



2021 Environment Management System & Community Engagement Report

March 31, 2022

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1 Summary

Over the last decade, Vale's Copper Cliff Smelter Operations have operated under both a site-specific standard (SSS) for nickel and sulphur dioxide (SO₂). These SSS approvals included a requirement to implement communication and community engagement plans and to form an Environmental Monitoring Team (EMT). This annual report documents 2021 community activities and environmental accomplishments.

Given the COVID-19 pandemic, community engagement was limited to online activity in 2021.

Vale's website, www.vale.com/canada is an excellent resource for information about the company's environmental performance and community involvement. Current and recent environmental monitoring results as well as real-time and historical monitoring results are posted on the website. Details about monitoring programs, emission reductions, dust emissions controls and other environmental initiatives can also be found [here](#).

Compliance with Ontario air quality standards is evaluated using dispersion modelling to determine maximum contaminant concentrations in the community, and also by measuring concentrations of SO₂, total suspended particulate (TSP) and metals at several monitoring stations throughout the community. In 2021, there was/were:

- no measured exceedances of the SO₂ standards attributable to Vale operations.
- one (1) modelled exceedance of the 1-hour SO₂ standard of 690µg/m³ (250ppb) which is equal to the 1-hour upper risk threshold (URT – due to the change in the SO₂ standard in January 2018) attributable to the Weak Acid Treatment Plant at the Smelter; and
- three (3) exceedances of the 24-hour TSP standard of 120 µg/m³ but after investigations, none of these can be attributed to Vale Operations.

Vale's Clean Atmospheric Emission Reduction (AER) Project and Surface Facilities Upgrade Project (SFU) were completed in 2020 and resulted in a greater than 85% reduction in SO₂ emissions from Vale's Smelter Operations, comparing operating years 2013-2016 (average of 143 200 tonnes SO₂) with emissions post Clean AER (average of 13 922 tonnes SO₂ for operating years 2019-2021). The Superstack and Copper Stack are now permanently disconnected from all processes and decommissioning of both stacks will be safely carried out in stages in subsequent years.

Even though the Superstack is no longer a source of SO₂ emissions, Vale continues to operate an Emission Reduction Program (ERP) to predict and monitor dispersion conditions and to manage other activities, such as slag pouring and Nickel Refinery converter operations

The Nickel SSS of 1µg/m³ (annual) issued to Vale's Copper Cliff Smelter in 2011 expired at the end of 2021, and a new SSS of 0.4µg/m³ (annual) was issued December 23, 2021.

The new SSS has a lower 24-hour reporting trigger and a new Nickel Action Plan. Updates for the previous Nickel SSS's Action Plan were submitted to Ministry of the Environment, Conservation and Parks (MECP) in March and September 2021.

In 2021, Vale received significantly less complaints from community members with a total of 11, compared to 25 and 57 in 2020 and 2019 respectively. The noted decrease in number of complaints received can be directly attributed to the substantial efforts Vale has made to curb SO₂ emissions through the completion of the Clean AER and Smelter Surface Facilities upgrade (SFU) projects.

2 Background

At the end of 2021, the following air quality related approvals from the Ministry of the Environment, Conservation and Parks (MECP) were in effect at the Vale Copper Cliff Smelter:

- Amended Environmental Compliance Approval # 6785-9BXPTC (January 2014)¹
- Nickel Site Specific Standard Approval (annual) # 502-11-rv0 (December 2021)

The Nickel SSS contains a requirement to continue the operation of the Environmental Monitoring Team (EMT) which was created as a requirement of the Nickel SSS issued in 2011. The EMT has representation from the community, the MECP and Vale. The purpose of the EMT is to serve as a forum for dissemination, consultation, review and exchange of information regarding the operation of the Smelter, environmental issues such as air monitoring, analysis of monitoring data, and to review any new or amended Ministry approvals, as required. Per the 2011 Nickel SSS, Vale typically provided bi-annual updates of monitoring results, Action Plan progress, and communications initiatives to the EMT.

Due to ongoing impacts from COVID restrictions, it was agreed that only one meeting would be held in 2021. This took place on October 7th.

With the completion of Vale's Clean AER and SFU Projects in 2020, the 2021 Nickel SSS now specifies that updates are only required annually.

This report documents the work of the EMT and the communications activities undertaken by Vale in 2021.

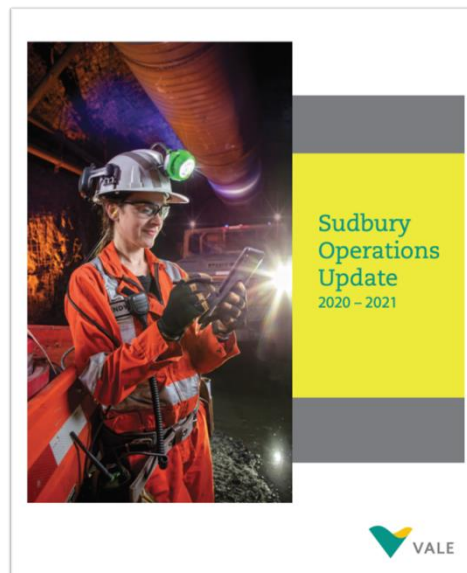
¹ Vale submitted an application to amend the Smelter's existing ECA (Air and Noise) in September 2020. The application requested an update to the terms and conditions to reflect the new operating reality of the Smelter (two new 450' Stacks, no more Superstack, Copper Stack or FBD Stack). Development of these terms and conditions were impacted by the development of the terms and conditions within the Smelter's new Nickel Site Specific Standard and Nickel Smelting and Refining SO₂ Regulation. Vale anticipates a draft ECA from the MECP shortly.

3 Communications and Community Engagement

The EMT provides proactive, transparent and timely communications that update current performance and the progress of Vale's Action Plan to meet the requirements of its Site-Specific Standard (SSS) Approval.

Information was shared through the course of the year via:

- The environment section of www.vale.com/canada
- The Clean AER Project website: [Clean AER Project website](#)
- [2020 EMT Community Report](#) (March 2021)
- [2020-2021 Integrated Community Report](#) (June 2021)
- Virtual Meetings with community groups



3.1 Vale Website

In addition to the Clean AER Project web page, Vale's website, www.vale.com/canada, also includes air quality information that further fulfill its site-specific standard approval requirements. The link below provides access to the relevant documents.

The air quality documents posted on this [site](#) include:

- Most recent and historical metals and SO₂ monitoring results (reported quarterly)
- Glossary of terms
- Details about the monitoring and emission reduction programs, and
- Information about dust emission controls

The website also includes information about Vale in the community as well as information about the company's water, reclamation and decommissioning management activities.

3.2 Report to Community

The annual Integrated Community Report was posted to Vale's [website](#) in June 2021 along with the reports from its other Canadian operating sites.

4 Community Air Quality Monitoring

4.1 Sulphur Dioxide

There are 18 fixed continuous SO₂ monitoring stations located in the community, owned by Vale and Sudbury Integrated Nickel Operations, a Glencore Company and operated and maintained by FROSKR (a division of BESTECH Canada Limited). In addition, the network includes the operation of three meteorological towers and Vale's mobile SO₂ monitoring unit. A map indicating the location of the stations is provided (see Figure 1).

In addition to the real-time monitoring data, quarterly and annual reports of SO₂ concentrations measured at the fixed stations were compiled and reported by an independent consultant and submitted to the MECP. The reports are posted on the Vale website on a quarterly basis.



Figure 1: Sudbury SO₂ Monitoring Network

With the completion of the Clean AER and SFU Projects in 2020, Vale has significantly reduced SO₂ emissions from its Sudbury area operations, both in terms of tonnes emitted and impact in the community:

- Improved milling techniques have removed more sulphides from the ore before it reaches the Smelter.
- The Smelter transitioned to a single furnace operation (from two furnaces) and discontinued all pyrometallurgical (molten metal operations which generate SO₂) copper processing operations.
- Two new converters with advanced offgas collection systems and a new Wet Gas Cleaning Plant effectively diverted +95% of the offgas reporting to the Superstack to the Acid Plant
- SO₂ is captured from all primary pyrometallurgical activities at the Smelter, wet-gas-cleaned and processed at the Acid Plant to produce marketable sulphur products.

Since the Summer 2020 PMP, the Superstack and Copper Stack are permanently disconnected from all processes. Decommissioning of both stacks will be carried out in stages and in a safe manner in subsequent years

Results from the monitoring network indicate that annual mean SO₂ concentrations were well below the annual AAQC of 4 ppb SO₂ in 2021 at all stations. All Vale stations were calculated to have annual arithmetic mean concentrations that were 1.4 ppb SO₂ or less. The highest annual average for 2021, at any of the Vale stations, was 1.4 ppb SO₂ measured at the Spruce Street station. The graph again highlights the continuing improvement in measured levels when compared to historic data (see Figure 2).

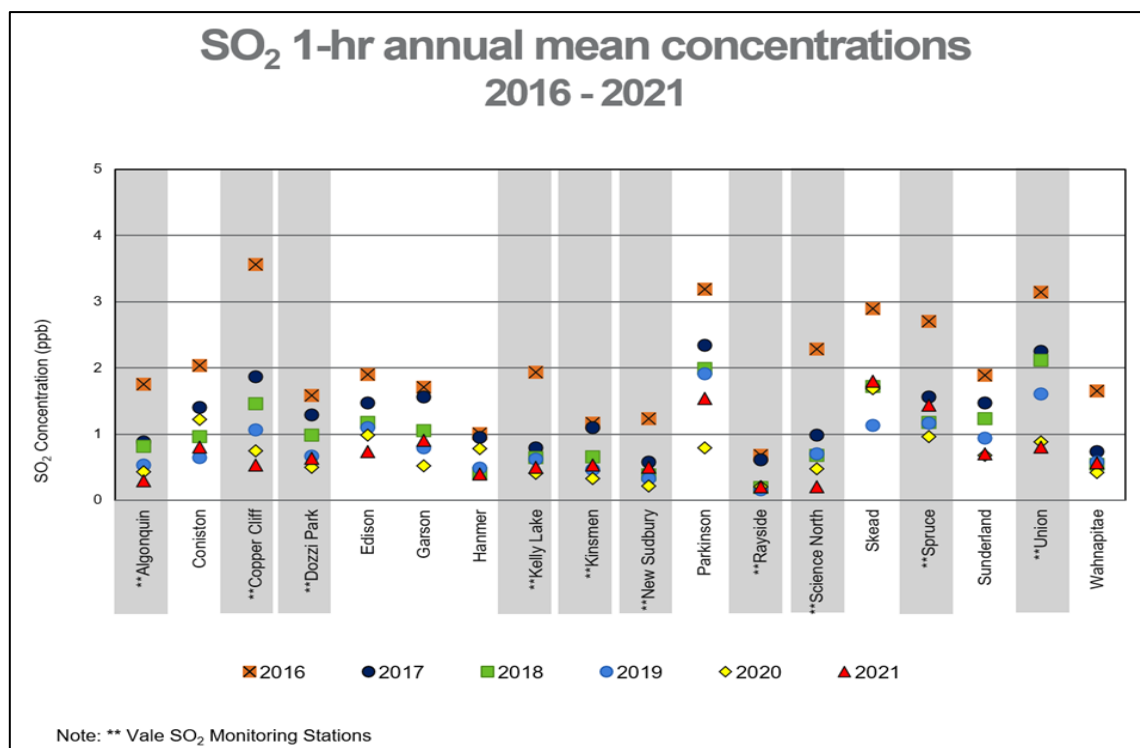


Figure 2: SO₂ Annual Mean Concentrations: All Stations 2016 to 2021

There was one (1) exceedance of the 1-hour SO₂ Ontario Regulation 419 standard of 250 ppb in 2021 measured at the Parkinson SO₂ monitoring station, however based on prevailing wind direction this exceedance is not associated with Vale operations. The highest maximum 1-hour SO₂ measured in 2021 at any of the **Vale SO₂ Monitoring Stations** was measured at the Kinsmen station, at 115 ppb. The graph below shows the 2016 to 2021 maximum 1-hour SO₂ concentrations for all the stations (see Figure 3).

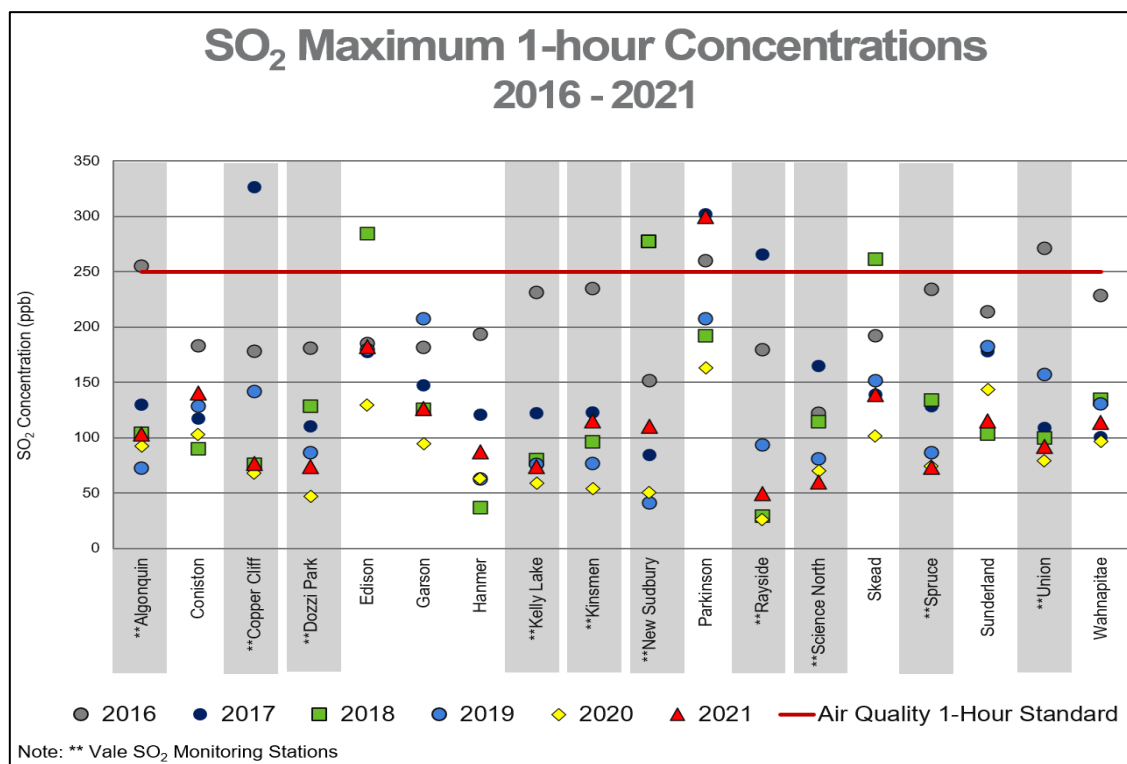


Figure 3: SO₂ Maximum 1-hour Concentrations (2016 to 2021)

4.2 Nickel

Vale's particulate sampling network operates on concurrent 3-day or 6-day sampling schedules, with 9 stations operating monitors that collect particulate matter on filters over a 24-hour period. The filters are sent to an independent lab/consultant for gravimetric and metals analyses and reporting.

Quarterly reports are posted on the Vale website as they become available (several weeks lag time required for filter and data analysis). A map showing the location of the 9 monitoring stations is provided below (Figure 4).

In 2021, the following nickel standards were in effect per the Nickel Site Specific Standard:

- 24-hr Upper Risk Threshold (URT) of 2 µg/m³ nickel.

- Annual average standard of $0.04 \mu\text{g}/\text{m}^3$ for Fielding Road monitoring station.
- Annual average standard of $1.0 \mu\text{g}/\text{m}^3$ for the remaining monitoring stations as per the site-specific standard in effect until December 2021.

In addition, there is a 24-hour standard for Total Suspended Particulate of $120 \mu\text{g}/\text{m}^3$.



Figure 4: Vale's particulate sampling network

There were three TSP exceedances measured in 2021:

- TSP Hi-Vol Particulate exceedance ($134 \mu\text{g}/\text{m}^3$) occurred on May 22nd at the Fielding Road Air Monitoring Station. A review of weather conditions on this day indicates that the source of the TSP was not from Vale sources
- TSP Hi-Vol Particulate exceedance ($128 \mu\text{g}/\text{m}^3$) occurred on December 18th at the Delki Dozzi Air Monitoring Station. A review of weather conditions on this day indicates that the source of the TSP was not from Vale sources.
- TSP Hi-Vol Particulate exceedance ($182 \mu\text{g}/\text{m}^3$) occurred on December 24th at the Spruce Street Air Monitoring Station. A review of weather conditions on this day indicates that the source of the TSP was not from Vale sources.

No nickel exceedances were reported in 2021. Nickel monitoring data for 2019, 2020 and 2021 for the 9 air quality monitoring stations are presented in the two graphs that follow. The most recent and historical detailed monitoring results for these and other metals measured at these stations are posted on the Vale website.

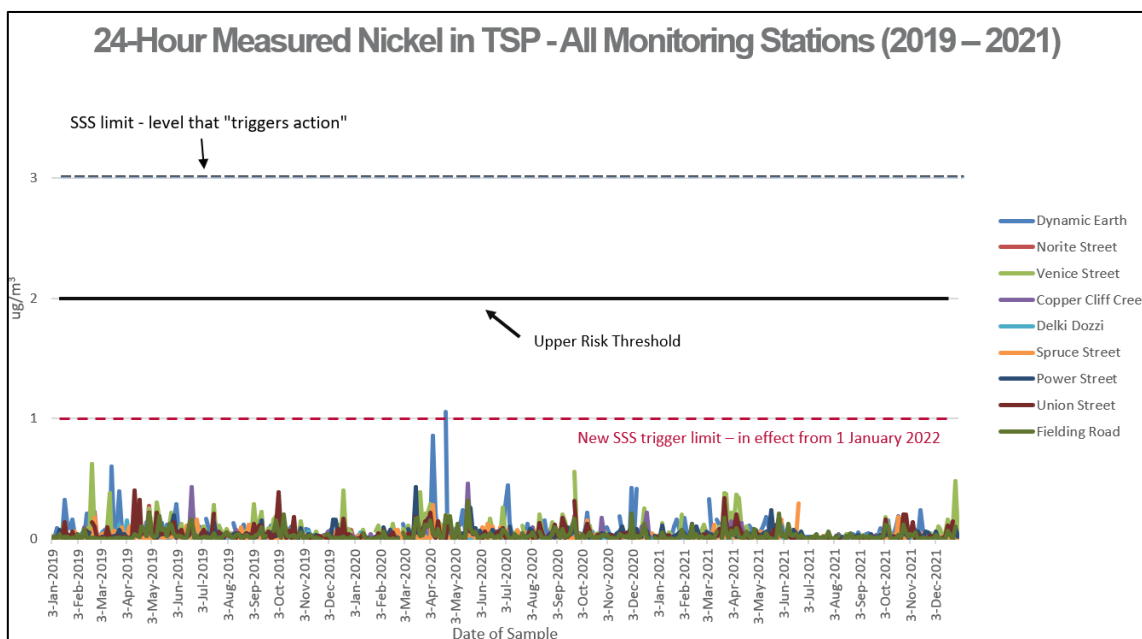
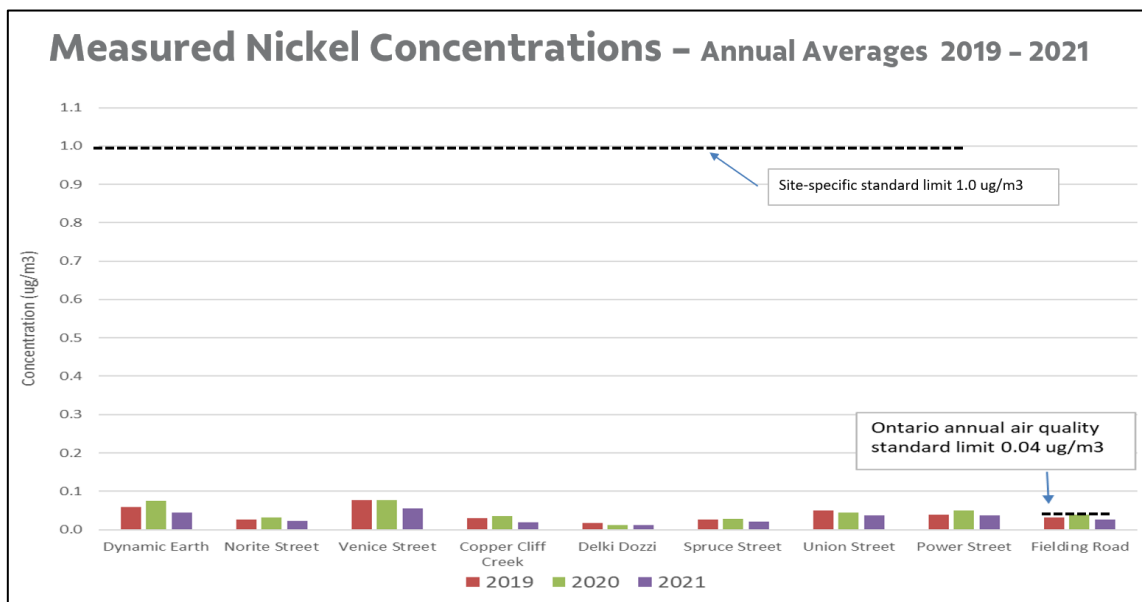


Figure 5: 24-hour Measured Nickel in TSP – all stations 2019 to 2021



Note: The Fielding Road station is not included in the nickel Site-specific Standard (SSS) for the Copper Cliff Smelter and as such fall under the Ontario annual standard limit of $0.04\mu\text{g}/\text{m}^3$.

Figure 6: Annual averaged Nickel concentrations – all stations 2019 to 2021

4.3 Dispersion Modelling

In addition to assessing compliance with air quality standards using community monitors, Vale also conducts dispersion modelling assessments, at least annually, to determine the maximum impact in the community from its emissions sources. The modelling predicts the maximum impact of various contaminants within a radius of at least 10km from Vale's operations using a 5-year meteorological data. The dispersion modelling conducted in 2021 demonstrated compliance with Ontario's air quality standards except for an event which occurred November 30 to December 3, 2021:

4.3.1 Exceedance of 1-hour SO₂ Standard

Upon startup, after a 3-week shutdown, elevated SO₂ emissions were measured from the Smelter's Weak Acid Treatment Plant Stack. This stack vents gasses from the headspace above various tanks containing liquid with dissolved SO₂ in them. Normally the gasses are scrubbed (SO₂ emissions reduced from 50g/s to below 2g/s) using a caustic solution, however a blockage formed during the 3-week shutdown (likely due to cold temperatures), preventing caustic injection in the scrubber. The dispersion modelling of the WATP Stack with the elevated SO₂ emissions resulted in a modelled 1-hour SO₂ exceedance of 2455µg/m³ compared to the standard of 690µg/m³ (which is equal to the upper risk threshold (URT)). The maximum 5-minute measured SO₂ at any of the community monitors during the event was 35ppb (less than 100µg/m³). The exceedance was reported to the MECP and the issue was resolved within 3 days. Vale is undertaking an Action Plan to prevent a future occurrence, including new alarms, instrumentation and training for operators.

5 Emissions Reduction Program

Vale's Emissions Reduction Program (ERP) has always been a significant contributor to the company's positive SO₂ emissions performance. The program has been evolving and adapting to operational changes to ensure compliance with the Environmental Compliance Approval (ECA). Even though the Superstack is no longer a source of SO₂ emissions, the ERP continues to be implemented. The ERP program was extensively restructured in 2019 to align with operational changes but the purpose of the ERP remains to predict and monitor dispersion conditions and to manage possible impacts that could result in elevated ambient SO₂ ground level concentrations in the community attributed to Vale sources.

The ERP Operator was traditionally responsible for controlling production in the Smelter converter and copper aisles (which were the major contributors to the Superstack plume) and in the Nickel Refinery converter aisle during adverse weather conditions. Now that there is no converter or copper production to control, the ERP Operator's role comprises of:

- Controlling production in the converter aisle of the Nickel Refinery.
- Monitoring weather, production and emissions monitoring systems – then providing guidance when certain maintenance activities and slag pouring activities should occur or be delayed.
- Mobile monitoring for SO₂ in the community when deemed necessary. In 2021, the mobile unit has been dispatched within the community a few times, actively monitoring for SO₂ only on two instances.

The ERP operators are available 24 hours per day, 7 days a week.

6 Environmental Community Concerns

The Smelter ECA and Nickel SSS require Vale to have a telephone number available to the public to register environmental complaints and concerns. All complaints/concerns must be documented and followed up. Vale has had a process in place to address community concerns for many years. For the Smelter, the telephone number is 705-682-8283. This number is answered by a Smelter employee 24 hours per day, 7 days per week. Vale also has a general community concerns line (705-222-VALE) that is also answered 24 hours per day, 7 days a week by an answering service. Vale employees respond to the concerns received on this line within 48 hours.

When community concern calls are received, they are routed to the appropriate department and the caller is contacted directly by a subject matter expert from Vale. A complaint log form is filled out that records the date, time, name, address and phone number of the person (if available), along with the wind direction at the time of the incident (available from Vale's meteorological records). Additional information (if applicable) is also captured in the log, including:

- Actions taken to investigate the cause of the complaint and result
- Recommendations for remedial measures
- Managerial/operational changes to avoid recurrence
- Feedback given to the caller

The Smelter ECA requires Vale to keep the complaint records on file for seven years, and to submit quarterly reports to the MECP summarizing the information about the complaints, including follow-up details. This information was submitted to the MECP for Q1, Q2, Q3 and Q4 of 2021.

Feedback on community concerns is also actively sought during various formal and informal interactions with our communities. The company invites the public to express their concerns through a variety of methods (phone lines, email, feedback forms and in person).

The Smelter Environmental Concerns Summaries for 2019 to 2021 are presented in Figure 7. There was a total of 11 community concerns logged in 2021, compared to 25 in 2020 and 57 in 2019.

The decreasing trend in number of complaints received is continuing with less than half the total number of complaints received in 2021 compared to total number received in 2020. The continuing downward trend can be directly attributed to the improvements made in recent years to capture sulphur dioxide resulting in a significant decrease in discharges to the atmosphere.

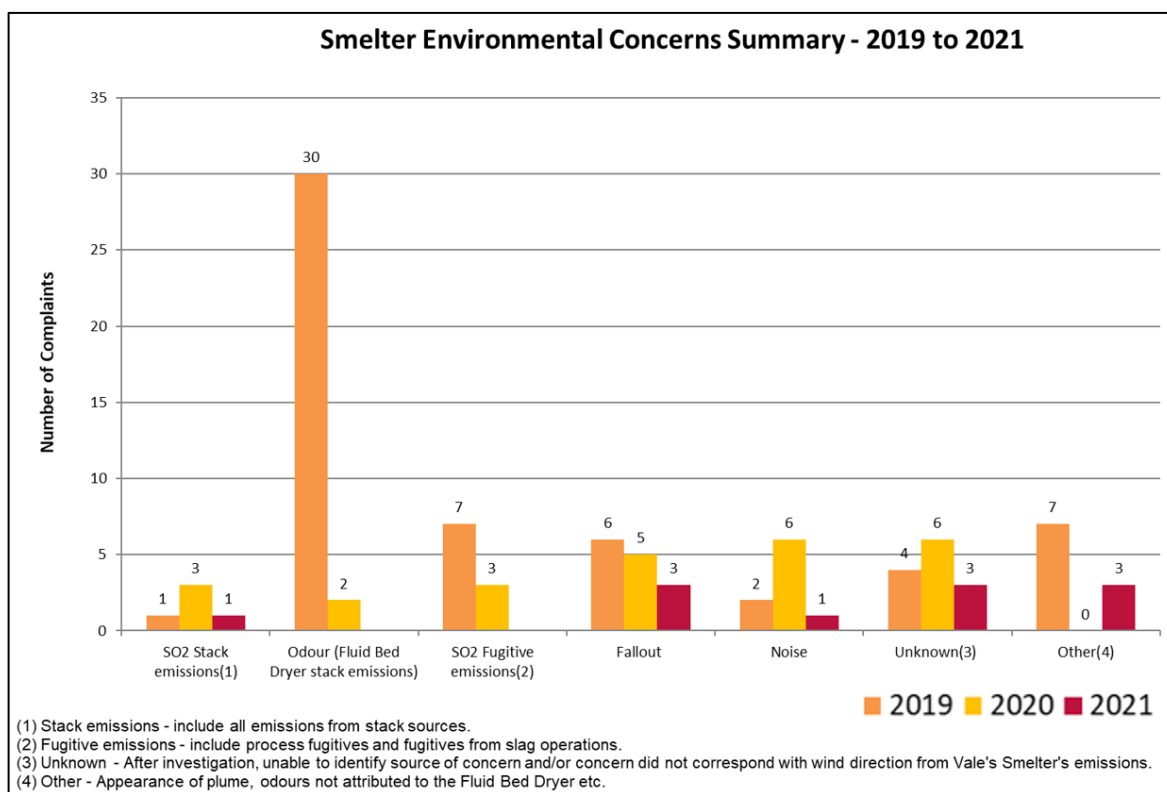


Figure 7: Vale Smelter Environmental Concerns Summary for 2019 to 2021

7 Nickel SSS Action Plan Update

The Nickel SSS of $1\mu\text{g}/\text{m}^3$ (annual) issued to Vale's Copper Cliff Smelter in 2011 expired at the end of 2021, and a new SSS of $0.4\mu\text{g}/\text{m}^3$ (annual) was issued December 23, 2021. All the action items in the 2011 Nickel SSS Action Plan had been implemented by the end of 2021 except the Material Handling Relocation project. The 2021 Nickel SSS Action Plan contains the following items:

| Action Plan Item | Timeline |
|--|--|
| Material Handling Relocation (This item was carried over from the previous Action Plan) | 2024 |
| Determine requirement for further track-out controls after MHR is complete | 2025 evaluation 2027 implementation if required |
| Implement Dust Emission Management Plan | ongoing |
| Study for options and cost Effectiveness to reduce traffic on main entrance road | 2026 |
| Annual evaluation and implementation of workroom improvement initiatives | 2023 and on |
| Annual workroom monitoring to confirm effectiveness of above | 2023 and on |
| Formal Housekeeping Protocol | 2023 and on |
| Formal Baghouse Protocol | 2023 and on |
| Study for efficiency of dust collection systems | 2026 |

Figure 8: 2021 Nickel SSS Action Plan

As with the previous Nickel SSS, Vale will continue preparing reports to update the status of its Action Plans annually. Updates are posted on Vale's website [\(link\)](#).

Initial construction activities related to improving foundation conditions occurred in 2021 for the Material Handling Relocation Project.

8 SO₂ Compliance

With the completion of the Clean AER and SFU projects, Vale's Copper Cliff Smelter and Nickel Refinery each meet the current provincial 1hr SO₂ standard of 690µg/m³, both modelled and measured.

Effective mid-2023, the MECP is reducing the 1hr SO₂ standard to 100µg/m³. When this was announced in 2018, the MECP recognized that various industries in Ontario would not be able to meet this standard and began working on Technical Standards or industry specific regulations to allow those industries to continue operating while progressively improving their SO₂ emissions scenarios. Specifically for the nickel smelting and refining industry, the MECP issued Regulation 652 in September 2021, which will be effective for Vale as of July 2023. The new regulation contains terms and conditions that require:

- Primary and secondary emissions capture on pyrometallurgical equipment (molten metal operations that generate SO₂)
- Study on the effectiveness of SO₂ capture over converting equipment
- Control of SO₂ emissions from pyrometallurgical equipment either by an Acid Plant, lime-injected baghouse, scrubber or other technology proposed by the company (with consideration for technical feasibility and cost-effectiveness)
- Monitoring and reporting requirements

9 Contact Info

For more information or to discuss this report, contact Gary Remington, Superintendent – Environment, Ontario Operations, Vale Canada Limited at: gary.remington@vale.com or 705-682-6866.