Catchment Modelling with SWAT – Fact Sheet

Linking lake restoration with end users for positive environmental outcomes

LERNZ
Lake Ecosystem Restoration New Zealand

Catchment Modelling in New Zealand using SWAT

Catchment models determine the source and extent of water quality problems in a catchment. Catchment models may be used to identify 'hotspots' in a region and once calibrated these models may be used to test various land management, landuse, and climate-change scenarios. SWAT (Soil & Water Assessment Tool) is a relatively complex model. The development of SWAT is a continuation of USDA Agricultural Research Service (ARS) modelling experience spanning more than 30 years. SWAT has been used with some degree of success by the LERNZ group at The University of Waikato and it has been applied to several New Zealand catchments. The model is capable of producing daily discharge and nutrient and sediment loads to streams at a sub-catchment level. ArcSWAT is an ArcGIS-ArcView extension and graphical user input interface for SWAT.

SWAT Data Requirements

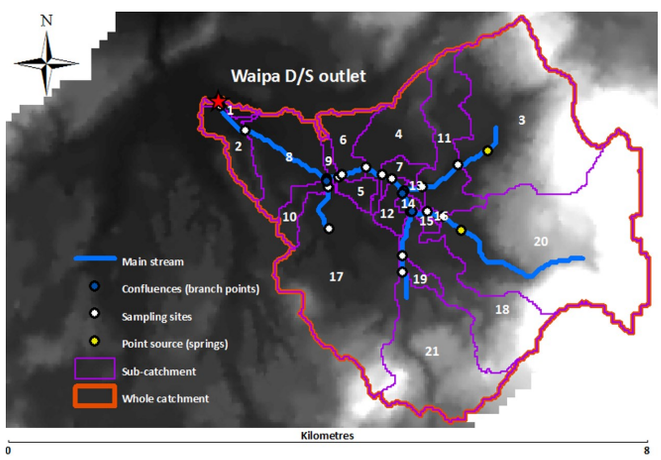
SWAT requires a variety of inputs including

- A Digital Elevation Model (DEM)
- Land use spatial layers
- Soil type spatial layers
- Meteorological data (rainfall, temperature, etc)
- Soil profile information

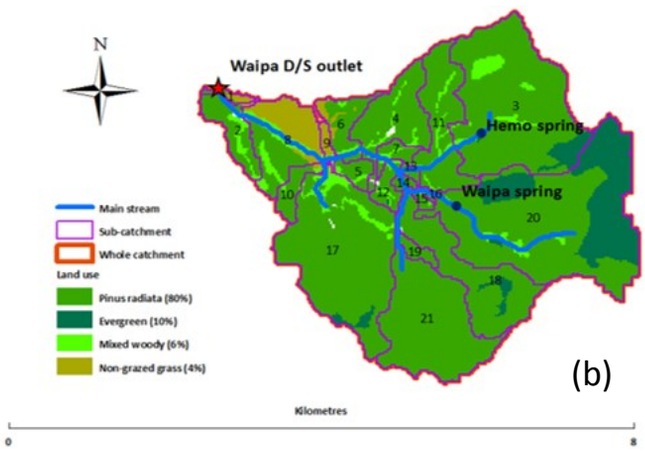
SWAT Model Configuration

Slope, landuse and soil spatial layers are used in SWAT to represent catchment characteristics that affect discharge and loads of nutrients and sediments (see Figure 1 (a), (b) and c)). In addition, a detailed knowledge of climate, soils and land management is also required.

Figure 1. (a) Digital elevation, (b) landuse and (c) soil type maps of the Lake Rotorua Waipa sub-catchment produced by the SWAT catchment model.



(a)



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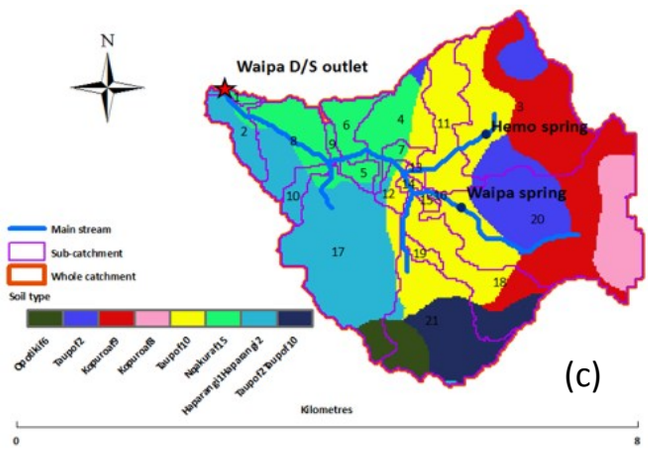

(c)

Catchment Modelling with SWAT – Fact Sheet Continued

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A SWAT Model Application— Rotorua Wastewater Disposal

One of the first applications of the SWAT model in New Zealand was its use in modelling a Rotorua sub-catchment. Treated wastewater from Rotorua City has been discharged to the near-by Whakarewarewa Forest since 1991, resulting in an increase of nutrient concentrations in the Waipa Stream (Figure 2). In a recent PhD project by Wang Me, SWAT was used to simulate changes in discharge areas and frequencies of wastewater applied. Simulations of discharge, sediment and nutrient loads (Figure 3) to the Waipa Stream showed that nutrient concentrations would take approximately one year to return to pre–irrigated levels if wastewater discharges were suddenly halted. Strategies to mitigate nitrate and dissolved reactive phosphorus leaching were shown to include irrigating over larger areas, modifying the irrigation frequency and avoiding irrigation during high rainfall events. The SWAT model was demonstrated to be an invaluable tool to guide future management decisions.

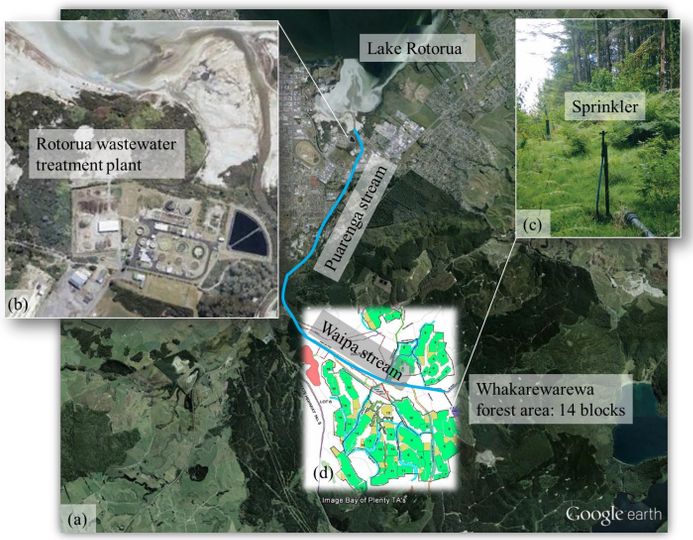

Figure 2. SWAT was used to simulate proposed changes to treated wastewater irrigation in the Waipa sub-catchment near Rotorua. Images (a, b) Google earth, c) Mike Scarsbrook,(d) Rotorua District Council.

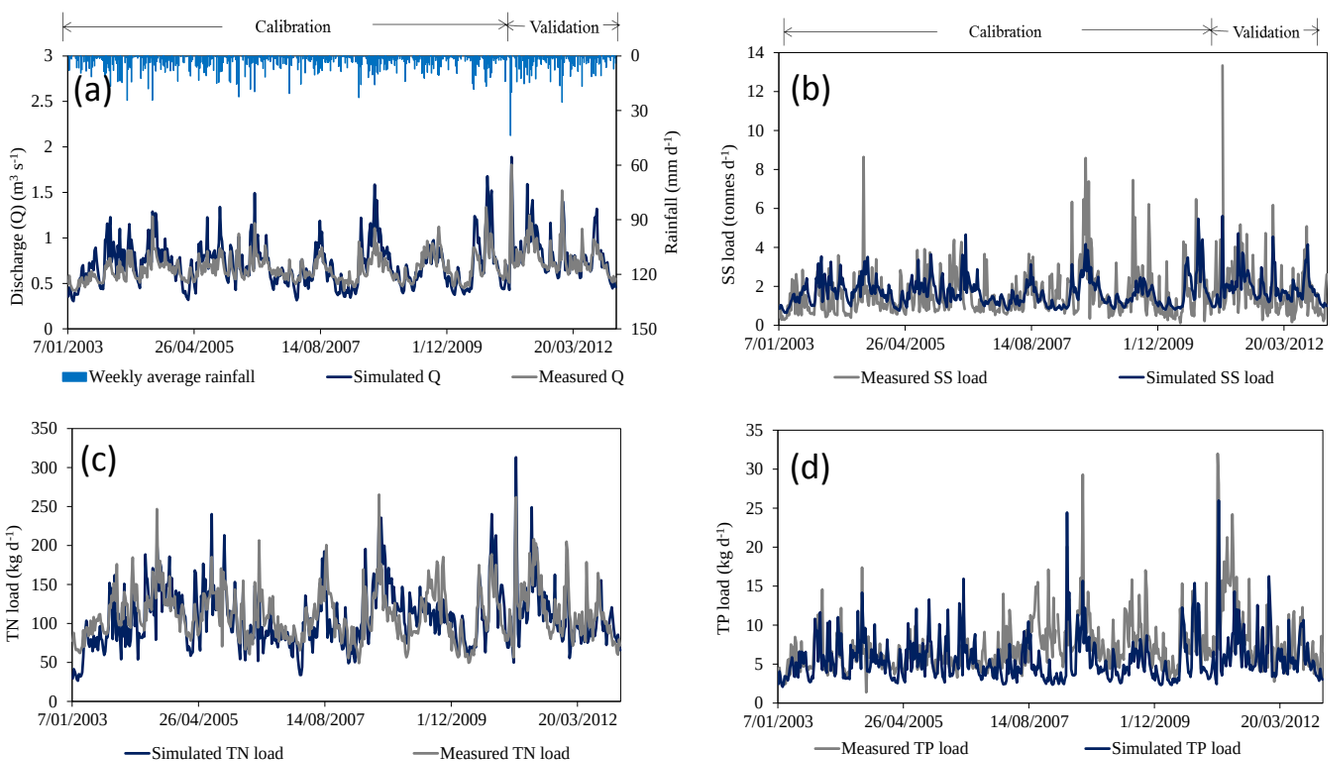

Figure 3. Weekly average values derived from SWAT-simulated daily outputs for (a) discharge, (b) suspended sediment (SS) load, (c) total nitrogen load (TN), and (d) total phosphorus load (TP), compared with weekly flow-adjusted measurements at Waipa D/S, Rotorua.