Water quality of Chum Creek, 2016
Report, November, 2017

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Summary

Chum Creek, a major tributary of the Watts River, joining it near Healesville, was sampled by Chum Creek Landcare volunteers at two locations regularly during 2016. Water quality parameters measured were – temperature, turbidity, pH, electrical conductivity, dissolved oxygen, and total coliforms. As the creek was observed to be highly turbid at times after rain, more intensive sampling of turbidity was undertaken during May, 2016.

Seasonal variations in the water quality parameters were found. This sampling of Chum Creek water quality was rather superficial, but it has suggested that Chum Creek water is generally not suitable for drinking within the section sampled. This is primarily from a turbidity and possibly also a biological perspective. There has been a major sediment source upstream of Blackwoods Rd. and turbidity levels rarely met the Australian drinking water guidelines. Total coliforms were usually present in the water, suggesting, although not conclusively, that the biological quality of the streamwater was questionable. Given the presence of a resident platypus population in the creek and the use of the creek by its residents, further sampling of the creek would be desirable to locate the sediment source(s) and determine whether or not there is a biological water quality problem.

Introduction

Chum Creek Landcare received a grant from Melbourne Water, whom we thank, to purchase some simple instruments to measure the physical, chemical, and biological quality of Chum Creek, which is a major tributary of the Watts River, joining it near Healesville. Two sampling sites were selected, based on those who volunteered to participate in the sampling. One site was just downstream of the junction of Heath, Old Chum Creek, and Chum Creek roads where Chum Creek flows through 762 Chum Creek Rd. (X1 in Figure 1), and the other was just upstream of the Yumbunga dam where Chum Creek flows through 420 Chum Creek Rd (X2 in Figure 1). The distance between the 2 sampling locations is approximately 3 km. Both sites are in the middle section (mixed forest and agriculture) of Chum Creek.

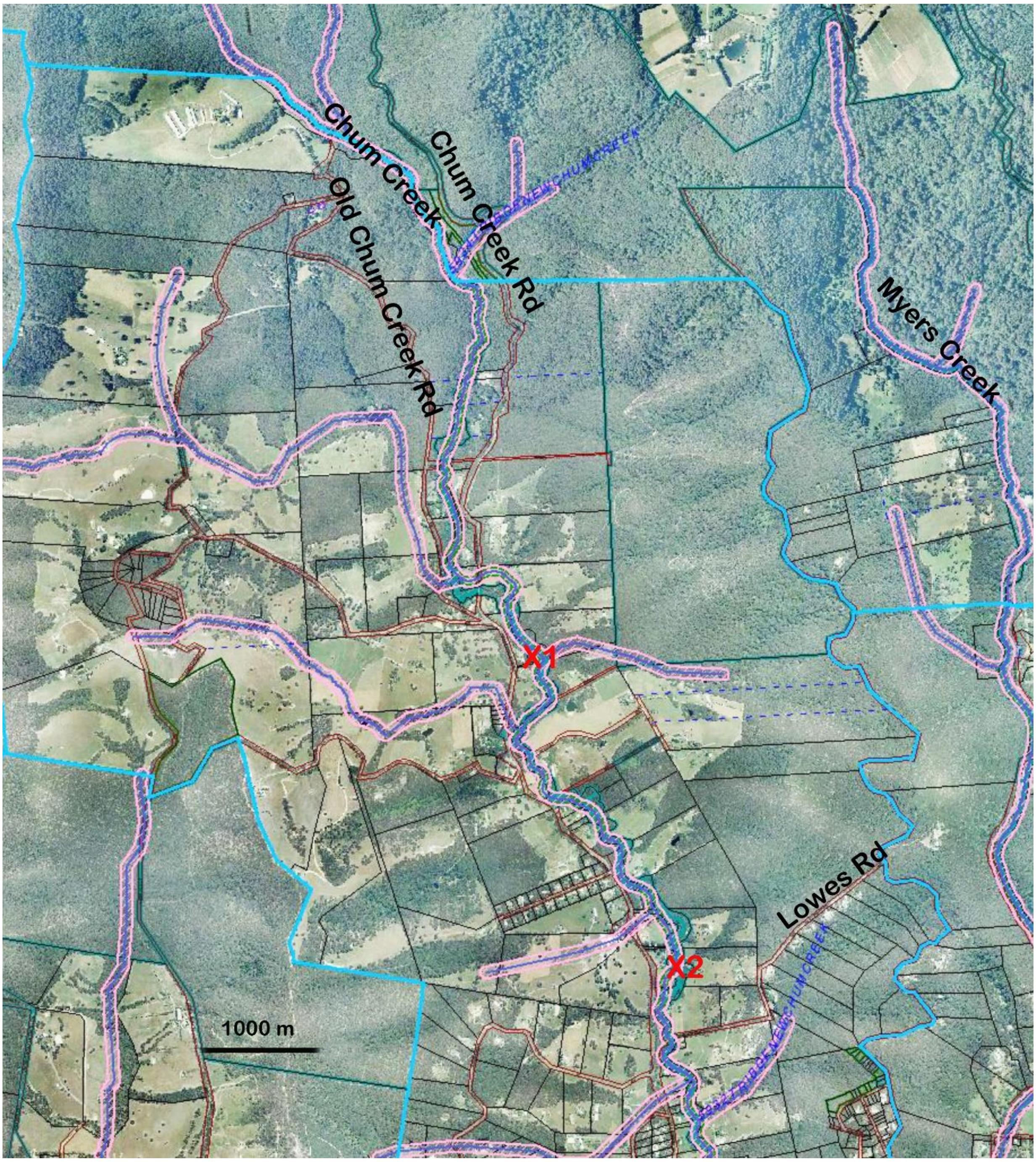

Figure 1. Location of the sampling sites on Chum Creek. Sites are X1 and X2.

Sampling methods

Sampling was conducted by Beth and Ken Bagley and Michael Feller at both locations slightly more than once a month for the 2016 year (13 samples from each sampling site for the year). Water quality parameters measured were –

Physical –

- Temperature (^{o}C) – measured using the temperature sensor in a Horiba Scientific LAQuAtwin compact conductivity meter EC22, as well as a Fisher Scientific digital thermometer;
- turbidity (index of the amount of sediment measured as NTU) – measured using a turbidity tube checked by also using an Analyte model 156 nephelometer.

Chemical –

- pH (acidity) – measured using Macherey-Nagel pH colour strips;
- electrical conductivity (quantity of dissolved chemical ions measured as microS/cm at 25 ^{o}C using a Horiba Scientific LAQuAtwin compact conductivity meter EC22 with conductivity and temperature sensors;
- dissolved oxygen – measured as mg/L using a Chemets Dissolved Oxygen K7512 kit using the Indigo Carmine method.

Biological –

- Total coliforms (present or absent) measured using Testkits bacteria (coliforms) test kits MUG/S.

Sampling was conducted at the same locations at each of the two properties during 2016 on January 6, February 3, March 3, April 8, May 8, May 31, June 27, July 28, August 22, October 9, November 4, November 30, and December 29. Sampling occurred at the downstream site (420 Chum Creek Rd. or X2) approximately 0.5 – 1.0 hour after sampling occurred at the upstream site (762 Chum Creek Rd.) so that approximately the same body of water was sampled at both sites, minimising potential differences due to different bodies of water being sampled.

As the creek was observed to be highly turbid at times after rain, more intensive sampling of turbidity was undertaken on 17 days in May, 2016 to assess how accurately the approximately once-a-month sampling represented turbidity in the creek over a longer time interval. Sampling was also conducted on May 11 at 7 different locations along an approximately 4.7 km section of the creek (Figure 2) to assess longitudinal variation in turbidity. This sampling followed two days when 26 mm of rain fell at 420 Chum Creek Rd. All these turbidity measurements were made using the Analyte nephelometer.

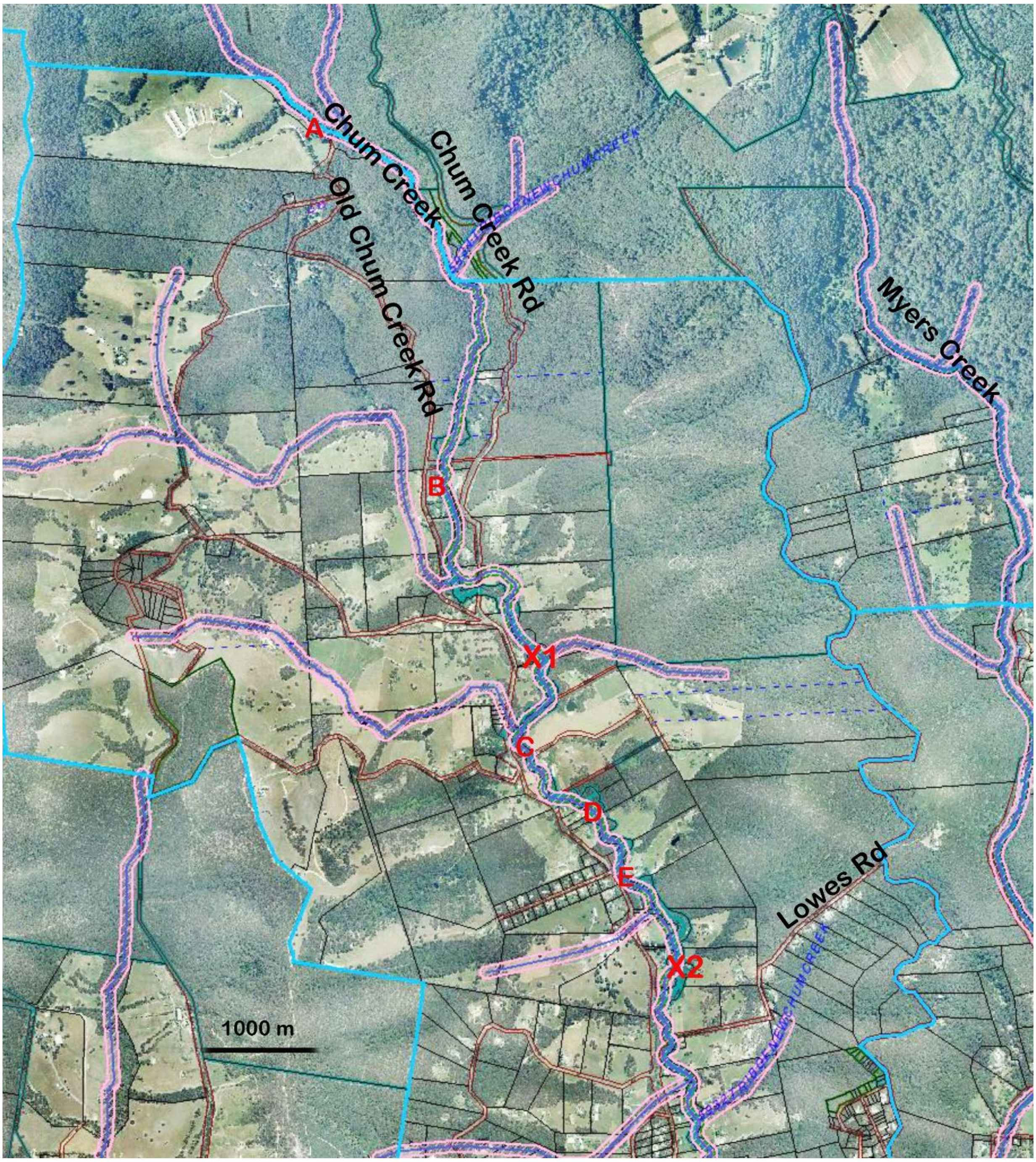

Figure 2. Location of the extended sampling sites for turbidity on Chum Creek. Sites are A – E and X1 and X2. Sites are: A – Old Chum Creek Rd. crossing of Chum Creek; B – CFA water collection point on Old Chum Creek Rd., C – Rogers Rd. crossing of Chum Creek: D – 656 Chum Creek Rd.; E – Blackwoods Rd. crossing of Chum Creek.

Results

Results are given in Figures 3 and 4.

Chum Creek **temperature** varied between ~22^{o} in summer to ~6^{o} in winter, reflecting differences in air temperature and solar radiation inputs, the latter being probably the dominant influence on creek temperature.

Dissolved oxygen is generally the inverse of creek temperature, being higher in winter and lower in summer as found at site X2. Lower water temperatures, allowing more oxygen to dissolve in the creek, and higher streamflows leading to more turbulence and more mixing of air (containing oxygen) with creek water explain the higher concentrations in winter. Site X1 is close to areas of turbulence in the creek (rocks and woody debris in the creek) perhaps explaining the lack of a major decrease in concentrations during the early part of the 2016-2017 summer. Critical levels for aquatic life (below 4-5 mg/L) may be reached during low flow periods in late summer.

pH or acidity levels displayed no obvious trends, ranging between 6.8 and 7.5, within the acceptable range for human drinking water and aquatic life.

Electrical conductivity measures the total amount of dissolved ionic chemicals in the stream and shows peaks in winter with lower levels in summer. This is probably a result of the products of decomposition during the summer sitting around until they are flushed into the creek by winter rains. Lighter rainfalls and soils rich in clay, which tend to hold on to ionic chemicals to a greater extent than sandy soils, could explain the continually higher chemical concentrations throughout the winter. Electrical conductivity values are generally higher than in Melbourne's tap water, but lower than in saline areas, indicating elevated chemical inputs, but not extremely elevated. Previous sampling and chemical analysis of Chum Creek water by M. Feller during 2003 – 2009 indicated that its electrical conductivity was most strongly and highly significantly correlated ($P<0.0001$) with concentrations of Na, Cl, K, Mg, SO_4, and Ca ($r = 0.82$, 0.71, 0.67, 0.61, 0.43, and 0.43, respectively), suggesting that some saline input into Chum Creek may be occurring. However, during surveys of the health of Chum Creek it was observed that a large pile of horse manure was placed immediately adjacent to the creek on one property and domestic animals accessed the creek on several properties, possibly accounting for some of the chemical inputs. Significant correlations between electrical conductivity and organic-N concentrations ($r = 0.17$, $P< 0.05$) and NH_4 concentrations ($r = 0.36$, $P<0.0001$) are consistent with this. However, all these correlations were calculated from measurements made several years before the Chum Creek health surveys, so their relevance to the current situation is unknown.

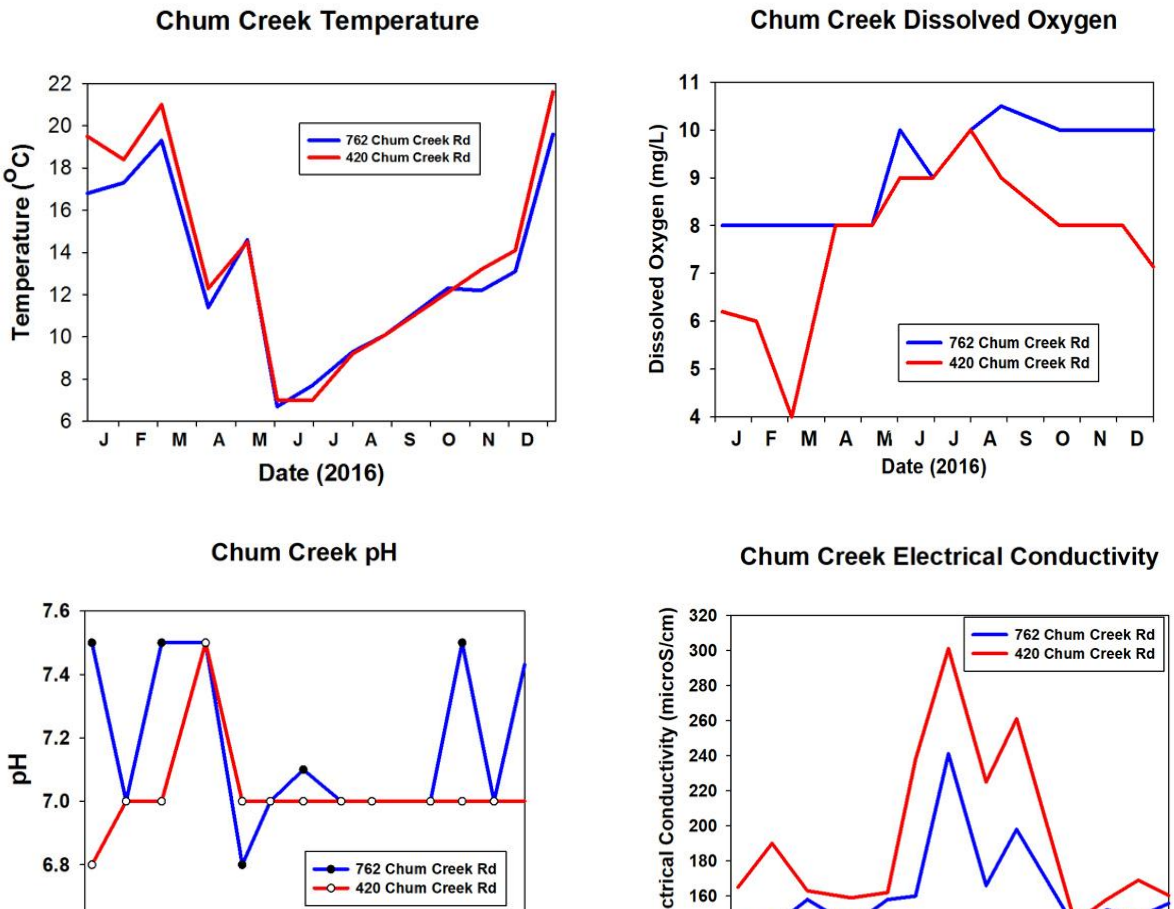

Figure 3. Temperature, dissolved oxygen concentrations, pH, and electrical conductivity of Chum Creek on sampling days during 2016.

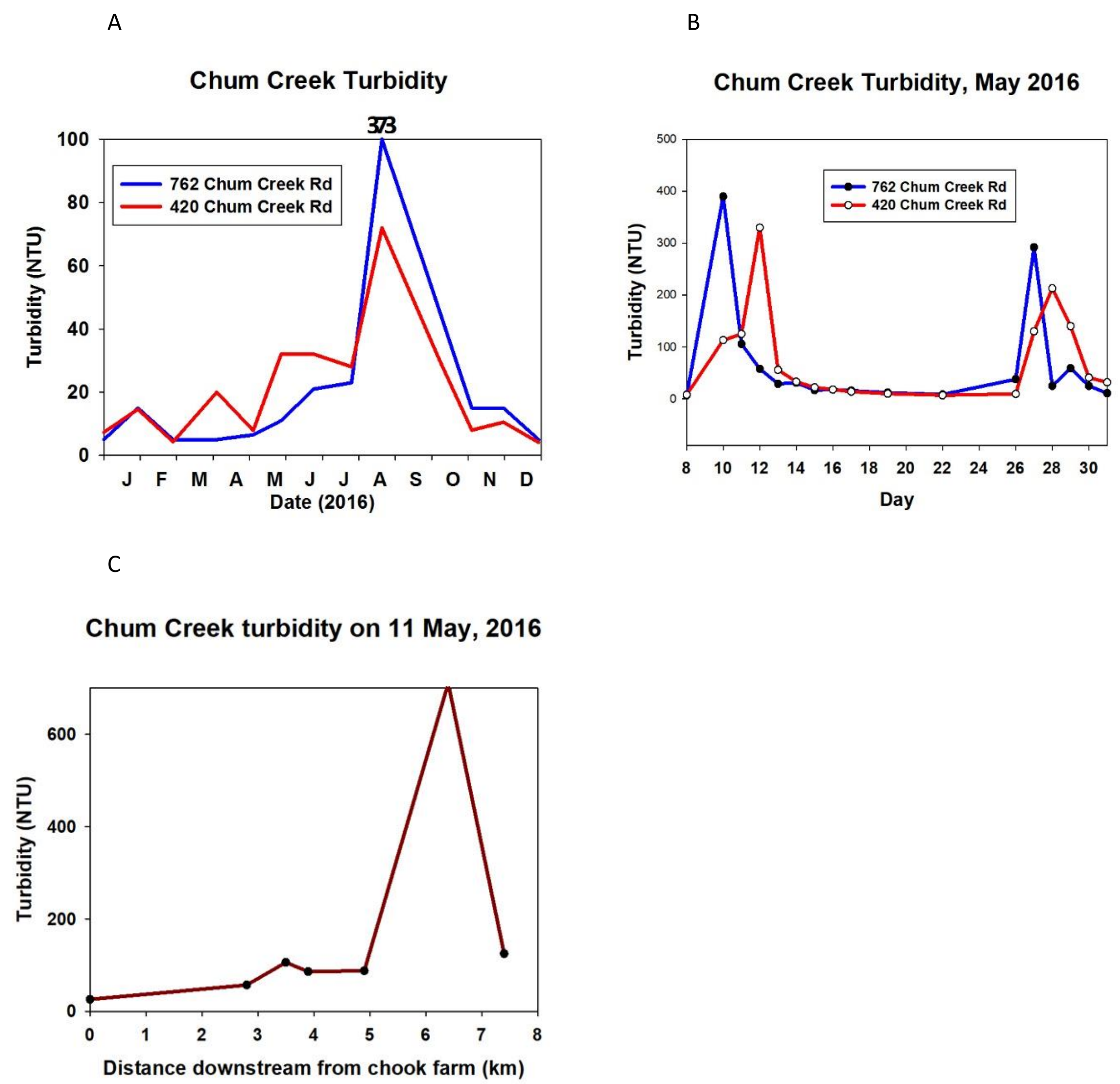

Figure 4. Turbidity of Chum Creek on sampling days during 2016.

Turbidity (sediment content) of Chum Creek from regular monthly sampling (Figure 4A) showed a maximum value (373 NTU) during late winter with winter values generally higher than summer values. This can be attributed to greater rainfall during winter washing sediment into the creek as well as higher winter flows scouring sediment from the streambed and streambanks. Chum Creek was observed to be highly turbid on days when sampling did not occur, and more frequent measurement during May, between the regular sampling days of May 8 and 31 (Figure 4B) suggested that turbidity was higher than on the regular sampling days on every sampling day except one at 762 Chum Creek Rd., and every sampling day except six at 420 Chum Creek Rd. This indicates that infrequent (once per month) sampling can give a poor indication of the turbidity regime of Chum Creek, suggesting frequent measurements are necessary to properly characterise the creek's turbidity regime. Thus, the number of measurements necessary to estimate the mean turbidity of Chum Creek for May, 2016, with a very wide level of uncertainty of 20 NTU with 90% confidence, would be approximately 40 for 420 Chum Creek Rd. and 70 for 762 Chum Creek Rd. (using calculations from Eaton et al. 1995).

Turbidity can also vary very widely along the length of Chum Creek sampled, as indicated in Figure 4C. The highest turbidity measured anywhere in Chum Creek during 2016 was 710 NTU at site E (Blackwoods Rd.), measured on May 11. This occurred after 26 mm rain fell in 2 days at 420 Chum Creek Rd. (9-10 May) with one intense fall of ~ 15 mm. The next highest turbidity (600 NTU – data not shown) was also measured at site E on May 27 after generally low intensity rain of 16 mm rain on May 25 then 12 mm rain on May 26 at 420 Chum Creek Rd.

It is noteworthy that only two turbidity measurements anywhere on Chum Creek during 2016 met the drinking water guideline of 5 NTU for Australia (NHMRC, NRMMC 2011). These measurements were 4.1 NTU (March 3) and 4.3 NTU (December 29) at site X2. Similar values may have also occurred at site X1, but the limited precision of the turbidity tube did not allow an accurate measurement at low turbidity levels. Most measurements (62 of the 64 measurements made with the nephelometer) exceeded the 5 NTU guideline. This suggests that from a turbidity perspective, Chum Creek water is rarely suitable for drinking.

The guideline by the Victorian EPA is a little less clear as it is 10 NTU for the Yarra River lowlands, but 5 NTU for highlands and forests (EPA Victoria 2004). Chum Creek at its confluence with Myers Creek would be intermediate between these two situations, although Melbourne Water uses the less strict 10 NTU for this location. Chum Creek where it was sampled by Chum Creek Landcare would appear to belong more to the highlands/forests category.

Coliform bacteria were found to be present at both sites X1 and X2 on all sampling days except in February, March, and May 8 when they were present at site X1 only, in May 31 when they were present at site X2 only, and April when they were not present at either site. Thus, coliform bacteria were present at site X1 or X2 on all sampling dates except April 8. This suggests that the biological quality of Chum Creek water, from a human drinking water perspective is questionable. Most coliform bacteria are not harmful to humans but the presence of total coliforms is a useful indicator of other pathogens which are harmful to humans. Consequently, the presence of total coliforms suggests, but not conclusively, that water is not suitable for human consumption.

Discussion

Further downstream on Chum Creek, close to where it is joined by it's tributary, Myers Creek, Melbourne Water has been sampling the creek and measuring various water quality parameters since 2008 (http://yarraandbay.vic.gov.au/report-card/yarra/YANEW0050#top_of_report). Based on six water quality parameters: nutrients (N and P), turbidity, dissolved oxygen, electrical conductivity (considered to be salinity), pH, and heavy metals (As, Cd, Cu, Cr, Ni, Pb, and Zn), Chum Creek water quality has been considered to be good overall since around 2010. Nitrogen concentrations and turbidity levels, however, have been relatively high and both are considered to rate as fair to very poor. Turbidities have usually exceeded the liberal 10 NTU level and have nearly always exceeded the 5 NTU level, consistent with the present work. Sampling by M. Feller near the Melbourne Water location in 2006 – 2008 found turbidity levels that were sometimes higher than upstream in the 2016 sampling area, suggesting that turbidity levels are problematic over much of the length of Chum Creek. Melbourne Water found electrical conductivity levels generally between 100 and 250 microS/cm, again consistent with the findings of the present upstream sampling. Melbourne Water's pH and dissolved oxygen levels, both indicating good water quality, were also consistent with the findings of the present upstream sampling.

Previous work for Chum Creek Landcare in surveys of the ecological health of the creek and its surrounding riparian vegetation (Barclay and Jeffs 2015, 2016, 2018) has obtained anecdotal evidence of a resident platypus population in Chum Creek. Locations where residents have seen platypus more than once in recent years are given in Figure 5. The presence of a resident platypus population, together with the presence of a human population which uses the creek, both argue in favour of maintaining high quality of Chum Creek water.

Conclusions

This sampling of Chum Creek water quality was rather superficial, but it has suggested that Chum Creek water quality is generally not suitable for drinking within the section sampled. This is primarily from a turbidity and possibly also from a biological perspective. There has been one or more major sediment sources upstream of Blackwoods Rd. It would be desirable to locate the sediment source(s) and determine whether or not there is a biological water quality problem. More intensive sampling, particularly of turbidity and bacteria, would also appear justified. This is because both are key water quality characteristics related to human health and turbidity is related to sediment levels which can impact aquatic invertebrates and animals, such as platypus, that depend on them. Sampling should be frequent enough to enable the monitoring to provide meaningful information. Sampling and analysis are required most frequently for microbial constituents, as even brief episodes of microbial contamination can lead to immediate illness in people and the particles that contribute to turbidity can contain

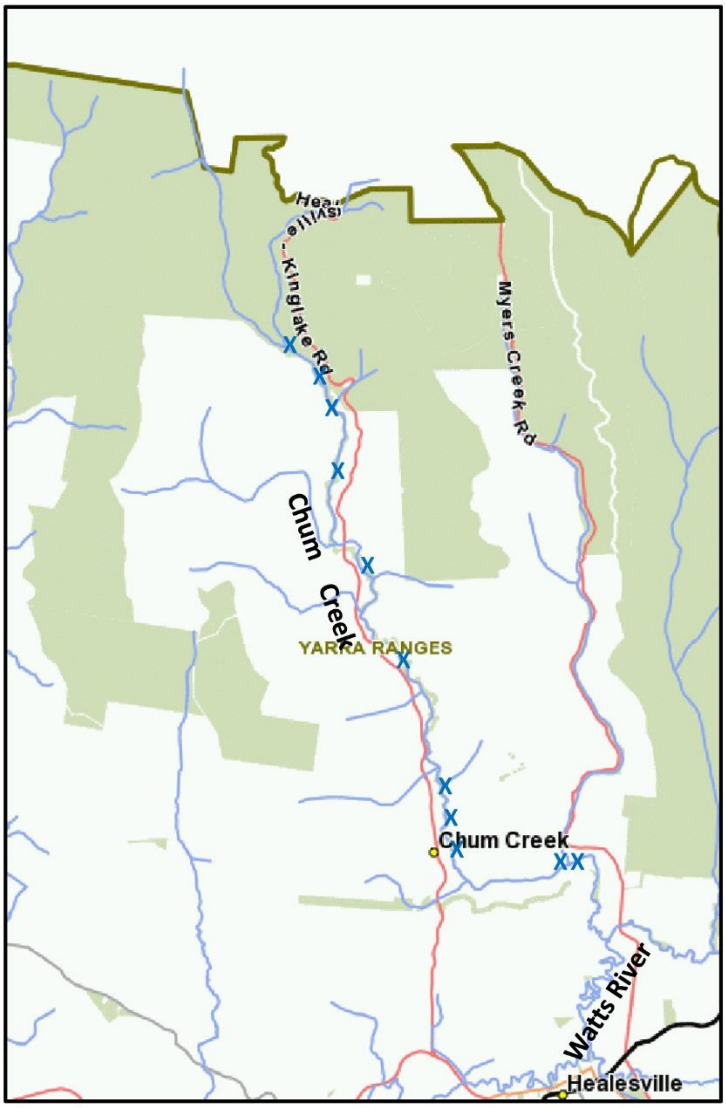

Figure 5. Approximate locations along Chum Creek where platypus have been sighted by local residents more than once in recent years. Locations are indicated by blue crosses.

pathogenic bacteria and effectively shield them from disinfectants used to purify water

References

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