Appendix 6.1 Calculations for Total Inorganic Nitrogen
No nitrification or denitrification of total inorganic nitrogen (TIN) was assumed for a more conservative approach. The method of calculation of the near field concentrations of TIN is the same as that used in the approved EIA report for Outlying Islands Sewerage Stage 1\textsuperscript{1} (OISS) and Development of the Integrated Waste Management Facilities Phase 1\textsuperscript{2} (IWMF) for suspended sediment plumes.

In this method, a simple model is used to calculate the depth averaged TIN concentrations along the centreline of a plume by solving the advection-diffusion equation for a continuous line source\textsuperscript{3}. This model is considered appropriate for the calculation of TIN from the proposed storm discharge because the equation is based on a continuous line source of sediment, which is a reasonable approximation of the TIN release due to stormwater discharge, assuming a similar property between suspended sediments and TIN.

The near field concentration formula is as follows:

$$C(x) = \frac{q}{(D \times x \times \omega \times \sqrt{\pi})}$$

where:
- \(C(x)\) = concentration at distance \(x\) from the source (mg/L);
- \(q\) = TIN release rate (kg/s);
- \(D\) = water depth (5 m);
- \(x\) = distance from source (m);
- \(\omega\) = diffusion velocity (0.01 m/s).

The diffusion velocity represents reductions in the centre-line concentrations due to lateral spreading, the value of 0.01m/s was recommended by Wilson, 1979 and adopted for the EIA reports of OISS and IWMF. \(q\) is calculated based on the following formula:

$$q = f \times [TIN]$$

where:
- \(f\) = discharge flow rate (m\(^3\)/hr)
- \([TIN]\) = Event mean concentration for storm water of total inorganic nitrogen (TIN)

With reference to Li et al. 2003\textsuperscript{4}, Table 1 summarised the event mean concentrations of ammonium and nitrate adopted for calculating the TIN concentration for with and without Project scenarios. Due to the reactive nature of ammonia and nitrite, it has been assumed that the concentration of ammonium accounts for both ammonium and ammonia, and nitrate accounts for both nitrate and nitrite.

<table>
<thead>
<tr>
<th>Ammonium (mg/L)</th>
<th>Nitrate (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.92</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Table 1: Event Mean Concentration of Ammonium and Nitrate

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1 EIA study for Outlying Islands Sewerage Stage 1, Phase II Package J – Sok Kwu Wan Sewage Collection, Treatment & Disposal Facilities, 2003, Drainage Services Department (AEIAR-075/2003)
2 EIA study for Development of the Integrated Waste Management Facilities Phase 1, 2011, Environmental Protection Department (AEIAR-163/2012)
4 H.E. Li, J.H.W. Lee, A. Koenig, A.W. Jayawardena, Nutrient Load Estimation of Nonpoint Source Pollution For Hong Kong Region, Diffuse Pollution Conference Dublin 2003
The below formulae summarised the calculations used to derived the TIN concentration.

\[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \]
\[ 2 \text{NH}_4^+ + 3 \text{O}_2 \rightarrow 2 \text{NO}_2^- + 2 \text{H}_2\text{O} + 4 \text{H}^+ \]
\[ \text{NH}_3 + \text{O}_2 \rightarrow \text{NO}_2^- + 3\text{H}^+ + 2\text{e}^- \]
\[ \text{NO}_2^- + \text{H}_2\text{O} \rightarrow \text{NO}_3^- + 2\text{H}^+ + 2\text{e}^- \]

\[ \text{TIN} = \text{NO}_3^- + \text{NO}_2^- + \text{NH}_4 + \text{NH}_3 \]

\( \text{NH}_3 \) = Ammonia  
\( \text{NH}_4 \) = Ammonium  
\( \text{TIN} \) = Total Inorganic Nitrogen  
\( \text{NO}_3 \) = Nitrate  
\( \text{NO}_2 \) = Nitrite  
\( \text{O} \) = oxygen  
\( \text{H} \) = Hydrogen  
\( \text{E} \) = electron

Table 2 summarised the discharge flow rates and calculated TIN release rates for the with and without Project scenarios.

<table>
<thead>
<tr>
<th></th>
<th>Discharge Flow Rate (m3/hr)</th>
<th>TIN Release Rate (kg/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Project</td>
<td>16,243</td>
<td>0.02477058</td>
</tr>
<tr>
<td>Without Project</td>
<td>4,765</td>
<td>0.00726663</td>
</tr>
</tbody>
</table>

As Outfall No. 3 is closest to the Southern Water Control Zone (WCZ) and with a significant increase in stormwater load after commissioning of the Project, the calculated TIN concentrations were based on the different distances from Outfall No. 3 to provide a mixing zone, and the calculated results have been summarised in Table 3 below.

Table 3: Calculated TIN concentrations

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>TIN WQO (mg/L)</th>
<th>With Project</th>
<th>Without Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.4</td>
<td>2.80E-01</td>
<td>8.20E-02</td>
</tr>
<tr>
<td>5</td>
<td>0.4</td>
<td>5.59E-02</td>
<td>1.64E-02</td>
</tr>
<tr>
<td>10</td>
<td>0.4</td>
<td>2.80E-02</td>
<td>8.20E-03</td>
</tr>
<tr>
<td>50</td>
<td>0.4</td>
<td>5.59E-03</td>
<td>1.64E-03</td>
</tr>
<tr>
<td>100</td>
<td>0.4</td>
<td>2.80E-03</td>
<td>8.20E-04</td>
</tr>
<tr>
<td>150</td>
<td>0.4</td>
<td>1.86E-03</td>
<td>5.47E-04</td>
</tr>
<tr>
<td>190*</td>
<td>0.1</td>
<td>1.47E-03</td>
<td>4.32E-04</td>
</tr>
<tr>
<td>200</td>
<td>0.1</td>
<td>1.40E-03</td>
<td>4.10E-04</td>
</tr>
</tbody>
</table>

*Direct distance from Outfall No. 3 to Southern WCZ without taking consideration into the land boundary