Objective:
- Devise and assess an evaluation framework for industrial by-products with potential for productive use in engineered water treatment wetlands or similar developments.

Introduction
- Extensive land use change has substantially increased (diffuse) pollutant loads to many aquatic environments.
- Conventional wastewater treatment systems frequently unsuitable due to on-going requirements for guaranteed power supply and skilled labour.
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Material Assessment Framework

**BASIC REQUIREMENTS**
- MSDS – nominal chemical/physical properties, safe handling & use
- Material source & generation process
- Intended application(s)

**PRIMARY CHARACTERISATION**
- Geochemistry
- Mineralogy (XRD)
- Radioactivity (U-Th series)
- P sorption capacity/retention index

**SECONDARY CHARACTERISATION**
- Identification of potential fit for purpose use
- Leach testing (e.g. modified TCLP)
- Ecotoxicity testing
- Microbiological testing as required

**TERTIARY CHARACTERISATION**
- Longer-term laboratory and/or pilot-scale field trials to validate fit for purpose use
- Comprehensive assessment of material’s projected life cycle

**USE REGISTRATION/LICENSE**
- Define conditions of use (limitations, reuse or disposal)
- Generate necessary supporting documentation for NRM agency/industry/domestic product use in intended locale

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**Example Material Assessment**

**Table 1: U-Th series radiochemistry, P sorption capacity, trace element geochemistry**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Absorbed dose rate, D (mGy/h)</th>
<th>Equivalent annual external dose (mSv)</th>
<th>Effective annual external dose (mSv)</th>
<th>P sorption capacity (mg/g)</th>
<th>Trace elements with concentration &gt; relevant soil/sediment guidelines (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JX1</td>
<td>20</td>
<td>0.12</td>
<td>0.02</td>
<td>14.0</td>
<td>Ba(1390), Be(1461), V(1520)</td>
</tr>
<tr>
<td>JX2</td>
<td>39</td>
<td>0.12</td>
<td>0.02</td>
<td>2.38</td>
<td>Ba(25), Ba(453), Cr(1080), Be(1082), Zn(1090)</td>
</tr>
<tr>
<td>JX3</td>
<td>192</td>
<td>1.38</td>
<td>0.24</td>
<td>12.2</td>
<td>Ba(1130), Ba(1180), Cr(1190), Be(1250), V(1260)</td>
</tr>
<tr>
<td>JX4</td>
<td>39</td>
<td>0.24</td>
<td>0.05</td>
<td>3.20</td>
<td>Ba(1540), Cr(1550), Be(1560), Cr(1560), Zn(1570)</td>
</tr>
<tr>
<td>JX5</td>
<td>110</td>
<td>0.12</td>
<td>0.02</td>
<td>9.32</td>
<td>Cr(1230), Cr(1240), Be(1250), Cr(1260), V(1270)</td>
</tr>
<tr>
<td>JX6</td>
<td>25</td>
<td>0.16</td>
<td>0.03</td>
<td>21.7</td>
<td>Cr(1330), Cr(1340), Be(1350), Cr(1360), V(1370)</td>
</tr>
<tr>
<td>JX7</td>
<td>186</td>
<td>1.34</td>
<td>0.23</td>
<td>16.7</td>
<td>Cr(1380), Cr(1390), Be(1390), Cr(1400), V(1410)</td>
</tr>
</tbody>
</table>

---

**Example Assessment Summary**

**Table 2: Nutrient (N, P) attenuation in laboratory column trials**

<table>
<thead>
<tr>
<th>Sample</th>
<th>EC or IC10</th>
<th>EC or IC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>JX1</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>JX2</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>JX3</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>JX4</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>JX5</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

---

**Example Figure 1: Nutrient (N, P) attenuation in laboratory column trials**

**Figure 2: Synthetic softwater leachate toxicity**

**Figure 3: Potential N, P & Si limitation of column leachates**

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