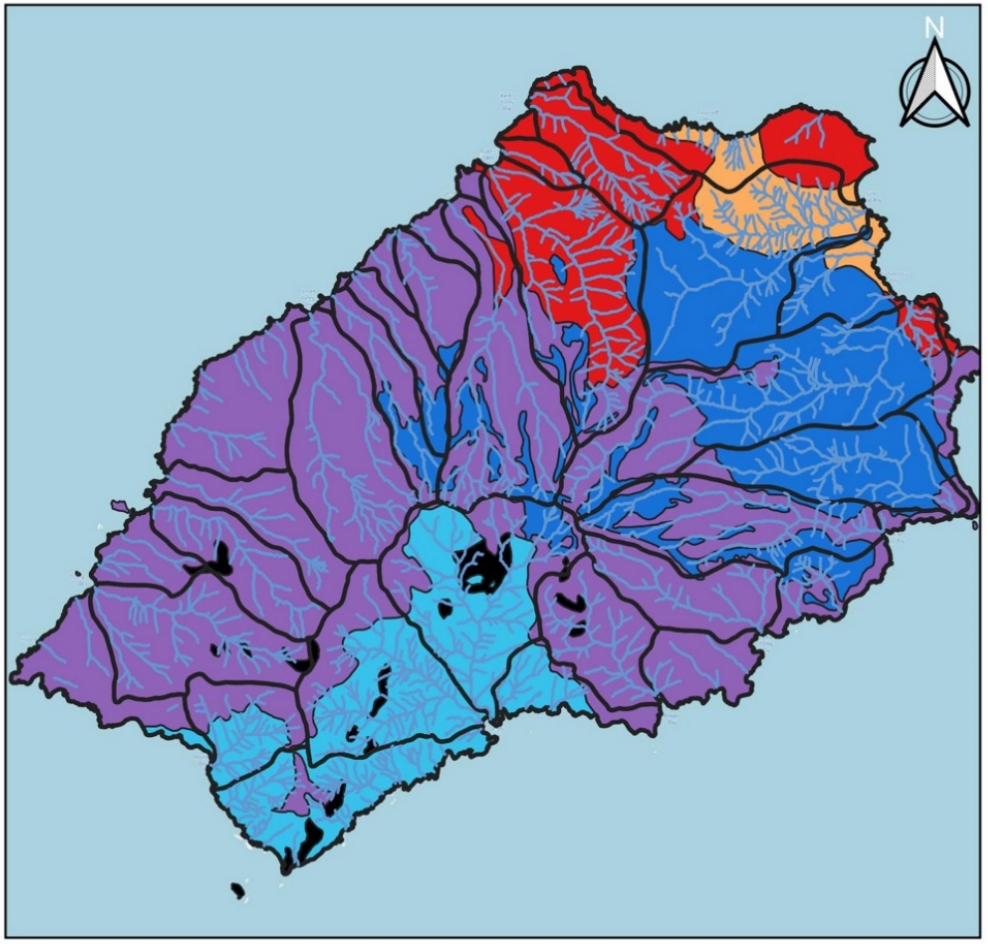
Water Resource Areas

Understanding the complex geology and hydrogeology of St Helena is an ongoing process. Every type of information (old and new) such as borehole logs, groundwater and surface water monitoring data, meteorological and climatological data, borehole pump test and water quality data is important. This data is used to evaluate differences between water catchments across the island.

New geophysics data, climate and water resource monitoring data and previous reports on the geology and hydrogeology of St Helena have been used to develop a revised understanding of the islands water supply. This conceptual model of how water moves across the island has identified 5 Water Resource Areas (WRA).

The 5 WRA are shown in a figure on the next page, next to a basic map of the island's geology.





Legend

Streams

WaterCatchments

Water Resource Areas

Area A

Area B

Area C

Area D

Area E

Geology

Late Intrusives (~8.8 Ma)

SW Upper Shield (~9.0 Ma)

SW Main Shield (~9.2 Ma)

SW Lower Shield (~9.3 Ma)

NE Upper Shield (~10.3 Ma)

NE Breccia (~11.3 Ma)

THE PEAKS NATIONAL PARK

0 1 2 3 4 5 km

Date: 1st August 2024

St Helena Cloud Forest Project

Conceptual Model Water Resource Areas and Geology

St Helena Government · Met Office · Connect · Centre for Ecology & Hydrology · Arctium

The 5 Water Resource Areas are:

WRA-A	Northern Catchment Units: Ruperts Valley to Turks Cap Valley
WRA-B	Eastern Catchment units: Fishers Valley and Dry Gut
WRA-C	Southeastern Catchment Units: Sharks, Deep and Powell Valleys
WRA-D	South Catchment Units: Sandy Bay and Broad Gut
WRA-E	Western Catchment units: Thompson Valley to James Valley

WRA-E is the largest area and includes 13 surface water catchments. This WRA has the highest mist/rainfall recharge of all the WRA and is the most important for islands water supply as it currently provides 35% of the islands water needs.

WRA-B is the 2nd most important water supply area and currently provides 33% of the islands water needs.

The purpose of the Water Resources Areas are to improve the level of understanding of the islands water resources and to provide a summary of the characteristics that influence and govern water resources in each Water Resource Area including its origin, flow, quality, storage and losses.

It is hoped that the WRA will serve as a supporting framework for current water resources management planning and catchment maintenance and to facilitate future decisions on water resources enhancement for greater climate change and water demand resilience.

Recommendations

1. WRA-A

The rehabilitation of the boreholes at Molly's Gut would yield a proportion of the 500m^3/d needed by Connect to deliver a secure water supply for the island. It is recommended that all deep boreholes are backfilled with bentonite grout to restore a shallow groundwater table. This work should be planned carefully and replacement well screens and case installed in shallow aquifers. A borehole camera survey should be completed at each borehole where the old well screen and case is removed so that the surrounding geology can be properly understood and additional fracture flows identified.

2. WRA-B

Fishers valley: There is opportunity for further development of boreholes in Fishers Valley however, care must be applied when drilling any new boreholes in this area as surface (unconfined) water can be lost to the lower aquifer if the confining layer is breached. The resource is also located within a candidate RAMSAR wetland (the only wetland on St Helena), so any new groundwater development should be planned with a study to fully understand potential risks associated with groundwater abstraction on the wetland.

Dry Gut: The yields of BHDG5 in Dry Gut should be further assessed to support the islands water supply as it has previously supported large

groundwater abstraction volumes during airport construction. It is essential that a better borehole design is used to avoid the borehole collapses in BHDG5 which have resulted in higher salinity groundwater (see DPLUS103 report for more detail). A program of continuous water level, water quality and water abstraction monitoring is needed in order to understand Dry Gut and the performance of BHDG5. Due to the collapse of BHDG5 when the pump was lifted, the borehole should be rehabilitated to avoid further borehole collapses. A new borehole (or reamed existing borehole) in combination with a better well design (liner, filter, pump location of the pump etc) will lead to higher and more sustainable yield a more stable water quality and no danger for collapse. A constant rate test and performance pump test are needed to assess groundwater yields, changes in water quality over time and potential impact on groundwater levels in observation boreholes surrounding BHDG5.

If the observation that BHDG5 may be supported by recharge from Fishers Valley and Sharks Valley, then BHDG5 is possibly a key borehole in groundwater exploitation at St Helena.

3. WRA-C

Sharks Valley should be reinvestigated as a potential groundwater abstraction source. Whilst accessibility may be an issue, the availability of the groundwater resource and the potential to apply for renewable and efficient pumping systems may be economically attractive for the resource to be considered to augment current supply.

There is an opportunity to monitor Hancock Spring and complete an investigation to determine its viability as a resource for Connect, especially in the context of future water stresses associated with climate change.

4. WRA-D

Streamflow in Sandy Bay is high and is supported from surface runoff draining from the southern flanks of the Peaks (Mount Acteon, Diana's Peak and Cuckolds Point) flowing down steep valleys such as Perkins Gut and Jockeys Gut. The costs of moving water from Sandy Bay to the north of the island have been previously assessed as too expensive, however this potential source of water should be assessed in more detail as part of an options appraisal.

5. Cloud Forest Restoration Areas

Due to the impacts of the Phytophthora infection within endemic cloud forest vegetation, planned restoration of the cloud forest within the Peaks National Park has been paused. The review of water resource and geology data has demonstrated the importance of the Iron Pot and Frenches Gut wellfields in the Lemon Valley Catchment. These wellfields are close to the top of the ridge near High Peak, and above the 690m contour, which the DPLUS051 report had indicated was the bottom of the cloud base within the Peaks. It is recommended that Crown land located within the wellfield catchments above the 690m contour is considered for reforestation with endemic cloud forest, as the catchments are located at a distance from the main Phytophthora infection area.

A larger scale Gumwood restoration below the cloud forest should also be considered with an ecological / hydrological gradation between the two, including trees on grazing land.

Leggs Gut V-Notch Weir
Photography by Capricorn Studios