A brief field assessment of native vegetation at sites close to the Vale New Caledonia facility

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Environmental Impact Solutions

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1. Summary

A decline in the condition of several native species, especially *Arillastrum gummiferum*, le chêne gomme, was observed in an area to the west of the industrial facility of Vale Nouvelle-Calédonie in December 2010. Vale Nouvelle-Calédonie commenced a number of investigations to identify the likely causal factors.

This report summarise a brief field assessment conducted on 25 September 2014 of vegetation condition at a few sites immediately adjacent to the boundary of the industrial facility of Vale Nouvelle-Calédonie. The locations were chosen to be "worst-case" the areas expected to be exposed to the highest concentrations of emissions and where vegetation injury had been previously observed.

It was observed that there were a few species showing symptoms of chlorosis and necrosis on leaves, consistent with damage associated with exposure to sulphur dioxide. Most of the symptoms were observed on old leaves consistent with exposure many months previously. A few of the symptoms were on young leaves possibly caused by recent exposure. The great majority of plants showed no symptoms consistent with damage associated with exposure to sulphur dioxide. New growth was mostly healthy and vigorous.

It is likely that that acute exposures to high SO_2 concentrations of infrequent and short durations may be associated with the injury to vegetation observed in these forested areas adjacent to the industrial facility of Vale Nouvelle-Calédonie.

Generally is appeared that the severity of symptoms and the extent of the area affected were less than previously observed.

2. Introduction

In areas adjacent to their facility in December 2010, Vale Nouvelle-Calédonie observed a decline in the condition of several native species, especially *Arillastrum gummiferum*, le chêne gomme, In response, a number of investigations were initiated to identify the likely causal and contributing factors.

The purpose of this report is to summarise a brief field assessment of vegetation condition at a few sites immediately adjacent to the boundary of the industrial facility of Vale Nouvelle-Calédonie conducted on 25 September 2014. The locations were chosen to be "worst-case" the areas expected to be exposed to the highest concentrations of emissions and where vegetation injury had been previously observed.

The major location of the injury to forest vegetation in 2011 was an area adjacent to the western boundary of the Vale Nouvelle-Calédonie facility in the vicinity of Creek Baie Nord. The location and extent of the area of vegetation decline as assessed by ground surveys in 2011 are shown in Figure 1.

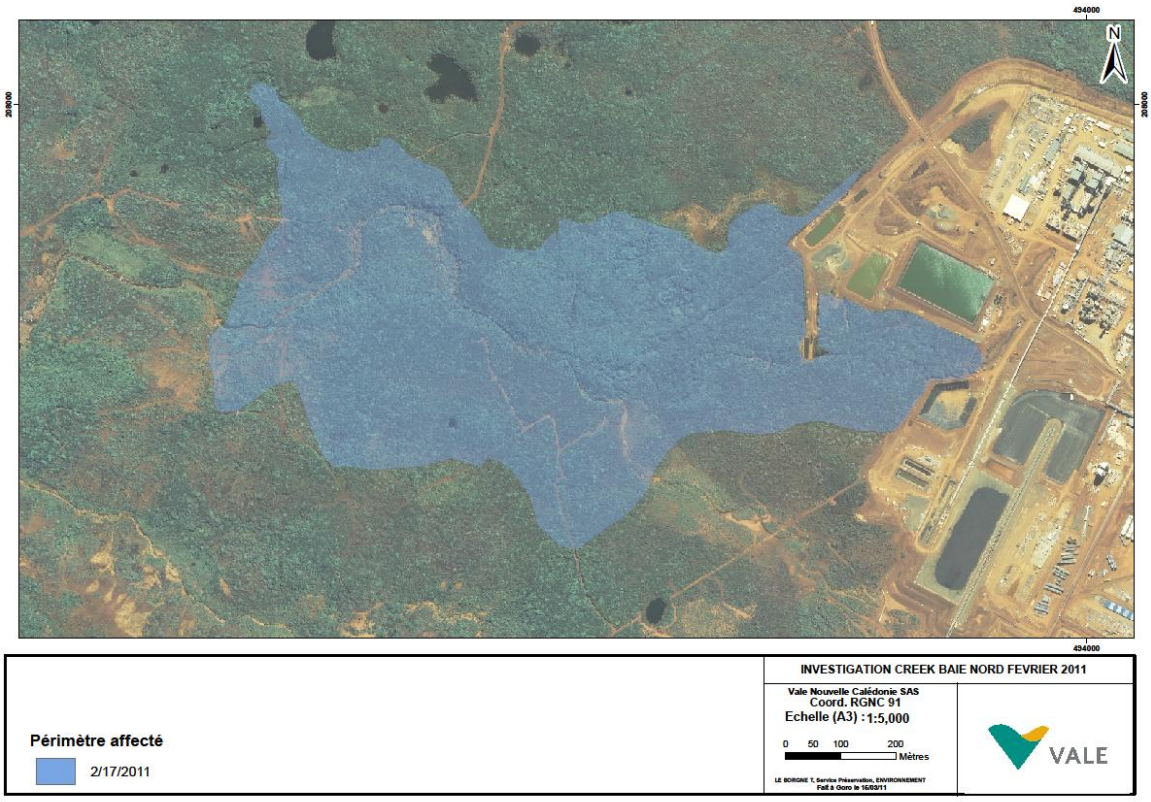

Figure 1. Location of the major area impacted by exposures in 2011

Previous studies have shown that the observed symptoms are found on only a few species, *Arillastrum gummiferum* and to a lesser extent on other species including *Flindersia fournierii* and *Gymnostoma deplancheanum*. In broad leaf trees and shrubs the symptoms observed consist of death (necrosis) of the leaf tips or parts of the leaf perimeter with a red-brown colouration of the dead leaf tissue, or on immature leaves, a brown-black colour. In some species there may be peripheral necrosis and leaf distortion including cupping and buckling. In other species there can be bleaching of leaf tissues (chlorosis). The symptoms observed in this area are clearly of acute injury, not long-term chronic injury.

The metabolic injury to leaves causes premature senescence and leaf fall. Previous observations show that there may be a small pile of leaves around the base of the trees affected in the field and obvious leaf loss in the canopy. Affected trees may show a "stag-horn" appearance with dead branches high is the tree and regrowth in the mid branches or lower. At lower level of the trees there may be re-grow or sprouting of new growth.

The ecosystem most affected by this decline is riparian forest and the sides of valleys adjacent to the creek Baie Nord. Some areas of this forest ecosystem are dominated by *Arillastrum gummiferum.*

Very little information and no scientific studies have been published on the impacts of air emissions from industrial and mining sources on vegetation in New Caledonia. The thresholds and standards applied in New Caledonia are derived from the thresholds of vegetation injury derived from studies in other countries. The regulatory threshold limits for the health of vegetation are set at a maximum of 1 hour for 570 $\mu g/m^3$ (218 ppb) and for 24 hours the limit is 230 $\mu g/m^3$ SO_2 (88 ppb).

3. Observations

Site PS 11

Site PS11 is understood to have recorded the highest average exposures to sulphur dioxide of all sites with passive samplers so it is a site with comparatively high levels of exposure to refinery emissions.

At this site at the time of inspection most of the vegetation showed no symptoms of a type associated with exposure to sulphur dioxide. There were visible signs of injury consistent with exposure to sulphur dioxide on a few species growing at the edge of the forest, including *Styphelia cymbulae*. The symptoms observed in *Styphelia cymbulae* consisted of an orange-brown coloured necrosis spreading in bands from the tips of leaves towards the mid-leaf region and along the leaf margins. Some leaf chlorosis was also apparent. Most of the symptoms were on old leaves.

Some top canopy trees in the forest, especially *Arillastrum gummiferum*, had died due to previous exposures to emissions some years ago.

Occasionally, symptoms were observed on young leaves possibly caused by recent exposure, but most of the new growth was healthy and vigorous.

Western side of refinery

An inspection of the condition of vegetation immediately outside and adjacent to the perimeter fence on the western boundary of the refinery indicated that most vegetation was in a normal condition. A small number of species showed injury similar to that produced by sulphur dioxide but it was mostly on older leaves and less frequent on younger leaves. The symptoms suggested that most of the injury was due to exposure some months earlier and there was relatively little evidence of recent injury to most species at most locations.

Injury was occasionally observed on individual specimens of *Gymnostoma deplancheanum, Codia spatulata* and on *Styphelia veillonii* growing immediately adjacent to the western boundary of the refinery.

Figure 2. Chlorosis in *Tristaniopsis callobuxus* (Myrtaceae) growing immediately adjacent to the western boundary of the refinery.

Figure 3. Symptoms of chlorosis and necrosis on *Gymnostoma deplancheanum* growing immediately adjacent to the western boundary of the refinery.

Figure 4. Symptoms of intercostal necrosis, chlorosis and anthocyanin accumulation on *Codia spatulata* growing immediately adjacent to the western boundary of the refinery. Insect damage is also apparent.

Figure 5. Symptoms of intercostal necrosis, chlorosis and anthocyanin accumulation on *Styphelia cymbulae* growing immediately adjacent to the western boundary of the refinery. Insect damage is also apparent.

Figure 6. Symptoms of peripheral necrosis, tip necrosis and chlorosis on *Styphelia veillonii* growing immediately adjacent to the western boundary of the refinery

4. Conclusions

A few species showed symptoms of chlorosis and necrosis on leaves consistent with damage associated with exposure to sulphur dioxide. Most of the symptoms were on old leaves possibly a result of exposure many months previously. Only a few of the symptoms were on young leaves. It is likely that that the observed symptoms were a result of acute exposures to high sulphur dioxide concentrations of infrequent and short durations. The great majority of plants showed no symptoms of damage associated with exposure to sulphur dioxide. New growth was mostly healthy and vigorous.

Generally is appeared that the severity of symptoms and the extent of the area affected were less than previously observed.