15 July 2019

Department of Environment, Land, Water and Planning
via online submission portal: Engage Victoria

Dear Sir / Madam

RE: CLIMATE CHANGE: REDUCING VICTORIA’S GREENHOUSE GAS EMISSIONS

Nagambie Resources Limited (NRL) makes this submission to the Victorian Government to provide input to the government’s decisions on targets and consideration of priority actions to reduce Victoria’s emissions for the development of pledges to 2025.

This submission identifies the management of waste acid sulfate soil (WASS) as a significant source of greenhouse gas emissions that is emerging in the Victorian economy. A significant reduction in emissions from this source can easily be achieved with multiple co-benefits, as Victoria already has the necessary infrastructure. Barriers to achieving significant emission reductions from this emerging source include the maladministration of existing government policy by regulators.

Waste acid sulfate soil

Acid Sulfate Soil and Rock is geological material containing metal sulphides. Typically, the metal sulfides are iron sulfides in the form of pyrite. Exposure of iron sulfides to oxygen – for example by drainage and excavation of these soils or rock – causes the sulfides to oxidise resulting in the generation of sulfuric acid. This may cause acidification of soils, surface water and groundwater. Acidic leachate can release aluminium, iron and other metals from soil and sediment, and has the potential for significant adverse environmental and human health impacts.

Acid sulfate soil is the generic term used to describe both actual acid sulfate soil and rock (AASS) and potential acid sulfate soil and rock (PASS). AASS is material already generating sulfuric acid as it oxidises. PASS is material that has not oxidised, but if exposed to oxygen would start to produce sulfuric acid. ASS material in Melbourne typically comes in two forms:

- Soil, sediment or unconsolidated material, such as Coode Island Silt (and similar geological material); and
- Consolidated rock mass, such as sandstones and siltstones of the Melbourne Formation.

When acid sulfate soil and rock is excavated and needs to be transported offsite, it becomes ‘waste acid sulfate soil and rock’ (WASS).

The emerging WASS issue

Victoria has commenced several major infrastructure projects which will be built over the next decade. Numerous other major infrastructure projects are planned, which if built, may extend the construction period into the following decade. Most of these projects will generate WASS. An estimate of the quantity of WASS that is likely to be generated from these projects is detailed below.

1
## Victoria’s committed projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Reported quantity of WASS that will be generated (million tonnes)</th>
<th>Source of estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro Tunnel</td>
<td>1.2</td>
<td>Chapter 20 - Contaminated Land and Spoil Management of the EES for the Melbourne Metro Rail Projects provides expected quantities of WASS that would be generated. Average densities of 2.65 t/m³ for acid sulfate rock (sandstone and siltstone) and 2.00 t/m³ for acid sulfate soil (derived from <a href="http://www.edumine.com/xtoolkit/tables/sgtables.htm">http://www.edumine.com/xtoolkit/tables/sgtables.htm</a>) have been applied to determine the expected WASS quantity in tonnes.</td>
</tr>
<tr>
<td>West Gate Tunnel</td>
<td>0.2</td>
<td>Based on information provided on p19-16 of the West Gate Tunnel Project EES</td>
</tr>
<tr>
<td>North East Link</td>
<td>6.6</td>
<td>Table 23-4 of the NELP EES states that the estimated volume of acid sulfate soil and rock that would be generated by the Project is 2,630,000 metres cubed (m³). Average densities, as above, have been applied to determine the expected WASS quantities in tonnes. It is noted that the EES’s Technical Report R – Greenhouse Gas report assumes a spoil density of 1.5 t/m³ (Appendix D - Tunnel calculations – Spoil transportation, page number not provided). This density is considered highly conservative and incorrect.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

## Victoria’s planned or proposed projects

<table>
<thead>
<tr>
<th>Planned or proposed project</th>
<th>Estimated quantity of WASS that will be generated (million tonnes)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suburban Rail Link</td>
<td>5.0 to 6.0</td>
</tr>
<tr>
<td>Airport Rail Link</td>
<td>0.1 - 0.2</td>
</tr>
<tr>
<td>Melbourne Metro 2</td>
<td>1.5 to 2.5</td>
</tr>
<tr>
<td>East West Link</td>
<td>2.5 to 3.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9.1 to 12.2</strong></td>
</tr>
</tbody>
</table>

¹ estimate only and is based on the probable infrastructure dimensions and local geology in the vicinity of the proposed infrastructure

From the above tables, it is evident that around 8.0 million tonnes (Mt) of WASS will be generated in Melbourne from committed projects over the next six to eight years (or approximately 1.0 to 1.2 Mt per year for the next six to eight years). An estimated additional 9.0 to 12.0 Mt of WASS could be generated in Melbourne if planned or proposed projects are built in the following decade.
Policy governing the management of WASS

The Industrial Waste Management Policy (Waste Acid Sulfate Soils), 1999 (the WASS Policy) is the policy that governs the management of waste acid sulfate soil in Victoria. IWMPs are statutory instruments and their provisions are legally enforceable and binding on all private individuals and all private and public sector organisations (EPA publication 680, p4).

The Policy, amongst other things:

- Requires WASS to be managed in accordance with best practice or any best practice environment management guidelines approved by the EPA (clause 9);
- Requires that WASS is disposed or reused only at premises where the occupier is (1) licensed under the Environment Protection Act 1970 (EP Act) to dispose of WASS, or (2) has an environment management plan (EMP) prepared in accordance with the Policy and approved by the EPA (clause 13);

With reference to clause 9 of the Policy, EPA Victoria’s current best practice management guideline is EPA (2009) Publication 655.1 Acid Sulfate Soils. The Department of Sustainability and Environment’s (2010) Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils is the other principal document in Victoria in which ‘best practice’ management of acid sulfate soil is described.

EPA(2009) and DSE(2010) provide for the following hierarchy of management approaches (Publication 655.1, p4):

1. Avoid disturbance
2. Minimise disturbance
3. Prevent oxidation
4. Treat to reduce or neutralise acidity
5. Offsite reuse or disposal

This hierarchy is based on the Principle of Waste Hierarchy which is one of the Principles of Environmental Protection enacted in law under section 11 of the Environment Protection Act 1970.

For projects where WASS needs to be removed offsite, such as Victoria’s committed major infrastructure projects (i.e. where Avoid disturbance and Minimise disturbance is not possible), the Policy’s intent is to avoid disposal to landfill and manage it at a facility with an approved EMP with a preference for those facilities that implement a management approach higher up the management hierarchy. The most preferred method is ‘Prevent oxidation’, which is better practice than ‘Treatment to reduce or neutralise acidity’ and ‘Offsite reuse or disposal.’ These approaches are further described below.

Prevent oxidation

The Prevent oxidation management approach involves placing excavated WASS in an anaerobic environment, such as underwater, where the oxidation of sulphides and thus the generation of acid, is prevented.
**Treat to reduce or neutralise acidity**

The WASS management method *Treat to reduce or neutralise acidity* involves mixing the WASS with a neutralising agent such as manufactured lime. This management method effectively allows the WASS to oxidise and generate acid, which is then reduced or neutralised by the lime. The treated material can then be reused at an appropriately approved facility (as approved under clause 13 of the WASS Policy). The reasons that treating WASS with lime is less preferred is as follows:

- **It is inherently an unsustainable management approach**, as it requires the consumption of other scarce resources (limestone and energy) to treat the waste. It requires operation of additional plant and heavy equipment to mix the two ingredients together, and it requires follow up and ongoing monitoring;

- **It is an extremely greenhouse gas intensive management method**, as both the production of lime and the treatment of the WASS with lime (termed ‘liming’) releases significant amounts of greenhouse gases (see discussion of greenhouse gas emissions below).

**Offsite reuse or disposal**

The least preferred WASS management approach as stated in the WASS Policy is *Offsite reuse or disposal*. This is a somewhat misleading title as the hierarchical management of WASS should not discourage its reuse.


> **EPA aims to work with industry to promote and encourage reuse options rather than disposal of acid sulfate soils to landfill. In particular, EPA will encourage the diversion of this material to unlicensed premises who have an EMP approved under the Policy setting out reuse proposals, in preference to disposal at landfill.**

For this statement, clearly the intent of the WASS Policy is:

- To prevent WASS disposal to landfills;
- Encourage reuse options at approved facilities, with a preference for facilities that use a WASS management approach higher up the hierarchy where practically accessible (see ‘Practically accessible’ test below).

The WASS Policy Impact Assessment also describes that the WASS Policy has been prepared in a manner that allows flexibility in the choice of WASS management approaches. At the time of its declaration (1999) there was likely limited facilities where WASS could be managed in accordance with the approaches higher up the hierarchy (i.e. prevent oxidation) and landfill disposal was considered an infinite resource. Today however, there are numerous facilities that offer best practice WASS management and landfill space is scarce (and difficult to create as demonstrated recently in the case of the expansion of Melbourne’s largest landfill – the Melbourne Regional Landfill).
Infrastructure that supports the WASS Policy

Numerous approved facilities in Victoria that can manage WASS already exist. These facilities are either landfills licenced to accept WASS or are facilities that have an environment management plan for the acceptance of WASS approved by the EPA (as per clause 13 of the WASS Policy), or both.

Searches of EPA’s database of approved licences reveals that there are six or seven licenced landfills that are approved to dump WASS in their facility. For supposed ‘commercial-in-confidence’ reasons, facilities with an approved EMP are not made publicly known by the EPA. However, from information obtained through Freedom of Information legislation, there are numerous facilities in Victoria that have an approved EMP to manage WASS. As of November 2018, there are approximately seven facilities with an approved EMP, two or three of which use Prevent oxidation (underwater storage) as the management approach. These facilities are located in Maddingly (located approximately 60km from Melbourne), Nagambie (NRL’s facility, located approximately 130km from Melbourne) and possibly Langwarrin (located approximately 50 km from Melbourne). The other facilities with an EPA approved EMP use Treatment to reduce or neutralise acidity approach to manage WASS.

Actual management of WASS in Victoria

Information obtained under Freedom of Information legislation reveals that WASS from the Metro Tunnel Project is currently being managed as follows:

- Transported to a landfill facility where it is being treated with lime and disposed of in areas adjacent to developed landfill cells (i.e. in potential future landfill space). This is supposedly occurring in accordance with an EPA approved EMP; and
- Transported to the Melbourne Regional Landfill, Victoria’s largest landfill, where it is being dumped directly into landfill cells without treatment. Alarmingly, at this landfill, the EPA changed the landfill licence in late 2018 (without any consultation) to allow this facility to take in WASS and also likely exempted the application of the landfill levy on the WASS received.

Based on the description of how WASS will be managed from the North East Link Project (provided in the Environment Effects Statement for this project), it is likely that WASS from this project will also end up being treated with lime and dumped in potential landfill space, or dumped directly into developed landfill space.

It is hoped that the Victorian Government intervenes and prevents the disposal of WASS directly to landfill. If 8Mt of WASS is dumped into landfill it will have a dramatic effect on the scheduled available landfilled space in Melbourne (established by Sustainability Victoria over the recent years). As landfill space becomes scarcer, landfill disposal fees for disposal of household (municipal) wastes will rise. This cost will be borne by local government and passed onto the Victoria’s rate payers.

Should WASS disposal to landfill be prevented, based on current practice there is the potential that 8.0 Mt to 20.0 Mt of WASS will be treated with lime. This is because, in Melbourne, it is generally the case that Treat to prevent or neutralise acidity facilities (i.e. facilities that
manage WASS by liming) are located closer to major infrastructure construction sites than Prevent oxidation WASS management facilities (where no liming is required), meaning the transport costs to the liming facility are lower than to the Prevent oxidation facility.

Cost of WASS management
For major infrastructure projects, governments typically appoint a principal contractor or a consortium of contractors. In the case of the Metro Tunnel Project construction, the appointed consortium is Cross Yarra Partnership (CYP) which is comprised of various multi-national construction companies. Typically, contractual arrangements require the principal contractor to bear the financial cost and proper management of the WASS generated. This includes the cost of transport and the disposal gate fee at the receiving facility. In practice, the principal contractor will appoint a trucking company to cart and dispose of the WASS. The trucking companies bid for this work and will price into their bids the lowest cost disposal option.

In September 2018 and March 2019, Nagambie Resources Limited wrote to Lendlease and Rail Projects Victoria respectively, to inform them that WASS from the Metro Tunnel Project was being managed in contradiction to policy intent and requirements. Their responses indicated that the principal contractor, and indeed the project owner, don’t really care where the WASS is disposed of, as long as the WASS ends up at a facility approved to accept the WASS (per correspondence with Rail Projects Victoria).

Greenhouse gas emissions from management of WASS
To demonstrate the unnecessary and significant greenhouse gas emissions that are emitted from treating WASS with lime (i.e. the Treat to reduce or neutralise acidity approach) compared to placing WASS beneath water (i.e. the Prevent oxidation approach), a comparison of emissions has been calculated below using data provided in the North East Link Project (NELP) Environmental Effects Statement (EES).

Greenhouse gas emissions from the NELP are assessed in Chapter 26 of the NELP EES. Chapter 26 is based on the information contained in Technical Report R – Greenhouse gas. In regard to the management of WASS, it appears that Technical Report R failed to consider the emissions associated with the production of lime needed to treat the generated WASS. If the intended WASS management method is Treat to prevent or neutralise acidity, then the emissions associated with this approach need to be included as a Scope 3 emission due to their materiality (as shown below). The EES for the Metro Tunnel Project (called the Melbourne Metro Rail Project or MMRP) also failed to consider this significant emission source.

Using the data provided in Technical Report R – Greenhouse gas, the following is a comparison of the carbon emissions that would be emitted if 8 Mt of WASS was managed under the following WASS management scenarios:

1. Treat to neutralise acidity, at a facility 35 km from the construction site; and
2. Prevention of oxidation at the Nagambie facility located 130 km from the construction site (note: this is only theoretical as the NRL’s facility can only take 6 Mt of WASS).
The emissions sources from managing the WASS at these facilities are:

<table>
<thead>
<tr>
<th>Emissions from transport</th>
<th>Emissions from liming</th>
<th>Emissions from the production of lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat to neutralise acidity</td>
<td>✓</td>
<td>+</td>
</tr>
<tr>
<td>Prevent oxidation</td>
<td>✓</td>
<td>+</td>
</tr>
</tbody>
</table>

Emissions associated with transport of WASS
Using information from Technical Report R – Greenhouse gas, the emissions associated with transporting the WASS to the various facilities are compared in the Table below.

<table>
<thead>
<tr>
<th>Treat to neutralise acidity facility (35 km one way)</th>
<th>Prevent oxidation (Nagambie facility, 130 km one way)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total WASS 8.0</td>
<td>8.0 Mt</td>
</tr>
<tr>
<td>Total WASS 3,018,868</td>
<td>3,018,868 m3</td>
</tr>
<tr>
<td>Total no. of trucks (25t per truck) 320,000</td>
<td>320,000 truckloads</td>
</tr>
<tr>
<td>Total kms for disposal of WASS 11,200,000</td>
<td>41,600,000 km</td>
</tr>
<tr>
<td>Total ASS transport diesel (0.00056 kL/km) 6,272</td>
<td>23,296 kL</td>
</tr>
<tr>
<td>Diesel fuel – energy content factor – Scope 1 (38.6 GJ/kL) 242,099</td>
<td>899,226 GJ</td>
</tr>
<tr>
<td>Scope 1 – CO2 (69.9 kg CO2-e /GJ) 16,922,720</td>
<td>62,855,897 kg CO2-e</td>
</tr>
<tr>
<td>Scope 1 – CH4 (0.1 kg CO2-e /GJ) 24,210</td>
<td>89,923 kg CO2-e</td>
</tr>
<tr>
<td>Scope 1 – N2O (0.5 kg CO2-e /GJ) 121,050</td>
<td>449,613 kg CO2-e</td>
</tr>
<tr>
<td>Scope 3 - (3.6 kg CO2-e /GJ) 871,556</td>
<td>3,237,214 kg CO2-e</td>
</tr>
<tr>
<td>TOTAL transport emissions 18</td>
<td>67 kt CO2-e</td>
</tr>
</tbody>
</table>

Emissions associated with liming of ASS
Appendix D of Technical Report R of the NFIP FFS states the liming rate is 186 kg lime per metre cubed of WASS. Therefore 561,509 tonnes (0.186 x 3,018,868) of lime is required for liming.

The Intergovernmental Panel on Climate Change (IPCC), 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4 (Agriculture, Forestry and Other Land Use), Institute for Global Environmental Strategies (IGES), Hayama, 2006, assumes the CO2 emission factor for agricultural liming of 0.12 tonne CO2 per tonne of CaCO3.

Therefore, emissions from liming WASS would be 67 kt CO2
Emissions from the production of lime

Using the publicly available greenhouse gas protocol sector specific tools calculator for lime production - Approach 1 (available online [https://ghgprotocol.org/calculation-tools], accessed 29 May 2019) the emissions of CO2-eq from the production of 561,509 tonnes of lime (using the most conservative default settings in the calculator) would be 415 kt.

Total comparable emissions

The estimated carbon emissions from the transport and treatment of WASS with lime at a facility on the outskirts of Melbourne compared with emissions from transport of the WASS to NRL’s Prevent oxidation facility are as follows:

<table>
<thead>
<tr>
<th>ASS management approach</th>
<th>Emissions from transport (kt CO2-e)</th>
<th>+</th>
<th>Liming (kt CO2-e)</th>
<th>+</th>
<th>Production of lime (kt CO2-e)</th>
<th>=</th>
<th>Total emissions (kt CO2-e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat to neutralise acidity</td>
<td>18</td>
<td>+</td>
<td>67</td>
<td>+</td>
<td>415</td>
<td>=</td>
<td>500</td>
</tr>
<tr>
<td>(outskirts of Melbourne)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevent oxidation</td>
<td>67</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>=</td>
<td>67</td>
</tr>
<tr>
<td>(Nagambie)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above estimates of emissions for the Treat to neutralise acidity facility, do not include the emissions from plant and equipment needed to mix the lime (which was included in the MMRP EES), nor the emissions associated with transporting over half a million tonne of lime to the Treat to neutralise acidity facility (which wasn’t included in the MMRP EES).

Conclusion

The above estimates show the carbon emissions associated with taking the WASS to a facility on the outskirts of Melbourne (35 km one way) where liming is required, would be over seven (7) times the carbon emissions associated with disposing of the WASS at the Nagambie Mine (130 km one way) where the Prevent oxidation approach is used (placing the WASS underwater).

Co-benefits from managing WASS in accordance with Policy intent

Apart from significant greenhouse gas emission reductions, the following co-benefits would be realised if WASS were managed in accordance with the intent of current policy:

1. Significant regional employment opportunities would be generated from city-centric infrastructure expenditures. In the case of NRL, if WASS were to be placed at the Nagambie facility, some 9 to 10 employment positions would be created to enable the facility to operate 24 hours per day (which is needed as WASS will be produced from tunnel boring machines operating 24 hours per day);
2. All WASS can be re-used without consuming additional resources to rehabilitate degraded areas. In the case of the Nagambie facility, the WASS would be reused to rehabilitate a legacy mine site to achieve enhance environment outcomes beyond that which is required, thus contributing to a circular economy.
3. Actual and potential landfill space would be preserved.

**Barriers to reducing emission reductions from WASS management**

**Ignoring policy**
In regard to the management of WASS, existing policy facilitates and encourages management options higher up the waste hierarchy. However, these policies are not always enforced by government. If the government did manage WASS as per the intent of its WASS Policy, significant greenhouse gas emissions could be achieved. The lack of implementation of policy intent has resulted in poorer social and environmental outcomes at the direct benefit for the appointed construction contractor.

**Government procurement practices**
Government procurement practices result in the project owner and actual waste producer (e.g. Rail Projects Victoria in the case of the Metro Rail Project) removing itself from the responsibility for ensuring WASS is managed in accordance with the intent of policy. Leaving WASS management to market forces results in significant externality costs, such as greenhouse gas emissions) as the cheapest WASS approach will be adopted.

**Changing legislation**
An additional and emerging risk is the changes planned to regulations under the new Environment Protection Act. The general environmental duty, on its own, will not encourage or cause WASS to be managed by approaches higher up the waste hierarchy. The introduction of the general environment duty could pose risk to the reuse of wastes if it leads to producers acting in a precautionary manner. Government should ensure there are other regulations which support the management of wastes to approaches as high up the waste hierarchy as practically accessible.

**Conclusion**
Victoria has an emerging issue of waste acid sulfate soil generation, which will be generated from the construction of committed major infrastructure projects over the next decade. If planned infrastructure projects are construction in the following decades, the emerging issue will double. However, if WASS is managed in accordance with the intent of existing policy, significant greenhouse emission reductions would be achieved. Other important co-benefits will also be achieved.

In Victoria, there are now several facilities that can accept WASS and manage it in a manner that is the highest on the WASS management hierarchy (for ASS that needs to be removed offsite – i.e. placement underwater). The management of WASS from the Metro Tunnel Project shows that the construction contractors are using the flexibility of the policy and guidelines as a way to manage WASS at the cheapest direct cost but at the expense of the State. This is being enabled by government regulators.

To avoid the significant unnecessary greenhouse gas emissions associated with the management of WASS, government should prioritise the Prevent oxidation WASS management approach.
Should you wish to discuss any of the above further, please contact me.

Yours faithfully

[Signature]

CEO

Nagambie Resources Limited

Declaration: Nagambie Resources Limited operates Victoria’s largest prevent oxidation WASS management facility. This facility is one of several that operate in Victoria.