Uncertainty of the non-point nutrient loadings estimates

• Available Flow Data

Flow Trent River = (Flow Healey Falls + Flow Crowe River) * 12,500/(9,090+1,990)

Basin Area of Trent River
Basin Area at Crowe River
Basin Area at Healey Falls

\[ R^2 = 0.974 \]
\[ \text{RMSE}=16.5 \text{ m s}^{-1} \]
Available Flow Data

Flow rates were adjusted to the difference between gauged drainage area and total drainage area.

Other un-gauged drainages were accounted for by calculating Wilton Creek Equivalents (Minns et al. 2004).
Uncertainty of the non-point nutrient loadings estimates

Available WQ Data

PWQMN data (MOE)

<table>
<thead>
<tr>
<th>River</th>
<th>Station Code</th>
<th>Start Year-End Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trent River</td>
<td>17002100102</td>
<td>1965-1971</td>
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<td>Trent River</td>
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<td>1971-1998</td>
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<td>Trent River</td>
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<td>Trent River</td>
<td>17002106802</td>
<td>2002-2010</td>
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<td>1965-2009</td>
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<td>Napanee River</td>
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<td>Wilton Creek</td>
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<td>Wilton Creek</td>
<td>17003700602</td>
<td>1975-1976</td>
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<td>Wilton Creek</td>
<td>17003700302</td>
<td>1988-2011</td>
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</tbody>
</table>
Uncertainty of the non-point nutrient loadings estimates

Rating curve and error estimation  
Minns et al. (2004)

\[ \ln(\text{Loading}) = a + b \ln(Q) \]

1. Rejection of the concentration outliers;
   
   Station mean ± 2SD

2. Test statistical differences among stations;
   
   ANCOVAs for each tributary with the “station” as the fixed factor and “year” as the covariate

3. TP loading by river:

\[ [\text{TP}] \times Q \]

4. Regressions for each river and each year;

5. If a regression was highly significant (P≤0.01), then the equation was kept in the analysis;
6. If $n<5$, $P>0.01$, or $r^2<0.75$, a common slope $b$ from all other years was used to estimate the coefficient $a$;

7. For those years with no data, an overall regression using all the data was developed, with $(\text{year}-1971)$ included as an additional independent variable in a stepwise regression, varying from linear up to a quadratic term;

8. For each year/river-specific regression, the standard error was recorded and subsequently used in the uncertainty analysis.
Uncertainty of the non-point nutrient loadings estimates

- Rating curve and error estimation
Uncertainty of the non-point nutrient loadings estimates

\[ y = 0.98x + 0.871 \]

\[ y = 1.0135x + 0.6776 \]

\[ R^2 = 0.7116 \]

\[ R^2 = 0.3295 \]

RMSE=174

RMSE=215
Uncertainty of the non-point nutrient loadings estimates
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Modelled Loading (kg day⁻¹)

Obs. Loading (kg day⁻¹)

R² = 0.3843
RMSE=13.6

R² = 0.551
RMSE=12.8

TP Loading (kg day⁻¹)

Salmon PM2004  Salmon PM2012  Salmon obs

Uncertainty of the non-point nutrient loadings estimates

- \( R^2 = 0.8531 \)
- RMSE = 10.5

- \( R^2 = 0.201 \)
- RMSE = 25.1

- Napanee PM2012
- Napanee PM2004

Graph showing Modelled Loading vs Obs. Loading and TP Loading (kg day\(^{-1}\)) from 1970 to 2010.
Uncertainty of the non-point nutrient loadings estimates
Uncertainty of the non-point nutrient loadings estimates

Pre P Control 1972-1978

2002 -2009
Upper Bay
Upper Bay

\[
\text{Net loading} = \text{flow}_{\text{non-point}} \times ([\text{TP}]_{\text{non-point input}} - [\text{TP}]_{\text{output}})
\]
Net loading = flow_{point} \times ([TP]_{point \ input} - [TP]_{output})
Upper Bay

![Graph showing the relationship between Input P and Output P in Upper Bay.](image-url)
Discrepancy exists between the current loading estimates and those reported by Minns et al. (2004).

This discrepancy stems from the procedure used to handle years with weak relationship between loading and flow.

Trent River is a major source for TP loading.

Seasonal-average (May - Oct) point source loading in Upper Bay has been lower than 15 kg/day during the model validation period (2002-2009).
Uncertainty of the non-point nutrient loadings estimates

- The model suggests a gradual establishment of an equilibrium state between inputs and outputs.

- The NET non-point TP loading contribution has switched to positive since the mid 80s.