



*Modelling *E. coli* in lakes Onoke and Wairarapa*

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2017

Introduction – assumptions

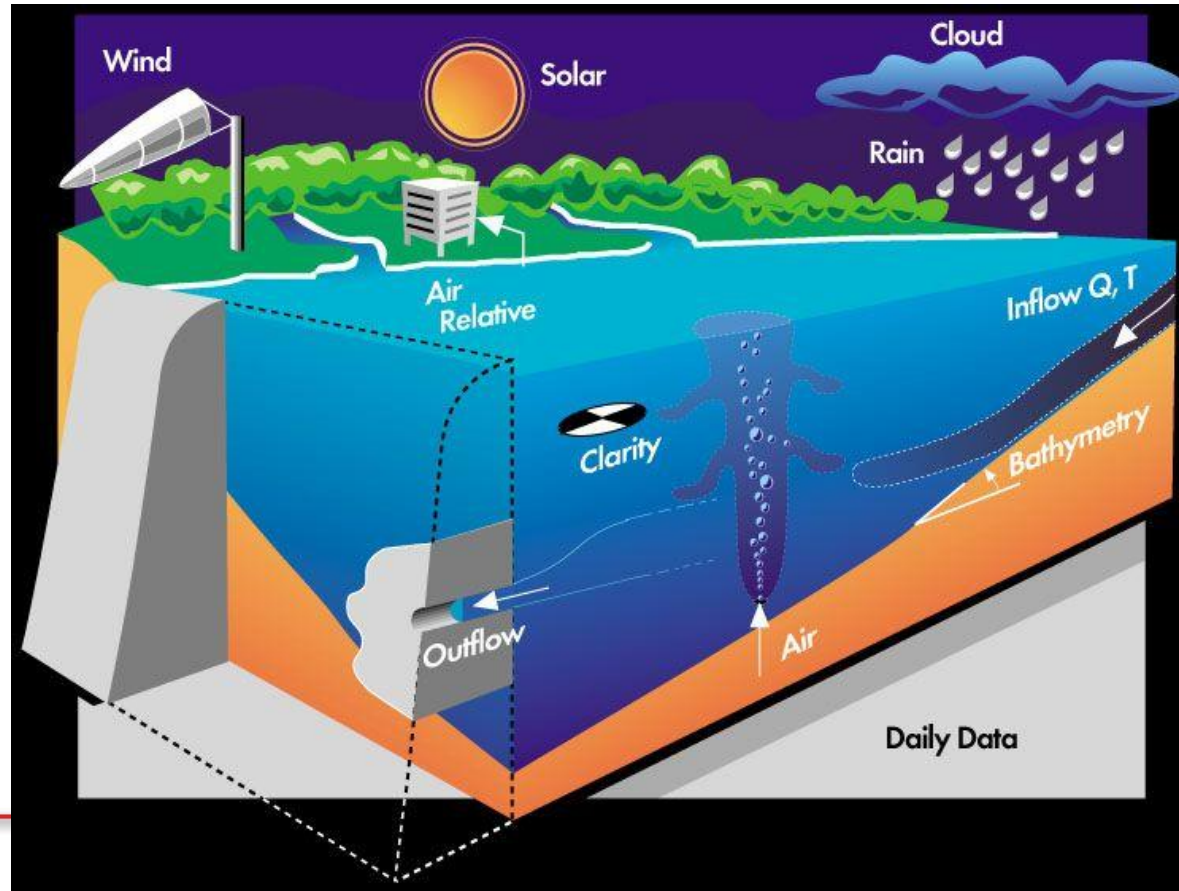
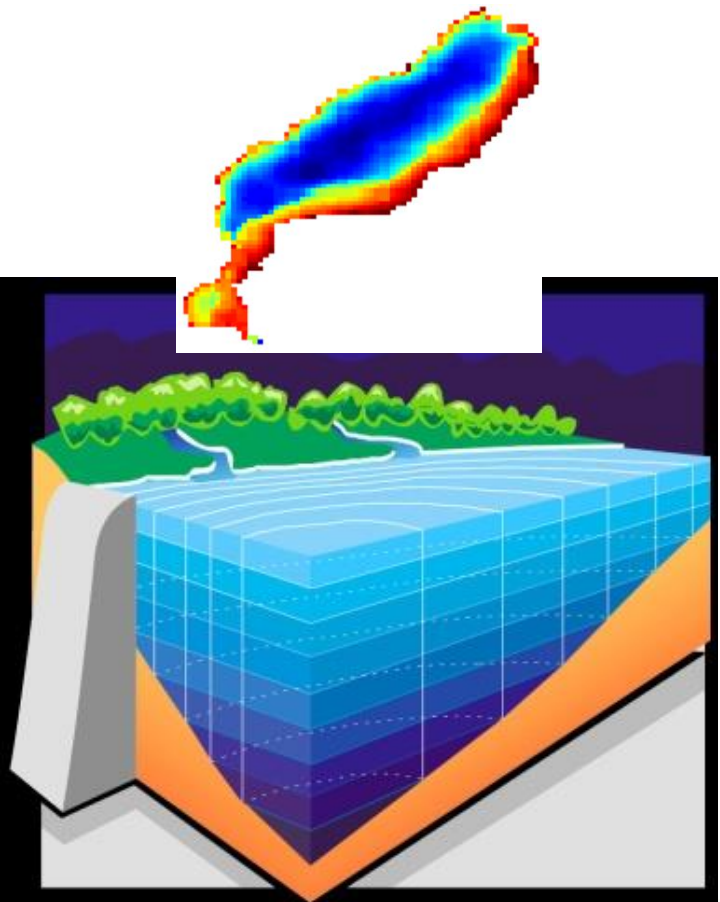
- Climate data VCN
- Changes to nutrient concentrations derived from catchment modelling/flow applied to sediment nutrient release rates
- Wairarapa – 25 largest flows modelled
- Onoke – 13 largest flows modelled
- Barrage inflow was modelled (Wairarapa)
- Ocean inflow was modelled (Onoke)
- For modelling of *E.coli*:

Bacteria do not accumulate in the sediment;

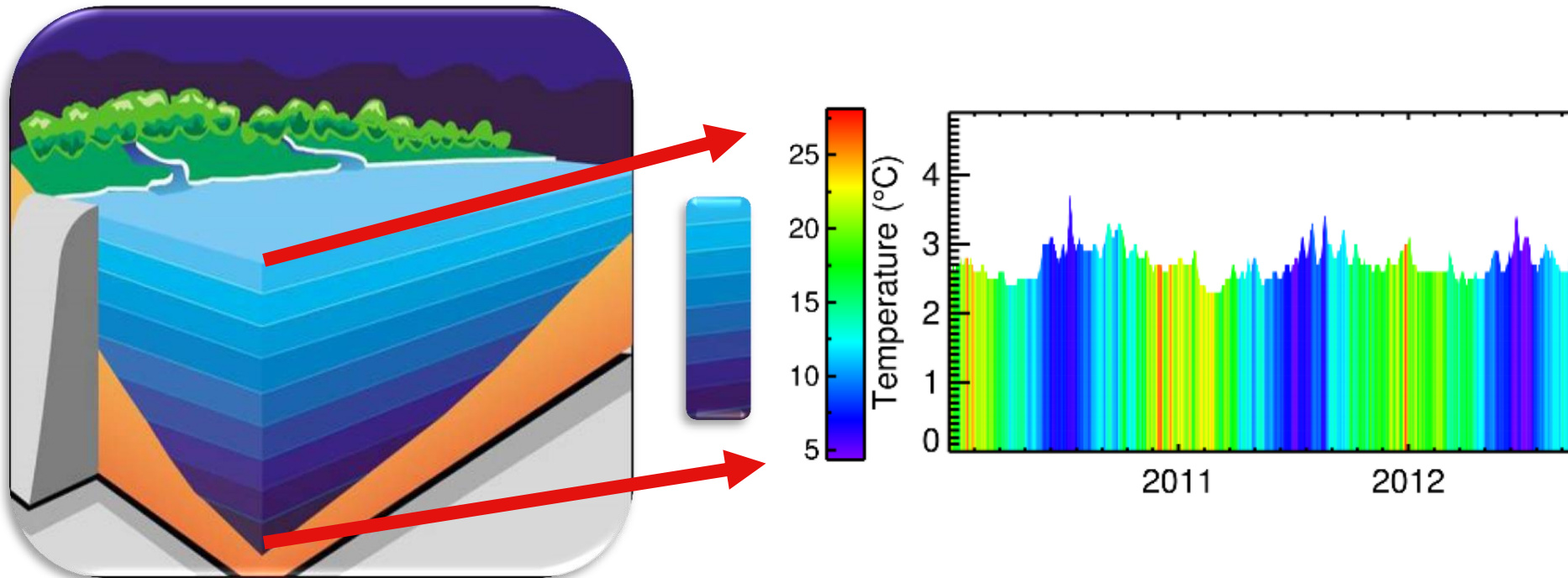
Bacteria do not grow in the lake;

Bacteria have a constant settling rate and mortality rate

Hydrodynamic and thermodynamic models in order to predict velocity, salinity and temperature in waterbodies



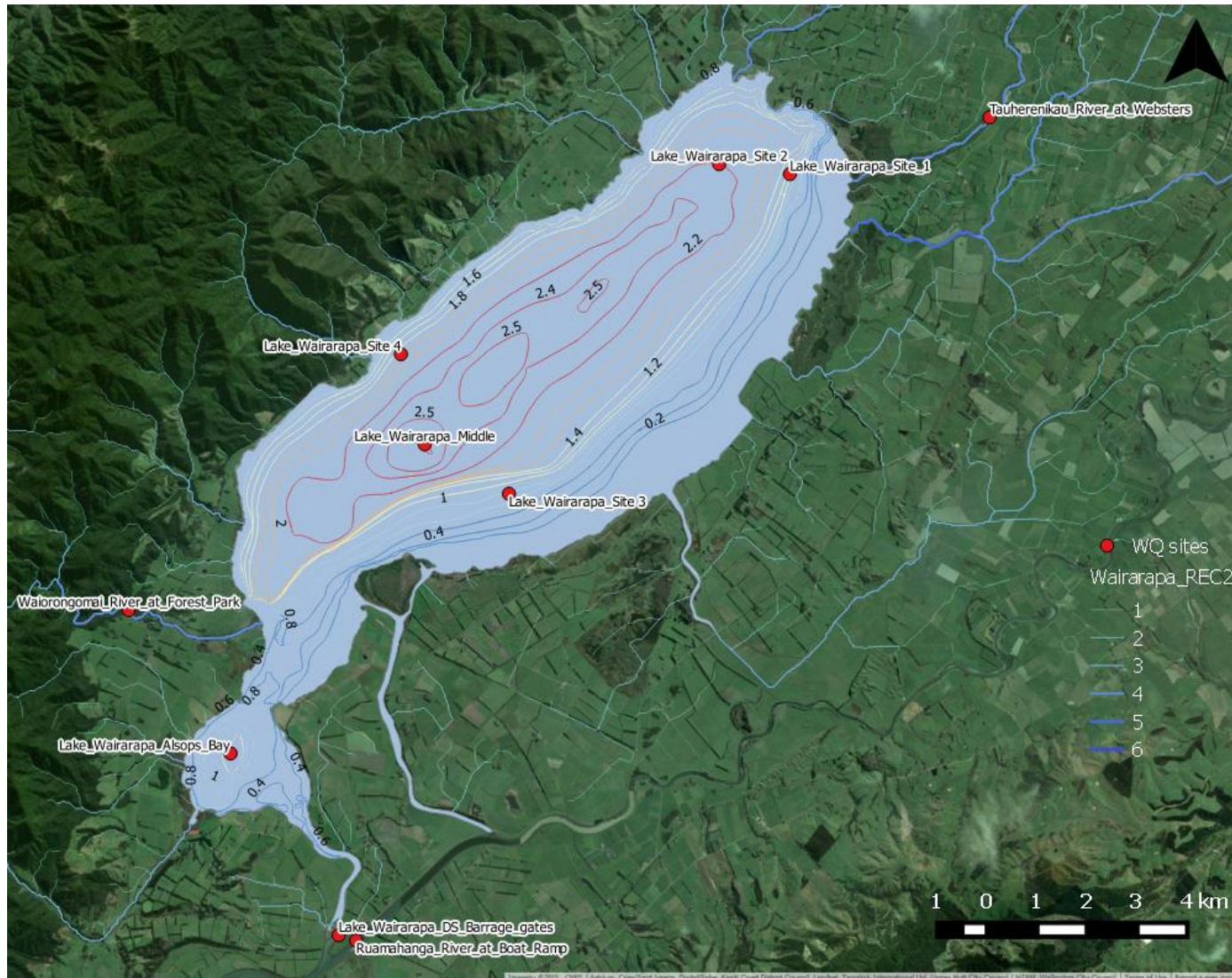
Hydrodynamic and thermodynamic models in order to predict velocity, salinity and temperature in waterbodies



Reporting points – Lake Onoke



Reporting points – Lake Wairarapa

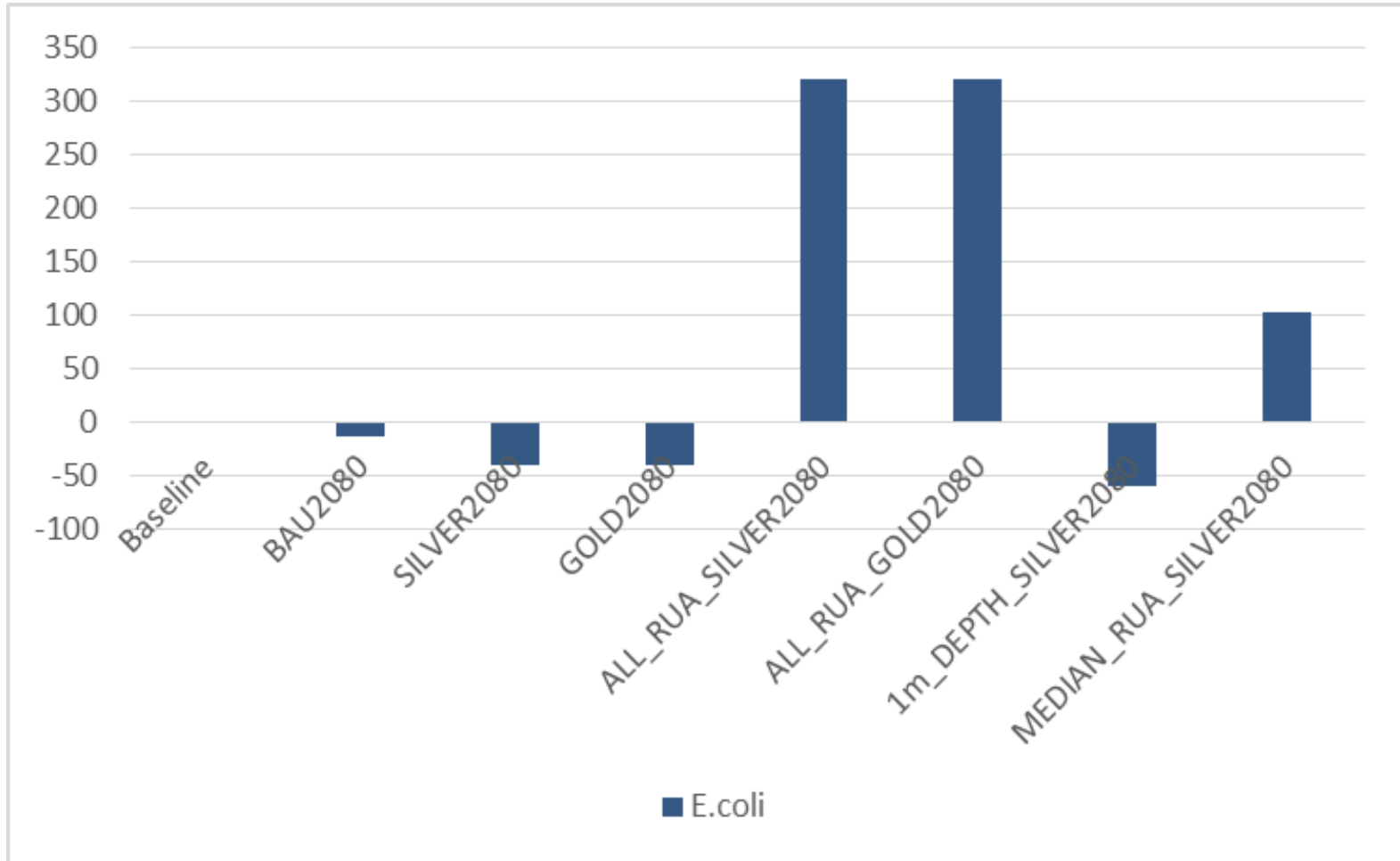


Scenarios – Lake specific

Lake specific modelling scenarios were run in addition to catchment scenarios. The Lake Wairarapa specific scenarios included: Modelling shorthand naming conventions	Description
ALL_RUA_SILVER2025/2040/2080 ALL_RUA GOLD2025/2040/2080	All flows of the Ruamāhanga River entering Lake Wairarapa. No flow by-passing via the diversion.
MEDIAN_RUA_SILVER2025/2040/2080	Flows below median flow go into Lake Wairarapa, and flows above median flow are by-passed
Outlet_Close_SILVER2025/2040/2080, Outlet_Close_Rua_All_SILVER2025/2040/2080	Lake Onoke outlet closed January to March every year. Lake Onoke outlet closed Jan to Mar, all Ruamahanga flows diverted into Lake Wairarapa before entering Onoke
1m_Inc_SILVER2025/2040/2080	Deepening both lakes by 1m

Wairarapa 1-D outputs

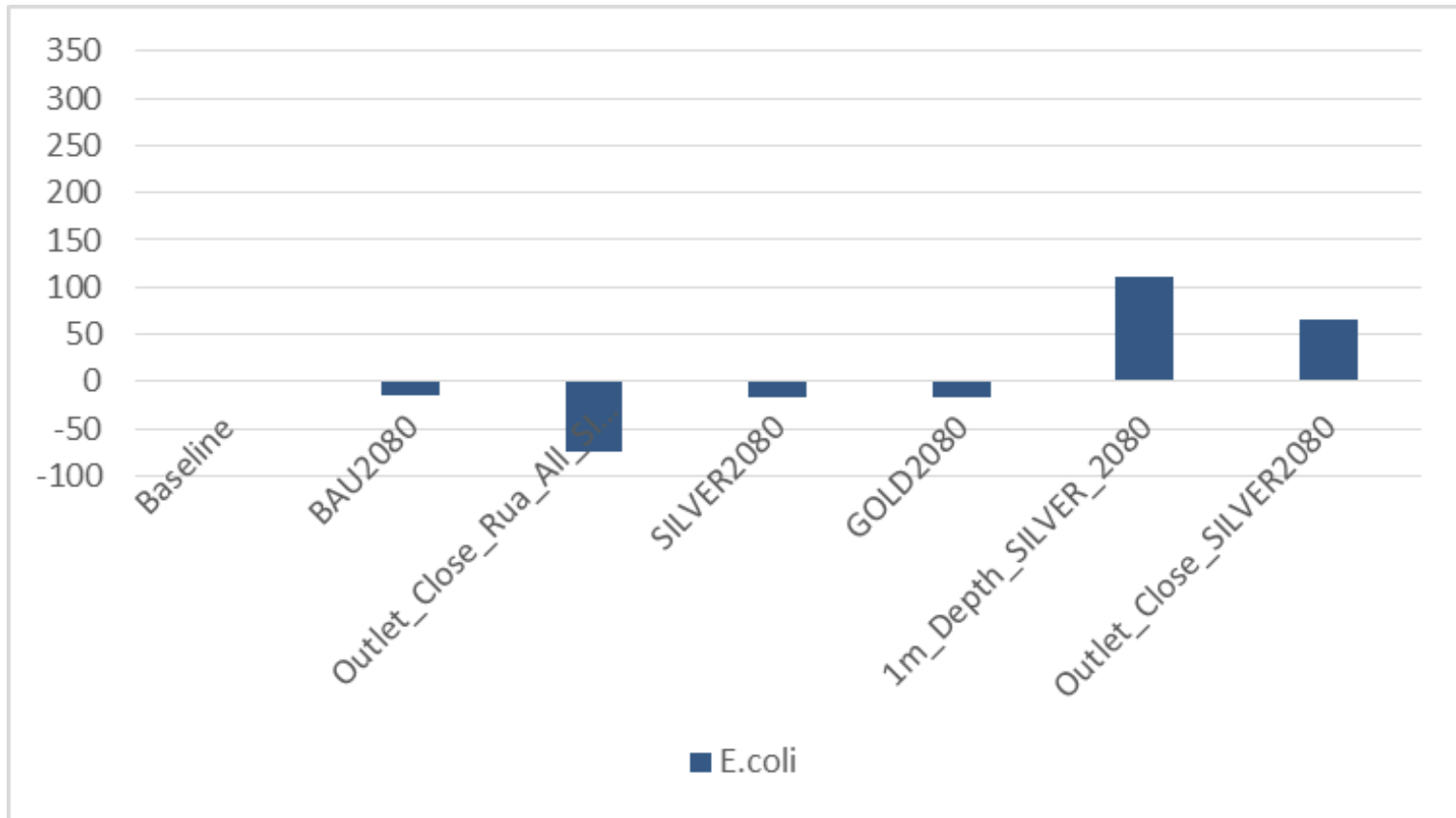
The 1-D simulated percentage change in *E.coli* concentrations in Lake Wairarapa comparing Baseline to 2080 scenarios.



- Catchment mitigation scenarios show small reduction in *E. coli* (0.8% for GOLD2080)
- Median concentration very low (less than 1CFU – for all scenarios)
- Diversion scenario shows large % increase in *E. coli* (321%)
- Still excellent swimmability but 3-D simulation shows hotspots...

Onoke 1-D outputs

The 1-D simulated percentage change in *E.coli* concentrations in Lake Onoke comparing Baseline to 2080 scenarios.



- Catchment loads reduced by 19% for SILVER/GOLD2080 – 16% reduction in median *E. coli* in Lake Onoke
- Lake level and flow scenarios show – increased *E. coli* conc
- Median conc changes were small (<1CFU)
- Large changes result primarily from changes in currents and *E. coli* transport which changes the length of time bacteria spend in each location

NPS swimming

Category	Percentage of Exceedances over 540 cfu/100 mL	Median E.coli per 100 mL	95 th percentile E.coli per 100 mL	Percentage of exceedances above 260 cfu/100 mL
Blue (Excellent)	< 5 percent	≤ 130	≤ 540	< 20 percent
Green (Good)	5–10 percent	≤ 130	≤ 1,000	20–30 percent
Yellow (Fair)	10–20 percent	≤ 130	≤ 1,200	20–34 percent
Orange (Intermittent)	20–30 percent	> 130	> 1,200	> 34 percent
Red (Poor)	> 30 percent	> 260	> 1,200	>50 percent

- Blue to Yellow- Suitable for primary contact recreation (swimming)
- Red and Orange- Generally unsuitable for swimming

Key changes between scenarios- 3-D



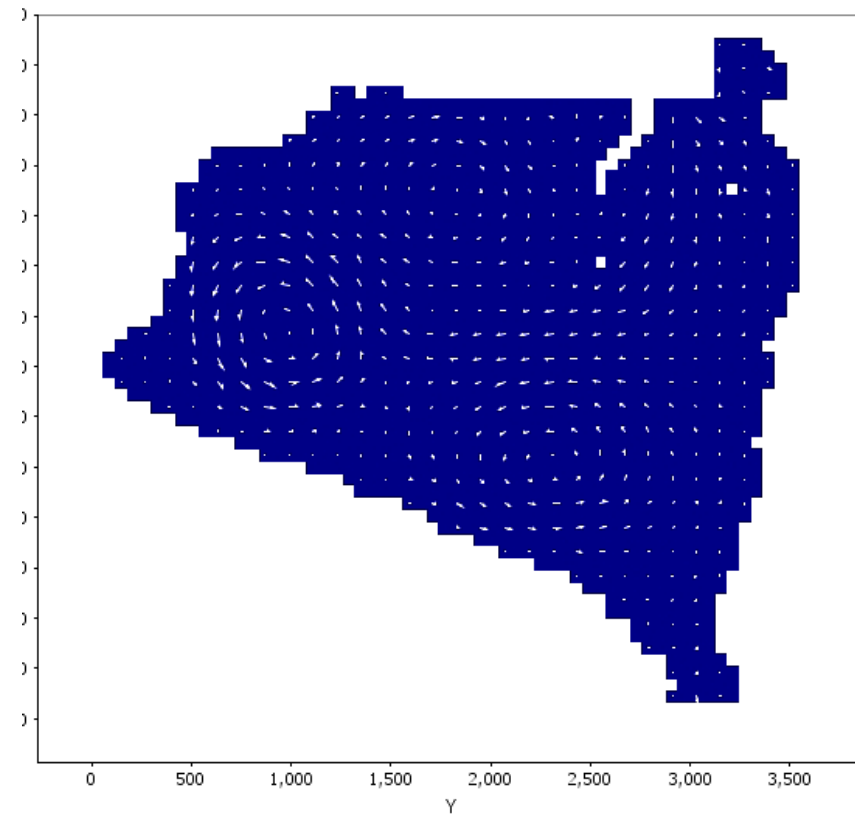
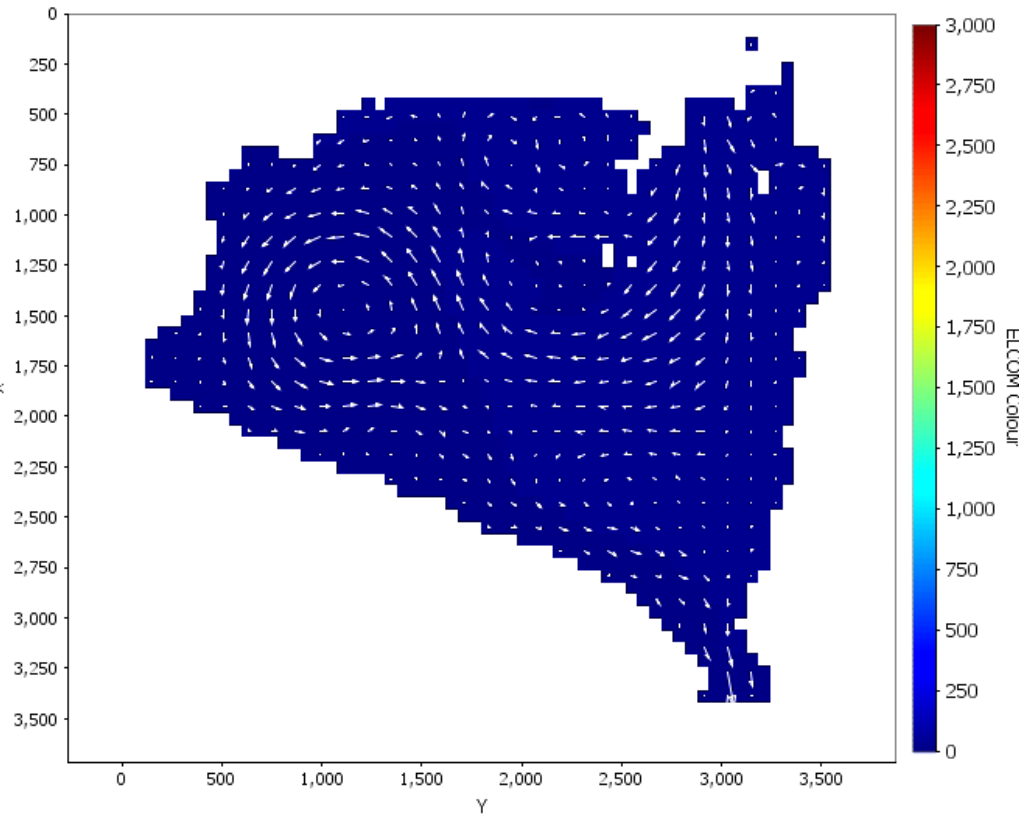
Site	Baseline	BAU2080	SILVER2080	GOLD2080	1m depth increase_SILVER2080	Outlet_close_SILVER2080	Outlet_close_RUA_SILVER2080	ALL_RUA_SILVER2080	MEDIAN_RUA_SILVER2080
Onoke S1	B	B	B	B	B	B	A		
Onoke Middle	B	B	B	B	D	B	A		
Onoke Deep	C	C	C	C	B	B	A		
Wai S2	A	A	A	A	A			A	A
Wai Middle	A	A	A	A	A			A	A
Wai Alsops	A	A	A	A	A			A	A
Wai Outlet	A	A	A	A	A			A	A

Baseline2080

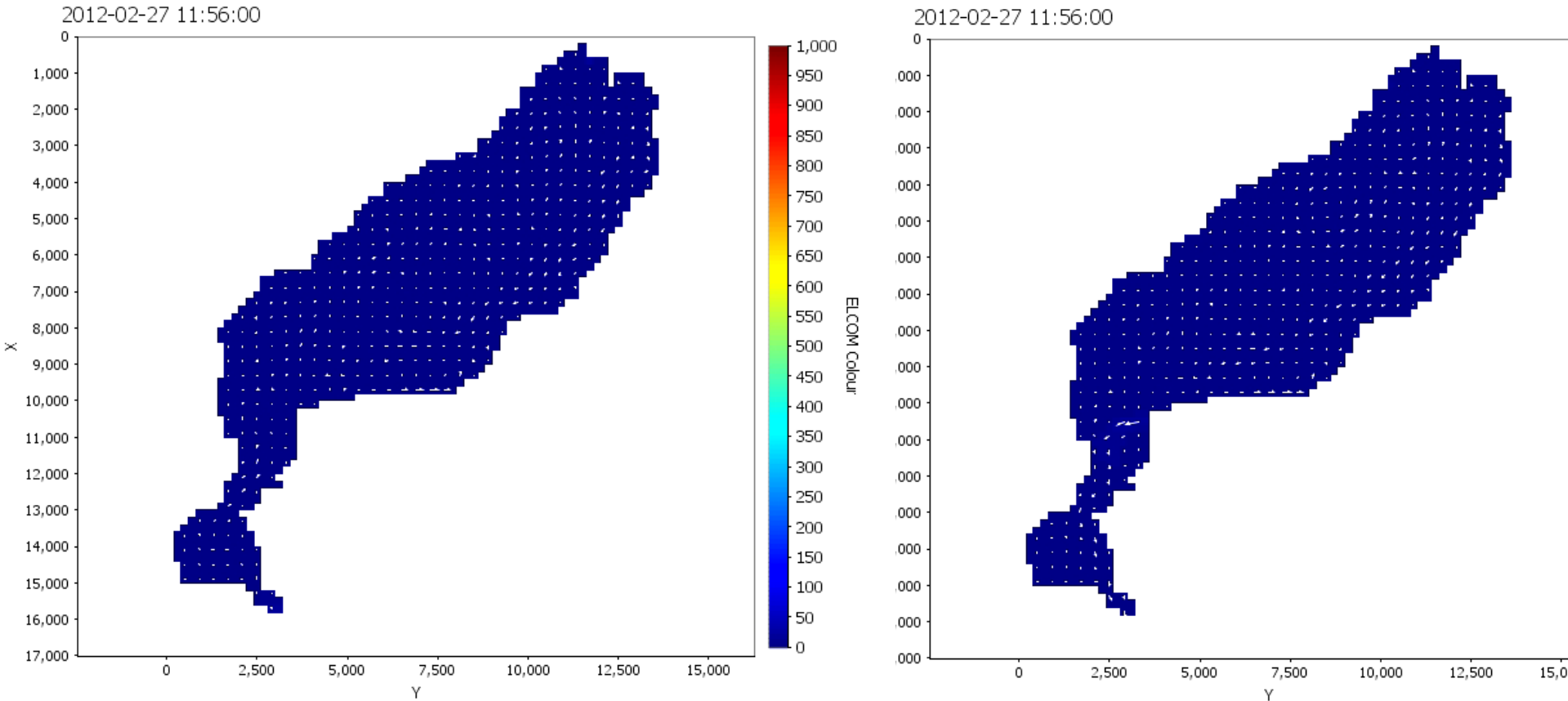
Outlet closed SILVER2080

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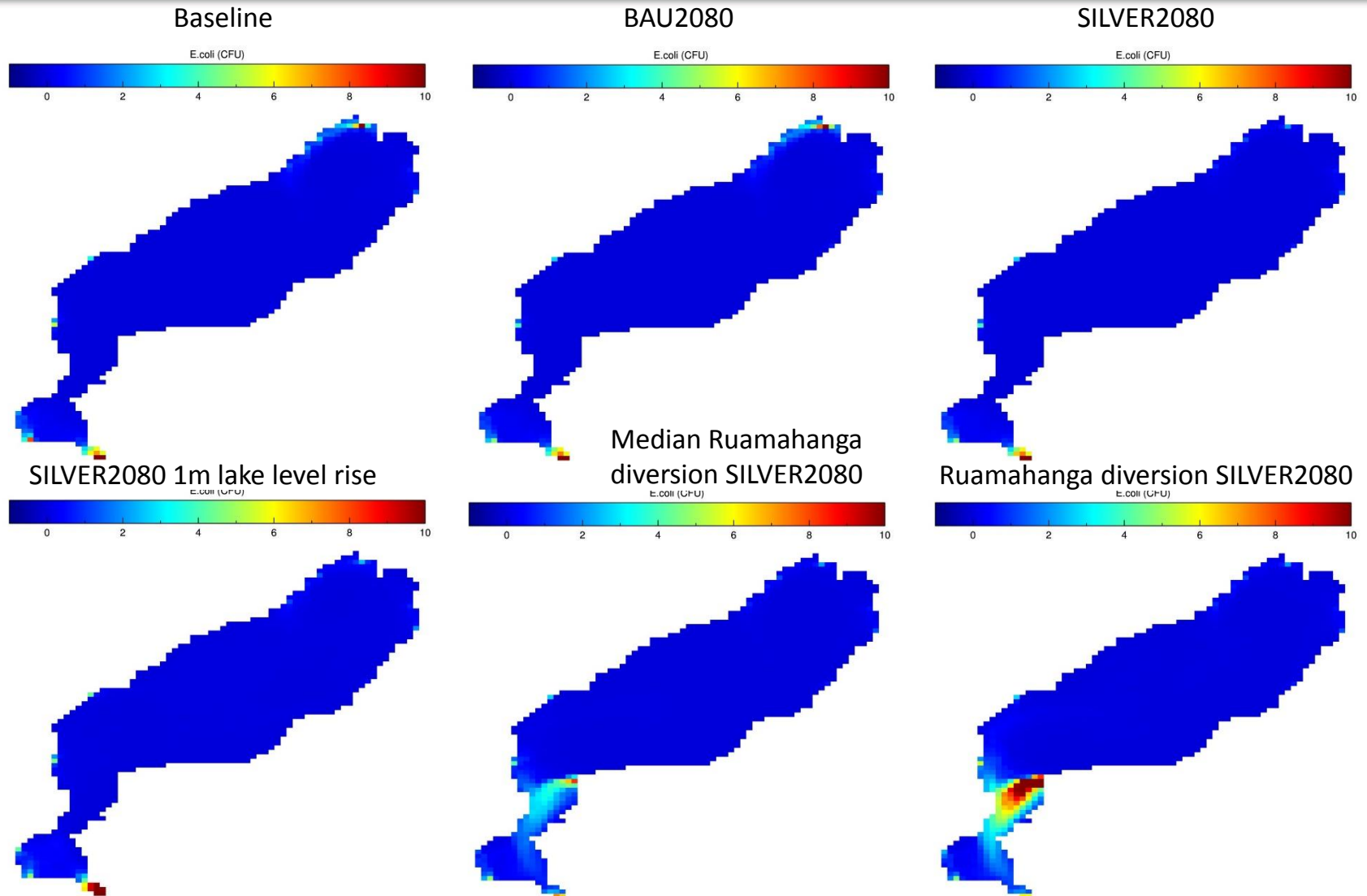
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3-D movies



3-D simulation results –Lake Wairarapa

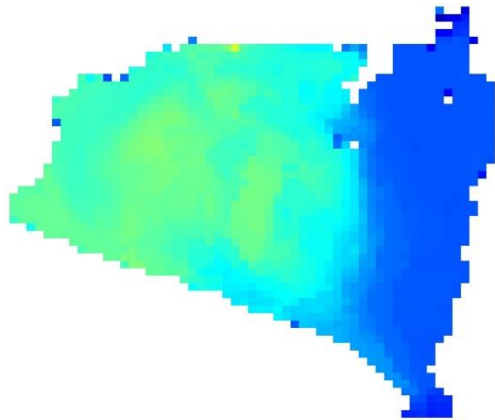
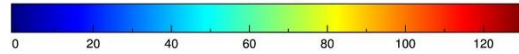


3-D simulation results –Lake Onoke



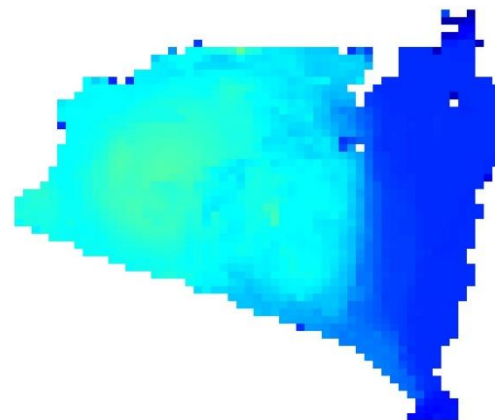
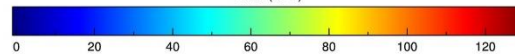
Baseline

E.coli (CFU)



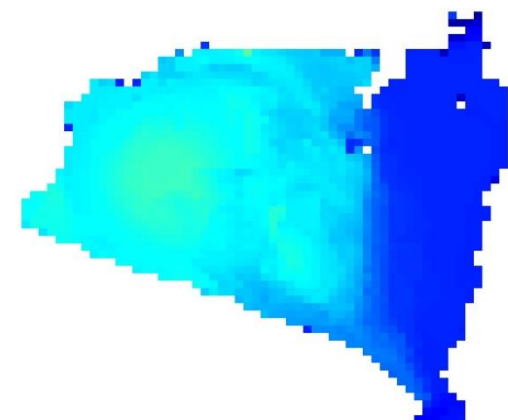
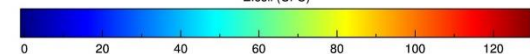
BAU2080

E.coli (CFU)



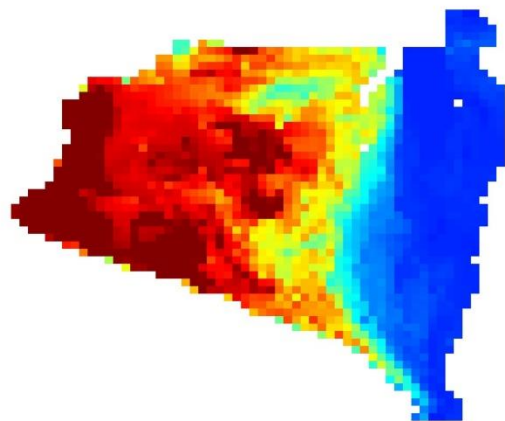
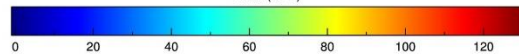
SILVER2080

E.coli (CFU)



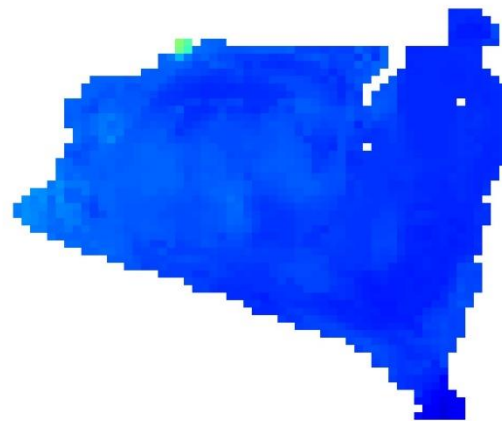
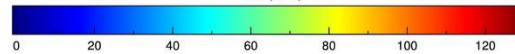
SILVER2080 1m increase

E.coli (CFU)



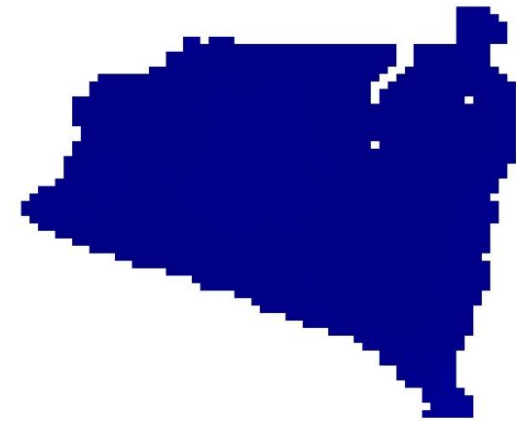
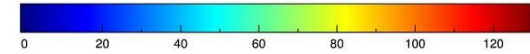
SILVER2080 outlet closed

E.coli (CFU)



SILVER2080 outlet closed Rua. diversion

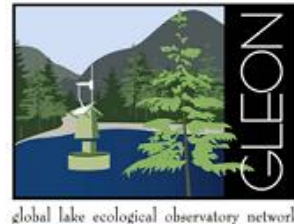
E.coli (CFU)



- Lake Wairarapa catchment scenarios show small reduction in *E. coli* inflow loads (0.8% for gold 2028) – show no shift in NOF bands
- Lake Onoke catchment scenarios show 19% reduction in *E. coli* inflow loads (GOLD 2080) – show no shift in NOF bands
- Flow diversion scenarios greatly increased *E. coli* in Lake Wairarapa (no shift in NOF bands)
- Diversion of Ruāmahanga results in shift in NOF bands in Onoke to “Excellent”, due to high mortality while flowing through Lake Wairarapa
- Lake Onoke circulation effects *E. coli*

Acknowledgements

- Greater Wellington Regional Council staff
- Ruamāhanga Whaitua Committee
- Chris McBride (UOW)



**Ministry of Business,
Innovation & Employment**

Landsat estimated total suspended solids

