STAFF REPORT

TO: Environment & Planning Committee

FROM: Trevor James, Resource Scientist

REFERENCE: W416, R07006

SUBJECT: **TEMPERATURE EFFECTS IN RESERVOIR CREEK - REPORT EP07/08/16** - Report prepared for meeting of 23 August 2007

(Note: If Councillors wish to see a full copy of this report (23 pages) please contact Trevor James).

1. INTRODUCTION

High stream temperatures are well known to cause adverse effects on a range of stream life. The scale of effect is described in Figure 1.

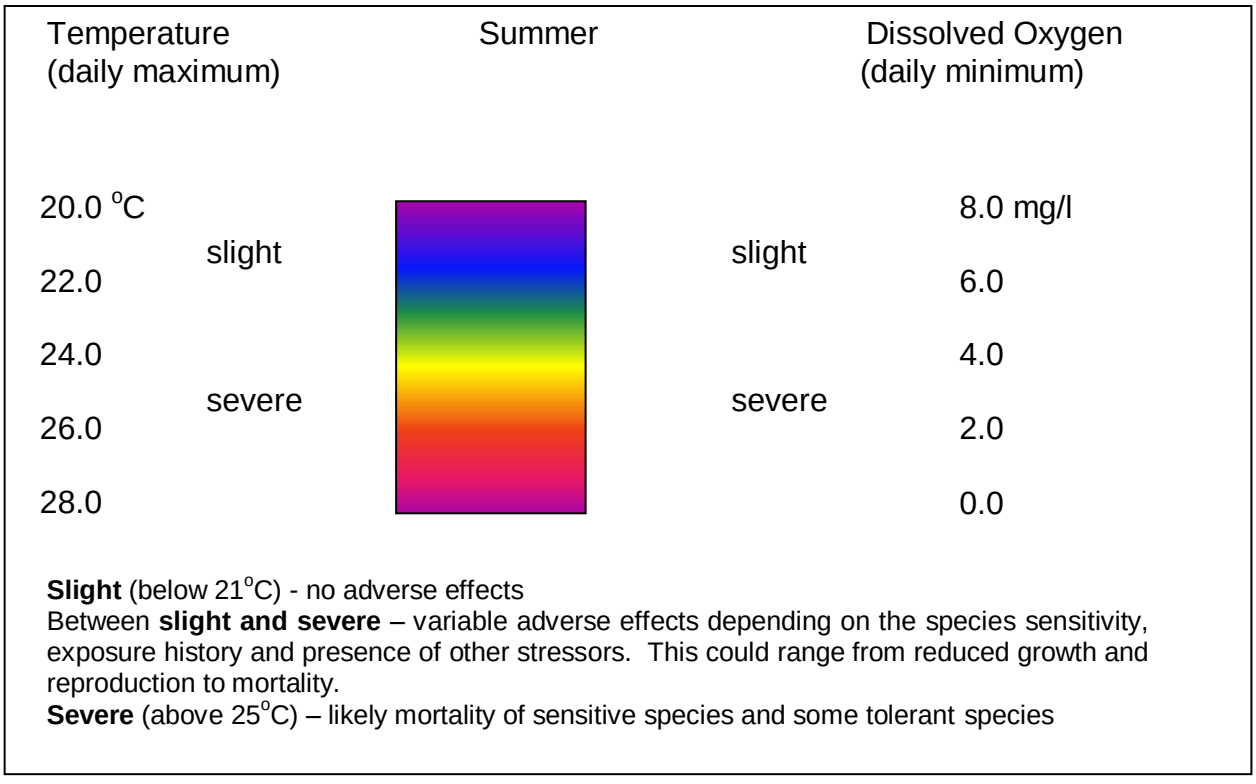


Figure 1: The effects of high water temperature and lower dissolved oxygen (taken from published literature).

Warm stream temperatures have been found in many un-shaded small streams in parts of the district. Occasional warm temperatures had been recorded in Reservoir Creek as a result of 'State of the Environment' Monitoring since 2000 but as these data are only collected quarterly, it is insufficient to conclude if there are temperature issues in the creek. Semi-continuous monitoring is required for this. Initial deployment of temperature loggers found there was an issue and subsequent deployments confirmed the main areas of concern.

2. METHODS

Inexpensive temperature loggers were deployed in 2004-2005 summer at two sites and then in the following two summers at three further sites.

3. RESULTS AND DISCUSSION

Reservoir Creek

Acceptable water temperatures were found in the upstream sites where the stream enters the urban area. Very high stream temperatures were found in the mid and lower sections of the creek, particularly where there was limited shading of the stream. The temperature (mid-point of daily maximum and daily mean) increased 6^{o}C in the section of waterway between Hill Street and Templemore Drive (see Figure 2). The increase due to Templemore Ponds was 1.5^{o}C. Similar numbers of days with very high stream temperatures occurred at the lower sites over the three summers of monitoring.

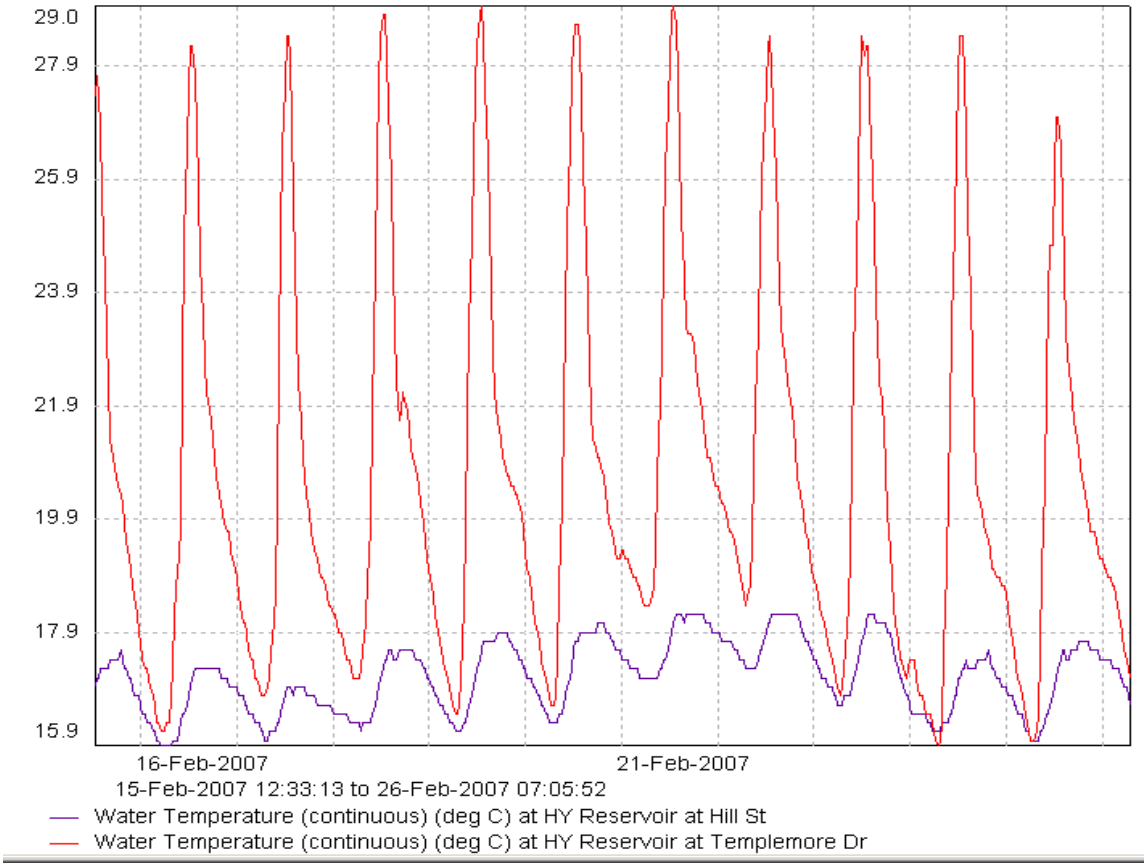


Figure 2: Over-plot of water temperature from Hill Street (pink) and Templemore Drive (red) sites 16-26 February, 2007.

These results show that the highest priority for shading of Reservoir Creek is in the middle reach. It is possible that there is a warm discharge, such as stormwater, somewhere in this reach which may be exasibating the temperature increase. It is recognized that stream works are required for approximately 100 metres upstream of Templemore Drive to increase flood flow capacity according to engineering estimates and it will not be possible to do any planting in this area until such time as an additional strip of land is purchased to enable widening the creek. This will have implications for the recovery of the creek's aquatic habitat.

The diversity and abundance of invertebrates in Reservoir Creek is much lower than expected at Tasman District Council's 'State of the Environment' monitoring site at Salisbury Road compared to the Marlborough Crescent (upstream) site. Macro-invertebrate Community Index (MCI) values are typically 70-90 at Salisbury Road and 100-120 at Marlborough Crescent. Although there are elevated nutrient (particularly nitrogen) and disease-causing organism concentrations, these are not at levels that, on their own, could cause such an adverse effect on the invertebrate population.

Stream Temperature Issues Across the Region

Stream temperature is likely to be a widespread issue in Tasman, particularly in smaller, unshaded waterways in the sunniest parts of the region. This includes Waimea, Moutere, Motueka and parts of Golden Bay. Spot measurements at many sites in the 'State of the Environment' Surface Water Quality Monitoring Programme as well as semi-continuous data from many sites have provided good evidence that high water temperatures are a significant issue throughout much of the region. These sites include the Motupiko (and tributaries), Sherry, Little Sydney, WaiwheroPearse, and Motueka River (Young et al. 2005) and Powell Creek in the Motupipi River Catchment in Golden Bay (James, T, 2007 unpublished). Invertebrate metrics at many of these sites indicate lowered life-supporting capacity of streams affected by high temperatures.

Modelling of stream temperature across the Tasman District indicates little change in shade from historic to contemporary conditions for small streams in catchments that remain in indigenous forest, but in small streams that have lost their riparian cover, the estimated temperature may be up to 5 degrees higher than under historic conditions (Leathwick, Unpublished data 2005; Davies-Colley et al 1998 and unpublished; Theurer et al 1984). This model estimated water temperature in small forested streams in January to be close to, or slightly below, the January air temperature. While these estimates are based on a very well-founded physical model, they should be used only as a broad indication of likely changes in water temperature (see Appendix Two for the main model inputs and assumptions). We would expect them to be most reliable for small streams having consistent levels of shade, i.e., where there has been ample opportunity for the stream to reach an equilibrium condition. Therefore the model is very reliable in lowland streams of low gradient in agricultural landscapes.

The model seemed to predict the January mean temperatures very well. January mean present-day stream temperatures in lower Reservoir Creek were predicted by the model to be 20-21 ^{o}C (see Appendix 1), with mean temperatures found in this study being 20.5^{o}C. There was a similar good fit for the upper sites. The model predicted for Reservoir Creek increases in stream temperature above historic levels of 2-2.5^{o}C in the upper reaches (upstream Marlborough Crescent) in forestry land use and 3-3.5^{o}C in the lower reaches (downstream of Stillwater Creek) in urban land use. It would be useful if the model output could show the mid-point between the daily mean and daily maxima.

The Tadmor and Sherry Rivers, which the model predicts to have mean January temperatures of 21-24 ^{o}C would be an obvious priority for further investigation.

Improving Stream Temperature

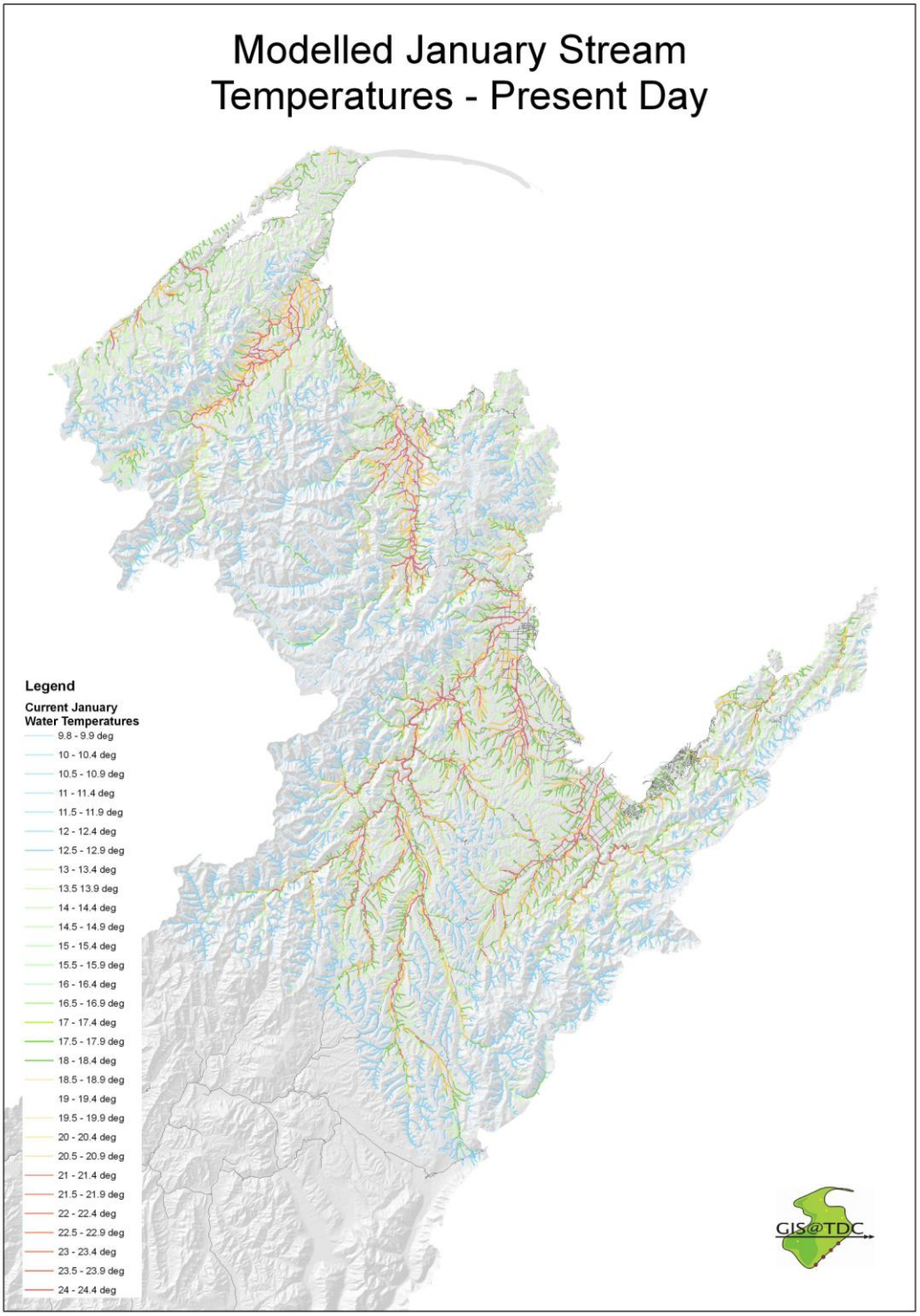
Planting stream-sides not only produces shade and controls water temperature but has many other benefits including providing food (leaves and insect rain), improved habitat for fish and invertebrates and filtering of contaminants from runoff from the adjacent land. Aquatic habitat is improved particularly by the presence of roots and woody debris that provide cover for fish and erosion then creates a variety of depth zones.

Tasman District Council's fencing fund helps rural landowners in the process of removing stock access from streams but does not provide plants for achieving good shade. Urban streams such as Reservoir Creek which will be the subject of a Sustainable Management Fund project will be planted by the Parks and Reserves Department.

4. RECOMMENDATION:

THAT Council receive the report entitled 'Temperature Effects in Reservoir Creek, 2007'.

Trevor James
Resource Scientist


Modelled January Stream Temperatures - Present Day
Legend
Current January Water Temperatures
9.8 - 9.9 deg
10 - 10.4 deg
10.5 - 10.9 deg
11 - 11.4 deg
11.5 - 11.9 deg
12 - 12.4 deg
12.5 - 12.9 deg
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