From: Rick Hind [redacted]
Sent: February 24, 2026 1:10 PM
To: DNV Input
Subject: Joint statement on malicious cyber activity targeting Canadian critical infrastructure - Canada.ca

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Council Members,
I am sharing a few items ahead of tonight's hearing to give you more time to read in advance of my oral remarks.
Rick Hind
[redacted]
https://www.canada.ca/en/communications-security/news/2025/11/joint-statement-on-malicious-cyber-activity-targeting-canadian-critical-infrastructure.html

Joint statement on malicious cyber activity targeting Canadian critical infrastructure

Communications Security Establishment Canada

November 26, 2025 – Ottawa, Ontario

Today, the Honourable David McGuinty, Minister of National Defence, and the Honourable Gary Anandasangaree, Minister of Public Safety, issued the following statement:

"Malicious cyber activity targeting Canada's critical infrastructure—like power, water, health, finance and transportation—are on the rise and are a real and urgent threat. These malicious activities are conducted by both cyber threat actors with ties to nation states and non-state actors and can disrupt essential services Canadians rely on every day. Any disruption to critical infrastructure is not only a threat to public health and safety, but also a threat to public confidence, the environment and the economy.

"State-sponsored cyber actors have the capability to target Canada's critical infrastructure, pre-positioning themselves to disrupt or destroy critical services in times of crisis or conflict. Cyber criminals and other non-state cyber actors continue to target critical infrastructure for financial gain, in support of geopolitical or ideological interests, or for personal reasons, such as acts of revenge by disgruntled former employees or customers.

"This is a call to be ready. Too often, hostile actors gain access to critical infrastructure through weaknesses that are preventable. We urge all critical infrastructure operators in Canada, particularly municipalities and private enterprises, to be vigilant and take immediate action to strengthen their defences. Adopt best practices in cyber security, like the Cyber Centre's Cyber Security Readiness Goals and secure-by-design principles. Report incidents promptly and work closely with government agencies to prevent and respond to threats.

"The Government of Canada is working tirelessly to detect, respond to, and mitigate threats. We are committed to transparency and collaboration, ensuring that Canadians and our critical infrastructure

sectors have the information and support they need to stay secure. We will continue to work with domestic partners and industry on countering and mitigating cyber threats to Canada's most essential systems.

"Protecting our critical infrastructure is essential for keeping Canadians safe and our economy strong. We call on all sectors and citizens to remain alert and take action—together, we can defend against cyber threats and safeguard our nation's future."

Associated links

- Backgrounder: Malicious cyber activity targeting Canadian critical infrastructure
- The cyber threat to Canada's water systems
- Security considerations for critical infrastructure (ITSAP.10.100)
- Cross-Sector Cyber Security Readiness Goals Toolkit

From:	DNV Input
To:	Mayor and Council - DNV
Subject:	FW: Speaking notes for Feb 24 public hearing
Date:	February 25, 2026 12:55:27 PM
Attachments:	Chemtrade speaking notes.docx

The below and attached are provided for information.

From: Chant.MLA, Susie <Susie.Chant.MLA@leg.bc.ca>
Sent: February 25, 2026 9:37 AM
To: DNV Input <input@dnv.org>
Subject: Speaking notes for Feb 24 public hearing

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Hello, please find attached Susie Chant's speaking notes from her participation in the February 24th public hearing on 100 Amherst Avenue.

Stephen Tweedale
Senior Constituency Advisor
North Vancouver-Seymour Constituency Office
Susie Chant, MLA
604-983-9859
bcgeu

Speaking notes for Feb 24th DNV Public Hearing on 100 Amherst Ave.

- Good evening, my name is Susie Chant.

- I'm joining you today from lands of the lək̓ʷəŋən People, those of the Songhees and Esquimalt.

- And I live in the District of North Vancouver, on the territory of the Squamish and Tsleil-Waututh Peoples.

- Thank you for the opportunity to address this public hearing.

- I'm speaking to you tonight as the member of the provincial legislature for North Vancouver-Seymour, in which Chemtrade's facility at 100 Amherst Avenue is located, as a health care professional, and as a lifelong North Shore resident.

- I'd like to express the strongest possible support for this application.

- Chemtrade is an important employer in the community, with one hundred and eighteen permanent, full time positions at its North Vancouver location.

- What I'd most like to focus on, however, is the fact that the continued operation of the Chemtrade facility is of crucial importance to our safe supply of drinking water here in North Vancouver and throughout British Columbia.

- Chlorine is a versatile disinfectant that kills many types of bacteria, viruses, and parasites that cause waterborne infections.

- The addition of chlorine to our water supply has greatly reduced the risk of these infections, and played a major role in virtually eliminating diseases like typhoid fever, cholera, and dysentery in developed countries.

- Simply put, chlorine is the disinfectant of choice for water treatment experts.

- And the vast majority of the liquid chlorine used to ensure the safety of drinking water in BC is produced right here in our community, at this facility.

- No alternative domestic source exists that can supply enough chlorine to meet the needs of our communities.

- But if the rezoning application before this council is not approved, and Chemtrade is forced to shut down this facility, the best case scenario is that the safety of our communities will be at the mercy of imported American supplies of chlorine.

- The reliability of those supplies would be contingent on the reliability of the people – well, let's be frank – the *person* controlling US trade policy.

- After the events of the last year, I for one do not relish the prospect of staking the safety of what's coming out of our taps on

the reliability and good will of the American president.

- And, as I said, that is the *best* case scenario.

- The worst case scenario is that we will no longer be able to meet our need for liquid chlorine at all.

- Not for love or money, not by hook or by crook.

- That's because American manufacturers of liquid chlorine are shuttering their facilities, which use outmoded, environmentally unsound production techniques employing asbestos.

- Even if these facilities can be modernized in a cost-effective manner – which is far from clear – doing so will still involve shutdowns that disrupt supply.

- The bottom line here is that the safety of our communities depends on protecting our domestic supply of liquid chlorine, and the facility at 100 Amherst is an essential component of that domestic supply.

- As for the safety of the facility itself, I would note that it has an operated with an outstanding safety record over a span of decades.

- This record is a testimony to the diligence of an exemplary workforce, a strong safety culture fostered and upheld by their employer, and the major investments in increased safety that Chemtrade has made over the years – with even more

improvements to come, if this application is approved.

- There is a lot at stake here.
- I don’t want to get cholera.
- And take it from a nurse: neither do you.
- I urge you to approve this application.
- Thank you.

From: DNV Input
To: DNV Input
Subject: FW: Water treatment
Date: February 25, 2026 12:56:29 PM
Attachments: image001.png

From: Marilyn Towill <Marilyn.Towill@metrovancouver.org>
Sent: Tuesday, February 24, 2026 9:03 PM
To: Lisa Muri <MuriL@dnv.org>
Subject: RE: Water treatment

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

We currently use sodium hypochlorite for our water treatment processes at our two water treatment plants (SCFP & CWTP) as well as our eight secondary disinfection stations.

Additional information:

- Some local municipalities who receive treated water from Metro Vancouver use sodium hypochlorite in their local rechlorination stations which are used to boost residual chlorine levels in their water distribution systems.
- Many non-Metro municipalities utilize sodium hypochlorite as part of their treatment processes – both primary treatment and rechlorination.
- Liquid Waste Services uses sodium hypochlorite for disinfection of their treated liquid waste prior to discharge to the environment. I believe this is mostly during the summer months.

Let me know if you have additional questions or need any more information.

Marilyn Towill, P. Eng.
General Manager
Water Services
t. 604.451.6069
c. 604.612.1131

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

From: Lisa Muri <MuriL@dnv.org>
Sent: Tuesday, February 24, 2026 8:30 PM

To: Marilyn Towill <Marilyn.Towill@metrovancouver.org>
Subject: Water treatment

WARNING: *This email originated from outside of our organization. Do not click any links or open attachments unless you trust the sender and know the content is safe.*

do we use pure chlorine to treat our water or hypochlorite?

Get Outlook for iOS

From: Jonsson, Amy <ajonsson@chemtradelogistics.com>
Sent: February 25, 2026 2:53 PM
To: Yan Zeng; DNV Input
Cc: Bossons, Dale; Robinson, Alan; Ritchey, Bryan; Afrooz Fallah
Subject: Submission from Chemtrade in regard to Feb 25 Public Hearing
Attachments: DNV rezoning application Feb 24 hearing follow up.pdf; MSDS sheet for SODIUM HYPOCHLORITE 12.5 PERCENT.pdf; NTSB NS Derailment and Hazardous Materials Release.pdf

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello Yan and District of North Vancouver,

Attached are three submissions from Chemtrade:

- A written submission of responses to question raised during the Feb 24 Public Hearing,
- A summary of the rail incident in East Palestine, Ohio,
- And a MSDS sheet for high potency bleach.

If you have any questions, please let me know.

Thank you –
Amy

This e-mail (including any attachments) is for the sole use of the intended recipient and may contain confidential information which may be protected by privilege. If you are not the intended recipient, please notify the sender immediately, delete this e-mail and destroy any copies. E-mail transmission cannot be guaranteed to be secure or error-free and the sender cannot accept responsibility for any errors or omissions resulting from such transmission. Thank you.

Chemtrade North Vancouver Rezoning Application Supporting Information

Securing safe drinking water for Canada

February 25, 2026

During the February 24, 2026, Public Hearing there was a lot of information shared around chlorine versus bleach, the limitations and challenges for both, historical incidents, and the movement of chlorine in North America.

Recent Rail Safety Data

- In the U.S. in 2024, there were **1,013,606 hazmat rail shipments** and in the U.S. and Canada, there were **~53,000 TIH shipments**.
- Across the more than 1 million hazmat shipments, only **41** incidents occurred which were classified as serious, **none involving fatalities**.
- The last serious chlorine related rail incident occurred in **2019**, involving a one-pound release with **no injuries**.
- There have been **no significant chlorine rail incidents since 2005** (Graniteville), which resulted in nine fatalities and ultimately prompted major changes to tank car specifications, regulations, and operating practices.
- Across approximately **20 million hazmat shipments over the past 20 years (2006–2025)**, there has been **one fatality** (in 2009; PHMSA 5800 report ID X-2009070185).

Taken together, the data makes one point abundantly clear: the probability of a serious hazardous materials release by rail is low, and decades of continuous engineering, regulatory improvement, and operational discipline have made rail the safest and most reliable way to transport hazmat over land. With more than 99.9% of all shipments arriving without incident, a steadily declining accident rate, and only a single fatality in roughly 20 million hazmat rail movements over the past 20 years, rail transportation provides a safety performance unmatched by any other ground-based mode.

References: *NTSB report from East Palatine incident, PHMSA 5800 database, www.aar.org*

Using chlorine to make bleach:

Bleach is the most widely used product for water treatment in Canada, and you cannot make bleach without chlorine. Chemtrade produces liquid chlorine, which is then shipped to customers across Canada and the US, where they take the liquid chlorine and process it into bleach, and then sell it to water treatment customers across Canada.

In a country as large as Canada, chlorine is required as bleach, even at high potency, breaks down significantly faster than chlorine. This reduced the distance it can be transported significantly, reducing shelf life and effectiveness.

Currently, liquid chlorine, when transported in a liquid chlorine railcar can be shipped and stored for up to six months before there is product degradation. Typically, a high-potency bleach made at 12.5% available chlorine will have decomposed to circa 10% within a week of manufacture under

the best of storage and handling conditions. (source: https://www.solenis.com/en/resources/blog/the-stability-of-chlorine-bleach-solutions/).



This greatly limits how far bleach can be transported, and for how long it can be stored and continue to be effective.

It is important to note that industrial bleach is approximately twice as concentrated as household bleach and is classified as a hazardous material. It is a strong corrosive and can cause severe skin burns and eye damage if exposed. It has a pH of 12-13.5 and is very toxic to aquatic life. If it is mixed with an acid, it will rapidly decompose and release chlorine gas.

The shipment of bleach:

Currently, liquid chlorine is transported by rail, the safest way to move hazardous materials in Canada, which is heavily regulated by the federal government.

The Chemtrade facility moves about 1400 liquid chlorine railcars from the facility (approximately 3 - 4 per day). In order to move the same amount of bleach to meet customers' needs, in Canada and the US, ***we would need to use over 80,000 bulk truck shipments (bleach is transported via truck) – this equates to about 220 trucks a day leaving our facility. This creates additional risk as the likelihood of an incident on local roadways would increase significantly***.

This not only adds to the cost for municipalities but also increases the carbon footprint of the product. Based on a round trip of approximately 1,000 kilometers per truck, that would produce 368,000 tonnes of carbon dioxide per year, which is equivalent to about seven per cent (7%) of all emissions from vehicles Metro Vancouver.

Quantitative Risk Assessment (QRA) Plan Development:

Chemtrade initially engaged BakerRisk to develop an updated quantitative Risk Assessment (QRA) plan for the facility in late 2023.

BakerRisk is an international organization that is one of the world's leading organizations in developing quantitative risk assessment (QRA) reports. Chemtrade provided BakerRisk with the draft engineering for the planned safety upgrades to model the impact of the planned upgrades on the facilities risk assessment.

BakerRisk uses advanced modelling technology and internationally accepted practices to develop the risk modeling for Chemtrade's facility – incorporating several scenarios in the risk assessment planning, including the release of hydrogen, gaseous chlorine, liquid chlorine, and hydrochloric acid.

Areas assessed in the QRA for possible releases include all process equipment, pressure vessels, piping systems, and railcar loading systems on site. Over 50 different potential leak sources (including areas like accidental railcar release, storage release, rail loading area accidental

release), and various causes (such as human error, piping rupture, equipment failure, or earthquake) are reflected in the final QRA curves. It should be noted that specific consideration was given to understanding the chlorine rail loading system release risk, as that is considered one of the high-risk activities on site.

An offsite derailment is not the focus of the QRA report.

The findings of the report showed that following the completion of the planned safety updates, the 10^{-6} risk contour would be at or near the property line. According to MIACC guidelines, there would be very few development restrictions beyond that line, which means that there would be very few development restrictions outside of Chemtrade's property line, and greatly reduced risk to the community.

In the fall of 2025, Chemtrade submitted the completed BakerRisk risk assessment report to the District of North Vancouver (the District) as part of its rezoning application package. As part of the District's rezoning application process, Baker Risk's final risk assessment report was sent to a company named RiskTec for independent peer review. This is a globally accepted model and practice.

K2 Pure Solutions and the Keep North Vancouver Safe Campaign:

In September 2024, journalists exposed the company behind the Keep North Vancouver Safe campaign, which had been running a campaign based on inaccurate information to try and drive opposition to the continued operation of the Chemtrade facility in North Vancouver. The campaign generated false letters and sent them to Council to try and create a sense of community resistance.

The company was K2 Pure Solutions, a bleach producer, based in Toronto, with operations in California. The company is a direct competitor to Chemtrade. The full article which ran on CBC, "**Campaign against B.C. chlorine plant was secretly funded by rival. Big money is trying to covertly influence local government, politicians say**", can be found here: *https://www.cbc.ca/news/canada/british-columbia/north-van-chlorine-plant-campaign-1.7319259. A full-length version of the article will also be part of our submission in Appendix A. We also included a link to the related article in CBC regarding the governments efforts to review lobbying as a result of this campaign, as Appendix B.*

Once the effort was uncovered, K2 Pure Solutions co-founder David Cynamon provided a statement to the media outlet, which was quoted in the article:

"K2 Pure Solutions co-founder David Cynamon, the former Argonauts owner, wrote in his own statement that the campaign was meant to shed light on the behind-the-scenes activities by Chemtrade, and provide residents of North Vancouver with the facts, and let them decide whether they want to support the continued production and transport of chlorine in their community."

Cynamon did not directly answer a question about whether running the anonymous campaign was ethical.

Late Wednesday afternoon, Cynamon issued a statement apologizing for how K2 Pure Solutions ran the campaign. The statement was also publicly posted on the Keep North Vancouver Safe website.

"We sincerely apologize if our lack of transparency has caused mistrust, and we hope that this mistake does not distract from the facts of the matter," Cynamon said."

A summary of the Graniteville, South Carolina Train Collision and Chlorine Release: *the incident that was a driver for improved car design, regulatory oversight and operations* (NTSB/RAR-05/04)

On January 6, 2005, at approximately 2:39 a.m., Norfolk Southern freight train 192, traveling about 47 mph, encountered a misaligned manual switch in Graniteville, South Carolina. The switch diverted the train from the main line onto an industry track, where it collided with standing Norfolk Southern local train P22. The collision derailed both locomotives and 16 of the 42 cars on train 192, as well as the locomotive and one car of P22.

Chlorine Tank Car Breach and Chemical Release

Three derailed tank cars contained **chlorine**; one of them (the **9th car**) was **punctured** by the coupler of the 11th car, releasing a large chlorine vapor cloud. This resulted in:

- **Nine fatalities** (the engineer plus eight civilians) due to chlorine gas inhalation
- **554 people** seeking medical care
- **75 hospital admissions**
- A **1-mile evacuation zone** displacing **~5,400 residents for several days**
- Total damages exceeding **$6.9 million**

The chlorine release expanded rapidly due to the gas's density (2.5× heavier than air), settling into low lying areas and producing a highly toxic atmosphere within minutes. Approximately **120,000 pounds** of chlorine were released.

Cause of the Accident

The **probable cause** was the **failure of the P22 crew** to **reline the main-line switch to its normal position** after completing work the previous evening. Contributing factors included:

- Lack of any reminder or visual cue indicating the switch position
- Crew time pressure near the end of their hours-of-service limit
- No job briefing at the industry track
- Poor visibility of the switch target from their final work position

Tank Car Performance

The punctured chlorine tank car was a **DOT-105J500W**, among the **strongest pressure tank cars** at the time in service.

Despite:

- Normalized steel

- 500-psi pressure rating
- Head and shell plates (13/16 in. head; ~0.78 in. shell)

It was still punctured due to impact from a steel coil car at approximately **42 mph**, demonstrating that even the most robust TIH tank cars **of the era** could not reliably withstand moderate speed derailment forces.

Key Safety Issues Identified

1. **Improperly lined switches** as a major national cause of train accidents
2. **Lack of conspicuous switch-position indicators** in non-signaled territory
3. **Tank car crashworthiness limitations** at moderate impact speeds
4. **Crew vulnerability to inhalation hazards** after surviving collisions

NTSB Safety Recommendations

The NTSB recommended that the Federal Railroad Administration (FRA):

Switch Safety

- Require **automatic visual/electronic switch-status indicators** in non-signaled territory (R-05-14)
- Require **speed restrictions** allowing trains to stop in time for misaligned switches (R-05-15)

TIH Tank-Car Risk Reduction

- Require **operational controls** such as positioning TIH tank cars toward train rear and reducing speeds through populated areas (R-05-16)

Crew Protection

- Require **emergency escape breathing apparatus** for crews on trains carrying inhalation hazard materials (R0517)

Bottom Line

The Graniteville disaster was caused by a **simple human error -** a switch left improperly lined—that triggered a cascade of consequences due to:

- the presence of **highly toxic chlorine**,
- **moderate-speed impact forces**, and
- vulnerabilities in both tank-car design and operating practices.

The incident drove major regulatory change and helped launch years of tank-car safety research—including efforts that eventually led to the **HM-246** TIH tank-car specifications and the **ATCCRP** initiative.

The **Advanced Tank Car Collaborative Research Program (ATCCRP)** was a multiyear, multistakeholder research initiative focused on improving the **safety, security, and crashworthiness** of rail tank cars transporting **Toxic Inhalation Hazard (TIH)** materials. It brought together shippers (ACC, CI, TFI), railroads (AAR), tank car builders/lessors (RSI), and U.S./Canadian government partners (PHMSA, FRA, DHS/TSA, and Transport Canada).

The program built on earlier work, including the **Next Generation Rail Tank Car (NGRTC)** project.

Purpose

ATCCRP's objective was to determine whether TIH tank cars could be made substantially more resistant to puncture and catastrophic release, and whether features beyond the existing **HM246 interim TIH tank car specifications** could provide meaningful improvements.

In December 2016, five major industry groups—The Chlorine Institute (CI), American Chemistry Council (ACC), The Fertilizer Institute (TFI), Association of American Railroads (AAR), and Railway Supply Institute (RSI)—jointly petition PHMSA to **convert the HM246 "interim" tank car standards for TIH (Toxic Inhalation Hazard) materials into the permanent, final regulatory specification**.

Industry demonstrates that **HM-246–compliant TIH tank cars have shown exceptional accident survivability**:

- **33 chlorine cars** meeting HM-246 spec have been involved in derailments/incidents.
- **14** had major damage (> $35,000 repairs).
- **6** rolled on their sides.
- **Zero releases of chlorine occurred.**
- Additionally, **10 HM-246 cars** carrying other TIHs derailed with **no releases**.

This demonstrates that the "interim" design already provides **dramatically improved real-world performance**.

Looking at the release in East Palestine:

The February 3, 2023 Norfolk Southern mixed freight derailment in East Palestine, Ohio, was a significant and unfortunate incident. The event was triggered by the catastrophic overheating and failure of a wheel bearing on a hopper car. At the time of the derailment, the train was traveling approximately 43 mph.

A total of 38 railcars derailed, including 11 hazardous materials tank cars. Several DOT111 tank cars carrying flammable and combustible liquids were punctured, releasing their contents and igniting, which resulted in a large, multiday fire.

Five DOT105J300W tank cars transporting vinyl chloride monomer (VCM) also derailed but **remained intact**. Although temperature readings showed the VCM tanks were stable or cooling, Norfolk Southern and its emergency response contractors asserted that dangerous polymerization was occurring and authorized a **vent and burn** of all five cars. Explosive charges were used to open each tank, igniting the VCM and creating a large, controlled fireball. The NTSB later concluded that this operation was **unnecessary**.

Relevance to Chlorine Rail Shipments

Several key points stand out in comparison to the discussion on chlorine rail shipments:

1. **Train Speed:**
   The derailment train was moving at ~43 mph—**13 mph above** the 30mph speed limit applied to chlorine tank car trains operating through Vancouver.
2. **DOT111 Car Performance:**
   The punctured DOT111 cars carrying flammable products had **inferior designs** relative to chlorine tank cars and are now **prohibited for flammable liquid service**.

3. **105J300W Car Performance:**
   The DOT105J300W cars transporting VCM have **significantly lower puncture resistance, crashworthiness, shell and head thickness, and pressure rating than chlorine tank cars**—yet none breached during the derailment.

Findings from the Advanced Tank Car Collaborative Research Program (ATCCRP)

The ATCCRP—funded jointly by PHMSA, FRA, DHS/TSA, Transport Canada, and industry—found that **increases in wall thickness and pressure class correlate strongly with improved puncture resistance** in TIH (Toxic Inhalation Hazard) tank car designs.
Key takeaways:

- The tank car specifications present in the East Palestine derailment (105J300W and DOT111) represent **older baseline designs** with significantly lower energy absorption capability.
- The **105H600W chlorine car specification**, aligned with the HM246 rule, provides:
  - Far higher puncture energy
  - Much lower conditional probability of release (CPR)
  - Better performance under oblique impacts and small impactor scenarios

Safety Performance of Railroads

Railroads remain the **safest mode of land transportation** for hazardous materials, playing a critical role in protecting communities, employees, and the environment.
The industry has:

- Implemented rigorous tank car design standards
- Developed specialized mobile apps for first responders
- Partnered with FRA to create route analysis software identifying the safest and most secure hazmat corridors
- Continued major investments in infrastructure, technology, and employee training

As a result, the **hazmat accident rate has fallen 80% since 2005**, reaching its **lowest level ever**. More than **99.9% of hazmat shipments by rail reach their destination without a release** caused by a train accident.
References: *NTSB report from East Palatine incident, PHMSA 5800 database, www.aar.org*

APPENDIX A: CBC article regarding source of Keep North Vancouver Safe campaign

https://www.cbc.ca/news/canada/british-columbia/north-van-chlorine-plant-campaign

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Campaign against B.C. chlorine plant was secretly funded by rival

Big money is trying to covertly influence local government, politicians say

Zak Vescera · for CBC News · Posted: Sep 11, 2024 5:00 AM PDT | Last Updated: September 11, 2024

Listen to this article
Estimated 9 minutes



Chemtrade Logistics Inc. facility in North Vancouver, B.C., on Wednesday, Aug. 28, 2024. (Ben Nelms/CBC)

294 comments

This story is a collaboration between the Investigative Journalism Foundation (IJF) and CBC Vancouver.

An online lobbying campaign against a North Vancouver chemical plant is secretly funded by one of that company's competitors.

For months, the anonymous directors of the website "Keep North Vancouver Safe" have spent thousands of dollars trying to convince local elected officials to stop chlorine production at a facility run by Chemtrade Logistics Inc. in the District of North Vancouver.

The group's Facebook page describes it as a local "environmental conservation organization" concerned about the environmental and safety risks posed by a hypothetical chlorine spill.

But an IJF and CBC Vancouver investigation has found the campaign was created by a Toronto-based lobbying firm working for K2 Pure Solutions, a company co-founded by a former owner of the Toronto Argonauts. Chemtrade considers K2 to be a top competitor.

The campaign appears designed to foil Chemtrade's bid to renew a lease that would allow it to keep producing chlorine.

WATCH | Chemical company targets rival with online influence campaign:



An online lobbying campaign targeting a North Vancouver chemical plant is secretly funded by one of that company's rivals, as revealed by a CBC News and Investigative Journalism Foundation investigation. District of North Vancouver councillors have received hundreds of emails from accounts claiming to be local residents who are concerned about a potential chlorine spill, but as Jon Hernandez reports, the campaign has been traced to a Toronto-based lobby firm and one of Chemtrade's direct competitors.

In June, social media users in the Lower Mainland began seeing advertisements from Keep North Vancouver Safe suggesting a chlorine disaster related to Chemtrade's North Vancouver plant is imminent.

One advertisement features a skull and crossbones and warns that "chlorine gas is invisible and can have severe health implications." Another, titled "Chlorine: A History of Danger," lists dates of chlorine disasters in North America and finishes with: "Vancouver, 20??."



An advertisement from Keep North Vancouver Safe suggests Vancouver is due for a chlorine disaster. (Keep North Vancouver Safe)

Elected officials targeted by the campaign say it is an example of big money trying to covertly influence local politics.

"It's awful. It's a horrible feeling. It really is not fair," said District of North Vancouver Coun. Lisa Muri. She said K2 should have been transparent about its identity and intentions.

"It's not honest. And certainly, in this day of division and divisiveness in society and in politics, why do we want to perpetuate dishonesty?" Muri said.

K2 did not make a spokesperson available for an interview. Neither did Crestview Strategies, the public relations agency that created the website.



District councillor Lisa Muri says it wasn't made clear to local leaders who was behind the Keep North Vancouver Safe campaign. (Jon Hernandez/CBC)

Senior Crestview consultant Jason Craik, a former staffer for ex-B.C. premier John Horgan, said in a written statement that the anonymous campaign was meant to "provide information to the residents of the District of North Vancouver" in response to Chemtrade's own public lobbying efforts.

K2 Pure Solutions co-founder David Cynamon, the former Argonauts owner, wrote in his own statement that the campaign was meant to "shed light on the behind-the-scenes activities by Chemtrade, and provide residents of North Vancouver with the facts, and let them decide whether they want to support the continued production and transport of chlorine in their community."

Cynamon did not directly answer a question about whether running the anonymous campaign was ethical.

Late Wednesday afternoon, Cynamon issued a statement apologizing for how K2 Pure Solutions ran the campaign. The statement was also publicly posted on the Keep North Vancouver Safe website.

"We sincerely apologize if our lack of transparency has caused mistrust, and we hope that this mistake does not distract from the facts of the matter," Cynamon said.

A quiet campaign

Crestview's campaign came at a decisive moment for Chemtrade.

The company's chemical plant in North Vancouver sits partially on land leased from the Vancouver Fraser Port Authority.

That plant, which employs roughly 120 people, has produced chlorine for more than 60 years under various owners.

The facility's current lease with the port authority, though, expires in 2030, when it will be required to stop making chlorine on port land.

Chemtrade is negotiating with the port authority to extend that lease and has lobbied all levels of government to secure their support.



Chemtrade's lease to produce chlorine on its site in North Vancouver ends in 2030. (Ben Nelms/CBC)

Alan Robinson, the company's group vice-president, commercial, said the company plans to submit an application for safety upgrades to the District of North Vancouver council.

As of Sept. 6, the Meta Ad library estimates Keep North Vancouver Safe spent more than $18,400 on 11 advertisements on Facebook and Instagram, most of them garnering tens of thousands of impressions.

Keep North Vancouver Safe has just a few dozen followers on those platforms, and the website — which contains multiple references to "the safety of our community" — contains no details about who runs it.

The website encourages users to contact elected officials using an embedded email feature. Listed recipients include the District of North Vancouver mayor and councillors, two MLAs and Premier David Eby.



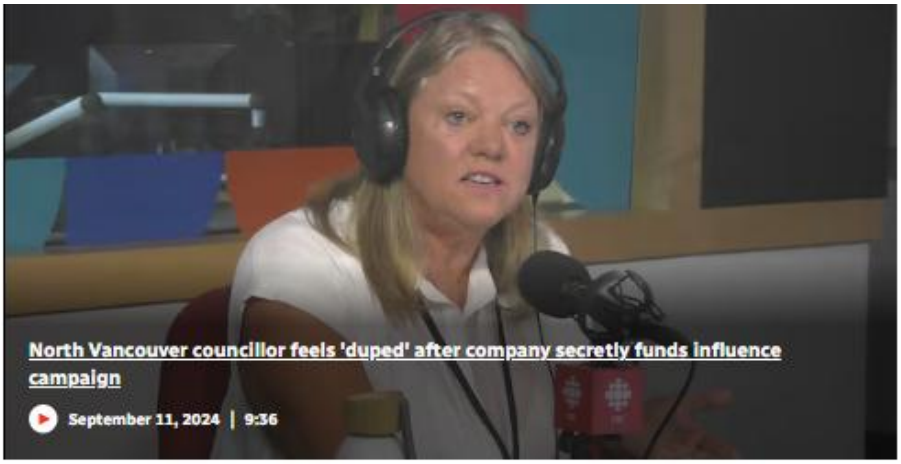
District councillor Catherine Pope reviews emails sent to her through the Keep North Vancouver Safe campaign. (Jon Hernandez/CBC)

District of North Vancouver Coun. Catherine Pope said in an August interview that she was receiving between 10 and 20 emails a day. She said that is the most correspondence she has received on any given issue since she was elected in 2022.

Pope said she was suspicious of those emails. She could not confirm the writers were residents, she said, and didn't like that the site's operators were anonymous.

"There is nothing on that website that identifies who is behind it. That concerns me. It is not transparent," Pope said.

WATCH | District of North Vancouver Coun. Catherine Pope reacts to revelations of online influence campaign:



Catherine Pope speaks about a recent collaboration between the Investigative Journalism Foundation and CBC Vancouver, which revealed that K2 Pure Solutions poured thousands of dollars into an effort to stop chlorine production at a plant run by the its rival.

The office of Susie Chant, the NDP MLA for North Vancouver–Seymour, confirmed she was also receiving those emails — and raised questions about their authenticity.

"From the around 30 emails they've received stemming from this website, only three seem to be possibly linked to real people, and of those three, it's unclear if they're even in her riding," B.C. NDP spokeswoman Julia Witte wrote in an email.

Witte did not respond to multiple emails and calls seeking clarification about why the party believed those messages were fake.

Robert Neubauer, a professor at the University of Winnipeg's Department of Rhetoric, Writing and Communications, said the campaign has the hallmarks of "astroturfing," when an interest group tries to imitate an organic, grassroots community campaign.

Neubauer said such strategies are perfectly legal but morally dubious.

"If you're transparent about [lobbying], that's just part of democracy. When you get into the astroturfing hiding who is behind the organization, then it becomes a problem," he said.

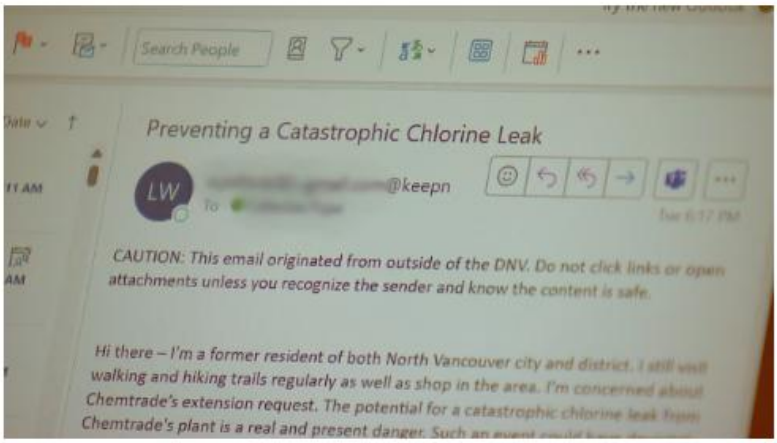
'It's not going to sway my decision'

Robinson, the Chemtrade vice-president, said his company noticed the advertisements but did not know who bought them.

"Usually, when there is lobbying or anything, you'd be open about who you are or what you represent," Robinson said.

Indeed, lobbyists at the provincial and federal levels typically have to publicly register who they work for, what they are lobbying for and the officials they have contacted.

But the Office of the Registrar of Lobbyists for B.C. says that rule doesn't apply to "grassroots lobbying efforts" wherein an organization encourages members of the public to contact officials about a given issue. That means it likely wouldn't apply to the emails sent to MLAs through the Keep North Vancouver Safe website.



An email from the Keep North Vancouver Safe campaign warns local politicians about a "catastrophic chlorine" leak. (Jon Hernandez/CBC)

"Lobbying legislation in some other jurisdictions does apply to grassroots lobbying, but the [provincial Lobbyists Transparency Act] does not," wrote Michelle Mitchell, a spokeswoman for the office.

The IJF and CBC Vancouver were able to identify Crestview's role in creating the website thanks to code on the website that included Crestview's name.

The IJF and CBC also found an older version of the website's email embed feature that listed a Crestview lobbyist as a recipient.

Craik, the Crestview lobbyist, had also directly approached officials at the municipal level.

On April 1, he wrote an email to District of North Vancouver Mayor Mike Little asking to speak with him about Chemtrade's lease on behalf of "a group of concerned stakeholders," according to a copy of those messages the IJF obtained through Freedom of Information legislation.

Popular Now in British Columbia

1 **Over 7K 'assault-style' firearms declared by British Columbians applying to buyback program**

2 **First signs of herring spawn spark excitement on Vancouver Island**

3 **Vancouver councillor calls his opponents drug users and dealers in social media video**

4 **Half-brother of Tumbler Ridge shooter arrested for breaking bail on attempted murder charge**

5 **1 person dead in avalanche near Pemberton, B.C.**

On April 1, he wrote an email to District of North Vancouver Mayor Mike Little asking to speak with him about Chemtrade's lease on behalf of "a group of concerned stakeholders," according to a copy of those messages the IJF obtained through Freedom of Information legislation.

- **Mysterious group behind mass texts seeking Canadians' views on carbon tax**

The IJF and CBC Vancouver have confirmed Craik also contacted Pope and Muri with a similar message.

In his written response, Craik said K2 Pure Solutions had lobbied officials across North America to end the practice of transporting chlorine by rail.



Instagram and Facebook ads from Keep North Vancouver Safe highlight concerns over Chemtrade's chemical production. (Keep North Vancouver Safe)

Craik said K2 aims to produce "exceptionally pure" bleach, which he argues can replace chlorine for water purification.

"We hope that by shining a light on what has been happening behind closed doors in their community, residents of the District of North Vancouver can now start asking their elected councillors the right questions and, frankly, whether they have their constituents or Chemtrade's best interests in mind," Craik said.

Robinson, though, said it would not be feasible for Chemtrade to switch wholesale to bleach production, in part because the product could not be transported long distances.

"You can't ship it far enough to really do the ecological approach that they're really suggesting," Robinson said.

Cynamon, K2's co-founder, argued in his statement that K2 Pure Solutions was not a direct competitor to Chemtrade because it does not transport chlorine and is located in a different region. But Chemtrade's latest quarterly reports do list K2 as a "key competitor" in the production of various chemicals, including chlorine.

Popular Now in British Columbia

1. Over 7K 'assault-style' firearms declared by British Columbians applying to buyback program
2. First signs of herring spawn spark excitement on Vancouver Island
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4. Half-brother of Tumbler Ridge shooter arrested for breaking bail on attempted murder charge
5. 1 person dead in avalanche near Pemberton, B.C.

"It's a competitor, so you can kind of assume what the benefits would be for a competitor if we had to close down our facility," Robinson said.

Robinson said he is not concerned about the lobbying affecting a potential deal with the port authority and the district. Nor were district councillors convinced.

'It's not going to sway my decision," Muri said.

She and Pope said they were frustrated Crestview and K2 Pure Solutions conducted their campaign secretly.

Muri compared it to the 2022 local election in Squamish, B.C., where an anonymous Facebook campaign spent more than $78,000 on advertisements targeting specific candidates, according to reporting from The Breach and The Tyee.

Muri's message to companies: "Honesty is the best policy."

- **Online bot campaign backing Pierre Poilievre prompts call for probe by election commissioner**

"Why wouldn't they just come clean and present who they were and be honest about it?" Muri said.

Corrections

- An earlier version of this story identified David Cynamon as a co-founder of Crestview Strategies. In fact, he is a co-founder of K2 Pure Solutions.
  Sep 11, 2024 10:47 AM PDT

ABOUT THE AUTHOR



Zak Vescera

Zak Vescera

Zak Vescera is a journalist based in Vancouver where he reports for the Investigative Journalism Foundation. He previously reported for the Tyee and the Saskatoon StarPhoenix.

With CBC files from Jon Hernandez and IJF files from Carly Penrose and Tori Marlan

Popular Now in British Columbia

1. **Over 7K 'assault-style' firearms declared by British Columbians applying to buyback program**
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APPENDIX B: CBC article regarding BC Attorney General intent to increase laws against anonymous lobbying

https://www.cbc.ca/news/canada/british-columbia/anonymous-lobbying-campaigns-bc-law-attorney-general-1.7345585

British Columbia

Time to tighten B.C. laws on anonymous lobbying: attorney general

Niki Sharma says re-elected B.C. NDP government would introduce new rules on 'grassroots' campaigns

Zak Vescera · for CBC News · Posted: Oct 08, 2024 9:33 AM PDT | Last Updated: October 8, 2024

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Estimated 5 minutes



The Chemtrade Logistics Inc. facility in North Vancouver, B.C., pictured on Aug. 28. An IJF/CBC Vancouver investigation found an anonymous lobbying campaign sought to influence local politicians' views on the chlorine plant. (Ben Nelms/CBC)

178 comments

This story is a collaboration between the Investigative Journalism Foundation (IJF) and CBC Vancouver.

British Columbia's attorney general says she wants to amend provincial laws to unmask special interest groups behind anonymous lobbying campaigns.

Niki Sharma said she hopes to introduce legislation that would require the groups behind so-called "grassroots" campaigns to declare who they are and who they are working for.

Sharma made the comment while reacting to an IJF/CBC Vancouver investigation about an anonymous lobbying campaign that sought to influence local politicians' views on a North Vancouver chlorine plant.

- **Campaign against B.C. chlorine plant was secretly funded by rival**

The campaign was quietly financed by a rival chemical company, which later apologized for the covert nature of its advertisements.

"The story was troubling when I heard about it," Sharma said in an interview conducted before B.C.'s election campaign began.

"Our lobby transparency act is an important tool to make sure things are done in a transparent way and you don't have this hidden lobbying ... that is a conflict or problematic. And we need to constantly step up our laws to do that."



B.C. Attorney General Niki Sharma says she wants to review B.C.'s lobbying regulations to improve tansparency behind grassroots campaigns. (Darryl Dyck/The Canadian Press)

Sharma, a B.C. NDP candidate who is seeking re-election in the Oct. 19 election, said she would revise provincial lobbying laws to apply to such campaigns if her party forms government. The Lobbyist Transparency Act is set to be reviewed in 2025.

- **Company apologizes for anonymous campaign against chlorine plant**

The Conservative Party of B.C., the NDP's main opposition in the election, did not respond to a request for comment on whether it would also change that law.

The IJF/CBC Vancouver investigation found that Ontario-based K2 Pure Solutions hired public relations firm Crestview Strategy to create a website and a suite of social media advertisements raising concerns about safety near the North Vancouver facility run by Chemtrade Logistics Inc.

It encouraged people to write directly to MLAs and district councillors, many of whom were alarmed that the campaign didn't identify a funder.

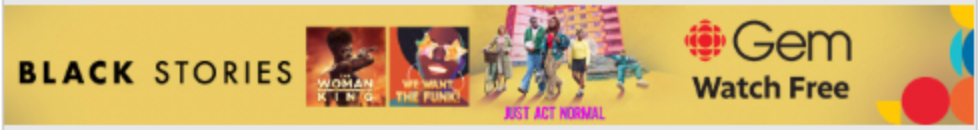
WATCH | Campaign against chlorine facility traced to rival company and lobby firm:



An online lobbying campaign targeting a North Vancouver chemical plant is secretly funded by one of that company's rivals, as revealed by a CBC News and Investigative Journalism Foundation investigation. District of North Vancouver councillors have received hundreds of emails from accounts claiming to be local residents who are concerned about a potential chlorine spill, but as Jon Hernandez reports, the campaign has been traced to a Toronto-based lobby firm and one of Chemtrade's direct competitors.

Normally, lobbyists who try to influence provincial officials in B.C. have to declare who they are and who they work for. But in B.C. those rules don't apply to "grassroots" campaigns, in which an interest group encourages members of the public to write to elected officials on a given issue.

"It's frustrating for the public, I'm guessing, to hear that there's groups trying to hide who is funding their campaigns," said District of North Vancouver Mayor Mike Little. "It helps us all to have full disclosure of who is lobbying our communities."

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The phenomenon isn't specific to B.C. A separate IJF investigation found Crestview Strategy had also created other anonymous or opaque websites on topics ranging from the Israel-Hamas conflict to land leases for a Toronto airport.

Ontario and the federal government have adopted rules that require disclosure around such "grassroots" campaigns.

Ian Stedman, an associate professor of Canadian law and public governance at York University, said the goal of such laws is to compel special interests to disclose their activity without unduly limiting the ability of ordinary citizens and advocacy groups to communicate concerns to government officials.

"Lobbyist registration laws are not about prohibiting people from lobbying," Stedman said.

"They're about making sure the lobbying that happens is publicly disclosed so members of the public and interested parties can go online and find out who is trying to influence policy and policymakers."



Instagram and Facebook ads from the Keep North Vancouver Safe campaign highlight concerns over Chemtrade's chemical production. (Keep North Vancouver Safe)

Stedman, a former employee of Ontario's Integrity Commissioner, argued such laws are even more important "in an era where we have digital fakes, deepfakes and online misinformation campaigns."

He said if B.C. does modernize its laws, it should include clauses on how those technologies could be used in such campaigns and give powers to independent commissioners to investigate potential violations.

"Like many laws, [lobbying] laws probably didn't contemplate the insane digital world that we live in," Stedman said.

Concerns over municipal lobbying

Little also says it's time for the province to start regulating lobbying at the municipal level.

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Currently, there is no requirement for lobbyists who want to influence local governments in B.C. to register via the provincial system.

The mayor argues that can allow large interests a lot of power in small towns. He pointed to Squamish, B.C., where a network of anonymous Facebook groups spent tens of thousands of dollars on advertisements targeting elected officials in the lead-up to a 2022 campaign.

"For municipalities, it's a little bit of a Wild West," Little said. "Not only can these groups lobby local governments, they can use their individuals to make donations to different campaigns and influence public policies in those ways.

"So, it's not like the federal and provincial governments where you have overt lobbying registrations, where you know who exactly is working for who."

Only the cities of Kelowna and Surrey maintain lobbyist registries in B.C., though Vancouver has also explored the idea.

Little argued a single, provincial system is needed, given smaller municipalities like his don't have the administrative resources to run their own registries.

In 2019, the Union of B.C. Municipalities endorsed a resolution asking the province to create a single, provincially administered lobbying registry. But the idea has yet to come to fruition.

Sharma said a municipal registry "was not a bad idea" but stopped short of any commitment.

ABOUT THE AUTHOR



Zak Vescera

Zak Vescera

SAFETY DATA SHEET

SODIUM HYPOCHLORITE 12.5%

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	SODIUM HYPOCHLORITE 12.5%
Other means of identification	:	Not applicable.
Recommended use	:	Sanitizer
Product dilution information	:	0.004 % - 0.16 %
Company	:	ECOLAB PTY LTD 2 Drake Avenue Macquarie Park, NSW Australia 2113 1 800 022 002
Emergency telephone number	:	1800 205 506, +64 7 958 2372
Issuing date	:	23.10.2020

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Product AS SOLD

Skin corrosion/irritation	:	Category 1B
Serious eye damage/eye irritation	:	Category 1

Product AT USE DILUTION
Not a hazardous substance or mixture.

GHS Label element

Product AS SOLD
Hazard pictograms :



Signal Word	:	Danger
Hazard Statements	:	Causes severe skin burns and eye damage.
Precautionary Statements	:	**Prevention:** Do not breathe dusts or mists. Wash skin thoroughly after handling. Wear protective gloves/ protective clothing/ eye protection/ face protection. **Response:** IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Wash contaminated clothing before reuse. **Storage:**

Store locked up.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Product AT USE DILUTION
Precautionary Statements : **Prevention:**
Wash hands thoroughly after handling.
Response:
Get medical advice/ attention if you feel unwell.
Storage:
Store in accordance with local regulations.

Product AS SOLD
Other hazards : Contact with acids liberates toxic gas.
Product AS SOLD

Mixing this product with acid or ammonia releases chlorine gas.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Product AS SOLD
Pure substance/mixture : Mixture

Chemical Name	CAS-No.	Concentration: (%)
sodium hypochlorite	7681-52-9	10 - 30

Product AT USE DILUTION

No hazardous ingredients

Section: 4. FIRST AID MEASURES

Product AS SOLD

In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

If swallowed : Contact the Poison's Information Centre (eg Australia 13 1126; New Zealand 0800 764 766).

Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.

If inhaled : Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.

Protection of first-aiders : If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Notes to physician : Treat symptomatically.

Most important symptoms and effects, both acute and delayed : See Section 11 for more detailed information on health effects and symptoms.

Product AT USE DILUTION

In case of eye contact	:	Rinse with plenty of water.
In case of skin contact	:	Rinse with plenty of water.
If swallowed	:	Contact the Poison's Information Centre (eg Australia 13 1126; New Zealand 0800 764 766). Rinse mouth. Get medical attention if symptoms occur.
If inhaled	:	Get medical attention if symptoms occur.

Section: 5. FIREFIGHTING MEASURES

Product AS SOLD

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting	:	Exposure to decomposition products may be a hazard to health.
Hazardous combustion products	:	Decomposition products may include the following materials: Halogenated compounds metal oxides
Special protective equipment for firefighters	:	In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.
Hazchem Code	:	2X

Section: 6. ACCIDENTAL RELEASE MEASURES

Product AS SOLD

Personal precautions, protective equipment and emergency procedures	:	Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain

material to ensure runoff does not reach a waterway.

Product AT USE DILUTION

Personal precautions, protective equipment and emergency procedures	:	Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	No special environmental precautions required.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway.

Section: 7. HANDLING AND STORAGE

Product AS SOLD

Advice on safe handling	:	Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Use only with adequate ventilation. Wash hands thoroughly after handling. Do not get in eyes, on skin, or on clothing. Mixing this product with acid or ammonia releases chlorine gas. In case of mechanical malfunction, or if in contact with unknown dilution of product, wear full Personal Protective Equipment (PPE).
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.
Storage temperature	:	0 °C to 40 °C

Product AT USE DILUTION

Advice on safe handling	:	Wash hands after handling. In case of mechanical malfunction, or if in contact with unknown dilution of product, wear full Personal Protective Equipment (PPE). For personal protection see section 8.
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Product AS SOLD
Components with workplace control parameters

Contains no substances with occupational exposure limit values.

Engineering measures	:	Effective exhaust ventilation system. Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection	:	Safety goggles Face-shield
Hand protection	:	Wear the following personal protective equipment: Standard glove type. PVC Impervious gloves Gloves should be discarded and replaced if there is any indication of

degradation or chemical breakthrough.

Skin protection	:	Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing Chemical resistant apron
Respiratory protection	:	Refer to AS/NZS 1715 and AS/NZS 1716 for selection, use and maintenance of respiratory protective equipment as applicable. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Product AT USE DILUTION

Engineering measures	:	Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Personal protective equipment

Eye protection	:	Safety glasses
Hand protection	:	Wear the following personal protective equipment: Standard glove type. PVC
Skin protection	:	No special protective equipment required.
Respiratory protection	:	Refer to AS/NZS 1715 and AS/NZS 1716 for selection, use and maintenance of respiratory protective equipment as applicable. No personal respiratory protective equipment normally required.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

		Product AS SOLD	Product AT USE DILUTION
Appearance	:	liquid	liquid
Colour	:	yellow	colourless
Odour	:	Chlorine	Chlorine
pH	:	12.0 - 13.5, (100 %)	8.5 - 10.5
Flash point	:	Not applicable., Does not sustain combustion.	
Odour Threshold	:	no data available	
Melting point/freezing point	:	no data available	
Initial boiling point and boiling range	:	100 °C	
Evaporation rate	:	no data available	
Flammability (solid, gas)	:	Not applicable.	
Upper explosion limit	:	no data available	
Lower explosion limit	:	no data available	

Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.15 - 1.25
Water solubility	:	soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition	:	no data available
Viscosity, kinematic	:	no data available
Explosive properties	:	no data available
Oxidizing properties	:	no data available
Molecular weight	:	no data available
VOC	:	no data available

Section: 10. STABILITY AND REACTIVITY

Product AS SOLD

Reactivity	:	No dangerous reaction known under conditions of normal use.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Mixing this product with acid or ammonia releases chlorine gas.
Conditions to avoid	:	None known.
Incompatible materials	:	Acids Organic materials Metals
Hazardous decomposition products	:	In case of fire hazardous decomposition products may be produced such as: Halogenated compounds metal oxides

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Product AS SOLD

Eyes	:	Causes serious eye damage.
Skin	:	Causes severe skin burns.
Ingestion	:	Causes digestive tract burns.
Inhalation	:	May cause nose, throat, and lung irritation.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Product AT USE DILUTION

Eyes	:	Health injuries are not known or expected under normal use.
Skin	:	Health injuries are not known or expected under normal use.
Ingestion	:	Health injuries are not known or expected under normal use.
Inhalation	:	Health injuries are not known or expected under normal use.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Product AS SOLD

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Pain, Corrosion
Ingestion	:	Corrosion, Abdominal pain
Inhalation	:	Respiratory irritation, Cough

Product AT USE DILUTION

Eye contact	:	No symptoms known or expected.
Skin contact	:	No symptoms known or expected.
Ingestion	:	No symptoms known or expected.
Inhalation	:	No symptoms known or expected.

Toxicity

Product AS SOLD
Product

Acute oral toxicity	:	no data available
Acute inhalation toxicity	:	no data available
Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Components

Acute oral toxicity : sodium hypochlorite
LD50 rat: 5,230 mg/kg

Components

Acute dermal toxicity : sodium hypochlorite
LD50 rabbit: > 10,000 mg/kg

Section: 12. ECOLOGICAL INFORMATION

Product AS SOLD
Ecotoxicity

Environmental Effects : Very toxic to aquatic life.

Product

Toxicity to fish : no data available

Toxicity to daphnia and other aquatic invertebrates : no data available

Toxicity to algae : no data available

Components

Toxicity to fish : sodium hypochlorite
96 h EC50: 0.14 mg/l

Components

Toxicity to daphnia and other aquatic invertebrates : sodium hypochlorite
48 h EC50: 0.071 mg/l

Persistence and degradability

Product AS SOLD
Not applicable - inorganic

Bioaccumulative potential

no data available

Mobility in soil

no data available

Other adverse effects

no data available

Section: 13. DISPOSAL CONSIDERATIONS

Product AS SOLD

Disposal methods : Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.

Disposal considerations : Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers. Dispose of in accordance with local, state, and federal regulations.

Product AT USE DILUTION

Disposal methods : Diluted product can be flushed to sanitary sewer.

Disposal considerations : Dispose of in accordance with local, state, and federal regulations.

Section: 14. TRANSPORT INFORMATION

Product AS SOLD

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (ADG)

UN number	:	1791
Description of the goods	:	HYPOCHLORITE SOLUTION
Class	:	8
Packing group	:	III
Hazchem Code	:	2X

Sea transport (IMDG/IMO)

UN number	:	1791
Description of the goods	:	HYPOCHLORITE SOLUTION
Class	:	8
Packing group	:	III
Marine pollutant	:	No

Section: 15. REGULATORY INFORMATION

National regulatory information

Standard for the Uniform Scheduling of Medicines and Poisons : Schedule 5

The components of this product are reported in the following inventories:

United States TSCA Inventory :
All substances listed as active on the TSCA inventory

Canadian Domestic Substances List (DSL) :
All components of this product are on the Canadian DSL.

Australia. Australian Industrial Chemicals Introduction Scheme (AICIS) :
On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand :
not determined

Japan. ENCS - Existing and New Chemical Substances Inventory :
On the inventory, or in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) :
On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) :
On the inventory, or in compliance with the inventory

China Inventory of Existing Chemical Substances :
On the inventory, or in compliance with the inventory

Taiwan Chemical Substance Inventory :
On the inventory, or in compliance with the inventory

Section: 16. OTHER INFORMATION

Sources of key data used to compile the Safety Data Sheet
Globally Harmonized System of Classification and Labelling of Chemicals (GHS)
IARC: (International Agency for Research on Cancer)
US. National Toxicology Program (NTP) Report on Carcinogens
ECHA List of Publishable Substances Registered
EU HPVCs (High Production Volume Chemicals)

Issuing date	:	23.10.2020
Date of first issue	:	25.11.2015
Version	:	1.1
Prepared by	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

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June 25, 2024 Railroad Investigation Report RIR-24-05

Norfolk Southern Railway Derailment and Hazardous Materials Release

East Palestine, Ohio
February 3, 2023

Abstract: This report discusses the February 3, 2023, derailment and subsequent hazardous materials releases involving Norfolk Southern Railway train 32N in East Palestine, Ohio. The derailment occurred shortly after a hot bearing detector broadcast a critical alarm about a wheel bearing's temperature. The derailed equipment included 11 tank cars carrying hazardous materials. Three of these hazardous materials tank cars sustained mechanical breaches during the derailment and released flammable or combustible materials; five others released flammable gases as a result of fire exposure or deliberate breaching with explosives to perform a vent and burn procedure. The safety issues identified in this report include the failure of systems intended to identify failing wheel bearings, inadequate training of volunteer first responders, delayed transmittal of train consist information to first responders, illegibility of fire-damaged placards, use of tank cars with documented poor derailment performance, a tank car certification process that could not ensure that tank car fittings are compatible with approved commodities, misleading written guidance and information about chemical hazards, and a flawed communication and decision-making process leading up to the deliberate breach of five tank cars containing vinyl chloride monomer. New recommendations are made to the Secretary of Transportation, the Federal Railroad Administration, the Pipeline and Hazardous Materials Safety Administration, the state of Ohio, the Columbiana County Emergency Management Agency, the Association of American Railroads, the International Association of Fire Chiefs, the International Association of Fire Fighters, the National Volunteer Fire Council, The Chlorine Institute, the American Chemistry Council, Norfolk Southern Railway, and Oxy Vinyls, LP. One recommendation is reiterated to the Class I railroads. One recommendation to the Secretary of Transportation, one recommendation to the Pipeline and Hazardous Materials Safety Administration, and two recommendations to the Federal Railroad Administration are classified.

NOTE: This report was reissued on July 23, 2024, with corrections to the description of the tank car TILX402025 lease on pages 57–58.

Contents

Figures ..... **iv**
Tables ..... **vi**
Acronyms and Abbreviations ..... **vii**
Executive Summary ..... **x**
What Happened x
What We Found x
What We Recommended xii
1 Factual Information **1**
1.1 Derailment Description 1
1.1.1 Prederailment Train Movements 2
1.1.2 Derailment and Initial Emergency Response 7
1.1.3 Vent and Burn 15
1.2 Norfolk Southern Railway 32
1.3 Data Recorders 32
1.4 Track and Signals 34
1.5 Wayside Bearing Defect Detection 37
1.5.1 Wayside Bearing Defect Detector Equipment and Configuration 38
1.5.2 NS Wayside Help Desk 40
1.5.3 NS Wayside Detector Alert and Alarm Criteria 40
1.5.4 Industry-Wide Use of Wayside Bearing Defect Detection 42
1.5.5 Other Bearing Defect Detection Technologies 44
1.6 Hopper car GPLX75465 45
1.6.1 Manufacture, Ownership, and Movement History 45
1.6.2 Bearing Examination 46
1.7 Accident Tank Cars 50
1.7.1 Summary of Derailed Equipment 50
1.7.2 Summary of Breaching Damage 51
1.7.3 Tank Car Certification 55
1.7.4 VCM Tank Cars 57

1.7.5 Postderailment Tank Car Examinations and Tests 59
1.8 Hazardous Materials 63
1.8.1 Vinyl Chloride, Stabilized (UN1086, Division 2.1) 65
1.8.2 Ethylene Glycol Monobutyl Ether (NA1993, Combustible Liquid) 69
1.8.3 Ethylhexyl Acrylate (NA1993, Combustible Liquid) 69
1.8.4 Isobutylene (UN1055, Division 2.1) 69
1.8.5 Butyl Acrylates (UN2348, Class 3) 70
1.8.6 Benzene Residue (UN1114, Class 3) 70
1.9 Emergency Response 70
1.9.1 Incident Command Structure 70
1.9.2 Emergency Responder Interoperability 72
1.9.3 The Chlorine Institute Chlorine Emergency Plan 73
1.9.4 Firefighter Training Requirements 74
1.9.5 Placarding 77
1.10 Vent and Burn Frequency and Guidance 78
1.11 Rules and Requirements for Hazardous Materials Trains 83
1.11.1 Key Trains and Key Routes 83
1.11.2 High-hazard Flammable Trains and Key Trains 85
1.11.3 Consist Notification 86
1.12 NTSB Special Investigation 87
1.13 Postaccident Actions 88
1.13.1 PHMSA 88
1.13.2 FRA 91
1.13.3 Norfolk Southern 94
2 Analysis 98
2.1 Introduction 98
2.2 The Derailment 100
2.2.1 Derailment Markings 100
2.2.2 Hopper Car GPLX75465 and L1 Bearing 101
2.2.3 Mechanical Inspection of Hopper Car 102
2.2.4 Bearing Failure Detection 103

2.2.5 Accident Bearing Failure Analysis 111
2.3 Early Emergency Response 113
2.3.1 Initial Deployment of Firefighters 113
2.3.2 Communication and Consist Information 115
2.3.3 Placard Legibility 121
2.4 Tank Car Derailment Performance 122
2.4.1 Sources of Released Material 124
2.4.2 Non-Pressure Tank Cars 125
2.4.3 Pressure Tank Cars 135
2.4.4 High-Hazard Flammable Trains 138
2.4.5 Key Trains 141
2.5 The Vent and Burn 141
2.5.1 Polymerization 142
2.5.2 Quality of VCM Hazard Information 149
2.5.3 Vent and Burn Communication and Justification 151
2.5.4 Vent and Burn Criteria 157
2.6 Locomotive Data Recorders 158
3 Conclusions 166
3.1 Findings 166
3.2 Probable Cause 170
4 Recommendations 172
4.1 New Recommendations 172
4.2 Previously Issued Recommendations Reiterated in this Report 177
4.3 Previously Issued Recommendations Classified in this Report 177
Board Member Statements 179
Appendixes 182
Appendix A: Investigation 182
Appendix B: Consolidated Recommendation Information 183
References 194

Figures

Figure 1. Overhead view of derailment and early fire. (Courtesy of Eric's Train Yard.). 2
Figure 2. Train 32N's route. 3
Figure 3. Map of final three HBDs encountered before derailment. 5
Figure 4. Diagram of hopper car wheelset and bearing positions. 6
Figure 5. Fire on wheelset #1 of the hopper car passing through Salem, Ohio. 6
Figure 6. Map of derailment site and command post. 9
Figure 7. Derailment pileup and VCM tank cars. 16
Figure 8. PRDs venting material energetically (left) and more typically (right). 17
Figure 9. Illustration of a vent and burn procedure. 19
Figure 10. The vent and burn 3 minutes after detonation. (Courtesy of NS.) 30
Figure 11. South running rail at MP 49.5. 36
Figure 12. Wheel flange marks on crossties east of MP 49.5. 37
Figure 13. Example of a Progress Rail Micro HBD. 39
Figure 14. Diagram of HBD scan location. 40
Figure 15. L1 journal as found on the scene. 47
Figure 16. Other L1 bearing components post recovery. 47
Figure 17. Diagram of a bearing with the journal removed. (Courtesy of SKF Group.) 47
Figure 18. Recovered bearing cup and other components. 49
Figure 19. Recovered bearing journal. 49
Figure 20. Leading A-end head punctures on tank car UTLX205907. 53
Figure 21. Tank car OCPX80235's protective housing with the aluminum cover missing. 60
Figure 22. Metallic debris in the PRDs of tank cars equipped with aluminum protective housing covers. 60
Figure 23. PRD diagram (left) and top-down view of exemplar (right). (Diagram courtesy of Midland Manufacturing with NTSB edits.) 62
Figure 24. NIMS incident command structure. (Courtesy of FEMA.) 71
Figure 25. Replacement placard on a derailed DOT-105 tank car containing isobutylene. 77
Figure 26. Postderailment photographs of placards exposed to heat. 78

Figure 27. FRA vent and burn checklist. (Courtesy of the FRA.) 82
Figure 28. Locations of derailment evidence. 102
Figure 29. Summary of HBD temperature measurements, alerts, and alarms. 104
Figure 30. Graph of VCM vapor pressure by temperature. 146
Figure 31. Measured temperatures and trendline for OCPX80370. 147
Figure 32. Tank car OCPX80370 temperature graph with vent and burn timing. 153

Tables

Table 1. Timeline of prederailment events. 7
Table 2. Timeline of HBD notification and early emergency response. 15
Table 3. SPSI tank car temperature measurements. 24
Table 4. Timeline of vent and burn decision. 31
Table 5. Summary of image recorder information. 32
Table 6. Timeline of recorder data requests and action. 34
Table 7. Summary of wayside detector survey results. 43
Table 8. Summary of breaching damage to hazardous materials tank cars. 52
Table 9. Summary of breaching damage to non-hazardous materials tank cars. 55
Table 10. Metallic debris sample information. 61
Table 11. Regulatory definitions of hazardous materials involved in the derailment. 64
Table 12. Summary of derailed hazardous materials. 64
Table 13. Loading temperatures and pressures for VCM tank cars. 68
Table 14. Lading information for VCM tank cars. 68
Table 15. Overheated bearing accidents by year. 108
Table 16. Summary of breaching damage to hazardous materials tank cars. 123
Table 17. Hazardous materials releases from DOT-111 tank cars. 131
Table 18. NTSB investigations of VCM releases. 143

Acronyms and Abbreviations

Abbreviation	Name
AAR	Association of American Railroads
ABD	acoustic bearing detector
ATC	advanced train control
BLEVE	boiling liquid expanding vapor explosion
BOV	bottom outlet valve
CCEMA	Columbiana County Emergency Management Agency
CFR	*Code of Federal Regulations*
CHLOREP	Chlorine Emergency Plan
CISA	Cybersecurity and Infrastructure Security Agency
CLM	car location messaging
EMS	emergency medical services
EPFD	East Palestine Fire Department
EPPD	East Palestine Police Department
ERG	Emergency Response Guidebook
ERI	Emergency Response Information
ESI	Explosive Service International
FAST Act	Fixing America's Surface Transportation Act
Fed. Reg.	*Federal Register*
FEMA	Federal Emergency Management Agency

Abbreviation	Name
FRA	Federal Railroad Administration
HBD	hot bearing detector, also called a hotbox detector
HHFT	high-hazard flammable train
IAFC	International Association of Fire Chiefs
IAFF	International Association of Fire Fighters
MP	milepost
NECP	National Emergency Communications Plan
NFPA	National Fire Protection Association
NPRM	Notice of Proposed Rulemaking
NIMS	National Incident Management System
NS	Norfolk Southern Railway
NTSB	National Transportation Safety Board
NVFC	National Volunteer Fire Council
Ohio EMS	Ohio Division of Emergency Medical Services
PHMSA	Pipeline and Hazardous Materials Safety Administration
PL	Public Law
PRD	pressure relief device
PSAP	Public Safety Answering Point
psig	pounds per square inch (gauge)
PTC	positive train control

Abbreviation	Name
PVC	polyvinyl chloride
SDS	safety data sheet
SPSI	Specialized Professional Services, Inc
SRS	Specialized Response Solutions
TRRA	Terminal Railroad Association of St. Louis
TSB	Transportation Safety Board of Canada
USDOT	United States Department of Transportation
VCM	vinyl chloride monomer
WENS	Wireless Emergency Notification System

Executive Summary

What Happened

On February 3, 2023, about 8:54 p.m., eastbound Norfolk Southern Railway (NS) train 32N derailed 38 mixed freight railcars at milepost 49.5 on the NS Fort Wayne Line of the Keystone Division in East Palestine, Ohio. Three tank cars carrying flammable and combustible hazardous materials were mechanically breached during the derailment. A fire ignited during the derailment and grew to involve lading released from these three mechanically breached tank cars, additional derailed tank cars carrying both hazardous and non-hazardous materials, and freight cars. Emergency responders established a 1-mile evacuation zone that affected about 2,000 residents. The derailed equipment included five hazardous materials tank cars carrying vinyl chloride monomer (VCM), a compressed liquified flammable gas offered for shipment as "UN1086 vinyl chloride, stabilized, 2.1." The five VCM tank cars were not mechanically breached during the derailment, but over the next day, four of these tank cars were exposed to fires and released material from pressure relief devices. These releases ceased on the afternoon of February 4. Acting on information provided by NS and its contractors that a dangerous chemical reaction was occurring within a VCM tank car, the incident commander managing the response chose to expand the evacuation zone and perform a vent and burn (a deliberate breach of a tank car) on all five derailed VCM tank cars. The incident commander was not aware of dissenting opinions the VCM shipper had provided to NS and its contractors. A contractor hired by NS breached the VCM tank cars at 4:37 p.m. on February 6, releasing and igniting their lading. No injuries were reported during the derailment or emergency response.

What We Found

The derailment occurred because a bearing on a hopper car overheated and caused an axle to separate. There was not enough evidence to determine whether a mechanical inspection conducted before the derailment failed to identify signs of bearing failure; the bearing may not have been showing visible problems at the time of the inspection.

A hot bearing detector traversed by train 32N detected an elevated temperature on the overheating bearing, but the low-priority alert it transmitted to railroad personnel did not reflect the true condition of the failing bearing. Because of design constraints, hot bearing detectors are likely to indicate misleadingly low bearing temperatures. This limit on detector performance, combined with NS's

standard operating procedures and the spacing between detectors, meant that the train's crew did not have adequate warning to stop the train before the derailment.

Research will be necessary to determine whether changes to wayside bearing defect detection systems—such as lower alert and alarm thresholds—would produce a significant safety improvement. Research is also necessary to determine what operational responses to bearing alerts and alarms are sufficient to prevent derailments.

The state of Ohio's laws regarding volunteer firefighter training were not sufficient to support a safe emergency response to the derailment. Further, the emergency response lacked efficient coordination because the responding agencies did not have common radio channels. Also hampering efforts was the illegible railcar placards after fire exposure. Delays in NS transmitting train consist information to emergency responders also increased responders' and the public's exposure to postderailment hazards.

The postderailment fires likely began because of hazardous materials released from a punctured DOT-111 tank car. The subsequent release of VCM from mechanically intact DOT-105 tank cars likely would not have occurred if the DOT-111 tank cars in the consist had survived the derailment. The presence of hazardous materials DOT-111 tank cars in a train can increase the risk of more resilient tank cars releasing hazardous materials following a derailment; the definition of key train does not account for this. Voluntary phase out of the remaining DOT-111 tank cars in hazardous materials service is technically possible but unlikely because of economic and business disincentives.

The VCM in the derailed DOT-105 tank cars remained in a stabilized environment (that is, was unable to undergo polymerization, a potentially dangerous chemical reaction) until those tank cars were deliberately breached with explosives (the vent and burn procedure). On-scene temperature trends did not indicate that a polymerization reaction was occurring and postaccident examinations confirmed this. The vent and burn procedure was not necessary to prevent a polymerization-induced explosion. One source of information about polymerization consulted by NS and its contractors, The Chlorine Institute's Pamphlet 171, included misleading information about signs of polymerization. NS and its contractors continued to describe polymerization as an imminent threat when expert opinions and available evidence should have led them to reconsider their course of action. NS compromised the integrity of the decision to vent and burn the tank cars by not communicating expertise and dissenting opinions to the incident commander making the final decision. This failure to communicate completely and accurately with the incident

commander was unjustified. The high local and environmental impacts of a vent and burn decision demonstrate the need for federal guidance about when to conduct a vent and burn.

Lastly, inward- and outward-facing recorders can provide the opportunity for railroads to verify train crew actions and for investigators to improve the quality of investigations; without a requirement, we have missed an opportunity to record important safety data.

The National Transportation Safety Board determines that the probable cause of the derailment involving Norfolk Southern Railway train 32N was the failure of the L1 bearing on the 23rd railcar in the consist that overheated and caused the axle to separate, derailing the train and leading to a postderailment fire that likely began with the release of a Class 3 flammable liquid from a DOT-111 tank car that was punctured during the derailment. Contributing to the postderailment fire and the severity of the hazardous materials release was the continued use of DOT-111 tank cars in hazardous materials service. Also contributing to the severity of the hazardous materials release were (1) the failure of Norfolk Southern Railway and its contractors to communicate relevant expertise and dissenting opinions to the incident commander and (2) the inaccurate representation by Norfolk Southern Railway and its contractors that the tank cars were at risk of catastrophic failure from a polymerization reaction, which created unwarranted urgency and led to the unnecessary decision to vent and burn five derailed vinyl chloride monomer tank cars to prevent a polymerization-induced tank car rupture. Contributing to the exposure of emergency responders and the public to postderailment hazards were (1) Norfolk Southern Railway's delay in transmitting the train consist information to emergency responders and (2) the state of Ohio's insufficient training requirements for volunteer firefighters.

What We Recommended

As a result of this investigation, we issued 34 new recommendations, reiterated 1 previously issued recommendation, and classified 4 recommendations.

We asked the Federal Railroad Administration (FRA) to conduct research on bearing defect detection systems, and recommended that the FRA use the results to establish regulations on related subjects:

- Railroads' use of bearing defect detection systems, including thresholds for alerts and alarms and distances between wayside detectors;

- Railroads' operational responses to bearing alerts and alarms; and
- Installation, inspection, and maintenance of wayside bearing defect detection systems.

We recommended that the Association of American Railroads develop a database of bearing failure and replacement data to help railroads, regulators, and investigators identify and address bearing failure risk factors.

We issued a recommendation to the state of Ohio to amend its statute limiting volunteer firefighter training and bring its training requirements in line with a widely accepted standard. To expand the reach of lessons learned at East Palestine, we recommended that the International Association of Fire Chiefs, the International Association of Fire Fighters, and National Volunteer Fire Council inform their members of the derailment and fire and encourage them to adopt training that meets a widely accepted standard. We also recommended that the National Volunteer Fire Council identify barriers to volunteer firefighter training and actions to address them.

To improve local preparedness, we recommended that the Columbiana County Emergency Management Agency develop a policy to immediately provide train consists to emergency responders and update its emergency plans to incorporate lessons learned from the East Palestine derailment.

We classified Closed—Acceptable Action a recommendation to the Pipeline and Hazardous Materials Administration (PHMSA) that it require railroads to immediately provide emergency responders with train consist information (R-07-4, Open—Unacceptable Response). We also recommended that NS review and revise its practices to ensure immediate communication of the consist to first responders. We made a new recommendation that PHMSA require that placards used to identify hazardous materials be able to survive accidents and fires.

We issued additional new recommendations to PHMSA expanding and accelerating the current phase out of DOT-111 tank cars from hazardous materials service and expanding the definition of high-hazard flammable trains to include a wider variety of hazardous materials and account for variations in how well different tank car specifications survive derailments. We made a related recommendation to the Association of American Railroads to account for the risk posed by certain tank cars in its definition of key train. We also recommended that the Association of American Railroads take steps to require manufacturers of tank car service equipment to demonstrate that their products are compatible with a tank car's intended lading

and that the FRA monitor the Association of American Railroads' progress to ensure they address weaknesses in their approval process.

Regarding the vent and burn decision, we recommended that The Chlorine Institute review and revise its pamphlet on VCM to ensure that it is accurate and suited to supporting emergency responses, and that it change its Chlorine Emergency Plan program to make sure specialized emergency response contractors can appropriately respond to chemical hazards during a VCM incident; that Oxy Vinyls update its safety data sheet for VCM to ensure that it is accurate and develop a policy to ensure that its expertise is communicated to the full incident command; that the American Chemistry Council and The Chlorine Institute make their members aware of the events at East Palestine and emphasize the importance of shippers communicating their expertise to the full incident command; that NS establish a policy of communicating all expert opinions to the full incident command, share information collected by its emergency response contractors with entities that provide hazardous materials guidance, and update its submissions the PHMSA incident database; that the FRA disseminate current and updated versions of its existing study on the vent and burn method to help guide incident commands in the future; and that PHMSA spread awareness of the FRA's most current guidance by referencing it in the next edition of the Emergency Response Guidebook. We made an additional recommendation to the International Association of Fire Chiefs, the International Association of Fire Fighters, and National Volunteer Fire Council to encourage the distribution of federal guidance about the vent and burn method.

We also classified Closed—Superseded recommendations to the Secretary of Transportation and the FRA regarding the installation and use of inward- and outward-facing audio and image recorders on locomotives (R-10-1, and R-10-2 to the FRA were Open—Unacceptable Response; R-19-7 to the Secretary of Transportation was Open—Await Response). We recommended that the FRA and Secretary of Transportation take the actions described in the closed recommendations, obtaining legislative authority to act if necessary.

We reiterated one recommendation to the Class I railroads regarding installation and use of audio and image recorders (R-13-26, Open—Acceptable Response).

1 Factual Information

1.1 Derailment Description

On February 3, 2023, about 8:54 p.m., eastbound Norfolk Southern Railway (NS) train 32N derailed 38 mixed freight railcars at milepost (MP) 49.5 on main track 1 of the NS Fort Wayne Line of the Keystone Division in East Palestine, Ohio.[1] The derailed equipment included 11 tank cars carrying hazardous materials. Three of these tank cars, carrying flammable and combustible hazardous materials, were mechanically breached during the derailment and released lading.[2] A fire ignited during the derailment and grew to involve 35 railcars: the 3 mechanically breached hazardous materials tank cars, 20 additional derailed tank and freight cars carrying both hazardous and non-hazardous materials, and 12 non-derailed freight cars. (See figure 1.) Emergency responders established a 1-mile evacuation zone that affected about 2,000 residents. Five of the derailed hazardous materials tank cars that were not mechanically breached in the derailment were carrying vinyl chloride monomer (VCM) offered for shipment as "UN1086 vinyl chloride, stabilized, 2.1."[3] Over the next day, these tank cars were exposed to fires and released material from pressure relief devices (PRDs).[4] These releases ceased on the afternoon of February 4 after the fires were mostly extinguished. Acting on information provided by NS and its contractors that a dangerous chemical reaction was occurring within a VCM tank car, the incident commander managing the response chose to expand the evacuation zone and perform a vent and burn (a deliberate breach of a tank car) on all five derailed VCM tank cars. The incident commander was not aware of dissenting opinions the VCM shipper had provided to NS and its contractors regarding this chemical reaction. A contractor hired by NS breached these VCM tank cars at 4:37 p.m. on February 6,

[1] (a) All times in this report are local time. (b) Visit ntsb.gov to find additional information in the public docket for this National Transportation Safety Board (NTSB) accident investigation (case number RRD23MR005). Further information is also available in the public docket for the NTSB Investigative Hearing held on June 22–23, 2023. Use the CAROL Query to search safety recommendations and investigations.

[2] *Lading* is synonymous with cargo. In this report, lading refers to materials transported in tank cars. Refer to Title 49 *Code of Federal Regulations* (*CFR*) Part 174 for more detailed regulatory uses of lading and related terms such as *bill of lading*.

[3] This shipping name indicates a flammable gas. A detailed explanation of the shipping name is provided in section 1.8, and the properties of VCM are discussed in section 1.8.1.

[4] *PRDs* are spring-loaded valves designed to release material if the pressure in a tank rises above a design threshold.

releasing and igniting their lading. No injuries were reported during the derailment or emergency response. NS estimated the damage to equipment to be about $3.4 million.[5]



Figure 1. Overhead view of derailment and early fire. (Courtesy of Eric's Train Yard.)

1.1.1 Prederailment Train Movements

Train 32N operated as an NS train from Madison, Illinois, until its derailment in East Palestine, Ohio. Its route is illustrated in figure 2.

[5] The NTSB does not directly assess environmental impacts. Questions about environmental impacts should be directed to the Environmental Protection Agency.



Figure 2. Train 32N's route.

NS received train 32N in interchange in the Terminal Railroad Association of St. Louis (TRRA) yard in Madison, Illinois, on February 1, 2023.[6] Qualified TRRA mechanical inspectors performed a brake test and mechanical inspection of the entire consist as required by Title 49 *Code of Federal Regulations* (*CFR*) Parts 232 and 215.[7] At the time of the inspection, the train consisted of 3 locomotives at the head end and 163 mixed freight railcars, including railcar GPLX75465 (hereafter the hopper car). The inspection did not result in any defect reports, and the train was approved for departure.

The train departed the TRRA yard with an NS crew at 10:14 p.m. on February 1, eastbound and destined for Conway Yard in Conway, Pennsylvania, with several intermediate stops. It arrived in an NS railyard in Decatur, Illinois, at 6:10 a.m. on February 2. A yard crew removed 55 railcars from the consist, added 40 railcars to the rear of the train, and repositioned one locomotive at line 112 as a distributed power

[6] (a) A train or railcar is *received in interchange* when one railroad turns it over to another. In this case, NS received train 32N from TRRA. (b) TRRA is a Class III switching and terminal railroad co-owned by several Class I railroads or their parent companies, including the Norfolk Southern Corporation.

[7] (a) A *qualified mechanical inspector* is defined in 49 *CFR* 229.5 as a person who has received instruction and training that includes hands-on experience in troubleshooting, inspection, testing, maintenance, or repair of locomotive equipment and whose primary responsibility is related to those functions. (b) Title 49 *CFR* Part 232 requires tests of air brake systems when railcars are added to a train; Part 215 requires pre-departure inspections of each railcar being placed in a train.

locomotive.[8] Qualified NS mechanical inspectors conducted a brake test and mechanical inspection on the 40 new railcars, as required by 49 *CFR* Parts 232 and 215, before adding them to train 32N.

Train 32N departed the Decatur railyard at 4:15 p.m. on February 2. Upon departure, train 32N consisted of 3 locomotives and 149 mixed freight cars (including 9 empty railcars distributed throughout the consist); the train weighed 17,977 tons and was 9,309 feet long. The train's consist remained unchanged throughout the train's subsequent movements.

The train arrived in Toledo, Ohio, about 1:00 p.m. on February 3, where the accident crew—an engineer, a conductor, and a conductor trainee—went on duty at 1:15 p.m.[9] The accident crew conducted a briefing with the previous crew and tested the train's brakes before departing.[10] The train departed Toledo, Ohio, at 2:15 p.m., beginning the last leg of its trip before the derailment.

During this leg, train 32N encountered three hot bearing detectors (HBDs) as shown in figure 3 and described below.[11] It fully traversed the first two and derailed while passing over the third.

[8] (a) A *line number* indicates the position of a piece of equipment in a train consist. Higher numbers are nearer the rear of the consist. Line numbers count locomotives while other common ways of describing railcar positions do not. As a result, line numbers differ from other descriptions of railcar positions; the 23rd railcar in train 32N was at line number 25, for example, because the train had 2 head-end locomotives. (b) *Distributed power locomotives* are used to manage in-train forces and improve the handling of long or heavy trains.

[9] The engineer had been hired by NS as a conductor in 1996 and had about 24 years of experience as an engineer. The conductor had been hired by NS in April 2022 and been promoted to conductor in July 2022. The conductor trainee had been hired by NS in October 2022.

[10] This test involved applying and releasing pressure through the air brake system to confirm continuity, or that the air brakes would apply and release on the last railcar in the consist.

[11] An *HBD* is a device located along the track, or wayside, designed to detect overheated bearings by using a pair of upward-facing infrared cameras to measure bearing temperatures relative to ambient (background) temperatures. Overheated bearings occur when inadequate lubrication, component misalignment, or mechanical damage increase bearing friction. The rail industry calls this phenomenon a "hot box" and sometimes refers to HBDs as "hot box detectors."

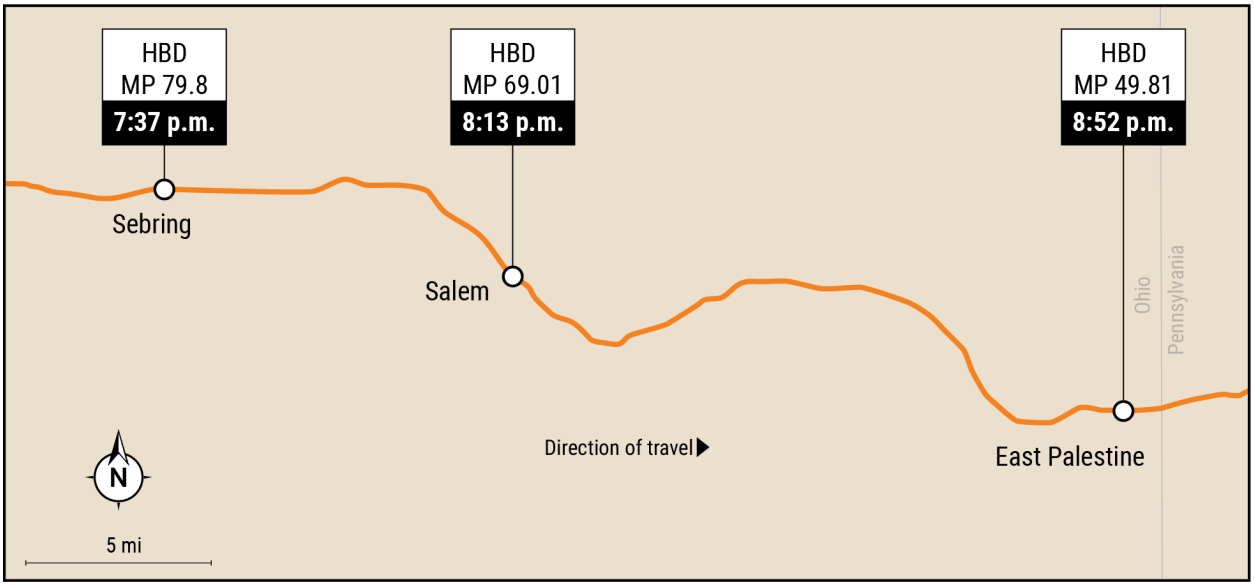


Figure 3. Map of final three HBDs encountered before derailment.

At 7:37 p.m., train 32N passed over an HBD at MP 79.8 in Sebring, Ohio. The HBD recorded a temperature 38°F above ambient on the right-side bearing of the 101st wheelset to pass the detector.[12] This corresponded to the left-side bearing on the first axle (the L1 bearing of wheelset #1) of the 23rd railcar, GPLX75465, the hopper car.[13] (See figure 4.) The HBD recorded a temperature 20°F above ambient for the right-side bearing on the same axle (the R1 bearing). The bearing temperatures did not result in any alert or alarm.

[12] The ambient temperature was measured by a thermometer at the nearby signal bungalow; this method of determining ambient temperature is typical for HBDs.

[13] In the freight rail industry, railcar axles are consistently numbered from the end of the railcar with the brake wheel (the B end). When the B end faces the direction of travel, the railcar's left-side wheels and bearings will be on the right side of the train. For hopper car GPLX75465, the L1 bearing was on the right side of the train in the direction of travel, or above the south rail.

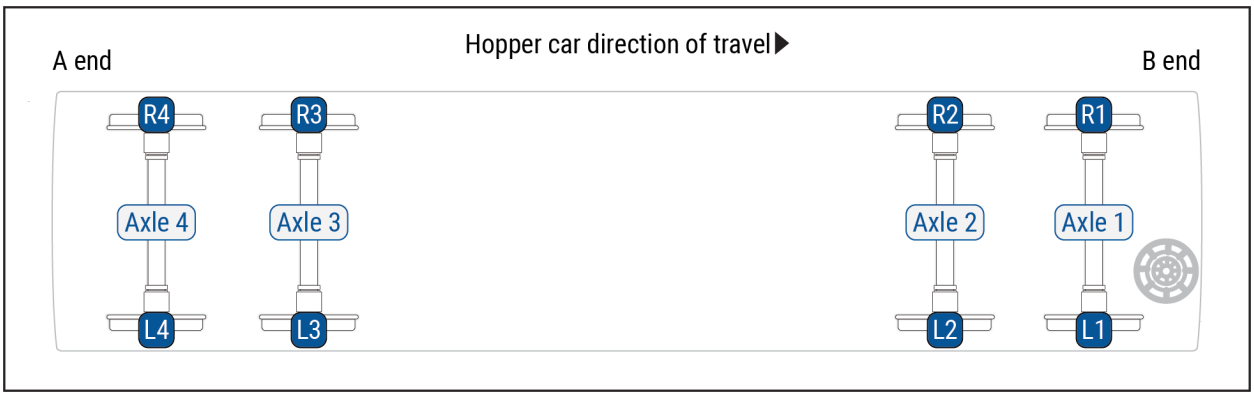


Figure 4. Diagram of hopper car wheelset and bearing positions.

Between 8:11 p.m. and 8:14 p.m., train 32N passed four surveillance cameras in Salem, Ohio, that recorded images of the train. The images showed a fire on wheelset #1 of the hopper car. (See figure 5 for an image from a surveillance camera positioned on South Lincoln Avenue.) The images did not show signs of fire on other railcars.

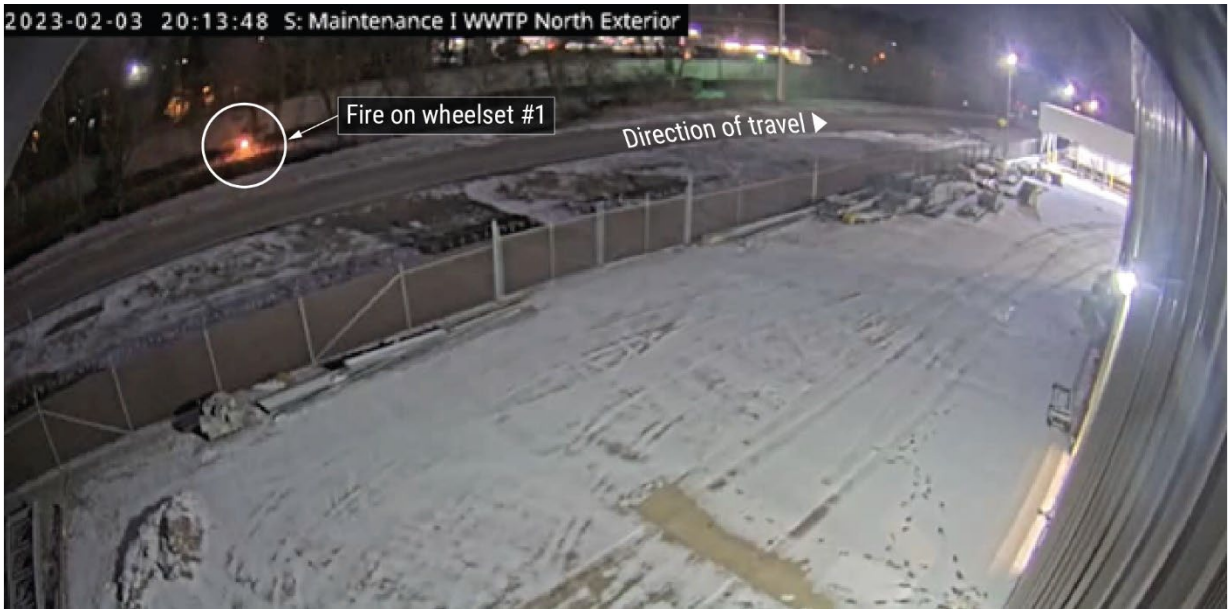


Figure 5. Fire on wheelset #1 of the hopper car passing through Salem, Ohio.

At 8:13 p.m., train 32N passed over the HBD in Salem, Ohio, (MP 69.01) near the surveillance cameras that recorded fire on the hopper car. The HBD recorded a temperature 103°F above ambient on the L1 bearing of the hopper car—a

temperature exceeding NS's 90°F above-ambient threshold for a non-critical alert.[14] The R1 bearing was 20°F above ambient. The HBD transmitted a non-critical alert to the advanced train control (ATC) desk about the temperature of the L1 bearing but, as designed, did not broadcast an alarm to the train's crew. The HBD did not transmit an alert about any other bearings. Train 32N's prederailment movements are summarized in figure 2 above and in table 1.

Table 1. Timeline of prederailment events.

Date	Time	Location	Event
2/1/2023	8:30 p.m.	Madison, Illinois	Train 32N is mechanically inspected in the TRRA yard by qualified mechanical inspectors.
2/1/2023	10:14 p.m.	Madison, Illinois	Train 32N departs the TRRA yard with an NS crew.
2/2/2023	12:31 p.m.	Decatur, Illinois	NS crews remove 55 railcars from the consist and add 40 pre-inspected railcars.
2/2/2023	4:15 p.m.	Decatur, Illinois	Train 32N departs the NS yard with an NS crew.
2/3/2023	1:15 p.m.	Toledo, Ohio	The accident crew goes on duty and conducts a briefing with train 32N's previous crew.
2/3/2023	2:15 p.m.	Toledo, Ohio	Train 32N departs the NS yard with the accident crew.
2/3/2023	7:37 p.m.	Sebring, Ohio	Train 32N traverses an HBD; no axles trigger alerts or alarms.
2/3/2023	8:11–14 p.m.	Salem, Ohio	Surveillance cameras capture images of fire near the L1 bearing of the hopper car.
2/3/2023	8:13 p.m.	Salem, Ohio	Train 32N traverses an HBD; the L1 bearing of the hopper car triggers a non-critical alert.

1.1.2 Derailment and Initial Emergency Response

About 8:52 p.m. on February 3, 2023, train 32N began to traverse an HBD at MP 49.81 in East Palestine, Ohio. Locomotive event recorder data showed the train was traveling about 43 mph. The maximum authorized speed in the area was 50 mph. Less than a minute later, this HBD recorded a temperature 253°F above ambient on

[14] Under NS procedures, a *non-critical alert* requires the ATC Wayside Help Desk analyst to monitor a bearing's temperature but does not require an immediate stop-and-inspect. Unlike alarms, alerts are not automatically broadcast to a train's crew. For more details on hot bearing alerts and alarms, see section 1.5.1.

the L1 bearing of the hopper car; the R1 bearing was still 20°F above ambient.[15] The HBD immediately transmitted a critical alarm. The alarm was received by the lead locomotive radio and broadcast over the in-cab speakers: "Critical alarm, critical alarm, critical alarm. Norfolk Southern milepost 49.8, track 1 hotbox, axle 101, south rail."[16]

Under NS operating rules, a critical alarm requires a train's crew to immediately stop the train and inspect the wheelset that triggered the alarm. According to event recorder data, the engineer began to slow the train using dynamic braking before 8:54 p.m.[17] Shortly afterward, when the head end of the train was near MP 49.5 and the consist was still passing over the HBD, the train experienced a train-line-initiated emergency braking application.[18] The head-end locomotives then traveled about 1,160 feet before coming to a stop 38 seconds later. The crew radioed to NS dispatch that it had experienced an emergency. The NS Cleveland East dispatcher confirmed the emergency at 8:56 p.m. and began coordinating train movements in the area to prevent other trains from colliding with train 32N.

The East Palestine Police Department (EPPD) public safety answering point (PSAP) received the first 911 call reporting a derailment, explosion, and fire at 8:56:49 p.m.[19] Additional 911 calls followed shortly afterward. East Palestine dispatch radioed an alarm to the East Palestine Fire Department (EPFD) at 8:58 p.m., requesting all available fire and emergency medical services (EMS) units to respond to a train derailment and fire. Dispatch records from East Palestine and Beaver County (a

[15] A reading of 253°F above ambient is the maximum reading for the type of HBD installed at MP 49.81; the actual temperature may have been higher.

[16] The alarm was captured by in-cab audio recording devices. The subject is outlined in section 1.3.

[17] *Dynamic braking* uses locomotives' traction motors to slow a train.

[18] An *emergency braking application* uses the maximum braking force available and is designed to stop a train as quickly as possible. An engineer can initiate one, usually as a last resort to avoid a collision. An emergency braking application can also be initiated automatically. In most trains, including train 32N, the air brakes are activated by reducing the pressure in the *train line* (or *brake pipe*) that runs the length of the consist. If the air hoses joining railcars together become disconnected, as may occur during a derailment, the pressure in the train line falls, automatically applying the emergency brakes.

[19] The Communications Division of the EPPD operated the PSAP, or 911 center, for East Palestine. It also operated the emergency services dispatching facility (dispatch), which was responsible for receiving and dispatching radio calls for police, fire, and emergency medical services (EMS) for East Palestine and nearby civil municipalities.

nearby county in Pennsylvania) indicate that 48 agencies were involved in the emergency response, including fire departments from neighboring communities and hazardous materials teams from East Liverpool, Ohio, and Beaver County, Pennsylvania. When interviewed by the National Transportation Safety Board (NTSB), personnel from EPPD and EPFD said they arrived on the scene about 9:00 p.m. and found derailment equipment and several fires, including a pool fire along the length of the derailment pileup.[20] The EPFD deputy fire chief assumed the role of incident commander and placed a phone call to the EPFD fire chief, who was on leave. The deputy fire chief established a command post about 400 feet from the east end of the derailment pileup at a business property owned by Leake Oil, a company that sells petroleum products such as heating oil and gasoline. (See figure 6.) The property was being used to store petroleum products at the time of the derailment.



Figure 6. Map of derailment site and command post.

Shortly after arriving on the scene, on the deputy fire chief's instructions, the EPFD began spraying water over the burning railcars. When interviewed by the NTSB,

[20] (a) Unless otherwise specified, interviews referenced in this report took place after the conclusion of the emergency response. (b) The term *pool fire* appears in federal regulations, such as 49 *CFR* Part 179 Appendix B, but it is not precisely defined. Generally, a pool fire is a fire fed by released material capable of engulfing a tank car.

the deputy fire chief said that he promptly found this tactic insufficient to suppress the fire, and that "the fire became much larger than I personally have ever seen."

At 9:04 p.m., East Palestine dispatch called the NS dispatch center in Atlanta, Georgia, to request train consist information. The individual who answered the phone said they would call back. The NTSB has no evidence that NS returned the call to East Palestine dispatch with the requested train consist information.

During the initial stages of the emergency response, while the conductor of train 32N was preparing to walk back along the train to assess its condition, the Cleveland East NS dispatcher informed the crew of reports that railcars were on fire. The conductor left the locomotive, saw smoke, and returned because of concerns about hazardous materials. The crew obtained permission from the NS Cleveland East dispatcher to separate the lead locomotives from the train and move to a safer distance.[21] At 10:17 p.m., the crew moved the lead locomotives, placing them about a mile from the fires. At 10:26 p.m., they began a second movement, stopping the locomotives about 26 miles from the fires at 11:54 p.m.

Between 9:00 p.m. and 10:00 p.m., responders continued to contact NS personnel requesting train consist information, began evacuating residential buildings near the derailment site, and used the Wireless Emergency Notification System (WENS) to advise residents within 1 mile of the derailment to shelter in place.[22] Shortly before 10:00 p.m., the NS northern regional hazmat manager emailed the consist for train 32N to the Columbiana County Emergency Management Agency (CCEMA) director, who had requested the information by phone.[23] Shortly afterward, through phone communication between NS and the EPFD, the deputy fire chief learned of two hazardous materials—benzene and VCM—in the train consist. When interviewed by the NTSB, the deputy fire chief said that he received the train

[21] NS rules documented in the Hazardous Materials Instructions for Rail (usually referred to as HM-1), revised January 1, 2019, require train crews to move to a safe distance when fire or a vapor cloud is visible during a possible hazardous materials release.

[22] *WENS* is a public safety system that allows customers who own compatible mobile devices to receive geographically targeted, text-like messages alerting them of imminent threats to safety in their area. Consumers do not need to sign up for this service. WENS allows government officials to send emergency alerts to all subscribers with WENS-capable devices if their wireless carrier participates in the program.

[23] CCEMA coordinated emergency management functions and disaster preparedness in Columbiana County, Ohio, where East Palestine is located. This included coordinating responses involving multiple local emergency response agencies, such as the EPFD, the EPPD, and fire and police departments from nearby communities.

consist "by word of mouth" on the night of the derailment but never received a physical or electronic copy.

About the same time as the first consist transmittal, the East Liverpool Fire Department fire chief was responding to the derailment and fire with a hazardous materials response team, having been activated at 9:24 p.m. When interviewed by the NTSB, he said that one of his technicians used a cell phone to access the AskRail application and obtain a copy of the train 32N consist before arriving on the scene at 9:54 p.m.[24] He also said in his interview that he received an emailed copy of the consist from the CCEMA director at 10:23 p.m. His team began working to determine which tank cars were involved with the fire, and the team concluded, based on the Emergency Response Guidebook (ERG), that the VCM "was the worst product involved," although the team could not yet determine whether the VCM tank cars were burning or only exposed to fire. He recommended a 1-mile evacuation to the CCEMA director based on the ERG guidance. In the absence of radio interoperability between his team and the EPFD, he stationed one of his technicians in the command post to keep responders there informed while he was doing research and other activities that took him away from the command post. In his interview with the NTSB, he characterized the incident command as "fractured" and noted that, "what we talk about in the classroom and training programs versus what happens out in the field in the middle of chaos can be different."

Between 10:15 p.m. and 10:30 p.m., the Beaver County hazardous materials response team arrived at the command post, having been contacted for assistance at 9:35 p.m. When interviewed by the NTSB, the Beaver County director of emergency services and chief of hazard materials, who was leading the Beaver County response team, said that the incident command was not yet well-defined:

> And in that office, again, it was a train wreck, again it was a—there was chaos. So, the command may not well have been defined at that point, but it eventually got defined as far as the incident command.

He also told the NTSB that he attempted to access the AskRail application with a laptop to obtain a copy of the train consist once on the scene, but that the application did not work until about 2:00 a.m. on February 4, 2023. He reported sharing hazardous materials information to responding Beaver County fire

[24] (a) AskRail is a software application intended to provide pre-qualified personnel with information about train consists. The application is discussed in more detail in section 1.13.1.2. (b) The East Liverpool Fire Department fire chief and this technician arrived on the scene about 20 minutes ahead of the rest of the response team.

departments because of the "radio situation" that would cause issues with other means of providing that information. His team focused on air monitoring with photoionization detectors, which are devices designed to detect volatile organic compounds such as VCM, and on hazardous materials identification.

About 11:00 p.m. the deputy fire chief ordered a 1-mile evacuation through WENS and the federal Integrated Public Alert & Warning System.[25] Later, shortly after midnight on February 4, the East Palestine mayor made a separate announcement of the 1-mile evacuation at a news conference.

NS hazardous materials personnel arrived on the scene about 11:00 p.m., followed by NS contractors specializing in hazardous materials response and industrial firefighting, including Specialized Professional Services, Inc. (SPSI).[26] When interviewed by the NTSB, the SPSI president reported that upon arrival he observed a fire burning in a ditch on the south side of the tracks along the length of the pileup and smelled the distinctive odor of butyl acrylates.[27] Initial SPSI efforts focused on determining which materials were burning. These efforts were hampered by poor visibility, which made it difficult to identify individual tank cars. In interviews with the NTSB, responding firefighters reported that placards for several tank cars had been destroyed by the fire, and low light and smoke complicated attempts to determine which tank cars (and therefore which ladings) were being exposed to fire conditions.

About midnight, February 3–4, the NS northern region hazmat manager advised the deputy fire chief to suspend fire suppression activities and withdraw personnel and equipment to a safer distance. The deputy fire chief accepted this advice, issuing instructions to move all personnel and operations outside of a 1-mile perimeter of the accident site. His staff relocated the command post to the EPFD's and EPPD's shared station, slightly less than a mile from the derailment site. The relocation was complete by 2:00 a.m. on February 4.

[25] The Integrated Public Alert & Warning System is the Federal Emergency Management Agency's national system for local alerting that provides information to the public through mobile phones, radio, and television.

[26] (a) The NS northern regional hazmat manager represented NS in the incident command early in the response, but various other NS personnel assumed that role over the course of the emergency response. (b) SPSI is an emergency response contractor and certified by The Chlorine Institute to respond to incidents involving VCM. NS contracted with SPSI and worked with them throughout the emergency response.

[27] Butyl acrylates are a flammable liquid. See section 1.8.5 for more information about this material. One derailed and mechanically breached tank car was carrying butyl acrylates.

The fire in the ditch south of the tracks continued to burn for about 3 hours after the derailment. The ditch fire ignited lading from tank cars containing butyl acrylates, ethylene glycol monobutyl ether, 2-ethylhexyl acrylate, propylene glycol, diethylene glycol, and petroleum lubricating oil; hopper cars containing plastic pellets (polyethylene and polyvinyl); and box cars containing various freights.[28] Excluding material released by PRDs on fire-exposed tank cars, these postderailment fires were fueled by the freight, lading, or components of 31 railcars. Fires fed by tank car lading continued to burn until the afternoon of February 4; fires involving hopper and box cars continued to smolder for several days after the derailment.

About 2:00 a.m. on February 4, 2023, the EPFD fire chief arrived on the scene and assumed the role of incident commander. According to his interview with the NTSB, he found a paper copy of the train consist on a table in the command post; this was the first time he obtained a complete copy. Events between train 32N reaching the East Palestine HBD and the arrival of the EPFD fire chief are summarized in a timeline in

[28] Butyl acrylates are a Class 3 flammable liquid, and ethylene glycol monobutyl ether and 2-ethylhexyl acrylate are combustible liquids. A detailed account of the hazardous materials involved in the derailment is provided in section 1.8. The other released ladings and plastic pellets can support combustion and caught fire, but they are not considered hazardous materials.

table 2.

Table 2. Timeline of HBD notification and early emergency response.

Date	Time	Event
2/3/2023	8:52 p.m.	Train 32N begins to traverse HBD at MP 49.81
2/3/2023	8:53 p.m.	HBD broadcasts a critical alarm for the L1 bearing on the hopper car
2/3/2023	8:53 p.m.	Crew begins to slow the train with dynamic braking
2/3/2023	8:54 p.m.	Train experiences an uncommanded emergency braking application
2/3/2023	8:56 p.m.	NS Cleveland East dispatcher confirms that train 32N has experienced an emergency
2/3/2023	8:56 p.m.	First 911 calls reach the EPFD PSAP (East Palestine dispatch)
2/3/2023	9:00 p.m.	EPFD personnel reach the derailment scene; deputy fire chief establishes first command post near derailment
2/3/2023	9:04 p.m.	East Palestine dispatch requests consist information from NS
2/3/2023	9:53 p.m.	Residents within 1 mile advised through WENS to shelter in place
2/3/2023	10:00 p.m	NS emails consist to CCEMA director
2/3/2023	11:00 p.m	Residents within 1 mile ordered through WENS to evacuate
2/3/2023	11:00 p.m	NS hazardous materials personnel reach the scene, followed by contractors
2/4/2023	12:00 a.m.	Command post relocated to fire and police station
2/4/2023	2:00 a.m.	EPFD fire chief arrives and assumes incident commander role

1.1.3 Vent and Burn

By early morning on February 4, 2023, fire suppression activities had resumed with a focus on containment: unmanned streams of water were directed at exposed structures around the perimeter of the fire. No additional water was sprayed directly on the fire. Later on February 4, in consultation with NS and after reviewing a paper copy of the train consist, the fire chief shut down the unmanned streams.[29] By the morning of Sunday, February 5, the command post had been relocated a second time to a public school slightly more than a mile from the derailment site to accommodate all necessary personnel.

The derailed equipment included five mechanically intact tank cars carrying VCM and one mechanically intact tank car carrying isobutylene offered for shipment

[29] When interviewed by the NTSB, the EPFD fire chief reported that someone took his only copy of the consist, and that he asked NS for an emailed version, which NS provided.

as "UN1055, isobutylene, 2.1."[30] All six were United States Department of Transportation (USDOT) Specification DOT-105J300W tank cars, usually referred to as DOT-105 tank cars. The isobutylene tank car (NATX35844) was positioned near the middle of the derailment pileup. One VCM tank car, OCPX80370 (line 55 in the consist), was positioned near the western end of the derailment pileup, exposed to a pool fire, and resting against a burning hopper car containing plastic pellets. The other four VCM tank cars—TILX402025 (line 28), OCPX80235 (line 29), OCPX80179 (line 30), and GATX95098 (line 31)—were positioned near the eastern edge of the derailment pileup. (See figure 7.) Tank car TILX402025 had come to rest between the two main tracks and was not directly exposed to a pool fire. Aerial images showed that the cover over the protective housing on TILX402025 remained closed during this period.[31] The other three VCM tank cars at the eastern edge of the pileup were grouped together and exposed to postderailment fires.



Figure 7. Derailment pileup and VCM tank cars.

On the scene, NS and its contractor personnel derived information about the status of these tank cars from observation of PRD activity, visual assessment of tank cars, pressure readings, photoionization detector readings, and temperature measurements taken using an infrared thermometer.[32] In interpreting these data, NS and contractor personnel referred to the safety data sheet (SDS) for VCM, the 2020 Emergency Response Guidebook (2020 ERG) published by the Pipeline and

[30] Isobutylene is a flammable gas in the same hazard class and division as VCM.

[31] The cover extends over the PRD and other top fittings. Typically, a PRD actuation causes a cover to open. When a PRD on a tank car transporting a flammable material opens as a result of fire exposure, the released material will often ignite.

[32] As discussed below, contractors were able to obtain pressure readings only from tank car TILX402025.

Hazardous Materials Safety Administration (PHMSA), and The Chlorine Institute's Pamphlet 171.[33]

The first PRD actuation on a VCM tank car occurred shortly after midnight on February 4. A PRD actuates when the pressure inside a tank reaches the PRD's start-to-discharge pressure—a pressure high enough to open a valve held closed by a spring. The PRD opens until the tank's pressure falls low enough for the valve to re-close. A PRD on a tank car exposed to a pool fire will typically go through this cycle multiple times. PRD cycling continued for the four fire-exposed VCM tank cars until midafternoon on February 4, when the pool fires near four of the tanks had largely subsided. After 1.5–2 hours without visible PRD activity, the PRD on tank car OCPX80179 actuated about 5:30 p.m. and vented continuously for about 70 minutes. This venting was more energetic than other PRD actuations on the VCM tank cars. (See figure 8 for a comparison.) The PRD on tank car OCPX80179 eventually re-closed and did not actuate again. NS and contractor personnel did not observe any further PRD activity from the VCM tank cars.

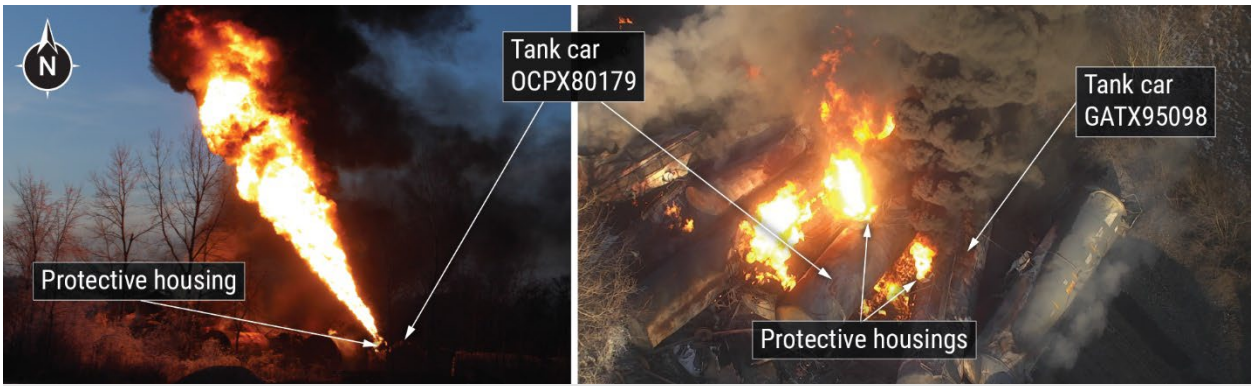


Figure 8. PRDs venting material energetically (left) and more typically (right).

When interviewed by the NTSB, the SPSI president said that before the energetic PRD actuation on OCPX80179, NS and SPSI had been considering two methods of unloading VCM from the tank cars, hot tapping and flaring, and had already rejected a third, product transfer, because three of the VCM tank cars had damaged fittings. Each method is summarized below:

- Product transfer—transferring lading from the unloading valves and fittings of each damaged tank into a receiving tank

[33] A *safety data sheet* is a summary of hazards and precautions prepared by a chemical manufacturer, importer, or employer. The SDS and the other sources of guidance and hazard information, in general and regarding VCM specifically, are discussed section 1.8.1.1.

- Flaring—a controlled release of lading through a flare pipe (a device designed to gradually burn off flammable material at a safe location) attached to top fittings

- A hot tap—welding a threaded nozzle onto the tank and drilling through the tank wall to allow flaring or transfer even if the original unloading valves and fittings were damaged

In his interview with the NTSB, the president of SPSI noted that the top fittings of three VCM tank cars appeared damaged, which meant removing the product without cutting through the tanks would be impossible.[34] He also said that cutting into the tanks for flaring or hot tapping would be dangerous because they might have partially emptied, meaning that the flame of a cutting torch could impinge on the vapor space (the part of the tank filled with vapor rather than liquid lading) and result in a fire or explosion.

The SPSI president told the NTSB in his interview that he interpreted the energetic PRD activity to mean that polymerization had occurred in tank car OCPX80179, produced an increase in tank pressure, and "gummed up" the PRD, preventing it from functioning normally.[35] He also said that polymerization was another reason not to attempt transloading because the VCM was not in its original, as-shipped condition and might be unsafe to move to another packaging even if the VCM tank cars' fittings were usable.

The SPSI president said that because of these concerns about polymerization affecting PRDs and the dangers of alternative methods of unloading, SPSI and NS "were already there at vent and burn in our minds" after 5:30 p.m. on February 4 based on their assessment of the energetic PRD actuation as indicating polymerization. The FRA characterizes a vent and burn as a last-resort method of unloading a damaged tank car, to be used only "when all other emergency product removal methods have been considered and rejected, and the consequences of not relieving the internal tank car pressure are determined to be greater than using this procedure" (FRA 1994). In a vent and burn, a tank car is punctured with explosives at

[34] In separate statements made during the NTSB Investigative Hearing, the president of SPSI said that the assessment of the valves' condition was based on footage from drones, and he revised his count to four tank cars with damaged fittings. See NTSB Investigative Hearing, Day 1, pp. 228–29.

[35] (a) See also the SPSI president's testimony at the NTSB Investigative Hearing Transcript, Day 1, pp. 145–46. (b) *Polymerization* is the process by which relatively small molecules (monomers) combine chemically to create larger chain- or network-like molecules (polymers). VCM polymerizes into polyvinyl chloride (PVC), a hard plastic.

the highest point in the tank to reduce the pressure in the tank car, then punctured with explosives at the lowest point in the tank to release lading. The released lading is directed through a trench and burned in a prepared pit. (See figure 9.) The president of SPSI told the NTSB in his interview that SPSI proposed venting and burning all five VCM tank cars even though not all five were showing signs of polymerization; in his stated opinion, the vent and burn procedure would result in a fire that could further damage any non-vented tank cars and make other methods of unloading more dangerous to contractor personnel.

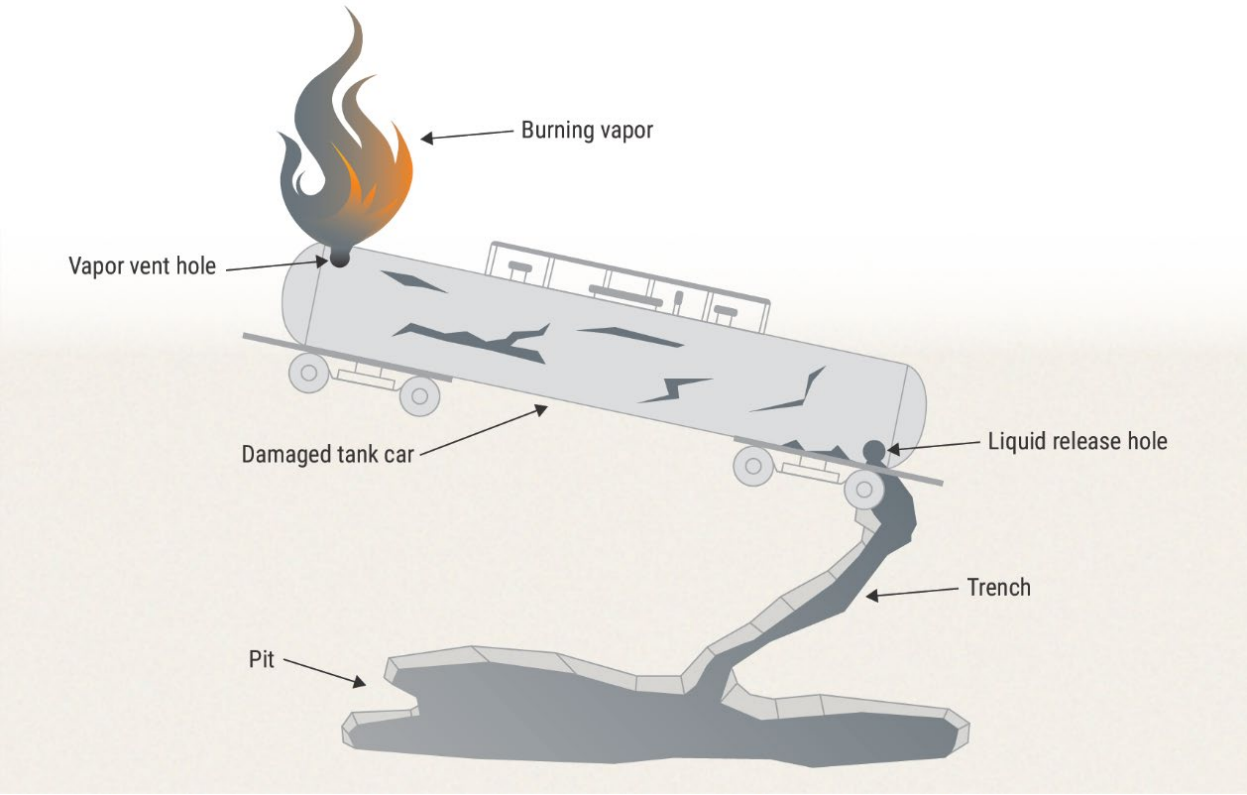


Figure 9. Illustration of a vent and burn procedure.

SPSI examined the VCM tank cars and attempted to measure their internal pressures on February 4. These examinations did not find indications that the tank cars had been mechanically breached or were releasing VCM except through PRDs. Because of the orientations of the tank cars and fire damage sustained by the top fittings, SPSI was able to obtain pressure measurements only from the easternmost VCM tank car, TILX402025 (line 28), which had not been exposed to the pool fire.[36]

[36] *Top fittings* are part of a tank car's service equipment and include features like liquid and vapor valves and PRDs.

When interviewed by the NTSB, the SPSI president recalled that the February 4 afternoon pressure measurement was "unremarkable." Another NS contractor, Specialized Response Solutions (SRS), began supporting the response on February 5 and also measured the internal pressure of tank car TILX402025.[37] The pressure measurements taken by SRS on February 5 indicated the tank's contents were stable at 60 pounds per square inch gauge (psig).[38] In postaccident interviews with the NTSB, the SRS senior project manager present at the scene said that tank car TILX402025 appeared to be "fairly stable," and that the contractors had developed a plan to clear that tank car from the tracks. He said that wrecking contractors who had been clearing railcars subsequently became concerned that the bolster assemblies on tank car TILX402025 had been damaged and decided to leave the tank car in place.[39]

On February 4–5, NS contractor personnel also approached tank car OCPX80370 (line 55), the tank car on the western side of the derailment and resting against a burning hopper car, to assess its condition. On both days, contractor personnel noted no audible hiss indicative of gas being released from the PRD, but a photoionization detector indicated the presence of volatile organic compounds near the top fittings' protective housing.[40] (VCM is a volatile organic compound.) When interviewed by the NTSB, the SPSI president said that he believed the PRD was leaking but not releasing enough flammable vapor to support combustion.[41] Based on his observation, he thought that the VCM was polymerizing, causing the PRD to become plugged with polymer.

The shipper of all five VCM tank cars was Oxy Vinyls, LP, which had also manufactured the VCM. Under 49 *CFR* Part 172 Subpart G, anyone who offers a hazardous material for transportation must ensure the availability of emergency

[37] Like SPSI, SRS is an emergency response contractor certified by The Chlorine Institute to respond to incidents involving VCM. NS contracted SRS and worked with them throughout the emergency response from February 5 onward. Both SPSI and SRS also communicated directly with the incident commander as discussed in this section.

[38] A pressure in *psig* indicates relative pressure—in this case, the difference in pressure between the interior of the tank and the outside atmosphere.

[39] In a tank car, the *bolster* is the component that bears the weight of the tank.

[40] A *photoionization detector* is a type of gas detector. Typical photoionization detectors measure the concentration of volatile organic compounds.

[41] It is common for PRDs to become damaged during operation and begin leaking (releasing vapor without actuating) or discharging below their original start-to-discharge pressures.

response information (ERI) on the shipping paper or a document such as an SDS, including the basic description and technical name of the hazardous material, hazard information, and immediate precautions to take following an accident or incident. The offeror must also provide an emergency response telephone number that is monitored by a person who is knowledgeable about the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material or has immediate access to a person who possesses that knowledge and information.

Oxy Vinyls provided an emergency response telephone number through CHEMTREC, a third-party company that operates a 24-hour call center for emergencies involving hazardous materials. An NS hazmat officer contacted CHEMTREC at 7:58 a.m. on February 4 and requested a copy of the SDS and a callback from the shipper. At 8:22 a.m. on the same day, CHEMTREC contacted Oxy Vinyls and facilitated communications between the two entities.

NS and SPSI first communicated directly with Oxy Vinyls, about 6:00 p.m. on February 4, in a conference call that included Oxy Vinyls' special situation team and four managers based in Dallas, Texas. During the conference call, Oxy Vinyls assessed a low probability of polymerization based on the observed PRD behavior but recommended monitoring the tank cars for an increase in temperature that could indicate an exothermic reaction.[42] Oxy Vinyls also recommended using modeling to assess the possible consequences of a tank car failure.

CTEH, another of NS's contractors, used the Complex Hazardous Air Release Model software program to produce theoretical tank car failure outcomes on the morning of February 5.[43] CTEH distributed the model results to NS at 4:15 a.m., and NS shared the results with the incident commander at 7:41 a.m. The modeled outcome was based on a type of tank car failure called a boiling liquid expanding vapor explosion (BLEVE). A BLEVE occurs when a tank car containing a liquified compressed gas (such as VCM) fails to contain its internal pressure. The loss of pressure results in a rapid decrease in the boiling point of the formerly pressurized liquid, which vaporizes and expands explosively, leading to a sudden and energetic product release. The Complex Hazardous Air Release Model developed at East

[42] An *exothermic* chemical reaction is one that produces heat.

[43] The Complex Hazardous Air Release Model is a modeling program that calculates the footprints of various chemical release effects, such as thermal radiation and overpressures.

Palestine indicated that tank car debris could be propelled about half a mile if a BLEVE occurred.

At 2:00 p.m. on February 5, three representatives from Oxy Vinyls arrived on the scene to provide technical assistance regarding the characteristics of VCM: a technical manager, a logistics process supervisor, and an emergency services lead. These representatives met with SPSI and SRS personnel and discussed the location and conditions of the derailed tank cars, the temperature measurements, and concerns about polymerization. The NTSB obtained the substance of the meeting from postaccident interviews with the participants. During the meeting, the Oxy Vinyls technical manager said that if polymerization occurred, it could lead to obstruction of a PRD, but that he was not an expert on polymerization. The Oxy Vinyls logistics process supervisor said the VCM was loaded under a nitrogen blanket to displace oxygen because oxygen could promote polymerization. If heated to about 185°F, the tank would reach a pressure high enough to actuate a PRD, but this actuation would not introduce oxygen. While PRD operation could expel nitrogen along with VCM, there would be no way for oxygen to enter the tank as long as the tank remained above atmospheric pressure. The SPSI president communicated that SPSI and SRS were asking about polymerization resulting in tank failure because the 2020 ERG and the Oxy Vinyls SDS listed polymerization as a potential hazard.

When discussing the possibility of a vent and burn or other means of unloading the VCM, Oxy Vinyls' technical manager estimated that for every 62 pounds of vinyl chloride burned in a fire, about 36 pounds of hydrogen chloride would be generated.[44] He suggested that flue gases from combusting vinyl chloride should go through a scrubber if NS chose to flare the tank cars.[45]

The NTSB had a brief conversation with the Oxy Vinyls on-scene representatives after this meeting to gather information for our investigation. The NS hazardous materials regional manager was present during the conversation. When discussing the possibility of a BLEVE resulting from polymerization, the Oxy Vinyls

[44] *Hydrogen chloride*, or HCl, is a colorless gas at room temperature that forms hydrochloric acid upon contact with water, including atmospheric water vapor and water in body tissue. The National Fire Protection Association's *NFPA 704: Standard System for the Identification of the Hazards of Materials for Emergency Response* classifies hydrogen chloride as corrosive and a level 3 health risk, meaning that short exposure could cause serious temporary or moderate residual injury (NFPA 2022).

[45] (a) A *scrubber* is an apparatus for purifying gases or vapors. (b) *Flaring* is a method of lading removal that involves burning lading at a safe location. (c) A flare was not performed on any of the tank cars involved in this accident.

representatives indicated that they had never had an incident lead to a BLEVE and were not sure what the outcome would be.[46]

Following Oxy Vinyls' earlier conference call recommendation to monitor the tank cars for an increase in temperature, SPSI and SRS began to monitor the temperatures of all five VCM tank cars about 4:00 p.m. on February 5. Under normal conditions, tank car lading temperatures are obtained by inserting a probe into the thermometer well, a narrow tube situated among the tank car's top fittings that extends into the lading. The process requires personnel to work in close proximity to the tank car's top fittings. At East Palestine, contractor personnel used infrared thermometers. The resulting measurements are shown in table 3. Tank car OCPX80370 was showing an elevated temperature. The other four VCM tank cars exhibited lower measured temperatures. Although the temperature measurements were used by NS and its contractors to assess the likelihood of polymerization, the opinions offered at the NTSB Investigative Hearing by the SPSI president and the Oxy Vinyls vice president of health, environment, safety, and security differed regarding the accuracy of the temperature readings. The SPSI president testified that he did not have high confidence in the temperature readings because pieces of jacket or thermal protection blanket might have been interfering with their attempts to take the temperature of the bare tank shell and because the temperature measured at one point on the shell might not accurately reflect temperatures across the entire tank car.[47] However, the Oxy Vinyls vice president of health, environment, safety, and security testified that he believed the temperature monitoring method SPSI used was valid for assessing whether polymerization was progressing.[48]

[46] As further discussed below, Oxy Vinyls was not yet a party to the investigation and not involved in the formal investigative progress meetings.

[47] (a) NTSB Investigative Hearing Transcript, Day 1, pp. 149–50. (b) *Jackets* and *thermal protection blankets* are features intended to protect a tank car during an accident. Tank car protection is discussed in more detail in section 1.7.1.

[48] NTSB Investigative Hearing Transcript, Day 1, pp. 173–75.

Table 3. SPSI tank car temperature measurements.

Date	Time	TILX402025 Temperature (°F)	OCPX80235 Temperature (°F)	OCPX80179 Temperature (°F)	GATX95098 Temperature (°F)	OCPX80370 Temperature (°F)
2/5/2023	4:00 p.m.	65	65	65	67	135
	5:00 p.m.	-	-	-	-	138
	6:00 p.m.	-	-	-	-	136
	7:00 p.m.	-	-	-	-	136
	8:00 p.m.	-	-	-	-	130
	9:00 p.m.	-	-	-	-	130
	10:00 p.m.	-	-	-	-	130
	11:00 p.m.	-	-	-	-	131
2/6/2023	12:00 a.m.	65	65	65	67	139*
	1:00 a.m.	65	65	65	67	129
	2:00 a.m.	-	-	-	-	-
	3:00 a.m.	-	-	-	-	-
	4:00 a.m.	-	-	-	-	-
	7:00 a.m.	62	63	90	115	120
	8:37 a.m.	62	65	65	65	127
	9:30 a.m.	65	65	65	65	126
	10:30 a.m.	65	65	65	65	126
	11:30 a.m.	65	65	65	65	126
	12:30 p.m.	65	65	65	65	126
	1:30 p.m.	65	65	65	65	126
	2:30 p.m.	65	65	65	65	126

*When interviewed by the NTSB, the EPFD fire chief noted that this increase in temperature coincided with the ignition of a small fire underneath tank car OCPX80370, and that the temperature decreased after the fire was extinguished.

On the afternoon of February 5, the Oxy Vinyls technical manager joined a conference call with off-site Oxy Vinyls personnel, including the special situations team in Dallas. When interviewed by the NTSB, the Oxy Vinyls technical manager said that the participants in the call reached a consensus that available evidence did not indicate polymerization within the tank cars: the tank cars had been loaded with an oxygen concentration too low to support polymerization, the temperatures measured on the tank cars' shells were lower than those a polymerization reaction would produce, and the PRDs could have stopped cycling because the temperature was below that which would produce vapor pressure sufficient to actuate the PRD. When interviewed by the NTSB, the Oxy Vinyls vice president of health, environment, safety, and security, who was also on the call, said that the participants also believed a

significant proportion of lading had already been vented from three VCM tank cars exposed to fires.

Around the same time, the SPSI president met with the NS system manager for hazardous materials and the SRS senior project manager. When interviewed by the NTSB, the SRS senior project manager said they concluded that polymerization was occurring within VCM tanks because of fire exposure and that the best option was a vent and burn. NS and its contractors began preparations to vent and burn the VCM tank cars. Between 3:00 p.m. and 5:00 p.m., the SRS senior project manager requested a response from an explosives contractor, Explosive Service International (ESI), while other contractors began excavating containment pits to receive VCM released during the vent and burn.[49] During these preparations, a sweep of the scene by NS contractors found no evidence that the VCM tank cars had been mechanically breached, and the residual fires were mostly under control.

At 5:47 p.m. on February 5, SPSI and SRS contacted the incident commander and said that circumstances might require a vent and burn of the VCM tank cars. In postaccident interviews with the NTSB, the SRS senior project manager said that the reasons not to attempt another method of unloading the tank cars—their damaged condition and the risk of polymerization—also supported venting and burning all five simultaneously. He said that venting and burning only some of the tank cars would have required personnel unloading the others to work near damaged tank cars and dangerous polymerization reactions. In the incident commander's postaccident interview with the NTSB, he said:

> It was explained to me that…how those cars were, that they couldn't single out one car and safely vent and burn it without the possibility of something happening to the other cars. And again, that one car, two car, three car, five car, there was a lot of discrepancy in my opinion about what they were going to do as far as the vent and burn in that process. Different people had said different things. We're only going to do one. We're going to do two. We're going to do five. And I don't feel

[49] (a) ESI is not affiliated with Engineering Systems, Inc. (ESi), a separate company that examined rail equipment recovered from the derailment. (b) The timing of the communication between the SRS senior project manager and ESI is based on the ESI president's interview with the NTSB. The ESI president was in Louisiana when he received the call from SRS, and it is not clear in his interview whether his stated "around three or four o'clock in the afternoon" is in Central Time or Eastern Time. The time range shown in the report reflects this uncertainty.

> that I comfortably had an answer to that 100 percent until we discussed that final discussion of the vent and burn process.

The incident commander said that he had been informed that safety devices were definitely not functioning on one tank car and were potentially not functioning on another.

About 6:00 p.m. on February 5, during a meeting with the NTSB to provide a progress update on the investigation, the NS systems manager for hazardous materials told the NTSB that VCM was polymerizing and obstructing PRDs, preventing them from functioning. He said that the temperature of one tank car, OCPX80370, had risen 3°F in 1 hour to 138°F, indicating a polymerization reaction. He also said that if the tank shell temperature rose to 185°F, the VCM would have reached the critical temperature for a runaway polymerization reaction, information he attributed to Oxy Vinyls.[50] NS assessed the most likely outcome of continuing polymerization was an explosion capable of propelling tank car fragments up to half a mile and producing large amounts of radiant heat. NS communicated to the NTSB that it favored a vent and burn to prevent this explosion.[51]

During the same conversations with the NTSB during the investigative progress meeting, the NS systems manager for hazardous materials described the three alternatives to a vent and burn (product transfer, hot tapping, and flaring) that NS and SPSI had rejected as unsafe because of the tank cars' unknown internal pressures and unknown extent of damage. The Oxy Vinyls representatives were not present at the investigative progress meeting, and Oxy Vinyls was not yet a party to the investigation.

About 7:00 p.m. on February 5, the Oxy Vinyls on-scene representatives met with SPSI, where they learned that SPSI had chosen a vent and burn as the best response. (NS had requested that Oxy Vinyls communicate through SPSI, which was in contact with NS.)[52] When interviewed by the NTSB after the accident, the Oxy Vinyls technical manager said that SPSI did not ask for Oxy Vinyls' opinion on the vent

[50] As discussed above, the Oxy Vinyls logistics process supervisor previously told SPSI and SRS that 185°F was the temperature that would result in pressures high enough to actuate a PRD on a VCM tank car. The NTSB did not find evidence of statements from Oxy Vinyls about 185°F being a critical temperature for polymerization.

[51] This meeting, like other on-scene meetings involving the NTSB, was in support of the investigation. The NTSB was not involved in the emergency response.

[52] NTSB Investigative Hearing Transcript, Day 1, p. 177.

and burn. Oxy Vinyls told SPSI that it did not interpret the available information as evidence of polymerization, as decided during the afternoon conference call with the special situations team in Dallas. The technical manager stated that the SPSI president responded by explaining his reasons for favoring the vent and burn, including his concerns about trying to transfer VCM from tank cars of unknown structural integrity.

When interviewed by the NTSB, the Oxy Vinyls vice president of health, environment, safety, and security, stated that during this meeting with SPSI, the Oxy Vinyls vice president of manufacturing told SPSI:

> …we're not on the ground with you, so if you're talking about a vent and burn decision, don't do it because of polymerization, because polymerization is not occurring, that was the gist. So, he was just trying to communicate [that a] vent and burn may have other motivators for it, but don't do it because of polymerization because it's not occurring and he was pretty absolute with that statement.

When interviewed by the NTSB, the Oxy Vinyls technical manager said that Oxy Vinyls did not formally approve or disapprove of the decision to vent and burn because it was not their role to recommend mitigation techniques. At the NTSB's Investigative Hearing, he testified that he was confident while on the scene that Oxy Vinyls' positions were being communicated to the full incident command.[53]

Shortly after noon on February 6, the incident command met to determine whether the vent and burn method was the best available option to mitigate the risk of an uncontrolled explosive tank rupture. This meeting involved an estimated 60–100 individuals, including people and organizations not part of the formal incident command, such as the governors of Ohio and Pennsylvania. Representatives from Oxy Vinyls were not present and had not been invited to attend. The NTSB did not find evidence that attendees other than NS and its contractors were aware that Oxy Vinyls had developed a dissenting opinion about polymerization. According to the incident commander's postaccident interview with the NTSB, no attendee objected to conducting the vent and burn based on the information presented and the potential BLEVE hazard as characterized by NS, SPSI, and SRS. The SPSI president and SRS project manager told the incident commander that the VCM was undergoing

[53] NTSB Investigative Hearing Transcript, Day 2, p. 253.

polymerization, was generating its own heat, and was unstable because of the elevated temperatures.[54]

Shortly after the incident command meeting, the incident commander focused on ensuring that appropriate residential evacuations were underway in preparation for a possible vent and burn. Once the Ohio and Pennsylvania governors were satisfied that evacuations were completed, an NS representative asked the incident commander and the Ohio governor to meet in a separate room with NS, SPSI, and SRS personnel, including the chief executive officer of NS. When interviewed by the NTSB after the accident, the incident commander reported that the SPSI president and SRS project manager said in this meeting that he had 13 minutes to decide whether to allow them to proceed with the vent and burn because they wanted to begin before 3:00 p.m. to avoid the effects of atmospheric temperature inversion and allow the vapor cloud to disperse. The incident commander said that he felt overwhelmed and blindsided by the size of the decision and significant time constraint. Before agreeing to proceed, the incident commander asked SPSI and SRS to explain the vent and burn process and to repeat why it was necessary. The SPSI president and SRS project manager told the incident commander that if a tank car's temperature rose to 150°F, for safety reasons they would withdraw personnel from the area and stop any attempt to prevent an uncontrolled explosive tank rupture. They also told the incident commander that if the temperature in a tank car reached 153–158°F, the result would be an uncontrolled polymerization reaction accompanied by a rapid rise in temperature.[55]

By the time of the meetings on February 6, the highest tank car temperatures had fallen from about 138°F the previous afternoon to about 126°F. When interviewed by the NTSB, the incident commander said the declining tank car temperatures did not impact SPSI's and SRS's urgency to conduct a vent and burn; SPSI and SRS were more concerned with the need to finish the procedure during daylight hours. Hearing no objections from anyone present during the meetings on the morning of February 6, and given the statements from NS, SPSI, and SRS that the vent and burn procedure was the only remaining option to avoid a catastrophic BLEVE, the incident commander consented to proceeding with the vent and burn. In interviews with the NTSB, the incident commander said that he bore the responsibility for this decision, and in his testimony at the NTSB's Investigative Hearing, he noted

[54] Based on SPSI and SRS temperature measurements, the hottest tank car, OCPX80370, had decreased in temperature from its peak of 138°F to about 126°F by the afternoon of February 6.

[55] The NTSB did not find this temperature range in written guidance about VCM consulted at the scene or in communications between Oxy Vinyls and NS and NS contractors.

the need to make the decision quickly based on the input from NS, SPSI, and SRS that there was no other option to prevent catastrophic failure of a tank car.[56]

According to the incident commander, no Oxy Vinyls employees were invited to these meetings, and none were present. Nor did any Oxy Vinyls employees communicate with the incident commander outside these meetings.

The vent and burn was originally scheduled for 1:00 p.m. on February 6, 2 hours ahead of the 3:00 p.m. deadline described to the incident commander by SPSI and SRS. However, the vent and burn was repeatedly delayed for technical and safety reasons: once to rewire the charges and three times because of unauthorized persons entering the evacuation zone. ESI detonated the vent and burn charges at 4:37 p.m. for all five VCM tank cars, puncturing each tank car at two points: the highest point in the vapor space and the lowest point where the liquid had pooled. The punctured tank cars expelled vapor, which was ignited by flares positioned near each tank car. Burning VCM resulted in a column of black smoke that grew into a persistent cloud. (See figure 10.) According to the NS system manager for hazardous materials, the cloud likely contained soot particles, carbon dioxide, carbon monoxide, hydrogen chloride, and a trace of phosgene (a toxic gas).

[56] NTSB Investigative Hearing Transcript, Day 2, p. 139.



Figure 10. The vent and burn 3 minutes after detonation. (Courtesy of NS.)

NS began wreckage clearing on February 7 following assessment of the isobutylene tank car that had come to rest between OCPX80370 and the eastern group of VCM tank cars. The isobutylene tank car was successfully moved to an adjacent staging area on February 7 and transloaded on February 22, after the vent and burn of the VCM tank cars.

NS resumed rail service through East Palestine on main track 2 (adjacent to the derailment site) on February 8, and the first train passed through the derailment site at 4:46 p.m. At 5:28 p.m. on February 8, the incident commander lifted the evacuation order as a result of meetings with the governors of Ohio and Pennsylvania, the Environmental Protection Agency, and the Centers for Disease Control and Prevention. Trains began using main track 1 on the morning of February 9. Table 4 provides a summary of the vent and burn timeline.

Table 4. Timeline of vent and burn decision.

Date	Time	Event
2/4/2023	Early morning	First PRD actuations on VCM tank cars
2/4/2023	Midday	PRD actuations cease
2/4/2023	5:30 p.m.	PRD on tank car OCPX80179 actuates and vents energetically and continuously for about 70 minutes
2/4/2023	After 5:30 p.m.	SPSI and NS are "already at a vent and burn" according to the SPSI president's interview with the NTSB
2/4/2023	6:00 p.m.	Conference call between SPSI, SRS, and off-scene Oxy Vinyls personnel; Oxy Vinyls recommends monitoring tank car temperatures
2/5/2023	2:00 pm.	Oxy Vinyls representatives arrive on the scene and meet with SPSI and SRS personnel
2/5/2023	4:00 pm.	Temperature monitoring begins
2/5/2023	Afternoon	Oxy Vinyls on-scene and off-scene teams reach consensus that polymerization is not occurring in fire-exposed VCM tank cars
2/5/2023	Between 3:00 p.m. and 5:00 p.m.	SRS asks ESI to travel to the scene in preparation for a vent and burn
2/5/2023	5:47 p.m.	SPSI and SRS recommend a vent and burn to the incident commander
2/5/2023	6:00 p.m.	NS tells the NTSB during an investigative update meeting that polymerization is occurring and that it is proposing a vent and burn
2/6/2023	Early afternoon	Incident command meets to discuss the vent and burn (Oxy Vinyls is not in attendence)
2/6/2023	Early afternoon	EPFD incident commander, Ohio governor, NS, SPSI, and SRS personnel have a separate meeting; the incident commander asks additional questions and agrees to the vent and burn; the incident commander is not aware that Oxy Vinyls has offered a dissenting opinion on polyermization
2/6/2023	1:00 p.m.	Proposed time for vent and burn
2/6/2023	4:37 p.m.	Charges detonate to vent all five VCM tank cars
2/8/2023	4:46 p.m.	The first train passes through the derailment site on main track 2
2/8/2023	5:28 p.m.	Evacuation lifts
2/9/2023	Morning	NS resumes rail service on main track 1

1.2 Norfolk Southern Railway

NS is categorized as a Class I railroad under the Surface Transportation Board regulations (49 *CFR* 1201).[57] NS operates about 19,420 route miles of track in 22 states and has rights in Canada over the Albany, New York, to Montreal, Ontario, route owned by Canadian Pacific Kansas City Limited. NS is a subsidiary of the Norfolk Southern Corporation and is headquartered in Atlanta, Georgia.

1.3 Data Recorders

The NTSB received event recorder files from the lead locomotive and the distributed power unit, which were equipped with model F3050 Central Railway MFG event recorders. These files included data from train 32N's movements leading up to the derailment and the derailment itself.

The NTSB received locomotive image recorder data provided by NS from five sources. Three of these sources were aboard the lead locomotive, and two sources were aboard the second locomotive. The provided files included audio and video data from about 15 minutes before the derailment, the derailment itself, and about 6 minutes after the derailment. The source, file count, and camera direction for each source are shown in table 5.

Table 5. Summary of image recorder information.

Camera	Locomotive	Number of Files	Total Video Length (minutes:seconds)
External forward facing	Lead	21	20:59
Inward rearward facing	Lead	19	19:00
Inward forward facing	Lead	21	20:59
External forward facing	Second	1	20:02
Inward forward facing	Second	1	20:01

The NTSB requested but did not receive additional image and audio data as described in

[57] *Railroad classes* I through III are defined by annual revenue. Of the three classes, Class I railroads have the highest annual revenues, currently defined as $900 million or more.

table 6.

Table 6. Timeline of recorder data requests and action.

Date	Time	Event
2/4/2023	7:30 a.m.	NTSB advises NS to hold and preserve all evidence
	1:30 p.m.	NTSB investigator in charge arrives at incident command post and requests full download of locomotive event and image recorders
	7:00 p.m.	NTSB investigator in charge discusses preservation and collection of image recorder data and possible on-scene viewing of forward-facing image recorder data
2/5/2023	6:00 a.m.	NTSB again requests inward- and forward-facing image recorder data from NS
	N/A	NTSB examines lead locomotive and finds that the image recorder memory modules have been removed and are sitting on the control console
	N/A	NS tells the NTSB that event and image recorder information has been uploaded to the shared file database for the investigation
	6:00 p.m.	NS shows NTSB and other parties about 10 minutes of data from the lead locomotive's forward-facing image recorder
2/13/2023	N/A	NTSB contacts NS about image recorder data, which have not yet been uploaded to the shared file database
	N/A	NS uploads the image recorder data; NTSB confirms that the data uploaded successfully
2/15/2023	3:00 p.m.	NTSB conducts formal audition of inward- and forward-facing image recorder data and finds about 30 minutes of data
	Afternoon	NTSB requests additional data to include the last four HBDs traversed by train 32N
2/16/2023	N/A	NS reports that no further image recorder data are available because the locomotives were returned to service, and their onboard recorders only included data going back to 2/10/2023
2/24/2023	10:40 a.m.	NTSB requests at least 24 hours of event recorder data including the derailment
	Noon	NS uploads 24 hours of event recorder data into the shared file service for the investigation, including data from 2/3/2023

1.4 Track and Signals

The derailment occurred on the NS Keystone–Fort Wayne Line, which extends from milepost MP 0 to MP 188 in an east-west direction and consists mostly of double main track. According to information provided by NS to the FRA on August 12, 2022, about 46 trains pass through East Palestine each day on the NS Keystone–Fort Wayne Line. Train movements near the derailment site are authorized by cab signal indications with an overlaid positive train control (PTC) system and coordinated by an

NS train dispatcher at the Dispatch Center in Atlanta, Georgia.[58] The NTSB's review of PTC data logs from train 32N did not identify issues with signal function on this line.

The track where the derailment occurred is designated Class 4 under Federal Railroad Administration (FRA) regulations, which allows a maximum speed of 60 mph for freight trains and 80 mph for passenger trains (49 *CFR* 213.9).[59] However, NS had permanently restricted the maximum authorized timetable speed for all trains to 50 mph.[60]

During the investigation, the NTSB reviewed NS track inspection records. Main track 1 near the derailment site was last inspected with rail flaw detection equipment on January 16, 2023; this inspection did not identify any safety-relevant rail defects. The track was visually inspected as required by 49 *CFR* 213.233 on January 31, 2023, and February 1, 2023; these inspections identified one track condition in need of repair 24.1 miles west of the derailment site (a broken switch component). The switch component had been repaired before train 32N passed over the switch on the day of the derailment.

On February 4, 2023, the NTSB performed a walking inspection on main track 1 between MP 51 and MP 49, which included the track between the East Palestine HBD and derailment site. The NTSB did not identify any track defects. During this walking inspection, the NTSB identified scrape-like markings on the top of the south running rail at MP 49.5. (See figure 11.) The markings were consistent with the side frame of a truck or similar railcar component sliding along the top surface of the railhead during a derailment.[61] Additional scrape-like markings extended 1,464 feet east from MP 49.5 along the south running rail. The crossties in this area exhibited grooves within the gage consistent with derailed wheel flanges running along the ground.[62] (See figure 12.) There were no similar markings west of MP 49.5.

[58] A *positive train control system* enforces speed limits and prevents a train from passing through a signal that requires it to stop.

[59] Track classes are categorized based on their speed limits.

[60] Instructions limiting train speeds were documented in the NS Pittsburgh Division Timetable. It is common for railroads to restrict speeds to below FRA maximums for safety reasons.

[61] A *side frame* is part of the truck. Each railcar has two trucks, and each truck contains two wheelsets. During normal operation, a side frame does not contact the running rail.

[62] *Gage* refers to the distance or space between the running rails. *Gage side* means the side of the rails toward the center of the track. *Field side* means the outward side.

The grooves and markings on the rail were consistent with a point of derailment at MP 49.5.

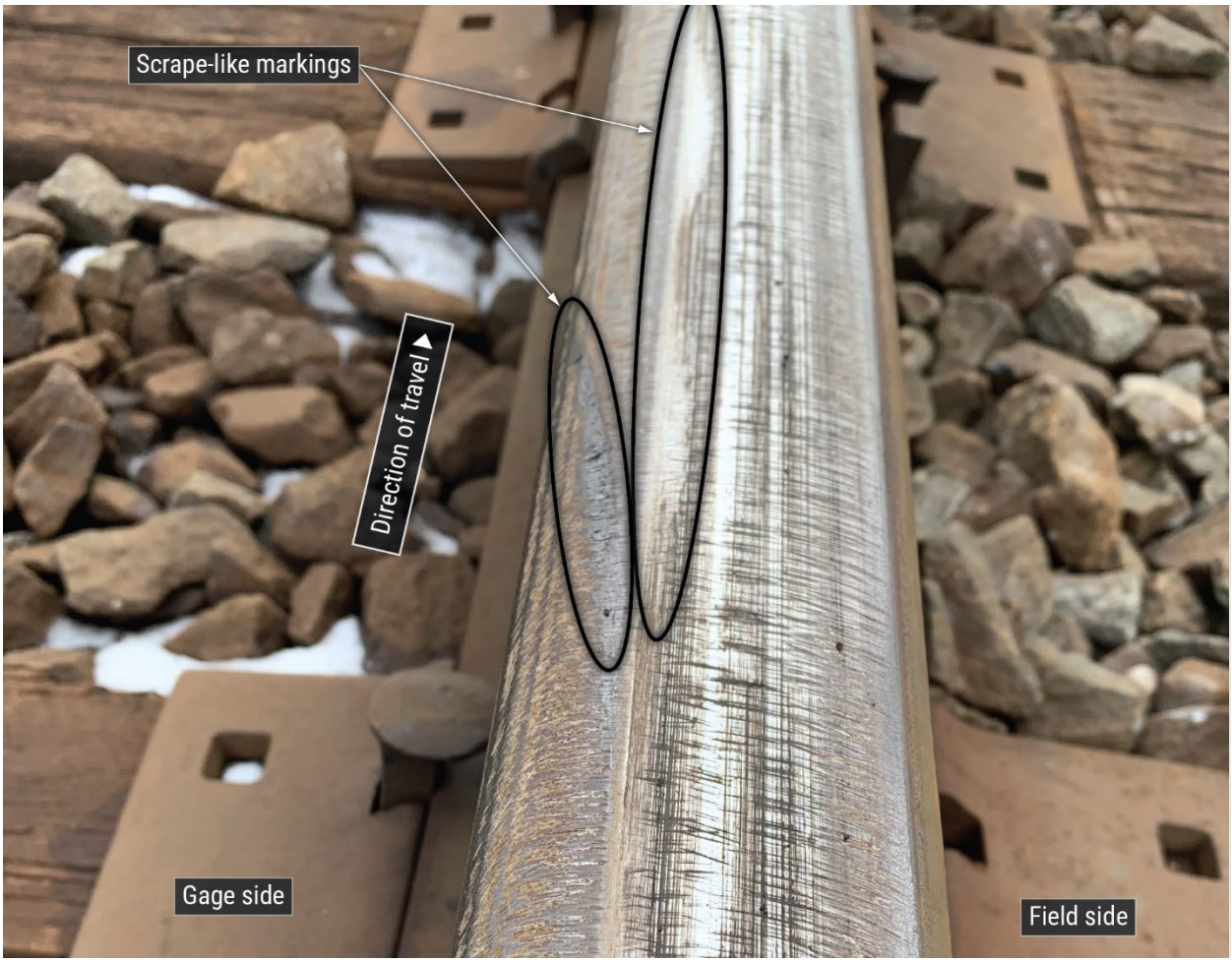


Figure 11. South running rail at MP 49.5.



Figure 12. Wheel flange marks on crossties east of MP 49.5.

The NTSB documented track geometry west of MP 49.5.[63] The NTSB did not identify any lateral or longitudinal rail movement, out-of-tolerance gage measurements, abnormal vertical rail deflection, or measurements deviating from NS's engineering design standards, curve specifications, or track profile charts.

1.5 Wayside Bearing Defect Detection

Wayside bearing defect detectors are devices intended to alert railroads to failing bearings in time to prevent a derailment or other accident. The two most common devices currently in use are HBDs and acoustic bearing detectors (ABDs).

[63] *Track geometry* refers to the gage, surface, and alignment of the track structure—physical characteristics that inform how vehicles interact with the track.

HBDs measure bearing temperatures and identify bearings in the process of overheating; ABDs monitor bearings for potential flaws by evaluating each bearing's acoustic signature as it passes wayside microphones. ABDs are intended to identify early signs of bearing degradation and allow railroads or railcar owners to service or replace bearings before they fail.

Wayside bearing defect detection systems are currently deployed by railroads voluntarily—all six Class I railroads use them—and are not regulated by the FRA. The Association of American Railroads (AAR) provides some guidance on the use of wayside bearing defect detection, but as discussed below in section 1.5.4, individual railroads vary in their approaches.

1.5.1 Wayside Bearing Defect Detector Equipment and Configuration

At the time of the East Palestine derailment, the average interval between HBDs in NS's rail network was about 13.9 miles.[64] The three HBDs train 32N traversed shortly before the derailment were Progress Rail Micro models configured to measure bearing temperatures 7.25 inches outboard of each running rail's inner edge, or near the inner edge of each bearing cup, with the infrared camera oriented 45° above the plane of the running rail.[65] (See figure 13 and figure 14.) At the East Palestine Investigative Hearing, the founding director of the University Transportation Research Center testified that changes to bearing temperature as measured on the exterior of the bearing cup tend to lag behind temperature changes in the bearing's interior.[66] An increase in temperature within the bearing may take 30 minutes to an hour to be accurately reflected by a temperature reading taken on the exterior of the bearing cup.

[64] Note that an average interval between detectors is not necessarily a typical interval; detectors can be closely spaced throughout some stretches of track but loosely spaced elsewhere.

[65] The *bearing cup* is the cylindrical housing that contains the rollers and other bearing components that move relative to the railcar.

[66] NTSB Investigative Hearing Transcript, Day 2, pp. 219–20.



Figure 13. Example of a Progress Rail Micro HBD.

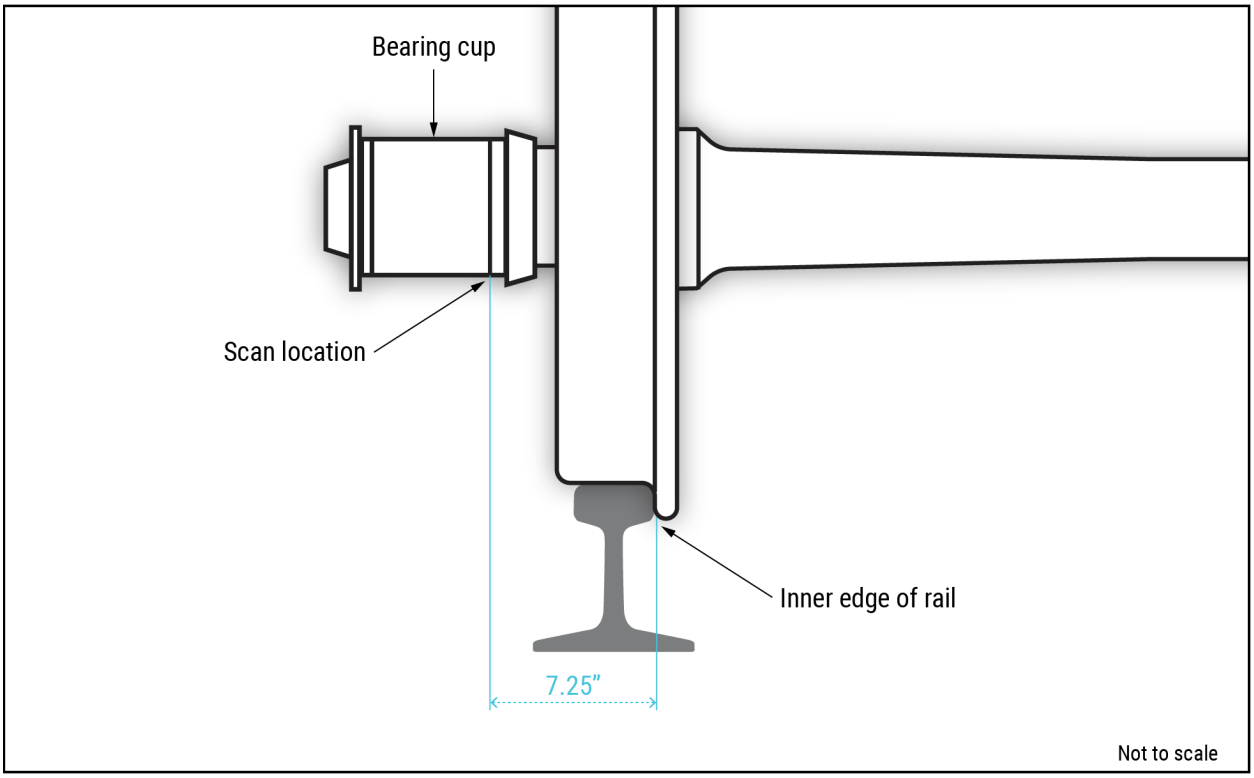


Figure 14. Diagram of HBD scan location.

1.5.2 NS Wayside Help Desk

All NS wayside detectors are monitored from the NS ATC Wayside Help Desk in Atlanta, Georgia. At the time of the East Palestine derailment, the Wayside Help Desk was staffed by single analysts working 12-hour shifts. An algorithm processes data from multiple HBDs and automatically displays alerts on the analyst's console. NS standard operating procedures establish alert criteria for temperature measurements and trends and specify analyst responses to various types of alerts as described in section 1.5.3.1.

1.5.3 NS Wayside Detector Alert and Alarm Criteria

1.5.3.1 NS Hot Bearing Alert and Alarm Criteria

NS divides abnormal HBD readings into two categories: alerts and alarms. Alerts are displayed on the Wayside Help Desk console and not broadcast directly to train crews. Alerts are triggered by any one of the following criteria:

- An HBD reading of 90°F or more above ambient with a Kt value greater than four;

- Readings that indicate a bearing is significantly warmer than other bearings on the same side of the train (an elevated Kt value) or the same piece of equipment (an elevated Ke value) even if the bearing has not exceeded 90°F; or
- A temperature differential of 115°F or more between bearings on the same axle.[67]

Not all alerts require that an analyst instruct the crew to stop and inspect the train. Under NS standard operating procedures, an analyst must give this instruction only for critical alerts, which occur if the Ke or Kt value for a single bearing exceeds four during a train's journey three times, or if the analyst receives a temperature differential alert. For alerts that do not meet these criteria (non-critical alerts) the analyst must instead monitor the affected train as it traverses subsequent HBDs to conduct a trend analysis of the suspect bearing's temperature.

An alarm is radioed directly to a train's crew by the HBD itself when the HBD detects a bearing temperature between 170°F and 200°F above ambient (a "warm bearing" alarm); the audible alarm communicates the type of alarm and location of the warm bearing. When a crew receives a warm bearing alarm, NS operating rules require the crew to reduce the train's speed until the last railcar has passed the HBD, then stop the train to inspect the affected wheelset.[68] An alarm is also triggered when the HBD detects a bearing temperature more than 200°F above ambient (a "critical bearing" alarm). When a crew receives a critical bearing alarm, NS operating rules require the crew to bring the train to a safe stop immediately to inspect the affected wheelset.

When train 32N traversed the Salem, Ohio, HBD at MP 49.81, it triggered an alert at the Wayside Help Desk based on a single bearing temperature of 103°F above ambient with a Kt value of 5.8. When interviewed by the NTSB, the analyst on duty said that he did not see the alert from that HBD because he was working to resolve other, higher-priority alerts. When asked what he would have done if he had seen the Salem HBD alert in real time, he said that he would have monitored train 32N for alerts from subsequent HBDs in accordance with NS protocols.

[67] The algorithm communicates the significance of a bearing's temperature as a pair of K values—statistical indicators of how one measurement varies relative to a population. A *Kt* value indicates variation between a bearing and other bearings on the same side of the train; a Ke value indicates variation between a bearing and other bearings on a single piece of equipment.

[68] Operating rules effective at the time of the derailment were documented in *NS Operating Rules*, effective January 1, 2019.

At the NTSB's Investigative Hearing, the NS Assistant Vice President of Signals and Communications testified that NS based its criteria for hot bearing alerts and alarms on AAR standards and has refined the system over its years in service.[69] He also stated that under the alert procedures, non-critical alerts require monitoring rather than an immediate stop-and-inspect. He stated that this reflects the reality that most alerts do not require a prompt reaction, and many alerts do not develop into future issues.[70]

1.5.3.2 Acoustic Bearing Detectors

In addition to HBDs, NS uses ABDs. ABDs are less common across the US rail network than HBDs; at the time of the derailment, NS had 5, and the Class I railroads had a total of 61. According to information provided by NS, its ABDs produced 3797 alerts between May 2013 and July 2023, and these alerts resulted in 2993 wheelset replacements handled by NS.

The last time the hopper car traversed an ABD was on October 12, 2022. The ABD returned a fault code of "noisy," one of several fault code prefixes that indicate the data returned by the ABD may not be reliable.[71]

1.5.4 Industry-Wide Use of Wayside Bearing Defect Detection

After the East Palestine derailment, the NTSB contacted all six Class I railroads and asked for information about how they use wayside bearing defect detection systems, including how they set alarm parameters, and planned changes. The results, provided between October 2023 and December 2023, are summarized in table 7.

[69] (a) NTSB Investigative Hearing Transcript, Day 2, pp. 211–12. (b) The AAR has a definition of a hot bearing, as discussed in section 1.5.4. The AAR also has recommended practices for trend analysis.

[70] NTSB Investigative Hearing Transcript, Day 2, pp. 212–13.

[71] Noisy, FBS (flanging, braking, slamming), shrk (shriek), and clpd (clipped) prefixes are indicative of non-bearing faults, errors, or other external inputs that may diminish the reliability of the information gathered by the ABD. These prefixes typically suggest that there is an error with the reading, not a bearing-related issue.

Table 7. Summary of wayside detector survey results.

Subject	Railroad #1	NS	Railroad #3	Railroad #4	Railroad #5	Railroad #6
Average HBD spacing before 2/2/2023	16.2 miles	13.9 miles	19.9 (key routes)	17.3 miles	12.7 miles	15–25 miles
Average HBD spacing in autumn 2023	14.9 miles	13.0 miles	19.9 (key routes)	17.3 miles	12.7 miles	15–25 miles
Plans to install more HBDs	Possibly	Possibly	Yes	Yes, to average 15 miles	Possibly	Yes, to average 20 miles on key routes with ABDs
Individual bearing alarm parameters before 2/2/2023	170°F above ambient	Critical 200°F above ambient; non-critical between 170°F and 200°F above ambient†	170°F above ambient	190°F above ambient	165°F on core routes; 136°F on non-core routes	180°F above ambient
Bearing differential alarm parameters before 2/2/2023	Not used	115°F	150°F	117°F	95°F on core routes; 69°F on non-core routes	150°F
Testing and inspection intervals	Every 15 days	Every 30 days	Monthly	Every 56 days	Monthly	Monthly
Calibration intervals	Every 30 days	Every 180 days	Every 6 months	Semi-annual	Twice a year	Every 6 months
Number of ABDs before 2/2/2023	11	5	26	7	7	5
Number of ABDs in autumn 2023	12	21	26	7	8	11
Plans to install more ABDs	Yes, 2 additional	Yes, 1 additional	Under review	No	Yes, 7 additional	Yes, 4 additional

*A *key route* is a route that carries a high yearly volume of hazardous materials as defined in AAR Circular OT-55.

†After the East Palestine derailment, NS eliminated the "warm bearing" alarm and set its critical alarm threshold at 170°F above ambient.

The AAR defines "overheated" bearings in Rule 36, Section 11 of its Field Manual (AAR 2023). Under this definition, a bearing is overheated if one of the following conditions is met:

- The surface of the bearing cup reaches an absolute temperature of 200°F as measured by an AAR-approved device;

- A wayside HBD measures a temperature at least 170°F above ambient; or

- A wayside HBD measures a temperature at least 95°F above the temperature of the mate bearing on the same wheelset.

If the measurement comes from an HBD, the suspect bearing must be manually checked with a different instrument to confirm that it is significantly hotter than the next hottest bearing on the same side of the equipment. This is intended to ensure that the correct bearing has been identified.

At the NTSB's Investigative Hearing, the AAR Senior Vice President of Safety and Operations testified that AAR overheated bearing definitions are based on billing thresholds that govern when a railroad can take a railcar out of service for repairs.[72] He also stated that individual railroads' thresholds for alerts and alarms are a balance between removing unsafe bearings from service and avoiding unnecessary stops that would reduce the effectiveness of the rail system. Railroads' choice of thresholds is normally made based on their experience with negotiating that balance.[73]

1.5.5 Other Bearing Defect Detection Technologies

The NTSB has identified bearing defect detection technologies not yet in widespread use, such non-wayside, railcar-mounted systems designed to monitor bearing health by measuring vibrations. These include a railcar-mounted system under development at the University Transportation Center for Railway Safety that underwent testing in 2015 (Tarawneh, Montalvo, and Wilson 2021).[74] A related system that also measures impact loads to monitor track and wheel conditions along with bearing health is undergoing field testing on short-line railroads (Pams et al. 2024).

[72] (a) NTSB Investigative Hearing Transcript, Day 2, pp. 215–16. (b) Responsibility for paying for railcar repairs is divided by contract between railroads and railcar owners or lessors. In general, a railcar defect that clearly places a railcar out of service, such as an overheated bearing that meets the AAR definition, is billable to the railcar owner or lessor.

[73] NTSB Investigative Hearing Transcript, Day 2, p. 215–16.

[74] The director of the University Transportation Center for Railway Safety at the University of Texas Rio Grande Valley, who was an author of the cited article, testified at the NTSB's Investigative Hearing about this family of technologies. See NTSB Investigative Hearing Transcript Day 2, pp. 235-36.

1.6 Hopper car GPLX75465

1.6.1 Manufacture, Ownership, and Movement History

GPLX75465 was a covered hopper railcar owned by the GATX Corporation and leased to Braskem America, Inc. It was manufactured in 1997 by Trinity Industries and purchased by GATX the same year.

The manufacturer of the bearings installed on the hopper car recommends moving equipment one railcar length every 6 months to distribute lubricant over bearing surfaces (Timken 2016). The NTSB reviewed 10 years of car location messaging (CLM) data to map the movement history of the hopper car. Movement is recorded by the CLM system only when a railcar passes a reader on a mainline, meaning that CLM records typically do not include movement within yards. CLM records showed that the hopper car remained in LaPorte, Texas, and did not pass a mainline reader for two periods exceeding 6 months: 565 days in 2017–2018 and 206 days in 2018–2019. Additional records from the yard in LaPorte where the hopper car was located indicated that it was moved within the yard during these periods; the longest period between movements was about 4 months.

Meteorological records reviewed by the NTSB showed that while the tank car was in LaPorte, Hurricane Harvey made landfall in southeast Texas and inflicted heavy rain over late August and early September 2017, resulting in widespread flooding. The weather reporting station at Houston Hobby Airport, about 14 miles from the LaPorte railyard, recorded 37 inches of rainfall from Hurricane Harvey.

CLM records also indicate that the hopper car was in Baltimore, Maryland, from June 1, 2016, until August 7, 2016. The weather reporting station at Baltimore/Washington International Thurgood Marshall Airport recorded severe weather during this period, including thunderstorms in June and July.

Timken states in its Guidelines for Bearings in Service, “Lubricant containing water is destructive to roller bearings, causing rapid wear. Take all possible precautions to prevent water from entering the bearing assembly. If the equipment is submerged in water deep enough that water could have entered the bearings, remove the bearing assemblies from the axles and send them to Timken for reconditioning” (Timken 2016).

Rule 36 of AAR’s Field Manual of the Interchange Rules states there is “cause for attention, at any time, roller bearings are partially or fully submerged” and that roller bearings submerged in a flood must be replaced (AAR 2023).

1.6.2 Bearing Examination

On February 4, 2023, the NTSB located the detached lead wheelset of the hopper car at the east end of the derailment pileup and near the hopper car itself. The hopper car was still smoldering, and the wheelset had been exposed to fire. The R1 bearing was still attached to the wheelset, but the L1 bearing and journal were missing, and the end of axle 1 was broken.[75] Later that day, the NTSB located components of the L1 bearing and journal from this wheelset west of the pileup and south of main track 1.[76] (See figure 15 and figure 16.) On February 5, after photographing the L1 bearing and journal in their as-found condition, the NTSB recovered the separated axle journal and several bearing components, including the outer seal, outer cone, bearing cup, inner cone, and inner seal, along with portions of cages and some rollers. Several rollers, the backing ring, and one inner seal wear ring were not found. (See figure 17 for a diagram of a disassembled bearing.) Note that there are inner and outer versions of several components.

[75] In a roller bearing, also called a journal bearing, one end of the axle is pressed into the bearing assembly. The part of the axle that sits inside the bearing itself is called the *bearing journal*.

[76] The NTSB matched the wheelset and bearing to the accident railcar using component identification numbers.



Figure 15. L1 journal as found on the scene.



Figure 16. Other L1 bearing components post recovery.

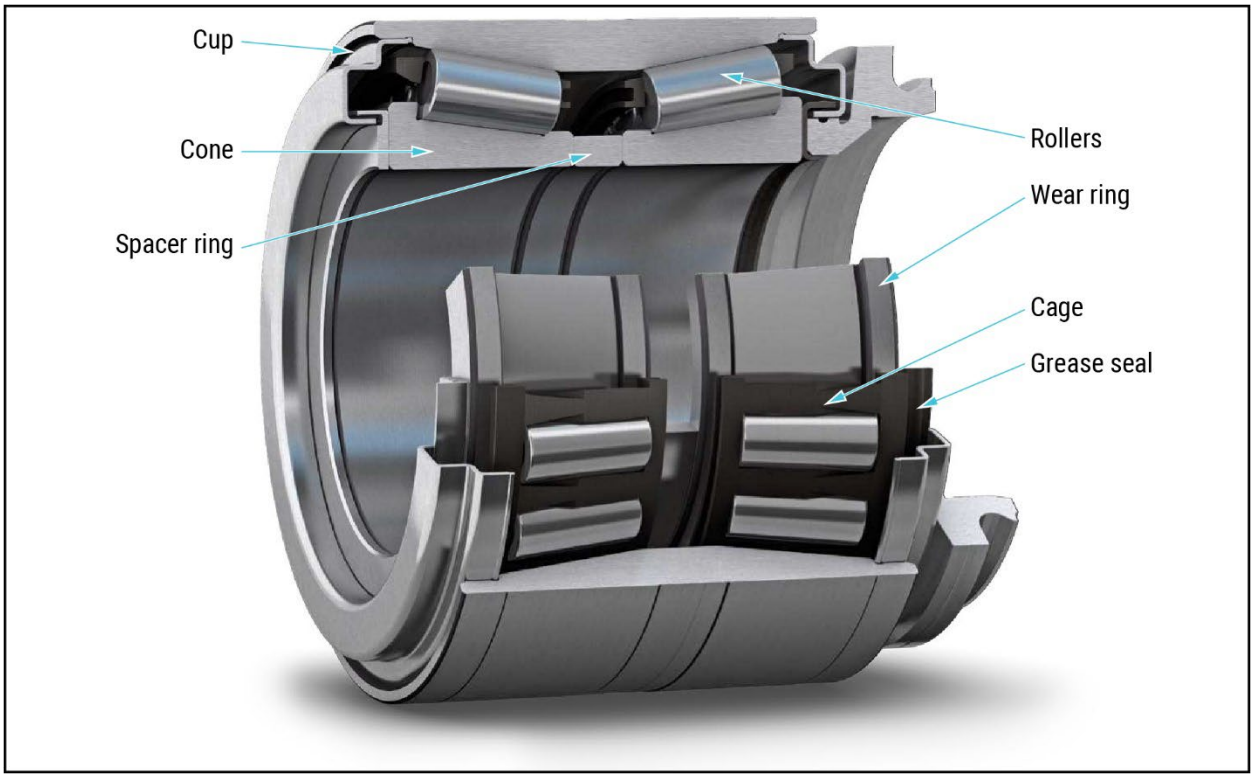


Figure 17. Diagram of a bearing with the journal removed. (Courtesy of SKF Group.)

An NTSB contractor disassembled and documented these components in the presence of the NTSB and party members on April 11, 2023. Markings on the components indicated that the bearing had been reconditioned in June 2011.[77] The L1 bearing's polymer grease seals were missing, and its steel components had sustained extensive damage as shown in figure 18 and figure 19, including:

- Melting: a change in state from a solid to a liquid. In failure analysis of metallic components, melting is typically preceded by softening and plastic deformation.
- Galling: a form of severe adhesive wear that occurs when metallic surfaces are in sliding contact. Galling can transfer material between these surfaces.
- Rub damage: a form of mechanical damage caused by two surfaces sliding against each other.
- Plastic deformation: a permanent change in the shape of a metallic component resulting from applied or internal forces.

[77] Bearings used in rail applications are commonly *reconditioned*—that is, disassembled, cleaned, inspected, repaired as needed, and reassembled—several times to extend their useful life.

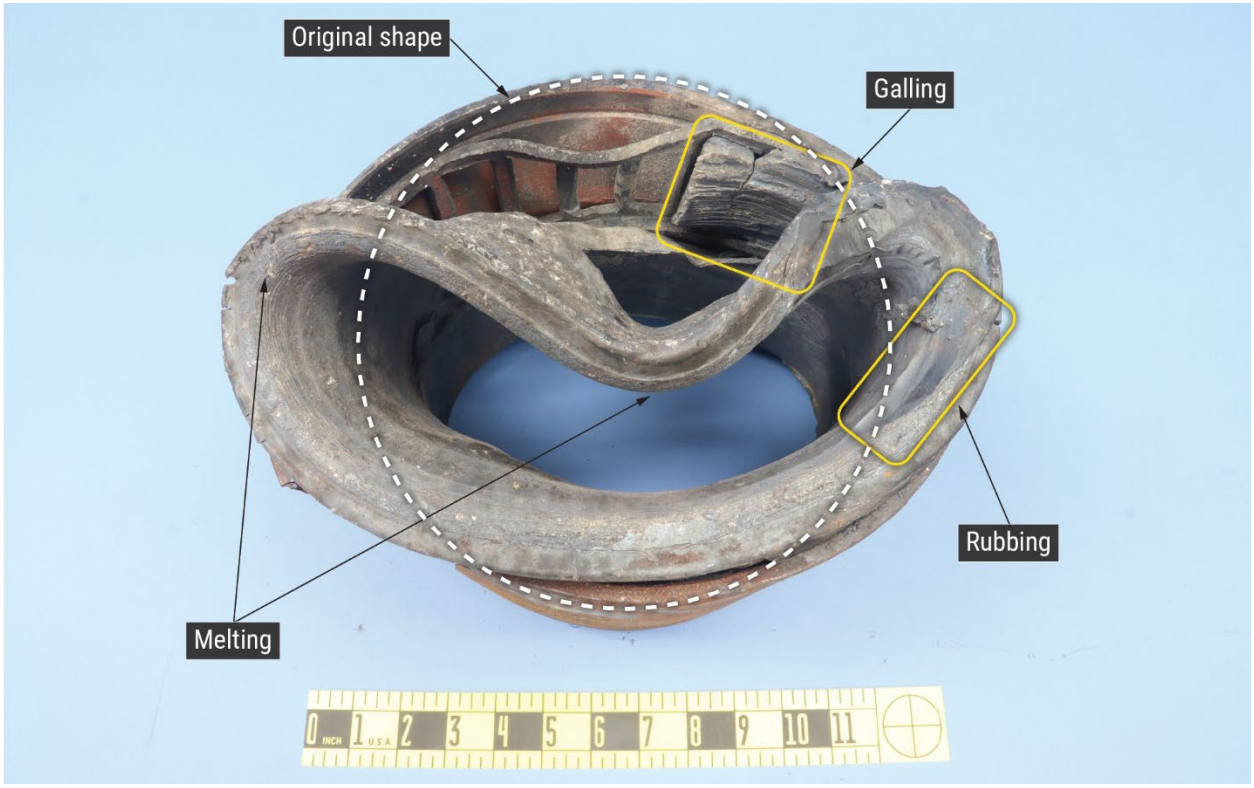


Figure 18. Recovered bearing cup and other components.

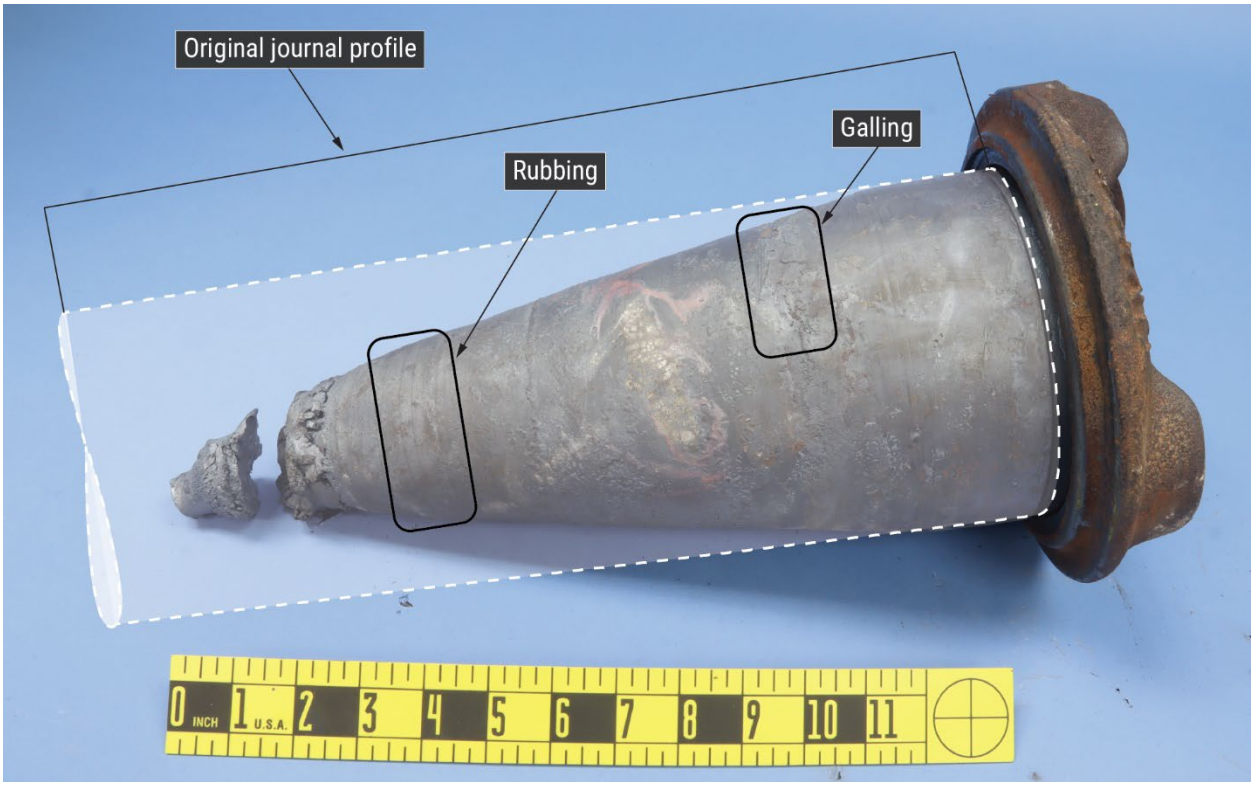


Figure 19. Recovered bearing journal.

1.7 Accident Tank Cars

1.7.1 Summary of Derailed Equipment

A total of 38 railcars derailed in East Palestine, including 27 tank cars. The derailed tank cars included four design specifications: DOT-105 (6 tank cars), DOT-111 (16 tank cars), DOT-117 (3 tank cars), and AAR-211 (2 tank cars).

The DOT-105 specification comprises a family of pressure tank cars whose subtype requirements are established at 49 *CFR* 179.101-1. The DOT-105 tank cars derailed in East Palestine were specification DOT-105J300W, meaning that they were jacketed and had a design bursting pressure of 750 psig and a test pressure of 300 psig.[78] They had a minimum head and shell plate thickness of 0.5625 inches of normalized steel, which was covered with a thermal protection system, and they lacked a bottom outlet or bottom washout. Each tank car was equipped with a single PRD among the top fittings, and within a protective housing, and with 0.5-inch-thick full-height headshields to protect the tank heads from impacts. Regulations at 49 *CFR* 179.16 require that tank head protection systems (head shields) be capable of sustaining, without loss of lading, coupler impacts to tank head at relative speeds of 18 mph.

The DOT-111 is one of several non-pressure tank car specifications established at 49 *CFR* 179 Subpart D. In general, DOT-111 tank cars may have features such as bottom outlet valves (BOVs) and hinged-and-bolted manways not found on DOT-105 tank cars. The specification itself does not require protective measures such as head shields or reclosing PRDs, though DOT-111 tank cars may be so equipped to qualify for certain kinds of hazardous materials service or to improve survivability. The DOT-111 tank cars that derailed in East Palestine were variously equipped with full-height head shields, half-height head shields, or no head shields. The 2015 Fixing America's Surface Transportation Act (FAST Act) established a phase-out schedule to remove DOT-111 and similar tank cars from flammable liquids service (Public Law

[78] (a) *Design bursting pressure* is the pressure at which a tank car will theoretically fail based on its physical properties. (b) *Test pressure* is the pressure at which a tank car is tested after its construction.

(PL) 114–94).[79] At the end of this phase out, by May 1, 2029, tank cars transporting flammable liquids must meet the newer DOT-117 specification.[80]

The DOT-117 specification, established at 49 *CFR* 179.202, is a non-pressure tank car intended to offer improved survivability over the DOT-111 in derailments and fire conditions. The specification requires a 0.5625-inch-thick shell, full-height head shields, a jacket and thermal protection system, top fittings protection, and a BOV operating mechanism designed to prevent releases in derailment scenarios. DOT-117 tank cars must meet the same thermal survivability performance requirements as pressure tank cars.

The AAR-211 is an industry (non-regulatory) specification for a non-pressure tank car similar to the DOT-111. Unlike the DOT-111, the AAR-211 does not require a complete post-weld heat treatment of the tank material, does not require the same examination of welded joints if constructed of carbon or alloy steel, and allows additional industry-specific fittings (AAR 2022a).

1.7.2 Summary of Breaching Damage

Of the 27 derailed tank cars, 11 were carrying hazardous materials and 16 were carrying non-hazardous materials.[81] On February 22, 2023, the NTSB examined the derailed hazardous materials railcars, eight of which released lading, to identify the primary sources of release. The examination results for the eight tank cars that released lading are summarized in table 8. The VCM tank cars lost lading through PRD activity and the vent and burn. The other hazardous materials tank cars lost lading mainly through mechanical damage—punctures or cracks in the tank heads.

[79] The NTSB has investigated numerous hazardous materials releases involving DOT-111 tank cars and made safety recommendations relevant to their removal from flammable liquids service. The subject is discussed in detail in section 2.4.2.

[80] The requirement that tank cars in flammable liquids service meet the DOT-117 specification means that two tank cars defined by industry specifications, the AAR-211 and CPC-1232, are also being disqualified from transporting flammable liquids. A CPC-1232 is a DOT-111 tank car built to additional industry standards and including specific protective features, such head shields and a PRD. The CPC-1232 standard is specifically referenced in the phase-out schedule, and the AAR-211 is relatively rare in flammable liquids service.

[81] For a detailed account of the hazardous materials in the derailed tank cars, see section 1.8.

Table 8. Summary of breaching damage to hazardous materials tank cars.

Line Number	Tank Car	Specification	Commodity	Amount Released	Primary Source of Release
28	TILX402025	DOT-105	VCM	Entire load	Vent and burn
29	OCPX80235	DOT-105	VCM	Entire load	PRD release, vent and burn
30	OCPX80179	DOT-105	VCM	Entire load	PRD release, vent and burn
31	GATX95098	DOT-105	VCM	Entire load	PRD release, vent and burn
36	SHPX211226	DOT-111	Ethylene glycol monobutyl ether	Entire load	Tank head crack, BOV fully open
38	DOWX73168	DOT-111	2-ethylhexyl acrylate	Partial load	Tank head cracks, tank head puncture
50	UTLX205907	DOT-111	Butyl acrylates	Entire load	Tank head punctures, manway gasket burned away
55	OCPX80370	DOT-105	VCM	Entire load	PRD release, vent and burn

Figure 16 shows an example of tank head punctures sustained by a DOT-111 tank car, UTLX205907, which was constructed of non-normalized steel (which is less damage tolerant than normalized steel) and not equipped with a head shield.



Figure 20. Leading A-end head punctures on tank car UTLX205907.

Of the 16 derailed tank cars that were carrying non-hazardous materials, 6 released lading. Investigators identified the primary sources of released lading based on a combination of SPSI observations, NTSB observations, and reviews of photographs taken on the scene. The primary sources of released lading for these six tank cars are summarized in

table 9.

Table 9. Summary of breaching damage to non-hazardous materials tank cars.

Line Number	Tank Car	Specification	Commodity	Amount Released	Primary Source of Release
34	RACX51435	DOT-111	Propylene glycol	Entire load	Head puncture
41	UTLX100055	DOT-111	Petroleum lubricating oil	Entire load	Manway cover missing, top fittings sheard off, shell puncture
42	XOMX110664	AAR-211	Petroleum lubricating oil	Most of load	Unknown, reported by SPSI
44	UTLX671310	DOT-111	Petroleum lubricating oil	Partial load	Top fittings leaking and on fire
45	CERX30072	DOT-111	Polypropyl glycol	Entire load	Head puncture
47	NATX231335	DOT-111	Diethylene glycol	Entire load	Shell puncture

All five DOT-105 specification tank cars that lost VCM lading did so through PRD operation or the subsequent vent and burn procedure. Most of the DOT-111 and AAR-211 specification tank cars (both hazardous and non-hazardous materials tank cars) that lost lading sustained mechanical breaches during the derailment itself. The three derailed DOT-117 tank cars were transporting non-hazardous materials, and none were breached during the derailment or emergency response. Based on these initial examinations and observations, the NTSB focused subsequent investigative activity on the specific VCM tank cars involved in the derailment, including their certification and fittings.

1.7.3 Tank Car Certification

Under 49 *CFR* 179.5, a tank car (or a series of tank cars sharing a single design) must have a certificate of construction before entering service. The certificate of construction certifies that the tank, equipment, and car fully conform to the requirements of their specification.

Certificates of construction are contingent on AAR approval. Under 49 *CFR* 179.3, applications for approval of designs, materials of construction, conversion, or alteration of tank car tanks, complete with detailed prints, must be submitted to the AAR executive director of tank car safety for consideration by the AAR Tank Car Committee or any other appropriate committee. The applications for approval are submitted to the AAR using an application for a certificate of construction (AAR Form 4-2, or an addendum on Form R-1). According to 49 *CFR* 179.3, the committee approves applications when, in its opinion, such tanks or equipment comply with the requirements of applicable hazardous materials

regulations. In practice, applications are reviewed by "independent third-party entities" whose requirements the AAR establishes in section M-1002 of its Manual of Standards and Recommended Practices (MSRP) (AAR 2014).

Under 49 *CFR* 173.31, no person may offer a hazardous material for transportation in a tank car unless that tank car meets applicable specification and packaging requirements. Tank cars and appurtenances may be used for the transportation of any commodity for which they are authorized in federal hazardous materials regulations and as specified on the certificate of construction.[82] The design and materials for fabrication, alteration, conversion, or welded repairs must be approved by the AAR in accordance with the Manual of Standards and Specifications for Tank Cars (M-1002). The design and materials of all valves and closures on tank cars must comply with Appendix A of M-1002 and be approved by the AAR Tank Car Committee.

The applicant for an AAR certificate of construction must certify that the tank car and its service equipment are compatible with the specified lading.[83] Upon reviewing the application for approval and certificate of construction, the AAR Tank Car Committee is then responsible for ensuring that all specification requirements are met. The tank car builder certifies the tank cars conform to the approved description and all applicable DOT and AAR requirements before the tank car is placed into hazardous materials service. Specification M-1002 further states that the revision or substitution for any valve or fitting, except substitution of equivalent kind approved on the certificate of construction, constitutes an alteration and must also be approved before use.

The design, materials, and flow capacity ratings of PRDs used on tank cars must also be approved by the AAR Tank Car Committee. In seeking approval of the Tank Car Committee for the PRD, the applicant—usually the PRD manufacturer—must file AAR Form 4-3, providing specifications and drawings and indicating the commodity for which the device is intended. AAR standards in Appendix A of the AAR Manual of Standards for Tank Cars also require determination of PRD flow

[82] Under 49 CFR 178.320, *appurtenance* means any attachment to a cargo tank that has no lading retention or containment function and provides no structural support to the cargo tank. Common appurtenances include manway covers, ladders, and fasteners.

[83] Changing a tank car's specified lading may require recertification depending on the exact change and whether the tank car needs to be retrofitted to transport the new lading.

capacity using either steam, air, natural gas, or the lading for which the PRD is intended (AAR 2014).

1.7.4 VCM Tank Cars

The five derailed VCM tank cars were all DOT-105s but entered service under four different certificates of construction, were equipped with different fittings, and were owned by three different companies.

Three tank cars were owned and maintained by Oxy Vinyls: OCPX80235, OCPX80179, and OCPX80370. All three were built under certificates of construction following AAR approval. For two tank cars, OCPX80235 and OCPX80179, the applicable certificate of construction specified the initial commodity as "vinyl chloride." For OCPX80370, the initial commodity was "vinyl chloride, inhibited, and products authorized in DOT Part 173 [*sic*] for which there are no special commodity requirements and nonregulated commodities compatible with this class of car."[84]

One tank car (GATX95098) was leased under a full-service agreement between GATX Corporation (the lessor) and Occidental Chemical Corporation (the lessee). Under this lease, the tank car was maintained by GATX and bore a GATX reporting mark.

GATX95098 was built under a certificate of construction following AAR approval. The initial commodity for this tank car was listed on the certificate of construction as "propylene oxide and products authorized in DOT 173 [*sic*] for which there are no special commodity requirements and nonregulated commodities compatible with this class of car."[85]

The fifth tank car (TILX402025) was leased under a master railcar lease agreement between Trinity Industries Leasing Company (the lessor, a subsidiary of Trinity Industries) and Occidental Chemical Corporation (the lessee). The lease

[84] Special requirements for compressed gases transported in tank cars are found in 49 *CFR* 173.314, which was last amended on December 21, 1990. See 55 *Federal Register* (Fed. Reg.) 52665.

[85] (a) Tank car GATX95098 was built in 1992. (b) Special requirements for compressed gases transported in tank cars and having a primary or secondary Division 2.1 (flammable gas) hazard are found in 49 *CFR* 173.314(j). VCM is a Division 2.1 flammable gas. Additionally, under 49 *CFR* Part 172 Subpart B, VCM is subject to Special Provision B44 as described in 49 *CFR* 172.102. Special Provision B44 requires that all parts of valves and safety relief devices in contact with lading must be made of a material which will not cause formation of acetylides.

provided that the lessee was responsible for the maintenance and replacement of tank car valves.

TILX402025 was built under a certificate of construction following AAR approval. The initial commodity for this tank car was listed on the certificate of construction as "vinyl chloride, inhibited." The top fittings specifications referenced in the certificate of construction included a specific PRD with a start-to-discharge pressure of 247.5 psig and aluminum-coated spring.[86]

After the derailment, the FRA inspected the five VCM tank cars, reviewed certificates of construction, and issued inspection reports to Oxy Vinyls, Trinity Rail, and GATX on August 16 and 21, 2023. The FRA reports noted that none of the five VCM tank cars matched its design approval.

More specifically, discrepancies reported by the FRA included:

- The certificate of construction for OCPX80235 specified a Midland Manufacturing model A-34247 PRD with a start-to-discharge pressure of 247.5 psig. According to Oxy Vinyls' records, the PRD on OCPX80235 was changed to an A-37247 in 2021.
- The certificate of construction for GATX95098 specified a Midland Manufacturing model A-34225 PRD with a start-to-discharge pressure of 225 psig. In 1996, the PRD was changed to a Midland Manufacturing model A-34247 with a start-to-discharge pressure of 247.5 psig.
- GATX records indicated the original angle valves on GATX95098 were Neles-Jamesbury model AZFRA, 2236-TT, with unknown serial numbers and manufacturing dates. An AAR Form R-1 (Report of Tank Repairs, Alteration, or Conversion) dated April 4, 2007, indicated that these valves were replaced with Midland A-720 angle valves.
- The revision level for drawings applicable to TILX402025 did not match the revision level approved on the original certificate of construction.
- For OCPX80179 and OCPX80370, the FRA noted missing or incorrect information on the AAR Form 4-2, such as incorrect drawing revision

[86] The Oxy Vinyls SDS for VCM states that VCM is incompatible with aluminum and aluminum alloys and can react exothermically with these materials. See section 1.8.1.1 for more information about VCM hazards.

levels and drawings with revision levels dated after the original approval.

1.7.5 Postderailment Tank Car Examinations and Tests

1.7.5.1 Tank Car Examinations

The NTSB's February 22, 2023, examination of the five derailed VCM tank cars identified no mechanical breaches other than those intentionally created during the vent and burn. The examination did not identify dents, cracks, gouges, or scores in the tank shells, and there were no signs of significant damage near weld zones. The NTSB also identified no evidence of shell bulging or stretching, common signs of thermal damage.

During these examinations, the NTSB found aluminum valve handles on all five VCM tank cars. The NTSB also found that the steel protective housing covers installed on two VCM tank cars (TILX402025 and OCPX80370) had remained attached to their respective housings. However, the aluminum protective housing covers installed on three VCM tank cars (OCPX80235, OCPX80179, and GATX95098) had been destroyed or were missing from their housings. (See figure 21 for an example.) The NTSB also observed metallic debris in the PRD top guides and protective housings of these three VCM tank cars.[87] (See figure 22.) Midland Manufacturing, the manufacturer of these three PRDs, notes in its PRD installation, maintenance, and operation manual that, "The area of discharge through the top guide must be unobstructed by foreign matter that would hinder free flow of discharging fluid" (Midland Manufacturing 2021).

[87] OCPX80370, which had a steel cover, had aluminum valve hand wheels on its top fittings, which were not found intact during postderailment examinations. However, the NTSB did not observe metallic debris in this tank car's PRD outlet guide.



Figure 21. Tank car OCPX80235's protective housing with the aluminum cover missing.



Figure 22. Metallic debris in the PRDs of tank cars equipped with aluminum protective housing covers.

Investigators collected samples of metallic debris and sent them to the NTSB Materials Laboratory in Washington, DC, for examination. After NS contractors removed pressure plates from all five VCM tank cars, the NTSB recovered the PRDs for bench testing at the Trinity Rail Maintenance Services Saginaw Plant in Saginaw,

Texas, on March 15–16, 2023.[88] During these tests, the NTSB collected two additional samples of metallic debris and sent them to the NTSB Materials Laboratory for analysis alongside the samples collected on the scene. Sample collection and location information is summarized in table 10. The NTSB Materials Laboratory determined that the samples were all more than 50% aluminum by weight.

Table 10. Metallic debris sample information.

Tank Car	Location of Sample Collection	Location of Sample
OCPX80235	On scene in East Palestine	PRD
OCPX80179	On scene in East Palestine	Protective housing
GATX95098	On scene in East Palestine	Top fittings protective housing
OCPX80235	Bench test Saginaw, Texas	PRD
GATX95098	Bench test Saginaw, Texas	Protective housing

1.7.5.2 PRD Bench Tests and Examinations

On March 15–16, 2023, the NTSB and Trinity Industries examined and bench tested the recovered PRDs. Figure 23 provides a diagram and photograph of a new Midland PRD comparable to the ones recovered from the VCM tank cars.

[88] Trinity Rail Maintenance Services is a subsidiary of Trinity Industries.

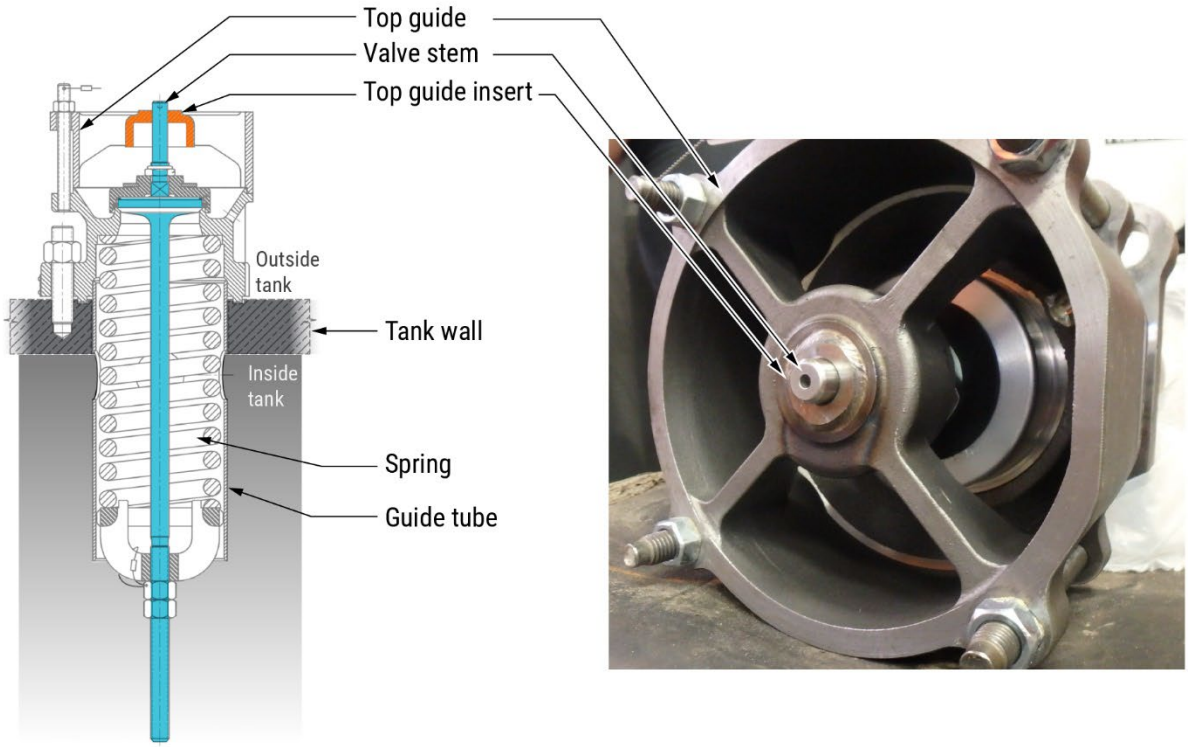


Figure 23. PRD diagram (left) and top-down view of exemplar (right). (Diagram courtesy of Midland Manufacturing with NTSB edits.)

The TILX402025 PRD top guide throat contained loose fragments of metallic debris. During testing, the PRD began to leak (release material without actuating) at 33.4 psig. According to its part specification, the spring was originally coated in aluminum. After bead blasting to remove carbon and soot, visual examination of the spring revealed that most of its aluminum coating was missing. The PRD did not contain any foreign matter obstructing its internal components.

The OCPX80235 PRD top guide discharge port contained about 0.56 pounds of melted and re-solidified metallic debris, mostly aluminum. The interior of the protective housing and interior surface of the pressure plate were corroded. When tested, the PRD began to leak or discharge at 122 psig. After replacement of the PRD's O-rings, the PRD held pressure up to 150 psig without leaking or discharging; investigators did not further increase the pressure for safety reasons. The interior of the protective housing and interior surface of the pressure plate were corroded. The PRD's internal parts were also covered in corrosion and a thin layer of carbon or soot. The PRD did not contain any foreign matter obstructing its internal components.

The OCPX80179 PRD top guide contained flakes of metallic debris, and solidified masses of melted aluminum were present around other valves fitted to the

pressure plate. The interior of the protective housing and interior surface of the pressure plate were corroded. When bench tested, the PRD began to leak at 49.2 psig and to discharge at 149.7 psig. The PRD valve stem was stuck to the top guide insert bushing and had to be destructively separated with torch cutting, hammering, and lubrication for further examination. The PRD spring had been permanently compressed such that it could not rebound to the minimum height specification for a new PRD. The PRD did not contain any foreign matter obstructing its internal components.

The GATX95098 PRD body had fused to the pressure plate and significant force was required to separate them. The top lock nut and retainer were stuck to the valve stem. The top guide discharge structure and top guide bushing had burned away from the PRD, and material had been eroded from the threaded steel mounting studs. Its spring was deformed and bent about 30° from its original shape. The PRD was too damaged to be bench tested under pressure or further dismantled.

The OCPX80370 PRD top guide was free of debris. The aluminum angle valve handwheels were missing, and the interior of the protective housing and interior surface of the pressure plate were corroded. When bench tested, the PRD did not leak or discharge at its rated state-to-discharge pressure of 247.5 psig and continued to hold pressure up to 275 psig. Investigators did not further increase the pressure for safety reasons. As with the PRD from OCPX80179, the PRD valve stem was stuck to the top guide insert bushing and had to be destructively separated with torch cutting, hammering, and lubrication for further examination. The top of the stainless steel valve stem was covered with rust.

After testing and disassembly, the PRD from OCPX80370 was shipped to the NTSB Materials Laboratory for further examination. When examined, the PRD exhibited thick layers of soot and reddish-brown burned deposits on its inner surfaces. Similar reddish-brown deposits were present in a band around the mating valve stem. These deposits persisted on the valve stem even after it was subjected to plastic bead blasting and the remainder of the valve stem appeared silver. The bottom of the band was about 0.75 inches from the valve stem end. The removal of other deposits left divots in the valve stem surface. The PRD did not contain any foreign matter obstructing its internal components.

1.8 Hazardous Materials

The derailed tank cars contained a total of six hazardous materials representing Class 3 flammable liquids, combustible liquids, and Division 2.1 flammable gases. Table 11 provides the regulatory definitions of these materials.

Table 11. Regulatory definitions of hazardous materials involved in the derailment.

Type of Material	*CFR* reference	Class	Defintion
Flammable liquid	173.120	3	A liquid with a flash point of not more than 140°F that does not meet a series of exceptions named in the regulation. Class 3 flammable liquids may be assigned to Packing Group I, II, or III based on their flash points and boiling points. Lower Packing Group numbers correlate to greater levels of hazard.
Combustable liquid	173.120(b)	N/A	A liquid with a flash point above 140°F and below 200°F. A flammable liquid with a flash point of 100°F or higher may be reclassified as a combustible liquid if it does not meet the definition of any other hazard class.
Flammable gas	173.115(a)	Class 2, Division 2.1	Any material which is a gas at 68°F or less and 14.7 pounds per square inch of pressure and is ignitable at 13% or lower concentration in air or has a flammable range in air of at least 12% regardless of the lower limit of flammability.*

* The *flammable range* is the difference between the minimum and maximum volume percentages of a material in air that forms a flammable mixture.

The specific hazardous materials involved in the derailment are listed in table 12 as described on their shipping waybills. Warnings and safety information associated with each hazardous material are discussed below.

Table 12. Summary of derailed hazardous materials.

Identification Number	Shipping Name	Hazard Class or Division	Packing Group	Notes	Released
UN1086	Vinyl chloride (stabilized)	2.1	N/A	Referred to as VCM in this report	Yes
NA1993	Combustible liquid, n.o.s.*	N/A	III	Ethylene glycol monobutyl ether, which is not specified by name in the DOT table	Yes
NA1993	Combustible liquid, n.o.s.	N/A	III	Ethylhexyl acrylate, which is not specified by name in the DOT table	Yes
UN1055	Isobutylene	2.1	N/A	Flammable liquified compressed gas	No
UN2348	Butyl acrylates (stabilized)	3	III	Flammable liquid	Yes
UN1114	Benzene (residue)	3	II	Flammable liquid	No

* *n.o.s.* means "not otherwise specified" and is used for substances not assigned a single technical name in the hazardous materials table at 49 *CFR* 172.101.

1.8.1 Vinyl Chloride, Stabilized (UN1086, Division 2.1)

On January 23–24, 2023, Oxy Vinyls loaded and shipped five tank cars with a total of 887,400 pounds of VCM at the Oxy Vinyls VCM plant in LaPorte, Texas. The shipment was destined for another Oxy Vinyls facility in Pedricktown, New Jersey. Oxy Vinyls' internal certificates of analysis for the VCM in these tank cars indicated the vinyl chloride was 99.99% pure by weight. Oxy Vinyls' specification calls for 99.98% purity.

1.8.1.1 VCM Hazard Information

Because VCM is a hazardous material, federal regulations require communication of hazard information through container marking or labeling, placarding, SDSs, and employee training.[89] Oxy Vinyls maintains an SDS for VCM, which was last revised on November 30, 2020, and was referenced by the incident command during the East Palestine emergency response on February 4, 2023. The SDS characterizes VCM as flammable, explosive in the presence of fire, and requiring stabilization (using either a polymerization inhibitor or purging to remove oxygen) to prevent dangerous polymerization.[90]

The SDS notes that VCM is incompatible with oxidizing agents, oxides of nitrogen, metals, aluminum and aluminum alloys, copper, and metal alkyl complexes and alkali metals such as sodium, potassium, and their alloys. According to the SDS, reactions with these substances can be strongly exothermic. It also notes that VCM is "generally stable at normal temperatures and pressures" but that violent (and exothermic) polymerization may occur if VCM is not stabilized or stored correctly, and that if not properly stabilized, VCM may polymerize when exposed to air, sunlight, aluminum, oxidizing agents, or excessive heat.

The incident command at East Palestine also referred to The Chlorine Institute's Pamphlet 171, which discusses VCM polymerization and includes guidance specific to VCM as a tank car lading. According to Pamphlet 171, a pressure above 68 psig in an intact tank car "may indicate that VCM is polymerizing inside the tank car" (The Chlorine Institute 2018a). The pamphlet also recommends using an infrared

[89] Under Occupational Safety and Health Administration requirements at 29 *CFR* 1920.1200, a chemical manufacturer, importer, or employer must prepare an SDS based on the full range of available scientific literature and other evidence concerning potential hazards.

[90] Federal regulations at 49 *CFR* 171.8 define "stabilized" as "is in a condition that precludes uncontrolled reaction" and state that this may be achieved through chemical inhibition, removing dissolved oxygen and inerting air space in a package, temperature control, or other methods.

thermometer on the pressure plate or manway of the tank, and states that if the measurement is "above ambient temperature it may imply that VCM is polymerizing inside the tank car." Finally, the pamphlet states, "If both pressure and temperature are above normal conditions, then a polymerization reaction is most likely occurring in the tank car. Appropriate action should be taken." Pamphlet 171 does not name specific "appropriate actions" for polymerization, but it does note the importance of obtaining an accurate damage assessment to determine whether to move the tank car within the incident area, transfer the lading on site, or relocate the tank car to a suitable industry facility for unloading or controlled venting (The Chlorine Institute 2018a).

The 2020 ERG, a USDOT resource intended for use by first responders during the initial phase of a transportation incident involving hazardous materials, designates stabilized VCM with a "P," signifying that it may polymerize explosively when heated or involved in a fire (PHMSA 2020). If a tank car carrying VCM is involved in a fire, the ERG recommends a 1-mile radius of evacuation.

FRA guidance on runaway reactions in tank cars, including polymerization of monomers, describes the principal hazard as overpressure leading to an explosion (FRA 1995). In a communication to the NTSB dated April 14, 2023, Oxy Vinyls also stated that "runaway polymerization reactions are highly exothermic and would be marked by a rapid, significant, and sustained increase in temperature and pressure."

In the months following the derailment, the NTSB gathered additional information about the risk of VCM polymerization under the conditions present at East Palestine. On April 3, 2023, the NTSB met with a chemistry professor with VCM industry experience, including as an employee of a company related to Oxy Vinyls, and expertise on polymers and organic chemistry.[91] He noted that VCM requires free radicals to initiate polymerization, and that a sustained reaction requires continuous introduction of free radicals; a small amount of free radicals in a tank car will not result in a sustained reaction.[92] He further explained that VCM cannot undergo spontaneous thermally generated polymerization, in which the VCM is converted to polymer by thermal energy alone, because the decomposition temperature of the

[91] This expert was a professor of chemistry at Indiana University and had previously worked for the Occidental Chemical Corporation, a company related to Oxy Vinyls, and was a paid consultant of Oxy Vinyls following the derailment. Oxy Vinyls recommended him as a technical expert before becoming a formal party to the investigation.

[92] A *free radical* is an atom, molecule, or ion with at least one unpaired valence electron. Most free radicals are highly chemically reactive.

VCM (1,022°F) is higher than the temperature at which the polymer is destroyed (572°F).[93]

At the NTSB's Investigative Hearing, the chemistry professor testified that the only condition under which VCM may polymerize is in the presence of a free radical initiator and that polymerization cannot occur without that initiator.[94] He also reviewed the Oxy Vinyls SDS for VCM and could not find scientific justification for the SDS's warnings regarding polymerization of stabilized VCM in the presence of oxygen, air, sunlight, heat, or aluminum. He referred specifically to an article stating that gaseous oxygen will not react with pure liquid VCM (Zilberman 1992). He also stated that temperatures of 180–185°F will have no effect on VCM.

Oxy Vinyls' vice president of health, environment, safety, and security also testified about the properties of stabilized VCM at the NTSB's Investigative Hearing. He stated that VCM can be stabilized by packaging it in a low-oxygen environment or though the addition of chemical inhibitors.[95] He testified that while some inhibitors can be lost through fire exposure, VCM stabilized through the removal of oxygen will remain stabilized when heated. He also stated that the SDS lists polymerization as a risk because the SDS covers a wide variety of scenarios, including manufacturing, industrial facilities, laboratories, storage, and transport in railcars, and it is intended to warn against polymerization if the VCM loses stabilization.

1.8.1.2 VCM Tank Car Lading

The VCM tank cars were loaded using an Oxy Vinyls standard operating procedure intended to stabilize the VCM for shipment by packaging it in a low-oxygen environment as required by Special Provision 21 of 49 *CFR* 172.102. The procedure outlined precautions, tank car inspections (pre- and post-loading), and safe practices for loading operations. These inspections included checking liquid and vapor valves and PRDs for leaks, examining connection threads, confirming oxygen concentration (less than 200 parts per million), and verifying the presences of appropriate and visible stenciling, placards, and security seals. Oxy Vinyls personnel noted no issues during inspections.

[93] The *decomposition temperature* is the temperature at which a substance chemically breaks down into other substances. For VCM, temperatures high enough to break carbon bonds and cause polymerization are too high to allow polyvinyl chloride (PVC) to exist.

[94] NTSB Investigative Hearing Transcript, Day 1, pp. 180–83.

[95] NTSB Investigative Hearing Transcript, Day 1, pp. 169–70.

Tank cars must be loaded within the outage limitations set by 49 *CFR* 173.24b(a) and by the stenciled load limits displayed on the tank car. According to the regulation, the minimum required outage is 1% of the total volume capacity of the tank for VCM shipped as a compressed liquefied gas.[96] In addition, under 49 *CFR* 179.13, each VCM tank car's gross weight (the combined weight of the tank car and its lading) could not exceed 263,000 pounds. Oxy Vinyls personnel recorded the loading temperature and pressure for each tank car, as shown in table 13, which resulted in the lading volumes and weights shown in table 14.

Table 13. Loading temperatures and pressures for VCM tank cars.

Tank Car Number	Final Loading Pressure (psig)	Final Loading Temperature (°F)
TILX402025	49.48	59.03
OCPX80235	38.26	59.00
OCPX80179	35.15	58.93
GATX95098	32.76	59.13
OCPX80370	45.84	69.33

Table 14. Lading information for VCM tank cars.

Tank Car Number	Gross Weight. (lbs.)	Lading Weight (lbs.)	Lading Volume at Loading Temperature (gallons)	Tank Capacity (gallons)
TILX402025	261,200	178,300	23,223	25,170
OCPX80235	261,250	177,250	23,086	24,875
OCPX80179	261,100	177,600	23,132	24,899
GATX95098	261,350	178,150	23,203	25,740
OCPX80370	256,900	176,100	22,936	24,620

1.8.1.3 Postderailment Sampling

On February 16–17, 2023, the Oxy Vinyls logistics process supervisor collected a total of 12 samples of residues from the interiors of the VCM tank cars involved in the vent and burn to test for the presence of polymerized vinyl chloride (polyvinyl chloride, or PVC). The logistic process supervisor collected these samples as NS contractors removed pressure plate assemblies from the vinyl chloride tank cars. The samples were mostly collected from residue adhering to points on the underside of pressure plates or within tank nozzles. Most samples resembled black powder or ash.

[96] *Outage* refers to the tank space, sometimes called the "vapor space," not occupied by lading.

The Oxy Vinyls logistics process supervisor delivered the 12 residue samples to the Oxy Vinyls Avon Lake, Ohio, Technical Center's PVC laboratory for analysis. Oxy Vinyls provided the NTSB with its analysis report on March 20, 2023. The analysis did not find PVC in any of the samples. Most of the samples' constituent elements were carbon, iron, and chlorine. Four samples, all collected from within or near the PRDs, contained 1–2% aluminum by weight.

1.8.2 Ethylene Glycol Monobutyl Ether (NA1993, Combustible Liquid)

On January 26, 2023, the Equistar Chemicals plant in Pasadena, Texas, loaded tank car SHPX211226 with 185,750 pounds of ethylene glycol monobutyl ether. The shipment was destined for Equistar Chemicals' Bayonne, New Jersey, facility.

According to the manufacturer's SDS, ethylene glycol monobutyl ether is flammable, toxic, odorous, explosive if vapors are concentrated, and may produce peroxides that will explode in response to heat or shock. Its flash point is 144°F. The ERG recommends a half-mile evacuation for tank car fires involving ethylene glycol monobutyl ether (PHMSA 2020).

1.8.3 Ethylhexyl Acrylate (NA1993, Combustible Liquid)

On January 27, 2023, the Union Carbide Corporation loaded tank car DOWX73168 with 205,900 pounds of ethylhexyl acrylate and shipped it from Union Carbide's Taft, Louisiana, plant. The shipment was destined for the Avery Dennison Corporation in Mill Hall, Pennsylvania.

The manufacturer's SDS notes that ethylhexyl acrylate is an irritant and a combustible liquid. Its flash point is 86°C (187°F).[97] The ERG recommends a half-mile evacuation for tank car fires involving ethylhexyl acrylate (PHMSA 2020).

1.8.4 Isobutylene (UN1055, Division 2.1)

On January 26, 2023, Lyondell Chemical Company loaded tank car NATX35844 with 155,642 pounds of isobutylene and shipped it from Pasadena,

[97] An SDS may use either Fahrenheit or Celsius. This report provides the original value and converts it into Fahrenheit when necessary.

Texas, destined for Synthomer Jefferson Hills LLC in Jefferson Hills, Pennsylvania. The isobutylene was described on the bill of lading as UN1055 isobutylene.

The manufacturer's SDS describes isobutylene as extremely flammable, colorless liquified compressed gas. Its flash point is listed as −76°C (−104°F). The ERG recommends a 1-mile evacuation for tank car fires involving isobutylene and directs the reader to BLEVE precautions (PHMSA 2020).

1.8.5 Butyl Acrylates (UN2348, Class 3)

On January 28, 2023, Arkema, Inc. loaded tank car UTLX205907 with 194,300 pounds of butyl acrylates and shipped it from Arkema's Pasadena, Texas, facility. The shipment was destined for another Arkema facility in Pottstown, Pennsylvania.

The manufacturer's SDS notes that butyl acrylates are irritants and harmful to aquatic life. The flash point is 102°F. The ERG recommends a half-mile evacuation for tank car fires involving butyl acrylates (PHMSA 2020).

1.8.6 Benzene Residue (UN1114, Class 3)

On January 25, 2023, SASOL Chemicals USA, LLC, shipped tank cars DPRX259013 and DPRX25867, having first unloaded their cargo of benzene. The tank cars contained an unknown amount of residue and were destined for PBF Holding in Delaware City, Delaware.

The manufacturer's SDS characterizes benzene as a highly flammable liquid and vapor, an irritant, and toxic to aquatic life. Its flash point is 12°F. The ERG recommends a half-mile evacuation for tank car fires involving benzene (PHMSA 2020).

1.9 Emergency Response

1.9.1 Incident Command Structure

The emergency response in East Palestine used the National Incident Management System (NIMS) doctrine developed by the Federal Emergency Management Agency (FEMA). Under this doctrine, a single incident command is responsible for the overall management of the incident. An incident commander or unified command conducts the command function, directing other functional areas to

meet whatever needs arise during the incident (FEMA 2017). Figure 24 illustrates the organization of a response with a single incident commander and general staff section chiefs for operations, planning, logistics, and finance and administration.

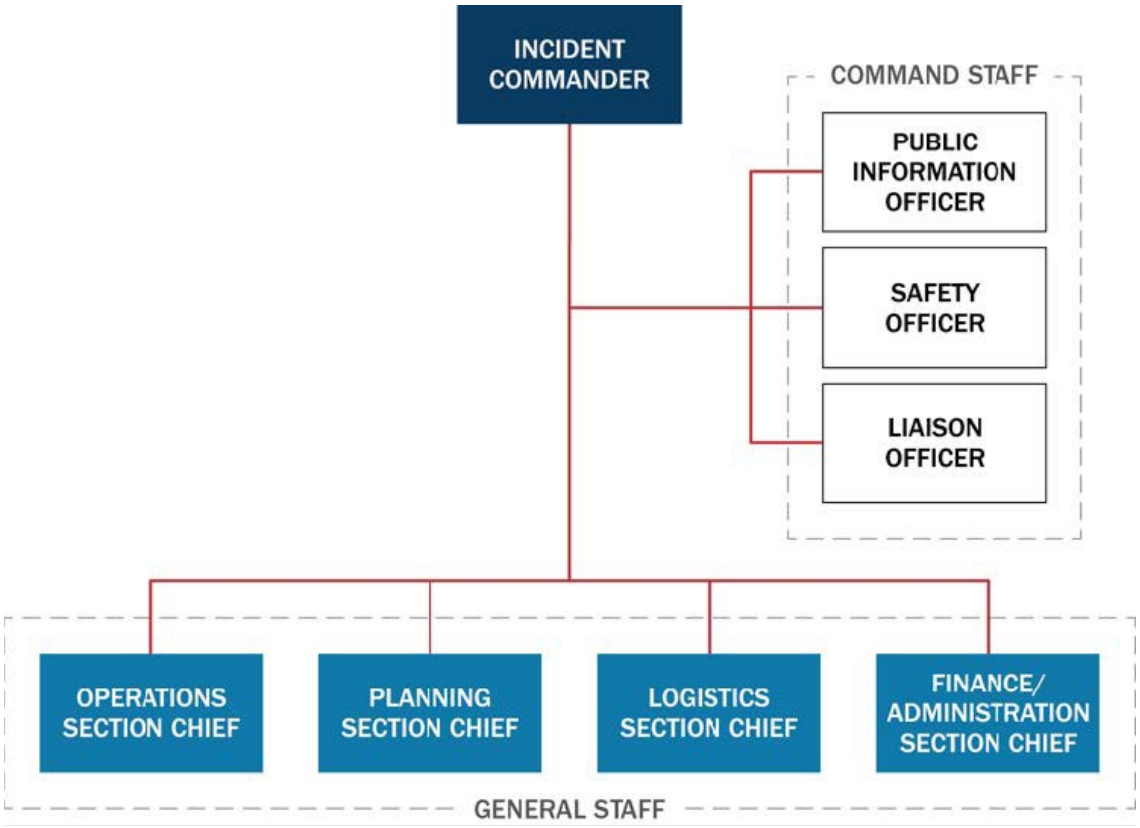


Figure 24. NIMS incident command structure. (Courtesy of FEMA.)

For incidents that do not involve multiple jurisdictions, a single incident commander performs the incident command function with the support of other involved agencies or organizations. The choice of an incident commander depends on the location of the incident:

> When an incident occurs within a single jurisdiction and without jurisdictional or functional agency overlap, the appropriate authority designates a single Incident Commander who has overall incident management responsibility. (FEMA 2017)

The East Palestine derailment occurred within the emergency services jurisdiction of the municipal agencies of East Palestine, a civil municipality of Columbiana County. These agencies include the EPFD and EPPD. The EPFD is the principal emergency services agency responsible for responding to fire suppression, emergency rescue, and an initial response to hazardous materials incidents within East Palestine. The role

of incident commander was assumed by the most senior available EPFD firefighter: initially the EPFD deputy fire chief, and later the EPFD fire chief.

Based on the NTSB's review of incident action plans completed during the emergency response, agency and organization representatives liaising with the incident commander included personnel from the Environmental Protection Agency, CCEMA, the Village of East Palestine, and NS. The incident command staffed all four general staff sections, and the operations section included fire, EMS, and law branches.

1.9.2 Emergency Responder Interoperability

The 2019 National Emergency Communications Plan (NECP) published by the Cybersecurity and Infrastructure Security Agency (CISA) provides a roadmap to emergency communications interoperability at all levels of government. One goal set by the NECP is communications coordination under NIMS:

> Public safety organizations use the National Incident Management System Incident Command System processes, methods, and structures across all disciplines, jurisdictions, and levels of government to standardize methods, practices, and actions during planned events and incident responses. As public safety organizations maintain, implement, upgrade, or replace existing communications capabilities, those capabilities should reflect an alignment with the National Incident Management System Incident Command System doctrine to ensure available fielded capabilities are sufficient to support primary, secondary, and backup services. (CISA 2019)

In support of this goal, interoperability channels have been designated and allocated by the federal government under regulations at 49 *CFR* Part 90, including very high frequency (commonly called VHF), ultra high frequency (commonly called UHF), 700MHz, and 800-MHz systems. Radio systems for emergency responders are subject to numerous regulations and standards governing their use and minimum interoperability requirements, including Federal Communications Commission regulations. For example, holding a Federal Communications Commission license as an emergency response agency fulfills a prerequisite Federal Communications Commission regulation allowing for the use of the national and state interoperability channels described above. Authorities having jurisdiction are ultimately responsible for ensuring interoperability through suitable equipment, protocols, and training of

personnel. CISA maintains a list of grant programs intended to support investment in emergency communications, including emergency responder interoperability.[98]

The fundamentals of interoperability within the Incident Command System under NIMS are addressed in the IS-700.B training course, which is freely available through FEMA. The course specifies an hour of training on communications and information management, including the need for interoperable equipment and noting that:

> Regardless of the communications hardware being used, standardized procedures, protocols, and formats are necessary to gather, collate, synthesize, and disseminate incident information. (FEMA 2020)

As discussed above in section 1.1.2, emergency responders at East Palestine reported issues with radio interoperability and consist and hazardous material information was disseminated during the response through a combination of emails, phone calls, radio communications, and paper copies.

1.9.3 The Chlorine Institute Chlorine Emergency Plan

In 1972, The Chlorine Institute launched the Chlorine Emergency Plan (CHLOREP) to provide transportation companies, emergency responders, and others with industry expertise on chlorine products such as VCM during incidents. As part of CHLOREP, The Chlorine Institute identifies capability requirements for emergency response contractors and regularly verifies that they meet these requirements. The highest level of capability under CHLOREP is Level 3, and as of the date of this report, there are three Level 3 contractors: SPSI, SRS, and United Professional Services, LTD.[99] As described in the "CHLOREP Contractor Verification Program Description," Level 3 contractors must be able to respond "to a chlorine leak from a small container … or minor release from a tank car" and must have "special handling and field transfer capabilities for severely or potentially damaged bulk chlorine containers (i.e. cargo tanks and tank cars)" (The Chlorine Institute 2018b). The Chlorine Institute verifies the capabilities of Level 3 contractors in the United States every 3 years.

[98] The full list is available here: https://www.cisa.gov/safecom/emergency-comms-grants-list.

[99] The Chlorine Institute maintains a list of CHLOREP contractors on its website; the list is accessible at https://www.chlorineinstitute.org/chlorep-contractors.

1.9.4 Firefighter Training Requirements

The EPFD is a volunteer fire department that performs fire suppression and other related emergency services for East Palestine, Ohio. In 2023, it had 39 personnel trained for fire response, EMS, or both. The EPFD fire chief was the only professional firefighter in the department. Training for volunteer and professional firefighters in Ohio is regulated under the State of Ohio Revised Code Section 4765.55.[100] The statute assigns responsibility for training and establishes limits for volunteer firefighter training programs:

> The executive director of the state board of emergency medical, fire, and transportation services, with the advice and counsel of the firefighter and fire safety inspector training committee of the state board of emergency medical, fire, and transportation services, shall assist in the establishment and maintenance by any state agency, or any county, township, city, village, school district, or educational service center of a fire service training program for the training of all persons in positions of any fire training certification level approved by the executive director, including full-time paid firefighters, part-time paid firefighters, volunteer firefighters, and fire safety inspectors in this state. The executive director, with the advice and counsel of the committee, shall adopt rules to regulate those firefighter and fire safety inspector training programs, and other training programs approved by the executive director. The rules may include, but need not be limited to, training curriculum, certification examinations, training schedules, minimum hours of instruction, attendance requirements, required equipment and facilities, basic physical requirements, and methods of training for all persons in positions of any fire training certification level approved by the executive director, including full-time paid firefighters, part-time paid firefighters, volunteer firefighters, and fire safety inspectors. The rules adopted to regulate training programs for volunteer firefighters shall not require more than thirty-six hours of training. (State of Ohio Revised Code Section 4765.55)

Under this section, training programs for volunteer firefighters cannot require more than 36 hours of training.

[100] The code has been revised three times since the East Palestine derailment. The version here cited was the one effective at the time of the derailment, last modified October 9, 2021.

The training program and formal Volunteer Firefighter certification is described on the Ohio Division of Emergency Medical Services (Ohio EMS) website. The program is characterized as an "awareness-level course" and is intended to provide a foundation for further training (Ohio EMS 2023). Because of the 36-hour statutory maximum for training, the course does not permit training in hazardous environments:

> As an *awareness-level course*, the Ohio Volunteer Firefighter Course is intended to be a foundation upon which firefighters can begin to build their training portfolio. Due to the 36-hour time constraint as set forth in section 4765.55 of the Ohio Revised Code, the Ohio Volunteer Firefighter course limits exposures to hazardous environments as described in the Ohio Administrative Code. The course *does not permit student participation* in any instruction involving the type of hazardous environments in which their fire department may operate. Prohibited activities include environments which are considered to be "Immediately Dangerous to Life or Health" (IDLH), including but not limited to, hot zone operations at uncontrolled fires or hazardous materials releases involving fixed structures, mobile equipment, or outdoor areas as well as operation of emergency vehicle apparatus.
>
> Due to the limitations of the Ohio Volunteer Firefighter Course, firefighters certified to the Volunteer Firefighter level shall be provided the additional training necessary to participate in fire department activities that exceed the training provided in the Volunteer Firefighter Course. *The fire chief or the authority having jurisdiction (AHJ) is responsible to provide additional proper training in these expanded areas if the firefighter is expected to function safely within an IDLH environment or operate emergency vehicle apparatus*. (Ohio EMS 2023, emphases in original)

Ohio EMS describes Ohio firefighter training curricula in course packets for its Certified Volunteer Firefighter Course, Firefighter I Course, and Firefighter II Transition Course. The Certified Volunteer Firefighter Course specifies a maximum of 36 hours of training (Ohio EMS 2019c). The course includes goals and instruction times for topics including scene safety (40 minutes), firefighter survival (50 minutes), use of portable fire extinguishers (130 minutes), use of a self-contained breathing apparatus (3 hours), and deployment of hoses (6 hours). Ohio EMS notes that the Ohio volunteer course does not meet the minimum Standard for Fire Fighter

Professional Qualifications established by the National Fire Protection Association (NFPA) as NFPA 1001.[101]

The Firefighter I Course specifies a minimum of 160 hours of training, including 5 hours of "live fire" training in actual fire suppression (Ohio EMS 2019a). In general, the course addresses in greater depth subjects covered under the volunteer training; for example, instruction time for use of a self-contained breathing apparatus is expanded to 14 hours. The course makes numerous references to NFPA standards, including the NFPA 1001 firefighter standard and NFPA 1072 hazardous materials awareness and operations standard. The course specifies 16 hours of cognitive training and 8 hours of practical training in hazardous materials awareness and operations. According to Ohio EMS, the Ohio Firefighter I certification meets the NFPA 1001 standard.

The Firefighter II Transition Course lists the Firefighter I Course as a prerequisite and specifies an additional 84 hours of training, including 14 hours of live fire training (Ohio EMS 2019b). In addition to further instruction on subjects covered in the Firefighter I Course, the Firefighter II Transition Course includes training on the Incident Command System and how to assume, transfer, and terminate command, along with advanced fire suppression techniques for flammable gas cylinders and flammable or combustible liquids. The Firefighter II certification is typical for career firefighters.

The EPFD fire chief was a career firefighter with a Firefighter II certification, which included training at the hazardous materials technician level.[102] The EPFD deputy fire chief was a volunteer with a Volunteer Firefighter certification, and he had also completed hazardous materials awareness- and operations-level trainings in 2022. According to training records reviewed by the NTSB, the training levels of the rest of the department ranged from no hazardous materials training to technician-level training.

[101] Effective January 10, 2024, the NFPA 1001 standard has been combined into the current NFPA 1010 Standard on Professional Qualifications for Firefighters. The NFPA 1010 standard requires a minimum of 160 hours of training for a professional firefighter.

[102] In increasing order of capability, the four levels of hazardous materials response training are awareness, operations, technician, and specialist. See 29 *CFR* 1910.20.

1.9.5 Placarding

Federal regulations at 49 *CFR* Part 172 Subpart F establish requirements for placarding of hazardous materials offered for transportation. In general, a railcar containing any quantity of hazardous material must be placarded on each side and at each end in accordance with the naming conventions and placard design requirements set throughout the subpart. Figure 25 shows an example of an intact replacement placard affixed to a derailed tank car after fires were extinguished.



Figure 25. Replacement placard on a derailed DOT-105 tank car containing isobutylene.

Federal placarding requirements include a performance standard for durability; under 49 *CFR* 172.519, placards must be capable of withstanding 30 days of exposure to open weather conditions without deterioration or a substantial reduction in effectiveness. The performance standards do not extend to postaccident survivability in a fire. Federal regulations allow placards to be made of any plastic, metal, or other material that can meet the performance standard, though if the

placard is made of tagboard, the tagboard must meet minimum thickness and weight requirements.

The 2020 ERG, effective at the time of the East Palestine derailment, advises emergency responders to use placards to identify hazards and relevant ERG guidance if identification numbers or proper shipping names are not available (PHMSA 2020). When attempting to read placards, emergency responders should approach from upwind, uphill, and upstream and remain at a safe distance. If possible, they should use binoculars. If multiple placards are present and reference multiple guides within the ERG, responders should base their precautions on the guide requiring the greatest degree of protective actions (PHMSA 2020). The 2024 ERG contains the same guidance regarding use of placards (PHMSA 2024).

When interviewed by the NTSB, the EPFD deputy fire chief reported that the placards affixed to several railcars had sustained damage and became illegible after being exposed to heat. The NTSB photographed several damaged placards during its on-scene investigation. Figure 26 provides two examples.



Figure 26. Postderailment photographs of placards exposed to heat.

1.10 Vent and Burn Frequency and Guidance

ESI is a contractor that provides vent and burn services. When interviewed by the NTSB, ESI's president said that railroads bring in his company as a last resort and that it had been about 3 years since he had last conducted a vent and burn. He characterized vent and burn procedures as very infrequent and undertaken by railroads only after the exhaustion of safer options. Describing ESI's role in the decision to undertake a vent and burn, he said:

> We have a role to do what I would consider what's morally and legally right to do. We're not going to just go in and do a vent and burn because we want to, you know, clean the site up. So what we do is we base our decision off what the railroad and the railroad's contractors have provided to us. But, as far as the final decision, that's usually done through the railroad, through the incident command structure, and then we're granted permission to do it based on the actual last… resort of being able to remediate the site.

MxV Rail's Security and Emergency Response Training Center provides guidance for vent and burn procedures as part of its tank car specialist training curriculum.[103] The training literature states that vent and burn should be considered when, after a thorough damage assessment, it is determined that the railcar cannot be moved safely and that there is no way to transfer the lading. It further states that venting and burning will resolve other problems, such as pressure buildup with potentially catastrophic results. The course material states that vent and burn is not an easy choice to make and should be used as a last resort.

In 1994, the FRA published a research report and accompanying practical handbook on the vent and burn method. The FRA commented in the 1994 report that "the lack of a standardized procedure has made each application unique and dangerous, and that several past field applications have failed to cut the desired hole and even resulted in tank failure" (FRA 1994). The research report lists "vinyl chloride" among the candidate products for vent and burn and notes a historical case of a vent and burn procedure on tank cars containing vinyl chloride: a vent and burn of several tank cars following a derailment in Muldraugh, Kentucky, in 1980.[104]

The 1994 handbook recommends the vent and burn process when all other emergency product removal methods have been considered and rejected (FRA 1994). According to the handbook, the vent and burn method may be used when the following conditions exist:

[103] The Security and Emergency Response Training Center tank car specialist course is a 5-day, 40-hour training that covers mitigation techniques for railroad incidents, including product transfer, containment methods, use of special containment devices, and flaring operations. The course covers rail vehicle threat and vulnerability assessments, including actions and responses to toxic or industrial hazardous materials releases. See course number PER-290 at https://sertc.org/courses/tcs/.

[104] The NTSB investigated this derailment and issued an investigative report focused on the derailment itself. The NTSB made no findings specific to the vent and burn but noted that postaccident emergency activities were "carried out in a coordinated and effective manner" (NTSB 1981).

- The tank car has been exposed to fire resulting in elevated internal pressure and possible tank damage.
- The tank car has been structurally weakened to an extent that it cannot be safely rerailed and moved to an appropriate unloading point.
- Site conditions prevent the use of cranes or other rerailing equipment.
- Conditions do not allow for the safe transfer, venting, or flaring of the tank car.
- Damage to leaking valves and fittings cannot be repaired.

Candidate products for the vent and burn method include:

- Flammable compressed gases such as propane, butane, or butadiene.
- Flammable or combustible liquids.
- Products subject to polymerization and shipped with inhibitors that can be lost in a fire situation, making rapid unloading necessary.

Both the 1994 report and handbook state that any product with a secondary hazard of "poison-inhalation hazard" should not be considered for a vent and burn, and that a vent and burn may release harmful byproducts of oxidation.

The handbook notes that the risks associated with this procedure include:

- The tank car could fail during the vent and burn due to undetected material flaws or improper application of explosives, resulting in injury to personnel and damage to property and the environment.
- There is no way to control the flow of product once the tank shell is breached.
- Multiple entries into the incident scene may be necessary for the application of explosives.

The handbook further recommends that a written plan of operation and a site safety plan should be prepared to ensure that all parties involved have a clear understanding of the impending actions.

In 2007, the FRA published the results of a study on the vent and burn method, building on the 1994 FRA research report and associated handbook. The resulting reports (Tank Car Vent and Burn Process Study: Phase I; and Tank Car Vent and Burn Process Study: Phase II) include detailed information about vent and burn procedures. Because the reports included detailed discussions of explosives, the reports were classified as Sensitive Security Information under 49 *CFR* Part 1520 and were not available to the general public until May 6, 2024, when the FRA released

public versions.[105] The 2007 reports also describe in greater detail the vent and burn criteria for specific ladings and include guidance not available in the 1994 handbook. The Phase II report recommends that:

- Incident commanders should use the included 24-item vent and burn checklist (see figure 27).
- Incident commanders should use the included vent and burn flowchart or process map.
- Incident commanders should use the vent and burn database as a valuable resource as they prepare for a vent and burn.
- Incident commanders should use the vent and burn report form contained in an appendix to the report to document important variables and events surrounding a vent and burn.

[105] (a) The NTSB obtained permission to disclose limited information from the reports during our Investigative Hearing. (b) Although now available through the FRA's website, both reports are still marked "Limited Distribution."

Appendix A.
Vent and Burn Checklist

(Place a check mark in the box next to the response that best describes the situation.)

Damage Assessment

Is tank car being impinged upon by fire?	Yes		Close to Fire		No	
Are contents of tank car burning?	Yes				No	
Is tank car venting continuously?	Yes				No	
Is shell rupture imminent?	Yes		Possible		No	
Is tank damaged?	Yes		Somewhat		No	
Has tank specification and construction material been determined?	Yes				No	
Is ambient temperature cold enough to cause brittle fracture?	Yes		Possible		No	

Location/Environment/Site Assessment

Is the tank close to other tank cars?	Yes		Somewhat		No	
Is the tank near buildings or structures?	Yes		Somewhat		No	
Is tank near habitation?	No		Within .025 mile		Within 0.5 mile	
Have inhabitants been evacuated?	Yes		In process		No	
Is excavation of burn pit possible?	No		Within .025 mile		Within 0.5 mile	
Is accident scene close to water sources?	No		Within .025 mile		Within 0.5 mile	
Will windspeed and direction produce dangerous product fallout?	Yes		Somewhat		No	

Product Considerations

Is product combustible?	Yes				No	
Is product polymerization a possibility?	Yes				No	
Will controlled release exceed toxicity levels?	Yes				No	
Will products of combustion exceed toxicity levels?	Yes				No	
What is the permeability of the soil?	High		Medium		Low	
What is the viscosity of the product?	High		Medium		Low	

Resources/Product Containment

Are local fire suppression personnel present?	Yes		On Call		No	
Is equipment available to dig pit and trench?	Yes		En route		No	
Is an explosives expert available?	Yes		En route		No	
Are proper explosives available?	Yes		En route		No	

Figure 27. FRA vent and burn checklist. (Courtesy of the FRA.)

The flowchart includes confirming that all alternatives to a vent and burn have been considered, ascertaining whether the product is suitable for a vent and burn, and creating a site safety plan. The checklist also advises incident commanders to consider toxic or otherwise hazardous combustion products from a vent and burn along with the consequences of an uncontrolled release of the product itself.

The report describes the database as "containing the itemized checklist, tank car material specifications, Universal Machine Language Equipment Register information, and commodity characteristics … developed in a format compatible with personal digital assistants and laptop computers" (FRA 2007a). The report provides screenshots and sample tables showing how to use the database, including a table titled "Hazard material class 2.1, flammable gas, suitable for V&B action" (FRA 2007a). Vinyl chloride is not listed in the table. The Phase I report includes additional tables and notes two chemical hazards associated with a vent and burn of vinyl chloride that make it "less suitable" for the method: self-reactivity if exposed to fire for a long duration and potential shock sensitivity (FRA 2007b).

The report makes reference to a compact disc containing a database compatible with Microsoft Access along with forms for providing information for the database, but the NTSB found no evidence that the database described in the Phase II report has been maintained, updated, or entered general use.

The incident command did not use the 1994 FRA report or handbook, or the 2007 FRA reports, as a reference for the East Palestine vent and burn. The NS hazardous materials regional manager, present at the scene, was one of the five authors of the 2007 FRA study while employed by the AAR. At the NTSB Investigative Hearing, he testified that he was not aware of the tools in this study being used in the lead-up to the vent and burn procedure at East Palestine.[106] The 2007 FRA reports were not available to the incident commander, and he was not aware nor made aware that such reports existed. The NTSB did not find evidence of formal checklists being prepared or used by NS or its contractors before the vent and burn.

1.11 Rules and Requirements for Hazardous Materials Trains

1.11.1 Key Trains and Key Routes

The AAR defines a key train in Circular OT-55-R as any train containing one tank car load of poison or toxic inhalation hazard, anhydrous ammonia, or ammonia

[106] NTSB Investigative Hearing Transcript, Day 2, pp. 404–5.

solutions; 20 car loads or intermodal portable tank loads of hazardous materials; or one or more car loads of spent nuclear fuel or high-level radioactive waste (AAR 2024a).[107] The circular restricts key trains to 50 mph, requires the use of roller bearings, and requires that:

> If a defect in a "Key Train" bearing is reported by a wayside detector, but a visual inspection fails to confirm evidence of a defect, the train will not exceed 30 mph until it has passed over the next wayside detector or` delivered to a terminal for a mechanical inspection. If the same car again sets off the next detector or is found to be defective, it must be set out from the train. (AAR 2024a)

The AAR defines a key route in Circular OT-55-R as:

> Any track with a combination of 10,000 car loads or intermodal portable tank loads of hazardous materials, or a combination of 4,000 car loadings of [poison or toxic inhalation hazard] (Hazard zone A, B, C, or D), anhydrous ammonia, flammable gas, Class 1.1 or 1.2 explosives, environmentally sensitive chemicals, Spent Nuclear Fuel (SNF), and High Level Radioactive Waste (HLRW) over a period of one year. (AAR 2024a)

AAR recommended practices specify that key routes have wayside bearing defect detectors spaced a maximum of 40 miles apart or that railroads install an equivalent level of protection using improved technologies. Main track on key routes must be inspected twice each year with rail defect detection and track geometry inspection cars, and sidings must receive these inspections at least once each year. Track used for meeting and passing key trains must be Class 2 or higher, and if a meet or pass must occur on a lesser class of track because of an emergency, one of the trains must stop before the other passes (AAR 2024a).

Train 32N was not a key train under the definition in OT-55-R because it did not include a total of 20 tank cars carrying hazardous materials or any of the specific hazardous materials identified in the definition. The AAR has not publicly identified the track involved in the East Palestine derailment as part of a key route, but the track

[107] This version of Circular OT-55-R is effective as of February 12, 2024. The version in effect at the time of the East Palestine derailment included the phrase "20 car loads of any combination of hazardous materials" in its definition of a key train. The updated circular notes that the change was made to resolve a discrepancy between the circular and the definition of a key train used in the *United States Hazardous Materials Instructions for Rail*, another AAR product.

exceeded Class 2 and had bearing defect detectors installed less than 40 miles apart near the derailment site.

1.11.2 High-hazard Flammable Trains and Key Trains

On August 1, 2014, PHMSA published a notice of proposed rulemaking (NPRM) in the *Federal Register* (Fed. Reg.) proposing a definition for a high-hazard flammable train (HHFT), a class of train that would be subject to requirements intended to reduce the probability and severity of flammable materials releases (79 Fed. Reg. 45016).[108] The NPRM defined an HHFT as any train with 20 or more tank cars of a Class 3 flammable liquid. Final rule HM-251, published May 8, 2015, defined an HHFT as:

> …a train comprised of 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or 35 or more loaded tank cars of a Class 3 flammable liquid across the entire train. (80 Fed. Reg. 26645)

In the final rule, PHMSA explained the revised definition as intended to focus HHFT requirements on trains transporting large quantities of ethanol or crude oil "while not affecting lower-risk trains that are not transporting similar bulk quantities of Class 3 flammable liquids" (80 Fed. Reg. 26645–26646).

The FAST Act, signed into law on December 4, 2015, defined an HHFT in Section 7302 as:

> …a single train transporting 20 or more tank cars loaded with a Class 3 flammable liquid in a continuous block or a single train transporting 35 or more tank cars loaded with a Class 3 flammable liquid throughout the train consist. (PL 114-94)

The FAST Act also directed the Secretary of Transportation to issue regulations to require each Class I railroad to provide advanced notification and information on HHFTs to each state's emergency response commission, including identification and a description of the Class 3 flammable liquid being transported, ERI, identification of the routes over which such liquid will be transported, and a railroad point of contact

[108] The NPRM was partially in response to NTSB safety recommendations. This subject is discussed in section 2.4.4.

responsible for communicating with state emergency response centers and local emergency responders (PL 114-94).

Current federal regulations at 49 *CFR* 171.8 reflect the tank car counts in the final rule and FAST Act: an HHFT is a single train with 20 or more loaded tanks carrying a Class 3 flammable liquid in a single block, or a single train with 35 or more such tank cars throughout the consist. Under 49 *CFR* 174.310, HHFTs must follow special routing and planning requirements described in 49 *CFR* 172.820, not exceed 50 mph, and be equipped with a two-way braking system or distributed power system if operating above 30 mph. The same regulation requires that tank cars manufactured after October 1, 2015, for use in an HHFT must meet the DOT-117 specification or another authorized specification as stated in 49 *CFR* Part 174 Subpart F. Regulations for advanced notification and provision of HHFT information to state emergency response commissions are established in 49 *CFR* 174.312.

Train 32N was transporting hazardous materials but was not an HHFT under any definition discussed in this section; it included fewer than 20 tank cars of Class 3 flammable liquid.

1.11.3 Consist Notification

1.11.3.1 Industry Standards and NS Rules

The AAR *United States Hazardous Materials Instructions for Rail,* commonly adopted by railroads as HM-1, includes guidelines for train crews following accidents involving hazardous materials (AAR 2022b). The NS version of HM-1 directs crews to make an emergency call during an emergency as radio rules require and provide the train dispatcher or yardmaster with as much relevant information as possible, including the specific location of the emergency, what railcars are involved, and the status of crewmembers. HM-1 also directs crews to immediately share any requested information from shipping documents with emergency responders, provide an extra copy of the train consist if one is available (crews are instructed to retain a copy of the train consist until it can be delivered to a railroad manager on the scene), and help emergency response personnel identify railcars and involved commodities while remaining at a safe distance.

1.11.3.2 Regulatory Requirements

ERI requirements for carriers (such as railroads) are established in 49 *CFR* Part 172 Subpart G. Under 49 *CFR* 172.600, a carrier may not accept hazardous material for transportation, unless (1) ERI conforming to Subpart G is

immediately available for use at all times the hazardous material is present and (2) ERI required by Subpart G is immediately available to any person who, as a representative of a government agency, responds to a hazardous materials incident or is conducting a hazardous materials investigation.

1.12 NTSB Special Investigation

In March 2023, the NTSB announced that we would conduct a special investigation of NS's organization and safety culture. The East Palestine derailment is one accident that led to the NTSB's decision to undertake a special investigation.

The NTSB's postderailment examinations of non-derailed equipment from train 32N identified FRA-reportable defects on 26% of the railcars, all of which had received NS or TRRA mechanical inspections. Most defects were minor. One railcar had a major defect: a missing cross-key retainer.[109] At the NTSB's Investigative Hearing, a representative of the Brotherhood of Railway Carmen/Transportation Communications Union testified about decreasing freight car inspection times afforded to inspectors at NS railyards.[110] The NTSB also obtained a copy of an email an NS senior general foreman sent to his team referring to the need to improve inspection times and appearing to state a target time of 90 seconds for both inbound and outbound railcars. NS did not inspect the hopper car relevant to the East Palestine derailment because it had been added to the train in the TRRA yard, but the NTSB will further explore the issue of inspection times as part of our special investigation.

Other accidents involving NS and under investigation at the time of the announcement included:

- Reed, Pennsylvania (RRD22LR003)
- Bessemer, Alabama (RRD23LR003)
- Anniston, Alabama (RRD23LR008)
- New Castle, Pennsylvania (RRD23FR011)

[109] A *cross-key retainer* is a railcar component that prevents dislodging of the cross key (also called the draft key) that secures the coupler assembly to the railcar.

[110] NTSB Investigative Hearing Transcript, Day 2, pp. 263–5.

- Elliston, Virginia (RRD23FR013)[111]

In addition to these investigations, the NTSB has conducted a survey of all 20,000 NS employees and begun an analysis of safety data. The results of the survey and safety data analysis will shape the direction of the special investigation.

1.13 Postaccident Actions

1.13.1 PHMSA

1.13.1.1 Aluminum Protective Housing Covers

In response to the East Palestine derailment, on March 2, 2023, PHMSA issued Safety Advisory Notice for Tank Cars Equipped with Aluminum Manway Protective Housing Covers to hazardous materials tank car owners and offerors (PHMSA 2023d). The safety advisory noted that while the effects of the melting aluminum covers was still under investigation, PHMSA was concerned that these covers may present a danger in pool fire situations. PHMSA requested that tank car owners and offerors survey their fleets to identify tank cars with aluminum protective housing covers and consider replacing them with carbon steel covers.

1.13.1.2 Consist Notification

On March 3, 2023, PHMSA issued Safety Advisory Notice for Railroad Emergency Preparedness to railroads to review access to the AskRail application among emergency response agencies along their routes (PHMSA 2023c).[112] The safety alert also noted the availability of PHMSA grants to support training resources to first responders and urged railroads to review, update, and disseminate emergency response plans among emergency response agencies, conducting

[111] As of this report's publication, these investigations are completed with published reports (Reed, Pennsylvania, and Bessemer, Alabama), will be closed without a final report (New Castle, Pennsylvania, and Elliston, Virginia), or are still in progress (Anniston, Alabama).

[112] AskRail is a software application developed by the North American Class I railroads and intended to provide pre-qualified personnel, such as emergency responders, with information about train consists. As discussed in section 1.1.2, the Beaver County director of emergency services and chief of hazard materials told the NTSB that he attempted to access the AskRail application using a laptop on the night of the derailment but was not initially successful. He said that the application began working about 2:00 a.m. on February 4, 2023. The East Liverpool fire chief told the NTSB in his interview that his hazardous materials team used a cell phone to access the AskRail application and obtain the train 32N consist before reaching the scene on the night of February 3, 2023.

training exercises as needed to ensure that communities are prepared for emergencies.

On June 27, 2023, PHMSA published an NPRM titled Hazardous Materials: FAST Act Requirements for Real-Time Train Consist Information, proposing amendments to its rules for hazard communication (88 Fed. Reg. 41541). The proposed amendments would require railroads to:

- Promptly forward train consist information to state-authorized local first responders within a 10-mile radius of an incident or accident involving the release or suspected release of hazardous materials.

- Generate, maintain externally to the train itself, and update in real time accurate train consist information in electronic form and make this information available to authorized first responders, emergency response officials, and law enforcement personnel at all times upon request.

On July 11, 2023, in coordination with the FRA, PHMSA issued Safety Advisory Notice Encouraging the Use of Real-Time Train Consist Information in 9-1-1 Call Centers, encouraging 911 call centers to download available resources, specifically the AskRail application, and use these resources to provide information about train consists to first responders (PHMSA 2023a).

On June 24, 2024, PHMSA published Final Rule HM-263 (89 Fed. Reg. 52956). Under the new rule, any railroad transporting hazardous materials must create and maintain accurate consist information for hazardous materials trains external to the train itself and in electronic form. This consist information must be immediately available to federal, state, and local first responders, emergency response officials, and law enforcement personnel upon request. For Class I and Class II railroads, the final rule further requires that:

> In the event of either an accident involving a train carrying hazardous materials, or incident involving the release or suspected release of hazardous material, railroads operating trains carrying hazardous material are required to immediately notify the primary PSAP responsible for the area where the incident occurred telephonically and the track owner (if the track owner and the railroad operating the train are different), and provide the train consist information to the primary PSAP/track owner electronically in a form that the PSAP/track owner is capable of readily accessing (i.e., a form the PSAP/track owner can

> access and use based on the specific information technology resources they have available) to assist in response and investigation efforts. This emergency notification requirement applies to situations that require response from local emergency response agencies. (89 Fed. Reg. 52957–52958)

Class III railroads may comply with the requirements described above or may use alternative means to provide consist information to emergency responders. If using an alternative means, a Class III railroad must develop a written plan documenting their alternative approach to providing consist information to PSAPs and local response agencies along its routes and conduct annual tests to demonstrate that their plan is effective (89 Fed. Reg. 52958).

Class I railroads must comply with these requirements within 1 year. Class II and III railroads must comply within 2 years.

1.13.1.3 DOT-111 Tank Cars in Flammable Liquids Service

On March 22, 2023, PHMSA issued Safety Advisory Notice for DOT-111 Tank Cars in Flammable Liquid Service to all entities using DOT-111 and CPC-1232 tank cars in flammable liquids service. PHMSA advised these entities to consider removing DOT-111 and CPC-1232 tank cars from service and replacing them with DOT-117 or DOT-117R tank cars as soon as practicable (PHMSA 2023b). PHMSA also recommended that rail carriers determine whether applying requirements for HHFTs to trains with fewer tank cars carrying flammable liquids is appropriate to ensure safe operations.

In the same safety advisory, PHMSA indicated that it believes an accelerated phase out of DOT-111 tank cars is technically possible:

> PHMSA believes that it is possible, and in the clear safety interest of the public, for tank car owners and shippers using DOT-111 tank cars to acquire the DOT-117J, or even DOT-117R, specification tank cars they need to continue operating well before the May 1, 2029, phase out. There is sufficient shop capacity to retrofit existing tank cars to the DOT-117R standard and to build new DOT-117J tank cars to replace the existing DOT-111 tank car and CPC-1232 tank car fleet. (PHMSA 2023b)

1.13.1.4 Placard Survivability

PHMSA partners with the Volpe Center's Small Business Innovative Research Program to encourage domestic small businesses to conduct research and

development on various topics. On February 8, 2024, the Volpe Center opened a solicitation for businesses to apply for Phase I grants (up to $200,000) to complete proof-of-concept work on placard survivability.[113]

1.13.2 FRA

1.13.2.1 NS Safety Assessment

Following the East Palestine derailment, the FRA conducted a safety assessment of NS from March 15 to May 15, 2023 (FRA 2023). The safety assessment included an evaluation of NS responses to previous FRA safety recommendations; inspections and investigations of safety-critical elements of NS operations; and surveys of NS employees and frontline supervisors in addition to semi-structured interviews (fixed questions with open-ended responses) of NS leaders and local labor leaders who were also NS employees.

As a result of this safety assessment, the FRA made 4 overall findings and 19 overall recommendations to NS in addition to more specific findings and recommendations; the overall findings and recommendations are quoted below:

FRA Finding 1:

NS Communications [*sic*] are not always open and effective and require improvement.

FRA Recommendations:

1. Evaluate the communications processes surrounding responses to wayside detector alerts and alarms to identify and eliminate gaps and delays.
2. Develop a new (or refine existing) policy that outlines how information will flow throughout the organization.
3. Review NS' communication policy and update it, as appropriate.
4. Inform all levels of management as well as employees about the communication methods and protocols NS will use to disseminate information.
5. Clarify where specific information can be located and what (if any) information is available via more than one method.

[113] A summary of the solicitation and topics for fiscal year 2024 is available here: https://www.volpe.dot.gov/work-us/small-business-innovation-research/fy241-sbir-solicitation-now-open.

6. If older communications systems (e.g., oral briefings, posted signage) are being phased out or eliminated in favor of electronic communications, ensure all employees are aware of this change and able to access the electronic systems.

FRA Finding 2:

NS employees and the organization do not always work to foster mutual trust.

FRA Recommendations:

1. Participate in the Confidential Close Call Reporting System (C^3RS) to allow employees to anonymously report safety close calls without fear of discipline or enforcement.
2. Continue to explore ways to increase trust.
3. Review existing discipline programs and ensure their application is consistent across locations and managers.
4. Develop and implement a policy for responding promptly and as publicly as possible to complaints.
5. Engage with employees and solicit feedback on their perceptions of the current state of trust at NS and how that could be improved and use that feedback to create action items designed to foster trust.
6. Include employees, and their representatives, in as many processes as possible including when required by regulation to consult with directly affected employees such as with 49 *CFR* Part 271: Risk Reduction Programs and Fatigue Risk Management Program.

FRA Finding 3:

NS Training and resources are not always effective at supporting safety efforts.

FRA Recommendations:

1. Create additional opportunities for employees to complete both required "rules class" trainings as well as supplemental safety training courses offered by NS during on duty hours. Consider taking concrete steps to set aside specific duty time for employees to participate in safety training opportunities.
2. Explore additional methods for evaluating the effectiveness of training, and develop and implement corrective actions in response to any findings.

3. Consider the methods that are used to administer training and explore the feasibility of offering more than one delivery method for trainings to account for the differences in learning styles and preferences of adult learners. In the absence of alternatives to online training, utilize a variety of instructional methods, such as text, narration, video segments, interactive features, and the ability to apply what has been learned to engage with as many different types of learners as possible.
4. Review the training offered to frontline supervisors and make changes, as needed, to ensure that frontline supervisors are trained in leadership skills and understand how they are empowered to do their jobs. Ensure that frontline supervisor training is of sufficient length, quality, and content to enable supervisors to lead their teams effectively and safely.

FRA Finding 4:

NS frequently focused solely on compliance with minimum safety standards.

FRA Recommendations:

1. Leverage partnerships with recently engaged safety culture consultants to review and act on the findings and recommendations in this report. Identify the polices and actions that have led to the observed positive results and determine how these successes can be improved upon, and how this information can be leveraged in other areas of the NS safety culture.
2. Explore ways, including developing corrective actions for previous safety recommendations which may go beyond minimal regulatory standards, to move from systems that are reactive and focused on lagging safety indicators to those which are proactive and focus on leading safety indicators.
3. Consider FRA's findings when conducting hazard identification and risk analysis as well as in the implementation of NS' Risk Reduction Program and Fatigue Risk Management Program.

1.13.2.2 DOT-111 Phase Out

On January 19, 2024, the FRA published a report describing the results of the FRA's Legacy Tank Car Focused Inspection Program, a program undertaken in response to the East Palestine derailment that focused inspection resources on DOT-111 tank cars and the shippers and tank car owners that have not yet upgraded to the DOT-117 specification (FRA 2024). The resulting inspections, conducted

between March 2023 and August 2023, included tank car owners that collectively own and control about 85% of the North American tank car fleet. The FRA found that some large tank car fleet owners have established retrofit programs, based on FAST Act compliance dates, to retrofit, scrap, and retire DOT-111 cars by the deadline and, in some cases, are implementing programs to move DOT-111 cars into services other than the transportation of flammable liquids. The FRA also found that while these tank car owners are on track to meet the May 2029 DOT-111 phase out, economic and practical challenges remain that prevent full-scale removal of the DOT-111 cars from service. Further, the FRA found that the cost and limited manufacturing capacity of new DOT-117 cars and corresponding lease rates of DOT-117 cars provided a disincentive for tank car owners and shippers to phase out DOT-111 cars faster than required, and that some existing long-term lease agreements between car owners and shippers are not subject to revision. However, the FRA also noted that the Railway Supply Institute has previously indicated that it may be technically and operationally feasible to accelerate the May 2029 phase-out deadline by 1 year.

1.13.3 Norfolk Southern

NS provided the postaccident actions described below in a letter to the NTSB.

1.13.3.1 Emergency Response

As a result of the East Palestine derailment, NS reported that it has begun integrating its emergency response notification process with RapidSOS, a digital platform designed to provide emergency responders with real-time consist information and notify NS of 911 calls reporting track emergencies in NS's rail network. RapidSOS automatically provides dispatch centers equipped with its software information about an emergency alert, such as the consist of a derailed train; the dispatch center can then send this information to first responders' mobile devices.

On September 21, 2023, NS began construction of a new first responder training center in East Palestine, Ohio. NS plans to cover the new center's operating costs for the next 10 years. NS intends the new center to offer both traditional fire service training and more specialized training for rail and other transportation emergencies. Planned training methods include classroom instruction, online resources, tabletop drills, and full-scale exercises.

1.13.3.2 Wayside Detection

After the East Palestine derailment, NS began increasing the number of HBDs and ABDs on its tracks. As of February 2024, NS reported that it had installed 144

new HBDs at 99 sites, reducing the average distance between HBDs from 13.9 miles to 12.28 miles. The new detectors include additional HBDs east and west of East Palestine. NS also plans to install about 140 additional HBDs on key routes, reducing the average distance between detectors on key routes to about 11 miles. NS has also increased the number of ABDs in its network from 5 to 17, which it expects will enable it to monitor 90% of railcars traveling on its main tracks annually.

In December 2023, NS installed its first multi-scan HBD, a detector designed to measure more temperature points on each bearing than current HBDs and provide algorithms with more complete information about bearing temperature.

NS reported that it has also piloted a thermal camera program at its Inman Yard in Atlanta. The pilot is intended to evaluate whether thermal cameras scanning the full face of a wheel can detect hot bearings. NS is also deploying thermal cameras as part of its development of digital train inspection portals. These portals are intended to use cameras and software to identify potential mechanical defects in trains passing at track speeds. Data from portals are relayed to the Wayside Help Desk, where analysts determine whether the data indicate a critical defect. NS deployed two portals in Leetonia, Ohio, in 2023.

On May 26, 2023, NS revised its bearing alarm criteria on its current HBD systems, eliminating the "warm bearing" category and classifying bearing temperatures more than 170°F above ambient as critical alarms. HBDs broadcast alarms to the crew immediately; the Wayside Help Desk receives a corresponding alert when the train has finished traversing the HBD.

NS is currently analyzing a year of bearing data to assess its hot bearing trending algorithms and identify opportunities for improvement. As part of this process, NS has removed, disassembled, and analyzed 108 bearings that algorithms identified as potentially problematic. NS plans to use the results of these analyses to further refine its algorithms.

Since the East Palestine derailment, NS has made changes to processes and employee resources involved in bearing defect detection. As of February 2024, NS reported that it has:

- Standardized the process that mechanical employees follow when responding to HBD alarms in the field. Mechanical employees are now instructed to contact the Help Desk before arriving on the scene and must complete a job briefing with the train crew upon arrival.

- Revised its "train matching" logic to strengthen alert communication. For an HBD to communicate an alert to the Wayside Help Desk, the software must match collected data to a specific train. NS has examined the causes for failed matches and taken steps to reduce their frequency.

- Begun developing a detector outage alert system to quickly identify nonfunctional wayside defect detectors. The planned detector outage alert system will send a notification to the Wayside Help Desk, allowing for faster dispatching of maintenance personnel.

- Supplied train crews with 5,000 handheld infrared thermometers and trained crews in their use. Certain wayside detector alarms and alerts require train crews to inspect a wheel bearing's temperature in the field. Handheld infrared thermometers are now train crews' primary source for field bearing temperature checks.

- Increased train crews' and dispatchers' real-time access to information about potential defects. Critical alerts now generate push notifications to train crews' mobile train reporting devices and pop-up alerts to dispatch, which require acknowledgment of receipt. Alarm information is now also displayed for train crews on the PTC on-board display.

- Implemented a new handling procedure that requires a stop-and-inspect response for all bearing and wheel alerts with Kt values above six. Now, for example, when a single bearing temperature spike alert or bearing temperature deviation alert arrives at the Wayside Help Desk, in addition to following the applicable desk procedures, the analyst reviews the Kt value and intervenes if it crosses a set threshold.

1.13.3.3 Wayside Help Desk Staffing and Processes

On July 10, 2023, NS suspended its remote work policy for Help Desk personnel and hired additional staff. As of February 2024, the Help Desk has 1 senior general manager, 4 general supervisors, 12 analysts, and 4 vacation relief analysts. Three analysts and one supervisor staff most Help Desk shifts.

On August 20, 2023, NS introduced communication scripts to standardize Help Desk situational responses to train crew calls. NS has also introduced a checklist to increase and standardize communication between dispatchers, Help Desk analysts, and train crews during inspection stops in the field. NS has indicated that these changes are intended to ensure compliance with operating rules and bulletins while protecting train crews.

1.13.3.4 Industry and Union Collaboration

In February 2024, NS signed an agreement with the Brotherhood of Locomotive Engineers and Trainmen and the International Association of Sheet Metal, Air, Rail and Transportation Workers—Transportation Division to develop a Close Call Confidential Reporting pilot program.[114] The pilot is planned to include NS's Atlanta, Georgia; Elkhart, Indiana; and Roanoke, Virginia, locations. The program will include a means for employees to report safety concerns confidentially.

[114] The FRA sponsors a Confidential Close Call Reporting System (commonly known as C^{3}RS). NS's communications with the NTSB refer instead to a "Close Call Confidential Reporting" pilot.

2 Analysis

2.1 Introduction

On February 3, 2023, NS freight train 32N, carrying both hazardous and non-hazardous materials, derailed in East Palestine, Ohio, shortly after triggering an HBD alarm. Derailed tank cars released lading, which ignited and led to a series of fires involving a mix of freight cars, non-hazardous materials tank cars, and hazardous materials tank cars. As emergency responders worked over the next 2 days to manage fires and protect the community, NS and its on-scene contractors expressed concerns to the incident commander that a dangerous polymerization reaction could be occurring within derailed DOT-105 tank cars carrying VCM. NS and its contractors interpreted documentation of VCM hazards, PRD activity, the detection of volatile organic compounds near a non-actuating PRD, and tank car temperature changes as indicative of dangerous polymerization within at least two tank cars (OCPX80179 and OCPX80370). NS and its contractors communicated to the incident commander that polymerization could lead to a BLEVE for at least one tank car (OCPX80370) with a large radius of destruction. The incident command and other interested entities discussed these concerns, and based on guidance provided by NS and its contractors, the incident commander authorized a vent and burn procedure, which occurred on February 6.

This analysis discusses the following safety issues:

- Failure of wayside monitoring systems to diagnose a hot wheel bearing in time for mitigation to prevent a derailment. (Section 2.2.4)
- Inadequate emergency response training for volunteer first responders. (Section 2.3.1)
- Delayed transmittal of train consist information necessary to protect first responders and the public. (Section 2.3.2)
- Illegible hazardous materials placards that prevented emergency responders from immediately identifying hazards. (Section 2.3.3)
- Continued use of DOT-111 tank cars with documented poor derailment performance and lading retention in hazardous materials service. (Section 2.4)

- Tank car certification process insufficient to ensure that tank car fittings are compatible with lading. (Section 2.4.3.1)

- Misleading written hazard information that adversely affected the vent and burn decision. (Section 2.5.2)

- Flawed communication and decision-making leading up to the vent and burn. (Section 2.5.3)

The NTSB established that the following factors did not contribute to the accident:

- *Defects in railroad track and infrastructure:* the track's condition and geometry near the derailment site did not show any defects that could have caused or contributed to the derailment.

- *Signals and train control systems:* signals and train control systems were functioning as designed at the time of the derailment.

- *The train crew's train handling and response to the bearing alarm and derailment:* the crew of train 32N acted in accordance with NS operating rules, responding appropriately to both the bearing alarm and the derailment itself.

- *The marking, placarding, and method of loading for the derailed VCM tank cars:* the VCM was loaded in a manner sufficient to stabilize the VCM for transport and was shipped under the correct proper shipping name (UN1086 vinyl chloride, stabilized, 2.1).

- *The weight and lading volume of all derailed hazardous materials tank cars:* no derailed hazardous materials tank cars were overloaded by weight or volume.

- *The mechanical crashworthiness of the derailed DOT-105 tank cars:* none of the six derailed DOT-105 tank cars sustained mechanical breaches during the derailment, including the five carrying VCM, and none released lading except through PRD activity or the vent and burn procedure.

The NTSB concludes that none of these issues contributed to the derailment of train 32N and subsequent hazardous materials release: (1) defects in railroad track or infrastructure; (2) the signals or train control system; (3) the train crew's proper train

handling and appropriate response to the bearing alarm and derailment; (4) the marking, placarding, and method of loading for the derailed VCM tank cars; (5) the weight and lading volume of the derailed hazardous materials tank cars; and (6) the mechanical crashworthiness of the derailed DOT-105 tank cars.

2.2 The Derailment

Eastbound train 32N derailed at MP 49.5, about 0.3 miles east of an HBD. Less than a minute before the derailment, this HBD broadcast a critical alarm to the crew for a left-side bearing (L1) on hopper car GPLX75465. Upon receiving the alarm, the crew acted in accordance with NS operating rules to immediately begin slowing the train in preparation for a stop. Before decelerating, the train was traveling about 43 mph, less than the maximum authorized speed of 50 mph.

While slowing and still traversing the HBD, train 32N experienced a train line–induced emergency braking application as one or more railcars became disconnected from the train. The front portion of the train slowed to a stop. The rear portion derailed 38 railcars (line numbers 25–62 inclusive), including the hopper car (line number 25).

2.2.1 Derailment Markings

The NTSB examined the track near the derailment site and identified scrape-like markings on the top of the south running rail near MP 49.5. Additional scrape-like markings extended east for more than 1,400 feet along the south running rail from MP 49.5 (no markings were found west of MP 49.5). These markings were consistent with a large metal component on one side of a railcar, likely the side frame of a truck, contacting the top of the railhead and sliding while the railcar remained in line with the track.[115] The crossties in this area exhibited grooves consistent with derailed wheel flanges running along the ground between the rails, also indicating that a wheelset had left the rails but not yet forced its railcar out of line. Therefore, the event that precipitated the derailment pileup resulted from one railcar's side frame dropping low enough to contact the railhead on one side, which is possible only if the side frame is no longer being held above the rail by one or both of its wheelsets.

[115] The markings were inconsistent with a wheel-climb derailment, in which a wheel flange typically climbs the side of a rail, leaves distinctive narrow marks on the top surface, and then departs the rail entirely.

One side frame contacting the track is consistent with a bearing failure and axle separation. When a bearing fails completely but remains in service, it can overheat and cause its axle to separate ("burn off") and break the connection between the wheelset and one side of the truck. This allows the side frame to descend and contact the top of the railhead. Because the marks at East Palestine were consistent with axle separation on the south side of the train (the right side in the direction of travel) and HBD records indicated a critical alarm on a bearing on the train's right side shortly before the derailment (the hopper car's L1 bearing), the NTSB searched the derailment site for the wheelset and bearing identified in the alarm to determine whether other physical evidence supported bearing failure as the cause of the derailment.

2.2.2 Hopper Car GPLX75465 and L1 Bearing

The NTSB found hopper car GPLX75465 on the east side of the derailment pileup on February 4, 2023. The lead wheelset had detached from the hopper car but remained nearby, suggesting that the wheelset itself had remained attached to the railcar during the early moments of the derailment. The R1 bearing was still attached to the wheelset, but the L1 bearing and mating axle journal (the part of the axle that extends into the bearing) were missing.

The NTSB recovered components from the L1 bearing and journal near the tracks west of the derailment pileup. (See figure 28.) The components' positions west of the pileup and far from the rest of the wheelset indicate that they became separated from the hopper car in the earliest moments of the derailment, when the hopper car was still west of its final, postderailment location.



Figure 28. Locations of derailment evidence.

The recovered L1 bearing components were heavily damaged. Two of the types of damage identified during NTSB Materials Laboratory examination—galling and rub damage—are characteristic of metal surfaces experiencing the excessive friction of a burn-off. The bearing cup showed signs of melting, another indication of excessive friction producing high temperatures and causing the bearing to overheat. The deformation of the journal from a cylinder into a cone shape was also characteristic of a burn-off.

The extent of the damage indicates that the axle journal burned off before the derailment, breaking the connection between the lead wheelset and the side frame of the lead truck. Based on the position of the recovered L1 bearing components, the friction damage to bearing components identified in laboratory examinations, track markings consistent with a bearing-failure derailment, and the triggering of an HBD critical bearing alarm less than a minute before the derailment, the NTSB concludes that train 32N derailed because the L1 bearing on railcar GPLX75465 overheated and caused the axle to separate, causing the railcar's lead truck to derail.

2.2.3 Mechanical Inspection of Hopper Car

The hopper car was visually inspected by qualified mechanical inspectors at the TRRA yard on February 1, 2023, in Madison, Illinois. When the NTSB examined non-derailed equipment after the accident, they identified multiple FRA-reportable defects on railcars that were not reported following the TRRA mechanical inspection. The number of defects identified during the NTSB's examinations calls into question the thoroughness of the 49 *CFR* 215 inspection performed on February 1. It is

possible that the L1 bearing was showing visible signs of failure, and that the mechanical inspection failed to identify them. However, no available evidence indicates that the L1 bearing on the hopper car was showing visible signs of deterioration on February 1. Predeparture inspections are performed visually, and the bearing components recovered after the derailment were too damaged to support a determination of how the bearing would have appeared to the TRRA mechanical inspectors. If a bearing is failing because of an internal defect, it might not show signs detectible even through a complete and thorough mechanical inspection performed in compliance with 49 *CFR* 215. The NTSB concludes that there is insufficient evidence to determine if the TRRA mechanical inspection of train 32N on February 1, 2023, failed to identify signs of failure on hopper car GPLX75465's L1 wheel bearing.

The mechanical inspection of 40 railcars added to train 32N at the NS yard on February 1 in Decatur, Illinois, did not include the hopper car; it was already part of the train's consist and was not required to be re-inspected under 49 *CFR* 215. In addition, the NS mechanical inspection failed to report FRA-reportable defects later identified on these railcars, but these unreported defects did not contribute to the derailment.

While the NS mechanical inspection of the last 40 railcars of train 32N did not contribute to the derailment, the NTSB Investigative Hearing included testimony from a representative of the Brotherhood of Railway Carmen/Transportation Communications Union that described decreasing freight car inspection times afforded to inspectors at NS railyards, and the NTSB obtained an email originally sent by an NS senior general foreman to his team that appeared to describe a goal of 90 seconds per railcar inspection.[116] Reduced or inadequate inspection times have the potential to adversely affect the quality of an inspection program. While the evidence available from the East Palestine investigation does not support a determination of whether mechanical inspection time goals contributed to the number of unreported defects on train 32N, the subject remains of interest to the NTSB and will be further examined as appropriate as part of the NTSB's special investigation into NS's organization and safety culture.

2.2.4 Bearing Failure Detection

The NTSB reviewed surveillance camera images along train 32N's route and data from the last three HBDs it traversed before derailing. (See figure 29.) The first of

[116] NTSB Investigative Hearing Transcript, Day 2, pp. 263–5.

these detectors, located in Sebring, Ohio, and about 30 miles west of the derailment site, did not record any bearing temperatures high enough to trigger an alert or alarm. Surveillance cameras in Sebring, Ohio, captured images of the train, and no anomalies were noted in the images.

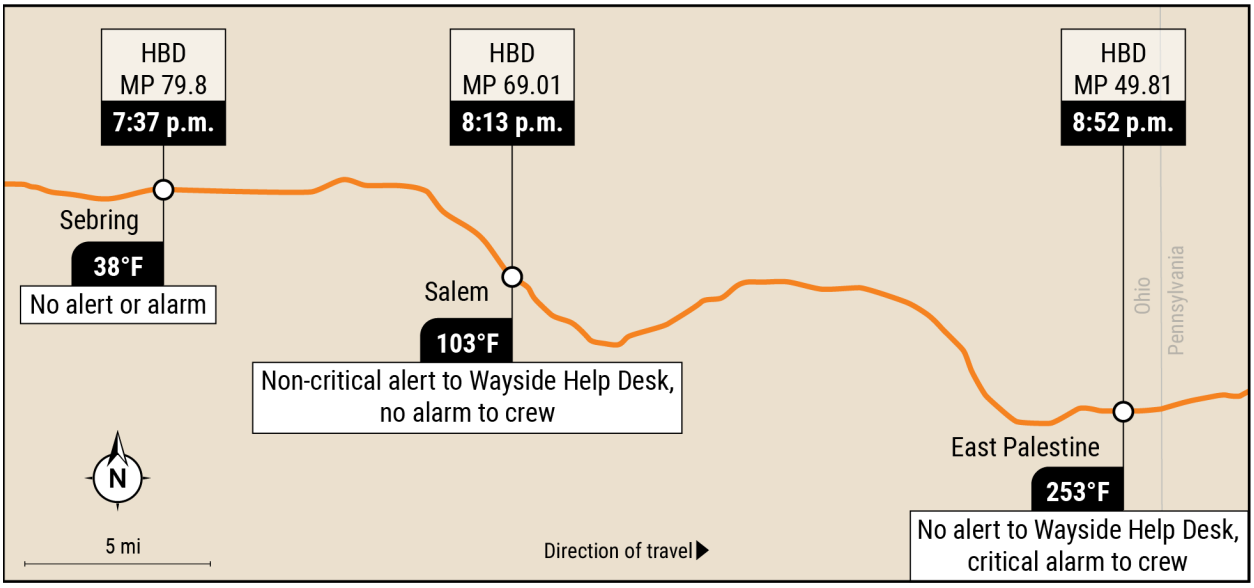


Figure 29. Summary of HBD temperature measurements, alerts, and alarms.

The first clear indications of bearing deterioration were captured by surveillance cameras in Salem, Ohio, about 19 miles from the derailment site. Images from these cameras showed a fire on the L1 bearing of the hopper car.

Shortly after the train passed the field of view of these surveillance cameras, it traversed an HBD in Salem, Ohio, which recorded a temperature 103°F above ambient on the L1 bearing of the hopper car. This measurement was below the 170°F threshold that would have triggered an alarm broadcast to the train crew, which remained unaware that a bearing was showing unusual behavior. The measurement met the NS temperature criteria to trigger a non-critical alert at the NS ATC Wayside Help Desk. The non-critical alert identified the L1 bearing as needing continued monitoring: a trend analysis based on data from additional HBDs. Because train 32N derailed before it finished traversing the next HBD (in East Palestine), this trend analysis could not take place. The analyst on duty also did not see the alert from the Salem HBD because he was working to resolve other, higher-priority alerts, but immediately seeing the Salem HBD alert would not have prevented the derailment; the train derailed before the analyst would have been required by NS procedures to take any actions.

The HBD in Salem, Ohio, was configured to take its temperature readings from the inner edge of the bearing cup. This configuration is intended to reduce the likelihood that railcar components will obstruct the HBD's view of the bearing. However, changes in temperature take time to equalize across different bearing components, meaning that as a bearing begins to overheat, the interior of a bearing may be hotter than the exterior, and two points on the exterior may differ in temperature. The fire visible in surveillance camera images indicates that at least the outer edge of the bearing was hot enough to result in the combustion of grease or another flammable substance. Part of the bearing was therefore hotter than the 103°F temperature the HBD measured at the inner edge of the bearing cup. The temperature measurement, which was likely lower than the bearing's actual highest temperature, resulted in a non-critical alert for a bearing that burned off and separated less than 20 miles later. The NTSB concludes that the non-critical alert transmitted by the Salem, Ohio, HBD did not reflect the true temperature and failing condition of the L1 wheel bearing.

It is unclear whether a different HBD design or configuration would have provided a more accurate measurement of the bearing's temperature. The NTSB's review of existing research on HBDs found that variations in railcar design pose significant challenges to measuring temperatures near the center or outer edge of the bearing cup; parts of the railcar's trucks can obstruct the HBDs field of view (Carter and Clasby 2017). Further, measuring a different or larger surface area of the bearing cup does not ensure that the measurement will include the hottest part of the bearing, which may be inside the bearing or outside the HBD's field of view. As discussed during the Investigative Hearing, changes in the exterior temperature of a bearing tend to lag behind changes in the interior temperature.[117] The NTSB concludes that a failing wheel bearing's actual internal temperatures will likely exceed external temperatures measured and reported by an HBD, and this limit on HBD accuracy is inherent in how current HBDs and railcar trucks are designed.

Following the non-critical alert transmitted by the Salem HBD, NS standard operating procedures required the employee staffing the Wayside Help Desk to monitor the L1 bearing as it traversed additional detectors and to determine whether the temperature trend required further action. However, the distance between the HBDs and the speed of bearing degradation were such that, by the time the train reached the next HBD, about 19 miles away in East Palestine, the L1 bearing was already failing. Its exterior temperature measurement had reached at least 253°F, more than 50°F above the critical bearing alarm threshold. The Wayside Help Desk

[117] NTSB Investigative Hearing Transcript, Day 2, pp. 219–20.

procedures did not create an opportunity to notify the crew of a problem before the East Palestine HBD broadcast a critical alarm. The bearing separated less than a minute later, as the crew began to stop the train. The NTSB concludes that the combination of NS standard operating procedures that required only continued monitoring for non-critical bearing alerts, the limited ability of HBDs to measure a bearing's actual internal temperature, and the distance between detectors did not give the train's crew adequate warning to stop the train before the suspect bearing failed and caused the derailment.

At the NTSB's Investigative Hearing, the NS Assistant Vice President of Signals and Communications testified that NS based its alert and alarm temperature thresholds on its own experience with HBDs and AAR standards.[118] However, as the AAR Senior Vice President of Safety and Operations testified, the AAR definition of an overheated bearing is based on what makes a railcar repair billable to the railcar owner or lessor, and railroads choose their own temperature thresholds and operating procedures based on their experience balancing between preventing bearing failures and avoiding unnecessary stops.[119] It is unclear whether the AAR definition of an overheated bearing is an appropriate temperature threshold for a wayside defect detection system intended to prevent accidents, especially when some current detector technologies—such as the HBDs relevant to the East Palestine derailment—may not accurately measure a bearing's maximum temperature.

To determine whether NS's use of wayside bearing defect detectors was representative of general industry practice, the NTSB requested information from all the Class I railroads about their use of wayside bearing defect detectors. All six Class I railroads responded, and the results are summarized in table 7. All six Class I railroads reported using HBDs and ABDs, but they varied in alarm criteria, wayside equipment inspection and maintenance intervals, detector spacing, and plans for future deployments of HBDs and ABDs. The available information also described HBD deployment in terms of "average" spacing between detectors, which may mask additional variation. Depending on the exact locations of the HBDs, the average spacing may not be the typical spacing, and the maximum distance between HBDs may differ dramatically from the average. In the East Palestine derailment, the three HBDs of interest were an average of about 15 miles apart, but the interval between the Salem HBD and East Palestine HBD was about 19 miles, and the train derailed while traversing the East Palestine HBD. The maximum distance between detectors is

[118] NTSB Investigative Hearing Transcript, Day 2, pp. 211–13.

[119] NTSB Investigative Hearing Transcript, Day 2, pp. 215–16.

therefore a useful metric in evaluating wayside bearing defect detection systems, but the current typical maximum is unclear.

The AAR does have recommended practices for HBD installation on key routes in its Circular OT-55-R, which specifies wayside defect detector spacing of 40 miles or less or "an equivalent level of protection based on improvements in technology" (AAR 2024a). However, the HBDs traversed by train 32N shortly before the derailment met this criterion, and the bearing that led to the derailment went from below the alert threshold to separated in about 30 miles. Further, this maximum applies only to key routes, and the option to install an "equivalent level of protection" invites the question of what level of protection a 40-mile maximum spacing provides compared to alternatives.

The NTSB acknowledges the positive impact of proven technologies such as HBDs and the growing use of newer technologies such as ABDs. However, the variations in wayside detector alarm criteria, configurations, and maintenance indicate that the rail industry has not reached a consensus on the optimal use and upkeep of wayside bearing defect detection systems. An AAR definition of an "overheated bearing" exists, but it relates to billing for repairs, not directly to safety or wayside detection. As the East Palestine derailment demonstrates, the successful use of wayside bearing defect detection systems depends on how these systems are implemented, including alert and alarm criteria that provide train crews with an opportunity to respond to overheating bearings before they fail. The performance of the HBD in Sebring, Ohio, also illustrates the importance of understanding each detection technology's limitations when planning and operating a wayside bearing defect detection system. Research into these subjects would provide a basis for a more informed approach to the use of bearing defect detection systems. The NTSB concludes that without research into how differences in alert and alarm thresholds and varied distances between detectors affect the performance of wayside bearing defect detection systems, railroads and regulators lack the information to determine what changes would produce significant safety improvements.

According to the database maintained by the FRA's Office of Safety Analysis, 69 of the 896 FRA-reportable rail accidents (7.7%) attributed to mechanical or electrical failures from 2020 through 2023 were caused by overheated wheel

bearings, making overheated wheel bearings the single most common mechanical or electrical cause of accidents.[120] The accident count by year is summarized in table 15.

Table 15. Overheated bearing accidents by year.

Accident Type	2020	2021	2022	2023
All mechanical and electrical	234	204	245	213
Overheated journal bearing	17	21	11	20

Because overheated wheel bearings are the single most common mechanical cause of accidents, the NTSB is concerned by the lack of industry consensus on a minimum standard for system configurations and related practices, including alert and alarm thresholds and operating rules. Further, the NTSB has identified additional bearing defect detection technologies undergoing testing and development, such as railcar-mounted bearing defect detectors, that may not share limitations specific to HBDs (Tarawneh, Montalvo, and Wilson 2021; Pams et al. 2024). The FRA has experience in fostering railroads' development and adoption of advanced safety technology, notably PTC, and is positioned to identify ways of improving bearing defect detection. Therefore, the NTSB recommends that the FRA research the effectiveness of current bearing defect detection systems, identify minimum standards to protect railroad personnel and the public, and make public the results of this research. In addition to experience and expertise in working with industry partners, the FRA has the regulatory authority to set and enforce minimum safety requirements, and railroads must meet or exceed the level of safety provided by FRA regulations. The NTSB recommends that the FRA use the results of the research described in R-24-2 to develop and establish minimum requirements for bearing defect detection systems, including criteria for bearing alert and alarm thresholds and maximum distances between wayside detectors.

However, even appropriate alert and alarm criteria are insufficient to protect safety if no alert is transmitted because of technical issues or if railroads do not respond effectively to alerts and alarms. In the months after the East Palestine derailment, the NTSB investigated two accidents in which a train traversed an HBD

[120] (a) The database counts only journal bearings, the type involved in the East Palestine derailment. (b) The FRA database is searchable and accessible here: https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Query/TrainAccidentsFYCYWithRates.aspx. (c) *Mechanical and electrical* are treated as a single category in this database. For context, the next three most common causes were worn flanges (5.9%), broken or defective knuckles (4.8%), and missing coupler detainer pins or cross keys (3.5%).

that detected an overheating bearing, but the wayside bearing defect detection system did not prevent a derailment from occurring shortly afterward.

The first derailment occurred on May 10, 2023, when NS freight train 14M in New Castle, Pennsylvania, derailed about 45 minutes after starting to traverse an HBD.[121] The HBD recorded a temperature of 253°F on the east-side bearing of the lead axle of the 164th railcar in the consist (line 167, a hopper car), a temperature high enough to trigger a critical alarm and critical alert, both of which require immediately stopping the train under NS operating rules. The NTSB reviewed radio transmission records and confirmed that the HBD transmitted a critical alarm. However, the NTSB's review of the locomotive data records showed that the alarm was not broadcast over the in-cab speakers, and the crew of train 14M was not warned that a bearing had overheated.[122] The NTSB also reviewed the Wayside Help Desk data logs and found that the desk did not receive an alert about the overheated bearing.

The NTSB's on-scene examination of the HBD determined that during maintenance, two transducers—critical components of the HBD that enable it to detect passing trains and count axles—had been removed and replaced in the wrong positions. The incorrectly positioned transducers prevented the HBD from communicating information to the Wayside Help Desk in a way the system could interpret and display. Even though the HBD correctly identified an overheated bearing, a pair of communication failures (one related to the improperly replaced transducers, the other of unknown causes) prevented the wayside bearing defect detection system from warning the crew of train 14M of a failed bearing.

The New Castle derailment illustrates the importance of test and inspection procedures adequate to identify compromised detectors. Currently, these practices are unregulated; the FRA has published guidance on wayside detection systems, but it has stopped short of imposing requirements (FRA 2019). However, railroads rely on wayside bearing defect detection systems for safe operation—much like signal systems, which the FRA regulates under 49 *CFR* Parts 235 and 236. Unlike the regulations for signal systems, there are no specific regulations for wayside bearing defect detectors prescribing intervals or standards for installation, inspection, testing, calibration, or general maintenance. The NTSB concludes that regulatory

[121] Visit ntsb.gov to find additional information in the public docket for this investigation (case number RRD23FR011).

[122] Available evidence did not support a determination of why the alarm was not broadcast over the in-cab speakers.

requirements for the installation, inspection, and maintenance of wayside bearing defect detectors would protect the reliability of these devices and improve the safety of railroad operations. Therefore, the NTSB recommends that the FRA establish requirements for the installation, inspection, and maintenance of wayside bearing defect detectors to protect the reliability of these devices and improve the safety of railroad operations.

The NTSB also investigated the July 6, 2023, derailment of an NS coal train near Elliston, Virginia.[123] In this accident, an HBD broadcast a critical alarm for a bearing on the lead axle of a the 71st railcar (line number 74, a gondola car), indicating a measured temperature of at least 170°F above ambient. When interviewed by the NTSB, the crew described how they stopped the train, confirmed a hot bearing using a temperature indicator stick, and communicated this confirmation to the Wayside Help Desk.[124] The Wayside Help Desk analyst directed them to set out the railcar for inspection. A dispatcher authorized the crew to move the train about 13 miles to a siding before setting out the suspect railcar for inspection. The derailment occurred during this movement while the train was traveling about 25 mph.

As a result of this derailment, NS issued an operations bulletin imposing additional speed and distance limits on moving equipment with suspect bearings. These improvements are confined to NS, and as indicated by the NTSB's survey of Class I railroads, operational responses to bearing alerts and alarms significantly vary by railroad. No publicly available research exists to support comparison of these varied responses, evaluate their effectiveness, and drive continuing improvements. The NTSB concludes that because the effectiveness of wayside bearing defect detection systems depends on appropriate operational responses, and because the rail industry has yet to arrive at a consensus standard for these responses, research is necessary to determine what operational responses to bearing alerts and alarms are sufficient to prevent bearing-related accidents. The NTSB also recommends that the FRA use the results of the research described in R-24-2 to develop and establish rules governing railroads' operational responses to bearing alerts and alarms.

[123] Visit ntsb.gov to find additional information in the public docket for this investigation (case number RRD23FR013).

[124] A *temperature indicator stick* is made of material that melts instantly when the surface it is touching reaches a certain temperature—in this case, 169°F.

2.2.5 Accident Bearing Failure Analysis

Railcar bearings can fail in several ways. Research has found that age-related bearing failures are the most common and can result from spalling, uneven loading, and lubrication breakdown, while the rarer non-age-related failures typically result from loose components, high loading, and water ingress (Iwand 2021).[125]

However, damage to the recovered components of the L1 bearing was too severe to allow laboratory determination of why the bearing burned off. Any traces of fatigue, loose components, loss of lubrication, water ingress, or other root causes that can eventually lead to bearing failure were erased by the high temperatures of the burn-off and subsequent fire exposure. While meteorological and CLM records indicate that the hopper car was subjected to severe weather in 2016 and 2017—including significant rainfall from Hurricane Harvey—the bearing continued in service for more than 5 years after Hurricane Harvey, and there is no evidence of the bearing showing signs of failure before the derailment sequence described in this report. The available evidence does not indicate that the bearing failed as a result of water ingress or a weather event, and the root cause of the bearing's failure remains unclear.

Lack of usable physical evidence following bearing burn-off is not an isolated problem. The NTSB also recovered burned-off bearing components during our investigation of the New Castle and Elliston derailments and found that both failed bearings had been reconditioned, but the components were too severely damaged to support laboratory determination of why either bearing burned off. The NTSB's investigations into the East Palestine, New Castle, and Elliston derailments all encountered the same general issue: a bearing failure significant enough to lead to an accident tends to destroy the evidence of its underlying cause. Testing has found that a bearing failure can happen rapidly; a bearing can go from below an alarm temperature to seized (no longer able to rotate as designed) in less than a minute (Leedham 1992). The accompanying increase in temperature is rapid enough that it is unlikely to be arrested in time to preserve useful forensic evidence about underlying causes even if the overheated bearing is detected and removed from service. Damaged bearings that remain in service long enough to burn off and cause a derailment are subjected to even more heat and friction. Examination of individual

[125] *Spalling* is the separation of flakes of chips of material, usually as a result of subsurface fatigue.

bearings after bearing-related accidents is unlikely to provide useful information about preventing or predicting bearing failures.

Lacking physical evidence from the bearings sufficient to determine why these three specific bearings burned off, the NTSB attempted to explore common factors across all three bearings: all were on freight cars, all were on lead axles, and all had been reconditioned. To establish a baseline for whether these factors influence bearing failure rates, a railroad, investigator, or regulator would need access to a database of detailed railcar bearing statistics. However, there is no current database that records bearing manufacturer, railcar type, mileage at failure, bearing position, new or reconditioned status, service type, and other factors that could plausibly affect bearing performance. Such a database would support efforts to identify trends in bearing failure and underlying commonalities. For example, a group of representatives of federal and state regulatory agencies and the natural gas and plastic pipe industries created The Plastic Pipe Database Committee, which maintains a database on the performance of plastic piping materials. The database is administered by the American Gas Association and is intended to support understanding of leak frequency and causes by collecting as much information as possible from a representative cross-section of the natural gas industry (Plastic Pipe Data Collection Committee 2015).

The NTSB is concerned that in the absence of comparable bearing data from across the rail industry, railroads, investigators, and regulators lack statistical baselines to help sort causally relevant factors from irrelevant ones. For example, all three burned-off bearings in the East Palestine, New Castle, and Elliston derailments were reconditioned. However, thousands of reconditioned railcar bearings operate without incident every day. Without additional information, railroads, investigators, and regulators cannot reliably identify factors of interest.

The practical difficulties of obtaining useful physical evidence from individual destroyed bearings invite two approaches to gathering more information about causes of bearing failure. First, consistent and detailed collection of information about bearings involved in accidents would, over time, allow investigators to identify common factors disproportionately represented in accident bearing failures (certain types of railcars or service, reconditioning, and maintenance intervals are plausible possibilities). Second, bearings replaced as part of scheduled maintenance or in response to early defect detection (such as by ABDs) provide opportunities to collect physical evidence or record background information regarding risk factors for unusual deterioration that could cause a bearing to fail sooner than expected. The NTSB concludes that a database capturing bearing failure and replacement information could help identify what factors pose an increased risk of burn-off so that

railroads, regulators, and investigators can better address bearing-related safety issues. The AAR already maintains a database of railcar billing records, which includes information about bearing replacements and supports industry research about bearing defects and defect detection. This database provides a starting point and potential model for future efforts. The NTSB recommends that the AAR develop a database of bearing failures and replacements and make it available to railroads, regulators, and investigators to help determine and address failure risk factors.

2.3 Early Emergency Response

The early emergency response at East Palestine focused on containing the fire, determining what hazardous material could have been released, protecting residents near the derailment site, and starting mitigation efforts for tank cars exposed to fire conditions. The EPFD and EPPD were the first agencies on the scene shortly after the derailment, about 9:00 p.m. on February 3, and the EPFD deputy fire chief served as incident commander for the first 5 hours of the response. After 11:00 p.m. on February 3, NS personnel and contractors arrived on the scene and began to provide expertise to emergency responders. About 2:00 a.m. on February 4, the EPFD fire chief assumed the incident commander role, and over the following days, response efforts shifted focus to the five derailed VCM tank cars.

The NTSB's investigation into the early emergency response identified safety issues with the initial deployment of firefighters, the transmittal of consist information, and the legibility of placards on hazardous materials tank cars.

2.3.1 Initial Deployment of Firefighters

The EPFD responded to 911 calls and reached the accident scene within 10 minutes of the derailment. During this stage of the emergency response, EPFD firefighters did not have access to the consist of train 32N but had observed tank cars among the derailed and burning equipment. The applicable guidance from the 2020 ERG was the "Mixed Load / Unidentified Cargo" entry for a fire involving tank cars, which advised a half-mile (or 2,640-foot) preliminary isolation and evacuation of the scene, noted the need for self-contained breathing apparatuses, and cautioned that materials may react violently with extinguishing agents, including water (PHMSA 2020). The entry recommended the use of water to cool containers but cautions against allowing water to enter those containers.

The EPFD deputy fire chief set up a command post at a business about 400 feet from the burning train, more than 2,000 feet inside the ERG-recommended

isolation and evacuation zone. Without referencing the 2020 ERG, volunteer firefighters approached the pileup and began applying water to contain the fire, which grew rapidly. Firefighters were equipped with self-contained breathing apparatuses, but without more information about the train's consist, the incident commander had no way of determining whether this personal protective equipment was adequate for operations within the half-mile isolation zone. The NTSB concludes that, while the EPFD deputy fire chief and other volunteer firefighters acted in good faith to protect their community, the initial emergency response did not conform to ERG guidance for fires involving tank cars and unknown materials; both the proximity of the first command post to the fire and the use of manned hoses near a fire involving unknown materials placed these firefighters at unnecessary risk.

Pre-certification volunteer firefighter training in Ohio is limited by statute under State of Ohio Revised Code Section 4765.55. A training course for a Volunteer Firefighter certificate may not exceed 36 hours. According to guidance distributed by Ohio EMS, the foundational volunteer firefighter course does not permit participation in training involving hazardous environments because of this time constraint (Ohio EMS 2023). The basic 36-hour training course does not meet the NFPA 1010 standard for professional firefighters (or the NFPA 1001 standard in place at the time of the derailment), which requires a minimum of 160 hours of training and includes job performance requirements not addressed in the volunteer course. Fire chiefs or authorities having jurisdiction are responsible for providing additional training for volunteer firefighters expected to operate in hazardous environments. However, the statute does not specify minimum standards, specific courses, or demonstration of skills or knowledge to ensure that additional training adequately prepares firefighters for hazardous environments. The EPFD deputy fire chief had completed two additional courses in hazardous materials awareness and operations in 2022, but the response in East Palestine still deviated from recommended practices by placing firefighters near burning tank cars and establishing a command post a few hundred feet from a fire involving unknown hazardous materials.

Statutory requirements and training courses for professional firefighters in Ohio meet the relevant NFPA 1010 standard. However, the NTSB is concerned that volunteer fire departments in the state of Ohio are called on to respond to the same incidents as their professional counterparts, as seen in this accident, but that volunteers may have only a fraction of the training Ohio requires for professional firefighters: 36 hours instead of at least 160 hours. Further, the Ohio statute significantly limits initial training for volunteers and has resulted in a prohibition on training in hazardous environments. While the statute instructs local authorities to provide additional training, it establishes no clear requirements or guidance on what

additional training is appropriate. The EPFD personnel who responded to the derailment and fire had varying training levels related to hazardous materials that ranged from no training at all to technician-level training, but the NTSB has not found evidence that their roles in the initial emergency response were tailored to their individual training levels. The NTSB concludes that the state of Ohio's statutory requirements for volunteer firefighter training were insufficient to support a safe emergency response to the East Palestine derailment led by a volunteer fire department. Therefore, the NTSB recommends that the state of Ohio amend its firefighter training statute and revise its volunteer firefighter certification standards to meet the NFPA 1010 standard for professional firefighters.

The National Volunteer Fire Council (NVFC) represents the interests of the volunteer fire, EMS, and rescue services. The International Association of Fire Chiefs (IAFC) represents the interests of emergency responders with a focus on leaders. The International Association of Fire Fighters (IAFF) is a labor union representing firefighters, emergency medical workers, and rescue workers in the United States and Canada.[126] These organizations provide resources, programs, education, and advocacy for emergency responders and are positioned to encourage adoption of standards to protect their members' safety, including identifying trainings and sources of funding. Thus, the NTSB recommends that the NVFC, IAFC, and IAFF advise their members of the circumstances of the East Palestine derailment and fire, identify fire departments whose personnel are not trained to the NFPA 1010 standard for professional firefighters, recommend that these departments adopt training that meets this standard, and inform them of funded training opportunities available through private, state, and federal programs. The NTSB also recommends that the NVFC identify barriers to adequate fire and emergency response training for volunteer firefighters, particularly for situations where hazardous materials are present, and publish actions states, municipalities, and the private sector can take to provide the flexibility necessary for volunteer firefighters to obtain training.

2.3.2 Communication and Consist Information

The NS Cleveland East dispatcher confirmed that the crew of train 32N had experienced an emergency about 8:56 p.m. Emergency responders made their first request for consist information about 9:04 p.m. by calling the NS dispatch center in Atlanta, Georgia, which did not provide the requested information at that time. Consist information did not reach emergency responders until shortly before

[126] Further information is available on these organizations' websites, accessible at https://www.nvfc.org/about/, https://www.iafc.org/, and https://www.iaff.org/.

10:00 p.m., when the NS regional hazardous materials manager emailed the consist to the CCEMA director while driving to the scene. About the same time, phone calls were taking place between NS personnel, the EPFD fire chief, and the incident commander. Through these calls, the incident commander became aware of two hazardous materials in the consist: benzene and VCM. After 10:00 p.m., consist information spread piecemeal through responding agencies and personnel. In interviews with the NTSB, emergency responders reported issues with radio interoperability and characterized the overall incident command as fractured or chaotic. Not until about 11:00 p.m., at the recommendation of the Ohio State Patrol, did the EPFD deputy fire chief, acting as the incident commander, issue a 1-mile evacuation—the distance recommended by the 2020 ERG for fires involving tank cars transporting VCM or isobutylene.[127] About the same time, NS personnel and contractors began arriving on the scene and recommending that firefighters redeploy to safer distances. Firefighters suspended fire suppression activities and relocated to safer positions around midnight on February 4. As part of the movement to safer locations, the deputy fire chief moved the command post to the combined police and fire station about a mile from the derailment site.

The emergency response effort involved many agencies from multiple jurisdictions and three states. The two hazardous materials teams dispatched to the scene—the East Liverpool and Beaver County teams—were unable to establish radio communications with the incident commander or other EPFD personnel, and concerns about radio communication led the Beaver County director of emergency services to share hazardous materials information with Beaver County fire departments directly in the expectation that radio issues might otherwise prevent them from receiving that information. The East Liverpool fire chief addressed the lack of radio interoperability by assigning personnel from his own team to stay in the command post so that his radio communications could reach other personnel stationed there.

These approaches to overcoming lack of interoperability reflect ingenuity and awareness of risk in the face of a challenging situation. However, reliance on face-to-face communications and lack of common channels to support interoperability reduce the efficiency of information sharing. The NTSB concludes that because there were not common radio channels between all responding agencies, the emergency response lacked efficient coordination.

[127] Neither VCM nor isobutylene had been released at this time. The ERG guidance applies to a fire involving tank cars carrying these materials; the recommended isolation and evacuation distances apply even if material is not being released or fueling the fire.

Interoperability is a goal set by the 2019 NECP, the national roadmap for ensuring effective communications under NIMS. The standards and methods described in the 2019 NECP and integrated into the overall NIMS doctrine remain the preferred approach to ensuring efficient, effective communication between emergency responders, and the fundamentals of interoperability are addressed in the associated training courses. CISA maintains a regularly updated list of federal financial assistance programs intended to support investment in emergency communications.[128]

The NTSB is concerned that complete and accurate consist information was not quickly and clearly communicated to the incident command after East Palestine dispatch contacted NS by phone and requested it. The slow provision of consist information to a single point of contact, followed by partial information provided over the phone to the incident commander, and then the slow distribution among responding agencies, delayed the evacuation to the ERG-recommended distance and protracted the time firefighters spent responding to an unknown set of hazards. Slow transmittal and distribution also delayed the Ohio State Patrol's recommendation to the incident commander that the shelter-in-place order be replaced by an evacuation, the response recommended in the 2020 ERG. The NTSB concludes that the delayed transmittal of consist information by NS to emergency responders needlessly increased the time emergency responders spent near the derailment pileup and delayed the evacuation order, resulting in unnecessary and increased exposure of emergency responders and the public to postderailment hazards.

In response to this accident, NS began integrating its emergency response notification process with RapidSOS, a digital platform designed to provide emergency responders with real-time consist information and notify NS of 911 calls reporting track emergencies in NS's rail network. This change is intended to make consist information available to first responders sooner and allow NS to begin responding to emergencies as soon as 911 calls are made. However, these changes may not address the specific problem present at East Palestine: an incoming request for information from a dispatch center remaining unanswered. The NTSB recommends that NS review and revise its procedures to immediately provide emergency responders with an accurate copy of the train consist upon becoming aware of an accident. The NTSB recommends that CCEMA adopt a policy to, upon receipt of a train consist, immediately provide it to the incident commander and all

[128] The complete list is available here: https://www.cisa.gov/safecom/emergency-comms-grants-list.

appropriate response agencies and departments. The NTSB also recommends that CCEMA update its Emergency Operations Plan, Hazardous Materials Response Plan, and Hazard Mitigation Plan, as appropriate, with lessons learned from the East Palestine derailment and fire, including, at a minimum, coordination among response agencies, communications, requests for and distribution of the train consist, staging and availability of equipment and other resources, and training for emergency responders.

The NTSB has investigated other accidents involving consist availability, including the July 10, 2005, collision and derailment of two Canadian National Railway Company freight trains in Anding, Mississippi, that resulted in four train crewmember fatalities, the release of 15,000 gallons of diesel fuel that burned for about 15 hours, and the evacuation of 100 residents (NTSB 2007). Seven tank cars containing hazardous materials residue derailed. The NTSB found that the railroad did not have the capability to provide first responders with consist information for one of the trains after the on-board copy was destroyed, and that this prevented emergency responders from promptly identifying the hazardous materials involved. The NTSB recommended that PHMSA:

> With the assistance of the Federal Railroad Administration, require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train. (R-07-4)[129]

On January 22, 2008, in a response to Safety Recommendation R-07-4, PHMSA indicated to the NTSB that it was examining (1) ways to improve the availability of accurate and immediate information for emergency responders on the scene of an accident and (2) strategies for enhancing emergency response planning and training efforts. Additionally, PHMSA indicated that it was evaluating the emergency response issues raised in the safety recommendation and the federal, state, and local government and industry programs intended to address those issues. Based on PHMSA's communications, the NTSB classified Safety Recommendation R-07-4 Open—Acceptable Response.

On March 2, 2012, we reiterated Safety Recommendation R-07-4 as a result of our investigation of the June 19, 2009, derailment of a Canadian National Railway

[129] Safety Recommendation R-07-4 is currently classified Open—Unacceptable Response.

Company ethanol unit train in Cherry Valley, Illinois (NTSB 2012b).[130] Our investigation determined that the original consist for the train had only 3 of the 76 cars in their proper positions. Because this was a unit train, all loaded tank cars were transporting ethanol. We found that:

> The inaccurate train consist carried by the crew did not affect the emergency response to this accident; however, had a mixture of hazardous commodities been involved, the inaccurate consist information could have hampered the response effort or put the safety of emergency responders and others at risk. (NTSB 2012b)

On September 6, 2013, PHMSA published an advance notice of proposed rulemaking, titled "Hazardous Materials: Rail Petitions and Recommendations to Improve the Safety of Railroad Tank Car Transportation" (78 Fed. Reg. 54849). In our December 5, 2013, response, we noted our ongoing investigation of the November 30, 2012, derailment of a Conrail freight train that released VCM in Paulsboro, New Jersey. The NTSB convened an Investigative Hearing on July 9–10, 2013, where emergency responders testified that their response actions were hindered by the lack of timely and accurate train consist information. Noting both the positive steps proposed by PHMSA and this hearing testimony, we commented:

> However, we are very disappointed that Safety Recommendation R-07-4 has remained open for more than 5 years. The NTSB is encouraged by the PHMSA Hazardous Materials Automated Cargo Communications for Efficient and Safe Shipments program (HM-ACCESS) and notes that PHMSA has instituted a paperless hazard communication pilot program to evaluate the feasibility and effectiveness of paperless electronic communication systems. Pending completion of the recommended action, the NTSB has classified Safety Recommendation R-07-4 "Open–Acceptable Response."

In our investigation of the Paulsboro derailment, we determined that the train consist and ERI were not provided to the incident command for more than 3 hours (NTSB 2014c). In our investigative report, we found that:

> During the early hours following the accident, Consolidated Rail Corporation personnel did not immediately provide critical hazardous

[130] (a) A *unit train* is a train transporting a single commodity. (b) Other aspects of this accident are discussed in more detail in section 2.4.2.2.

materials information to emergency responders that could have assisted in executing a safer response to this accident. (NTSB 2014c).

We therefore reiterated Safety Recommendation R-07-4. In our August 26, 2014, letter to PHMSA, we noted that we believed available technologies could and should be used to supplement the paper-based train consist for improving the dissemination of chemical hazard information to emergency responders.

On May 23, 2023, we sent a letter to PHMSA regarding the lack of an NPRM or final rule requiring real-time consist notifications and observing that other than a January 19, 2017, advance notice of proposed rulemaking that had not led to a final rule, PHMSA had not taken action to address Safety Recommendation R-07-4 (82 Fed. Reg. 6451). We therefore classified Safety Recommendation R-07-4 Open—Unacceptable Response.

On June 27, 2023, partially in response to this safety recommendation and following the East Palestine derailment, PHMSA issued an NPRM titled "Hazardous Materials: FAST Act Requirements for Real-Time Train Consist Information," proposing amendments to its rules for hazard communication. The proposed rule would require Class I railroads to promptly provide consist information to nearby emergency responders in the event of a release or suspected release of hazardous materials.

On August 23, 2023, the NTSB commented on the proposed rule.[131] While pleased to see this NPRM, we noted three concerns: the proposed rule does not define "promptly"; notification depends on "the release or suspected release" of hazardous materials, not only an accident or incident involving a train carrying hazardous materials; and one version of the proposed rule would apply only to Class I railroads. Waiting to determine whether a release is "suspected" rather than merely possible could slow consist notification. Further, non-Class I railroads can experience hazardous materials releases. For example, the NTSB investigated a release involving a Class II railroad in June 2023 in Reed Point, Montana, when a Montana Rail Link freight train derailed 15 hazardous materials tank cars and released hazardous materials (molten sulfur and asphalt petroleum liquid) into the Yellowstone River.[132]

[131] The full text of the NTSB's comments is available here: https://www.regulations.gov/comment/PHMSA-2016-0015-0023.

[132] For more information about this accident, refer to the docket for this investigation: https://data.ntsb.gov/Docket/?NTSBNumber=HMD23LR002.

On June 24, 2024, PHMSA published Final Rule HM-263, Hazardous Materials: FAST Act Requirements for Real-Time Train Consist Information, requiring that any Class I or II railroad transporting hazardous materials immediately contact the local PSAP and provide consist information when a train carrying hazardous materials is involved in an accident that will require a response from local response agencies (81 Fed. Reg. 52926). The final rule specifies that the consist information must be provided electronically in a form the PSAP can readily access. Class III railroads must either follow the same requirements as other railroads or develop their own plans for alternative means of providing consist information to local PSAPs or emergency response agencies. If using an alternative means, Class III railroads must prepare written plans and conduct annual tests to demonstrate that their plans are effective. Class I railroads have 1 year to comply with the new rule; Class II and III railroads have 2 years to comply.

We recognize that PHMSA has addressed the concerns we identified in our NPRM comments by creating a final rule that requires immediate consist notification following an accident, addresses all rail accidents involving hazardous materials trains that affect local response agencies, and applies to all railroads that transport hazardous materials. The NTSB concludes that PHMSA's Hazardous Materials: FAST Act Requirements for Real-Time Train Consist Information addresses the safety concerns of Safety Recommendation R-07-4. The NTSB therefore classifies Safety Recommendation R-07-4 as Closed—Acceptable Action.

2.3.3 Placard Legibility

When a shipping name or identification number cannot be associated with a tank car or other package during an emergency response, the 2024 ERG (like the 2020 ERG current at the time of the East Palestine derailment) recommends reading the placards from a safe distance to determine what protective measures are appropriate (PHMSA 2024). Under 49 *CFR* 172.519, placards must be capable of withstanding 30 days of exposure to open weather conditions without deterioration or a substantial reduction in effectiveness. The performance standard does not address derailments or fires—circumstances under which emergency responders may need to use placards as instructed by the 2024 ERG.

The derailment of train 32N produced a derailment footprint about 1,200 feet long and comprising a mixture of hazardous and non-hazardous materials tank cars. Even with access to consist information, distinguishing which tank cars contained hazardous materials depended on the legibility of tank car markings, placarding, or accurate assessment of a tank car's original line number. Because the derailment

displaced tank cars from their original order and damaged or obscured markings, placards were the best option for responders to identify hazardous materials and appropriate protective measures. However, as the deputy fire chief reported in interviews with the NTSB, responding firefighters found that placards had been destroyed by fire and could not aid efforts to identify hazardous materials present at the scene. Firefighters continued to operate close to the derailment pileup and fires until NS personnel and contractors advised them to withdraw to a safer distance. Therefore, the NTSB concludes that the vulnerability of tank car placards to fire exposure resulted in illegible placards and hampered emergency responders' efforts to identify hazards. Current federal requirements for placards address normal transportation conditions but do not account for placard survivability during derailments or fire exposure. The requirements for survivability therefore do not adequately account for events where placards may be the sole immediate source of hazard information and will be subjected to fire or other sources of damage. The 2024 ERG notes that this scenario is possible, and it occurred at East Palestine. Placarding requirements should include survivability sufficient to ensure that placards are usable by emergency responders during rail and other transportation emergencies. The NTSB is aware of placard designs, such as placards cut from steel, likely to offer improved survivability under accident conditions compared to tagboard or plastic. The NTSB recommends that PHMSA require that placards be able to survive fires and accidents and remain legible during such emergencies long enough to fulfill their functions as described in the ERG.

2.4 Tank Car Derailment Performance

The derailment involved 27 tank cars of four specifications: DOT-111, AAR-211, DOT-105, and DOT-117. During the derailment and subsequent fire, three DOT-111 tank cars released hazardous materials: ethylene glycol monobutyl ether, 2-ethylhexyl acrylate, and butyl acrylates. During the same period, five DOT-111 tank cars and one AAR-211 tank car released non-hazardous materials: propylene glycol, petroleum lubricating oil, and diethylene glycol.

None of the three DOT-117 tank cars that derailed sustained breaches or released lading during the derailment or emergency response.

Of the six DOT-105 tanks involved in the derailment, one (a tank car transporting isobutylene) did not release lading, was not involved in the vent and burn, and was later transloaded; it was not breached during the derailment or at any time during the emergency response. Postaccident examinations of the five derailed DOT-105 tank cars carrying VCM identified no evidence of impact damage

penetrating into the tank shells. While relative speeds and chaotic movements leading to impacts between railcars cannot be predicted with certainty, the derailment speed itself exceeded the performance standard for tank head puncture resistance systems mandated in 49 *CFR* 179.16, which requires that head shields be capable of withstanding coupler impacts at relative speeds of 18 mph. FRA research has found that a loaded and constrained DOT-105 car constructed of TC128 grade B steel would likely puncture when impacted in its shell mid-section (an area not protected by the head shield) by a coupler-sized object at 14.5–17 mph (FRA 2018).[133] Despite the speed and energies involved in this derailment, the impact damages did not significantly challenge the lading retention capability of the DOT-105 tank cars. Postaccident examinations also identified no evidence of thermal tears.

During exposure to fires in the hours following the derailment, four DOT-105 tank cars released VCM through operation of their PRDs. Days after the derailment, on February 6, these four and one additional DOT-105 released more VCM through intentional breaching during a vent and burn procedure, which will be discussed further in section 2.5. Breaching damage for hazardous materials tank cars is summarized in table 16 (see also section 1.7.2).

Table 16. Summary of breaching damage to hazardous materials tank cars.

Line Number	Tank Car	Specification	Commodity	Amount Released	Primary Source of Release
28	TILX402025	DOT-105	VCM	Entire load	Vent and burn
29	OCPX80235	DOT-105	VCM	Entire load	PRD release, vent and burn
30	OCPX80179	DOT-105	VCM	Entire load	PRD release, vent and burn
31	GATX95098	DOT-105	VCM	Entire load	PRD release, vent and burn
36	SHPX211226	DOT-111	Ethylene glycol monobutyl ether	Entire load	Tank head crack, BOV fully open
38	DOWX73168	DOT-111	2-ethylhexyl acrylate	Partial load	Tank head cracks, tank head puncture
50	UTLX205907	DOT-111	Butyl acrylates	Entire load	Tank head punctures, manway gasket burned away
55	OCPX80370	DOT-105	VCM	Entire load	PRD release, vent and burn

[133] In the associated testing, the tank shell was struck by a 297,000-pound ram car equipped with a 12-inch by 12-inch impactor.

2.4.1 Sources of Released Material

Postderailment examinations of tank cars identified three main sources of released lading: mechanical breaches sustained during the derailment, releases through PRDs, and the vent and burn procedure.

Of the 16 DOT-111 tank cars that derailed, 7 sustained mechanical breaches: 3 hazardous materials tank cars and 4 non-hazardous materials tank cars. One additional non-hazardous material DOT-111 tank car released lading through its top fittings. It is unclear whether the top fittings were compromised by mechanical damage or fire exposure. One of the two AAR-211 tank cars also lost lading, but the source of the release was not reported to the NTSB.[134] Neither AAR-211 tank car was carrying hazardous materials.

The fires eventually involved a variety of ladings and cargos. The first material to ignite was likely butyl acrylates, a Class 3 flammable liquid, released from DOT-111 tank car UTLX205907.[135] Butyl acrylates have a lower flash point (104°F) than any other released material, and the tank likely released its lading rapidly because of large tank head punctures. (See figure 20.) The large pool fire that burned for 2–3 hours in the ditch along the length of the derailment site was likely fueled by butyl acrylates.

The two mechanically breached DOT-111 tank cars transporting combustible liquids (SHPX211226 carrying ethylene glycol monobutyl ether and DOWX73168 carrying 2-ethylhexyl acrylate) are less probable candidates for the fire originator because of their ladings' higher flash points (144°F and 187°F, respectively). These tank cars still presented a greater fire risk than the other mechanically breached tank cars, all of which were carrying liquids that were less likely to produce flammable vapor or had flash points too high to be classified as hazardous materials. Therefore, the NTSB concludes that the postderailment fire likely began with hazardous material released from a mechanically breached DOT-111 tank car, most probably the butyl acrylates released from tank car UTLX205907.

The initial 2- to 3-hour pool fire led to additional fires involving released lading and various freight car commodities such as plastic pellets. These fires exposed

[134] The AAR-211 is generally similar to the DOT-111. Refer to section 1.7.1 for further detail.

[135] A derailment provides numerous potential ignition sources, such as sparks between colliding railcars. The available evidence did not indicate a specific ignition source for this accident.

derailed VCM tank cars to heat, and four of these tank cars released lading through PRD operation as a result of fire exposure.

On February 6, after NS and its contractors told the rest of the incident command that the heated VCM could undergo exothermic polymerization and cause a BLEVE, the incident commander approved a vent and burn procedure that released and ignited the VCM remaining in all five derailed VCM tank cars. The sequence of events that led to the incident commander's decision to vent and burn therefore began with a pool fire initiated by hazardous materials released from at least one mechanically breached DOT-111 tank car. The NTSB concludes that if DOT-111 tank cars transporting combustible and flammable liquids had not sustained mechanical breaches during the derailment, the DOT-105 tank cars transporting VCM likely would not have been exposed to the fire conditions that led to concerns about polymerization and ultimately the vent and burn actions that released additional lading from those five DOT-105 tank cars.

2.4.2 Non-Pressure Tank Cars

2.4.2.1 DOT-111 Derailment Performance at East Palestine

The DOT-111 and DOT-117 specifications are both non-pressure tank cars in widespread hazardous materials service, and the East Palestine derailment involved both specifications. Postderailment examination of the seven mechanically breached DOT-111 tank cars found that five sustained cracks or punctures in tank heads. This type of damage is consistent with impacts to the tank heads, usually between adjacent railcars as railcars' kinetic energy causes them to collide end-to-end (run-in) and leave the track (create a pileup) during a derailment. This indicates that the single most common failure mode for DOT-111 tank cars in East Palestine was tank head protection insufficient to preserve tank integrity. The DOT-117 tank cars subjected to the same derailment were equipped with full-height head shields and remained mechanically intact, underscoring the greater relative vulnerability of the DOT-111 tank cars to mechanical breaches.

2.4.2.2 Past DOT-111 Derailment Performance and Regulatory Action

The DOT-111 specification's vulnerability to breaches during derailments is a well-documented issue. The NTSB calculated release rates for DOT-111 tank cars in a 1991 safety study titled Transport of Hazardous Materials by Rail. The studied period extended from March 1988 through February 1989 and included 45 rail accidents involving 149 tank cars. The study found that 54% of DOT-111 tank cars involved in accidents in 1988–1989 released lading, and that head and shell punctures

accounted for 22% of releases (NTSB 1991). The NTSB observed a similar breach rate at East Palestine: the mechanical and thermal crashworthiness performance of DOT-111 tank cars in East Palestine represents a breach rate of 50% (8 of 16 derailed DOT-111s released lading), and a breach rate of 44% from confirmed mechanical damage.

Hazardous materials releases from DOT-111 tank cars have led to several investigations, safety recommendations, and regulatory actions. On June 19, 2009, Canadian National Railway Company ethanol unit train U70691-18 derailed in Cherry Valley, Illinois (NTSB 2012b). Of the 19 DOT-111 tank cars that derailed, 13 were breached and caught fire, resulting in the release of about 324,000 gallons of ethanol. The postderailment fire resulted in one death, nine injuries, and the evacuation of 600 homes within half a mile of the accident. The NTSB found that the inadequate design of the DOT-111 tank cars contributed to the severity of the accident. The NTSB determined that if enhanced tank head and shell puncture-resistance systems such as head shields, tank jackets, and increased shell thicknesses had been features of the DOT-111 tank cars involved in this accident, the release of hazardous materials likely would have been significantly reduced.

As a result of our investigation of the Cherry Valley derailment and fire, the NTSB issued the following safety recommendations to PHMSA:

> Require that all newly manufactured and existing general service tank cars authorized for transportation of denatured fuel ethanol and crude oil in Packing Groups I and II have enhanced tank head and shell puncture-resistance systems and top fittings protection that exceeds existing design requirements for DOT-111 tank cars. (R-12-5)[136]
>
> Require that all bottom outlet valves used on newly manufactured and existing non-pressure tank cars are designed to remain closed during accidents in which the valve and operating handle are subjected to impact forces. (R-12-6)[137]

The NTSB classified Safety Recommendations R-12-5 and R-12-6 Closed—Acceptable Action on July 12, 2016, after PHMSA's adoption of final rule HM-251, which established the DOT-117 specification and required that tank cars in Class 3 flammable liquids service meet the associated standards if used in HHFTs.

[136] Safety Recommendation R-12-5 is currently classified Closed—Acceptable Action.

[137] Safety Recommendation R-12-6 is currently classified Closed—Acceptable Action.

The DOT-117 specification included the protective features described in the safety recommendations, and we noted in our letter to PHMSA that we commended the decision to require the DOT-117 specification for all Class 3 flammable liquids being transported in HHFTs, not only ethanol and crude oil.

On July 5, 2013, a Montreal Maine and Atlantic freight train with 72 DOT-111 tank cars carrying petroleum crude oil derailed in Lac-Mégantic Quebec, Canada (TSB 2014b).[138] Following a crew change, the train was left unattended on the mainline track. The train began to move uncontrolled on a descending grade, derailing 63 tank cars that released 1.6 million gallons of crude oil that ignited and killed 47 people.

The NTSB issued safety recommendations derived from its participation in the Transportation Safety Board of Canada's (TSB) investigation. Because the Cherry Valley recommendations regarding DOT-111 were recent and still open, our recommendations following Lac-Mégantic addressed safety issues other than the low survivability of DOT-111 tank cars. However, in safety recommendation letters addressed to PHMSA and the FRA, the NTSB noted the potential destructive effects of large numbers of derailed DOT-111 tank cars containing flammable materials and referenced other relevant NTSB investigations, including:

- The July 11, 2012, NS train derailment in a Columbus, Ohio, industrial area, in which three derailed DOT-111 tank cars released about 53,000 gallons of ethanol, with energetic rupture of one tank car in a postderailment fire (NTSB 2014b).

- The October 7, 2011, derailment of an Iowa Interstate Railroad train in Tiskilwa, Illinois, of 10 DOT-111 tank cars, resulting in fire, energetic rupture of several tank cars, and the release of 162,000 gallons of ethanol (NTSB 2013a).

- The October 20, 2006, NS ethanol unit train derailment in New Brighton, Pennsylvania, in which 23 DOT-111 tank cars derailed, fell from a bridge, caught fire, and released more than 485,000 gallons of ethanol (NTSB 2008).

On December 30, 2013, a westbound BNSF Railway train derailed 13 railcars transporting grain in Casselton, North Dakota, fouling the adjacent main track (NTSB 2017d). An eastbound BNSF Railway train with 104 tank cars loaded with petroleum crude oil struck a derailed railcar. The collision derailed 20 DOT-111 tank cars from

[138] The Transportation Safety Board of Canada (TSB) granted the NTSB observer status on the investigation.

the eastbound train; 18 tank cars were breached and released about 476,000 gallons of crude oil that subsequently caught fire. DOT-111 tank cars that released lading included 13 with torn or punctured heads and shells, 3 with thermal tears, 10 with damaged valves and fittings, and 3 that released product from BOVs. The investigation noted that the release was made more severe by the pooling of a flammable liquid that caught fire and caused additional tank cars to fail.

The NTSB adopted its report for Casselton on February 7, 2017, and released it on March 9, 2017, but because another NTSB derailment investigation involving DOT-111 tank cars led to urgent recommendations before the Casselton investigation was complete, the Casselton report classified existing safety recommendations relevant to the DOT-111 specification instead of issuing new ones. This additional investigation concerned the February 16, 2015, derailment of 27 loaded DOT-111 tank cars from a CSX Transportation crude oil unit train in Mount Carbon, West Virginia.[139] The tank cars were constructed to the CPC-1232 standard, but none had thermal protection. During the derailment, two tank cars were punctured and released more than 50,000 gallons of crude oil. Nineteen tank cars became involved in a postderailment pool fire that caused thermal tank shell failures on 13 tank cars that had otherwise survived the derailment. During our investigation, the NTSB collected information about three additional derailments in which 15 other CPC-1232 thermally failed and released thousands of gallons of flammable crude oil.[140]

The NTSB noted that the DOT-111 tank cars (including those manufactured to the CPC-1232 standard) were not required to be equipped with thermal protection systems to protect the tank from exposure to pool or torch fire conditions. In our recommendation letter to PHMSA, the NTSB concluded:

> The thermal performance and pressure relief capacity of bare steel tank cars that conform to current federal and industry requirements is

[139] The NTSB did not issue a separate final report for the Mount Carbon investigation. The associated docket is available at DCA15FR005.

[140] The three reviewed accidents included the February 14, 2015, derailment of a Canadian National Railway Company crude oil unit train that derailed 29 tank cars in a remote area near Gogama, Ontario (TSB 2017b); the March 5, 2015, derailment of a BNSF Railway crude oil unit train that derailed 21 CPC-1232 tank cars south of Galena, Illinois (FRA 2015); and the March 7, 2015, derailment of a Canadian National Railway Company crude oil unit train that derailed 39 CPC-1232 cars near Gogama, Ontario (TSB 2017a).

insufficient to prevent tank failures from pool fire thermal exposure and the resulting overpressurization.

As the result of our investigation, the NTSB issued urgent safety recommendations to PHMSA:

> Require that all new and existing tank cars used to transport all Class 3 flammable liquids be equipped with thermal protection systems that meet or exceed the thermal performance standards outlined in Title 49 *Code of Federal Regulations* 179.18(a) and are appropriately qualified for the tank car configuration and the commodity transported. (R-15-14, Urgent)[141]
>
> In conjunction with thermal protection systems called for in safety recommendation R-15-14, require that all new and existing tank cars used to transport all Class 3 flammable liquids be equipped with appropriately sized pressure relief devices that allow the release of pressure under fire conditions to ensure thermal performance that meets or exceeds the requirements of Title 49 *Code of Federal Regulations* 179.18(a), and that minimizes the likelihood of energetic thermal ruptures. (R-15-15, Urgent)[142]
>
> Require an aggressive, intermediate progress milestone schedule, such as a 20 percent yearly completion metric over a 5-year implementation period, for the replacement or retrofitting of legacy DOT-111 and CPC-1232 tank cars to appropriate tank car performance standards, that includes equipping these tank cars with jackets, thermal protection, and appropriately sized pressure relief devices. (R-15-16, Urgent)[143]

PHMSA published final rule HM-251 before publication of the NTSB's report on the Casselton derailment. Final rule HM-251 created the DOT-117 specification, which includes thermal performance standards, and required the specification's use

[141] Safety Recommendation R-15-14 is currently classified Closed—Acceptable Action.

[142] Safety Recommendation R-15-15 is currently classified Closed—Acceptable Action.

[143] (a) Safety Recommendation R-15-16 is currently classified Closed—No Longer Applicable. (b) The NTSB issued a fourth urgent safety recommendation, R-15-17, to support monitoring the replacement or retrofitting of tank cars. This safety recommendation (currently classified Closed—Acceptable Alternate Action) is less relevant to the current state of the DOT-111 phase out and is omitted from the discussion for brevity.

in HHFTs. However, as the NTSB noted in its letter to PHMSA on July 12, 2016, the final rule did not require thermal protection systems or PRDs on all tank cars in Class 3 flammable liquids service—only tank cars used in HHFTs. Because PHMSA was still drafting regulations associated with the passage of the FAST Act, the NTSB classified Safety Recommendations R-15-14 and R-15-15 Open—Acceptable Response. On August 15, 2016, after passage of the FAST Act, PHMSA issued final rule HM-251C, establishing a phase-out schedule for all tank cars in Class 3 flammable liquids service, including tank cars in non-HHFT trains. The NTSB classified Safety Recommendations R-15-14 and R-15-15 Closed—Acceptable Action in our report on the Casselton derailment (NTSB 2017d). We noted in our March 3, 2017, letter to PHMSA that:

> The FAST Act kept an implementation schedule for continued use of tank cars in crude oil and ethanol service similar to that provided in [PHMSA final rule HM-251], requiring full DOT-117 compliance by May 1, 2025. However, the FAST Act also requires retrofitting or removing from service tank cars transporting other Class 3 flammable liquids in Packing Group I by May 1, 2025, and in Packing Groups II and III by May 1, 2029.

This phase-out timeline is current as of the date of this report. The FAST Act phase-out mandates do not provide the Secretary of Transportation the discretion to change the compliance dates. In Safety Recommendation R-15-16, the NTSB advocated for a more aggressive phase-out date but recognized that the congressional mandate had overtaken PHMSA's ability to implement the recommended action. Therefore, on February 11, 2020, the NTSB classified Safety Recommendation R-15-16 Closed—No Longer Applicable.

While the eventual phase out of DOT-111 tank cars from flammable liquids service is a positive step, the NTSB is concerned by the current timeline for replacing DOT-111 tank cars with the superior DOT-117 specification. The history of accidents involving DOT-111 tank cars highlights their poor mechanical and thermal survivability, but the FAST Act phase out will leave some DOT-111 tank cars in flammable liquids service until 2029—including the specific combination of DOT-111 tank car and lading that failed and contributed to other hazardous materials releases at East Palestine. Tank car UTLX205907 released flammable liquid (butyl acrylates) through a head-end puncture, a failure mode that the DOT-117 specification, with its required head shield, is specifically designed to prevent. It is likely that if tank car UTLX205907 had met the DOT-117 specification, the consequences of the East Palestine derailment would have been much less severe.

The NTSB has identified other accidents in which the greater vulnerability of the DOT-111 relative to the DOT-117 and other authorized tank car specifications likely contributed to the severity of a hazardous materials release. From 2013 through 2023, the NTSB investigated 17 accidents in which damaged DOT-111 and CPC-1232 tank cars released hazardous materials. (See table 17.) In 15 of these accidents (88%), the hazardous materials release likely would have been prevented or reduced by the use of a more robust tank car specification, such as the DOT-117, with a thicker tank shell, thermal protection, and consistent use of full-height head shields.

Table 17. Hazardous materials releases from DOT-111 tank cars.

NTSB Accident Number	Location and Date	Breached Hazardous Materials DOT-111s	Description	Specification Likely Contributed to Release
HMD23LR002	Reed Point, Montana, 6/24/2023	9	Nine DOT-111s were mechanically breached, releasing molten sulfur and asphalt into the Yellowstone River.	Yes
RRD23MR005	East Palestine, Ohio, 2/3/2023	8	Eight DOT-111s were breached, three carrying hazardous materials. A pool fire damaged 5 other tank cars carrying vinyl chloride.	Yes
RRD20LR005	Tempe, Arizona, 7/29/2020	1	One DOT-111 carrying cyclohexanone released 2,200 gallons from its damaged manway cover after falling from a bridge.	No
RRD20FR002	Draffin, Kentucky, 2/13/2020	2	Two DOT-111s at the head of the train were breached by head punctures and shell cracks, releasing 38,400 gallons of burning ethanol. DOT-117Rs positioned on either side were not breached.	Yes
RRD19FR008	Sarnia, Ontario, 6/28/2019	1	One DOT-111 derailed in the Sarnia tunnel and released 13,000 gallons of sulfuric acid from a head puncture.	Yes
RRD19FR007	Forth Worth, Texas, 4/24/2019	1	One DOT-111 released 28,800 gallons of burning ethanol when its head and shell sustained large mechanical tears. Two DOT-117Rs were also punctured, releasing an additional 38,000 gallons.	Yes

NTSB Accident Number	Location and Date	Breached Hazardous Materials DOT-111s	Description	Specification Likely Contributed to Release
DCA17FR011	Hyndman, Pennsylvania, 8/2/2017	2	One DOT-111 was mechanically breached and released molten sulfur through a shell tear; a second released asphalt from a BOV.	Yes
DCA17SH002	Money, Mississippi, 4/30/2017	1	One CPC-1232 tank car was pushed into a DOT-117J tank car resulting in a breached head that released 30,000 gallons of crude oil.	Yes
DCA17MR007	Graettinger, Iowa, 3/10/2017	14	Fourteen DOT-111s sustained head and shell breaches and one thermal tear, releasing 322,000 gallons of ethanol.	Yes
DCA17SH001	Fredericksburg, Virginia, 11/2/2016	1	One DOT-111 fractured at a weld during a hard coupling event and released 68 gallons of ethanol.	No
DCA15FR016	Lesterville, South Dakota, 9/19/2015	3	Two DOT-111s sustained head and shell breaches from coupler impacts, and one CPC-1232 BOV opened. The three tanks cars released 49,700 gallons of ethanol that ignited.	Yes
DCA15FR009	Heimdal, North Dakota, 5/6/2015	6	Six CPC-1232s were breached by two head punctures, two thermal tears, and one open BOV, releasing 96,000 gallons of crude oil.	Yes
DCA15FR005	Mount Carbon, West Virginia, 2/16/2015	20	Two CPC-1232s sustained mechanical shell breaches and three had BOV releases. This led to 13 other CPC-1232s sustaining thermal tears, releasing 378,000 gallons of crude oil.	Yes
DCA14FR008	Lynchburg, Virginia, 4/30/2014	3	One CPC-1232 was breached by a mechanical shell tear, and two CPC-1232s released lading through BOVs.	Yes
DCA14FR002	Plaster Rock, New Brunswick, 1/8/2014	3	Two DOT-111s sustained mechanical head and shell breaches, and one CPC-1232 had a BOV release. Together, they released 60,000 gallons of burning crude oil. Pool fires resulted in damage to three butane tank cars that were subjected to a vent and burn.	Yes

NTSB Accident Number	Location and Date	Breached Hazardous Materials DOT-111s	Description	Specification Likely Contributed to Release
DCA13SR006	Casselton, North Dakota, 12/30/2013	18	Eighteen DOT-111s released crude oil from head and shell punctures; three other DOT-111s released crude oil from thermal tears. The total release was 476,000 gallons.	Yes
DCA13SR006	Lac-Mégantic, Quebec, 7/6/2013	60	Sixty DOT-111 tank cars released crude oil from head and shell punctures, resulting in 47 deaths.	Yes

2.4.2.3 Acceleration of DOT-111 Tank Car Phase Out

The DOT-111 specification's known poor derailment performance warrants removing the specification from hazardous materials service as quickly as possible. Although its ability to accelerate the phase out of DOT-111 tank cars is curtailed by the FAST Act, PHMSA has acknowledged the safety benefits of an expedited replacement or retrofit schedule. In response to the East Palestine derailment, PHMSA urged companies that own and use DOT-111 tank cars in flammable liquids service to consider replacing them with DOT-117 or DOT-117R specification tank cars as soon as practicable in the interest of public safety (PHMSA 2023b). As stated in its March 22, 2023, safety advisory, PHMSA believes it is possible for tank car owners and the shipping industry to acquire enough DOT-117 tank cars for flammable liquids service well before the May 1, 2029, phase-out date mandated by the FAST Act (PHMSA 2023b). PHMSA also expressed confidence that this can be accomplished with existing shop capacity. Similarly, the FRA's January 2024 report on its Legacy Tank Car Focused Inspection Program noted that the Railway Supply Institute has previously indicated that it may be technically and operationally feasible to accelerate the May 2029 DOT-111 phase-out deadline by 1 year (FRA 2024).

However, the DOT-111 specification continues in widespread flammable liquids service. According to the AAR, there were almost 26,600 DOT-117 tank cars and about 6,700 pressure tank cars (DOT-105 and DOT-112 specifications, which exceed the DOT-117 requirements) used to transport flammable liquids other than crude oil and ethanol in 2023, while about 25,300 DOT-111 and CPC-1232 tank cars are still in use for other flammable liquids (AAR 2024b). In other words, about 43% of tank cars transporting flammable liquids other than crude oil and ethanol still did not meet the DOT-117 specification in 2023. Further, the 2024 FRA report found that while some tank car owners are on track to meet the May 2029 phase-out deadline, economic factors create disincentives for a faster phase out (FRA 2024). The NTSB

concludes that voluntary industry action to improve the safety of the tank car fleet by completing the phase out of remaining DOT-111 tank cars in flammable liquids service ahead of the FAST Act mandate is feasible, but such action is unlikely because of economic and business disincentives. As of the date of this report, congressional action has been proposed to accelerate the phase out of certain tank cars, including the DOT-111 specification, from flammable liquids service by May 1, 2025, 4 years sooner than required under the FAST Act.[144] The NTSB recommends that PHMSA obtain the necessary legislative authority and accelerate the deadline for removing specification DOT-111 tank cars from flammable liquids service.

2.4.2.4 Non-pressure Tank Cars in Other Hazardous Materials Service

The NTSB is concerned by continued use of DOT-111 and similar tank cars in hazardous materials service partially because hazardous materials releases can cascade: the failure of one tank car can fuel a fire, which can lead other tank cars to release lading. In East Palestine, DOT-111 tank cars carrying flammable and combustible liquids likely contributed to fires that caused hazardous materials releases from PRDs fitted to pressure tank cars—pressure tank cars that remained intact during the derailment and otherwise would have retained lading. The East Palestine derailment demonstrates that hazardous materials tank cars with relatively poor derailment survivability can adversely affect the lading retention of more resilient tank cars, such as DOT-105 tank cars. The NTSB concludes that the presence of DOT-111 tank cars carrying hazardous materials in a mixed freight train increases the risk of lading releases from other, more resilient tank cars during a derailment.

The FAST Act does not require non-pressure tanks used to transport combustible or other non-flammable hazardous materials to meet the DOT-117 specification. This means there is no phase-out schedule for DOT-111, AAR-211, or CPC-1232 tank cars in other than flammable liquids service (such as combustible or other non-flammable hazardous materials). Of the three DOT-111 tank cars that released hazardous materials during the East Palestine derailment, two were transporting combustible liquids and therefore were not subject to the FAST Act. Therefore, the NTSB recommends that PHMSA establish a tank car replacement schedule whereby non-pressure tank cars in any hazardous materials service must meet or exceed the safety standards of the DOT-117 specification; if necessary, obtain legislative authority to act on this recommendation.

[144] See S. 576, the proposed Rail Safety Act of 2023. The text of the bill as introduced on March 3, 2023, is available here: https://www.govinfo.gov/content/pkg/BILLS-118s576is/pdf/BILLS-118s576is.pdf.

2.4.3 Pressure Tank Cars

The five DOT-105s that released material (the VCM tank cars) did so through a combination of PRD actuation and the vent and burn procedure initiated by the incident command in response to NS's and its contractors' statements about polymerization causing a BLEVE. The NTSB therefore focused our investigation on the VCM tank car tanks and fittings to determine whether their design or construction contributed to the hazardous materials releases caused by postderailment fires.

2.4.3.1 Tank Car and Fittings Certification

Under 49 *CFR* 179.5, a tank car must have a certificate of construction before entering service. Under 49 *CFR* 179.3, applications for approval of designs, materials of construction, conversion, or alteration of tank car tanks, complete with detailed prints, must be considered and approved by the AAR Tank Car Committee or other appropriate committees before a certificate of construction can be issued. Applicants must specify commodities and certify that the tank car and its service equipment (such as PRDs) are compatible with the specified lading as described in the AAR MSRP, M-1002, Specifications for Tank Cars. The AAR also approves PRD designs through a separate process, which asks the applicant to specify the commodity with which the PRD will be used. Applicants must test a PRD's flow rate using a test fluid such as steam, air, or natural gas. The AAR approval processes for tank cars and PRDs do not include independent evaluation of whether an applicant's certification of compatibility is accurate.

Four of the five derailed VCM tank cars were certified for "vinyl chloride." The fifth, GATX95098, was certified for "propylene oxide and products authorized in DOT 173 [sic] for which there are no special commodity requirements and nonregulated commodities compatible with this class of car." VCM is a Division 2.1 flammable gas and is therefore subject to the special requirements of 49 *CFR* 173.314(j). However, the NTSB did not identify evidence that the tank car did not meet these requirements or that its original lading certification materially affected its suitability for use in VCM service or created a specific safety risk.

The certificates of construction for three of the VCM tank cars reference design drawings that specify aluminum components: for TILX402025, the version of a PRD with an aluminum-coated spring, and for OCPX80235 and OCPX80179, an aluminum protective housing cover. The NTSB's postderailment examinations of the VCM tank cars also identified aluminum valve handwheels on tank car OCPX80370.

The Oxy Vinyls SDS for VCM lists aluminum as incompatible with VCM because it may result in violently exothermic (heat-producing) reactions. While expert testimony at the NTSB Investigative Hearing called into question the scientific basis for this incompatibility warning, the NTSB is concerned that tank cars certified for VCM service had protective housing covers, valve handwheels, and PRD components made of a material specifically described as incompatible by the lading's SDS.[145] There is no evidence that the AAR Tank Car Committee or any third-party approver took note of this incompatibility or raised concerns, and the five derailed tank cars transporting VCM were in service with aluminum components.

The current approval process for certificates of construction depends on the accuracy of manufacturers' own representations of their products' compatibility with ladings and compliance with regulations. The AAR does not appear to consistently verify these representations through independent testing, reference to relevant scientific literature, or demonstration. The AAR's approval process was insufficient to prevent the VCM tank cars involved in the East Palestine derailment from being certified despite the possible incompatibility of fittings with the specified lading. The NTSB concludes that the current AAR tank car certificate of construction approval process lacks a means of verifying manufacturers' claims and is therefore insufficient to ensure that tank cars and their fittings are appropriate for their specified lading. The AAR's current review process cannot reliably identify tank cars whose fittings may be incompatible with the specified lading, creating safety hazards that could be avoided by more careful review, appropriate testing, or use of SDSs and other sources of hazard information. The NTSB recommends that the AAR revise the MSRP, M-1002, Specifications for Tank Cars, to establish criteria and procedures for manufacturers of tank car service equipment to demonstrate compatibility of PRDs and other AAR-approved service equipment with intended ladings. The NTSB also recommends that the FRA monitor the progress of the AAR's action on R-24-20 and use its regulatory authority to ensure that the AAR addresses weaknesses in its tank car service equipment approval process.

2.4.3.2 Observed PRD Performance

Before the vent and burn, the DOT-105 tank cars that lost lading (the VCM tank cars) did so through PRD actuation. These releases began after four of the VCM tank cars were exposed to fire conditions and generally ended by mid-day on February 4, 2023, as many of the fires were extinguished. The last PRD actuation on a VCM tank car occurred about 5:30 p.m., when tank car OCPX80179 vented

[145] NTSB Investigative Hearing Transcript, Day 1, pp. 183–84.

energetically for about 70 minutes. This PRD release was significantly more violent and protracted than any other release observed following the derailment, suggesting that the PRD was venting VCM at a higher pressure than normal. After the 70-minute discharge, the PRD ceased operation and did not actuate again.

The NTSB's initial on-site examinations of the VCM tank cars found that the tank car protective housings that had been fitted with aluminum protective covers were missing those covers (OCPX80235, OCPX80179, and GATX95098), while steel protective covers had remained attached and largely intact (OCPX80370 and TILX402025). This is likely because aluminum has a lower melting point than steel: 1,221°F compared to 2,500–2,800°F, depending on the type of steel. Protective housings that originally had aluminum covers contained metallic debris that NTSB Materials Laboratory testing confirmed was mostly aluminum, indicating that the covers had melted and entered the housing itself. As a result, three PRD top guides contained aluminum debris that had melted and resolidified.

The manufacturer of these PRDs warns in its product manual against allowing foreign matter into the top guide because foreign matter could hinder the flow of discharging fluid (Midland Manufacturing 2021). It is unclear whether the presence of aluminum in the PRD top guides of tank cars OCPX80235, OCPX80179, and GATX95098 adversely affected the function of their PRDs. Although the top fittings for tank car OCPX80370 included aluminum valve hand wheels, its housing cover was made of carbon steel, and there were no signs of aluminum debris in the PRD's top guide. It is therefore unlikely that melted aluminum damaged or obstructed the PRD on tank car OCPX80370.

The NTSB recovered all five PRDs for bench testing, disassembly, and examination at the Trinity Rail Maintenance Services Saginaw Plant in Saginaw, Texas, on March 15–16, 2023. One PRD (from tank car GATX95098) was fused to the pressure plate, and the top guide discharge structure and top guide bushing were missing. The PRD was too damaged to be tested. None of the other four PRDs performed to specification in their as-received condition when bench tested; this is not unusual for PRDs recovered from tank cars that have been exposed to fire conditions. Three PRDs (TILX402025, OCPX80235, and OCPX80179) began to leak or discharge significantly below their specified start-to-discharge pressure.[146] The PRD valve stem from OCPX80370 was stuck closed and did not leak or discharge when pressurized to 275 psig, or more than 25 pounds per square inch above its

[146] Tank car TILX402025 was not exposed to fire before the vent and burn, and there is no evidence that its PRD actuated to reduce tank pressure. Its PRD was likely damaged during the vent and burn.

designed start-to-discharge pressure; for safety reasons, no higher pressures were attempted.

When investigators disassembled and examined the PRDs, they found damage to internal components, including parts that had become stuck together, deteriorated aluminum coatings on interior parts, signs of corrosion, and bent or permanently compressed springs. The nature of the damage suggests that exposure to heat and corrosive gases—such as the hydrogen chloride produced by the burning VCM—during lading releases is sufficient to explain the PRDs' degraded condition at the time of bench testing. However, to preserve chemical and physical evidence, the PRDs were not cleaned before being shipped for testing and examination. Corrosion that began during lading releases may have continued during the 6 weeks between the derailment and bench testing. Therefore, the bench tests and examinations may not accurately indicate the level of corrosion present in the PRDs on February 3-4, 2023.

The postderailment examinations found no evidence of any foreign matter, such as PVC, obstructing the function of the PRDs or valves. This indicates that the observed increase in start-to-discharge pressure (for the PRD from tank car OCPX80370) was a result of mechanical or chemical damage to PRD components, not of polymerization producing solid material able to obstruct a PRD. While the evidence does not support a definitive determination about how the presence of aluminum affected PRD performance, the NTSB's examinations confirmed that aluminum components, including protective housing covers and PRD spring coatings, did not remain intact and likely melted when exposed to burning VCM during actuation. The NTSB concludes that while the use of aluminum in the VCM tank cars and PRDs rendered them susceptible to thermal damage, there is insufficient evidence to determine whether this greater susceptibility created a safety hazard or contributed to the release of hazardous materials following the East Palestine derailment.

2.4.4 High-Hazard Flammable Trains

Following our participation in the TSB's investigation of the Lac-Mégantic, Quebec, derailment and fire involving a crude oil unit train, the NTSB issued the following safety recommendations to the FRA:

> Work with the Pipeline and Hazardous Materials Safety Administration to expand hazardous materials route planning and selection requirements for railroads under Title 49 *Code of Federal Regulations* 172.820 to include key trains transporting flammable liquids as defined by the

> Association of American Railroads Circular No. OT-55-N and, where technically feasible, require rerouting to avoid transportation of such hazardous materials through populated and other sensitive areas. (R-14-1)[147]

We issued a corresponding recommendation to PHMSA:

> Work with the Federal Railroad Administration to expand hazardous materials route planning and selection requirements for railroads under Title 49 *Code of Federal Regulations* 172.820 to include key trains transporting flammable liquids as defined by the Association of American Railroads Circular No. OT-55-N and, where technically feasible, require rerouting to avoid transportation of such hazardous materials through populated and other sensitive areas. (R-14-4)[148]

In response, PHMSA issued an NPRM on August 1, 2014, titled "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains" (79 Fed. Reg. 45016).[149] In our comments on the NPRM, we noted several concerns with the proposed rule. One touched on a possible misapplication of Safety Recommendation R-14-4:

> Safety Recommendation R-14-4 urges PHMSA to include "key trains" carrying flammable liquids in its route-planning requirement. The recommendation refers to the definition of key train in AAR Circular No. OT-55-N, which lists 20 tank cars of any combination of hazardous material as the threshold number of tank cars in the consist. In referring to the AAR circular, we intended to suggest using a preexisting industry standard for route planning, but not to endorse a 20-tank-car threshold for HHFTs. We caution you not to use Safety Recommendation R-14-4 to imply that we endorse a 20-tank-car threshold for any other purpose.

We also noted the narrow range of hazardous materials encompassed by the HHFT definition, which included only Class 3 flammable liquids:

[147] Safety Recommendation R-14-1 is currently classified Closed—Acceptable Action.

[148] Safety Recommendation R-14-4 is currently classified Closed—Acceptable Action.

[149] See section 1.11.2 for more information about this rule and its relationship to later versions of the HHFT definition.

> We believe the definition should include a broad range of hazardous materials, similar to the revised definition of a key train in AAR Circular No. OT–55–N. The circular's reference to "any combination of hazardous material" includes hazard class 2, division 2.1 (flammable gas) materials and combustible liquids, as defined at 49 *CFR* 173.115(a) and 173.120(b).

On May 8, 2015, PHMSA published the final rule, HM-251, defining an HHFT as a train with 20 or more tank cars transporting a Class 3 flammable liquid in a single block or 35 or more such tank cars throughout the consist (80 Fed. Reg. 26644). As a result, the NTSB classified Safety Recommendations R-14-1 and R-14-4 Closed—Acceptable Action on September 16, 2015. The FAST Act, signed into law December 4, 2015, includes a statutory definition of HHFT that uses the same tank car counts and commodities; under the FAST Act, PHMSA no longer has the discretion to change the definition of HHFT (PL 114-94).

The rules governing the operation of HHFTs are designed to prevent or mitigate a derailment involving a large number of flammable liquids tank cars, partially to reduce the risk of one breached tank car compromising others. When exposed to fire conditions, flammable liquids tank cars can experience a cascade of releases as each breached tank car spreads the fire to involve more tank cars. The risk and potential scope of this cascading failure mode increases with greater numbers of flammable liquids tank cars.

Train 32N was not an HHFT, but the NTSB's investigation determined that the sequence of hazardous materials releases was similar to what the HHFT rules are designed to prevent. The East Palestine derailment led to mechanical breaches in DOT-111 tank cars that released flammable and combustible liquids, caused fires that exposed more tank cars to heat, and eventually released a Class 2.1 flammable gas through PRD actuation from DOT-105 tank cars that were mechanically intact. The sequence of hazardous materials releases observed at East Palestine shows that non-HHFT mixed freight trains are vulnerable to cascading hazardous materials releases if the consist includes hazardous materials and tank cars relatively likely to compromise the lading retention of other tanks cars in the consist. The breached DOT-111 tank cars caused other tank cars to release lading even though train 32N had fewer than 20 (or 35) hazardous materials tank cars and even though most of the hazardous materials in the derailed tank cars were not Class 3 flammable liquids.

While it is unclear whether applying the operating requirements for HHFTs to train 32N would have mitigated the postderailment fires, the postderailment releases show that the release scenario addressed by HHFT regulations is not confined to

HHFT trains: the specifics of tank car derailment performance and presence of non-flammable liquids hazardous materials are both relevant to assessing a mixed freight train's level of hazard. Therefore, the NTSB concludes that cascading hazardous materials releases are not unique to HHFTs, and the probability of a cascading hazardous materials release depends in part on variations in tank car survivability and on the presence of hazardous materials other than Class 3 flammable liquids, such as combustible liquids and Division 2.1 flammable gases. Accordingly, the NTSB recommends that PHMSA revise the definition of HHFT to account for differences in survivability between tank car specifications and to include hazardous materials other than flammable liquids, such as combustible liquids and Division 2.1 flammable gases, that can contribute to cascading hazardous materials releases; if necessary, obtain legislative authority to act on this recommendation.

2.4.5 Key Trains

The definition of key train in AAR Circular OT-55 includes a threshold of 20 car loads of hazardous materials, or a single car load of especially hazardous materials such as spent nuclear fuel, and a train that meets either threshold is subject to recommended practices for maximum speeds and additional procedures for defective bearings. In setting these two thresholds, the definition reflects different levels of lading hazards. However, it does not distinguish between tank cars with different probabilities of releasing hazardous materials during an accident. As discussed above in section 2.4.2.2, the DOT-111 specification, and by extension the similar AAR-211 specification, are generally less survivable than tank cars that meet the DOT-117 standard. A simple tank car count therefore does not provide an accurate representation of how hazardous a train is; the specifications of the tank cars transporting hazardous materials are also relevant to the assessment. The NTSB concludes that the definition of key train in AAR Circular OT-55 does not account for differences in survivability between different tank car specifications, and the DOT-111 and AAR-211 specifications can pose an elevated risk of a hazardous materials release compared to other specifications, such as the DOT-117. The NTSB recommends that the AAR revise the definition of key train in Circular OT-55 to designate as a key train any train containing tank cars transporting hazardous materials that do not meet the DOT-117 standard.

2.5 The Vent and Burn

An NS contractor performed a vent and burn of all five derailed VCM tank cars on February 6, 2023. One tank car, TILX402025, had not released VCM through its PRD and was therefore likely full at the time of the vent and burn. The other four tank

cars had released unknown amounts of lading through PRDs before the vent and burn; the vent and burn released whatever lading was still contained in the tank cars.

The incident commander approved this action in the belief that exposure to heat during postderailment fires had caused the VCM to begin polymerizing and that the vent and burn was necessary to prevent a polymerization reaction within at least one tank car from causing a catastrophic tank rupture. This belief was based on statements from NS and its contractors, which formed their judgment based on a reading of VCM hazard information, observed PRD activity, and infrared thermometer temperature measurements taken from the shells of VCM tank cars. NS consistently advocated for a vent and burn to prevent a tank failure, though it considered and rejected alternative means of unloading VCM from the derailed tank cars.

Oxy Vinyls, which was providing support to NS and its contractors but was not in direct communication with the incident commander, concluded based on the same evidence and its own knowledge of VCM that dangerous polymerization was not occurring. Oxy Vinyls shared its conclusions with NS and NS's contractors while on the scene; these conclusions were not communicated to the incident commander.

The NTSB's investigation into the vent and burn addressed four core subjects: whether dangerous polymerization was occurring within the derailed and fire-exposed VCM tank cars, the quality of the VCM hazard information available to responders, the communication and decision-making processes that led to the vent and burn, and the availability of sound criteria for when a vent and burn is appropriate.

2.5.1 Polymerization

The NTSB obtained expert opinions on VCM polymerization from Oxy Vinyls' LaPorte plant technical manager and a chemistry professor at Indiana University. Based on their interviews, hearing testimony, and references to scientific literature, stabilized VCM—in the case of East Palestine, VCM packaged in tank cars in a low-oxygen environment—cannot polymerize when exposed to heat without the presence of an initiator (free radicals), and it cannot sustain a polymerization reaction without the continued introduction of free radicals, which are consumed during the polymerization process. In other words, a runaway polymerization reaction is not possible if the VCM is stabilized, and VCM will remain stabilized as long as it remains in a low-oxygen environment.

Previous NTSB investigations and PHMSA incident reports further support that stabilized VCM (that is, VCM in a low-oxygen environment) is unlikely to polymerize in

a tank car. The NTSB has investigated seven rail accidents in which VCM tank cars released lading. These investigations are summarized in table 18.

Table 18. NTSB investigations of VCM releases.

NTSB Report Number	Location	Date	Notes	Evidence of VCM Polymerization
NTSB/RAR-70-2	Glendora, Mississippi	9/11/1969	Two tank cars released VCM, resulting in fires and several explosions.	No
NTSB/RAR-72-6	Houston, Texas	10/19/1971	Two VCM tank cars were punctured and released VCM, which exploded; the explosion was a result of rapid combustion.	No
NTSB/RAR-78-8	Lewisville, Arkansas	3/29/1978	A punctured tank car released VCM, which immediately exploded.	No
NTSB/RAR-81-1	Muldraugh, Kentucky	7/26/1980	Two VCM tank cars were punctured in a derailment and released lading that then exploded. Another VCM tank was exposed to fire, vented lading through its PRD, and likely reached temperatures of 185-190°F.* A VCM tank car was vented and burned 4 days after the derailment, along with other fire-exposed tank cars.	No
NTSB/RAR-83/05	Livingston, Louisiana	9/28/1982	Two VCM tank cars were breached during a derailment and contributed to a fire. Three more VCM tank cars began to vent lading as a result of fire exposure. One VCM tank car was thermally breached and exploded, along with a tank car containing tetra-ethyl lead. Six VCM tank cars were vented and burned about 2 weeks after the derailment to dispose of their lading.	No
NTSB/RAR-05/01	Tamaroa, Illinois	2/9/2003	A punctured VCM tank car released part of its load. The rest was removed using a hot tap.	No
NTSB/RAR-14/01	Paulsboro, New Jersey	11/30/2012	One punctured VCM tank car released a cloud of vapor.	No

* This temperature estimate is based on the temperature / vapor pressure curve for VCM.

No NTSB investigation of a VCM release from a tank car has identified evidence of polymerization. In the seven investigations summarized in table 18, four VCM releases (Glendora, Houston, Lewisville, and Muldraugh) resulted in explosions

attributable to combustion. In the Livingston release, one tank car exploded as a result of thermal failure during exposure to an intense fire (a non-VCM tank car also exploded). In these five cases, released VCM ignited—sometimes explosively—but did not show signs of polymerization. In the Paulsboro release, the VCM spread as a vapor cloud and was exposed to atmospheric oxygen for an extended period but showed no signs of polymerization.[150] These releases suggest that VCM does not tend to polymerize in a tank car exposed to heat or even one breached by outside mechanical forces.

PHMSA maintains the Hazmat Incident Database, which contains information reported on Hazardous Materials Incident Report Form 5800.1. A database query for 1971 through 2023 identified 73 incidents involving UN1086 (stabilized VCM) in transportation.[151] Five reports from NS listed "polymerization" as the cause of package failure—the reports NS filed for the five VCM tank cars involved in East Palestine. These tank cars released lading through PRD activity and were breached with explosives during the vent and burn, not by polymerization. There were no other reports of polymerization in the event descriptions or cause of failure descriptions for the remaining 68 incidents.

The NTSB's analyses of on-scene observations cited by NS as signs of polymerization assess not only whether the observations were consistent with polymerization, but also whether a more probable explanation is sufficient to account for the observation. The two credible observations are PRD activity and tank temperature measurements, both discussed below.

The PRDs on the four VCM tank cars exposed to fire cycled for several hours before they stopped actuating. Based on the cessation of PRD activity and traces of a volatile organic compound (plausibly VCM) detected near the protective housing of OCPX80370 on February 5, 2023, the SPSI president believed that the PRD had become plugged with polymer (PVC), causing it to release small amounts of vapor but not enough to combust. The presence of PVC within the PRD would have indicated that polymerization was occurring within the tank. However, the post-vent and burn examination of disassembled PRDs found no signs of foreign matter, such as PVC, obstructing their operation. As discussed in section 2.4.3.2, physical damage

[150] The NTSB's report for the Tamaroa release does not directly state that the released VCM did not ignite, but it does note that the punctured tank car was "not involved in the fire" that affected other derailed equipment (NTSB 2005).

[151] The PHMSA database contains individual reports for each tank car when incidents involve multiple tank cars of VCM in a derailment.

to the PRD from tank car OCPX80370 was adequate to explain an elevated start-to-discharge pressure. This PRD's valve stem was stuck closed, and the PRD would not actuate even at pressures above its specified start-to-discharge pressure. The condition of the PRD suggests that it was no longer functioning normally after being exposed to fire conditions and burning VCM during actuation, but that its observed behavior was unrelated to polymerization. The NTSB concludes that postaccident examinations, which found no solidified chemical matter blocking pressure relief devices and other tank car service equipment openings, do not indicate that a polymerization reaction occurred within any of the five VCM tank cars.

During postaccident testing, the other three testable PRDs (from tank cars TILX402025, OCPX80235, and OCPX80179) all began to leak or discharge below their specified start-to-discharge pressures because of physical damage. Two of these PRDs (OCPX80235 and OCPX80179) cycled during fire exposure and eventually ceased operation. Because PRD actuation is a function of pressure and pressure is a function of temperature, the NTSB was able to use the postaccident test pressures to determine a set of maximum temperatures for the lading in those two VCM tank cars in the hours before the vent and burn. (For OCPX80235, the highest temperature the lading could reach without actuating a PRD was about 136°F; for OCPX80179, about 150°F. See below for methodology.) Further, SPSI and SRS recorded temperature measurements for all five VCM tank cars while monitoring for a temperature increase that could indicate polymerization. If those measured temperatures remained below the deteriorated PRDs' start-to-discharge pressures, then the temperature of the lading alone would explain the cessation of PRD activity.

A PRD on a tank car transporting a liquefied compressed gas reaches its start-to-discharge pressure when the temperature of the lading increases, raising the lading's vapor pressure (which normally equals the internal tank pressure).[152] *Yaws' Critical Property Data for Chemical Engineers and Chemists* provides vapor pressure values for VCM at different temperatures (Yaws 2014). Based on those values, VCM vapor pressure rises with temperature along the curve shown in figure 30.[153]

[152] The phase change from a liquid to a gas typically creates a much greater pressure change than the thermal expansion of a liquid.

[153] Subsequent exact values for temperatures and vapor pressures in this report are taken directly from table 12 of *Yaws' Critical Property Data for Chemical Engineers and Chemists*.

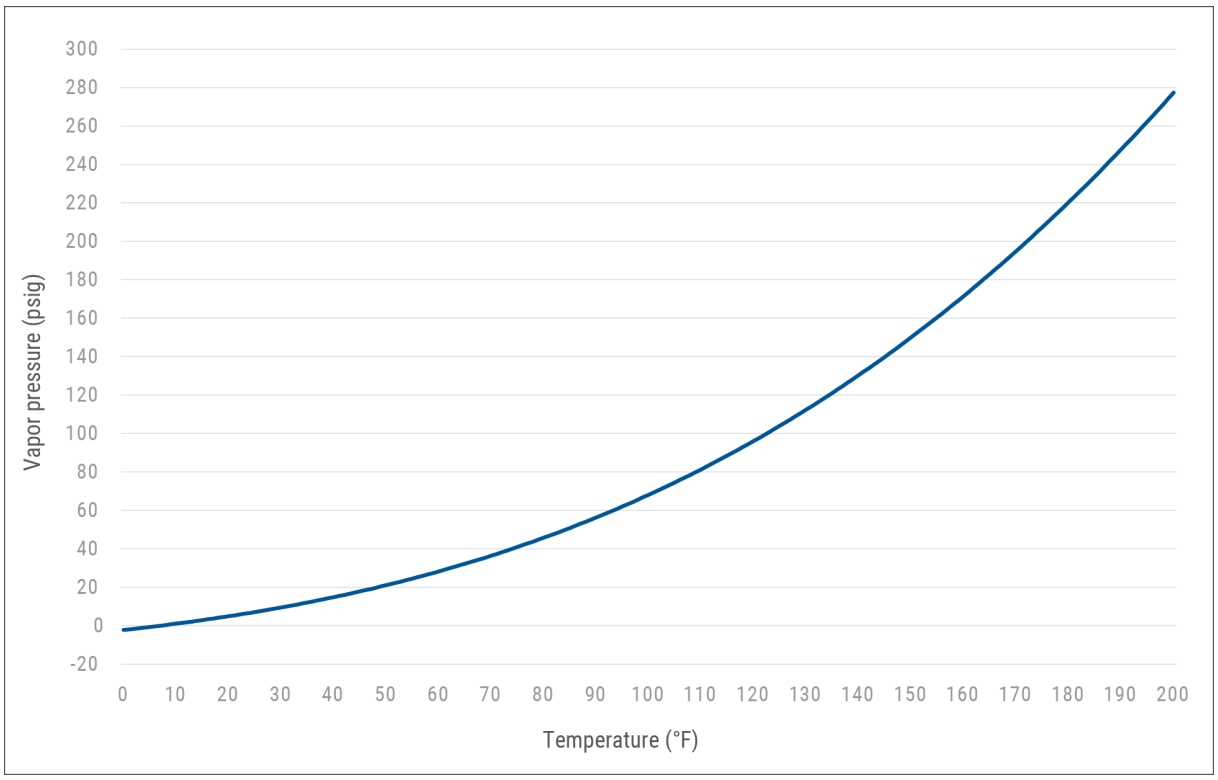


Figure 30. Graph of VCM vapor pressure by temperature.

The lowest start-to-discharge pressure identified during postaccident testing of a PRD known to actuate during fire exposure and then cease was 122 psig (OCPX80235). This pressure corresponds to a lading temperature of about 136°F. For OCPX80179, the start-to-discharge pressure identified during testing was 149.7 psig, which corresponds to a temperature of about 150°F. Typical measured temperatures for tank cars OCPX80235 and OCPX80179 ranged from 62 to 67°F. Similar analysis applies to the PRD with an elevated start-to-discharge pressure (from tank car OCPX80370). Given that this PRD would not start to discharge at 275 psig during testing, the lading temperature would have to exceed 199°F to actuate the PRD. The highest measured temperature for this tank car was 139°F, indicating a pressure of about 128 psig—much too low to overcome the stuck valve stem. Therefore, lading temperatures (and therefore internal tank pressures) are sufficient to explain the cessation of PRD activity even for PRDs with reduced start-to-discharge pressures, and PRD activity is not indicative of polymerization.

NS and its contractors also interpreted tank car temperatures as signs of polymerization. At Oxy Vinyls' recommendation, SPSI and SRS collected regular tank car temperature measurements on February 5–6, 2023, using an infrared thermometer to monitor the exterior shell surfaces at points where the jacket and thermal protection blanket had been torn away in the derailment. The measured

temperatures are listed in table 3. In discussions with the incident commander and the NTSB on scene, NS noted a 3°F increase in temperature for tank car OCPX80370 as an indication that polymerization was occurring. This increase to 138°F on the afternoon of February 5 was close to the highest temperature recorded on a tank car shell (139°F, measured during a brief fire under the tank car about midnight on February 5-6). Tank car OCPX80370 was the only tank car to show significant variations in temperature during monitoring.[154] The temperature for OCPX80370 is plotted in figure 31 (blue), along with a trendline (red).

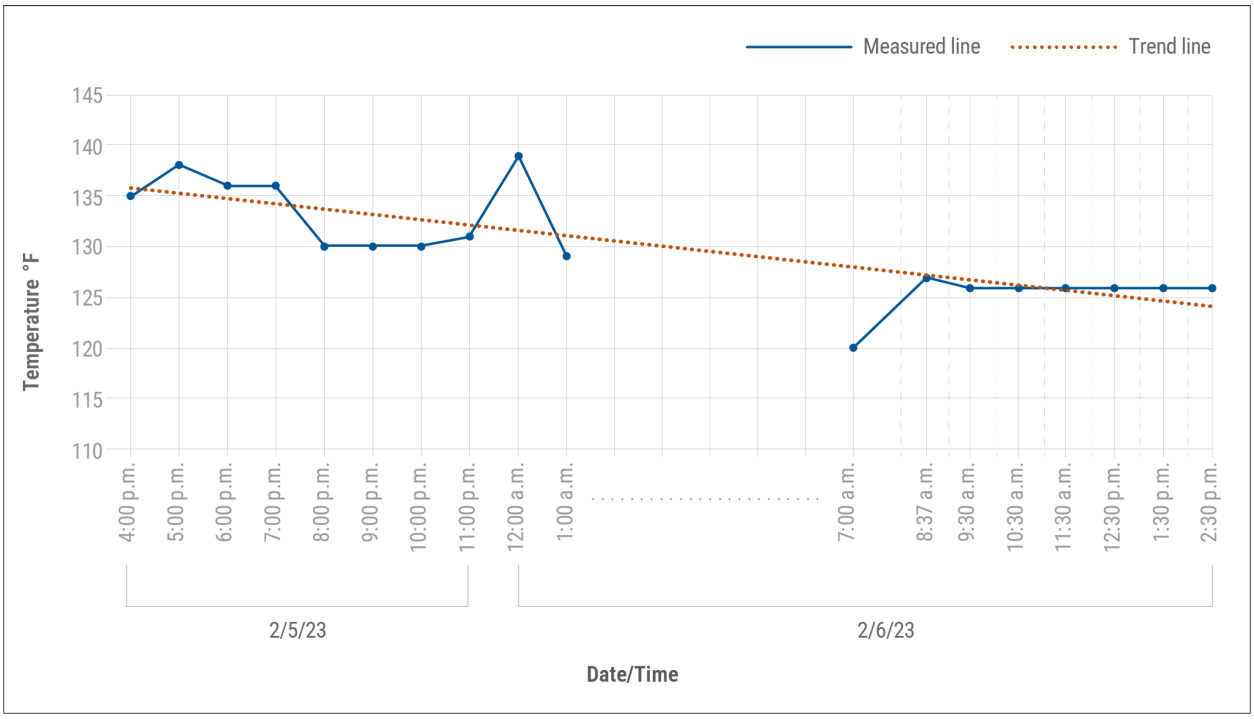


Figure 31. Measured temperatures and trendline for OCPX80370.

According to information Oxy Vinyls provided the NTSB after the vent and burn, a runaway polymerization reaction would produce "a rapid, significant, and sustained increase in temperature and pressure." The dashed red trendline in the figure shows a gradual decline instead. The surface temperature measurements therefore do not indicate exothermic polymerization in tank car OCPX80370. Measured variations in temperature were likely the result of environmental conditions and the limitations of the method used. Because of non-uniform heating caused by

[154] Two other tank cars—OCPX80179 and GATX95098—each have a single outlier temperature measured at 7:00 a.m. on February 6. Measurements taken about 1.5 hours later showed both cars back at their more typical temperatures of about 65°F. Because these outliers are the only elevated temperatures for these tank cars and they were taken at the same time, they are likely skewed by some unknown error or variable in the environment or measuring technique.

internal circulation and exposure of parts of the tank car shells to external fire, the ideal location to collect temperature measurements would have been from the tank car's thermometer well. But access to top fittings houses was hampered by fires and thermally damaged fittings, and infrared thermometer measurements were the only ones available for tank car OCPX80370. The SPSI president testified that he did not have confidence in the temperature readings because pieces of jacket or thermal protection blanket might have been interfering with attempts to take the temperature of the bare tank shell, meaning that not every measurement was taken from the intended part of the tank.[155]

Tank car OCPX80370's generally elevated temperature relative to the other tank cars was likely a result of the tank car leaning against a burning hopper car for 2–3 days. The nearby fire may have slowed the cooling of the lading and compromised the accuracy of the temperature measurements; infrared thermometers cannot distinguish between radiated heat (the internal warmth of the tank car) and reflected heat (energy released by the hopper car fire and bounced off the tank car shell). Measured fluctuations in temperature were therefore likely the result of environmental conditions, heat being reflected from the tank car, and the limitations of the measurement method. Even discounting the effects of nearby external heat sources, temperature measurements of tank car OCPX80370 were consistent with cooling lading, not runaway polymerization. The NTSB concludes that the observed downward temperature trend in tank car OCPX80370 indicates that polymerization was not occurring within the tank car, contrary to the representation by NS and its contractors.

In fact, all four VCM tank cars that released material through PRDs must have reached temperatures significantly higher than 139°F during the postderailment fires and then cooled before SPSI and SRS began taking measurements. These tank cars were equipped with PRDs with start-to-discharge pressures of 247.5 psig. During the first releases, before burning VCM could have begun to impact PRD performance, the vapor pressure of the VCM within the four venting tank cars must therefore have reached a minimum of 247.5 psig, and the lading a corresponding minimum temperature of about 189°F. These four tank cars exceeded the highest temperature measured by SPSI without experiencing a runaway polymerization reaction: all four had cooled after the fires were largely extinguished on February 4, as documented in table 3.

[155] NTSB Investigative Hearing Transcript Day 1, pp. 149–50.

Evidence available after the vent and burn also does not support polymerization. During the vent and burn, all five VCM tank cars expelled material, indicating that the cars were still under positive internal pressure. Oxygen and other contaminants therefore could not enter the tank cars before the vent and burn, and the VCM remained in a low-oxygen, stabilized environment not conducive to polymerization. As discussed above, PRDs recovered from all five tank cars did not contain obstructions of PVC, and examinations did not identify foreign matter obstructing their operation. Finally, Oxy Vinyls performed laboratory analyses on residue samples recovered from the interiors of the VCM tank cars. While these analyses did not definitively rule out the presence of PVC (VCM and PVC are chemically similar) they did not find evidence of PVC. The NTSB concludes that the VCM within the derailed DOT-105 tank cars remained in a stabilized environment until the vent and burn and did not undergo polymerization; the vent and burn procedure was not necessary to prevent a polymerization-induced tank rupture. NS's submissions to the PHMSA Incident Database incorrectly describe polymerization as a cause of package failure in all five VCM tank cars. The NTSB recommends that NS update its submissions to the PHMSA Incident Database to accurately reflect the cause of package failures following the East Palestine derailment.

2.5.2 Quality of VCM Hazard Information

Sources of VCM hazard information referenced by NS and its contractors before the vent and burn included the 2020 ERG, Oxy Vinyls' SDS, and The Chlorine Institute's Pamphlet 171. The 2020 ERG and Oxy Vinyls' SDS both list polymerization as a hazard associated with VCM. However, the 2020 ERG and SDS guidance are both intended to address circumstances other than when the VCM is within the interior of a mechanically intact tank car. The SDS guidance is intended to address potential hazards to include industrial settings and other environments distinct from conditions incident to transportation. Given that the SDS is required by regulation to address a wide range of hazards and the 2020 ERG is intended as a quick-reference guide for initial responses to a variety of transportation-related incidents, it is reasonable to expect that both will include guidance that addresses a wide range of applications and requires further context and expertise to use effectively.

Pamphlet 171 includes guidance specifically for emergency response involving intact VCM tank cars. This guidance states that a pressure above 68 psig or a tank surface temperature reading "above ambient temperature" may be indicative of polymerization. While these statements are true—exothermic polymerization produces increases in temperature and pressure—they do not take into consideration other explanations of elevated temperatures and pressures and can lead the reader

to incorrectly conclude polymerization is occurring. Further, Pamphlet 171 may bias the reader against more probable explanations by stating that increased temperature and pressure together mean that polymerization is "most likely occurring in the tank car." This statement is not true for an intact tank car that has been exposed to a fire or was otherwise externally heated. Further, temperature and pressure are correlated and therefore should not be treated as two separate signs of polymerization.

As discussed in section 2.5.1, expert opinion and historical evidence both indicate that dangerous polymerization of VCM is unlikely within an intact tank car. Pamphlet 171's claim that increases in temperature and pressure indicate that polymerization is "most likely" occurring in intact VCM tank cars is overstated and therefore misleading. NS and its contractors referred to Pamphlet 171 in addition to the Oxy Vinyls SDS and 2020 ERG while forming their initial judgments that polymerization was occurring within the derailed VCM tank cars. The NTSB concludes that language in The Chlorine Institute's Pamphlet 171 overstates the probability of VCM polymerization in scenarios where tank cars remain intact, likely leading those using the pamphlet during an emergency response effort to overestimate the likelihood of polymerization. Therefore, the NTSB recommends that The Chlorine Institute review and revise Pamphlet 171 to ensure that its safety messages about VCM polymerization in tank cars are accurate and adequately support determining whether a rail accident poses a risk of polymerization. The NTSB also recommends that Oxy Vinyls update the SDS for VCM to accurately reflect the potential risks of VCM and the hazards that increase such risks.

SPSI and SRS were Level 3 CHLOREP contactors vetted by The Chlorine Institute to provide expertise and a capable emergency response to chlorine incidents. CHLOREP is intended to provide emergency responders—including incident commands—with accurate information and chlorine industry expertise. The capabilities The Chlorine Institute requires for Level 3 contractors do not specifically include vent and burn decision-making, focusing instead on safe field transfer (transloading) of chlorine products from damaged packaging. The Chlorine Institute verifies these capabilities every 3 years.

As the president of SPSI told the NTSB in an interview, one of the reasons SPSI and SRS did not attempt transloading of VCM was concern that the product had already polymerized, making it unsafe to move regardless of the condition of the VCM tank cars' fittings. However, available evidence did not indicate polymerization, and polymerization had not occurred. SRS and SPSI did not correctly interpret evidence relevant to polymerization, recognize the limitations or inaccuracies of the available written guidance about VCM hazards, or make use of Oxy Vinyls' expert opinion that available evidence did not point to polymerization. The events at East

Palestine show that knowledge of VCM chemistry sufficient to determine whether polymerization has occurred is relevant to the intended role of Level 3 CHLOREP contractors, which should be capable of transloading VCM whenever it is safe to do so and of providing accurate hazard information to the full incident command. The NTSB concludes that because Level 3 CHLOREP contractors are expected to provide advanced emergency response capabilities, including communicating expertise to other on-scene personnel and the transloading of VCM, these contractors should possess or know how to obtain enough technical knowledge to accurately assess how chemical hazards, such as polymerization, affect a safe response to a VCM incident. The NTSB recommends that The Chlorine Institute review and revise its CHLOREP training and verification programs to ensure that Level 3 contractors possess or can obtain enough technical knowledge of VCM to accurately assess and respond to chemical hazards like polymerization during a VCM incident.

Information recorded on the scene by emergency response contractors, notably the temperatures of the tank cars and the timing of PRD actuation, was relevant to determining whether written guidance was accurate and effective in supporting the emergency response. Fire-exposed VCM tank cars did exhibit elevated temperatures and pressures—which Pamphlet 171 states are indicators of likely polymerization—but later examinations found no evidence that polymerization had occurred. The NTSB concludes that information collected during real-world accidents is a vital resource in ensuring that hazardous materials guidance is suitable for supporting responses to transportation emergencies. The NTSB recommends that NS adopt policies to ensure that its emergency response contractors keep detailed records of information used to make decisions involving hazardous materials, and share this information with shippers, relevant chemical associations, and other entities that provide hazardous materials guidance.

2.5.3 Vent and Burn Communication and Justification

The vent and burn decision began with NS and its contractors interpreting an energetic PRD actuation on the afternoon of February 4, 2023, followed by cessation of PRD activity as a sign that VCM had polymerized and obstructed a PRD, causing a build up of pressure and then preventing the PRD from actuating again. According to the NTSB's interview with the SPSI president, on February 4, SPSI and NS were already “at a vent and burn” decision because of the unusual PRD activity and the polymerization hazard information in the 2020 ERG, Pamphlet 171, and SDS.

Starting on the morning of February 4, NS and its contractors had access to VCM expertise from Oxy Vinyls. Oxy Vinyls called into question the likelihood of

polymerization. In a conference call with SPSI and NS on the afternoon of February 4, Oxy Vinyls personnel in Dallas, Texas, assessed a low probability of polymerization and recommended monitoring the tank cars' temperatures. Runaway exothermic polymerization would produce a rapid, sustained increase in temperature. This rapid, sustained increase in temperature was not occurring, as discussed in section 2.5.1.

On February 5, 2023, representatives from Oxy Vinyls arrived on the scene and met with SPSI and SRS personnel. During this meeting, the Oxy Vinyls logistics process supervisor explained the VCM stabilization process and that a lading temperature above 185°F could actuate a PRD but not introduce oxygen into the tank and destabilize the VCM. The Oxy Vinyl representatives indicated that they had never had a VCM incident lead to a BLEVE.

Despite this new information from Oxy Vinyls, NS and its contractors continued to respond to the situation as though the VCM was polymerizing. About 5:45 p.m. on February 5, 2023, after the meeting with Oxy Vinyls' on-scene representatives, SPSI and SRS contacted the incident commander and said that circumstances might require a vent and burn. This action demonstrated a focus on polymerization to the exclusion of alternatives even after Oxy Vinyls employees' initial judgment that polymerization was unlikely, and it ignored contradictory evidence: between 5:00 p.m. and 6:00 p.m., the measured temperature of the suspect tank car had fallen 2°F. The temperature continued to trend downward over the next day, as shown in figure 32. NS and its contractors continued to assert the necessity of a vent and burn when Oxy Vinyls' expert opinions and on-scene evidence should have led them to question their original focus on polymerization.

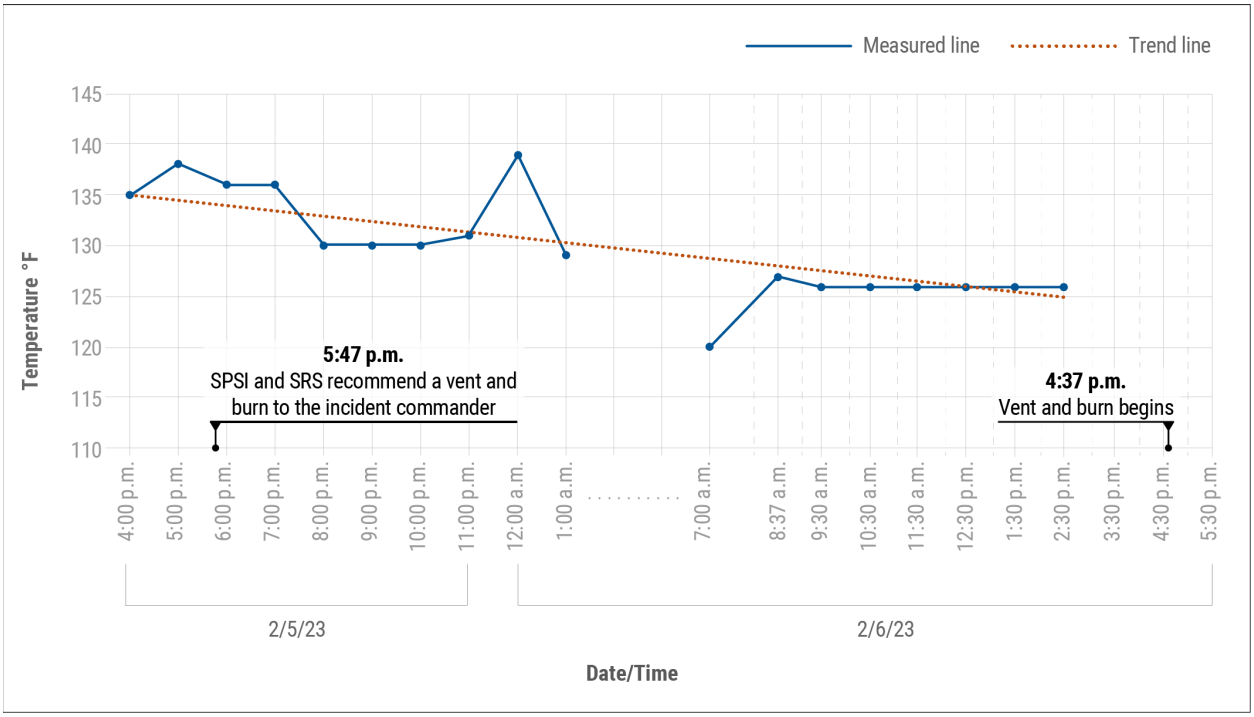


Figure 32. Tank car OCPX80370 temperature graph with vent and burn timing.

While NS and its contractors continued to advocate for a vent and burn, the on-scene Oxy Vinyls representatives conducted another conference call with the Oxy Vinyls team in Dallas. They reached a consensus that the available evidence did not indicate polymerization. By the time Oxy Vinyls met with SPSI at 7:00 p.m. on February 5, NS had begun preparations for the vent and burn. Oxy Vinyls shared its conclusions with SPSI, but SPSI did not reconsider its course of action, and neither SPSI nor NS shared Oxy Vinyls' conclusions with the rest of the incident command. The NTSB concludes that NS and its contractors continued to assert the necessity of a vent and burn after expert opinion and available evidence should have led them to re-evaluate their initial conclusions regarding polymerization.

Throughout these meetings and conversations, Oxy Vinyls had no contact with the incident commander or elements of the incident command other than through NS, SRS, and SPSI. Oxy Vinyls personnel expected NS and its contractors to relay information to the rest of the incident command. However, Oxy Vinyls' conclusions about the lack of polymerization were not relayed to the incident commander or other personnel in the incident command. There is no evidence that the incident command was aware that Oxy Vinyls was available as a source of expertise on VCM at any time up to the final vent and burn decision.

The incident commander, the EPFD fire chief, approved the vent and burn based on information from NS, SRS, and SPSI. The incident commander made his

decision after two meetings on the afternoon of February 6, 2023. The first meeting involved the wider incident command and participation from entities not formally part of the incident command, such as the governors of Ohio and Pennsylvania. The second, smaller meeting involved only the incident commander, the Ohio Governor, and representatives from NS, SRS, and SPSI. Oxy Vinyls was not invited to or present at either meeting, and no attendees questioned the NS position that dangerous polymerization was occurring in the VCM tank cars.

The NTSB is concerned by the absence of Oxy Vinyls' opinions and information from the decision-making process. At the NTSB's Investigative Hearing, the Oxy Vinyls technical manager testified that he was confident that Oxy Vinyls' opinions were being relayed to the full incident command, but NS and its contractors were not doing so.[156] During the second meeting on February 6, NS and its contractors told the incident commander that if the temperature in a tank car reached 153–158°F, the result would be an uncontrolled polymerization reaction.[157] This temperature range is not contained in the written guidance referenced during the emergency response and does not correspond to information that Oxy Vinyls shared with NS or its contractors. NS stated that if a tank car temperature reached 150°F, NS and its contractors would have to cease any efforts to prevent an explosion. NS also gave the incident commander a 13-minute time limit on his decision, claiming that the vent and burn needed to be conducted by 3:00 p.m. to finish in daylight and to avoid an atmospheric inversion that would hamper dispersion of the vapor cloud. The charges for the vent and burn were detonated at 4:37 p.m. following a series of delays, indicating that 3:00 p.m. was not a hard deadline for the procedure.

NS's communications with the incident commander produced a heightened sense of urgency around the vent and burn; the incident commander testified at the NTSB's Investigative Hearing that he had to make a decision quickly to avoid catastrophic failure of a tank car.[158] These communications included incomplete and inaccurate information that pushed the incident commander toward approving the vent and burn. The NTSB concludes that NS and its contractors compromised the integrity of the vent and burn decision by creating unwarranted urgency and not communicating expert opinions and information completely and accurately to the incident commander. Without Oxy Vinyls to share its determinations, the incident

[156] NTSB Investigative Hearing Transcript, Day 2, p. 253.

[157] At this time, temperature readings from the exterior of the hottest tank car, OCPX80370, were about 126°F and had been trending downward.

[158] NTSB Investigative Hearing Transcript, Day 2, p. 139.

commander did not have a basis to effectively question the immediate necessity of the vent and burn. The NTSB concludes that the absence of Oxy Vinyls' expertise from the formal incident command denied the incident commander relevant information necessary to make a fully informed decision about the vent and burn. The NTSB recommends that Oxy Vinyls develop a policy to ensure that expertise on chemicals manufactured and offered for transportation by Oxy Vinyls is communicated to and shared with the full incident command during transportation accidents or incidents. The NTSB also recommends that the American Chemistry Council and The Chlorine Institute advise their members of the circumstances of the East Palestine derailment and fire and the need for shippers to ensure their expertise is communicated to and shared with the full incident command.

Oxy Vinyls developed conclusions about polymerizations and shared them with NS and its contractors in the expectation that its expertise would be passed onto decision-makers and taken into consideration. The NTSB is concerned by NS's decision not to relay Oxy Vinyls' conclusions that contradicted its early judgements about polymerization to the incident commander. NS was aware of expert opinions that contradicted its own and those of its contractors and, by not relaying the information, denied the rest of the incident command a chance to weigh the dissenting opinions before making a final decision.

Several explanations for NS's sustained preference for the vent and burn are consistent with available evidence, including confirmation bias and the perceived safety risks of alternative means of unloading the VCM. The explanations presented here are possibilities, but the evidence did not support a determination of which of these explanations, if any, was the main reason for the sustained preference for the vent and burn.

Confirmation bias is defined by the American Psychological Association as "the tendency to gather evidence that confirms preexisting expectations, typically by emphasizing or pursuing supporting evidence while dismissing or failing to seek contradictory evidence" (American Psychological Association 2018). NS and its contractors arrived at a belief in the need for a vent and burn as early as the afternoon of February 4, and the subsequent pattern of dismissing contradictory evidence while interpreting ambiguous evidence as support for the original belief is consistent with confirmation bias. Confirmation bias does not explain NS's inaccurate communications with the incident commander, but it does account for NS's failure to use Oxy Vinyls' expertise effectively or to revise its original position as more facts became available.

On February 5, 2023, NS told the NTSB that it had considered and rejected alternative means of unloading the VCM tank cars: transloading, hot tapping, and flaring. Several tank cars had damaged fittings, such as melted aluminum components, that could have made transloading or flaring the VCM unsafe or impossible. Hot tapping would have required personnel to puncture the tank cars and work near damaged equipment during the unloading process, exposing personnel to risk. Of the alternatives considered on the scene, NS described the vent and burn as presenting the least safety risk to railroad personnel, which was one reason NS provided for preferring the vent and burn and using the procedure on all five VCM tank cars instead of only the tank car with an elevated temperature (OCPX80370).

However, NS overlooked an alternative option: allowing the tank cars to finish cooling, then taking additional time to complete an assessment of each tank car's condition. When interviewed by the NTSB, the incident commander said he had been informed that the positions of the tank cars meant that venting and burning one would pose a risk to the others, and that venting and burning all five simultaneously was appropriate as a safety precaution. But a sixth tank car, a derailed DOT-105 tank car carrying isobutylene, a flammable gas in the same hazard class and division as VCM, was located closer than the four cooler VCM tank cars to tank car OCPX80370. The isobutylene tank car was therefore also closer to the vent and burn procedure performed on OCPX80370. The isobutylene tank car was not vented and burned, and it was successfully moved on February 7 and transloaded on February 23 following a damage assessment, which suggests that the nearby vent and burn did not render it unsafe to handle or unload. By performing a vent and burn of all five VCM tank cars on February 6, NS denied itself the option of assessing the structural condition and fittings of the VCM tank cars with the same thoroughness it applied to the isobutylene tank car.

The NTSB concludes that, no explanation or argument for NS and its contractors' continued advocacy for the vent and burn procedure justifies failing to communicate relevant expertise and dissenting opinions to the incident commander. The NTSB recommends that NS develop a policy to ensure that the expertise of manufacturers and shippers of hazardous materials involved in transportation accidents or incidents is communicated to its on-scene representatives and contractors and shared with the full incident command.

2.5.4 Vent and Burn Criteria

The FRA recognizes the vent and burn method as a valid but high-risk last-resort procedure for unloading tank cars transporting at least certain compressed liquified flammable gases, as shown by its 1994 and 2007 guidance on the method. The second 2007 report (Phase II of the associated study) includes guidance on when a vent and burn should be considered, what commodities are candidates for the procedure, and how an incident command should approach the decision (FRA 2007a). At least one individual involved in the East Palestine emergency response had knowledge of the 2007 study and Phase II report; the NS regional hazardous materials manager, then employed by the AAR, was one of the contributing authors. However, there is no evidence that the specific guidance in the Phase II report was used during the vent and burn decision, and the incident commander was not aware of the report's existence. Even if he had known about the report, he would not have had ready access to it because of the report's status as Sensitive Security Information.

While it is unclear whether access to the Phase II report would have led the incident commander to a different decision, the report would have provided him with additional information and the tools needed to ask further questions of NS and its contractors. The Phase II report's guidance, cautions, and checklists would have provided the incident commander with additional knowledge and resources when deciding whether to approve the vent and burn. The presence of public, well-known criteria for when to attempt vent and burn procedures would also have provided a baseline for conversations among NS, its contractors, and the rest of the incident command.

On May 6, 2007, the FRA released publicly available versions of the Phase I and Phase II reports on its website, but web publication may not be sufficient to distribute this guidance. The 1994 handbook was available on the FRA's website at the time of the East Palestine derailment but was not consulted during the lead-up to the vent and burn. The NTSB is concerned that the FRA's most recent and complete guidance about when to attempt the vent and burn method has not been widely disseminated to emergency responders. A vent and burn procedure was not necessary in East Palestine to prevent a BLEVE, but what was true in East Palestine may not hold in other circumstances or for other products. The NTSB concludes that the significant local and environmental impacts of a vent and burn decision demonstrate the need for federal guidance about what products and circumstances are candidates for the vent and burn method. The NTSB recommends that the FRA distribute the public versions of its 2007 vent and burn reports to emergency responder associations, including the IAFC, IAFF, and NVFC. To increase awareness

of federal guidance, the NTSB recommends that the IAFC, IAFF, and NVFC advise their members of the circumstances surrounding the vent and burn at East Palestine, the importance of obtaining information from the shipper when considering a vent and burn, and the availability of federal guidance on when the vent and burn method may be appropriate.

While the 2007 reports contain useful guidance, they were developed before the East Palestine vent and burn and therefore do not incorporate lessons learned from that accident. The Phase II report does not advise an incident command to contact the shipper when considering a vent and burn, for example, instead directing the incident commander to a database that has not been widely distributed. The checklist provided in the Phase II report does not always clearly indicate how the answers to its questions should shape a vent and burn decision. For example, it includes a row for product viscosity (high, medium, or low) but does not clearly explain how an incident command can determine viscosities or how different viscosities will affect a vent and burn (FRA 2007a). The NTSB recommends that the FRA update and re-publish its 2007 vent and burn reports to include clear instructions to consult the shipper when considering a vent and burn, more comprehensive guidance on what products are candidates for a vent and burn along with what chemical and other hazards may result, and an updated process flow chart incorporating lessons from the East Palestine vent and burn; the re-published reports should identify the questions an incident commander should ask when considering a vent and burn, distinguish the meaning of the answers, and identify the resources necessary to make an informed decision. The NTSB also recommends that the FRA make the updated versions of the 2007 vent and burn reports described in R-24-8 available to emergency responder associations, including the IAFC, IAFF, and NVFC. The NTSB also recommends that PHMSA distribute the FRA's most current guidance on the vent and burn method to emergency response agencies by referencing it in the next edition of the ERG.

2.6 Locomotive Data Recorders

The lead locomotive of train 32N was equipped with both head-end and inward-facing image recorders that provided investigators with video and audio data detailing the crew's activities and actions in the moments leading up to and during the derailment. NS voluntarily installed these devices; image and audio recorders are not required by FRA regulations for freight locomotives. In this accident, the audio and video data demonstrated and confirmed that the crewmembers were alert and responded appropriately to the hot bearing alarm. Additionally, the data were instrumental in corroborating crew statements.

The NTSB has determined that many previous railroad accident investigations would have benefitted from this technology. In a number of these accidents, the operator was killed, seriously injured, or could not recall details moments before the accident. However, even in the cases where the operator was not injured, audio and image recorders could be used to help verify what might have been seen and what crew actions were taken during the accident sequence.

For example, audio and image recorders were beneficial to our investigation of the Amtrak passenger train 501 derailment in DuPont, Washington, on December 18, 2017 (NTSB 2019). In that accident, the locomotive was equipped with an inward-facing image recorder that provided both a visual and audio recording of the crewmember activities during the accident trip. The device was voluntarily installed, and the recorded information proved extremely useful in the NTSB investigation.

Further, image recordings were also beneficial to our investigations of the January 4, 2017, collision of two Southeastern Pennsylvania Transportation Authority trolleys in Philadelphia, Pennsylvania, and the April 3, 2016, Amtrak accident in Chester, Pennsylvania (NTSB 2018b, NTSB 2017c). In those accidents, as in East Palestine, investigators used the image recordings to gather additional pertinent information about the accident sequence and used the audio recordings to corroborate the statements made by the operating crews. In turn, this information was used to develop recommendations to improve the safety of train operations. These types of recorders are also critical to improving operational safety and management oversight.

Unfortunately, in many other railroad accidents, the NTSB has not been able to determine the actions of the crewmembers operating the train because of the lack of inward-facing image and audio recordings. In our investigation of the August 12, 2019, collision of two CSX Transportation freight trains near Carey, Ohio, the NTSB was unable to determine the actions of the westbound train's crewmembers when they were operating the train from Columbus, Ohio, to Carey, Ohio; the actions of the westbound train engineer operating alone in the locomotive cab; or the events leading up to the collision (NTSB 2020c). This collision again demonstrated the need for in-cab recording devices to better understand and thereby prevent serious railroad collisions.

Similar issues were found during the NTSB's investigation of the September 12, 2008, head-on collision in Chatsworth, California, between a Metrolink passenger train and a Union Pacific Railroad freight train (NTSB 2010). The NTSB was unable to determine the actions of the Metrolink engineer leading up to the collision, and after discovering some illicit activities by the train engineer during

previous trips, the NTSB determined that Metrolink had no way of monitoring the train engineer's activities to ensure appropriate behavior.

The Chatsworth collision, in which 25 people were killed and 102 people were injured, underscored the importance of understanding the activities of crewmembers in the time leading up to the collision. As a result of that investigation, on February 23, 2010, the NTSB issued Safety Recommendations R-10-1 and R-10-2 to the FRA:

> Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-1)[159]

> Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. (R-10-2)[160]

In the 14 years since these recommendations were issued, the NTSB has reiterated them in the following seven major railroad accident investigations:

- September 30, 2010, collision of two Canadian National Railway freight trains near Two Harbors, Minnesota (NTSB 2013c)
- April 17, 2011, collision of a BNSF coal train with the rear end of a standing BNSF maintenance-of-way train in Red Oak, Iowa (NTSB 2012a)
- June 24, 2012, head-on collision of two Union Pacific Railroad freight trains near Goodwell, Oklahoma (NTSB 2013b)
- May 25, 2013, collision of a Union Pacific Railroad freight train with a BNSF Railway freight train near Chaffee, Missouri (NTSB 2014a)

[159] Safety Recommendation R-10-1 is currently classified Open—Unacceptable Response.

[160] Safety Recommendation R-10-2 is currently classified Open—Unacceptable Response.

- April 28, 2015, collision of two Southwestern Railroad freight trains near Roswell, New Mexico (NTSB 2018c)
- May 12, 2015, derailment of a National Railroad Passenger Corporation (Amtrak) passenger train in Philadelphia, Pennsylvania (NTSB 2016a)
- August 12, 2019, collision of two CSX Transportation freight trains near Carey, Ohio (NTSB 2020c)

Following the investigation of one of these accidents, the June 24, 2012, collision in Goodwell, Oklahoma, the NTSB made the following safety recommendation to all Class I railroads:

> Install in all controlling locomotive cabs and cab car operating compartments crash- and fire-protected inward- and outward-facing audio and image recorders. The devices should have a minimum 12-hour continuous recording capability. (R-13-26)

In response to Safety Recommendation R-13-26, on December 10, 2014, NS informed us that it already used outward-facing image recorders, and that it was analyzing safety benefits, costs, and employee privacy concerns related to inward-facing image recorders. On May 4, 2015, we noted these efforts and encouraged NS to install the recommended inward-facing audio and image recorders. Pending completion of that action, Safety Recommendation R-13-26 was classified Open—Acceptable Response. On December 23, 2021, we followed up with NS on the status of implementation of the recommendation, but we have not yet received a reply. The lead locomotive involved in the East Palestine derailment was equipped with inward- and outward-facing image and audio recorders.

We issued R-13-26 to a total of seven Class I railroads. Of the remaining six Class I railroads, three have a status of Open—Acceptable Response, two have a status of Open—Unacceptable Response, and one has a status of Open—Await Response because the railroad has not yet responded. We are concerned that in over 10 years since we issued R-13-26, none of the Class I railroads has fully implemented this recommendation.

In response to Safety Recommendations R-10-1 and R-10-2, the FRA announced at a May 28, 2015, meeting of the Railroad Safety Advisory Committee that in the absence of Railroad Safety Advisory Committee consensus recommendations, the FRA was proceeding with an NPRM addressing mandatory installation of locomotive recording devices in both freight and passenger railroads. As a result, on September 29, 2015, Safety Recommendations R-10-1 and R-10-2 were classified Open—Acceptable Response.

The 2015 FAST Act required the Secretary of Transportation to promulgate, within 2 years after the date of the FAST Act, regulations to require each railroad carrier that provides regularly scheduled, intercity rail passenger or commuter rail passenger transportation to install inward- and outward-facing image recording devices in all controlling locomotive cabs and cab car operating compartments. However, the FRA did not develop regulations requiring that recording devices be installed in intercity rail passenger or commuter passenger transportation within the 2-year deadline.

In our May 2019 DuPont accident report, the NTSB concluded that:

> The Federal Railroad Administration has demonstrated an unwillingness to implement the recommendations and regulation that would require inward-facing video and audio devices that are critical to accident investigations and improving safety on our nation's railroads. (NTSB 2019)

We further concluded that:

> Inward-facing recorders with both image and audio capabilities can increase the understanding of the circumstances of an accident, and, ultimately, provide greater precision in safety recommendations and subsequent safety improvements.

Consequently, we issued the following recommendation to the Secretary of Transportation on June 21, 2019:

> Require the Federal Railroad Administration to issue regulations for inward-facing recorders that include image and audio recordings as recommended by the National Transportation Safety Board in R-10-1 and R-10-2. (R-19-7)

We have yet to receive a response from the Secretary of Transportation and the recommendation remains classified Open—Await Response. On July 24, 2019, 9 years after we issued R-10-1 and R-10-2 and more than a year and a half after the FAST Act required regulatory action, the FRA published an NPRM, titled "Locomotive Image and Audio Recording Devices for Passenger Trains," proposing a requirement to install inward- and outward-facing recorders in passenger trains (84 Fed. Reg. 35712). The NPRM was only partially responsive to the NTSB recommendations because it did not apply to freight railroads.

On September 16, 2019, the NTSB stated the following in response to the NPRM:

> Freight trains and passenger trains operate on the same railroad tracks, posing the risk of accidents that have the potential to significantly affect the public. From a safety management system perspective, it is probable that recorded information about safety problems identified in freight railroad accidents and incidents could inform, mitigate, or prevent similar safety problems that might potentially affect passenger railroad operations. As a result, we believe it would be shortsighted to limit the proposed rule to passenger railroads. The FRA should ensure one level of safety for both passenger and freight railroads. Further, we firmly believe any such devices that railroads have already voluntarily installed, whether on freight or passenger trains, should be required to meet the minimum standards in the final rule.

Of the seven reiterations since we issued R-10-1 and R-10-2, six have involved collisions of freight trains.

In our 2020 Carey report, we concluded that "inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures" (NTSB 2020c). As a result, we reiterated Safety Recommendations R-10-1 and R-10-2 to the FRA. Because it had been 10 years since the recommendations were issued and the FRA had begun to address only passenger railroads, and not freight railroads, Safety Recommendations R-10-1 and R-10-2 were classified Open—Unacceptable Response.

On October 12, 2023, the FRA published the final rule, "Locomotive Image and Audio Recording Devices for Passenger Trains," amending 49 *CFR* Parts 217, 218, 229, and 299. The FRA rule requires installation of inward- and outward-facing locomotive image recording devices on all lead locomotives in passenger trains, as required by the FAST Act. The FRA declined to require freight railroads to install recording devices at the time of the rulemaking, saying the statutory requirements at 49 *United States Code* 20168(a) did not apply to freight locomotives (88 Fed. Reg. 70722). The rule falls short of our recommendations because it fails to require audio recording and excludes freight rail from any requirements. More than 14 years have passed since we recommended that the FRA require audio and image recorders in all locomotives, whether on freight or passenger trains. The recommendations were prompted by railroad accident investigations in which the NTSB determined having inward- and outward-facing audio and image recorders would have provided crucial

information to the railroads, their workforces, the FRA, and the NTSB that could have improved safety. In a number of those accidents, the operator died, was seriously injured, or could not recall details from moments before the accident.

Inward- and outward-facing audio and image recorders that are crash- and fire-protected provide valuable information about the events leading up to and during an accident in determining why it occurred. In this case, inward-facing image and audio data were instrumental in eliminating the train crew's performance as a factor in the accident. Further, recorded image and audio information allows railroads, labor unions, the FRA, and the NTSB to identify and immediately address critical improvements that directly impact the safety of the rail industry, the traveling public, and the communities in which our railroads operate. The NTSB concludes that inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures. Therefore, the NTSB reiterates Safety Recommendation R-13-26 to the Class I railroads.

The NTSB believes that the FRA has the regulatory authority to establish regulations to act on Safety Recommendations R-10-1 and R-10-2. The relevant language in the FAST Act mandated that the FRA require image recorders for passenger and commuter trains but did not modify the FRA's existing authority to establish requirements for rail equipment, including image and audio recorders, to improve safety. However, we note that the FRA's rulemaking on image recorders resulted from a specific legislative mandate to act, and we believe that a legislative mandate to act on Safety Recommendations R-10-1 and R-10-2 would result in the FRA satisfying these long-standing recommendations. Therefore, the NTSB recommends that the FRA require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash and fire protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. If necessary, obtain legislative authority to act on this recommendation. The NTSB also recommends that the FRA require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential

to safety. If necessary, obtain legislative authority to act on this recommendation. Safety Recommendations R-10-1 and R-10-2 are classified Closed—Superseded.

Finally, the NTSB concludes that the FRA's final rule in response to the FAST Act did not require audio recording in passenger locomotives and did not require inward- and outward-facing image and audio recording in freight rail locomotives, resulting in a missed opportunity to record important safety data. As noted above, the FAST Act did not directly mandate that the FRA establish regulations that would satisfy Safety Recommendations R-10-1 and R-10-2, and the FRA's October 2023 rulemaking did not address all the safety concerns raised by the NTSB. Therefore, the NTSB recommends that the Secretary of Transportation require the FRA to issue regulations for inward-facing recorders that include image and audio recordings as recommended by the NTSB in R-24-10 and R-24-11. If necessary, obtain legislative authority to act on this recommendation. Safety Recommendation R-19-7 is classified Closed—Superseded.

3 Conclusions

3.1 Findings

1. None of these issues contributed to the derailment of train 32N and subsequent hazardous materials release: (1) defects in railroad track or infrastructure; (2) the signals or train control system; (3) the train crew's proper train handling and appropriate response to the bearing alarm and derailment; (4) the marking, placarding, and method of loading for the derailed vinyl chloride monomer tank cars; (5) the weight and lading volume of the derailed hazardous materials tank cars; and (6) the mechanical crashworthiness of the derailed DOT-105 tank cars.

2. Train 32N derailed because the L1 bearing on railcar GPLX75465 overheated and caused the axle to separate, causing the railcar's lead truck to derail.

3. There is insufficient evidence to determine if the Terminal Railroad Association of St. Louis mechanical inspection of train 32N on February 1, 2023, failed to identify signs of failure on hopper car GPLX75465's L1 wheel bearing.

4. The non-critical alert transmitted by the Salem, Ohio, hot bearing detector did not reflect the true temperature and failing condition of the L1 wheel bearing.

5. A failing wheel bearing's actual internal temperatures will likely exceed external temperatures measured and reported by a hot bearing detector (HBD), and this limit on HBD accuracy is inherent in how current HBDs and railcar trucks are designed.

6. The combination of Norfolk Southern Railway standard operating procedures that required only continued monitoring for non-critical bearing alerts, the limited ability of hot bearing detectors to measure a bearing's actual internal temperature, and the distance between detectors did not give the train's crew adequate warning to stop the train before the suspect bearing failed and caused the derailment.

7. Without research into how differences in alert and alarm thresholds and varied distances between detectors affect the performance of wayside bearing defect detection systems, railroads and regulators lack the

information to determine what changes would produce significant safety improvements.

8. Regulatory requirements for the installation, inspection, and maintenance of wayside bearing defect detectors would protect the reliability of these devices and improve the safety of railroad operations.

9. Because the effectiveness of wayside bearing defect detection systems depends on appropriate operational responses, and because the rail industry has yet to arrive at a consensus standard for these responses, research is necessary to determine what operational responses to bearing alerts and alarms are sufficient to prevent bearing-related accidents.

10. A database capturing bearing failure and replacement information could help identify what factors pose an increased risk of burn-off so that railroads, regulators, and investigators can better address bearing-related safety issues.

11. While the East Palestine Fire Department deputy fire chief and other volunteer firefighters acted in good faith to protect their community, the initial emergency response did not conform to Emergency Response Guidebook guidance for fires involving tank cars and unknown materials; both the proximity of the first command post to the fire and the use of manned hoses near a fire involving unknown materials placed these firefighters at unnecessary risk.

12. The state of Ohio's statutory requirements for volunteer firefighter training were insufficient to support a safe emergency response to the East Palestine derailment led by a volunteer fire department.

13. Because there were not common radio channels between all responding agencies, the emergency response lacked efficient coordination.

14. The delayed transmittal of consist information by Norfolk Southern Railway to emergency responders needlessly increased the time emergency responders spent near the derailment pileup and delayed the evacuation order, resulting in unnecessary and increased exposure of emergency responders and the public to postderailment hazards.

15. The Pipeline and Hazardous Materials Safety Administration's Hazardous Materials: FAST Act Requirements for Real-Time Train Consist Information addresses the safety concerns of Safety Recommendation R-07-4.

16. The vulnerability of tank car placards to fire exposure resulted in illegible placards and hampered emergency responders' efforts to identify hazards.

17. The postderailment fire likely began with hazardous material released from a mechanically breached DOT-111 tank car, most probably the butyl acrylates released from tank car UTLX205907.

18. If DOT-111 tank cars transporting combustible and flammable liquids had not sustained mechanical breaches during the derailment, the DOT-105 tank cars transporting vinyl chloride monomer likely would not have been exposed to the fire conditions that led to concerns about polymerization and ultimately the vent and burn actions that released additional lading from those five DOT-105 tank cars.

19. Voluntary industry action to improve the safety of the tank car fleet by completing the phase out of remaining DOT-111 tank cars in flammable liquids service ahead of the Fixing America's Surface Transportation Act mandate is feasible, but such action is unlikely because of economic and business disincentives.

20. The presence of DOT-111 tank cars carrying hazardous materials in a mixed freight train increases the risk of lading releases from other, more resilient tank cars during a derailment.

21. The current Association of American Railroads tank car certificate of construction approval process lacks a means of verifying manufacturers' claims and is therefore insufficient to ensure that tank cars and their fittings are appropriate for their specified lading.

22. While the use of aluminum in the vinyl chloride monomer tank cars and pressure relief devices rendered them susceptible to thermal damage, there is insufficient evidence to determine whether this greater susceptibility created a safety hazard or contributed to the release of hazardous materials following the East Palestine derailment.

23. Cascading hazardous materials releases are not unique to high-hazard flammable trains, and the probability of a cascading hazardous materials release depends in part on variations in tank car survivability and on the presence of hazardous materials other than Class 3 flammable liquids, such as combustible liquids and Division 2.1 flammable gases.

24. The definition of key train in Association of American Railroads Circular OT-55 does not account for differences in survivability between different tank car specifications, and the DOT-111 and AAR-211 specifications can pose an elevated risk of a hazardous materials release compared to other specifications, such as the DOT-117.

25. Postaccident examinations, which found no solidified chemical matter blocking pressure relief devices and other tank car service equipment openings, do not indicate that a polymerization reaction occurred within any of the five vinyl chloride monomer tank cars.

26. The observed downward temperature trend in tank car OCPX80370 indicates that polymerization was not occurring within the tank car, contrary to the representation by Norfolk Southern Railway and its contractors.

27. The vinyl chloride monomer within the derailed DOT-105 tank cars remained in a stabilized environment until the vent and burn and did not undergo polymerization; the vent and burn procedure was not necessary to prevent a polymerization-induced tank rupture.

28. Language in The Chlorine Institute's Pamphlet 171 overstates the probability of vinyl chloride monomer polymerization in scenarios where tank cars remain intact, likely leading those using the pamphlet during an emergency response effort to overestimate the likelihood of polymerization.

29. Because Level 3 CHLOREP contractors are expected to provide advanced emergency response capabilities, including communicating expertise to other on-scene personnel and the transloading of vinyl chloride monomer (VCM), these contractors should possess or know how to obtain enough technical knowledge to accurately assess how chemical hazards, such as polymerization, affect a safe response to a VCM incident.

30. Information collected during real-world accidents is a vital resource in ensuring that hazardous materials guidance is suitable for supporting responses to transportation emergencies.

31. Norfolk Southern Railway and its contractors continued to assert the necessity of a vent and burn after expert opinion and available evidence should have led them to re-evaluate their initial conclusions regarding polymerization.

32. Norfolk Southern Railway and its contractors compromised the integrity of the vent and burn decision by creating unwarranted urgency and not communicating expert opinions and information completely and accurately to the incident commander.

33. The absence of Oxy Vinyls' expertise from the formal incident command denied the incident commander relevant information necessary to make a fully informed decision about the vent and burn.

34. No explanation or argument for Norfolk Southern Railway and its contractors' continued advocacy for the vent and burn procedure justifies failing to communicate relevant expertise and dissenting opinions to the incident commander.

35. The significant local and environmental impacts of a vent and burn decision demonstrate the need for federal guidance about what products and circumstances are candidates for the vent and burn method.

36. Inward- and outward-facing recorders can improve the quality of accident and incident investigations and provide the opportunity for proactive steps by railroad management to verify that train crew actions are in accordance with safety rules and procedures.

37. The Federal Railroad Administration's final rule in response to the Fixing America's Surface Transportation Act did not require audio recording in passenger locomotives and did not require inward- and outward-facing image and audio recording in freight rail locomotives, resulting in a missed opportunity to record important safety data.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the derailment involving Norfolk Southern Railway train 32N was the failure of the L1 bearing on the 23rd railcar in the consist that overheated and caused the axle to separate, derailing the train and leading to a postderailment fire that likely began with the release of a Class 3 flammable liquid from a DOT-111 tank car that was punctured during the derailment. Contributing to the postderailment fire and the severity of the hazardous materials release was the continued use of DOT-111 tank cars in hazardous materials service. Also contributing to the severity of the hazardous materials release were (1) the failure of Norfolk Southern Railway and its contractors to communicate relevant expertise and dissenting opinions to the incident

commander and (2) the inaccurate representation by Norfolk Southern Railway and its contractors that the tank cars were at risk of catastrophic failure from a polymerization reaction, which created unwarranted urgency and led to the unnecessary decision to vent and burn five derailed vinyl chloride monomer tank cars to prevent a polymerization-induced tank car rupture. Contributing to the exposure of emergency responders and the public to postderailment hazards were (1) Norfolk Southern Railway's delay in transmitting the train consist information to emergency responders and (2) the state of Ohio's insufficient training requirements for volunteer firefighters.

4 Recommendations

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations.

To the Secretary of Transportation:

Require the Federal Railroad Administration to issue regulations for inward-facing recorders that include image and audio recordings as recommended by the National Transportation Safety Board in R-24-10 and R-24-11. If necessary, obtain legislative authority to act on this recommendation. (R-24-1)

To the Federal Railroad Administration:

Research the effectiveness of current bearing defect detection systems, identify minimum standards to protect railroad personnel and the public, and make public the results of this research. (R-24-2)

Use the results of the research described in R-24-2 to develop and establish minimum requirements for bearing defect detection systems, including criteria for bearing alert and alarm thresholds and maximum distances between wayside detectors. (R-24-3)

Establish requirements for the installation, inspection, and maintenance of wayside bearing defect detectors to protect the reliability of these devices and improve the safety of railroad operations. (R-24-4)

Use the results of the research described in R-24-2 to develop and establish rules governing railroads' operational responses to bearing alerts and alarms. (R-24-5)

Monitor the progress of the Association of American Railroads' (AAR) action on R-24-20 and use your regulatory authority to ensure that the AAR addresses weaknesses in its tank car service equipment approval process. (R-24-6)

Distribute the public versions of your 2007 vent and burn reports to emergency responder associations, including the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council. (R-24-7)

Update and re-publish your 2007 vent and burn reports to include clear instructions to consult the shipper when considering a vent and burn, more comprehensive guidance on what products are candidates for a vent and burn along with what chemical and other hazards may result, and an updated process flow chart incorporating lessons from the East Palestine vent and burn; the re-published reports should identify the questions an incident commander should ask when considering a vent and burn, distinguish the meaning of the answers, and identify the resources necessary to make an informed decision. (R-24-8)

Make the updated versions of the 2007 vent and burn reports described in R-24-8 available to emergency responder associations, including the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council. (R-24-9)

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash and fire protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. If necessary, obtain legislative authority to act on this recommendation. (R-24-10)

Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. If necessary, obtain legislative authority to act on this recommendation. (R-24-11)

To the Pipeline and Hazardous Materials Safety Administration:

Require that placards be able to survive fires and accidents and remain legible during such emergencies long enough to fulfill their functions as described in the Emergency Response Guidebook. (I-24-1)

Obtain the necessary legislative authority and accelerate the deadline for removing specification DOT-111 tank cars from flammable liquids service. (R-24-12)

Establish a tank car replacement schedule whereby non-pressure tank cars in any hazardous materials service must meet or exceed the safety standards of the DOT-117 specification; if necessary, obtain legislative authority to act on this recommendation. (R-24-13)

Revise the definition of high-hazard flammable train to account for differences in survivability between tank car specifications and to include hazardous materials other than flammable liquids, such as combustible liquids and Division 2.1 flammable gases, that can contribute to cascading hazardous materials releases; if necessary, obtain legislative authority to act on this recommendation. (R-24-14)

Distribute the Federal Railroad Administration's most current guidance on the vent and burn method to emergency response agencies by referencing it in the next edition of the Emergency Response Guidebook. (R-24-15)

To the state of Ohio:

Amend your firefighter training statute and revise your volunteer firefighter certification standards to meet the NFPA 1010 standard for professional firefighters. (R-24-16)

To the Columbiana County Emergency Management Agency:

Adopt a policy to, upon receipt of a train consist, immediately provide it to the incident commander and all appropriate response agencies and departments. (R-24-17)

Update your Emergency Operations Plan, Hazardous Materials Response Plan, and Hazard Mitigation Plan, as appropriate, with lessons learned from the East Palestine derailment and fire, including, at a minimum, coordination among response agencies, communications, requests for and distribution of the train consist, staging and availability of equipment and other resources, and training for emergency responders. (R-24-18)

To the Association of American Railroads:

Develop a database of bearing failures and replacements and make it available to railroads, regulators, and investigators to help determine and address failure risk factors. (R-24-19)

Revise the Manual of Standards and Recommended Practices, M-1002, Specifications for Tank Cars, to establish criteria and procedures for

manufacturers of tank car service equipment to demonstrate compatibility of pressure relief devices and other Association of American Railroads-approved service equipment with intended ladings. (R-24-20)

Revise the definition of key train in Circular OT-55 to designate as a key train any train containing tank cars transporting hazardous materials that do not meet the DOT-117 standard. (R-24-21)

To the National Volunteer Fire Council:

Identify barriers to adequate fire and emergency response training for volunteer firefighters, particularly for situations where hazardous materials are present, and publish actions states, municipalities, and the private sector can take to provide the flexibility necessary for volunteer firefighters to obtain training. (R-24-22)

To the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council:

Advise your members of the circumstances of the East Palestine derailment and fire, identify fire departments whose personnel are not trained to the NFPA 1010 standard for professional firefighters, recommend that these departments adopt training that meets this standard, and inform them of funded training opportunities available through private, state, and federal programs. (R-24-23)

Advise your members of the circumstances surrounding the vent and burn at East Palestine, the importance of obtaining information from the shipper when considering a vent and burn, and the availability of federal guidance on when the vent and burn method may be appropriate. (R-24-24)

To The Chlorine Institute:

Review and revise Pamphlet 171 to ensure that its safety messages about vinyl chloride monomer polymerization in tank cars are accurate and adequately support determining whether a rail accident poses a risk of polymerization. (R-24-25)

Review and revise your Chlorine Emergency Plan training and verification programs to ensure that Level 3 contractors possess or can obtain enough technical knowledge of vinyl chloride monomer (VCM) to

accurately assess and respond to chemical hazards like polymerization during a VCM incident. (R-24-26)

To the American Chemistry Council and The Chlorine Institute:

Advise your members of the circumstances of the East Palestine derailment and fire and the need for shippers to ensure their expertise is communicated to and shared with the full incident command. (R-24-27)

To Norfolk Southern Railway:

Review and revise your procedures to immediately provide emergency responders with an accurate copy of the train consist upon becoming aware of an accident. (R-24-28)

Update your submissions to the Pipeline and Hazardous Materials Safety Administration's Incident Database to accurately reflect the cause of package failures following the East Palestine derailment. (R-24-29)

Adopt policies to ensure that your emergency response contractors keep detailed records of information used to make decisions involving hazardous materials, and share this information with shippers, relevant chemical associations, and other entities that provide hazardous materials guidance. (R-24-30)

Develop a policy to ensure that the expertise of manufacturers and shippers of hazardous materials involved in transportation accidents or incidents is communicated to your on-scene representatives and contractors and shared with the full incident command. (R-24-31)

To Oxy Vinyls, LP:

Update the safety data sheet for vinyl chloride monomer (VCM) to accurately reflect the potential risks of VCM and the hazards that increase such risks. (R-24-32)

Develop a policy to ensure that expertise on chemicals manufactured and offered for transportation by Oxy Vinyls is communicated to and shared with the full incident command during transportation accidents or incidents. (R-24-33)

4.2 Previously Issued Recommendations Reiterated in this Report

The National Transportation Safety Board reiterates the following safety recommendations.

To the Class I railroads:

> Install in all controlling locomotive cabs and cab car operating compartments crash- and fire-protected inward- and outward-facing audio and image recorders. The devices should have a minimum 12-hour continuous recording capability. (R-13-26)

4.3 Previously Issued Recommendations Classified in this Report

The National Transportation Safety Board classifies the following safety recommendations.

To the Secretary of Transportation:

> Require the Federal Railroad Administration to issue regulations for inward-facing recorders that include image and audio recordings as recommended by the National Transportation Safety Board in R-10-1 and R-10-2. (R-19-7)

Safety Recommendation R-19-7 is classified Closed—Superseded in section 2.6 of this report.

To the Federal Railroad Administration:

> Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash- and fire-protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. (R-10-1)

Safety Recommendation R-10-1 is classified Closed—Superseded in section 2.6 of this report.

Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. (R-10-2)

Safety Recommendation R-10-2 is classified Closed—Superseded in section 2.6 of this report.

To the Pipeline and Hazardous Materials Safety Administration:

With the assistance of the Federal Railroad Administration, require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train. (R-07-4)

Safety Recommendation R-07-4 is classified Closed—Acceptable Action in section 2.3.2 of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER HOMENDY
Chair

MICHAEL GRAHAM
Member

THOMAS CHAPMAN
Member

ALVIN BROWN
Member

J. TODD INMAN
Member

Report Date: June 25, 2024

Board Member Statements

Member Thomas Chapman filed the following concurring statement on July 2, 2024. Chair Jennifer Homendy and Member Alvin Brown joined in this statement.

I concur and join in the Board's unanimous adoption of the investigation report.

A key finding in the report notes that "*Norfolk Southern Railway and its contractors continued to assert the necessity of a vent and burn after expert opinion and available evidence should have led them to re-evaluate their initial conclusions regarding polymerization.*"

Further, "*Norfolk Southern Railway and its contractors compromised the integrity of the vent and burn decision by creating unwarranted urgency and not communicating expert opinions and information completely and accurately to the incident commander.*"

Finally, "*[n]o explanation or argument for Norfolk Southern Railway and its contractors' continued advocacy for the vent and burn procedure justifies failing to communicate relevant expertise and dissenting opinions to the incident commander.*"

In the wake of the derailment, the hazardous materials release, and the subsequent fire, the community of East Palestine, Ohio, was further traumatized by the flawed decision to conduct a rare vent and burn procedure on five hazardous materials tank cars carrying vinyl chloride monomer. Undoubtedly, there will be long-term economic harm to the community. And some fear the massive vent and burn event will result in potential health or environmental impacts which may not be fully understood for years to come.

Our investigation confirmed that the vent and burn procedure was not necessary to prevent a polymerization-induced tank rupture of any of the five tank cars carrying vinyl chloride monomer. There was sufficient information and expertise available at the time to conclude that the vent and burn was unnecessary. Sadly, the decision was made without knowledge of dissenting opinions and evidence indicating that polymerization was not occurring.

Lessons must be learned from the chaotic process which lead to the erroneous decision to vent and burn. Never again should any community suffer the pain of East Palestine.

Member J. Todd Inman filed the following concurring statement on July 2, 2024.

Commentary on Recommendations

Upon review of the investigatory material and draft report put together by NTSB staff, it became apparent how many similarities there were in this Norfolk Southern train 32N derailment to previous accidents the NTSB has investigated going back several decades. Unfortunately, while the NTSB issued numerous recommendations following those investigations, many remained incomplete or were closed-unacceptable that could have had a meaningful impact on February 3, 2023, and the days that followed. Examples include the phase-out of DOT-111 tank cars and the need for inward- and outward- facing recorders capable of at least 12 hours of recording.

Another area that was scrutinized by the investigation and found to have contributed to the inadequate and unsafe incident response was the lack of timely access to the train consist for first responders. In 2007, the Board recommended the Federal Railroad Administration (FRA) issue a requirement that railroads immediately provide emergency responders with accurate and real-time information regarding hazardous materials on a train. One day before the Board met, the Pipeline and Hazardous Materials Safety Administration (PHMSA) finally issued a regulation implementing this recommendation. While such a regulation would have made a difference for this accident, I am hopeful future accident responders will benefit from this regulation that was far overdue.

What the traveling public cannot afford is inaction on the recommendations issued and reiterated in response to this investigation. I would encourage each entity that received a recommendation to work with our Office of Safety Recommendations and Communications to find the quickest way to make meaningful progress towards the implementation of the Board's recommendations. While my amendment to recommendation #1 was not adopted, I implore the FRA to quickly identify a vehicle by which the research described under the recommendation can be conducted with haste, like an existing contract with a recognized research entity. I will also take the opportunity to advocate that the FRA, and any entity selected to conduct such research, ensure the research is not limited to current technologies in use in rail, but also explores other systems and technologies under development or in use in other fields that may have the ability to improve the accuracy of bearing detection, especially across varying car designs.

Commentary on the Purpose of NTSB Investigations

While the original purpose of reserving the opportunity to submit a Board Member Statement was to further highlight the importance of the recommendations of the report, I would be remiss if the opportunity was not also taken to remind the agency and future parties as a whole that we are entrusted by the public to investigate accidents, determine a probable cause, and issue recommendations that will improve transportation for the general public. As our regulations state "NTSB investigations are fact-finding proceedings with no adverse parties… and are not conducted for the purpose of determining the rights, liabilities, or blame of any person or entity, as they are not adjudicatory proceedings."[161] It is a difficult line to draw, but one that we need to be careful of never blurring as we deal with entities and individuals that may not elevate safety improvement in the manner we do, that hinder or hamper the work of our investigators, and that do not abide by the expectations of the NTSB.

My fear is that some of the comments made in connection to the Board Meeting and underlying investigation were not in response to information documented in our report or the accident itself and may have overshadowed the important content of the report, the work of the NTSB's investigators, and the attention our recommendations deserve. While some discussion may have been warranted regarding alleged breaches of the party agreement and the impact it may have had on our staff and the investigation, the party system has proven to be effective over the 57-year history of the NTSB. The party system must be preserved to ensure we continue to receive the engagement necessary from industry and regulators that allows us to effectuate change in the transportation system. It is our responsibility to protect the party system in order to keep the public safe and it is the responsibility of the parties to embrace it. This requires respect and good faith by all participants and avoiding the placement of blame by parties or the NTSB at any point.

[161] 49 *CFR* § 831.4(c)

Appendixes

Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified on February 3, 2023, of the derailment of Norfolk Southern Railway train 32N. The train was carrying several hazardous materials, and breached tank cars released hazardous materials and ignited. The incident commander later decided to deliberately breach five hazardous materials tank cars because of concerns that chemical reactions in at least one tank car could result in an explosion. No injuries were reported.

The NTSB launched Member Michael Graham, an investigator in charge, and a team to investigate the cause of the derailment, the hazardous materials release, and the emergency response.

Parties to the investigation included the Pipeline and Hazardous Materials Safety Administration; Federal Railroad Administration; Ohio State Highway Patrol; Village of East Palestine; Norfolk Southern Corporation; Trinity Industries Leasing Company; Oxy Vinyls, LP; GATX Corporation (owner of an involved tank car and the first hopper car to derail); Midland Manufacturing (a manufacturer of tank car fittings); Brotherhood of Locomotive Engineers and Trainmen; Transportation Communications Union; Brotherhood of Railway Carmen; International Association of Sheet Metal, Air, Rail and Transportation Workers; and International Association of Firefighters.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the Secretary of Transportation

R-24-1

Require the Federal Railroad Administration to issue regulations for inward-facing recorders that include image and audio recordings as recommended by the National Transportation Safety Board in R-24-10 and R-24-11. If necessary, obtain legislative authority to act on this recommendation.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.6, Locomotive Data Recorders. Information supporting (b)(1) can be found on pages 158–65; (b)(2) and (b)(3) are not applicable.

To the Federal Railroad Administration

R-24-2

Research the effectiveness of current bearing defect detection systems, identify minimum standards to protect railroad personnel and the public, and make public the results of this research.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.2.4, Bearing Failure Detection. Information supporting (b)(1) can be found on pages 103–08; (b)(2) can be found on pages 107-08; and (b)(3) is not applicable.

R-24-3

Use the results of the research described in R-24-2 to develop and establish minimum requirements for bearing defect detection systems, including criteria for bearing alert and alarm thresholds and maximum distances between wayside detectors.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.2.4, Bearing Failure Detection. Information supporting (b)(1) can be found on pages 103–08; (b)(2) can be found on pages 107-08, and (b)(3) is not applicable.

R-24-4

Establish requirements for the installation, inspection, and maintenance of wayside bearing defect detectors to protect the reliability of these devices and improve the safety of railroad operations.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.2.4, Bearing Failure Detection. Information supporting (b)(1) can be found on pages 109–10; (b)(2) and (b)(3) are not applicable.

R-24-5

Use the results of the research described in R-24-2 to develop and establish rules governing railroads' operational responses to bearing alerts and alarms.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.2.4, Bearing Failure Detection. Information supporting (b)(1) can be found on page 110; (b)(2) and (b)(3) are not applicable.

R-24-6

Monitor the progress of the Association of American Railroads' (AAR) action on R-24-20 and use your regulatory authority to ensure

that the AAR addresses weaknesses in its tank car service equipment approval process.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.3.1, Tank Car and Fittings Certification. Information supporting (b)(1) can be found on pages 135–36; (b)(2) and (b)(3) are not applicable.

R-24-7

Distribute the public versions of your 2007 vent and burn reports to emergency responder associations, including the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.4, Vent and Burn Criteria. Information supporting (b)(1) can be found on pages 157–58; (b)(2) can be found on pages 157–58; and (b)(3) is not applicable.

R-24-8

Update and re-publish your 2007 vent and burn reports to include clear instructions to consult the shipper when considering a vent and burn, more comprehensive guidance on what products are candidates for a vent and burn along with what chemical and other hazards may result, and an updated process flow chart incorporating lessons from the East Palestine vent and burn; the re-published reports should identify the questions an incident commander should ask when considering a vent and burn, distinguish the meaning of the answers, and identify the resources necessary to make an informed decision.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.4, Vent and Burn Criteria. Information supporting (b)(1) can be found on pages 157–58; (b)(2) can be found on pages 157–58; and (b)(3) is not applicable.

R-24-9

Make the updated versions of the 2007 vent and burn reports described in R-24-8 available to emergency responder associations, including the International Association of Fire Chiefs, the

International Association of Fire Fighters, and the National Volunteer Fire Council.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.4, Vent and Burn Criteria. Information supporting (b)(1) can be found on pages 157–58; (b)(2) can be found on pages 157–58; and (b)(3) is not applicable.

R-24-10

Require the installation, in all controlling locomotive cabs and cab car operating compartments, of crash and fire protected inward- and outward-facing audio and image recorders capable of providing recordings to verify that train crew actions are in accordance with rules and procedures that are essential to safety as well as train conditions. The devices should have a minimum 12-hour continuous recording capability with recordings that are easily accessible for review, with appropriate limitations on public release, for the investigation of accidents or for use by management in carrying out efficiency testing and systemwide performance monitoring programs. If necessary, obtain legislative authority to act on this recommendation.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.6, Locomotive Data Recorders. Information supporting (b)(1) can be found on pages 158–65; (b)(2) and (b)(3) are not applicable.

R-24-11

Require that railroads regularly review and use in-cab audio and image recordings (with appropriate limitations on public release), in conjunction with other performance data, to verify that train crew actions are in accordance with rules and procedures that are essential to safety. If necessary, obtain legislative authority to act on this recommendation.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.6, Locomotive Data Recorders. Information supporting (b)(1) can be found on pages 158–65; (b)(2) and (b)(3) are not applicable.

To the Pipeline and Hazardous Materials Safety Administration

I-24-1

Require that placards be able to survive fires and accidents and remain legible during such emergencies long enough to fulfill their functions as described in the Emergency Response Guidebook.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.3, Placard Legibility. Information supporting (b)(1) can be found on pages 121–22; (b)(2) and (b)(3) are not applicable.

R-24-12

Obtain the necessary legislative authority and accelerate the deadline for removing specification DOT-111 tank cars from flammable liquids service.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.2, Non-Pressure Tank Cars. Information supporting (b)(1) can be found on pages 125–34; (b)(2) can be found on pages 133–34; and (b)(3) is not applicable.

R-24-13

Establish a tank car replacement schedule whereby non-pressure tank cars in any hazardous materials service must meet or exceed the safety standards of the DOT-117 specification; if necessary, obtain legislative authority to act on this recommendation.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.2, Non-Pressure Tank Cars. Information supporting (b)(1) can be found on pages 125–34; (b)(2) and (b)(3) are not applicable.

R-24-14

Revise the definition of high-hazard flammable train to account for differences in survivability between tank car specifications and to include hazardous materials other than flammable liquids, such as combustible liquids and Division 2.1 flammable gases, that can contribute to cascading hazardous materials releases; if necessary, obtain legislative authority to act on this recommendation.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.4, High-Hazard Flammable Trains. Information supporting (b)(1) can be found on pages 138–141; (b)(2) and (b)(3) are not applicable.

R-24-15

Distribute the Federal Railroad Administration's most current guidance on the vent and burn method to emergency response agencies by referencing it in the next edition of the Emergency Response Guidebook.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.4, Vent and Burn Criteria. Information supporting (b)(1) can be found on pages 157–58; (b)(2) can be found on pages 157–58; and (b)(3) is not applicable.

To the state of Ohio

R-24-16

Amend your firefighter training statute and revise your volunteer firefighter certification standards to meet the NFPA 1010 standard for professional firefighters.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.1, Initial Deployment of Firefighters. Information supporting (b)(1) can be found on pages 113–15; (b)(2) and (b)(3) are not applicable.

To the Columbiana County Emergency Management Agency

R-24-17

Adopt a policy to, upon receipt of a train consist, immediately provide it to the incident commander and all appropriate response agencies and departments.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.2, Communication and Consist Information. Information supporting (b)(1) can be found on pages 115–18; (b)(2) and (b)(3) are not applicable.

R-24-18

Update your Emergency Operations Plan, Hazardous Materials Response Plan, and Hazard Mitigation Plan, as appropriate, with lessons learned from the East Palestine derailment and fire, including, at a minimum, coordination among response agencies, communications, requests for and distribution of the train consist, staging and availability of equipment and other resources, and training for emergency responders.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.2, Communication and Consist Information. Information supporting (b)(1) can be found on pages 115–18; (b)(2) and (b)(3) are not applicable.

To the Association of American Railroads

R-24-19

Develop a database of bearing failures and replacements and make it available to railroads, regulators, and investigators to help determine and address failure risk factors.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.2.5, Accident Bearing Failure Analysis. Information supporting (b)(1) can be found on pages 111–13; (b)(2) can be found on page 109 and (b)(3) is not applicable.

R-24-20

Revise the Manual of Standards and Recommended Practices, M-1002, Specifications for Tank Cars, to establish criteria and procedures for manufacturers of tank car service equipment to demonstrate compatibility of pressure relief devices and other Association of American Railroads-approved service equipment with intended ladings.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.3.1, Tank Car and Fittings Certification. Information supporting (b)(1) can be found on pages 135–36; (b)(2) and (b)(3) are not applicable.

R-24-21

Revise the definition of key train in Circular OT-55 to designate as a key train any train containing tank cars transporting hazardous materials that do not meet the DOT-117 standard.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.5, Key Trains. Information supporting (b)(1) can be found on page 141; (b)(2) and (b)(3) are not applicable.

To the National Volunteer Fire Council

R-24-22

Identify barriers to adequate fire and emergency response training for volunteer firefighters, particularly for situations where hazardous materials are present, and publish actions states, municipalities, and the private sector can take to provide the flexibility necessary for volunteer firefighters to obtain training.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.1, Initial Deployment of Firefighters. Information supporting (b)(1) can be found on pages 113–15; (b)(2) and (b)(3) are not applicable.

To the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council

R-24-23

Advise your members of the circumstances of the East Palestine derailment and fire, identify fire departments whose personnel are not trained to the NFPA 1010 standard for professional firefighters, recommend that these departments adopt training that meets this standard, and inform them of funded training opportunities available through private, state, and federal programs.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.1, Initial Deployment of Firefighters. Information supporting (b)(1) can be found on pages 113–15; (b)(2) and (b)(3) are not applicable.

R-24-24

Advise your members of the circumstances surrounding the vent and burn at East Palestine, the importance of obtaining information from the shipper when considering a vent and burn, and the availability of federal guidance on when the vent and burn method may be appropriate.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.4, Vent and Burn Criteria. Information supporting (b)(1) can be found on pages 157–58; (b)(2) can be found on pages 157–58; and (b)(3) is not applicable.

To The Chlorine Institute

R-24-25

Review and revise Pamphlet 171 to ensure that its safety messages about vinyl chloride monomer polymerization in tank cars are accurate and adequately support determining whether a rail accident poses a risk of polymerization.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.2, Quality of VCM Hazard Information. Information supporting (b)(1) can be found on pages 149–51; (b)(2) and (b)(3) are not applicable.

R-24-26

Review and revise your Chlorine Emergency Plan training and verification programs to ensure that Level 3 contractors possess or can obtain enough technical knowledge of vinyl chloride monomer (VCM) to accurately assess and respond to chemical hazards like polymerization during a VCM incident.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.2, Quality of VCM Hazard Information. Information supporting (b)(1) can be found on pages 149–51; (b)(2) and (b)(3) are not applicable.

To the American Chemistry Council and The Chlorine Institute:

R-24-27

Advise your members of the circumstances of the East Palestine derailment and fire and the need for shippers to ensure their expertise is communicated to and shared with the full incident command.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.3, Vent and Burn Communication and Justification. Information supporting (b)(1) can be found on pages 151–55; (b)(2) and (b)(3) are not applicable.

To Norfolk Southern Railway

R-24-28

Review and revise your procedures to immediately provide emergency responders with an accurate copy of the train consist upon becoming aware of an accident.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.2, Communication and Consist Information. Information supporting (b)(1) can be found on pages 115–18; (b)(2) and (b)(3) are not applicable.

R-24-29

Update your submissions to the Pipeline and Hazardous Materials Safety Administration's Incident Database to accurately reflect the cause of package failures following the East Palestine derailment.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.1, Polymerization. Information supporting (b)(1) can be found on pages 142–49; (b)(2) and (b)(3) are not applicable.

R-24-30

Adopt policies to ensure that your emergency response contractors keep detailed records of information used to make decisions involving hazardous materials, and share this information with shippers, relevant chemical associations, and other entities that provide hazardous materials guidance.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.2, Quality of VCM Hazard Information. Information supporting (b)(1) can be found on pages 149–51; (b)(2) and (b)(3) are not applicable.

R-24-31

Develop a policy to ensure that expertise communicated to your on-scene representatives and contractors is shared with the full incident command.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.3, Vent and Burn Communication and Justification. Information supporting (b)(1) can be found on pages 151–56; (b)(2) and (b)(3) are not applicable.

To Oxy Vinyls, LP

R-24-32

Update the safety data sheet for vinyl chloride monomer (VCM) to accurately reflect the potential risks of VCM and the hazards that increase such risks.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.2, Quality of VCM Hazard Information. Information supporting (b)(1) can be found on pages 149–51; (b)(2) and (b)(3) are not applicable.

R-24-33

Develop a policy to ensure that expertise on chemicals manufactured and offered for transportation by Oxy Vinyls is communicated to and shared with the full incident command during transportation accidents or incidents.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5.3, Vent and Burn Communication and Justification. Information supporting (b)(1) can be found on pages 151–55; (b)(2) and (b)(3) are not applicable.

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Alexandria, VA 22312
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NTIS website

From: Jeff Powell
To: DNV Input
Subject: Re: Comments on the Chemtrade rezoning application
Date: February 25, 2026 4:07:31 PM

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello again Mayor and Council,

I am writing you once again, just before the deadline, because yesterday's public hearing about the Chemtrade rezoning has left me in a serious quandary. My previous email (below) said I support the rezoning and letting Chemtrade continue their work. Now, I struggle with that a bit, but not enough to firmly change my mind. Here are some thoughts for you to ponder.

- The truth is, as stated at the meeting, that most water systems use sodium hypochlorite (bleach) for disinfection. That is true. I have personally lived on land with its own well, and keeping that water clean and drinkable was a nightmare. Ozone helped but has no staying power inside pipes. You simply cannot get enough ozone to dissolve in the water for it to hang around 1 or 5 or 50 kilometres down the line. Similarly with UV light. That only works on contact, and the water must be filtered first. Bacteria and viruses can hide inside particles and so evade the light. The only real option is to get chlorine in the water somehow, generally from bleach.
- To create bleach, you need chlorine. It's as simple as that. Without a source of chlorine, you cannot create bleach.
- Chlorine comes from salt. Vast amounts of salt. You have to mine it from salt beds or ship it in. That's why the plant is located where it is: they need port access to get the salt they need.
- Chlorine in gas form is vastly smaller than bleach. Someone from Chemtrade said if they had to produce bleach instead of chlorine and still produce enough to treat all the water the plant currently supplies, there would be 70,000-100,000 trucks coming out of that plant each year. Even if he was grossly overstating the number, it would still add vast truck traffic to our local roads.
- Bleach breaks down over time. This is a fact. Exactly how much of a problem it is, I cannot say. One side or the other may exaggerate to make their point. I lack the knowledge to know how serious a problem it is. And of course the rate of degradation will vary with temperature, time, and probably the strength of the bleach itself. It's almost certainly not a simple answer.
- The simple truth is that chlorine is the most effective way we have to move around that much sterilization potential. It's concentrated and doesn't degrade.
- Someone said that a document from Metro Vancouver was misinformation or disinformation because it said both "Bleach" and "Chlorine". That's simply not true. Bleach breaks down and releases the chlorine, which is highly reactive and kills things living in the water. The bleach is the source of the chlorine.

But of course, nothing is ever simple.

- I was surprised to learn that the safety evaluations simply didn't look into what happens when a railcar leaves the plant site. That may be "how it is done" in the industry - I don't know - but that risk has to be taken into account somewhere.
- I was also very surprised to hear that there was no consideration of bad actor, terrorist, or cyber attacks on the plant itself. In these times, such things simply must be considered. I know there are regular cyber intrusions into water systems in the USA, and in some cases those intrusions have resulted in unintended changes to the plant operation.
- These feel like large oversights to me, but I am not an expert in the field, and this may simply be "the way things are."

But then we have a whole host of different concerns and questions.

- Imagine the plant continues to operate:
    - What are the implications of a sizable leak at the plant? I know they have a sterling safety

record, and I am aware that the safety evaluations say such things are unlikely. But imagine an earthquake knocks down a building that lands on top of 4 railcars full of chlorine, which crack open. That's potentially much worse than the "worst case" the safety reports appear to have evaluated.
    - Or what if a train derails somewhere down the tracks in a populated area, again with cars spilling their contents?
    - I fully understand the claims from various people present last night that the new cars haven't yet spilled a drop, even when derailed. But that doesn't mean they are impenetrable. That just means the conditions for a leak or spill haven't been encountered yet. I assure you that those cars can leak under the right conditions. Such conditions might require a terrorist attack, but they are definitely possible.
    - And what of the claim made by two people last night that "empty" cars aren't really empty? I have no basis for evaluating that myself. Is it true? And if so, what are the implications? I simply do not know, but I think the answer might be relevant to the decision made.
    - What are the legal, moral, and ethical implications of letting this plant continue to operate when there are legitimate concerns? I don't think the answers here are easy.
- Now imagine the plant gets shut down:
    - There are vast potential implications of such an event, including:
        - Loss of chlorine to create bleach to treat water here, in communities across western Canada, and across the western USA. How many people getting waterborne diseases does it take before we have offset the risk of a railcar release or issue at the plant? And disease is a real potential. Again, I have maintained my own well, and it was not fun. If cities have to find new sources of bleach, the entire industry will have to adapt to the change. It will not happen overnight.
        - Loss of jobs. That may seem a small thing, but for those involved it would be serious.
        - Loss of tax revenue. Again, a small thing, but these add up.
        - Loss of a bargaining chip in Canada's relations with the USA. Sadly, this is more significant than I would like.
    - What are the moral, legal, and ethical implications of causing the plant to close? It is possible that people - even children - could die of preventable disease if there is no quick adjustment to get bleach to the cities that need it. That's not an exaggeration, sadly. Without adequate bleach supplies, there are harmful bacteria in every water supply. Those with weaker immune systems will be at risk if they have to drink untreated water over time.
- How does a city council in a relatively small community like ours find itself judging such an issue? Do you have the authority and willingness to make either choice? The implications of either vote could ripple out and cause substantial harm. Or not.
- This decision drew in people from all over, each of whom has a point of view. I want to share something of my own. It amounts to this: we're all terrible at understanding risk.
    - Everything we do is risky. Some people flew here on planes to attend that meeting. Occasionally airplanes crash. There is risk there, but they got on the plane anyway. What is the relative risk of an airplane crash vs. a train derailment involving a tank car full of chlorine? I honestly have no idea, and I suspect the people making the presentations don't know either. Again, humans are very bad at understanding risk.
    - It is probably far more dangerous to drive to that meeting than to fly there. And you're certainly more likely to be involved in a road accident than in a train car derailment. The problem is the potential size of the events. If a car crashes, or even two, only a few people are involved. If a plane crashes, hundreds are lost. And if a chlorine car were to derail and break open, thousands could be exposed and possibly die. The relative size of

these events makes one worse than another, but for those involved, they are all potentially just as bad. Once again, we are all bad at understanding and evaluating risk.

- I'd like to share a brief story. In Chicago, there used to be an airport named Meigs Field. It was built right on the shore of Lake Michigan, and it was primarily used by private pilots. When it was built, it was far from residential areas and even most businesses, as I understand things. No one was bothered by the airport. But over time the city grew around it, and local residents started to get concerned. Noise, plane crashes, and so on. These were real issues for those who lived and worked near there, but the airport had been there first, before such concerns existed. A long string of legal battles ensued, and in 2003, in the middle of the night, just after a win for their side, Mayor Richard M. Daley sent bulldozers out to destroy the runway before an appeal could stop them. That airport doesn't exist anymore. Why share this? Well, the Chemtrade plant is arguably in a similar situation. It existed before there was substantial population and risk in the area. In fact, the rail lines it makes use of probably existed in relatively unpopulated areas as well. But now, both the plant and the rail lines are deep in populated space of various kinds. Should the plant take precedence because it was there before? Or does the population that built up around it, despite the risks of doing so, outweigh the plant and the products it produces? Once again I am going to be honest. I don't know. And I think anyone who thinks such a decision is easy isn't being honest with themself.

I stand by my statements in my first email. But I was definitely naive about the risks in some ways. (Once again, say it with me: We're all bad at understanding risk. That includes me.)

I have no way to make the decision. or even to pick a side.

- The eventual loss of the plant could have severe consequences, and keeping it in place could too.
- Are the risk evaluations performed actually adequate? It seems not, but I could be wrong.
- The plant existed before the risk was significant, so perhaps it should be grandfathered in? But that doesn't mean that the people and businesses around it should be exposed to that risk. How to choose?
- How to balance the potential for tainted drinking water in various cities against the low likelihood of a serious chlorine spill somewhere?
- Should the councillors for a small city have that kind of power over the lives (and expenses) of so many, including residents of other cities and even another country?

I have no answers for you. Absolutely none. Neither side appeals to me anymore.

I am sorry you are in the position of having to make a decision about this.

I wish you understanding.

Jeff Powell

On Sat, Feb 21, 2026 at 1:03 PM Jeff Powell [redacted] wrote:

> Dear Mayor and Council,
>
> As you know, I don't comment on items before the Council all that often. But I have commented on the Chemtrade rezoning application in the past, and I am doing so again now as my thoughts have evolved. My initial position on the plant was concerned, but I wanted to know more. **At this time I fully support the rezoning and letting them continue their work on the site.**
>
> As I say, initially, I had concerns, but I did a fair bit of research.
>
> - I attended their open house and toured their plant.
> - I contacted Metro Vancouver and gained access to the first data from their Seismic Micronization Project, which helped me understand what kind of ground the Chemtrade plant is built on.
> - I contacted a long-term friend and retired architect who designed industrial buildings, including high-tech fabrication facilities that handled all kinds of toxic chemicals and were located on seismically active ground elsewhere in the world, and asked him about this plant given what I have learned.
>
> In the end I am reassured that Chemtrade's stated design intent is good and that they can operate that plant with minimal risk.
>
> In addition:
>
> - We need to keep the jobs associated with that plant here.
> - All of Canada is better off for having that plant in place here on the west coast. Without it, we would potentially be even more dependent on the USA for chlorine, and we are all aware of just how much we have to avoid additional entanglements with the USA these days.
> - The only organized opposition to the Chemtrade rezoning that I have encountered came from a competitor that acted dishonestly in the extreme. I discount it entirely as a result of their tactics.
>
> I encourage you to approve their rezoning request and let them get on with their plant modernization.
>
> That said, as with any corporate entity, I would like to see their work tracked to be sure they follow through on their modernization and safety plans. Given the large and growing population in that area, those new safety measures are a requirement, not something optional that can be discarded once the rezoning is approved. If there is some legal method of requiring Chemtrade to follow through on their development and safety commitments, that might be worth doing. That concern arises not from anything specific I have read or seen in this case, but rather from a general distrust of corporations driven by their quarterly bottom line.
>
> Thank you for your consideration.
>
> Jeff Powell
> DNV resident, relatively close to the plant itself

From: Corrie Kost [redacted]
Sent: February 25, 2026 4:17 PM
To: DNV Input
Cc: Mayor and Council - DNV
Subject: More reports for the public record of 100 Amherst Ave Zoning Bylaw Amendments
Attachments: Report of Public Hearing Mar31 Apr1 May31 1998 on Bylaw 7008.pdf; Is it true that -Liquid chlorine is identified in federal drinking water guidelines as the primary disinfectant used by Canadian municipalities.pdf; Key Issues about the Chlorine plant future plans.pdf

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Your Worship and Members of Council,

The attachments, if not already so, should be part of the record for this public hearing.

Yours truly,
Corrie Kost
[redacted]

More reports for the public record of 100 Amherst Ave Zoning Bylaw Amendments->Report of Public Hearing Mar31 Apr1 May31 1998 on Bylaw 7008.pdf

REPORT of the **Public Hearing** held in the Council Chamber of the District Municipal Hall, 355 West Queens Avenue, North Vancouver, B.C. on Tuesday, March 31, Wednesday April 1, and Thursday, May 21, 1998

The Hearing commenced at 7:09 p.m. on Tuesday, March 31, 1998.

PRESENT:

Mayor: Don Bell

Councillors: Trevor Carolan, Ernie Crist, Glenys Deering-Robb, Janice Harris, Lisa Muri, Pat Munroe

Staff: Mr. J.I. Torry, Manager – Planning
Mr. G. Carlson, Manager – Engineering Services
Mr. G. Joyce, Manager – Traffic & Engineering Administration
Mr. C. Thorn, Executive Assistant to the Mayor
Ms A. Hilsen, Deputy Municipal Clerk
Ms B. Audette, Committee Clerk

Also in Attendance: Mr. Ross Peterson, North/West Vancouver Emergency Program
Mr. Brian Wallace, N.D. Lea Consultants
Mr. John Haythorne, Bull Housser & Tupper

BYLAW 7008 "Rezoning Bylaw 1089"

Applicant: CXY Chemicals Ltd. (Canadian Occidental Petroleum Ltd.)

Subject Land: Portion of Lot 5, Block H, D.L. 193 and 611, Plan 17801, VPC V-1381(4), Parcel "A" Land 550,284 square feet, Parcel "B" Water 217,766 square feet and V-1381(5) Water 21,399 square feet (PID: 007-253-265); Lot 1 of Lot B, D.L. 611, Plan 17800 (PID: 007-254-067); and Portion of Lot A, Block B, D.L. 193, Plan 1587 (PID: 014-538-415). Those properties generally bounded by Amherst Avenue on the west, the CNR rail line to the south, the realigned Dollarton Highway and Ewen Street to the north, and Forester Street to the east.

Proposed Amendments: To amend the Zoning Bylaw to create two new Comprehensive Development Zones 18 (CD18) and 19 (CD19) and to rezone the subject lands from General Industrial Zone (I2) and General Commercial Zone 3 (C3) to those new zones.

Purpose: The purpose of the rezoning is to establish specific land use and development regulations for the subject properties to enable the Company to develop its lands in a manner consistent with the current Maplewood Official Community Plan.

The Deputy Municipal Clerk advised that the statutory notification and advertising requirements had been met.

The Manager – Planning introduced the staff members and resource consultants in attendance at the Public Hearing. He briefly outlined the history of the proposed application indicating that a Public Hearing held on June 11, 1996 for a previous rezoning application was adjourned. Staff were requested to seek an independent review of the August 1994 Bovar Concord Environmental Quantitative Risk Assessment Study and to conduct a series of public information meetings jointly

with Canadian Occidental Petroleum Ltd. Arthur D. Little was retained to review the QRA Study and to conduct an assessment of the 1978 Beak Report. On July 26, 1996, Arthur D. Little submitted the assessment of the Beak Report. In May 1997, Canadian Occidental Petroleum Ltd. and Bovar Concord undertook to update the QRA Study to reflect the improvements that had been implemented at the plant up to December 1996. On July 11, 1997, Arthur D. Little submitted the independent review of the CXY Chemicals Assessment of Chlorine Safety Risk to the Public (1997 Update Report) and on August 12, 1997 Arthur D. Little presented their findings to Council. Public information meetings were held on September 23, 1997 and on October 30, 1997 to review the Reports, improvements to plant operations and safety concerns. The Manager – Planning advised that the risk contours for the plant had been reduced to reflect the safety improvements implemented by CXY Chemicals Ltd. As a result of the reduced risk assessment and the diminished risk contours, the proposed uses for the subject lands have been expanded to include uses that were excluded from the previous proposal. The Manager – Planning reviewed the proposed building regulations for the two Comprehensive Development Zones.

On March 18, 1998, the Advisory Planning Commission reviewed the proposed amendments and expressed unanimous support for the Bylaw.

The Deputy Municipal Clerk advised that all correspondence received prior to the close of the Hearing will be circulated to Council and will form part of the Public Hearing record.

PUBLIC INPUT:

1. Jane FLEMING **IN FAVOUR**
100 Amherst Avenue

- Representative of CXY Chemicals Ltd. and Canadian Occidental Petroleum Ltd.
- Submitted a petition in support of the proposed Bylaw
- Reviewed the present zoning status and OCP land use designation for the subject lands
- The proposed Bylaw amendments were initiated by the District to facilitate the realignment of Dollarton Highway
- The subjects lands are in a mandatory development permit area
- The proposed commercial parcel north of the realigned Dollarton Highway and west of Riverside Drive has been excluded from the Bylaw at the request of the community until the Seymour Local Area Planning process has been completed
- The chlorine plant will continue to operate regardless of the outcome of this application
- Reviewed the history of the subject lands and application process from 1991 to the present
- The realignment of Dollarton Highway will result in upgrading of surrounding roads and services including water, lighting, drainage, intersections and signal lights
- CXY Chemicals and the District will enter into a cost sharing agreement for the Dollarton realignment
- The agreement has been developed but has not been approved yet
- The agreement will include a restrictive covenant that will ensure that CXY Chemicals maintains a reduced level of storage of chlorine gas and restricts shipping gas tanks by barge
- The applicant does not have a specific development plan for the site
- It is anticipated that servicing the large site would take approximately 2 years and development would take approximately 5 to 7 years to complete
- The applicant does not intend to permit big box retail use and would be prepared to restrict the land use to exclude this type of retail use
- Will work with the community to address public concerns about design guidelines
- The proposed rezoning would result in many benefits to the community including an increased tax base, new employment, a safer road network, safer travel for trucks leaving the chlorine plant and improved traffic circulation

- The proposed amendments will not resolve all issues but this is the first step to improve the existing area
- The proposed changes would be an improvement for the Maplewood community as a whole and would create a buffer between the community and the plant

In response to a question from Councillor Crist regarding funding for the new Dollarton Bridge and what contribution CXY Chemicals might provide, Ms Fleming clarified that discussions are ongoing with staff regarding funding for the bridge and details have not been finalized yet.

2. Thom KLINE **OPPOSED**
950 Roche Point Drive

- Read and submitted a letter dated October 30, 1997
- Attended the public information meetings but has additional unanswered questions
- Expressed concern that there appears to be no safety plan after a seismic event for people who would occupy the redeveloped CXY lands
- Nearby homes would be compromised by chlorine gas
- The District has a duty of safety to people who would occupy the new buildings
- The District emergency preparedness plan and CXY's plan for people outside the plant are unclear
- The value of the development to residents of the District is questionable, both as a cost to the taxpayer and as a solution to traffic congestion
- The Heritage Fund is not an option to pay the District share of costs
- New development should be self supporting and should not depend on the existing tax base
- New job creation is a poor reason for approving the proposed rezoning since the existing community already has work
- Any future jobs would require additional housing which would increase local traffic congestion
- Suggested that alternate options be considered such as improving the existing Dollarton Highway with overhead walkways or assessing a surtax on CXY for redeveloping the property to pay for the new bridge
- There should be no cost to the community for the redevelopment of the CXY lands
- Member of the Management Committee of the Seymour Local Area Planning process
- It appears that the Maplewood Business Park is a good plan however community input is missing
- The proposed application is circumventing the Local Area Planning process
- Questioned why this process needs to be rushed
- The community has not been adequately canvassed and there are still many unanswered questions

3. Dave SAWERS **IN FAVOUR**
4492 Lions Avenue

- Resident and property owner in the District for over 20 years
- Supports the proposed application because it will create new jobs and improve the tax base
- It will produce the additional benefit of providing a buffer between the residential neighbourhood and the heavy industrial area
- Has been an employee of CXY Chemicals for 19 years
- The plant is a safe operation and is not a threat to the community

4. Dave SADLER **OPPOSED**
277 Roche Point Drive

- Read and submitted a written presentation

- The proposed use changes from heavy manufacturing to commercial/retail are inappropriate for this area
- Business operations that generate much less traffic are needed because traffic is the greatest threat to livability in the Seymour area
- The public process has been seriously undermined by the applicant and the District
- Supports the development of industry on the subject lands and the Dollarton realignment in principal, however, the proposed application would degrade the quality of life in Seymour
- The subject lands are located adjacent to three other large developable industrial sites, Maplewood Business Park, Tolko site and Vancouver Port Corporation's site
- The District Economic Development Strategy Study predicts that these four sites could employ a total of 6,500 workers if used for light industrial or business park purposes
- The potential development of these sites is imminent and could result in an increase of 6,500 people travelling to and from work approximately one kilometer from the congested Second Narrows Bridge
- Planning for these sites should be completed concurrently rather than individually
- Commercial/retail is not a desirable use for this area because it would generate too much traffic
- Traffic is a major concern for Seymour because all vehicles must use two gateways, Dollarton Highway and Seymour Parkway
- Since the District taxpayer will pay for part of the road and bridge infrastructure, the District should develop a business plan to address the four industrial sites to ensure financial viability for the District
- Tolko and Vancouver Port Corporation will benefit from the road and bridge upgrades and should be asked to contribute toward the cost
- Industrial land should be retained for industrial use which produces higher paying jobs than commercial/retail use
- The proposed zoning changes would result in the addition of 17 additional land uses which are mainly in the commercial/retail sector
- CXY Chemicals should disclose the future use of the CD17 parcel that was removed from the proposed rezoning
- The proposed height of 60 feet in the CD19 zone is inappropriate for the scenic route along the Dollarton Highway
- Expressed concern regarding big box retail and suggested that some retailers describe themselves are wholesalers by operating as discount retailers
- Mega stores would create mega traffic
- Supports a maximum height of 28 feet which is standard for many business parks
- CXY has neglected to provide a vision to which the community could respond
- There have been many public meetings regarding safety and the community expected a similar series of meetings to address the rezoning proposal
- The Dollarton realignment will benefit CXY as well as District residents
- The rezoning application was referred to a Public Hearing within 14 days with no public information meetings
- The advertising for the Public Hearing did not provide enough information regarding the application such as the proposed building regulations
- The public consultation process is inconsistent
- There is pressure to complete this application process because construction was started on the Dollarton realignment and funds have already been expended
- The District Waterfront Task Force Industrial Working Group has not commented on the proposed rezoning
- The Chair of the Industrial Working Group is the CXY representative and should have declared a conflict of interest in this matter
- This application interferes with the Seymour Local Area Plan visioning process and constricts the scope of the study
- Improved safety at the chlorine plant should not be contingent on approval of land development applications

- Accidents and unexpected failures can happen no matter how many safety measures are in effect and an accident at the chlorine plant has the potential to kill many people
- Any development should reflect that the Dollarton Highway is a designated scenic highway and a gateway to Deep Cove and Mount Seymour Provincial Park
- A proposal such as the Maplewood Business Park would be acceptable and would provide worthwhile employment to North Shore residents
- A business park encourages business to business operations and produces less vehicular traffic
- Recommended that Council reject the proposed application and initiate a visioning process between CXY Chemicals and the Seymour community
- Recommended that public information meetings be held to review a new proposal
- Recommended that a traffic analysis of all four industrial sites in the area be provided
- Recommended that the proposed application be referred to the Seymour Local Area Planning process
- Asked Council not to circumvent the public consultation and information process

5. Wayne NEMETH **IN FAVOUR**
388 Roslyn Boulevard

- Recommended acceptance of the proposed Bylaw
- Resident of the District for 50 years
- The application would expand the District tax base and provide new jobs
- The applicant has been dealing with the application since 1991 and the proposal should not be delayed
- Cost sharing for the road upgrades is a bonus to the District
- Rejection of the proposed application would not result in a closure of the chlorine plant
- CXY Chemicals has been a good corporate citizen for 40 years and has supported many local businesses
- The proposed development would benefit everyone

6. Chris KWAN **OPPOSED**
3660 Osprey Court

- There are many positive elements to the CXY proposal such as the creation of employment opportunities and broadening of the tax base
- The Dollarton realignment is essential to the livability of the Maplewood community
- The opportunity for cost sharing of the road and bridge improvements is appealing
- The community needs more information and has additional questions to be answered
- She is a member of the Management Committee for the Seymour Local Area Planning process
- On October 29, 1997, Council unanimously endorsed the Seymour Local Area Planning process and work is well under way with the participation of many community volunteers
- It appears that input from the community planning process would be pre-empted by the approval of the proposed rezoning application
- The existing Maplewood OCP is 15 years old and should be reviewed every 5 years
- Excluding input from the Seymour Local Area Planning process and from the Waterfront Task Force is wasteful
- CXY Chemicals has been a good corporate citizen in reducing the risk factors at the chlorine plant and holding public information meetings regarding safety
- The public should also be included in the proposed land use decision however the community has had no opportunity for input
- Expressed concern regarding the proposed land uses permitted under the Bylaw
- Pointed out that uses listed in the original Bylaw which were intended to be excluded until the chlorine plant was permanently closed have not been included under the current proposed Bylaw

- Sympathetic to the frustration of CXY Chemicals over the delay of the application, however, the proposal was deferred to address important safety concerns and the land use application should not be rubber stamped because of the earlier postponement
- The rezoning application should be studied and addressed through the planning process with public consultation
- Questioned how the land use list was developed
- The community should know what CXY plans to construct on the subject lands
- The land use indicates a significant retail component that does not fit in with the industrial or business park use
- Questioned what aesthetic standards would be established
- Has read all the available information and stated that more information is needed and the public should have time to review the information
- Urged Council to initiate a public information process and to include the Seymour Local Area Planning committees and the Waterfront Task Force

7. Jenny WALTER **IN FAVOUR**
2012 Dollarton Highway

- Resided in this area for over 7 years
- Would like the proposed rezoning to proceed
- The Dollarton Highway would be redirected out of the residential community
- The subject lands would no longer be zoned for heavy industrial use
- It would result in improved amenities for the community
- The Maplewood community has decayed for five years waiting for the safety report to be addressed
- The existing traffic pattern is dangerous for the community
- Rejection of the proposed application will not affect the applicant but it would have a negative impact on the residents of this neighbourhood
- Asked for Council's support to remove heavy industry from the area
- The Maplewood area has been seriously neglected and needs immediate help to raise it to the standards of surrounding neighbourhoods
- If the application is deferred to the Seymour Local Area Planning process, the opportunity may be lost
- Stated that a door-to-door survey in the neighbourhood indicated that 90 percent favour the Dollarton realignment and also favour the proposed rezoning

8. Clive WALTON **OPPOSED**
3925 Blantyre Place

- A member of the Waterfront Task Force Industrial Working Group and also a representative of the Roche Point Community Association
- Expressed frustration at the process
- The Waterfront Task Force has been asked to study waterfront lands but this separate process is circumventing that study
- Questioned why the Task Force was appointed if its input is not requested
- The new bridge would not solve the traffic problem which constricts at the access lane to the Second Narrows Bridge
- Rapid transit is needed to solve the traffic problems in this area

9. Sheila McLEOD **IN FAVOUR**
200 Dollarton Highway

- Resident of this area for 33 years
- Maplewood is the only neighbourhood in the Seymour area where the highway has not been improved
- Maplewood is the gateway for the Seymour area but residents also live in the

community
- The proposed application would create the opportunity for new jobs in an area of high unemployment and an opportunity for residents not to have to commute to work
- Urged Council to consider the application based on facts and not to delay the efforts of the Maplewood community

10. **Wendy DANSIE** **OPPOSED**
2290 Dollarton Highway

- Member of the Maplewood community and strongly opposed to the rezoning of the subject lands
- Attended the public information meetings and is skeptical that the community will benefit from the proposed application
- Suggested that, if businesses were to relocate to a new business park on the North Shore, existing employees would be relocated to the new site
- Questioned how the District would pay for the road infrastructure and stated that the taxpayer cannot take on an additional burden
- It would be more sensible to use the money to improve the community as a whole
- Traffic is congested and will worsen with the disruption of construction
- Additional development will result in more vehicles and traffic and will have a negative impact on the environment
- Expressed concern regarding the wildlife in the area

In response to a question from Mayor Bell, Ms Dansie suggested that she is opposed to any dangerous, heavy industrial use of the subject lands and also stated that restaurants would be an inappropriate use for the area.

11. Tom YOUNG **IN FAVOUR**
2012 Dollarton Highway

- 15 year resident of the Maplewood community and President of the Maplewood Community Association
- The Maplewood Community Association surveyed the community regarding the proposed changes and, with an 80 percent response rate, found that 90 percent of the respondents supported the Dollarton Highway realignment
- Expressed concern that the Maplewood neighbourhood has deteriorated while surrounding areas have been improved
- The community should be self contained with a mix of residential and retail and business uses
- The draft Bylaw would allow uses to support a vision of a complete community for people and not vehicles
- Expressed concern regarding the proposed site coverage and suggested that it be reduced to 10 percent to allow for additional green space, buffers and corridors to allow for walkways and bike paths
- Parking areas should be constructed of pervious materials
- Supports the suggestion of a Restrictive Covenant to exclude uses such as big box retail, drive-ins and fast food outlets
- Would like to have a community advisory panel appointed to review each development application for the subject lands
- Any land use that does not support a high level of employment opportunities should be discouraged
- The northwest quadrant of the CXY lands is within the residential neighbourhood
- The Maplewood Community Association would withdraw its support for the CXY Chemicals proposal if a residential component is not included in that parcel of land
- Maplewood residents would like to decide what will happen in their own community

12. Allan ORR **OPPOSED**
847 Roche Point Drive

- Read and submitted a written presentation
- Questioned what impact the proposed CXY development would have on vehicle congestion for westbound traffic across the new bridge and noted that the N.D. Lea Report indicates the potential for development of approximately 1991 residential units in the East Seymour area
- The road and bridge projects appear to be positive benefits for Maplewood residents, Seymour residents and inbound traffic
- The Transportation Planning Advisory Committee approved the proposed road and bridge project in principal in December 1997 based on the assumption that a four land bridge would improve westbound traffic and split the westbound traffic to allow buses, trucks and cars destined for Main Street to move out of the congestion in the single lane access route to the Second Narrows Bridge
- The Transportation Planning Advisory Committee did not consider the rezoning of the CXY lands and the N.D. Lea Report and other recent information was not available at that time
- Questioned whether the Dollarton realignment and the new bridge would result in an improvement for both eastbound and westbound traffic
- Suggested that the N.D. Lea Report indicates that the CXY development proposal should not be considered in isolation from the larger planning perspective
- Reviewed projected traffic volumes from the N.D. Lea Report and the March 30, 1998 staff report on the Dollarton Realignment Traffic Review
- Suggested that the new bridge would improve westbound traffic flows in the morning but would not solve the congestion for eastbound traffic travelling toward the Second Narrows Bridge
- The potential for greatly increased traffic volumes using the new bridge should be addressed
- Noted that the road and bridge improvements would provide improved access for emergency services vehicles
- Suggested that there would be no advantage to cyclists unless modification are made to the west side of the bridge as cyclists must contend with right-turning vehicles proceeding to the Second Narrows overpass
- A business park would make more sense from a transportation point of view as it would create minimal impact on daily traffic levels
- Expressed concern about some of the retail uses permitted under the proposed rezoning Bylaw and the impact those uses could have on traffic congestion
- Suggested that two transportation questions should be addressed before the proposed rezoning is allowed to proceed
- The development potential for the CXY lands should be clarified to determine what uses are envisioned and what impact these uses would have on traffic in the area
- Will the single lane access route from the new bridge be able to cope with the additional traffic generated from the new business zone as well as the potential residential development in the Seymour area
- Suggested that solutions to the growing transportation problem in Seymour could come from the Seymour Local Area Planning process; the new G.V.T.A. and citizen advisory committees; engineering reports; and B.C. Transit surveys
- Suggested that the Dollarton and Riverside intersection would resemble the Marine Drive and Pemberton intersection if retail businesses are permitted to dominate the CXY development

13. Jim COUTTS **IN FAVOUR**
1037 Heritage Boulevard

- Supports the rezoning to light industrial and business park use and the removal of

heavy industry
- The proposed rezoning is consistent with the OCP and with other uses in the area
- The realignment of the Dollarton Highway would improve traffic and remove a safety hazard for school children
- CXY is willing to contribute to the Dollarton realignment
- CXY Chemicals has demonstrated a commitment to address public safety concerns
- The proposed rezoning would provide additional employment in the District and would improve the tax base
- CXY has acted in good faith and has involved the community

14. Bill TRACEY **OPPOSED**
3804 Brockton Crescent

- Opposed to the proposed rezoning at this time and under the present circumstances
- Acknowledged that the development of the subject lands is desirable
- The District needs additional commercial property and a place for high tech industry
- Understands that CXY is frustrated with the delay
- The delay was due to environmental and safety reasons and the public meetings were held to address those issues and did not address the rezoning application
- A Town Hall meeting should be held to bring the community together to formulate recommendations for the development of this site and to allow the community time to work on eliminating the current differences that divide the residents
- The Seymour Local Area Planning committees and the Waterfront Task Force should be consulted and contribute to the process
- If the proposed development would take 5 to 7 years to complete, another 9 or 10 months would not have a significant impact
- Suggested that the District would regret a hurried decision and should allow the community time to decide what is best for everyone
- Asked Council to defeat the Bylaw or to adjourn the Public Hearing to allow additional meetings and work within the community

15. Judi AINSWORTH **IN FAVOUR**
West Keith Road, City of North Vancouver

- Spoke on behalf of the North Vancouver Chamber of Commerce representing over 570 corporate members with approximately 10,000 employees
- The proposed rezoning application is an opportunity to allow District residents to work in North Vancouver
- The District should consider this opportunity for employment growth as the Economic Development Strategy recommends this type of opportunity
- The North Vancouver Chamber of Commerce has strongly supported the retention of industrial zoned lands
- This application would provide a buffer between the industrial site and local residents
- If this opportunity is not considered, traffic leading to the bridge will worsen as more residents are forced to seek work away from the North Shore
- The proposal would allow the realignment of the Dollarton Highway and construction of a new bridge
- Recommended that Council approve the rezoning application
- The District is working with CXY and the community to ensure that there will be positive economic development on the property
- Council has a leadership role in the economic development of the North Shore

In response to a question from Councillor Crist, Ms Ainsworth confirmed that the North Vancouver Chamber of Commerce strongly advocates the promotion of tourism on the North Shore and the encouragement of labour intensive business. Councillor Crist inquired whether the continuing presence of the CXY chlorine plant is conducive to those goals. Ms. Ainsworth stated that all

existing and potential businesses have a role to fill in the economic development of the North Shore. Future economic development should be directed to clean, positive, sustainable industry however the existing business has proven itself and it remains economically viable.

16. Corrie KOST **OPPOSED**
2851 Colwood Drive

- Read and submitted a written presentation with attachments
- Suggested that the District should not allow any additional development in areas which would put more people at risk
- Would prefer that the proposed Bylaw be rejected or that the Public Hearing be adjourned to allow for additional public information meetings
- Expressed concern that a premature decision could be precipitated by the suggestion that CXY Chemicals might withdraw the application
- This is a multifaceted issue including risk assessment, transportation, livability, financing/taxes and ethics
- Suggested that the risk assessment reports are inadequate
- Stated that QRA's assess fatal risks and do not encompass risks to health, safety and the environment
- The District should set higher safety standards than the minimum standards established by MIACC
- The private assessment of the chlorine plant completed for the insurance company should be made public
- Suggested that the risk assessment reports contain information that is incomplete, confusing and misleading
- Partial answers to the public information meetings held in September and October 1997 were only recently provided and some information has not yet been made available
- The public meetings were inadequate to have a meaningful dialogue
- Outlined a comparison to 10 of 40 existing chlorine plants in the U.S. noting the locations, plant capacities and emissions and surrounding residential densities
- Suggested that low density housing should be defined as not more than four to six units per acre (RS3) rather than 12-24 units per acre (RM)
- Expressed concern regarding proposed land uses such as restaurants and retail food outlets and noted that these uses were previously excluded until the chlorine plant was permanently closed
- There should be a business plan for this area and financial information for the taxpayer before the application is approved
- Questioned whether a business has the right to pollute or threaten the wellbeing of adjacent residents when hazards have been underestimated
- Does not oppose a business park in this area but is opposed to the uses listed in the Bylaw
- Recommendation rejection of the Bylaw

The Public Hearing was recessed from 9:40 to 10:00 p.m.

17. Denis WILES **IN FAVOUR**
150 – 509 West 22 Street

- The proposed application would help to open development in East Seymour and would address some of the existing traffic problems
- The District needs to have some development and jobs
- It may be necessary to review the type of buildings to be constructed on the site
- The proposal is logical and should proceed

18. Doug HILL **OPPOSED**

4125 Russel Court

- Member of the Seymour Local Area Planning Transportation Committee
- The Committee has not been asked to provide input regarding the proposed Bylaw and has not been asked to provide an update on its progress
- The public has not been provided adequate opportunity for input on this process
- Requested that more public information meetings be scheduled
- Asked that the Seymour Local Area Planning process be included in this decision making process

19. Bob MacLEOD **IN FAVOUR**
4333 Bakerview Street

- Manager of Sterling Pulp Chemicals Ltd. which is located between the CXY chlorine plant and the Tolko site
- Sterling Pulp Chemicals Ltd. is a good neighbour and contributes approximately $1 million taxes to the District each year
- CXY has acted in good faith to manage the risk factors relating to the chlorine plant and to develop a business park on its adjacent lands
- Supports the Bylaw to broaden the industrial and commercial tax base and benefit District residents
- The realignment of Dollarton Highway will enhance the safety and security of local residents
- CXY will share the cost of the road infrastructure
- The proposal would provide a buffer between residents and industry
- Urged Council to seize the opportunity and go forward with the plan for the benefit of the Maplewood community

In response to a question from Councillor Crist regarding the purpose of the buffer zone, Mr. MacLeod stated that it if preferable not to have residential neighbourhoods immediately adjacent to industrial sites for reasons of plant security.

20. Karen BARNETT
940 Roche Point Drive

- Does not have enough information to make a decision regarding the application
- Based on the information available, does not support the Bylaw
- Sympathizes with Maplewood residents and acknowledged that the area needs to be revitalized
- Suggested that there are a number of questions concerning economics and building regulations that should be addressed in a public meeting forum such as a Town Hall meeting
- The public should have had additional information and public meetings before the Public Hearing was held
- Recommended that Council adjourn the Public Hearing and allow more information meetings for the public

In response to a question from Councillor Deering-Robb, Ms Barnett stated that she would like information on the economics of a business park; the impact on District tax revenue; and on the financing arrangements for the Highway realignment and bridge construction.

21. John WALKLEY **IN FAVOUR**
351 Seymour River Place

- Member of the Seymour Local Area Planning Economic Development Committee
- Has lived in the Maplewood area for 20 years

- Pleased with the proposed development concept
- Residents of Maplewood have endorsed the development
- More concerned about traffic risks for his children than the risks associated with the chlorine plant
- The realignment of the Dollarton Highway is critical to the Maplewood community
- The Maplewood Community made a detailed plan for the four zones and subsequently met with CXY Chemicals
- CXY has stated that the road realignment will not proceed without the development
- Advised Council that the community would like to establish a village centre
- The community plan encouraged residential and light industrial mixed use for the fourth parcel
- The community would like to see industry that reflects the talents of residents in the area
- The residents would like business that would not lead to an increase in traffic on the Second Narrows Bridge
- It would be appropriate to use this site to build a high tech business park
- If residents were to carpool, it would help to reduce the traffic gridlock
- The Second Narrows Bridge traffic issue is the jurisdiction of the province and cannot be addressed by the District
- The District could look into a broader long term land use for the chlorine plant site
- This waterfront site could be reserved for the use of District residents
- A chlorine plant is an inappropriate use for this property and the District should support a plan which would lead to phasing out the plant
- Maplewood residents would like more input into planning for the four parcels of CXY land and they do not want to wait two years for the Seymour Local Area Plan to be completed
- The road realignment is needed now

22. Ross MUIRHEAD **OPPOSED**
3096A Paisley Road

- Redevelopment of the subject lands would result in the loss of 30 acres of green space buffer in the Maplewood community
- The green space acts to reduce the risk of chlorine exposure for children at Maplewood Elementary School
- Loss of the buffer zone would allow chlorine gas to travel faster if there was a leak because wind would carry the gas over the level area
- The QRA did not address the issue of wind conditions in the event of an earthquake
- Suggested that the risk contours should be reconsidered to allow for wind conditions
- Asked Council to instruct staff to request that Bovar Concord prepare a report on the effect of wind and the loss of the green space buffer in the event of a chlorine gas leak
- Asked Council to prevent the loss of the green space buffer zone

23. Lawrence NG **IN FAVOUR**
2011 Dollarton Highway

- Representing Imperial Oil Company
- Former property owner of an Esso station site that was needed for the Dollarton Highway realignment
- Does not agree that the planning process has been rushed and thinks it is time for a decision
- Received a letter from the District in October 1992 regarding the proposed realignment
- Concluded an agreement in September 1995 to replace the Esso station site with another location and the station was closed in December 1995
- It has taken four years and a large investment to reach this stage when the Dollarton realignment was intended to be completed within two years

- Expressed frustration that the Dollarton realignment may not proceed after four years
- The Esso station has been out of business for over two years and there are many unhappy customers in the area
- As the property owner, the delay has had a direct impact on his business
- Supports the proposed rezoning as it will benefit property owners in the area
- Urged Council to approve the application
- CXY Chemicals has engaged in extensive public consultation with residents and businesses in the community
- CXY Chemicals has responded to issues raised by the QRA and by the District
- It is impossible to address the concerns of all parties
- The realignment will improve traffic safety in the area and create a more efficient traffic pattern

In response to a question from Councillor Muri, Mr. Ng advised that a replacement site for the Esso station would not be identified until the rezoning process has been approved.

24. Angela TRUDEAU **OPPOSED**
2589 Derbyshire Way

- Co-chair of the Blueridge Community Association
- The Community Association has not had an opportunity to discuss and respond to the proposed Bylaw
- The Community Association distributed a flyer in Blueridge to explain the Public Hearing process and the complex issues surrounding this application
- The flyer suggested three options which were (1) Support the Bylaw as proposed; (2) Oppose the Bylaw as proposed; or (3) Defer the process to allow for public discussion and more information
- Nine respondents opposed the Bylaw and twenty-two respondents requested more information
- Respondents expressed concern at the lack of community involvement in the planning process
- The community wants to participate in the planning for this property
- If the District chooses to encourage public involvement, the process must be consistent or the public will lose faith in the system
- There should be more time between the staff Report to Council and the Public Hearing
- Industrial uses on this site would benefit the District and the Maplewood neighbourhood
- Cannot support the Bylaw as presented
- Expressed concern regarding the proposed land uses in the Comprehensive Development Zones
- CD 19 clearly indicates business park use while CD 19 appears to be a mixture of uses
- There are too many commercial and retail uses listed under CD19
- MIACC standards are meant as guidelines and are not specific about adjacent uses, however the essence is that fewer people should be exposed to risks
- Manufacturing businesses with up to 100 employees would be a suitable use for the subject lands according to MIACC guidelines
- A retail building supply operation would require approximately 20,000 customers per week to be profitable and this would not meet the MIACC guidelines
- The proposed development would place a large number of people in close proximity to risk
- The District must consider the number of people and the type of activity in addition to the level of risk
- The process should go back to the community to provide more information about the proposed development
- The guidelines for the Maplewood Business Park provides a clear definition of the proposed development
- The transportation options are important and expensive and District taxpayers should

have the necessary information about the funding options before the Bylaw is approved
- A contingency plan will be needed for construction of the new bridge which will wreak havoc on the lives of East Seymour residents
- There are many options for funding the infrastructure and it is unacceptable to turn to the Heritage fund again
- Community consultation is a valid and important undertaking and the District should listen to the community on all applications
- It is possible and important to find a means to bring all parties together to discuss this proposal and the Maplewood community could be identified as a priority issue
- A business park is an appropriate use for this property but not as defined by the proposed Bylaw

DISPOSITION:

Mayor Bell indicated that, in view of the fact that there were a considerable number of speakers still to be heard, the Public Hearing would be adjourned and reconvened in the Council Chambers of the Municipal Hall at 355 West Queens Road, North Vancouver on Wednesday, April 1, 1998 at 7:00 p.m..

The Hearing was adjourned at 10:48 p.m. and reconvened at 7:05 p.m. on Wednesday, April 1, 1998 with the following in attendance:

PRESENT:

Mayor: Don Bell
Councillors: Trevor Carolan, Ernie Crist, Glenys Deering-Robb, Janice Harris, Lisa Muri, Pat Munroe

Staff: Ms. R. Tolerton, Assistant Municipal Clerk
Ms. D. Hibbard, Committee Clerk
Mr. J.I. Torry, Acting Director of Community Planning, Building, Land and Bylaw Services
Mr. R. Peterson, Coordinator N&WV Emergency Program

Public Input

1. Marian LAUDER **IN FAVOR**
on behalf of R. Underhill
100 Amherst Avenue

- **stated that he has been employed at the CXY plant for over 21 years**
- **feels that the operation is safe and responsible on a daily basis**
- **feels that the road layout is not adequate for today's traffic**
- **feels a better road system is required for improved truck access**
- **urges Council to move forward with the new infrastructure**

2. Eric ANDERSON **OPPOSED**
2589 Derbyshire Way

- expressed his traffic concerns with regard to the Dollarton area
- feels that there is a large number of vehicles heading towards bridge and out of the Seymour area
- sees the issues of risk, taxation, livability, civic democracy in relation to this proposal

- feels that members of the public were not informed about certain areas being excluded from the Seymour Local Plan
- feels that the Waterfront Task Force is affected by this proposal
- suggests there may be a conflict of interest for chair of Industrial Waterfront Task Force
- suggests that the Maplewood area residents are keen for revitalization
- feels that Maplewood is an integral part of Seymour, and changes will affect all of the Seymour area
- feels that there is a flaw in the process and matters of extreme importance should be brought to the public's attention
- felt that the public information meeting was focused on the risks of the Chlorine plant not the proposal
- suggested that members of Council have now suddenly concluded that the residents don't need to be informed
- urges Council to really let the public look at the proposal look before they decide
- feels the only appropriate thing to do is to adjourn the public hearing and go back to public for information meetings which will enabling residents to make up their minds
- urges Council to let civic democracy happen
- feels that the risk factors were not clearly defined
- asked Council why they allow further developments when there is a definite risk
- feels that by starting the realignment it will prejudging the outcome of the hearings
- asked why Council would not allow light commercial and industrial uses on that location
- asked Council if they will be raiding our depleting Heritage Fund once more
- was horrified to find out that no traffic study or traffic count has been done
- feels the residents need to be informed about how much the realignment will cost us
- feels that the N.D. Lee survey was not useful wants to know how much money was spent on it
- stated that his traffic count showed that 81% of cars were going into the bridge lane
- by adding the proposed uses into the bylaw, you will add to the traffic concerns
- asked if the rezoning make a difference positively or negatively?
- feels that the small benefit disappear for the residents
- feels that some uses can benefit the entire community but they need to have input
- feels that his livability is at stake
- urges Council to say no to this Bylaw

3. Joe HOWASA **IN FAVOR**
Port Coquitlam

- supports the rezoning proposal
- feels that there is a loss of opportunities if this does not proceed
- feels that the process has taken a few years already and hasn't been rushed

- urged Council that time could pass and revenue could be lost and OXY's money could also be lost
- suggests that the Maplewood community has supported this proposal and now it must move on
- feels that OXY has done considerable amount of work to improve safety
- since OXY has demonstrate ability to reduce risk Council should demonstrate theirs and alleviate traffic concerns
- suggests that the realignment won't fix the Second Narrows traffic but will alleviate the safety concerns

4. E. CAMPBELL **IN FAVOR**
CEPU Local 697, CXY Chemicals

- feels that there are underlying reasons at hand to the close down the plant
- stated that in his opinion it is a safe environment
- suggested that OXY set high standards and met them
- feels the plant will only become safer over time

5. Cas BOHLKEN **OPPOSED**
2480 Hayseed Close

- briefly reviewed Council's decision in the mid 1950's to allow CXY to build the plant in the Maplewood flats
- stated that the population of Seymour was less than 5000 today it has grown to 24,000 and is still climbing
- stated that chlorine production has increased to 340 Tons a day
- feels that the reasons for Council to make original decision are still not clear, but have left the Maplewood waterfront a virtual wasteland
- feels that the District Planning Department came out with documents Seymour 1-10 in order to create a conservation zone between the River Estuary and the Indian Reserve
- stated that three years later the same planning department came out with series called Maplewood community plan stating that most of the area should be zoned Industrial
- reminded residents that the original Maplewood OCP is still in place today
- feels that as long as these contaminating industry are here it cannot be called a peoples place
- urged Council that now is the time to find ways to get these industries to relocate
- feels that this area is to valuable to be squandered
- compared OXY's good safety record to the Titanic
- stated that the BOVAR report predicts a major quake every 300 to 500 years
- feels that the new Bylaw does not address the residents concerns
- suggested that formal public information meting should have been held with regard to the new information
- public acceptance can only be through public involvement
- urged Council not to close the Public Hearing but to let the Local Plans and Task Forces run their course

6. Marian LAUDER **IN FAVOUR**
2936 Eddystone Crescent

- stated her support for the realignment
- feels the Dollarton area poses a safety risk to residents
- commutes daily and suggested that it is common to see U-Turns and residents winding through the streets
- suggested that the number of commuters puling out and driving on wrong side of road is rather large
- feels that Dollarton and Seymour River Place is most dangerous intersection
- currently uses 12 of the existing small business and would use more if available
- suggested that she would have to travel across Seymour if these business were to relocate
- works at OXY and has since 1987
- stated that she bought her home after starting work there and informed Council that 48 other employees live in the area
- feels safe and has confidence in her co workers and the company

7. Linda MELVILLE **OPPOSED**
2263 Dollarton Highway

- feels that the term 'Business Park' has been used al lot with respect to this development

Asked Mr. Torry if the Bylaw as it stands now would have a business park located on the map where her house is situated.

Mr. Torry referred to the map and outlined the business park area which staff was to look into for replotting. He informed Ms. Melville that the proposed 'Business Park' is situated above her property and therefore would not affect her property.

- feels that there are ongoing problems and they have to accept the risks
- feels that if the Bylaw is passed it opens doors to business wanting to re locate there
- feels the District will want to acquire the adjacent properties
- stated her total opposition to the Bylaw
- urged Council to reconsider what the District does with its own land and what CXY can do with theirs
- suggested that CXY, a large corporation with many shareholders is dictating to the area residents what will happen next

Asked Council if there is a way out of the realignment now without the Bylaw being passed?

The Mayor advised that the land expropriation would be possible.

G. Carlson advised that a Business Park can't be successful without the realignment.

Asked if there is a realignment agreement.

G. Carlson replied that there is an agreement signed with a total cost of 7.5 million and a cost sharing agreement in place.

Asked Council if the Bylaw does not proceed could the District finish the realignment, or would there have to be a payoff?

G. Carlson advised that yes the realignment could proceed, but without subsidy the District would have to adsorb all costs.

- wants Maplewood to be a better place to live, but feels that by passing the bylaw is wrong and urges Council to think about ethics and to listen to the people
- stated that she owns a Heritage house and is proud of it and plans to stay there, and feels that the District should clean up the area
- asked the residents to pay off the realignment and then talk about the land and see if it is for sale
- feels that maybe the business will see the light and take off out of the area
- hopes that chlorine will no longer be profitable, and go to another area
- urged Council that what the residents want down there is to have waterfront walkways and not to worry about security risks and chemical plants

7. David THOMPSON **IN FAVOUR**
131 West Third Street

- enjoys living on the north shore
- not living in the District will not reap the benefits of the tax dollars, traffic improvements
- feels that as a resident and homeowner he has concerns about his property value
- feels that warehouse and light industry can make a community if properly done
- feels that growing business bring jobs and people into the area
- doesn't see any negative impacts
- suggested that the traffic resulting from this development will be going against the flow, but noted that it is sometimes heavy times in am

8. Jennifer HARRINGTON **OPPOSED**
1026 Shavington

- stated that she works for Wild Bird Trust and commutes every day along the highway on bicycle
- suggested that it is not an easy place to commute upon, especially by bike
- suggested that she would like to see a paved bike area
- her main concern is the impact on the environmental areas
- she sees a space 3 times the size of the sanctuary to be developed
- urged Council to consider the effect this development will have on the existing wildlife
- if development goes through asked that Council put al lot of thought into the natural habitat and kinds of animals there
- urges Council to think about wildlife corridors to allow the animals to travel
- the OXY land is second growth coniferous forest
- informed Council that a coopers hawk nest has been found in CXY lands and this is a endangered species
- recommends that the particular marsh areas should be examined closely before it is developed and save a number of them for the habitat

- feels that the lands also contain some animals and a large number of vegetation for food consumption
- suggested that in addition to MacKay creek there are some intermittent creeks and feels that they could be enhanced and turned into salmon bearing creeks
- feels that the Maplewood conservation area contains many endangered species and it has come a long way from what it was
- feels that its proximity to the chlorine plant is not great, but wants allot of thought put into any expansion
- hopes that the animals will not just disappear and doesn't want to see problems with animals encroaching into human settlements
- urges Council to seek information on sustaining what is there and providing buffer zones, etc.

9. John BILLAM **IN FAVOUR**
OXY Plant Manger

- feels Council has to deal with a complex subject and there are important factors to deal with
- wants to say that over last three years two very eminent consultants have studied the plant and have come out with positive assessments
- stated that CXY is one of 52 plants in North America, and there are 15-20 plants older than can CXY
- suggested that there have been major changes to the safety aspects of operation
- feels that the plant offers risks, but management has done a lot to mitigate that and that it is controllable
- he supports local residents and what they want to accomplish, and is concerned about safety the aspects and would not want to have a fatality in the area
- urged Council to press on

10. Doug CLOUDA **IN FAVOUR**
1546 Oxford Street

- lives I mile of the plant
- feels that there is a need to make progress
- suggested that we have raw land right now and there is a need to make money
- encourages development of a business park
- feels that there should be less tax to homeowner and more to business
- feels that there are certainly traffic concerns in the area
- suggested that the highway realignment would make traffic much safer and by combining widened roads this would improve the traffic flow
- feels the new highway would provide efficient road networks
- noted the wonderful partnership between industry and community
- feels that there have been more than enough studies done already, tax dollars have been used and we can now proceed
- urged Council to get to work and approve the Bylaw

11. Brad ESHLEMAN **IN FAVOUR**
15 Mountain Highway (Western Stevedoring)

- stated that he is a member of industrial Waterfront Task Force

- stated his support for the proposal
- feels that this development provides positive aspects to the community
- consensus proved better transportation aspects
- feels that the critical issue is the heavy industrial waterfront uses
- feels that maintaining waterfront business is critical

12. Alf EDDY **IN FAVOUR**
1150 Lynn Valley Road

- stated that he has lived in the District for 31 years
- expressed his support for the bylaw
- is pleased to be associated with the Maplewood area residents
- feels that we never get perfect planning, and this is an improvement to the area
- stated that he is sensitive to the revenue the District will earn from this development
- feels that traffic problems do exist
- backs Council in their support

13. Malcom MCLAREN **IN FAVOUR**
4381 Cheviot (represents Allied Shipbuilders, 1087 Harbour Road

- informed Council that Allied has been at their location since 1967 and many employees are North Shore residents
- expressed Allied's support for the bylaw
- feels that regarding local issues, all lands have been zoned industrial since 1969 and CXY has been there since the 1950s
- suggested that people moved there knowing a chlorine plant was there
- feels that there are concerns but presumes that the studies are correct
- feels that the concerns raised existed prior to the N.D. Lee study
- feels that the traffic in Maplewood area is very busy
- suggested that all business generate many vehicles and people
- expressed his support for closing Riverside
- is keen that original people kept good access to the area
- suggested making Riverside Drive right turn only access
- suggested a proper stop light at the corner of Amherst
- expressed his surprise to see stop at Amherst without light
- feels that traffic in general should be solved but that the business park will not create a problem
- feels that the application is consistent with Maplewood Plan
- understands that purpose is to identify uses in preferred locations
- conclusion is that bylaw is consistent with the 15 year old community plan
- urged Council to enforce the planning objectives set out originally
- suggested that in the future more Seymour Area Planning will address residential development based on what the plans are

Councillor Muri informed him that the Maplewood OCP was to be reviewed every 5 years and that this has not been done in 15 years.

- Feels strongly about comments and feels that this plan has been revisited and traffic studies have been done,
- suggested that the plan is there for a reason.

14. Winn WRIGHT **IN FAVOUR**
2525 Panorama Drive

- expressed his support for the rezoning
- stated that he visits the plant and owns a copy of the Q.R.A. and is sure the regulations in place have been respected
- overall he believes in the risk assessments report
- pleased that CXY has spent millions to allow the new zone to be introduced
- listened to arguments on traffic and has not been told that how a business park will affect the lineups from 7:30 -9:00 a.m.
- doesn't' see issue of how a business park can affect early morning traffic
- doesn't believe that there is a valid reason for relocation of plant, feels that they are in compliance and safe
- asked Council if we are prepared to have heavy industrial use instead of light industrial use
- feels that if this application is not accepted we are in fact preferring the heavier uses
- feels that the issue is quite complicated and most people say they like what is there now
- suggested that the money CXY has spent on upgrades to have it stay the same would not make sense
- realignment of highway is for the benefit of a vision to bring people into the area
- bottom line is what is the cost and what is it worth, and there is no way to value it to the District
- feels all business parks are greatly different from each other
- large amount of taxable dollars to be made from redevelopment of light industry
- light impact settling in this area mostly high tech industry and this should be promoted
- sees the very little housing development in a giant community, schooled, community centers, libraries have been delayed and we need the dollars to supply these residential uses
- in light industrial there are no schools, etc. and it is a net tax gain the District can enjoy
- CXY is a land owner and will likely sell to a developer
- suggested that the existing OCP may have been adopted years ago, but Dollarton highway is in need of realignment and this need has only increased in time
- concerns of the community have been addressed by the applicant, and most sensitive area has been removed
- feels we are left with issues of timing and process, allot of time has been spent on the two Q.R.A.'s over many years and not allot of detail on land uses
- feels there could be a way to deal with uses that are not acceptable to the community and this may mean a restrictive covenant
- OXY has spent allot of money and dealt with many issues and in business when you spend money there has to be return and one day it has to come back
- hopes that the overall picture benefits of zoning and the faith in the applicant can follow through with the adoption of the bylaws
- feels that in the next election we are heading to an increase in taxes

- supports bylaw because he believes it is a fiscal direction Council can take to maintain it's tax base, not accepting this bylaw will add fuel to the members in the next election
- hoping that Council can look at the cause and effect and have faith
- urged Council to support the Bylaw

Councillor Munroe asked about the high tech business and the factors considered when going into the area, and with CXY there, would it attract high tech business into the area?

W. Wright replied that he sees this as an attractive area and that the eventual developer will make the best ways to get to the amenities possible and work with the surrounding area. He feels that there are lots of models of areas that are hazardous and close to industries. So much time has been spent on risk assessment and what does the area has to offer to business should be the question.

Councilor Munroe asked if he means high tech industry would want to be here for business reasons?

W. Wright replied that a mix of heavy and light is common and works well.

Councillor Deering-Rob asked about the Tilsbury Park area.

W. Wright replied that it is much more aligned to Anacis Island and is not as light as what is being proposed here.

Councillor Deering-Robb inquired as to height of buildings in most industrial parks.

W. Wright replied that in Surrey's it is 40ft., but in the Canada Way area it is well beyond what is proposed. Suggested that in order to gain height you have to have the use, and elevators are required leading to higher operating costs. It would be nice to see a user similar to Discovery Park coming into the area.

15. Glen KERR **IN FAVOUR**
2245 Windridge Drive

- thanked CXY for their support of the bylaw
- if CXY gets the go ahead feels that Seymour residents will be unhappy
- feels there is a need for realignment
- thinks that public meetings must be carried out before CXY gets approval
- stated his desire to live here in the future
- urges Council to find a middle ground in this proposal

16. Jane FLEMING **IN FAVOUR**
CXY Chemicals Speaking for a second t time

- stated that discussions are ongoing with possible businesses for the site
- appreciates what the community is saying
- has no difficulty in reducing some uses for the site
- stated that there are potential users and does believe there are high quality jobs to come into community

Councillor Crist asked if can CXY is seeking development partners, and have they not previously stated they do not want to bring more people into the area?

J. Fleming stated that they do not want places such as Costco which allow more members of the public to be brought into the area. Feels that high tech industries are more acceptable to the area.

Councillor Crist asked why they do not want people passing through the area?

J. Fleming replied they are looking for high quality industries and realizes that people will also be passing through the area, but they are concerned about uses which would create large numbers of people in parking lots, etc.

Councillor Crist asked if that is a contradiction to the bylaws uses and inquired as to why they do not want people around?

J. Fleming replied that there is a major difference in having a stable work force who come in and work day in and day out in the facility. This way they can discuss the kind of industry CXY is and not have types of industry that have hundreds in and out during the day.

Councillor Crist asked why CXY is objecting to visitors?

J. Fleming replied that she did not state this and she does not feel that visitors are not welcome but does not support a large number people coming in next to the facility that they cannot manage.

Councillor Deering-Robb asked if Mr. Torry could comment on process to remove uses from the bylaw.

Mr. Torry replied that to change to uses any further would require another amendment to the existing bylaw.

J. Fleming suggested that in terms of the kind of uses they see appropriate, the plant manager would be better able to answer these questions.

17. Bill TRACEY **OPPOSED**
1138 Brockton Crescent

- feels that one option might be to adjourn this hearing and to permit the community to hold town hall meetings to further discuss the zoning issues
- suggested that a healing process is appropriate and the issue seems to be divisive
- feels that the pros and cons are varied
- feels there seems to be a general agreement to a pulling back to try to find those areas in which we agree and where we disagree
- there are difficulties and at this point it is impossible to amend the bylaw now
- suggests that a new date is set and a town hall meeting be held and a public shirtsleeves session be held

- suggested that the Chairs of the Community Associations are made aware of this and he is fully convinced that this suggestion would be acceptable

Councillor Munroe asked about the town hall meeting approach and how many meetings would be required ?

B. Tracey replied that it could be dealt with in one meeting and there should still be a possibility to hold more if needed.

- feels it is important that this meeting be facilitated and held in the Seymour Area and be held in a town hall format
- feels that smaller workgroups are better and accomplish more, maybe limiting the topics would serve better

18. David SADLER **OPPOSED**
277 Roche Point Drive

Asked Mr. Torry with respect to idea of meaningful process concerning the industrial, traffic concerns, how many meetings do you think it would require?

Mr. Torry replied that since the 1993 traffic and Q.R.A. concerns have been dealt with and traffic studies have been conducted since 1981, those issues have had ample debate. On the issue of traffic and the Dollarton realignment and its funding this is being dealt with during a shirtsleeves meeting. He also felt that design concerns etc. could be dealt with in possibly 2-3 meetings.

Asked if the project could go ahead without a four lane Dollarton bridge?

Mr. Torry replied that the Planning Department is looking at two-three acres of development over four years, the other issue is to deal with the bridge head.

Asked if the Planning Department recommends that this go ahead with out also including a four lane bride?

Mr. Torry replied that we do need a bridge.

Asked if the cost of 13 1/2 million dollars is a 50-50 split between us and developer or is it 25-75?

- feels the major concern is traffic and to get a handle on this, and to estimate the number of trips any kind of business will generate
- feels that if zoned industrial it would generate 20,000 vehicular trips onto the site ever day, retail would increases the number
- suggested that if expanded to cover the number of employees it is up to 65,000 vehicular trips per day, this is business park purposes only
- urges Council to look at the bigger picture and not just this development
- recognized that plant has no interest in being in this location, District should discourage not encourage
- feels that the residents need a commitment as to how much longer CXY is going to be here
- residents are terrified by the threats to abandon the realignment if the Bylaw denied

- fully intends to outline the tactics that have been taken by the company
- feels the construction of the realignment should not be tied into the rezoning but should be dealt with separately
- suggested the Community Association doesn't support the proposal unless housing was on the fourth quadrant but this won't be allowed by CXY
- regarding the safety of the plant feels the District should be discouraging more housing in the area
- feels that the Maplewood Community came with the assumption that housing was available on quadrant four which means the safety revue hasn't been completed properly
- feels CXY has not worked with all of the community
- hears that the Imperial Oil bulldozed a perfectly good gas station in the hopes that they could relocate
- suggested that some members of Council are attempting to derail the public process and blame it on the community
- feels the magnitude of review is indicative of the danger
- feels massive repercussions are going to be felt
- sees Councils only option is to defeat this proposal and to start fresh
- has heard lots of people speaking for industrial development but not to the type of industrial development they want

19. Wayne NEMETH **IN FAVOUR**
388 Roslyn Boulevard

- speaking as a resident and employee
- the employees are responsible for the safe and efficient running of the plant
- feels there is a great deal of misunderstanding
- feels that if Council approaches the company many questions could be answered
- asked if the District is able to guarantee people's safety doing everyday activities
- feels that the plant is doing everything to ensure safety
- suggested that traffic will still increase and population will grow because the North Shore is a popular place to live and retire
- feels the residents have legitimate concerns and they should all be addressed by private meetings after the zoning takes place
- feels the traffic will be there regardless, and asked should the residents be denied
- should the 90% of residents in favor have to go through all this again
- CXY has high safety standards and there have been no emissions past the fences in years
- urges Council to move forward with this

20. Wendy DANSIE **OPPOSED**
2290 Dollarton Highway

- expressed concerns over Ms. Fleming's comments and the training of employees working in the business park
- wants clarification on the changes proposed to the zoning
- asked if the application is changing from the current state

Mayor Bell answers that if Council wants to consider removing some of the uses there would be another public hearing and that there is the capacity to do so.

W. Dansie asked with respect to training it is CXY's policy to train employees in the vicinity?

21. Winn Wright **IN FAVOUR**
2525 Panorama Drive Speaking for a Second Time

- suggests that he might be able to clarify the uses available and asked the Mayor how the bylaw came about and how much work went into creating the current uses

Mayor Bell clarified the uses and the resulting Q.R.A. which determined some of the uses to be removed and which were subsequently added after the latest review.

Mr. Torry clarified that the MICA guidelines were used and the uses were determined by those. They tired to look at the existing uses and fit in the allowable ones. They also tried to delete the heavy construction uses and automotive uses and keep the others that would meet the intent of the bylaw.

W. Wright questioned discussions with the applicant, suggested that if he were to have input into what tenants were to go into the business park, a more high tech environment would be preferable. He suggested that timing is everything, and if the developer has invested eight years and no profit has been made, there is a loss.

- suggested that we are not sure of what demand there is for a high tech use, but suspects a deviation of this would be an ideal use, and would speed up the process
- feels that the issue is more of timing and how much time do we have to debate these issues
- feels decisions that are to be made are corporate ones
- is concerned for the future and the area he lives in

W. Wright asked if these bylaws are adopted, could restrictive covenants be put into place without damaging the intent of the bylaw?

Mr. Torry replied that legally that is not a supportable idea.

W. Wright suggested that he hopes that discussions on the corporate level will take more time.

Councillor Carolan asked if Mr. Torry could suggest ways to amend the land uses.

Councillor Munroe asked for a specific method relating to changes to be made to the bylaw.

Councillor Crist asked Mr. Torry if the Municipality has the power to rezone any and all lands in the District.

Mr. Torry replied yes they do.

Councillor Crist asked what would happen if land earmarked for rezoning but not in use was to be rezoned to other than heavy industrial use?

Mr. Torry replied that Council has the right to change the zoning with due process.

Mr. Wright asked if the applicant said they want to sell, could anyone apply to rezone this particular land?

Mr. Torry replied that someone could not come forward with out authorization to apply from the owner.

Mr. Wright asked can the Municipality begin the process without the applicant agreeing to it?

Mr. Torry replied yes and gave the recent CMHC challenge as an example.

There followed a general discussion on the process to amend the bylaw with Mr. Torry outlining possible processes.

22. Linda MELVILLE **OPPOSED**
3363 Dollarton Speaking for a second time

Asked Councillor Munroe about his comment relating to keeping the bylaw and the process?

Mayor Bell then clarified the process.

- She urged Council to close the hearing and start over
- would like to say that she feels. CXY has been threatening the residents and the District.
- urged Council to go ahead with the realignment and think over what to do with the lands later

23. David SADLER **OPPOSED**
277 Roche Point Drive Speaking for a second time

- states that we can see what happens when we don't stick to the process
- if the public information meetings ensure that a sufficient and well thought out presentation can be made then give the public the information

24. Jane FLEMING **IN FAVOUR**
CXY Chemicals Speaking for a third time

- hopes that Council adjourn the hearing and then CXY can decide how long they are in this for

Disposition

Moved by COUNCILLOR CRIST, Seconded by COUNCILLOR MURI and DEFEATED That Bylaw 7008 be returned to a Regular meeting of Council and the Public Hearing be CLOSED.

Voting Against : Councillors Deering-Robb, Harris, Munroe and Carolan

Moved by COUNCILLOR CAROLAN, Seconded by COUNCILLOR HARRIS
That staff be instructed to arrange one or more public meetings on the issues relative to this Bylaw and that the Public Hearing be ADJOURNED and RECONVENED on Tuesday, May 12, 1998 at 7:00 p.m. in the District Hall Council Chambers.

Moved by COUNCILLOR CAROLAN, Seconded by COUNCILLOR MUNROE and CARRIED,
That the foregoing motion be amended by deleting "Tuesda y, May 12, 1998 and substituting "Thursday, May 21, 1998"

Voting Against : Councillor Harris

The original motion, as amended, was then put and CARRIED

Voting Against : Councillor Crist

Adjournment:

11:05 p.m. the Mayor declared that the Public Hearing on Bylaw 7008 was adjourned and would be reconvened at 7:00 p.m. on May 21, 1998 in the Council Chambers of the District Hall.

The Hearing reconvened at 7:14 p.m. on Thursday, May 21, 1998 with the following in attendance:

PRESENT:

Mayor: Don Bell

Councillors: Trevor Carolan, Ernie Crist, Glenys Deering-Robb, Janice Harris, Lisa Muri, Pat Munroe

Staff: Mr. J.I. Torry, Manager – Planning
Mr. J.D. McLean, Asst. Manager – Design, Drafting & Mapping
Ms R. Tolerton, Assistant Municipal Clerk
Ms B. Audette, Committee Clerk

Also in Attendance: Mr. Ross Peterson, North/West Vancouver Emergency Program

The Assistant Municipal Clerk stated that there was no statutory requirement to advertise this Reconvened Public Hearing, as the date, time and place of the reconvening had been stated at the previous Public Hearing before adjournment.

The Manager – Planning advised that public meetings had been held since the Public Hearing adjourned on April 1, 1998. In response to public input, the applicant has offered to delete specific land uses from the proposed Bylaw and to reduce the allowable Floor Space Ratio, building height and building coverage. The Manager – Planning explained that, if Council wished to consider revisions to the proposed Bylaw, it would be preferable to prepare a new Bylaw, which would include the amendments, and to hold a new Public Hearing.

The Manager – Planning stated that the Comprehensive Development Zone 17 in the north-west quadrant of the subject lands had been excluded from the current proposed Bylaw because additional planning was required, however, the community had requested that this portion of the lands be included in the Bylaw.

Planning for the phasing and funding of the Dollarton Highway realignment and bridge expansion

would be addressed once the rezoning application has been completed.

Mayor Bell outlined the options available to Council with respect to a decision on the current proposed Bylaw.

The Assistant Municipal Clerk advised that all correspondence received prior to the close of the Hearing will be circulated to Council and will form part of the Public Hearing record.

PUBLIC INPUT:

1. M. BYCHEK **IN FAVOUR**
2212 Dollarton Highway

- Expressed support for the proposed Bylaw

2. Angela TRUDEAU **OPPOSED**
2590 Derbyshire Way

- Spoke on behalf of the Blueridge Community Association
- The proposed uses for the business park are too broad
- Blueridge residents support broadening the tax base and are opposed to using the Heritage Fund for capital projects and development
- The proposed application is an affront to the work of the Seymour Local Planning Committee
- The District must consider the question of how a business park would relate to future use of the existing chlorine plant site
- The public meetings held in the past month have not been conducive to general public consultation as there has been a lack of communication to residents who were not able to attend the public meetings
- The public meetings did not demonstrate the need for a business park
- Blueridge Community Association cannot support the proposed Bylaw
- Urged Council not to proceed with the rezoning

3. Jean BYCHEK **IN FAVOUR**
2212 Dollarton Highway

- Expressed support for the proposed rezoning and requested that the process be expedited
- Expressed concern regarding the impact on her property if it is deemed to be required for the Dollarton Highway realignment

Mayor Bell Clarified that the District would attempt to achieve a mutually acceptable agreement for a land exchange with property owners of land needed for the Dollarton Highway realignment. If negotiations failed to produce an acceptable agreement, the District could expropriate the land in questions and the matter could be settled by arbitration.

4. Wendy DANSIE **OPPOSED**
2290 Dollarton Highway

- Had envisaged that the Dollarton Highway realignment would be addressed through this Public Hearing
- Attended the public meetings last month and heard the opposing perspectives
- Has not been convinced that there has been enough research into traffic issues or that the Dollarton Highway realignment is necessary

- The realignment will create a faster route to the Second Narrows bridgehead
- Local traffic would be streamlined on a more direct route, however, commuter traffic travelling through the Maplewood community would benefit most
- It would be better to encourage use of public transit and facilitate use of private vehicles by upgrading and realigning the Dollarton Highway
- With respect to safety issues, noted that no child has ever been injured by traffic on the Dollarton Highway
- Mount Seymour Boulevard was constructed to accommodate a significant traffic flow
- The District cannot afford to proceed with the realignment and bridge expansion
- Opposed to borrowing or using the Heritage Fund for the road and bridge construction
- Noted that the rules for use of the Heritage Fund have changed
- Residents cannot afford increased taxes, however, it is realistic to expect taxes to increase
- It is realistic to expect that costs for the road and bridge construction would exceed the projected costs of $9.7 million
- The District should not consider rezoning the subject lands without an agreement from the applicant to remove the chlorine plant
- The subject lands provide a minimal buffer zone between residents and the chlorine plant and removal of the buffer zone will cause more people to be more severely affected by the plant
- The District has an obligation to preserve wildlife corridors and greenspace as much as possible
- Development cannot be stopped but it must be more responsive to the community
- The proposed rezoning and realignment will lead to future applications to redevelop other large sites in the Maplewood community

In response to Ms Dansie's question regarding the regulations for use of the Heritage Fund, Mayor Bell agreed to send a copy of the Heritage Fund Bylaw to her.

5. Scott SMITH **IN FAVOUR**
1500 – 200 Granville Street

- Representing Tolko Industries Ltd.
- Submitted and read a letter from Tolko Industries Ltd.
- Expressed support for the Dollarton Highway realignment
- Tolko advocates consultation of industry and Maplewood residents to facilitate a timely solution to technical planning details if the proposed infrastructure change proceeds

6. Kristina VANDERVOORT **OPPOSED**
3615 Mount Seymour Boulevard

- An industrial park is an inappropriate use in a residential community with an elementary school and a bird sanctuary
- It has been identified that there is a high percentage of school age children with asthma east of Lynn Creek
- Her family is concerned about the environmental and health impact of the chlorine plant
- The Parent Advisory Councils of Lynnmour Elementary School and Maplewood Community School were unaware of the Public Hearing and therefore unable to provide input
- Children at Maplewood Community School are exposed to pollutants from the chlorine plant
- The proposed rezoning would result in the removal of the treed buffer zone between the plant and Maplewood Community School and should only be approved if the school is relocated to another area
- Opposed to the proposed rezoning unless there is a negotiated time frame to phase out the CanOxy chlorine plant and to save the buffer zone

7. Angela TRUDEAU **IN FAVOUR**
2590 Derbyshire Way

- Risk assessment is an important issue which has not been fully explored
- The Maplewood community has many examples of poor land use decisions such as the elementary school adjacent to the chlorine plant
- It is important to examine the risk assessment from the perspective of the entire North Shore
- This issue should be addressed by a Task Force rather than a Public Hearing
- The business use amendments offered by CXY would improve the proposal
- MIACC guidelines suggest that low density employment opportunities would be suitable for the subject land
- It is important to consider the application in terms of the total number of people per acre working on the site and to establish emergency training and shelter for employees
- Port lands are a precious asset and the CanOxy chlorine plant lands should remain industrial zoned and port based
- The business park should be light industrial and port based and the north west quadrant should be commercial use and not residential
- When the chlorine plant is removed, there will be great opportunity for land assembly and redevelopment
- Would like to see current land use amendments directed at having few businesses on large parcels to facilitate future redevelopment opportunities
- The most important upgrade for traffic will be the Keith Road overpass and the Burrard crossing
- These improvements will dictate the nature and viability of development in the Seymour area
- All other traffic issues relate to the distribution of traffic
- Riverside north is accessible to Dollarton and is a non-conforming road adjacent to Maplewood Community School. It should be added to the list for upgrading
- Opposed to using the Heritage Fund to pay for road upgrades
- Opposed to approving residential development to pay for the infrastructure improvements. Residential development should only proceed from a recognized need for community development
- The road improvements should be funded by setting aside money annually until sufficient funds have been accumulated
- Opposed to including the north west quadrant (the CD17 Zone) in the current rezoning application because the proposal is not consistent with the existing OCP and the new Seymour Plan is presently under consideration
- It is unacceptable to bypass the Seymour Planning process
- CXY would receive a significant advantage if traffic is rerouted through its land and it is entirely fair to ask a consideration in return
- A business park would be a good use for this site
- Asked Council to be selective about proceeding with this proposal

8. Linda MELVILLE **OPPOSED**
2263 Dollarton Highway

- Asked if the proposed amendments would include an amendment to the Maplewood OCP

The Maplewood OCP and the proposed application would be consistent with the existing Maplewood OCP and inquired whether there is a need to amend the OCP

- Questions whether the rezoning is for a business park or if CXY could sell parcels of land for development

Mayor Bell clarified that if the rezoning were approved, CXY would be able to develop the land or

- Expressed concern that, if the subject lands are rezoned and sold in parcels, the area would become “Lynnmour East”
- Expressed concern that the District would consider expropriation of residential property
- The proposed Bylaw would affect the liveability of the Maplewood community

Mayor Bell clarified that the usual process is to negotiate a land exchange agreement with an owner and expropriation would only be considered if an agreement cannot be reached and the property is deemed necessary for municipal use for the realignment of the Dollarton Highway.

- Suggested that the District should have considered expropriating CXY lands for the realignment instead of residential lands

Mayor Bell explained that the property being considered for rezoning is completely within the CXY land holdings. CXY wishes to rezone the property and the District had identified a need to realign the Dollarton Highway creating an opportunity for mutual benefit.

- Questioned why the proposed Bylaw does not include the Dollarton Highway realignment

Mayor Bell advised that the lands for the realignment are not included under the proposed rezoning as the Dollarton Highway lands would be dedicated for road use if the rezoning proposal were accepted.

The Manager – Planning clarified that the lands would be dedicated as part of a subdivision plan.

- Asked Council to defeat the proposed Bylaw
- The proposed rezoning should be considered as part of the Seymour Planning process
- Questioned the adequacy of the MIACC guidelines

Mr. Ross Peterson stated that the MIACC guidelines were developed by a consensus group of scientists representing universities, industry and the federal government as a means of assessing risk pertaining use. He advised that there are a number of approaches used to assess risk and the essential focus of all is to limit public exposure to risk.

- Suggested that more people should not be placed on these lands and exposed to risk from the chlorine plant
- Would like the realignment to be abandoned and asked Council to seek another resolution to the traffic problem separate from the CXY lands
- Suggested that taxes could be raised to pay the CXY share of the realignment

In response to a question from Councillor Munroe regarding the acquisition of land for the realignment, Ms Melville suggested that the land could be purchased or expropriated from CXY.

- Suggested that the Maplewood business park should not be a capital project and expressed concern that residential land could be expropriated for a non-capital project
- If it is a capital project, the land should be expropriated from CXY
- The chlorine plant is dangerous and the buffer zone is an important protection for the community
- Asked Council not to rezone the buffer zone
- Would like to have the chlorine plant removed and volunteered to participate if a task force is struck
- The chlorine plant has been an ongoing concern for many years
- The District must consider the future and cannot pass this Bylaw without thinking about

future use of the lands

9. Doug CLOUDA **IN FAVOUR**
1546 Oxford Street

- Resides approximately one mile north of the CXY chlorine plant
- Is a long term employee of CXY and resident of the District
- Supports the rezoning and urged Council to approve
- The proposal would attract business and industry which would help to reduce the residential tax share and broaden the tax base
- The District should increase the number of tax payers and revenue
- An increase in the number of businesses will create a demand for services and spin-off industries
- There have been enough studies and information to proceed
- Asked Council not to waste more tax dollars on duplicating existing studies
- Urged Council to support the Bylaw

10. **Tom YOUNG** **IN FAVOUR**
2012 Dollarton Highway

- President of the Maplewood Community Association
- Expressed appreciation for the recent town hall meetings and the opportunity for communication with residents
- The Maplewood Community Association fully supports the changes proposed by CXY and would welcome a new Bylaw which includes the amendments
- Asked Council to consider the enthusiastic support of the Maplewood Community Association
- The Maplewood Community Association is encouraged that CXY is no longer opposed to a small residential component in the development
- The Maplewood Community Association recommends the following
  - That the lands be developed in an aesthetically pleasing manner
  - That the businesses be clean, quiet and non-toxic
  - That five percent of the lands be devoted to public use
  - That wildlife corridors be established
- It is unlikely that the land will remain vacant or be developed for residential single-family use
- This is the best option because it will remove the threat of heavy industry and will result in the realignment of the Dollarton Highway
- The Maplewood community will always be a mixed use community
- The community would benefit from inclusion of the north west quadrant in the new Bylaw
- The bridge issues should be separate from the CXY rezoning
- Recommended that a committee of residents and industrial representatives be formed to make recommendations to Council with assistance from N.D. Lea Consultants

11. John WALKLEY **IN FAVOUR**
351 Seymour River Place

- The north west quadrant is very important to the Maplewood Community Association and it should be included in the new Bylaw
- The community wants the Dollarton Highway realignment to proceed as soon as possible
- The existing Dollarton Highway is dangerous and residents fear for the safety of adults and children trying to cross the road
- It is essential to bring the north west quadrant into the proposal to create a Maplewood village and to attract good business prospects

- The proposal should specify having industry in a business park
- It is not necessary to remove all the trees
- The proposal could be liveable and a credit to the neighbourhood
- Current planning supports mixed use with industry, commercial and residential together so residents won't have to commute across the Second Narrows bridge
- Would like to expedite the rezoning of the north west quadrant

Mayor Bell clarified that the north west quadrant would be the Comprehensive Development Zone 17 (CD17) and that the parcel was deleted from the existing proposed Bylaw because of concerns raised by the public.

12. George HORNER **IN FAVOUR**
113 Charles Street

- Represented Guido and Joanne Tinaburri and Falesca Importing Ltd.
- Read and submitted a letter of support
- Falesca Importing Ltd. has been in business over 20 years and has employed a number of people
- Expressed support for the proposed rezoning application and the Dollarton Highway realignment
- Falesca attended all public meetings in connection with the Dollarton realignment and has consulted with other Maplewood industrial property owners
- On May 20, 1998 a joint meeting of available Maplewood industrial property owners and 3 members of the Maplewood Community Association executive was held and the following recommendations were agreed upon
  - Expedite the Dollarton realignment
  - Expedite development of the District business park
  - Expedite rezoning of the north west quadrant of CXY lands in consultation with the Maplewood Community Association to achieve a suitable mixed use zone
  - District staff and consultants meet with a representative committee of the Maplewood community during the planning and design stages for traffic circulation and intersection design
- Asked Council to approve the rezoning

In response to a question from Councillor Muri, Mr. Horner expressed support for the rezoning of the subject lands.

In response to a question from Councillor Munroe, Mr. Horner clarified that the proposed rezoning and highway realignment is desireable because it represents a good business decision and the business community supports the rezoning.

13. Robert MEARNS **IN FAVOUR**
251 Seymour River Place

- Suggested that the Seymour community has had many needs addressed such as social programs, ice arenas, golf facilities, Kiwanis residential care, recreation areas, sporting programs and housing
- The need that has been overlooked is diversity in business development
- If the proposed Bylaw is approved, these needs would be addressed over a number of years
- The proposed rezoning would provide a positive benefit to the Maplewood community and to the North Shore
- Strongly urged Council to support the rezoning
- There has been enough discussion, studies and review and the project should proceed

14. Steve Okrainetz **IN FAVOUR**

2275 Windridge Drive

- Expressed support for defeat of the existing proposed Bylaw and the drafting of a new application for a rezoning Bylaw
- Urged Council to include the north west quadrant in the new application because it is an integral component of the Maplewood community
- Encouraged Council to re-examine the Dollarton realignment because it is not needed
- Maplewood residents are trying to create a community in Maplewood and the realignment and bridge expansion will create a thoroughfare in the midst of the community
- The Dollarton Highway should be a gateway leading into the community

15. Bill TRACEY **IN FAVOUR**
2804 Brockton Crescent

- Expressed support for the rezoning of the subject lands in accordance with the land use revisions proposed by CXY
- The proposed rezoning conforms with the existing OCP however the north west quadrant (CD17 Zone) should not be included because the existing OCP would not permit a mixed use development and the Maplewood OCP would have to be amended
- The Seymour Planning process is proceeding expeditiously and there is no reason to bypass the planning process to include the north west quadrant
- The Seymour Planning Committee would welcome Maplewood residents to come forward and make recommendations regarding planning for the community
- Suggested that Council could give the existing proposed Bylaw second and third reading and withhold final approval until the Bylaw could be amended to include the proposed changes regarding land use and building regulations

[illegible]
- Residents would like the proposed realignment to proceed and want the construction to commence as soon as possible
- The subject lands are approximately eighteen and one-half acres and is a relatively small site in terms of industrial lands
- Urged Council to proceed with the rezoning so the community can start to see the benefits of the project

In response to a question from Councillor Munroe, Mr. Tracey stated that he supports the rezoning of the subjects lands outside of the Seymour Planning process because the application complies with the existing OCP. He stated that the north west quadrant should not be included because it would require an amendment to the Maplewood OCP and suggested that it would not be too long to wait for the Seymour Planning process to be completed. Mr. Tracey advised that residents are anxious to proceed with the Dollarton Highway realignment and he therefore supports the rezoning of the subject lands prior to completion of the Seymour Plan.

16. Wynn WRIGHT **IN FAVOUR**
2525 Panorama Drive

- **Expressed support for the proposed Bylaw and the outcome of the recent town hall meetings**
- **CXY listened to the concerns of the community in general regarding the sensitive issue of retail land use**
- **The amendments proposed by CXY would direct the use toward business park**
- **The revised proposal would be liveable and worth striving for**

- **The high tech uses and local manufacturing are in great demand**
- **Corporations make decision quickly and there is a risk associated with waiting too long to make land use decisions**
- **The community would like to proceed with the rezoning and the Dollarton Highway realignment**
- **Asked Council to pass the existing proposed Bylaw and to consider amendments later**

17. Sheila MC LEOD **IN FAVOUR**
Dollarton Highway

- Former resident of Deep Cove and currently lives in Maplewood
- Maplewood residents have come together as a community
- The Maplewood community are the people most affected by the proposed Bylaw and should receive first consideration
- The community has clearly expressed support for more residential development in the north west quadrant (CD17) because it will provide a greater sense of community
- There are many obstacles in the Maplewood community and the area needs a centre and sense of pride and ownership
- There are many rental properties and the rate of tenant turnover is high
- Expressed support for a Public Hearing any time in June
- The community needs this proposal to proceed as soon as possible

18. Dave SADLER **OPPOSED**
277 Roche Point Drive

- The issue of safety regarding the chlorine plant has not been concluded
- The Bovar and Little Reports have helped to introduce improvements to safety, however, the District has not identified an acceptable level of risk for the community
- This issue cannot be ignored
- There is greater likelihood that deaths would be caused in the community from a chlorine gas leak than from an earthquake
- It is important to determine what level of risk is acceptable and what the population and density would be before any land use amendments proceed
- There has been discussion regarding a business park, however, the proposed Bylaw does not stipulate a business park
- It appears that the public does not have a clear understanding of the proposal
- Raised questions regarding the N.D. Lea traffic study regarding the amount of traffic to be generated by the proposed amendments
- Noted that most businesses start work at approximately the same time
- The realignment and expanded bridge would not reduce the waiting time to enter the Second Narrows bridge but would reduce the length of the lineup by converting it to a two-lane lineup
- Expressed doubt regarding the service levels suggested by the N.D. Lea study for the Dollarton Highway following the realignment
- If the District wishes to use Development Cost Charges to pay for the infrastructure upgrading, it must consider the additional impact of 1,000 new residents in the Seymour area that would result from the development
- The proposed bridge expansion will increase the value of the industrial lands in the Maplewood area and the $14 million cost of upgrading the bridge should be underwritten by the industrial property owners
- The CXY lands should remain as presently zoned because it would generate less traffic
- Asked Council to vote against the proposed rezoning and to help preserve the liveability in the Seymour community

18. Corrie KOST **OPPOSED**

2861 Colwood Drive

- The key element to this issue is the potential risks of the chlorine plant
- There has been no statement from Council regarding acceptance of the MIACC guidelines
- Asked Council not to make a hasty decision and noted that land values will continue to appreciate if the process is delayed to ensure sound decision making
- Unable to support the existing proposed Bylaw because of the proposed restaurant use
- Urged Council not to accept the current Bylaw or the proposed amendments
- The proposed realignment of Dollarton and bridge expansion will affect residents of the western side of the District because traffic will divert to the Lions Gate crossing
- Displayed and reviewed a chart of common risks in North America
- Noted that the risk of death from an earthquake is 5 to 50 time lower than the risk of death from a chlorine gas leak
- The chlorine plant greatly magnifies the risk association with an earthquake
- The MIACC guidelines do not consider the number of people living in proximity to a chlorine plant
- The District should investigate the number of deaths anticipated if there is a chlorine tank leak

In response to a question from Councillor Carolan, Mr. Kost explained that Council should seek information regarding the expected number of deaths in the event of a chlorine gas leak in order to make a comfortable decision. Mr. Kost suggested that Council could decide to wait until the chlorine plant is no longer in operation and pointed out that the lands would increase in value if a decision were postponed.

In response to a question from Councillor Munroe, Mr. Kost confirmed that reducing the number of people in the area would reduce the number of fatalities but would not reduce the risk. Mr. Kost stressed the importance of determining how many deaths could occur if there was a chlorine gas leak.

DISPOSITION:

MOVED by Councillor CRIST, Seconded by Councillor MURI and CARRIED
THAT Bylaw 7008 be returned to Council on May 25, 1998 for further consideration.

Mayor BELL declared the Public Hearing in respect of Bylaw 7008 **CLOSED** at 9:48 p.m.

Certified correct:

_____

Committee Clerk

Is it true that "Liquid chlorine is identified in federal drinking water guidelines as the primary disinfectant used by Canadian municipalities, and Chemtrade supplies a significant portion of the chlorine used in Metro Vancouver's drinking water treatment system, supporting regional public health infrastructure"

Here's how the **statement you asked about** lines up with reliable sources:

✅ 1. Chlorine is a commonly used disinfectant in Canadian drinking water systems

- The *Guidelines for Canadian Drinking Water Quality* document from the Government of Canada and Health Canada make clear that **chlorine is widely used as a disinfectant** (both primary and to maintain a disinfectant residual) in drinking water treatment across Canada.
- A *Statistics Canada* survey (referenced by Chemtrade itself) found that **96 % of Canadian municipalities use chlorine in their municipal water treatment**.

But the guidelines themselves do *not* single out "liquid chlorine" as the exclusive or mandated disinfectant; they state that chlorine in some form is widely used but do not prescribe a specific product form (gas, hypochlorite solution, chloramine, etc.).

⚠️ 2. Federal Guidelines don't explicitly label *liquid* chlorine as "the primary disinfectant"

- Health Canada's documentation discusses chlorine broadly (free chlorine, which may be added as gas or in solution), and acknowledges that chlorine and chloramine are used for primary and secondary disinfection.
- The wording "primary disinfectant" in the guidelines refers to the process of killing pathogens, not necessarily a specific chemical form mandated federally.

So the **claim that federal guidelines specifically identify *liquid chlorine* as the primary disinfectant** is an oversimplification. The guidelines emphasize *chlorine-based disinfection* broadly, rather than a specific chemical delivery form.

✅ 3. Chlorine is important in Metro Vancouver's drinking water treatment

- Metro Vancouver uses **chlorine (often added as a solution such as sodium hypochlorite)** as part of its treatment process, especially to maintain a disinfectant residual in the distribution system.
- Metro Vancouver also uses **ozone and UV light** at its main treatment plants for primary disinfection, with chlorine added before distribution to prevent regrowth of bacteria.

So it's true that **chlorine plays a key disinfecting role in Metro Vancouver's water system**.

✅ 4. Chemtrade is a major supplier of liquid chlorine in Canada

- Chemtrade's own communications state that its **North Vancouver chlor-alkali facility produces about 40 % of Canada's liquid chlorine supply**, and regionally more than 70 % of the liquid chlorine available in BC and Alberta.
- The company also says its production supports water treatment systems across Canada.

📜 Summary

Part of the Claim	Supported by Evidence?
Liquid chlorine is identified in federal drinking water guidelines as the primary disinfectant	**Not exactly** — federal guidelines refer broadly to chlorine (in various forms) being widely used for disinfection, but don't single out "liquid chlorine" as the required or primary form.
Chemtrade supplies a significant portion of chlorine used in Metro Vancouver's system	**Yes — Chemtrade is a major Canadian supplier of liquid chlorine, and Metro Vancouver uses chlorine in its treatment processes.**

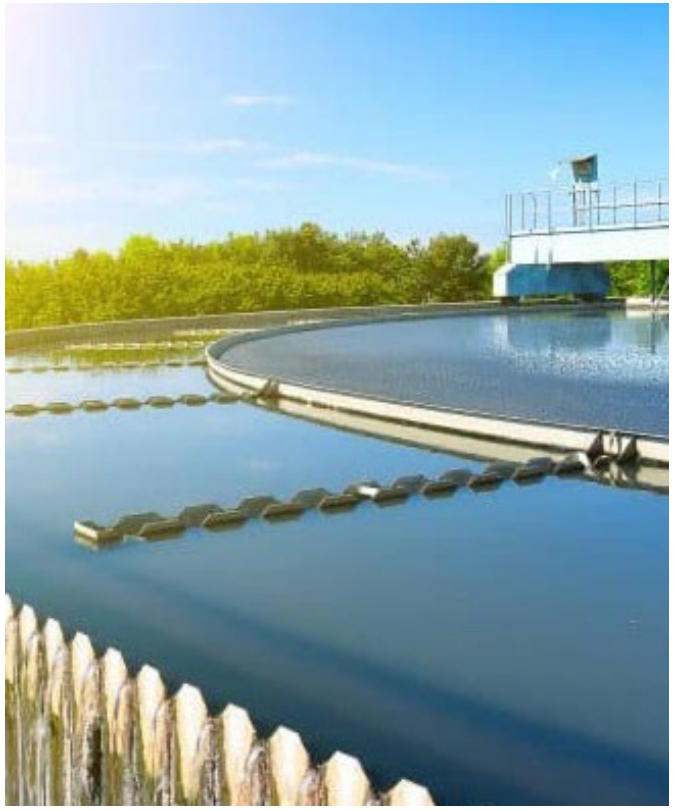
Key Issues about the Chlorine plant future plans

- The plant has had no serious chlorine releases since it started in 1957
- If such a Chlorine plant were proposed to be here today it would not be permitted
- IMHO the future vision for Maplewood can never be fulfilled so long as this plant exists
- The DNV taxes/fees collected by this facility should not be a factor in deciding this issue
- The plant's liability insurance of $300million(1) in the 1990's should be about $1Billion today
- If there is no such insurance currently in place then it speaks volumes about the risks!
- The proposed Bylaw 8778 does not have an expiry date for the production of chlorine
- A global survey indicated no chlorine plant in the world lies this close to housing
- The BakerRisk report that the latest 10^{-6} contour **does not lie within the site boundary**.
- No results for a "worst-case" situation (say during an extreme earthquake) was ever studied.

(1) See Aug 25 1998 Public Hearing that Canadian Occidental Petroleum carried a $300m US funds of liability insurance.

CHEMTRADE







Responsible Care®
Good Chemistry at Work

Securing safe drinking water for Canadians and reducing potential risk to the NVAN community

Chemtrade North Vancouver overview



Essential to Canada's Water

- 40% of Canada's liquid chlorine supply
- Treats 70% of Western Canada's drinking water
- Secure Canadian capacity to treat and secure drinking water
- Chlorine provides residual protection, has a long shelf life, and is commercially viable



Economic Benefits

- 118 full-time employees
- $24.5M annual payroll
- $150M injected into the economy
- Almost $6.7M taxes and fees to District of North Vancouver in 2025

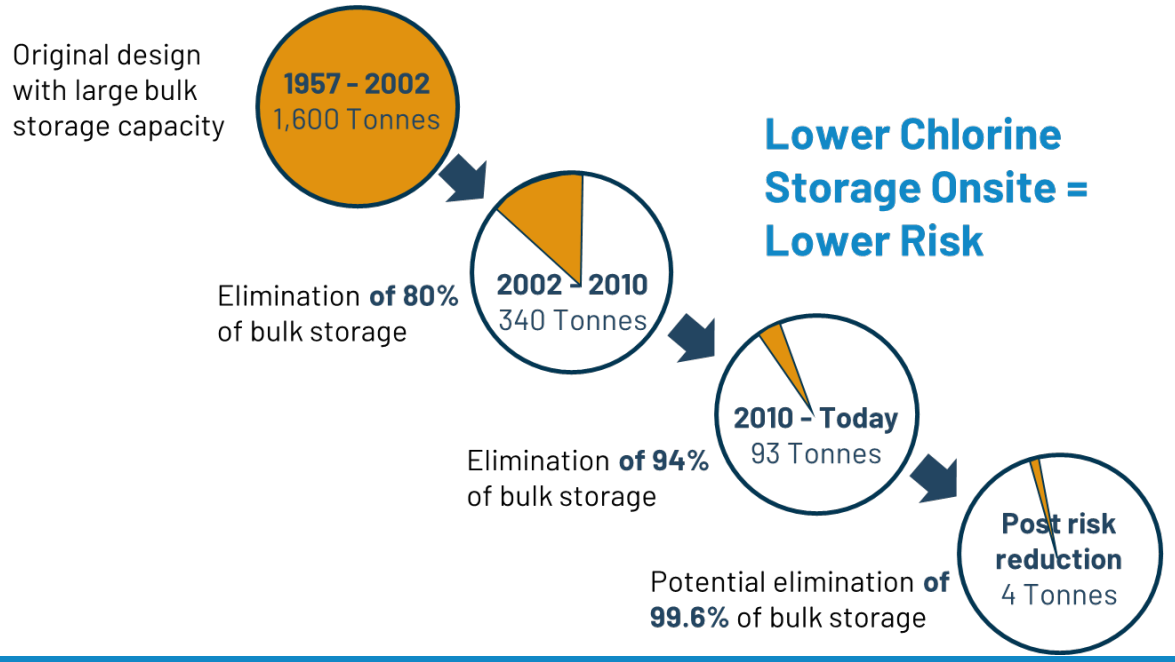


Modern, Clean, & Safe

- Operating safely since 1957
- Since 2010 invested >$500M to upgrade safety
- Produces chlorine, caustic soda, hydrochloric acid, and hydrogen
- Supports critical Canadian industries like water treatment, energy, tech, pulp & paper, manufacturing

Safe and reliable operator

- Chemtrade hasn't experienced a significant release since purchasing the facility
- Employees receive extensive training , and the facility conducts joint exercises with local first responders
- 94% reduction in onsite chlorine storage , with plans to move to a produceand-ship model which will significantly reduce risk to the community
- Plannedsignificant further improvements to improve reliability and safety, and reduce potential risk



Rail is the safest way to move chlorine

Vancouver is a major port for North America, and is the only port in North America connected to three Class 1 railways that service the Pacific Coast - *Canadian National (CN), Canadian Pacific Kansas City (CPKC) and BNSF (Burlington Northern Santa Fe Railway Company).*

Rail is the safest method of shipping hazardous materials and is heavily regulated by government and industry regulations. **In the almost 70-year history of North Vancouver plant there have been no non-accidental releases (NAR) of chlorine from railcars released by the plant.**

Chlorine is shipped in specialized cars that include several elements of protections and redundancies. **Accidental releases from chlorine railcars is extremely rare.**

Comprehensive railcar maintenance program and **minimum four onsite inspections:** arrival, pre-loading, post-loading and before departing site.

Chlorine is classified as a Toxic Inhalation Hazard (TIH) and movement is **heavily regulated by the federal government. Chemtrade has never had a TIH release during transportation.**

We maintain an Emergency Response Plan, **coordinate with local first responders, and are members of CHLOREP and TRANSCAER**

Liquid chlorine is transported on **hazardous material routes, are positively tracked and must travel at reduced speeds.**

Employees receive **extensive ongoing training and must follow safe operating procedures.**

Planned investment in further safety improvements



Left: *new railcar enclosure building and tank farm*
Above: *closer look at the railcar enclosure building*

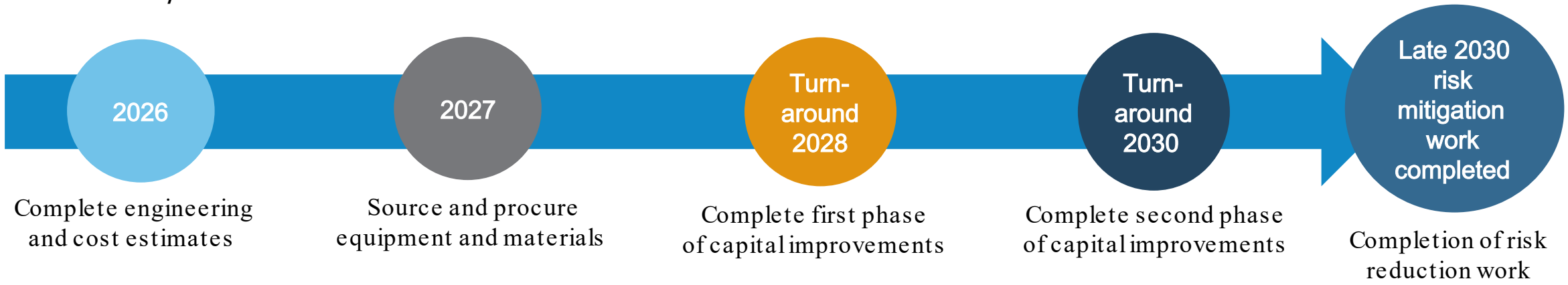
Planned safety enhancements:

- Reduce liquid chlorine storage onsite to absolute minimum by removing all bulk storage and loading liquid chlorine directly into railcars (produce and ship model)
- All rail loading activities in a sealed building equipped with air scrubbers
- Install seismically activated safety shutoff valves

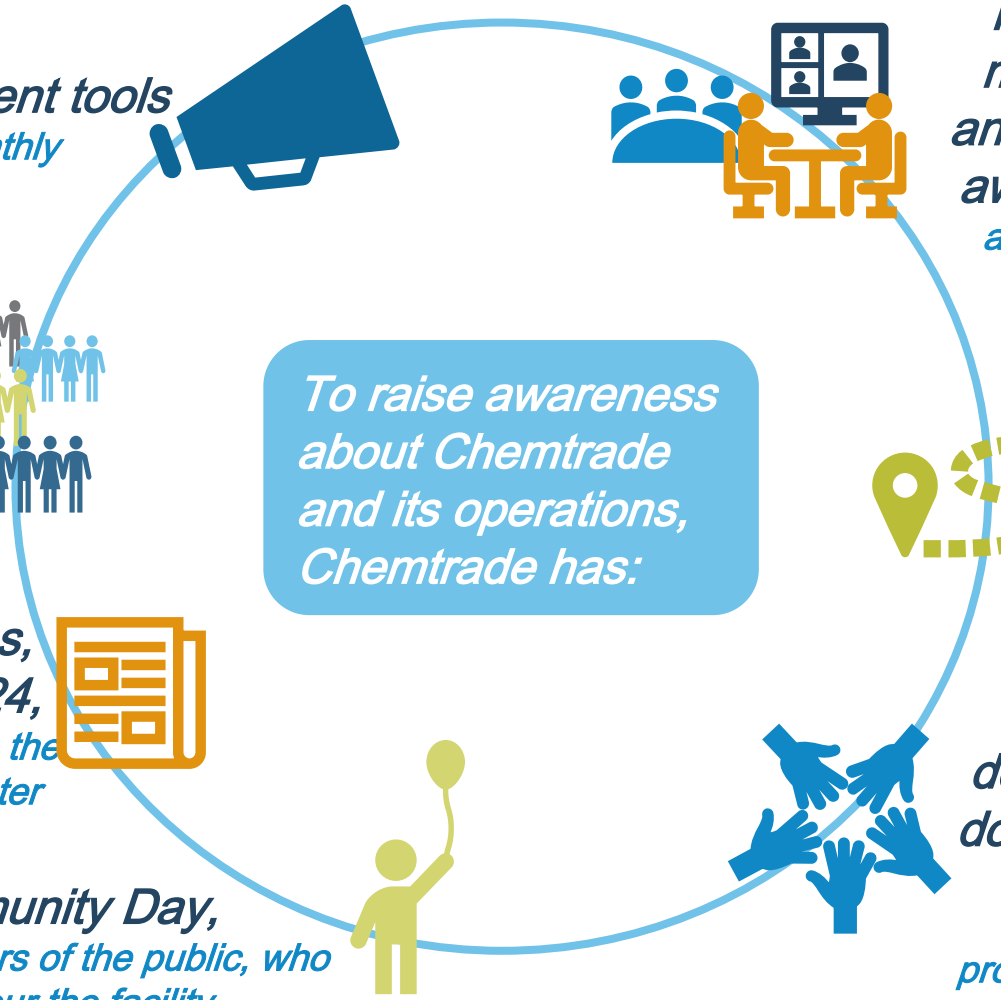
Implementation of safety improvements

Roughly four years to complete full improvement projects (late 2030)

- Engineering work has started with cost estimates expected in fourthquarter of 2026
- Begin sourcing and ordering required equipment and materials in 2027
- All construction work would be done during plant turnarounds that are scheduled every two years
  - *Next planned turnarounds are scheduled for 2028 and 2030*



Engaging with the community



Created two new engagement tools
AskChemtrade.ca and bi-monthly community newsletter

Met with hundreds of community members, including First Nations, and all levels of government, to raise awareness (virtually and in person),
and have received overwhelmingly positive feedback

Held three open house meetings to raise awareness – two in 2024, one in 2025
and received overwhelmingly positive feedback

Started a public tour program
Over 150 members of the public have toured our facility

Participated in several media articles, including during the rail strike of 2024,
receiving national and US media coverage on the role our facility plays in supporting drinking water

Invested tens of thousands of dollars into the community through donations, sponsorship, and in-kind,
including local initiatives focused on supporting local first responders, youth programs, supporting STEM opportunities, and Indigenous communities

Hosted first Community Day,
Attended by over 350 members of the public, who had the opportunity to tour the facility

Why apply for rezoning? Benefits from our operations

Why look to rezone?

- Facility produces **70% of chlorine for Western Canada** and **40% of Canada's liquid chlorine**, essential for **safe drinking water treatment**
- Global geopolitical shifts increase the need for **secure domestic chlorine production**
- Rezoning enables **continued investment** in major safety upgrades to **reduce community risk**

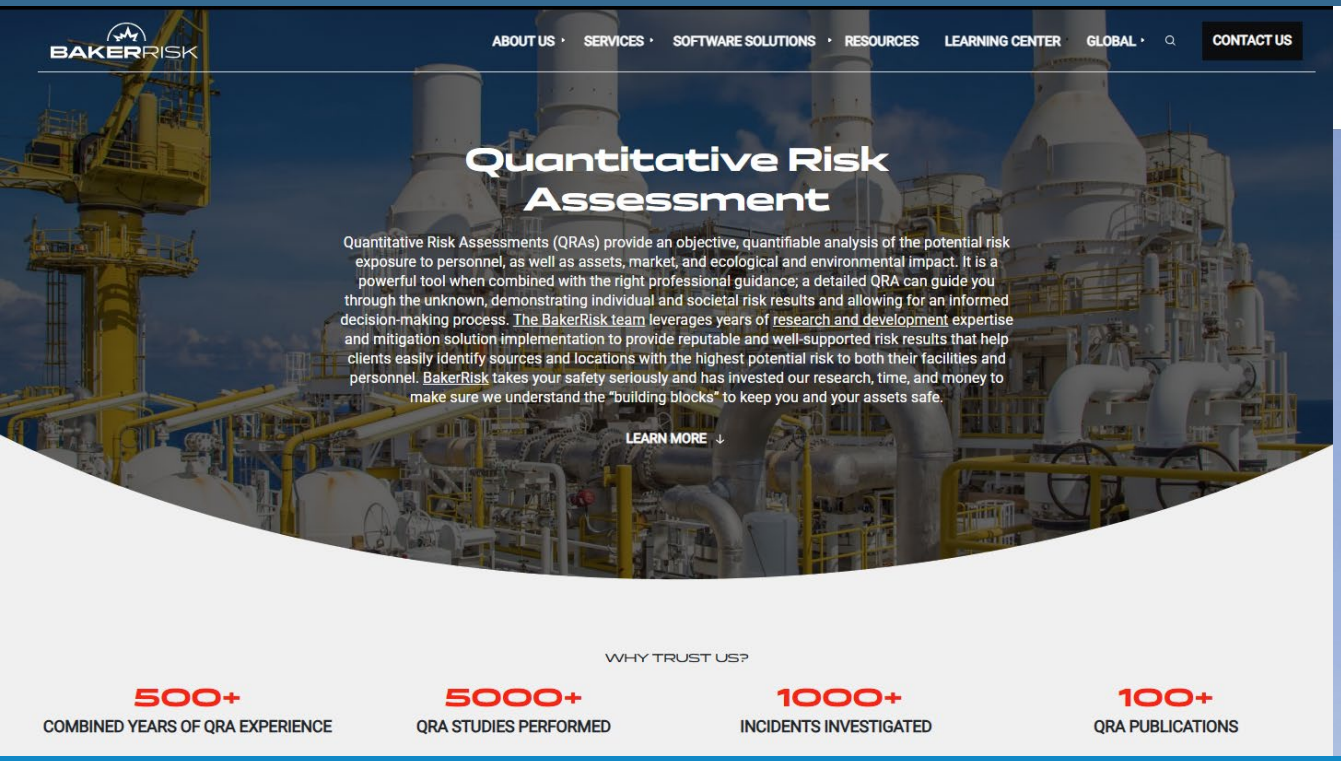


Benefits from our ongoing operations:

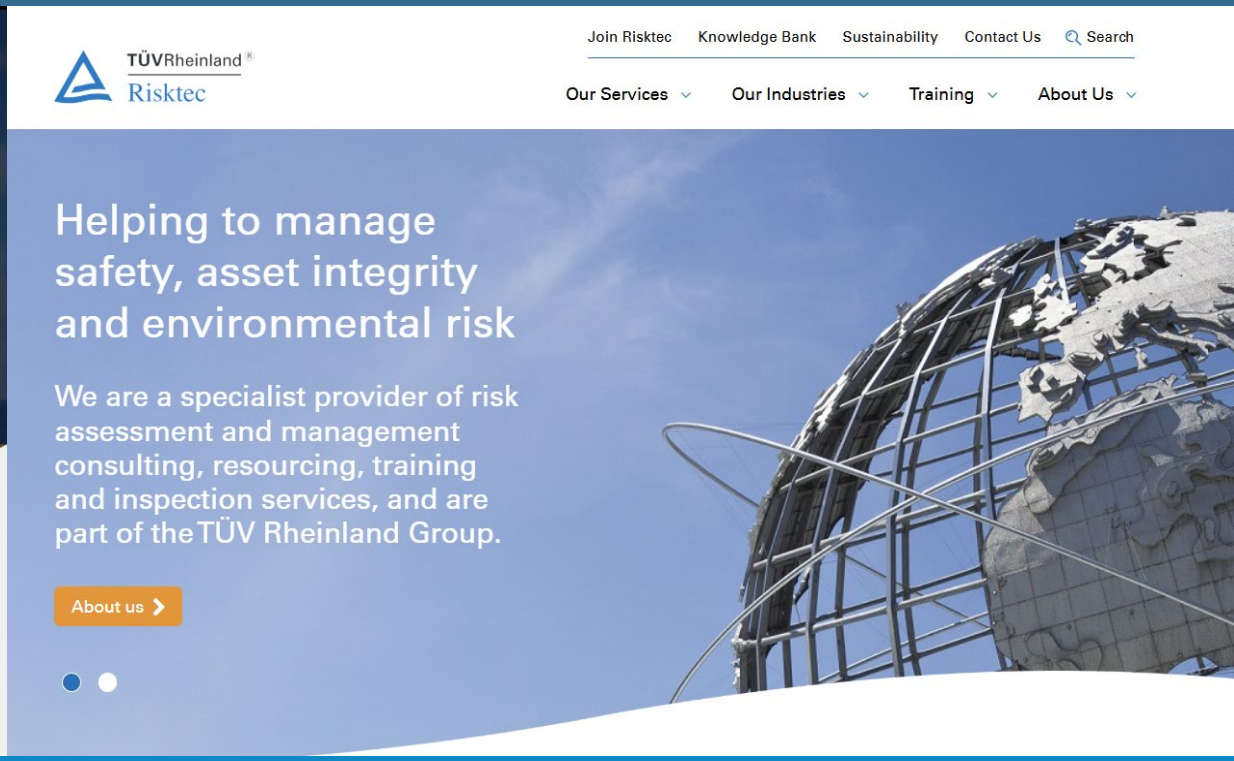
- Provides **118 well-paid, local jobs with an annual payroll of over $24.5 million**
- A **strong community partner** through **investment programs and partnerships**
- We pay **millions in municipal taxes and fees**
- Our products **supporting other critical BC and Canadian industries** (technology, energy, pulp and paper, manufacturing)
- Our facility **injects $150 million into the economy through spend with contractors, suppliers, and vendors**

CHEMTRADE

Using trusted, global experts to develop and review our Quantitative Risk Assessment



QRA developed by BakerRisk



QRA peer reviewed by Risktec

Defining risk

- **BakerRisk** uses a data-intensive approach to identify maximum credible events without guesswork

- QRA (quantitative risk assessment) evaluates three core components:
  - ***Consequence*** *(the severity of the outcome of an incident): using receptor or occupancy data to convert consequences into exposure vulnerabilities*
  - ***Risk*** *(there is an element of risk to all human activities): risk is calculated based on frequency estimates (likelihood) and consequence results*
  - ***Likelihood*** *(how likely is the event to occur): the team estimates release frequencies and conditional probabilities for weather conditions, wind direction, ignition probability, and time of day*

- Uses **advanced modeling tools**, site-specific operations, and historical data to assess all potential hazards.

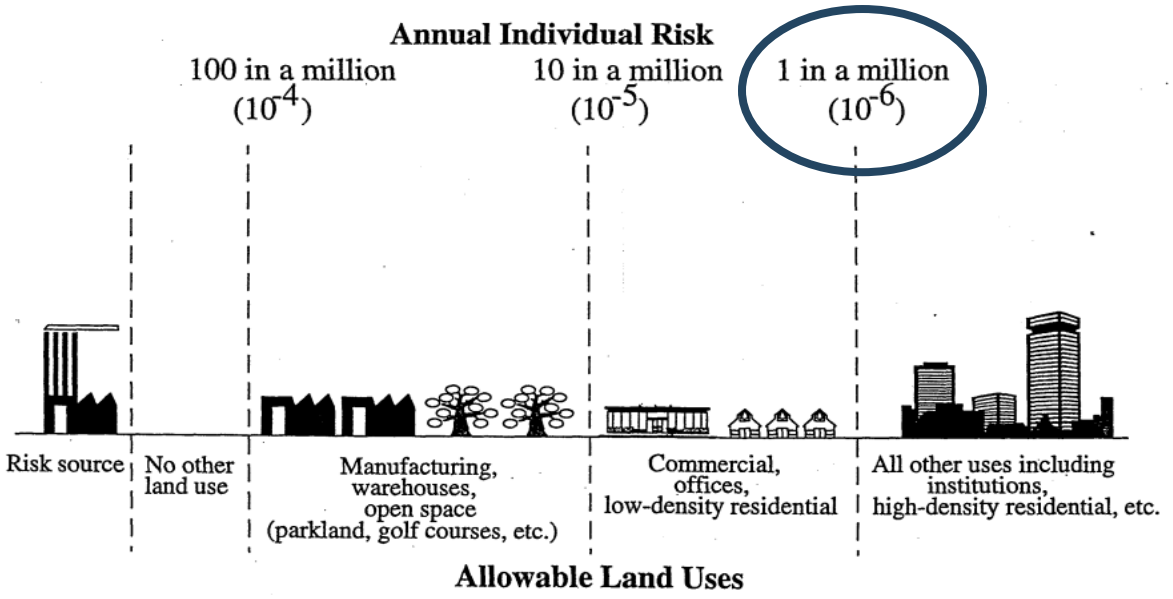
- Ensures a **thorough identification and assessment** of potential risks at the facility

Acceptable risk

- The Major Industrial Accidents Council of Canada (MIACC) guidelines were developed to establish national, consensus-based standards for preventing, preparing for, and responding to major industrial accidents involving hazardous substances and to provide a standardized approach to land-use planning and risk management.

- Everyday examples of people choosing activities which have an acceptable risk defined at one in a million risk of death and represented by the 10^{-6} curve on a QRA assessment: *taking an long-haul (1,000 kms) flight, skiing for one day, or riding on a passenger train. These activities have about a one in a million risk of death*[1]

- Canada's approach reflects global consensus on industrial risks and land use planning.



[1] University of Cambridge, BBC

Scenarios included in the updated QRA and findings

Scenarios Assessed:

- Over 50 potential leak sources modeled, including accidental railcar releases, railcar storage releases, equipment failures, and rail-loading area incidents
- Causes reviewed included human error, piping rupture, equipment failure, and earthquakes
- Assessment includes the worst-case scenario: full release of a chlorine railcar onsite

Key Findings:

- After planned safety upgrades, the 10^{-6} risk contour moves to at or near the Chemtrade fenceline, significantly reducing community risk
- Resulting risk levels meet or are better than MIACC guidelines

Risktec concluded the BakerRisk QRA is well-developed, credible, and defensible

Updated risk reduction curves



- To help provide context,outside of the 10^{-6} curve, you would have a greater chance of dying in a plane crash during a long-haul flight (1,000 kms) or riding public transit than being harmed by our North Vancouver operations.
- Once the safety projects are completed, there will be very limited restrictions on land development outside of Chemtrade fence line and potential risk to the surrounding community will be greatly reduced.

Questions











From: Kelly Bond [redacted]
Sent: February 25, 2026 8:05 PM
To: DNV Input; Mayor and Council - DNV
Subject: Has anyone reviewed safety plans with nearby residential?
Attachments: Screenshot_20260225_194834_Chrome.jpg; Screenshot_20260225_194622_Chrome.jpg

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good Evening,

I heard last night from Staff that "notification" of any safety compromise from Chemtrade would be required to be conveyed to tenants by developer of said residential and was written into development covenants. I couldn't quickly find the development covenants to read the phrasing.

While this concern may be slightly outside the scope of thr Chemtrade rezoning itself, I'm curious about previous rezonings made prior to this change to Chemtrade site and if "new" saftey sessions and protocols would be required with approval of this application.

Have these safety sessions written into covenants been monitored consistently for compliance at the residences in questions by DNV? For instance at [redacted]? Do "safety sessions" take place whenever there is tenant changeover? How are you protecting citizens on an ongoing basis?

Attached are screenshots from one document from the 2013 Front Street/Dollarton rezoning that I very hastily found in the council agendas.

Thank you.

Kelly Bond

- Stated that as an owner of a business within the 75m radius of the proposed development, he had not been informed.

6. QUESTIONS FROM COUNCIL

Council queried whether the units would be single level units or multi levels. Staff advised that the units would be single level but are wider than normal.

Council queried how many units were at level two adaptability and how many units where at level three adaptability. Staff advised that all units will be level two adaptability and no units are at level three adaptability.

Council queried if the windows will be earthquake rated and if so what magnitude of earthquake are they rated for. Staff noted that the current building code requires that the proposed development be constructed to ensure that the building remains in place for enough time to allow residents to evacuate. There may still be damage to the building. The intent would be for residents to leave their units and migrate towards the corridor were there are no windows.

Staff advised that Phase 2 will be governed by CD68 zone requirements.

Council questioned the level of finish within the suites. The developer advised that the finish would be good quality but not luxurious to maintain affordability.

Council queried what the determined market rent will be. The developer advised that they are estimating $1.90 to $2.00 per square foot.

Council questioned what measures will be taken to ensure tenants are aware of the Canexus Chlorine Plant. The developer noted that this building will have professional management, tenant's guidelines, and safety sessions. Council requested that staff work with the developer to develop a disclosure form as part of the tenant agreement.

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chrome-native://p 27

Landscaping is proposed around the perimeter of the site, augmenting the planting along Dollarton Highway and within the site to assist in screening the open parking area. The project incorporates a central pedestrian plaza with a water feature on the south side of the mixed use building at the entry to the breezeway and a plaza at the west end of the mixed use building. The landscape plan is included as Attachment C.

Canexus Impact

Building Measures and Shelter-in-Place Guidelines

To assess the location of the proposed residential units in terms of the proximity of the project to Canexus and the potential hazard associated with their liquid chlorine manufacturing process and storage, GWL retained a consultant to develop specific measures including the introduction of exterior chlorine gas detectors on the building and a voice communication system tied to the fire alarm system. In addition, the consultant has developed shelter-in-place guidelines for building occupants. These building measures and guidelines will be enforced under the development covenant as a condition of rezoning which will also require that GWL provide the shelter-in-place guidelines to their future tenants.

Chemical Risk Assessment:

This development site is located between the 10^{-5} and 10^{-6} risk hazard contours which were established as a result of the proximity of the Canexus chlorine plant. Under the MIACC Land Use Guidelines, residential development between these risk contours should be limited. Council previously limited the residential density to 8 units per acre. This application for 80 units is consistent with that limitation, but it includes the residential development potential associated with GWL's Lot C property on the east side of Riverside Drive. This approach to aggregate the residential development potential utilizing all of the Company's lands north of Dollarton Highway and mass those units at the north end of the development site was reviewed by risk hazard consultant Doug McCutcheon and Associates, to determine if it met the intent of the MIACC Land Use Guidelines. Mr. McCutcheon confirmed that the proposal does meet the intent of the MIACC Guidelines and from a risk perspective, is supported. Mr. McCutcheon's analysis was peer reviewed by Canexus' risk hazard consultant. The conclusions of the McCutcheon and Associates report were supported by the Canexus peer review.

Land Use Covenants:

A covenant between Canexus and GWL is registered on Lot A limiting land uses to those permitted on the south side of Dollarton Highway which does not include residential uses. On the strength of Mr McCutcheon's report and their own consultant's review, Canexus has agreed to amend the covenant to allow residential development as proposed and a letter

from the company to that effect is included as Attachment D. The covenant document is in the process of being amended and will be executed and ready for registration prior to adoption of a rezoning bylaw.

To further support this approach, GWL will be required to register an additional restrictive covenant over their Lot C lands east of Riverside Drive prior to adoption of a rezoning bylaw which will prohibit any future residential development on that property, ensuring that the residential development on the Company's lands north of Dollarton Highway does not exceed the 8 unit/acre limitation.

Bylaw 7962

To implement this project, Bylaw 7962 (Attachment A) creates a new Comprehensive Development Zone 68 (CD68) which is applied to the entire site, including the Phase 2 area and the new zone:

- establishes the list of uses, including live/work uses

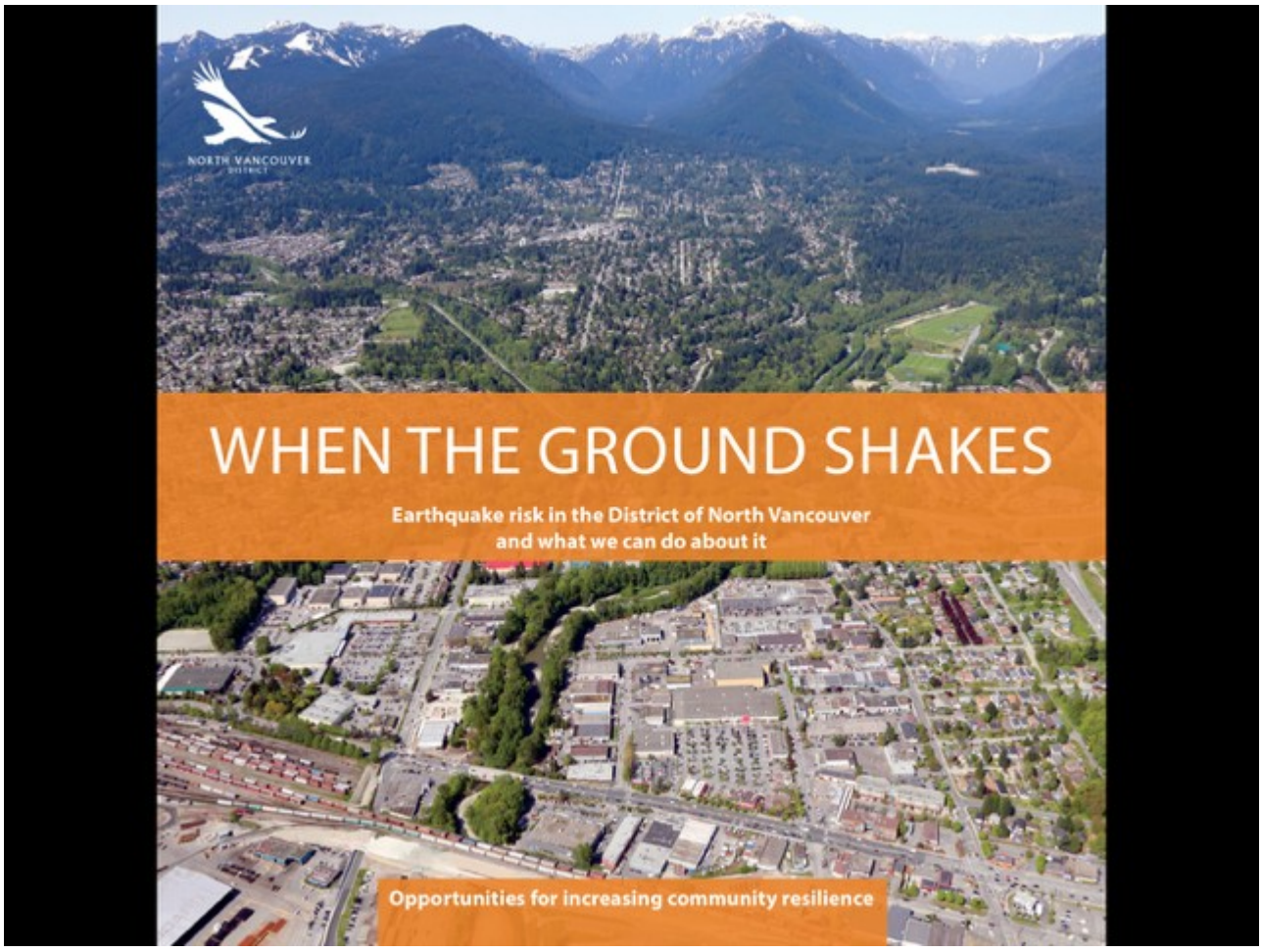
From: Peter Teevan [redacted]
Sent: February 25, 2026 8:09 PM
To: DNV Input
Cc: Mike Little, Mayor; Lisa Muri; Betty Forbes; Herman Mah; Jordan Back; Catherine Pope; James Hanson
Subject: Chemtrade information Feb 25 8:06pm

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

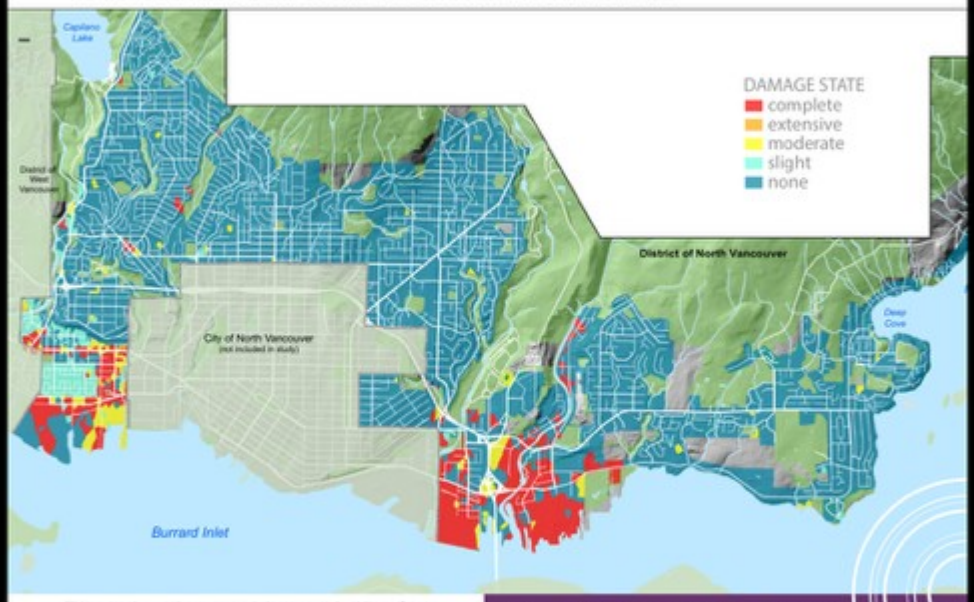
This information is submitted before the vote on possible closure of the public hearing.

Mayor and council, this is from YOUR own DNV Document - found online



WHERE WILL DAMAGE OCCUR?

BUILDING DAMAGE EXPECTED UNDER CURRENT CONDITIONS



This map shows the expected damage to buildings from a M7.3 earthquake based on building age, location, and construction type. Complete and extensive damage to a building means that the building will need to be replaced. Moderate and slight damage can usually be repaired.

Some areas of the DNV will be more damaged than others. Where these overlap with socially vulnerable areas, the demand for emergency support services is likely to be the greatest—both during and after a disaster.

14



Note that your own document depicts the Chemtrade 100 Amherst Site as “COMPLETE DAMAGE”
Sent from my iPad

C. KOST

Right to Know

Hazardous Substance Fact Sheet

Common Name: **CHLORINE**

Synonym: Molecular Chlorine

Chemical Name: Chlorine

Date: November 2007 Revision: October 2015

CAS Number: 7782-50-5

RTK Substance Number: 0367

DOT Number: UN 1017

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Description and Use

Chlorine is a yellow-green gas with a strong, irritating odor. It can be a liquid under pressure or cold temperatures. It is used as a bleach and disinfectant in water purification and sewage treatment, and in making other chlorinated chemicals.

▸ **ODOR THRESHOLD= 0.2 to 0.4 ppm**
The range of accepted odor threshold values is quite broad. Caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

Hazard Summary

Hazard Rating	NJDHSS	NFPA
HEALTH	-	4
FLAMMABILITY	-	0
REACTIVITY	-	0

NONFLAMMABLE GAS
STRONG OXIDIZER
CYLINDERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

Reason for Citation

▸ **Chlorine** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, DEP, IRIS, NFPA and EPA.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact
▸ Immediately flush with large amounts of cool water. Continue for at least 30 minutes, occasionally lifting upper and lower lids. Remove contact lenses, if worn, while rinsing. Immediate medical attention is necessary.

Skin Contact
▸ Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water. Seek medical attention Immediately.

Breathing
▸ Remove the person from exposure.
▸ Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
▸ Transfer promptly to a medical facility.
▸ Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

- **Chlorine** can affect you when inhaled and may pass through the skin.
- Contact can severely irritate and burn the skin and eyes.
- Contact with liquid **Chlorine** can cause frostbite.
- Exposure can irritate the nose and throat.
- Inhaling **Chlorine** can irritate the lungs. Higher exposure may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency.
- **Chlorine** may cause an asthma-like allergy.
- Exposure to **Chlorine** can cause headache, dizziness, nausea and vomiting.
- Repeated exposure can lead to permanent lung damage.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 ppm**, not to be exceeded at any time.

NIOSH: The recommended airborne exposure limit (REL) is **0.5 ppm**, which should not be exceeded during any 15-minute work period.

ACGIH: The threshold limit value (TLV) is **0.5 ppm** averaged over an 8-hour workshift and **1 ppm** as a STEL (short-term exposure limit).

▸ The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

SUBMITTED AT THE
FEB 25 2016
PUBLIC HEARING

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (http://nj.gov/health/workplacehealthandsafety/right-to-know/) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) requires private employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Chlorine**:

- Contact can severely irritate and burn the skin and eyes with possible eye damage.
- Contact with liquid **Chlorine** can cause frostbite.
- Exposure can irritate the nose and throat causing coughing and wheezing.
- Inhaling **Chlorine** can irritate the lungs causing coughing and/or shortness of breath. Higher exposure may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.
- Exposure can cause headache, dizziness, nausea and vomiting.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Chlorine** and can last for months or years:

Cancer Hazard
- While **Chlorine** has been tested, it is not classifiable as to its potential to cause cancer.

Reproductive Hazard
- While **Chlorine** has been tested, it is not classifiable as to its potential to cause reproductive harm.

Other Effects
- **Chlorine** may cause an asthma-like allergy. Future exposure can cause asthma attacks with shortness of breath, wheezing, coughing, and/or chest tightness.
- Repeated exposure may cause bronchitis to develop with cough, phlegm, and/or shortness of breath and may lead to permanent lung damage.
- Long term exposure can damage the teeth, cause a skin rash, swelling and blisters, and hoarseness or loss of voice.

Medical

Medical Testing
For those with frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that:

- Lung function tests
- Check teeth for signs of erosion

If symptoms develop or overexposure is suspected, the following is recommended:

- Consider chest x-ray after acute overexposure

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- Because smoking can cause heart disease, as well as lung cancer, emphysema, and other respiratory problems, it may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require **expert advice** on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on *Control Banding* at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with information and training concerning their hazards.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Special training is required to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA Compressed Gases Standard (29 CFR 1910.101).

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Chlorine**. Wear personal protective equipment made from material which can not be permeated and/or degraded by this substance. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- Safety equipment manufacturers recommend *Butyl*, *Neoprene* or *Viton®* for gloves and *DuPont Tychem® CPF3*, *CPF4*, *Responder®*, *TK®*, *Reflector®*, and *Kappler Zytron® 300* and *Zytron® 500* as protective materials for clothing.
- Where exposure to cold equipment, vapors, or liquid may occur, employees should be provided with special clothing designed to prevent the freezing of body tissues.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection

Improper use of respirators is dangerous. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.5 ppm**, use a NIOSH approved full facepiece respirator with an acid gas cartridge which is specifically approved for **Chlorine**. Increased protection is obtained from full facepiece powered-air purifying respirators.
- If while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Chlorine**, or if while wearing particulate filters abnormal resistance to breathing is experienced, or eye irritation occurs while wearing a full facepiece respirator, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Be sure to consider all potential exposures in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over **5 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **30 ppm** is immediately dangerous to life and health. If the possibility of exposure above **30 ppm** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Chlorine** is a nonflammable gas.
- Cylinders may vent rapidly or explode when heated.
- Use water spray to keep fire-exposed containers cool.
- DO NOT USE WATER directly on the source of the **Chlorine** leak.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Chlorine** is leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Ventilate area of leak to disperse the gas.
- Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.
- DO NOT USE WATER directly on the source of the **Chlorine** leak.

Handling and Storage

Prior to working with **Chlorine** you should be trained on its proper handling and storage.

- **Chlorine** will react with WATER to form *Acid solutions* (such as *Hydrogen Chloride*).
- Explosive compounds are formed or **Chlorine** reacts explosively with ACETYLENE; ETHER; FLUORINE COMPOUNDS; TURPENTINE; ALCOHOLS; HYDROGEN; FINELY DIVIDED METALS; AMMONIA; STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); and MANY OTHER CHEMICALS.
- **Chlorine** is a STRONG OXIDIZER which can ignite ORGANICS and COMBUSTIBLES (wood, paper and oil).
- Store in tightly closed containers in a cool, well-ventilated area away from SUNLIGHT and temperatures over 125°F (52°C).

Occupational Health Information Resources

The New Jersey Department of Health and Occupational Health Service, offers multiple services in occupational health. These include: Right to Know information resources, public presentations, general references, industrial hygiene information, surveys and investigations, and medical evaluation.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.nj.gov
Web address:
http://nj.gov/health/workplacehealthandsafety/right-to-know/

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

NJ Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Chemical Name: **CHLORINE**

Synonym: Molecular Chlorine
CAS No: 7782-50-5
Molecular Formula: Cl_2
RTK Substance No: 0367
Description: Yellow-green gas with strong irritating odor. Can be a liquid under pressure or cold temperatures.

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
4 - Health **0 - Fire** **0 - Reactivity** **DOT#:** UN 1017 **ERG Guide #:** 124 **Hazard Class:** 2.3 (Poison Gas)	Nonflammable Gas Cylinders may vent rapidly or explode when heated. Remove gas with fine water spray. DO NOT USE WATER DIRECTLY ON THE SOURCE OF THE LEAK.	Strong Oxidizer Reacts with WATER to form *Acid solutions*. Forms explosive compounds or reacts explosively with ACETYLENE, ETHER, FLUORINE COMPOUNDS, TURPENTINE, ALCOHOLS, HYDROGEN, FINELY DIVIDED METALS, AMMONIA, STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE), and MANY OTHER CHEMICALS.

SPILL/LEAKS

Isolation Distance: (All Directions):
Small spill - 30 meters (100 feet)
Large spill - 240 meters (800 feet)

Ventilate area to disperse gas.
Stop flow of gas or place leaking cylinder in a safe place.
DO NOT USE WATER DIRECTLY ON THE SOURCE OF LEAK.
Toxic to aquatic organisms.

PHYSICAL PROPERTIES

Odor Threshold:	0.2 to 0.4 ppm
Flash Point:	N/A
LEL:	N/A
UEL:	**N/A**
Vapor Density:	**2.5 (air = 1)**
Vapor Pressure:	5,025 mm Hg at 68°F (20°C)
Solubility:	Slightly soluble
Ionization Potential:	11.48 eV
Freezing Point:	-150°F (-101°C)
Boiling Point:	-29°F (-34°C)

EXPOSURE LIMITS

OSHA:	1 ppm Ceiling
NIOSH:	0.5 ppm 15-minute Ceiling
ACGIH:	0.5 ppm 8-hr, 1 ppm STEL
IDLH LEVEL:	10 ppm
ERPG 1	1 ppm
ERPG 2	3 ppm
ERPG 3	20 ppm

PROTECTIVE EQUIPMENT

Gloves:	Butyl, Neoprene, Viton®
Coverall:	DuPont Tychem® CPF3, CPF4, Responder®, TK®, Reflector®, Kappler Zytron® 300 and Zytron ® 500
Boot:	Neoprene
Respirator:	>0.5 ppm CCR with cartridge for Chlorine or Acid Gas >5 ppm Supplied-air respirator >10 ppm SCBA

HEALTH EFFECTS

Eyes:	Irritation, burns and possible eye damage
Skin:	Irritation, burns Liquid can cause frostbite
Acute:	Nose, throat and lung irritation, coughing (Pulmonary edema) Headache, nausea, vomiting
Chronic:	Cancer - Tested (Not Classifiable). Asthma with shortness of breath, wheezing, coughing and/or chest tightness Damage to teeth, skin blisters and hoarseness

FIRST AID AND DECONTAMINATION

Remove the person from exposure.
Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Immediate medical attention is necessary.
For contact with *liquified gas* quickly flush skin with luke warm water.
Do not rub or reheat area.
Begin artificial respiration if breathing has stopped and CPR if necessary.
Transfer to a medical facility.
Observation is recommended as symptoms may be delayed.

C. KOST

Chlorine Accidents Take a Big Human Toll

https://www.scientificamerican.com/article/chlorine-accidents-take-big-human-toll/

Over the past 10 years, there have been hundreds of accidents involving chlorine nationwide, injuring thousands

- By Jane Kay, Environmental Health News on October 20, 2011

Beverly Martinez was sitting at her desk in the office of a California scrap metal recycling plant when she felt the blast rattle her window.

One of her co-workers, Leonardo Morales Zavala, rushed through her door, struggling to breathe. "Run!" he yelled. He had just cut into a one-ton tank to recycle it in the yard – a football field away – and out poured a noxious substance. He didn't know what it was.

The workers ran as fast as they could toward the street. But they couldn't escape the giant, greenish-yellow cloud. A couple dozen people – workers and customers – dropped to the ground, gasping for air. Martinez fell, too.

"I couldn't get up. I felt like I was being strangled. I thought, 'I'm going to die. I'll never see my granddaughter grow up,' " Martinez said.

As she struggled to reach the building across the street, she heard a voice. "Bev, Bev, help!" It was Ricky Mejia, a 23-year-old inspector, calling to her from the ground.

"Ricky couldn't breathe, he couldn't walk. I'm stocky, and I told him to grab my side. Myrna Navarro was already hanging on my shoulder. She was praying enough for everyone. In my head, I was getting to the Firestone tire warehouse across the street. It seemed like an eternity," she said.

"Then, I couldn't do it anymore. I said to Ricky, 'Your wife is pregnant. You've got a baby coming. Get up!' " They finally made it to the warehouse, where Mejia collapsed.

More than a year later, the ghost of a chlorine cloud lingers like a vivid nightmare at Tulare Iron and Metal Inc., located in the heart of California's Central Valley.

On that June afternoon in 2010, 23 people were taken to hospitals and six were kept for treatment, including Mejia, who was hospitalized for 11 days, two of them on life support. Sixteen months later, the workers are still beset with health problems, including lung, stomach and Post Traumatic Stress Disorders.

Over the past 10 years, chlorine has been involved in hundreds of accidents nationwide, injuring thousands of workers and townspeople, and killing some, according to federal databases. It is second only to carbon monoxide when it comes to the percentage of accidents that cause injuries, according to the newest federal data.

Chlorine is one of the most widely used industrial chemicals in the world today, with 13 million tons produced annually in the United States alone.

An element that is abundant in the Earth's crust and oceans, the powerful, corrosive substance is considered essential to an array of products. It is used in manufacturing plastics, synthesizing other chemicals, purifying

water supplies, treating sewage and making refrigerants, varnishes, pesticides, drugs, disinfectants, bleaches and other consumer products.

In recent years, accidents have occurred when chlorine leaked or spilled, pressurized tanks were punctured, train cars derailed or when other chemicals were improperly – and often unknowingly – mixed with it. In some cases, thousands of people have been evacuated after an accident at a factory or during transport of liquefied chlorine. Janitors, housekeepers and others also have been exposed when they mix acidic household chemicals with bleach or swimming pool chemicals.

The worst chlorine gas accident in the country occurred in 2005, when 18 freight train cars derailed and released 120,000 pounds of chlorine gas in the mill town of Graniteville, S.C. Nine people were killed and at least 1,400 people were exposed, resulting in more than 550 people treated at hospitals, including some with serious lung injuries. More than 5,000 people were evacuated from their homes.

Chlorine gas is particularly insidious. Even small exposures can trigger coughing, choking and wheezing, and burn the eyes, skin and throat. Inhaling large amounts constricts the airways by inflaming the lining of the throat and lungs. At the same time, fluid accumulates in the lungs, making it doubly hard to breathe. People can literally drown in their own body fluids. At high exposures, a few deep breaths are lethal.

In Tulare, Calif., the chlorine concentrations at the recycling plant were extremely high. Three hours after it happened, the Visalia Fire Department measured the gas at 328 parts per million near the tank. It was probably much higher when the workers were trying to escape. Studies show 40-60 ppm produces lung injury; 430 ppm usually causes death in 30 minutes, and 1,000 ppm is fatal within a few minutes. Under federal standards, workers are never supposed to be exposed to concentrations exceeding 1 ppm.

"Exposure to high levels of chlorine gas from a release can cause severe health effects, including death," said Mary Anne Duncan, an epidemiologist at the federal Agency for Toxic Substances and Disease Registry who has assisted with the aftermath of several chlorine accidents, including the one in Tulare.

Erik Svendsen, who studied the health effects of the Graniteville chlorine cloud, said researchers knew they would find pulmonary and other health problems in people exposed. But they found a lot of Post Traumatic Stress Disorders, too.

"Chlorine was used as a war gas for a reason. It was designed not just to kill the enemy but also to inflict fear in the enemy. You remember every second you were exposed to the gas. You don't know where to go. You see your clothes bleach before your very eyes. You see animals die," said Svendsen, a Tulane University epidemiologist.

"It's not just a toxic event. It's a traumatic event. You're powerless. You're being exposed to something you can't stop. You have a metabolic stress response that has effects on the body physiologically."

Only four months before the accident in Tulare, five workers were injured at another California recycler, U.S. Metal in Indio, when a crane worker pierced a cylinder tank and set off an explosive chlorine gas release.

And in July, at Tyson Foods Inc., in Springdale, Ark., chlorine gas was released after the accidental mixing of two chemicals, exposing 173 people and sending 50 to hospitals, including five that wound up in intensive care. Chlorine is used in the company's sanitizing washes.

Across the country, data going back to 1993 show that chlorine accidents occur in the United States at the rate of at least once every two or three days, and about one-third of them cause injuries.

In 2009 alone, chlorine was involved in 181 reported accidents with 56 resulting in injuries, based on the latest report from a federal database called Hazardous Substances Emergency Events Surveillance (HSEES). That amounts to 3.8 percent of all the reported chemical emergencies that year. Chlorine had a high percentage with victims, 30.9 percent, second only to carbon monoxide, which had 41.7 percent with victims. Roughly one-third of the states reported, and only for a part of the year, so the real number of accidents and injuries is much higher, experts say.

"Chlorine releases in fixed facilities resulted in victims and evacuations in more industry categories than any other substance," says a 2004 study by researchers from the Agency for Toxic Substances and Disease Registry. That study was based on HSEES data of 40,000 chemical incidents from 1996 through 2001.

Accidents involving chlorine "were more likely to result in events with victims, evacuations and decontaminations when compared with non-chlorine events," according to another study by the same federal agency published in 2002.

Of 865 events involving chlorine alone between 1993 and 2000, 275 caused injuries, the study says. Of the 1,071 victims, 759 were workers, 235 were members of the public and most of the rest were first responders.

Transporting chlorine also poses more risks than other substances. The U.S. Department of Transportation issued a report last month weighting the most serious accidents in terms of deaths and major injuries from 2005 to 2009. Chlorine led the list with 83 major injuries and nine fatalities out of 48 rail and road accidents compared to gasoline, second on the list, which had 19 major injuries and 30 fatalities out of 1,306 rail and road accidents.

Estimating the number of hazardous materials accidents that affect the public is difficult. Many go unreported. There are at least five national databases of chemical spills, including one for worker accidents and one from the Department of Transportation, and they all have limitations.

For worker accidents, the database by the U.S. Department of Labor's Occupational Safety and Health Administration is considered the best available. Yet officials agree that a lack of consistent reporting among states leads to under-reported accounting. The numbers clearly are imprecise: While the HSEES database reported 56 chlorine accidents with injuries in roughly one-third of the states in just one year, the OSHA database reported only 45 chlorine accidents involving workers nationally over 10 years.

Representatives of the Chlorine Institute, the trade group most familiar with the chlorine industry, said it couldn't discuss the situations in which most chlorine accidents occur. They also wouldn't comment on the data showing the frequency of injuries and evacuations, saying they weren't familiar with the HSEES database or the studies.

"Incidents are rare" in the production of chlorine among Chlorine Institute members, said Frank Reiner, president of the national trade group of 220 manufacturers and distributors. In an e-mail, Reiner said, "the safety performance of the industry has been very good" and his group shares information among members to avoid future problems.

Chlorine is arguably the most essential chemical in use today, industry experts say. It is produced in such large volumes because it can be easily combined with other elements and molecules, transforming it into new classes of chemicals. Industry considers it vital to the synthesis of plastics, drugs, microchips and many other products around the globe. Though there are alternatives for some uses, there are few equally effective and viable substitutes for others, such as water disinfection.

About 93 percent of pharmaceuticals are manufactured with chlorine.

"Chlorine is not in the final product, but it is needed at an intermediate stage to direct reactivity and make sure you make the molecule you want. Being able to avoid the use of chlorine in these cases is a very intense area of current research in green chemistry," said Audrey Moores, an assistant professor in the Department of Chemistry at McGill University in Montreal.

In Tulare last year, the source of the poison released at the recycling plant was a one-ton pressurized cylinder, unmarked as hazardous and accepted in good faith as harmless scrap metal by a recycling inspector. County officials believe the chlorine inside had been used to disinfect food supplies.

Ron Rushing, owner of Tulare Iron and Metal, declined to comment about the accident. The California Division of Occupational Safety and Health has fined the company $15,000 for failing to make certain that containers do not contain hazardous materials and for failing to properly train workers. The company is appealing the fine. Records from Tulare County and federal courts do not show any lawsuits filed against the company related to the accident.

Most of the injured employees are back to work – but they are not back to normal.

Six months after the accident, "19 people were still seeing a physician for problems related to the chlorine release," said Dr. Rachel Roisman, a California Dept. of Public Health medical officer who worked on a health assessment of the workers with county officials.

People reported shortness of breath, change in sense of smell, headache, congestion or phlegm, dizziness, light-headedness and chest pain and tightness.

"Some people were still very affected by the incident either physically and/or psychologically. It had been a significant event for them. For some people, it was definitely still with them," Roisman said.

Now, 16 months later, of four hospitalized workers, Ricky Mejia, who spent 11 days in the hospital – two breathing with the help of a mechanical ventilator – still is suffering from lung ailments and other health problems. He uses an inhaler, and misses some work because of his illness.

Morales Zavala, 48, the shearing machine operator who pierced the unlabeled cylinder tank and ran to warn the staff, is still on the job, suffering from poor health, including stomach problems. Fellow workers say he has lost 40 to 50 pounds, and has a hard time eating.

As for two other hospitalized employees, Danni Cuevas, 23, is back at work after recuperating for weeks, and Gladis Alaniz, 29, a clerk, has left the company.

The first responders were initially told that a 300-gallon tank had ruptured, perhaps containing ammonia, said firefighter-paramedic Karl Kassner with the Visalia Fire Department Hazardous Materials Response Team.

But when the firefighters in self-contained suits got close and sent camera images to the haz-mat trailer where Kassner and others waited, "we saw the one-ton cylinder and knew right away it was more than likely liquid chlorine that had been under pressure. We could hear the team's chlorine alarm going off," Kassner said. When he called on the radio and learned the concentration was 328 ppm, they all knew that it remained at a level known to firefighters as "immediately dangerous to life and health," even three hours after the original release.

Sometimes when Martinez looks at any cylinder, she feels a sense of panic. To the workers, the accident seems like yesterday. They can't shake the feeling of being unable to breathe.

Martinez recalls how the chlorine gas on their clothes made the ambulance drivers cough, and how people driving on the freeway a half-mile away could smell it. She remembers not breathing normally for days, and wanting to take showers every 20 minutes. "Sweat smelling like chlorine poured out of me. My husband said my coughs smelled like chlorine," she said.

Working about 120 yards from the tank, John Espinola, shop supervisor, felt like his head had been covered in Saran wrap. "You felt like your breath was being taken away. You're engulfed in a yellowish cloud. I was just gasping for air. I couldn't get enough oxygen," he said.

Doctors say people who survive heavy chlorine exposure may suffer acute respiratory distress syndrome. Some people develop chemical pneumonitis, an inflammation of the lungs, from breathing in chemical fumes. They can recover or end up with permanent scarring of the lungs, which reduces their breathing capacity.

Even a one-time high-level exposure can lead to irritant-induced asthma. People develop bronchitis, or inflammation of the airways. In some, but not in all people, the bronchitis induces asthma, said Dr. John Balmes, professor at the University of California at San Francisco and division chief of occupational and environmental medicine at San Francisco General Hospital. Balmes' laboratory has been studying the respiratory health effects of air pollutants for 25 years, and he reviewed parts of the U.S. Health and Human Services' toxicological profile for chlorine released last year.

What happens when a person breathes chlorine is that the corrosive substance splits hydrogen from water in moist human tissue, releasing oxygen and hydrogen chloride, which do the damage. Scientists say there are palliative remedies but no antidote.

Researchers believe that an injury from chlorine gas to the airway lining – or the epithelium – can somehow lead to persistent airway hyper-responsiveness, Balmes said. Smoking and allergies seem to increase the risk of permanent asthma after chemical exposures.

"Most people get better once they've recovered from the chemical bronchitis. Some don't," Balmes said.

Government agencies are ramping up programs to prevent future chemical accidents.

Within days of the accident in Tulare, federal, state and county public health officials turned to a new assessment tool in an effort to reduce chemical accidents. Called ACE, or Assessment of Chemical Exposures, the investigation focuses on circumstances surrounding a chemical accident, the health effects and recommendations for prevention.

As a result of the federal visit, the state mailed an alert urging 1,200 metal recyclers to take only containers that are cut open, dry or without a valve or plug; treat closed containers as potential hazardous waste, and develop and practice an evacuation plan to stay upwind of a hazardous gas release.

The Institute of Scrap Recycling Industries, a national trade association, sent the California alert to its 1,500 members in a weekly newsletter, said John Gilstrap, safety director. When he and his staff train employees in an OSHA 10-hour safety program, they warn that containers "are extremely hazardous unless they've been rendered incapable of holding pressure," he said.

Carrying out the practice of accepting only cut tanks may sound elementary, he said, but metal recyclers handle truckloads of scrap cargo and so monitoring is challenging.

In Tulare, Beverly Martinez, a Tulare native and seven-year employee of Tulare Iron and Metal, and the other workers now reject all uncut containers.

"We've turned away tons of tanks because they're not cut in half. I say, 'I don't care how good a customer you are. We're not taking it,'" said Martinez, an office manager.

"I can honestly say it was a life-altering event. I never came so close to death, or what you feel it would be. We all lived through it. That was the good thing."

This article originally ran at Environmental Health News, *a news source published by Environmental Health Sciences, a nonprofit media company.*

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Original Article

The Effect of Exposure to Low Levels of Chlorine Gas on the Pulmonary Function and Symptoms in a Chloralkali Unit

Masoud Neghab (PHD)[a], Fatemeh Amiri (MSc)[b*], Esmaeel Soleimani (MSc)[b], Seyed Younus Hosseini (MSc)[b]

[a] Research Center for Health Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[b] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran

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*Correspondence
Fatemeh Amiri(MSc)
Tel: +98 91 77316784
E-mail: fatemehamiri1366@gmail.com

ABSTRACT

Background: The present study was undertaken to ascertain whether (or not) long term occupational exposure to low (sub-TLV levels) atmospheric concentrations of chlorine gas was associated with any significant decrements in the parameters of pulmonary function and/or increased prevalence of respiratory symptoms.

Methods: In this retrospective cohort study that was performed in 2012, 54 workers of a local chloralkali unit and 38 non-exposed office staff were enrolled and compared. Atmospheric concentrations of chlorine gas were measured by numerous sampling with gas detector tubes. Data on respiratory symptoms were gathered using a standard questionnaire. Furthermore, spirometry test was performed for subjects both prior to and at the end of shift.

Results: Mean atmospheric concentration of chlorine gas was 0.27 ±0.05 ppm that was lower than the existing TLV value for this toxic irritant gas. Symptoms of respiratory diseases were significantly more frequent among exposed subjects than in referent individuals. Additionally, mean values of most parameters of pulmonary function including FEV_1 (P=0.031), FEV_1/FVC ratio (P=0.003) and PEF (P=0.005) were significantly lower than their corresponding values for unexposed subjects. Additional cross shift decrements were also noted in some lung functional capacities, although changes were not statistically significant.

Conclusions: Exposure to sub-TLV levels of chlorine gas is associated with statistically significant decrements in the parameters of pulmonary function as well as increased prevalence of respiratory symptoms.

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Introduction

Chlorine is a reactive gas, widely used over the last few decades in different industries. Exposure to it commonly occurs in mixing household chemicals, swimming pools, and industrial settings. Occupational exposures can occur during production, storage, and transportation of chlorine, in the manufacturing and processing of many products including plastics, rubbers, metals, papers, pharmaceuticals, pesticides, cosmetics, disinfectants, batteries, antifreeze, and adhesives. Under normal operating conditions, workers may be exposed to low levels of chlorine. However, high-level exposures can also occur if a large amount of chlorine is released during an accident [1]. The available toxicological information about chlorine is almost entirely on its respiratory effects [2].

The respiratory effects of occupational exposure to high concentrations of chlorine gas have been investigated [3, 4]. Poisoning symptoms, ranging from simple respiratory irritations, bronchial spasm, bronchial and alveolar damage, to pulmonary diseases, have been described and are similar in both humans and animals. Although these effects can be diminished or resolved with cessation of exposure and medical management, there is doubt as to whether long term exposure to low concentrations of chlorine gas following an acute episode can result in permanent and irreversible changes in lung functional capacities [3].

Respiratory effects of long-term exposure to low levels of chlorine gas have not been well documented, and are subject to debate and controversy. For instance, shortness of breath, cardiac arrhythmias, chest pain, reactive airways dysfunction syndrome (RADS), tooth erosion and increased number of common cold cases have been reported because of exposure to low levels of chlorine gas. Additionally, exposure to low levels of chlorine gas has been an important factor in developing occupational asthma [3].

Similarly, a high prevalence of pulmonary disorders in female cleaners due to exposure to chlorine-containing bleaches (0-0.4ppm) is reported (5). It is found a significant relationship between development of asthma and chronic bronchitis and exposure to this chemical [3].

Moreover, exposure to sub-TLV levels of chlorine by swimmers during training is associated with the development of asthma and airway hyper responsiveness symptoms [6]. Conversely, Patil et al. did not find any association between

occupational exposure to 0.15 ppm of chlorine gas for 10.9 yr and the prevalence of respiratory symptoms such as dyspnea, increased cases of common old, cardiac arrhythmias and chest pain in chloralkali workers. No evidence of permanent lung disorders was found during clinical examinations, radiography and spirometry of these workers[7]. No clinical significant symptoms of respiratory disorders in workers exposed to chlorine gas for 10 yr at concentrations twice as high as Patil's study (0.298 ppm) was found[8].

Therefore, controversy exists considering the potential of chlorine gas to induce respiratory symptoms and/or lung functional impairments, particularly, at low exposure levels. Hence, the present study was, undertaken to address further this issue.

Methods

This retrospective cohort study was performed at a chloralkali unit of a local petrochemical complex in 2012, where chlorine gas and caustic soda are produced in a process called mercury cell process[9].

In brief, in the chloralkali electrolysis process, an aqueous solution of sodium chloride is electrolyzed electrolytically by direct current, producing chlorine, hydrogen, and sodium hydroxide solution. The overall reaction of the process takes place in two parts, at the anode and at the cathode. There are three basic processes for the electrolytic production of chlorine, the nature of the cathode reaction depending on the specific process as follows: (1) the diaphragm cell process,(2) the mercury cell process and (3) the membrane cell process. In the mercury cell process, sodium amalgam is produced at the cathode. The amalgam reacts with water in a separate reactor, called the decomposer, to produce hydrogen gas and caustic soda solution. Because the brine is recirculated, solid salt is required for resaturation. The brine, which must be quite pure, is first dechlorinated and then purified by a straightforward precipitation – filtration process. The products are extremely pure. The chlorine, along with a little oxygen, generally can be used without further purification. The sodium hydroxide solution contains little chloride and leaves the decomposer with a 50wt% concentration[10].

Fifty four subjects working in a local chloralkali unit were studied. Similarly, 38 non-exposed subjects whose age, sex, work experience, smoking habits, socioeconomic status, level of education, and place of living were in parallel with the exposed subjects; were randomly selected from office staff of the plant as referent group. None of the exposed subjects had history of exposure to chemicals known to induce pulmonotoxicity. Additionally, they were free of preexisting medical conditions, particularly those of respiratory illnesses, chest operations or injuries. Likewise, none of the subjects in the referent group had been exposed occupationally or non-occupationally to chlorine or other chemicals known to cause respiratory symptoms or ventilatory disorders.

All subjects signed an informed consent form before participating in the study. The study was approved by the Ethics Committee of Shiraz University of Medical Sciences. The study was conducted in accordance with the Helsinki Declaration of 1964 as revised in 2013[11].

Subjects were interviewed and respiratory symptom questionnaire, as suggested by the American Thoracic Society[12] were filled out for them. The questionnaire contained questions concerning respiratory symptoms such as cough, wheezing and dyspnea, smoking habits, occupational history, preexisting medical conditions and family history of each employee.

The prevalence of symptoms of respiratory diseases was then calculated from the data extracted from the completed questionnaires. Information extracted from the questionnaires was then used to obtain symptom prevalence data among the exposed and unexposed groups.

Pulmonary function test (PFT) was performed according to the guidelines given by the ATS[13] and measured with a portable calibrated vitalograph spirometer (Vitalograph-COMPACT, Buckingham-England) on site, twice for the exposed subjects (at the beginning and at the end of shift) and once for the referent individuals, details of which have been discussed elsewhere[14,15].

Atmospheric concentrations of chlorine gas were estimated using gas detector tubes. Colorimetric tubes are regarded as +/-35 percent accurate with measurements down to one-half the exposure limit and +/-25 percent accurate up to five times the exposure limit[16].Thirty samples were taken during four different shifts (Saturday morning and afternoon and Monday morning and afternoon) in different parts of the plant, which was a relatively small workshop.

Data were analyzed using INSTAT software and SPSS software version 20 (Chicago, IL, USA). The independent student's *t*-test and chi-square tests were used. A *P* value of <0.05 was considered statistically significant.

Moreover, both simple logistic regression and multiple logistic regression analyses were performed to analyze the association between exposure to chlorine gas and symptoms of respiratory diseases. Smoking status was considered as a potential confounder in the model.

Results

Demographic variables, smoking habits and area concentrations of chlorine are presented in Table 1. Only length of employment (P=0.015) and length of smoking of referent subjects (P=0.021) were significantly higher than those of exposed subjects. The mean duration of exposure for exposed group was 6.76±6.86 yr, the number of smokers among exposed and referent subjects were 17 and 10, respectively and the difference was not statistically significant. Chlorine concentrations showed little variability in different areas (about 0.2 ppm). Workers did not wear any respiratory protective equipment during their daily activities over the course of their employment.

Table 1: Demographic characteristics of exposed and unexposed subjects

	Exposed n=54		Unexposed n=38		
Parameter	Mean	SD	Mean	SD	*P* value
Age (yr)	34.83	8.47	36.10	6.87	0.224
Weight (kg)	73.64	9.11	73.78	10.97	0.474
Height (cm)	173.98	6.37	172.23	5.70	0.089
Duration of employment (yr)	6.76	6.86	10.94	9.32	0.015
Length of smoking (yr)	5.28	3.79	7.00	4.10	0.021
Chlorine concentration (ppm)	0.27	0.05	0.00	0.00	-

Table 2 illustrates the prevalence of respiratory symptoms. As shown, frequency of cough, phlegm, productive cough and wheezing were significantly higher in exposed subjects than in referent group.

Table 2: Prevalence of respiratory symptoms in exposed and unexposed subjects

Variables	Exposed	Unexposed	Unadjusted OR (95% CI)	*P* value	Adjusted OR (95% CI)[a]	*P* value
Cough	30	2	22.50 (4.91, 103.05)	0.001	22.74 (4.92, 105.05)	0.001
Phlegm	36	4	17.00 (5.22, 55.35)	0.001	18.91 (5.49, 65.14)	0.001
Productive cough	13	1	11.73 (1.46, 94.09)	0.020	11.56 (1.44, 93.17)	0.021
Wheezing	12	1	10.57 (1.31, 85.24)	0.027	10.41 (1.28, 84.12)	0.028
Breathlessness	26	11	2.27 (0.94, 5.50)	0.067	2.33 (0.91, 5.96)	0.079

[a] adjusted for smoking

Univariate analysis (unadjusted OR) revealed that the prevalence of cough (P=0.001), phlegm (P=0.001), productive cough (P=0.020) and wheezing (P=0.027) were significantly higher in exposed group than in referent individuals. When the potential confounding effects of smoking was controlled (adjusted OR in multiple logistic) the association between exposure to chlorine gas and the prevalence of cough (P=0.001), phlegm (P=0.001), productive cough (P=0.021) and wheezing (P=0.028) remained significant.

Table 3 depicts the results of spirometry. As shown, FEV_1 (P=0.031), FEV_1/FVC ratio (P=0.003) and PEF (P=0.005) were significantly lower in exposed group than in referent individuals. All parameters of pulmonary function showed additional decrements at the end of shift, although the difference did not reach statistical significance.

Table 3: Percentage predicted pulmonary function among exposed and unexposed subjects

	Exposed, n=54						*P* value		
	Before shift		After shift		Unexposed, n=38				
Parameter	Mean	SD	Mean	SD	Mean	SD	Before vs. After	Before vs. Unexposed	After vs. Unexposed
FVC	91.97	9.62	91.44	11.35	94.05	13.61	0.397	0.196	0.160
FEV1	86.13	13.25	82.75	9.91	91.39	13.11	0.068	0.031	0.001
FEV1/FVC	92.07	9.88	90.29	8.64	97.23	6.94	0.161	0.003	0.001
PEF	79.79	21.48	75.35	17.98	90.81	17.16	0.123	0.005	0.001

Discussion

The present study examined chronic and acute respiratory effects of exposure to sub-TLV levels of chlorine gas. Exposed subjects were free from preexisting medical conditions. Additionally, there were no significant differences between both groups as far as major confounding variables were concerned.

The mean concentration of chlorine gas was 0.27 ±0.05 ppm, which is lower than the existing TLV value of 0.5 ppm recommended by ACGIH [17] for this toxic, irritant gas. This small variability indirectly indicates that the mean value reported here would be an acceptable predictor of overall exposure scenario.

Our findings indicate that the prevalence of respiratory symptoms was significantly higher in exposed subjects than in the non-exposed employees.

Similar findings have been reported by some other investigators. Kennedy et al. compared 321 pulp mill workers with a control group of 237 rail yard workers in similar working conditions but not exposed to chlorine. Average chlorine levels in the pulp mill were below 1 ppm. Pulp mill workers (both smokers and nonsmokers) who reported being gassed were significantly more likely to report wheezing on occasion than were other pulp mill workers and rail yard workers [18]. Similarly, Enarson et al. compared 392 pulp mill workers exposed to chlorine with a group of 310 rail yard workers living in the same community, but not exposed to chlorine. Workers were exposed to an average of 0.02 ppm of Cl_2. They reported increased prevalence of chest tightness and wheezing in workers exposed to chlorine gas at a pulp mill industry [19]. Interestingly, different results have also been reported by others. For instance, Rotman et al. studied the effects of exposure to low levels of chlorine (0.5 or 1.0 ppm) on normal volunteers and found that even though chlorine at low concentrations did not produce any serious subjective symptoms, it adversely affected pulmonary function transiently [20]. Likewise, Chasis et al. did not find any evidence of chlorine-induced pulmonary disease in 29 hospitalized cases exposed to low levels of chlorine gas [21].

Mean values of most, before shift and after shift, parameters of pulmonary function of exposed subjects were significantly lower than those of referent subjects were. Additionally, all parameters of pulmonary function showed additional decrements at the end of shift, although, the difference did not reach statistical significance.

In the line with these observations, Boskabady et al. studied the effects of exposure to chlorine on pulmonary function tests in Iranian lifeguards and showed that exposure to chlorine was associated with significant reductions in PFT values of lifeguards [22]. Similarly, McCord studied industrial poisoning from low concentrations of chlorine gas and reported that the worker might have had a decrease in pulmonary function because of chlorine exposure [23]. Surprisingly, discrepant results on chlorine exposure and PFT changes have also been reported. Ferris et al. compared 147 men in a pulp mill industry to 124 men in a paper mill. The former had previous exposure to chlorine and sulphur dioxide gases. No significant differences were noted in the results of PFTs between both groups. The prevalence of respiratory symptoms in both plants was lower than that of the male population in the community [24]. Patil et al. studied the health of Diaphragm Cell Workers Exposed to Chlorine. Level of occupational exposure to chlorine gas was 0.146±0.287ppm. No evidence of permanent lung disorders was found during clinical examinations, radiography and spirometry of these workers [7].

Although the exact reason(s) of these inconsistencies and discrepancies are not known, differences in exposure concentrations, length of exposure, occupational and non-occupational exposure to other toxic agents in the past, present co-exposure to other chemicals, the possibility of

exposure to higher or lower concentrations of chlorine gas in the past, use of respiratory protective equipment, and a difference in sample size may explain, at least in part, these discrepancies.

To differentiate between acute and chronic effects of chlorine, PFTs were measured twice for the exposed subjects, first, after a 2-day exposure free period (prior to shift) and the second at the end of shift.

Apart from FVC, the pre-shift (obtained after a 48 h exposure free period) values of all parameters of pulmonary function of exposed subjects were significantly lower than those of referent subjects, indicating that exposure to chlorine has been associated with chronic irreversible decrements in some parameters of pulmonary function.

This observation was made while unexposed employees were, on average, more than a year older than exposed employees were, had worked about 4 yr more than the exposed subjects work and had smoked about two years more than their exposed counterparts had.

Although additional post-shift decrements were noted in PFTs of exposed subjects, their difference with pre-shift values of the same individuals did not reach statistical significance, indicating that under the existing scenario, exposure to chlorine was not associated with acute changes in PFTs.

It may be argued that the mean values of most parameters of pulmonary function have exceeded 80%, and therefore, this could be viewed as a normal spirogram result[22]. However, over 10% difference between the results of spirometry of exposed and unexposed individuals and about 5% decrement in the parameters of pulmonary function of exposed subjects at the end of shift, both of which being statistically significant, could not simply be overlooked. In fact, it is important to note that OSHA considers FEV1 declines of as little as 5% to be clinically significant[23].

Given the above and in view of the pattern of the spirometry results (significant decrements in FEV1 and FEV1/FVC ratio of exposed employees[22]), it would be plausible to assume that long term consequences and ramifications of these changes are likely to result in obstructive pulmonary disease, consistent with the mechanism of effect of chlorine.This proposition is also in line with the previous findings, which showed abnormal radiographic signs (diffuse bronchiolitis) and abnormal PFTs (obstructive ventilatory disorders)[18,28].

Due to the inherent limitations of the retrospective cohort studies, cause and effect relationships could not be established from studies such as the present investigation. Therefore, one might argue that observed changes are not necessarily related to exposure to chlorine. While the authors agree with this view, it should be noted that a few lines of circumstantial evidence support the proposition that the observed abnormalities are likely to be the direct consequence of exposure to chlorine.

First, none of the exposed subjects had any history of respiratory diseases or preexisting medical conditions at the beginning of their employment in the plant or prior to it. Second, exposed subjects did not have any history of exposure to any other chemicals known to cause respiratory disorders, during the course of their employment. Third, despite the fact that referent subjects were older than their exposed counterparts and their length of employment and years smoked were significantly higher than those of exposed individuals, the prevalence of respiratory symptoms and lung functional disorders were significantly higher in exposed workers. Fourth, although PFT values showed a relative recovery after a 48-h exposure free period, they still were significantly lower than those of referent subjects were. Fifth, when the effects of an important potential confounder, cigarette smoking, was controlled, significant association remained between exposure to chlorine gas and the prevalence of respiratory symptoms.

Additional, longitudinal, follow up cohort studies with larger sample sizes are clearly needed to further substantiate these preliminary findings in group of workers whose exposure to chlorine have been quantified by more sensitive methods than the semi-quantitative method used in this study due to technical difficulties and lack of equipment in our laboratory.

Conclusions

Long-term occupational exposure to even sub-TLV concentrations of chlorine gas can be a risk factor for chronic lung disorders manifested by significant increases in the prevalence of respiratory symptoms and subtle chronic irreversible decrements in the parameters of pulmonary function. Thus, engineering control measures and the use of appropriate respirators are recommended to eliminate or reduce workers' exposure to chlorine. Active rather than common periodic examinations are recommended to identify susceptible workers prior to developing permanent irreversible respiratory disorders.

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Conflict of interest statement

The authors have no conflict of interest to declare.

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Chlorine Risk Comparison: Large Release Event vs. Chronic Low-Level Exposure

Aspect	Large Release Event	Chronic Low-Level Exposure
Nature of Risk	Acute, short-duration, potentially high-consequence event.	Continuous or intermittent exposure at low concentrations.
Exposure Duration	Seconds to minutes.	Weeks, months, or years.
Primary Hazards	Toxic inhalation, chemical burns, possible fatalities, environmental contamination.	Respiratory irritation, corrosion of equipment, cumulative worker or neighbourhood health effects.
Detection & Monitoring	Immediate alarms from sensors; visible gas cloud likely; public alert possible.	Often undetected without sensitive continuous monitoring; odour may be below detection threshold.
Health Thresholds	IDLH = 10 ppm; ERPG-3 (life-threatening) = 20 ppm for 1 hour; concentrations can exceed 100 ppm near source.	Chronic exposure effects begin near 0.1–0.3 ppm for sensitive individuals; workplace limits (TLV-TWA) = 0.5 ppm.
Typical Consequences	Requires evacuation or shelter-in-place; emergency response activation; regulatory reporting mandatory.	Usually confined to workplace or plant perimeter; long-term nuisance or health concern if persistent.
Public Communication	High media visibility; may erode trust if not promptly disclosed.	Low visibility; public may remain unaware unless cumulative effects or odour complaints occur.
Regulatory Focus	Emergency preparedness, containment design, incident reporting, plume modelling.	Occupational hygiene, emissions permits, ventilation and scrubbing efficiency.
Frequency vs. Severity	Very low frequency but very high severity.	High frequency but low severity per occurrence.
Prevention / Mitigation / Communication	**Engineering controls:** robust containment, automatic shutoffs, leak detectors, and secondary barriers. **Procedural controls:** emergency drills, incident reporting, real-time air monitoring. **Communication:** public notification protocols, transparent post-event disclosure, community engagement. **For chronic risks:** continuous emission tracking, third-party audits, routine health surveillance, and open data on long-term air quality trends.	

AI discussion attached

C. KOST submit

Afrooz Fallah
District of North Vancouver
355 West Queens Road
North Vancouver, BC V7N 4N5

TÜVRheinland®
Risktec

Risktec Solutions (Canada) Ltd
Suite 1000
Bankers Hall West
888, 3rd Street SW
Calgary, AB T2P 5C5
Canada
Website: www.risktec.tuv.com
E-mail: enquiries@risktec.tuv.com
Tel: +1 403 269 2106

6th February 2026

Risktec Project No.: CHEML-4

BakerRisk Project No.: 01-08654-004-25 Rev. 2

Confirmation of Response to Peer Review Comments – Revised QRA

Dear Afrooz,

Risktec Solutions (Canada) Ltd. (Risktec) has reviewed the revised Quantitative Risk Assessment (QRA) prepared by BakerRisk on behalf of Chemtrade, together with the accompanying response matrix addressing Risktec's earlier peer review comments.

Based on our review, it is our professional opinion that the key peer review comments have been adequately addressed in the revised QRA and associated Fault Tree Analysis (FTA). The updates provided improve clarity, transparency, logic, referencing and alignment with the risk assessment methodology and risk tolerance framework. The revised assessment reasonably reflects the current facility design and proposed risk reduction measures, and the conclusions presented are consistent with the updated analysis.

Consequently, Risktec considers the revised QRA, and associated FTA, to be suitable for its intended purpose in supporting the District of North Vancouver's consideration of the proposed application.

Please do not hesitate to contact Risktec should further clarification be required.

Yours sincerely

N. Badri

Naser Badri
for Risktec Solutions (Canada) Limited

Risktec Document Number *CHEML-04-R01*

Report Section	Observations	Recommended Improvement	BakerRisk Response	Report Revisions	Recommendation Type
Report - Chemtrade North Vancouver FSS/QRA Update - 01-08858-004-25					
Executive Summary	- Provides a clear overview of the QRA/FSS objectives, key findings, and risk mitigation measures - Figure 2 shows the LSIR contours, but not relative to the offsite receptors	- Recommend adding the offsite receptor locations in Figure 2 (similar to Figure 11) and adding the LSIR values for each receptor	BakerRisk revised Executive Summary to include identification of offsite receptor locations and provide LSIR information per receptor in tabular format.	Added previously Figure 11 to the Executive Summary and LSIR information in Table 2 (page v and vi).	Editorial
Section 1 - Introduction	- Clearly states the purpose: conduct FSS, QRA, and CFD to support rezoning applications and evaluate the proposed design of Chemtrade chlor-alkali plant - Would be helpful to clarify upfront which facility areas are included/excluded from the QRA, instead of relying on later sections.	- Recommend to define all standards and guidance documents that were followed for this study.	BakerRisk added standards and guidance reference to report.	Added a list of standards and guidance used in the FSS and QRA study to new Section 10 (page 41); added reference to this in Section 1 (page 2).	Editorial
Section 1.1 - Brief Plant Description	- The description emphasizes the proposed modifications, but would be helpful to consolidate a single system-level description (i.e, major chlorine inventories, pressure systems, isolation boundaries)	- Recommend clearly identifying which buildings/equipment are existing vs proposed (tabular format would be ideal)	BakerRisk added a table to communicate existing vs new buildings/equipment.	Added Table 2 to this section of the report (page 3-4) to document this information.	Editorial
Section 1.2 - Proposed Railcar Loading Process and Building Design	- The dependencies on design assumptions are not introduced in this section, but are critical to both consequence and frequency modelling.	- Recommend referencing the sections detailing the design assumptions	BakerRisk added reference to sections further discussing design assumptions in Section 1.2.	Referenced relevant sections with design assumptions in Section 1.2 (page 7).	Editorial
Section 2 - Objectives and Scope of Work	- This section provides a detailed breakdown of the objectives and scope for the FSS/QRA and CFD modelling. - The scope does not formally define what is excluded - Would be good to clarify how the CFD results were intended to be used (i.e, supplement to SafeSite)	- Recommend adding a subsection detailing what is excluded in the study (e.g., onsite risk, societal risk, etc.)	BakerRisk added a subsection regarding exclusions.	Exclusions section added to report, Section 2.1 (page 8).	**Editorial**
Section 3 - Tolerance Criteria	- MIACC land use planning guidelines appear in a figure in the executive summary, but are not well summarized textually in the main body. - The offsite receptors of interest are organized well; however, it does not detail their corresponding MIACC threshold. - Would be ideal to move the MIACC land use planning guidelines figure to Section 3 instead of the Executive Summary.	- Recommend to add a column in Table 1 providing the individual risk thresholds (i.e. LSIR thresholds) for the identified offsite receptors	BakerRisk added a column to identify LSIR at each receptor point.	Added additional column to Table 1 with LSIR thresholds for receptors (page 9).	Editorial
Section 4 - Consequence Analysis Methodology Summary	- Methodology references SafeSite dispersion modelling, jetpool fire models, and probit methods. - States reliance on Jack Rabbit II chlorine validation for the dispersion model - Provides a mix of high-level summary and detailed assumptions, but some assumptions are presented without justification (i.e, pool diameter and depth limits) - CFD results are said to be consistent with SafeSite, but numerical comparison or validation method is not shown.	- No recommendations		None	
Section 4.1 - Assumptions	- Assumptions are listed clearly and are comprehensive - Several assumptions significantly affect conservatism but are not justified, such as the use of default pool limits (25 m diameter, 1 m depth) - Some assumptions rely on Chemtrade input (e.g, compressor shutdown behaviour) - The last bullet in Section 4.1 should be clearly stated at the beginning of the section as it's an important statement. - Assumptions based on Chemtrade input (i.e, compressor shutdown) will need to be validated in detailed design	- Recommend providing technical justification or cite design documents for assumed used pool limits	Pool limits are applied to prevent prediction of an infinitely large pool with negligible depth. The default pool limit used in this QRA is a conservative limitation to account for pool surface composition, barriers to flow, topography, and drainage. The limits are set using engineering judgment based on past QRA studies where sites were surveyed for maximum pool surface size.	None	Technical
Section 4.2 - Hazard Identification	- Hazard identification is thorough and tied to PFDs/P&IDs - Three (3) release sizes applied uniformly, which is standard practice - The large railcar breach scenario is based on a previous assessment made by another 3rd party consultant in 2006	- Recommend reviewing and validating that the conditions used in 2006 large railcar break scenarios remain applicable to the current design.	BakerRisk has validated the railcar storage conditions (i.e., temperature, pressure) as part of this study and added language to the report to reflect this.	Added confirmation that BakerRisk validated stored railcar process conditions (page 13).	Technical
Section 4.3 - Consequence Analysis	- Describes full modelling chain (i.e, discharge to consequence results) - SafeSite used as the software - CFD was used for only two railcar release direction, but is summarized in detail in Appendix E - Scenarios were run to steady-state up to 60 minutes	- Suggest adding a summary table comparing CFD vs SafeSite results to demonstrate consistency	BakerRisk added a summary table in the appendix comparing CFD vs SafeSite.	Added CFD vs Safesite dispersion distance comparison summary table to Appendix E (page E-9). This is referenced in Section 4.3 (page 14).	Editorial
Section 5 - Consequence Analysis Inputs	- Provides a brief introduction the section detailing the consequence analysis inputs and where additional information can be found (i.e, Appendix D) - Details the exclusions for consequence modelling	- No recommendations		none	
Section 5.1 - Hazard Identification	- Hazard sources mapped from PFDs and P&IDs and releases appear comprehensive and aligned with equipment locations - Indoor vs outdoor scenarios are provided	- No recommendations		none	
Section 5.1.1 - Indoor Dispersion Scenarios	- Indoor dispersion assumed to be well-mixed within the fixed volume - Scrubber capacity (15,000 lb/h) applied as a mitigation limit and partial scrubbing is modelled by subtracting scrubber capacity from the release rate - Table 2 provides all of the release sources (or hazard sources), but inventory values are not provided	- No recommendations		none	
Section 5.1.2 - Release Durations	- Releases from piping scenarios use 10 min, 30 min, and 60 min durations - Releases during loading operation scenarios use 1 min, 5 min, and 60 min durations	- No recommendations		none	
Section 5.2 - Materials	- Toxicity values sourced from TNO Purple Book; lethality concentrations listed for 1%, 10%, 90% fatalities over 10 min averaging time - Materials list appears to be complete	- Recommend to validate the toxic probit parameters (i.e, A, B, N) for Chlorine and Hydrochloric Acid against the latest revision of the TNO Purple Book. Changes to these parameters may have an impact on the 1%, 10%, and 90% lethality concentrations	The QRA study uses the latest edition of the probit references from TNO Purple Book (2005). This reference is typical across industry for chlorine and hydrochloric acid probits (e.g., DNV/Phast).	Added year of publication to Table 8 (page 29).	Technical
Section 5.3 - Meteorological Data	- STAR data used with a reasonable dataset (YVR 2018-2022) - Explains the nomenclature for weather conditions and specifies where to find additional information in the appendices.	- No recommendations		none	
Section 6 - Risk Analysis Methodology Summary	- The QRA was conducted using BakerRisk's internal software: QRATool - The tasks associated with the methodology is consistent with industry practices	- No recommendations		none	
Section 6.1 - Assumptions	- The assumptions are comprehensive - Several frequency reductions are applied, and benchmarked by the FTA and not literature (e.g, CCPS or API guidance) - LSIR assumes outdoor offsite receptors, which may be considered conservative	- No recommendations		none	
Section 6.2 - Hazard Impacts	- The consequence results from SafeSite were imported into QRATool to conduct the risk modelling, which is a standard process.	- No recommendations		none	

Section 5.3 - Frequency Rates	- Industry average failure rate data was used, however, the report does not state the source. - The equipment counts and frequencies are provided in the QRA results spreadsheet (Equipment Count tab); however, it does not state that this spreadsheet is found in Appendix D	- Recommend adding the source associated with the failure rates summarized in Table 5 (Failure Rate Data - Releases)	BakerRisk provided a list of references for the industry average failure rate used to develop Table 5 and referenced Appendix D for the equipment counts and frequencies. References for each individual rate value will not be provided.	Added reference to Appendix D, Equipment count tab (page 31). Added industry-average failure rate database references as well as information regarding unique failure rates, e.g., FTA (page 32 and 33).	Editorial
Section 5.4 - Release Frequencies	- Release frequencies for all hazard sources are appropriately discussed in this section. - Risktec does not have access to the spreadsheets in Appendix D (FSS and QRA Spreadsheets); therefore, it is assumed that all event frequencies are summarized for all hazard sources - Assumed that the F Flammable, F Fire, and F Toxic tabs are in the QRA Results Spreadsheet, as it's not specified. - Immediate and delayed ignition probability split is not discussed	- If not done already, it is recommended to specify in a tabular format the data source corresponding to the frequency rates used for each hazard source (e.g. FTA, 2006 QRA, CCPS, IOGP, etc.). This information can be added to the QRA Results Spreadsheet - Recommend adding discussion regarding the immediate and delayed ignition (typical split is 60 50)	BakerRisk provided a list of references for the industry average failure rate used to develop Table 5 and referenced Appendix D for the equipment counts and frequencies. References for each individual rate value will not be provided. BakerRisk added additional discussion on ignition probability calculations.	See above for report changes corresponding to failure rates. Added discussion and table regarding early vs late vs no ignition probability (page 36).	Editorial
Section 6.5 - Wind Direction and Weather Probability Data	- The assumption associated with the early ignition events (i.e., jet fires / pool fires) is sensible	- No recommendations		none	
Section 7 - Consequence Analysis Results	- This section appropriately summarizes where all the consequence analysis results can be found (i.e. Appendix D) using SafeSite. - Comment was made that the CFD dispersion results were consistent with SafeSite, but there's no side-by-side comparison of the results. Based on the discussion in Appendix E they are identical, but this result may be surprising given the additional detail needed to model CFD.	- No recommendations		none	
Section 8 - Risk Analysis Results	- A bit odd referencing the Executive Summary as its purpose is to be a standalone section. Additionally, the purpose of Section 8 is to summarize the risk results. - Provides the location of where to find additional risk results and inputs (i.e. Appendix D) - Correctly defines LSIR and introduces the LSIR contours overlapping with the offsite receptor locations, which are clearly identified. - LSIR contours indicate compliance with MIACC land use planning thresholds; however, does not include LSIR values for each offsite receptor along with its relative MIACC threshold. - There is no discussion regarding the Control Zone (Represented by the 1E-04/year LSIR contour) - The far-field and near-field risk-driving scenarios are summarized at the end of the section, but does not provide its impact to the offsite receptors	- Recommend to add LSIR values for each of the offsite receptors, as well as their corresponding MIACC threshold. It provides additional insight regarding the risk at each location. - Recommend to add discussion regarding the Control Zone, which is represented by the 1E-04 /year LSIR contour. Under the MIACC risk tolerance framework, the Control Zone is intended to reflect the highest level of risk reasonably expected to occur during normal plant operation and is used to guide land-use decisions and operations controls. The 1E-04 /year contour must remain entirely within the industrial facility property boundary. Based on the LSIR contours, this seems to be the case; however, it should be discussed in this section of the report (as well as the Conclusion and Executive Summary). - Recommend adding a table detailing the event percentage contributions (i.e. fire and toxic) from the risk-driving scenarios impacting the offsite receptors. This information could be used to support more informed decision-making regarding where additional mitigation or design improvements should be made. This recommendation may be more beneficial in the detailed design stages.	BakerRisk added LSIR values for each offsite receptor and hazard distribution between fire, toxic, and flash fire. Chemtrade provided the approximate property boundary for BakerRisk to comment on Control Zone.	Added a table showing LSIR values for each offsite receptor and the portion contributed by toxic and fire hazards in Executive Summary (page v). All offsite risk is due to toxic hazards, negligible risk is posed by flash fire and jet / pool fires. Added discussion on Control Zone in the main body of the report (page 39) as well as high-level statements in Executive Summary (page vi) and Conclusion (page 40). A figure was added (page 39) showing comparison of the risk contours (i.e., 1E-4 Control Zone) to the property boundary.	Editorial & Technical
Section 9 - Conclusions and Recommendations	- Concludes that the risk tolerability criteria are met - Notes the need for updated LSIR calculations if the design changes - Highlights the dependency on the assumptions and the need for detailed design verification	- No recommendations		none	
Appendix A - Consequence and Risk Modelling Details	- Provides a good summary of the consequence and risk modelling details; however, not all of the sections are applicable to this study (e.g. societal risk)	- Suggest removing the aspects of this appendix that are not applicable to this study to avoid potential confusion for the reader.	BakerRisk reviewed and adjusted appendix accordingly.	Appendix A revised to reflect appropriate modeling methodology for this study (page A-3 through A-8).	Editorial
Appendix B - Source Definitions, Locations, and LSIR Contours	- All information provided in attachments not accessed by Riskdec	- No recommendations		none	
Appendix C - Statistical Meteorological Data	- All information provided in the appendix is consistent with industry practices	- No recommendations		none	
Appendix D - FSS and QRA Spreadsheets	- All information provided in attachments not accessed by Riskdec	- No recommendations		none	
Appendix E - CFD Analysis	- **The CFD analysis provides information and results consistent with industry practices** - **States that Table E-1 summarizes the distances from the source to the 103 ppm chlorine concentration for both SafeSite and CFD analysis.** Were the identical distances reached for both software?	- Recommend providing a graph and/or table showing a side-by-side comparison between the results from SafeSite and the CFD analysis.	BakerRisk added documentation comparing SafeSite and CFD dispersion results.	CFD and SafeSite comparison added (pages E-9, E-13)	Editorial
Appendix F - Seismic Risk Analysis	- Reviewed the structural anchoring, piping supports, and seismic survivability of key chlorine systems	- No recommendations		none	

Overview of Report: Provide a summary outlining the purpose of each risk assessment report (Quantitative Risk Assessment and Fault Tree Analysis) and confirm that the appropriate studies have been and are being undertaken.	The QRA/FSS and supporting CFD analyses were undertaken to evaluate the potential offsite and onsite risks associated with the proposed modifications at the Chemtrade North Vancouver facility. The report aims to: - Identify credible chlorine release scenarios associated with the existing and proposed facility configuration. - Quantify the potential fire, flammable dispersion, and toxic exposure impacts, including indoor and outdoor dispersion, under various meteorological and operating conditions. - Assess the individual risk (i.e., LSIR) relative to established risk tolerance criteria (i.e., MIACC/CSChE). - Evaluate the performance of existing and proposed safeguards, including detection, scrubbing, ventilation, and isolation systems. - Provide engineering input to support the District's review of the Rezoning Application by demonstrating risk acceptability based on recognized Canadian and international best practices. Based on the review of the QRA/FSS and associated appendices, the appropriate studies have been conducted, including: - Hazard identification - Consequence modelling (indoor and outdoor) - CFD analysis of key scenarios - Frequency analysis (frequency data, parts count, ignition probability) - Individual risk (LSIR) calculations - Review of mitigation performance (scrubbers, detection, ventilation) - Seismic screening The report represents a complete and appropriate study for a facility of this type and are consistent with typical QRA/FSS expectations for rezoning and regulatory consultation.

Compliance with Risk Tolerance Standards Confirm whether the risk and safety work continues to satisfy the prescribed methodology and criteria established by the Canadian Society of Chemical Engineers (CSChE) publication, "Risk Assessment – Recommended Practices for Municipalities and Industry" (formerly Major Industrial Accidents Council of Canada or MIACC). Confirm that the facility meets current industry standards for risk tolerance.	The CSChE publication "Risk Assessment – Recommended Practices for Municipalities and Industry" (formerly MIACC) is the most widely recognized Canadian framework for evaluating offsite risk acceptance. The key criteria include: - Individual risk thresholds - Guidance for land-use planning in proximity to industrial facilities - Use of transparent methodology grounded in recognized engineering practice. Based on the QRA results: - The LSIR results at the offsite receptors do not exceed their corresponding thresholds - The facility's overall risk profile falls within acceptable MIACC/CSChE tolerability limits - Methodologies used are consistent with the recommended practices - The application of conservative modelling assumptions contributes to a protective assessment in line with MIACC expectations The QRA/FSS demonstrates compliance with CSChE/MIACC risk tolerance standards and meets current industry expectations for risk assessments.
Progression of Risk Reduction and Safety Work Based on the reviewer a professional assessment of the materials and any discussions with the project team, provide commentary on the expected effectiveness and validity of risk reduction measures in comparison to the current facility design. Confirm whether this work aligns with industry best practices and identify any notable improvements or continued risk reduction measures.	The report documents several significant improvements in the proposed facility configuration that are expected to reduce risk relative to the current operating arrangement. These include: - Installation of enhanced chlorine detection and improved shutdown logic in the Liquefaction Building. - Addition of a ventilated and more controlled enclosure for the railcar loading process, including louvers, stack ventilation, and dedicated chlorine scrubbing. - Increased mitigation capacity with a 15,000 lb/hr emergency scrubber, which significantly reduces release magnitudes for indoor events. - Proposed improvements to isolation and compressor shutdown logic, reducing frequency of large indoor releases. - Updated building configurations that reduce worker exposure pathways and enable improved shelter-in-place performance. Risk reduction measures adopted in the proposed design provide improvements in both: - Consequence severity through improved ventilation/scrubbing - Event frequency through enhanced detection and automated shutoff actions These measures align with industry best practices, including CCPS and API guidance for chlorine systems, which emphasize early detection, rapid isolation, and enclosed mitigation where feasible. The progression of safety work represents a strong, well-aligned path toward risk reduction and demonstrates continuous improvement consistent with industry expectations for facilities handling chlorine.
Building Location and Construction For the District's consideration of the Rezoning Application, confirm that the locations and methods of construction of process equipment and buildings will support safe facility operations and meet the CSChE criteria for acceptable risk, to the extent that information is available at the present engineering stage.	Based on the information currently available, the siting and construction approach for major process buildings is generally consistent with risk-based design practices. Some observations include: - The proposed Railcar Loading Building features enhanced ventilation and mitigation provisions that reduce indoor chlorine accumulation. - Building locations maintain separation distances from high-risk equipment as far as practical within the constrained industrial site. - Some buildings appear to support Shelter-in-Place (SIP) strategies, and probit-based toxicity assessments support their expected performance. - No MIACC/CSChE criteria are exceeded at property boundaries given current building placement. - The FSS and QRA support the conclusion that building siting does not introduce unacceptable risk. Based on the engineering information provided, building locations and construction methods support safe facility operation and meet CSChE tolerability criteria for offsite risk. However, future detailed design validation is recommended, but does not change the present conclusion.
Reliability of the Reports Assess whether the reports are reasonable and reliable. If there are any deficiencies or areas of concern, identify them and provide recommendations for resolution.	The QRA/FSS and CFD analyses appear reasonable, technically defensible, and consistent with industry practices. The methodologies are appropriate for the hazards at the site, and the underlying logic is aligned with recognized risk assessment practices. The following are the areas of strength: - Comprehensive hazard identification and scenario selection - Conservative modelling choices - Robust use of validated models - Transparent assumptions and clear traceability to process information - Consistency between modelling results and previous studies (i.e, 2006 QRA) The following are the areas of improvement: - Providing more detailed information regarding the risk results (e.g, tabular LSIR results for each offsite receptor and their corresponding MIACC thresholds) - Certain assumptions rely on Chemtrade's design intent (e.g, compressor shutdown timing, ventilation rates, scrubber capacity) and should be validated during detailed engineering - CFD was performed for only limited scenarios. Additional comparisons may be beneficial in future iterations. - Sensitivity analyses could be strengthened and beneficial for future iterations (e.g, low wind speed, varying operator response times) The report is reliable, internally consistent, and appropriate for rezoning and land-use planning decisions. Any remaining uncertainties are typical for a project at this stage and do not materially affect the overall conclusion that the facility meets the applicable risk tolerance criteria.

Rialto Document Number *CHEML-04-R01*

Report Section	Observations	Recommended Improvement	BakerRisk Response	Report Revisions
Report - Railcar Leading Chloride Release Fault Tree - Chemtrade - 02-0164-004-25				
Section 1 - Scope of Work	Reviewed - no comments.	n/a		None
Section 2 - Fault Tree Analysis - Team	Reviewed - no comments.	n/a		None
Section 3 - Fault Tree Analysis	Section 3.1.1 - minor comment, author should ensure that that the system boundary definition is explicit. this does not impact the methodology but useful for understanding the logic to the FTA.	No specific recommendations that require report revision.		None
	Section 3 would assist with adding any assumptions, exclusions, and data justification, that has been used in the methodology, however the section still reads well and is logical.	See 'Observations' no specific recommendations that require immediate revision		None
	Section 3.1.4 - FTA logic and methodology appears sound and consistent with relevant standards and best practice.	No recommendations.		None
	Section 3.1.5 - would be beneficial to include discussion of HEART assessment for frequencies / probabilities, however methodology is sound / logical.	No recommendations.		None
	Section 3.1.6 - Availability, it should be explicit here that any safety system / measure require regular proof testing to ensure it's functionality.	No specific recommendations that require report revision.		None
	Section 3.4.2 - review has confirmed that formulas stated /used here are consistent with CSChE guidance.	No recommendations.		None
	Section 3.4.4 - A HEP of 0.01 is acceptable for some human activities under CSChE guidance, however, it does not account of poor training etc. For such activities with poor culture etc. a HEP of 0.1 may be more appropriate.	HEPs are critical on some FTA or calculated frequencies, thus on those with potential cliff edges effects they HRA should be reviewed and consider whether it is conservative.	BakerRisk agrees that an HRA should be performed at some point to verify the HEPs. A simplified HEART analysis was performed for this QRA as an exercise to estimate the order of magnitude for the HEP. Conducting a formal HRA was identified as an area for improvement during the detailed design stage of this project. Chemtrade has assured that additional safeguards and independent checks will be added should the HEP be greater than 0.01.	Revised wording for Recommendation 5 (page 20).
	Section 3.3.4 - HEART task identifiers look appropriate, although would be useful to see how the APOA etc. was calculated as does effect the final HEP. Note that HEART calculations are for a single action / activity.	The reader would be benefit from understanding the APOA, see later comment on HEART appendix calculations.	APOA selection documented in Appendix E.	Added reference in Section 3.3.4 to Appendix E (page 11). Added additional APOA discussion to Appendix E (page E-8).
	Section 3.3.4 - review has confirmed that for HEP calculations HEART is allowed / consistent with CSChE guidance and international best practice.	No recommendations.		None
Section 4 - System Description	No comments	n/a		None
Section 5 Assumptions	No comments, apart from above comments relating to listing specific FTA assumptions which are not included in this section.	n/a		None
Section 6 Recommendations	A review has confirmed that recommendations look sound / logical. For Recommendation 4 we would suggest that rather than Validate, that the client ensure training procedures etc. in place, as HEPs are key to frequencies etc. thus review should be key to findings.	Review of wording of recommendation 4, minor comment - see Observation notes.	Reviewed and revised wording of Recommendation 4.	Revised wording for Recommendation 4 (page 20).
Section 7 Event Descriptions and Results	A review of the section has confirmed that the logic for the gates etc. appears correct and consistence with guidance / best practice.	No recommendations.		None
	The review has noted that identified scenarios are heavily reliant on human factors / HEP based on basic HEART methodology, however the use of this methodology appears appropriate under CSChE guidance.	No recommendations.		None
Appendix A - Fault Trees	Note: Appendix A has been reviewed based on selection of sample data.	n/a		None
	TP1 - Review of FTA shows that top level logic appears correct.	No recommendations.		None
	GT11 - Review of FTA, shows that HEPs reflect HRA discussed in main body of text, and logic appears correct.	No recommendations.		None
	GT43 - Review of FTA shows logic and frequencies look logical gates look correct.	No recommendations.		None
	GT23 - Review of FTA shows logic and frequencies look logical gates look correct.	No recommendations.		None
	GT27 - Review of FTA shows logic and frequencies look logical gates look correct.	No recommendations.		None
	GT31 - Review of FTA shows logic and frequencies look logical gates look correct.	No recommendations.		None
	GT39 - Review of FTA shows logic and frequencies look logical gates look correct.	No recommendations.		None
Appendix B - Fault Trees	TP2 - Review shows that logic appears sound, with loadings and unavailability.	No recommendations.		None
	GT56 - Review of failures with respect to each hose and consistency across failure routes, appears correct.	No recommendations.		None
	GT47 - review has shown that Page 8 reference within the FTA appears incorrect, although GT46 unavailability appears accurate, this comment applies through other FTAs in the appendices where page references here been added to the trees.	Referencing with FTA to specific trees / pages should be reviewed across the appendices to ensure accuracy and maintain traceability of route.	BakerRisk reviewed FTA referencing to ensure traceability between pages.	Page referencing corrected for Appendix A and B.
	GT12 - HEPs and associated failure modes appear accurate.	No recommendations.		None
	GT36 - Review shows that logic / methodology appears correct.	No recommendations.		None
Appendix C - Failure Models Note: Appendix C has been reviewed based on selection of sample data.	DICC - IEC reference and logic, assumptions appear logical / correct.	No recommendations.		None
	ERC - check of referencing etc. and logic, all appear correct	No recommendations.		None
	HEP001 - review of HEP shows that it appears correct based on main body text, note wording is consistent with HEART methodology.	No recommendations.		None
	HS5 - reference appears to be missing, however consistent with above lines.	Review of references to ensure all correctly linked.	BakerRisk updated the reference for HS5.	Added HSE reference for HS5 failure model (page C-8).
Appendix D - Base Event Failure Models	Review of Appendix shows that FTA links and logic appear correct.	No recommendations.		None
Appendix E - Human Error Probability Verification via HEART	A review of the HEART calculations has show that it is difficult for the reader to understand the selection of EPCs etc. It would be beneficial to add the logic to the section so that the reader can understand / check the selection of EPCs.	Review of the EPC logic and add justification / assumptions to section, as key to final HEP value.	There is a lack of documented justification for EPC selection as procedures, processes, manning resource, and operator training are yet to be finalized. Based on confirmation from Chemtrade, it was assumed that all operators carrying any stages of the loading process shall be adequately trained in the required procedures, hazards, safeguards, and the importance of each critical step. Language was added in the report to reflect these assumptions.	Additional language added to Recommendation 4 and 5 (page 20) and following Table E-3 (page E-5) commenting on assumptions supporting EPC selection.
	Noting the above comment, a review of the EPCs has been carried out. The logic behind the selection of EPC 35, appears unclear? What is the justification for disruption of normal sleep cycles?	See above and below recommendations.	See response see above. Disruption of sleep cycles was included as loading operators work rotating shifts.	Additional language following Table E-3 (page E-5) commenting on assumptions supporting EPC selection.
	A further review notes that the selected EPCs are not necessarily logical, it would be more influenced by high stress, etc. The methodology behind the EPC selection is not clear to the reader and does not appear consistent with the scenarios considered, and without justification of selection may not be accurate for use within the HEART methodology.	Review of all EPC selection, and add justification to selection based on scenarios and likely contributing factors to human error.	See responses above	None
Whole Report	A review of the report shows that it appears well written, logical and comprehensive based on sample data review. However some of the HEP and logic for referencing within the FTA requires review. Recommendations here reflect these findings.	n/a		None

C. KOST

You said:

Can you analyze the following attachment? The print is hard for me to read.

ChatGPT said:

Of course — I'd be very glad to help.

Please upload the attachment (PDF, image, Word file, etc.), and I will:

- Extract and clearly re-format the text
- Enlarge or clarify any hard-to-read sections
- Summarize the key points
- Identify any technical, financial, or policy issues that stand out
- Flag inconsistencies or areas that may require closer scrutiny

If this relates to the chlorine plant, DNV zoning, or another local matter, I'll analyze it with that context in mind.

Go ahead and attach the file when ready.

You said:

Peer Review by Risktec - Feb 6 2026.pdf

PDF

ChatGPT said:

Thank you — I've carefully reviewed the document.

This is a **peer review letter from Risktec Solutions (Canada) Ltd.**, dated **February 6, 2026**, regarding a revised Quantitative Risk Assessment (QRA) prepared by **BakerRisk** for the Chemtrade chlorine railcar loading facility.**

Below is a clear, structured analysis in plain language.

1️⃣ Overall Conclusion of the Peer Review

Risktec states:

The key peer review comments have been adequately addressed.
The revised QRA and Fault Tree Analysis (FTA) are suitable for their intended purpose.

In short:
They accept the revised QRA as professionally adequate.

However — and this is important — several subtle technical concerns remain embedded in the commentary.

2 What Actually Changed?

The review focused heavily on:

- Fault Tree Analysis (FTA) logic
- Human Error Probability (HEP)
- HEART methodology (human reliability tool)
- Referencing consistency in appendices
- Clarity of assumptions

Most structural and mathematical elements were found to be:

- Logical
- Consistent with CSChE guidance
- Technically sound

3 The Most Important Technical Issue

⚠ Human Error Probability (HEP) Assumptions

This is the most significant technical vulnerability in the entire document.

The Issue:

The QRA uses a Human Error Probability (HEP) of **0.01 (1%)** for key actions.

Risktec notes:

- 0.01 is acceptable **under good training and strong safety culture**
- But in poorer conditions, 0.1 (10%) may be more appropriate
- Some fault trees are highly sensitive to HEP values
- "Cliff edge effects" may exist

That phrase is critical.

What is a Cliff Edge Effect?

A small change in HEP (e.g., 0.01 → 0.05 or 0.1) could dramatically increase:

- Event frequency
- Risk contour results
- Individual risk values

This means:
The model may be structurally sound —
but highly sensitive to optimistic human reliability assumptions.

4 Formal HRA Not Yet Done

BakerRisk admits:

- Only a simplified HEART analysis was performed.
- A full Human Reliability Analysis (HRA) will occur later.
- Final procedures, training, and staffing are not finalized.
- Assumptions were made that operators will be adequately trained.

This is a key vulnerability.

In plain terms:

The QRA depends on assumptions about future training and safety culture that do not yet exist.

5 EPC Selection Concerns (Human Factors Logic)

Risktec questioned:

- How Error Producing Conditions (EPCs) were selected.
- Why sleep disruption (rotating shifts) was included.
- Whether high stress factors were properly considered.
- Whether EPC selection logic was clearly justified.

BakerRisk responded by:

- Adding explanatory language.
- Referencing Appendix E.
- Clarifying assumptions.

But importantly:
Risktec originally said EPC logic "does not appear consistent with the scenarios considered."

That is not a trivial remark.

6 Reliance on Human Controls

Risktec notes:

Identified scenarios are heavily reliant on human factors.

This matters.

When risk mitigation depends heavily on:

- Operator training
- Procedural compliance
- Human attentiveness

Risk becomes culturally dependent rather than physically engineered out.

From a risk engineering standpoint:
Human-dependent safeguards are weaker than passive engineered safeguards.

7 Referencing Errors

Minor but notable:

- Some incorrect page references in FTAs
- Missing references (e.g., HS5)
- Traceability issues across appendices

These were corrected.

Not fatal — but indicate document complexity and revision layers.

8 What They Did NOT Question

Risktec did not challenge:

- The overall risk tolerance framework
- The CSChE methodology
- The mathematical structure of the FTA
- The top event logic
- Hose failure consistency
- Load/unavailability modelling
- Consequence modelling formulas

So structurally:
The model architecture appears sound.

9 The Single Biggest Technical Weakness

If I must identify one:

The risk results depend materially on assumed Human Error Probabilities that are not yet validated by formal HRA or finalized operating procedures.

This creates:

- Sensitivity uncertainty
- Cultural dependency
- Potential underestimation if real-world conditions degrade

That is the core technical vulnerability.

10 Strategic Implications for Council Dynamics

If this is going before DNV Council:

The review letter gives political cover:

"Peer reviewed. Adequate."

But technically, the live issue becomes:

- What happens if HEP is 0.05 instead of 0.01?

- Has a sensitivity analysis been presented?
- Are independent safeguards added if HEP increases?
- Is training enforceable or assumed?

These are calm, technical questions — not emotional ones.

Final Balanced Assessment

Strengths:

✓ Structured
✓ Uses recognized methodology
✓ Peer reviewed
✓ Corrections made
✓ Mathematically coherent

Weaknesses:

⚠ Heavily human-factor dependent
⚠ Simplified HRA only
⚠ Future safeguards assumed, not demonstrated
⚠ Possible cliff-edge sensitivity

If you would like, I can next provide:

- Five strategically powerful hearing questions
- A one-paragraph summary suitable for public comment
- A technical sensitivity explanation simplified for council
- Or a comparison between engineered vs. human safeguards in chlorine facilities

Given your long experience in local politics, this is a subtle document — not flawed, but structurally dependent on optimistic human reliability assumptions.

Your instincts to look closely were well placed.

C. KOST

A Short Summary of Risk Assessments Related to Maplewood

by Corrie Kost [redacted] – version date Nov 22, 2017

A universal minimum industry requirement is that the 10^{-4} risk contour not go outside the property line (ref 1) of the creator of the risk. As indicated on page 39 of the Aug 8th 2012 Maplewood Chemical Hazard DPA Final Report by DOUG MCCUTCHEON and Associated (hereafter called the "Final Report") this is clearly not the case. See Figure 18 below. In fact, the 10^{-4} risk contour crosses over the area accessible by the general public – for example the North Shore Recycling and Drop-off Depot on Riverside Drive. In Canada the MIACC guidelines do not permit any other land uses inside the 10^{-4} annual individual risk contour. In other places (eg. slide 78 of reference 11) the Individual Fatality Risk contour of $5*10^{-5}$ per year is required to remain on site, while the $5*10^{-6}$ per year can extend into industrial developments only.

It should also be noted that on page 17 of the "Final Report" - low-density residential of up to **10units with ground level access per net hectare** should be allowed in the region bounded by 10^{-5} to 10^{-6} contours (see Figure 3 attached). This **corresponds to 4units per net acre.** Council **changed this to 8units per net acre** on the basis that the units would be so small as to likely have an occupancy of about 1 person per unit. Since the occupancy numbers per unit are not controlled by law, or is even regulated, **this relaxation should not be implemented**. It should also be noted, that to best of my knowledge the "Final Report" did not take account of the 2015 report (ref 7) of the Earthquake Risk Study for the District of North Vancouver.

In addition, I find that "voluntary" risk should be distinguished from "involuntary" risks. On page 8 of the "Final Report" it states "Globally the acceptable level of risk for an industrial operation is similar to that risk that we as individuals are willing to accept when we travel by commercial air, rail or bus" ie. 10^{-6}. This misses the point on voluntary vs. involuntary (see some definitions in the references section). The acceptable risk that others impose upon use should be no more than, say, being hit by lightning ie. 10^{-7}.

To date only Individual Risks have been calculated. That is, the risk contours in the "Final Report" only calculated the probability of a fatality to an individual who occupies a specific location 24hrs/day. **Societal Risks,** which produce f/N graphs, although requested as a condition by council in 2007 for the continued operation of the chlorine plant, were, to my knowledge, **never done**. When calculating the consequences (expected number of fatalities) of any unique accident, the answer will depend on the local population density and distribution. Therefore, unlike individual risk contours, an *f/N* curve will change if the local population density or distribution changes. For a simple explanation of the three basic calculations – Hazard Footprints, Individual Risk, and Societal Risk, please see reference 10.

Since the population distribution in the area is proposed to dramatically change it behooves council to have a consultant perform the Societal Risk. For example, the Dutch have adopted a standard which has as an acceptable guideline 10 fatalities at a frequency not more than 1.E-05/yr, 100 fatalities at no more than 1.E-07/yr, and 1000 fatalities at no more than 1.E-09/yr (ref 13)

For a chlorine plant in Melbourne (ref 2) *"the nearest resident is 1.5 km away and the surrounding land areas are either vacant or are filled with warehouses and general manufacturing activities. The plant occupies approximately 8 ha of a total land area of 20 ha, with the vacant area providing a buffer zone for risk contours from the plant. The criteria set by the state government is that the* ***10^{-6} individual fatality risk contour must not lie outside the site boundary*** *and the buffer zone ensures that this is the case".*

NB.

Distance as a guide:

In Australia, a guideline of 300 to 1500 meters from the plant boundary is used as a rule of thumb for non-major industrial developments. The DNV existing chlorine plant falls into the "major" category. In the 2014 OCP of Lloydminster Planning District, Saskatchewan, the minimum separation distance from any Hazardous Industrial Site (see attachment 1) is 1.6Km from any single family home and 2.4Km from multilot residential building sites . (ref 3) The municipality of Lumsden,

Saskatchewan uses an almost identical table (page 63 of reference 5) – that is, 1.6Km from any single family home and 2.4Km from multilot residential building sites for the separation from Hazardous Industrial sites.

Note that buildings in the DNV within the 10^{-6} risk contours will require HVAC systems (ref 4 page 36) that maintain a slight positive pressure inside the building to prevent chlorine from entering. However, if a large earthquake (see reference 7 – note particularly pages 32(attached as figure 32),33 and 35 as it relates to Maplewood) triggers a chlorine release (a much more likely time than at other times) the structure of most buildings are likely to be compromised and allow chlorine to enter. Access by emergency services would also be constrained since even a low ppm (parts per million) of chlorine will make normal engines inoperable. Recovery, not rescue, would be the likely scenario.

Notwithstanding the MIACC guidelines I find it unacceptable to move the 10^{-6} risk contour (of Figure 18) some 50 metres closer to the chlorine plant in order to align it with Front Street "for land use planning purposes"

City of Edmonton

Edmonton used a more pragmatic approach. In the review "Risk Based Land-Use Planning in the Edmonton Area – by Doug McCutcheon"(ref 6) it is recommended that the maximum amount of chlorine that should be stored within a 3 Km radius of the plant is 1,825Kg. Currently there is **far** more than that stored both inside (60,000Kg) and outside of the North Vancouver Chlorine plant!

Concerns expressed by the local community

I would like to note some of concerns that have been expressed by others in the subject area. From two 2011 articles (references 8 and 9) I take particular note of *"If Canexus has a terrible release and it kills 10,000 people, Canexus will go bankrupt and they'll just walk away. The people in North Vancouver or Vancouver won't even have someone they can sue."*

Why Canexus did not cease chlorine production in 2007

In 2007 the existing lease (Ref No. V1381(06)) at that time was valid until

June 30, 2018. Despite the desires of the Maplewood community (and council) to terminate this hazard in their neighbourhood the Vancouver Port Authority, who appears to have ultimate jurisdiction of the subject land, agreed to extend the lease to 2032.

What is the worst case scenario for the release of the full 60Tons of chlorine?
However unlikely it may be I believe our residents deserve to know the worst case potential impact of the complete release, say during a cloudless night and low winds, of the on-site storage tank (60Tons) of chlorine.

For the less technically minded...
You may wish to read the Oct 20/2011 Scientific American article "Chlorine Accidents Take a Big Human Toll" (ref 12)

RECOMMENDATION

Whereas, contrary to the MIACC guidelines, the chlorine plant imposes a substantial risk to the community well outside their property line, and

Whereas simple calculations indicate that the chlorine plant stores 300/74/33 times more chlorine than is prudent even if it were respectively 1/2/3Km from any residential areas, and

Whereas the Societal Risk calculations, as requested by council in 2007, have yet to be performed:

I urge council not to proceed with any further densification in the Maplewood area.

There is some evidence to support not proceeding with any new residential developments within at least 3 kilometers of the chlorine plant. This unfortunately includes all of Lower Lynn.

The safety of our residents should override any other considerations.

References

(1) http://www.planning.nsw.gov.au/~/media/Files/DPE/Reports/quantitative-risk-assessment-summary-report-botany-industrial-park-2012-09-25.ashx

(2) https://books.google.ca/books?isbn=0470999462

(3) http://crosbyhanna.ca/assets/LPD-OCP-FINAL.pdf

(4) http://www.dnv.org/sites/default/files/edocs/Maplewood-Implementatoin-Plan-Final.pdf

(5) http://lumsden.ca/wp-content/uploads/rm189/pdfs/bylaws/2014/OCP_Bylaw%2006-12%20R%20M_Lumsden.pdf

(6)http://www.cheminst.ca/sites/default/files/pdfs/Connect/PMS/CSChE%202007%20-%20McCutcheon%202.pdf

(7)http://ftp.maps.canada.ca/pub/nrcan_rncan/publications/ess_sst/296/296439/of_7816.pdf

(8) https://www.vancouverobserver.com/public%20safety/2011/03/28/after-japanese-earthquake-north-vancouver-residents-raise-questions-about

(9) https://www.vancouverobserver.com/chlorine/2011/03/31/north-vancouver-ready-chlorine-leak-during-earthquake

(10) http://www.questconsult.com/papers/risk-acceptance-criteria/

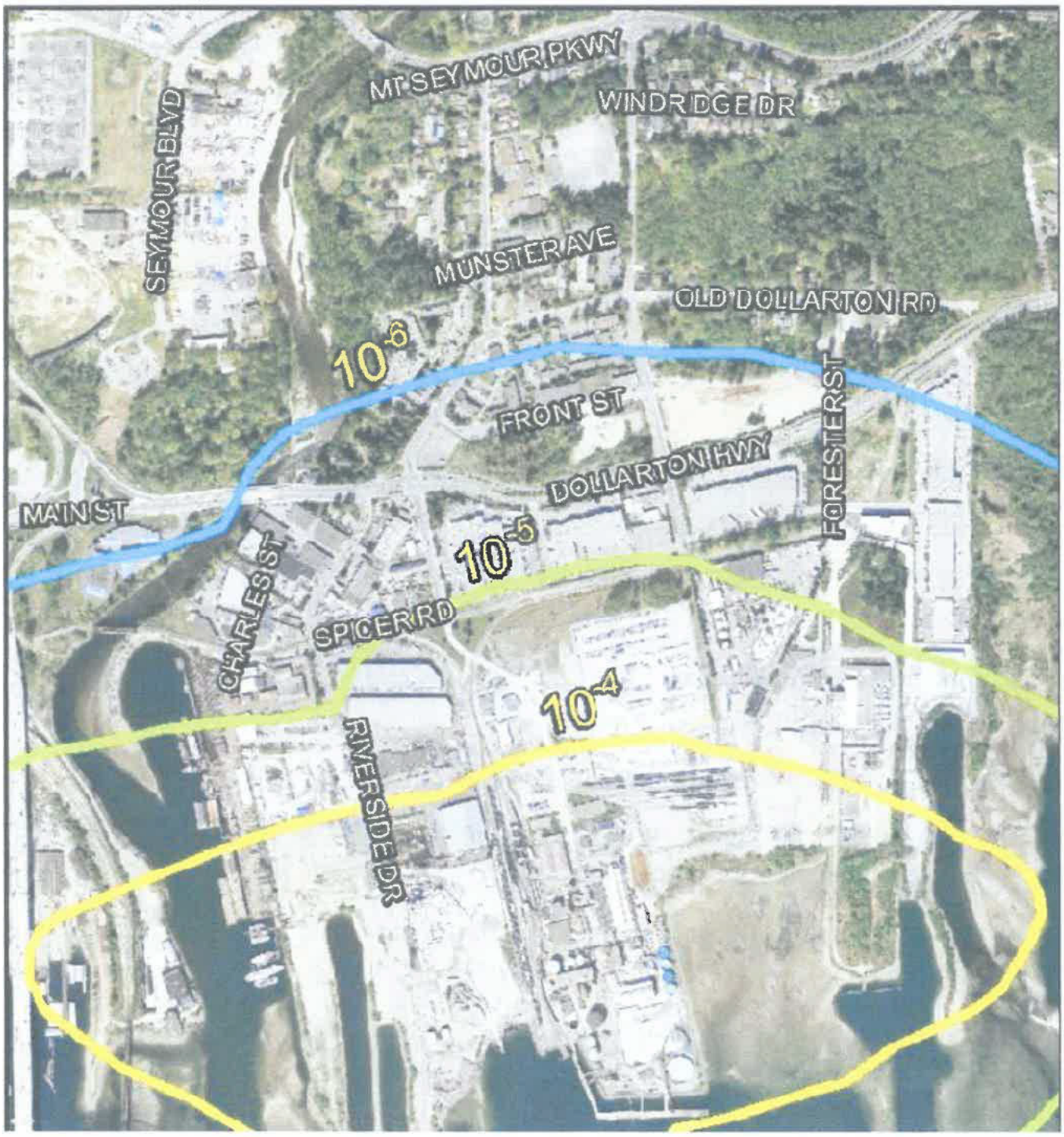
(11)https://www.researchgate.net/file.PostFileLoader.html?id=579aff8148954cd06f60c964&assetKey=AS%3A389081830838272%401469775745231

(12) https://www.scientificamerican.com/article/chlorine-accidents-take-big-human-toll/

(13)http://sache.org/workshop/2013Faculty/files/QRA%20Presentation%20for%20%20AICHEME%20in%20Richmond_1486_1.pdf -page8

- **Voluntary risk** is associated with activities in which a person participates by choice. Examples of voluntary activities include driving a car, flying in an airplane, rock climbing, and scuba diving. Generally, the individual uses his own value system and experience to determine if the risk of a voluntary activity is acceptable to him.
- **Involuntary risks** are associated with activities, conditions, or events to which a person might be exposed without his consent. Examples of involuntary risks include the risk of premature death from illness, natural disasters (earthquakes, floods, etc.), or the **production and transportation of hazardous materials**. For certain industrial activities, the "allowable" or "acceptable" levels of involuntary risk might be set by some government agency, rather than by each individual.

ıexus TCP Project Risk Contours:



Maplewood Chemical Hazard DPA Preliminary Study For The District of North Vancouver FINAL REPORT AUGUST 8th, 2012

Final Report

FIGURE 18

crosbyhanna.ca/assets/LPD-OCP-FINAL.pdf page 49 to specify minimal separation from hazardous uses
Lloydminster Planning District Commission Saskatoon, SK

Table 8.1
Lloydminster Planning District
Required Separation Distance Between Uses
(In Metres)

		Municipal Wells	Residential			City of Lloydminster	Intensive Agriculture	Airport / Airstrip	Commercial	Gravel Pit	Waste Management		Anhydrous		Industrial	Hazard Industrial
			Single	MFR	Tourist Accommodation						Solid	Liquid	Non-Refrigerated	Refrigerated		
Residential	Single [1]	--	--	--	--	--	--	--	200	150	457	600	305	600	300	1,600
	Multi-lot Country Residential [2]	--	--	--	--	--	--	806	200	300	457	600	305	600	800	2,400
	Tourist Accommodation [3]	--	--	--	--	--	--	--	200	300	457	600	305	600	800	1,600
Intensive Agriculture [4]		--	--	--	--	--	--	--	--	--	--	--	--	--	800	1,600
Airport / Airstrip [5]		--	--	800	--	800	--	--	--	--	--	--	--	--	--	--
Commercial (Agriculture) [6]		--	300	800	800	--	800	--	--	--	457	300	--	--	--	--
Waste Management [7]	Solid	1,600	457	457	457	457	457	--	457	--	--	--	--	--	457	--
	Liquid	1,600	600	600	600	600	300	--	300	--	--	--	--	--	300	--
Anhydrous [8]	Non-Refrigerated	--	300	300	300	300	--	--	--	--	--	--	--	--	--	--
	Refrigerated	--	600	600	600	600	--	--	--	--	--	--	--	--	--	--
Industrial [9]		800	300	800	800	[9]	800	--	--	--	457	300	--	--	--	--
Hazardous Industrial [9]		1,600	1,600	2,400	1,600	[9]	1,600	--	--	--	--	--	--	--	--	--

Distances are measured as follows - Between closest point of nearest

- Single Residential Building...
- Multilot Residential Building Site...
- Tourist Accommodation Facility...
- Intensive Agricultural Site...
- Airport / Airstrip Facility...
- Commercial Site...
- Waste Management Facility or Lagoon...
- Anhydrous Ammonia Storage Facility...
- Industrial Site...
- Hazardous Industrial Site...

... to the nearest residential building, corporate limit, airport or airstrip, gravel pit, anhydrous ammonia storage, or waste management facility and the site lines for other uses.

The location of industrial and Hazardous Industrial development in the Planning District is managed by the Future Land Use Concept contained in this Official Community Plan. Refer to Section 5.1.2.1 for separation distances from land uses on an adjacent Rural Municipality.

Hazardous Industries distance from Multilot Residential Building Site: 2.4Km

Hazardous industries minimal distance from Single Family Residential: 1.6Km

ATTACHMENT 1

City of Edmonton

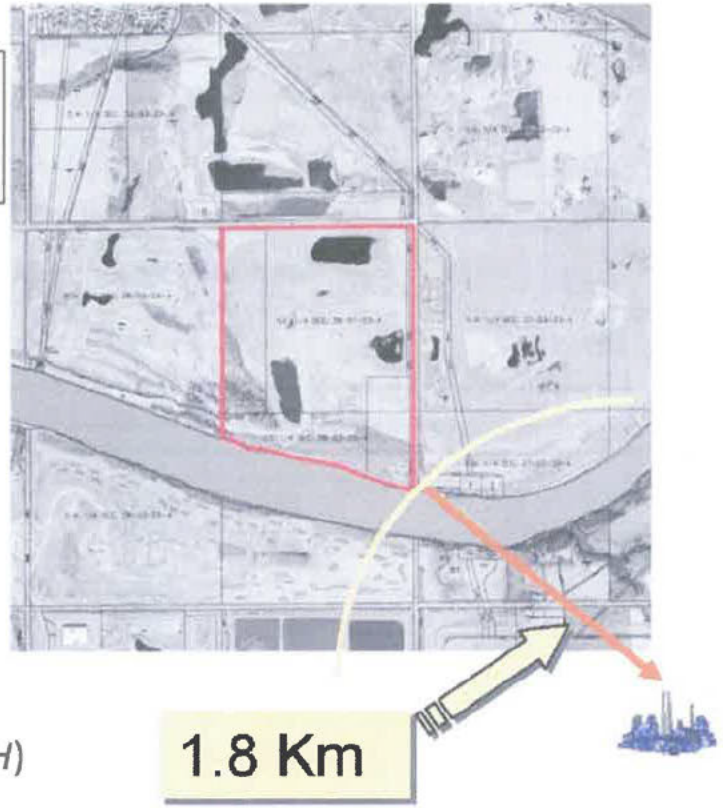
A camp for underprivileged children almost run year round. At most 1,000 people there at one time.

One approach used for a risk assessment for the City was to determine the maximum amount of hazardous chemicals could be located in a heavy industry zone to the south. The table below shows some of the quantities.

Not a lot.

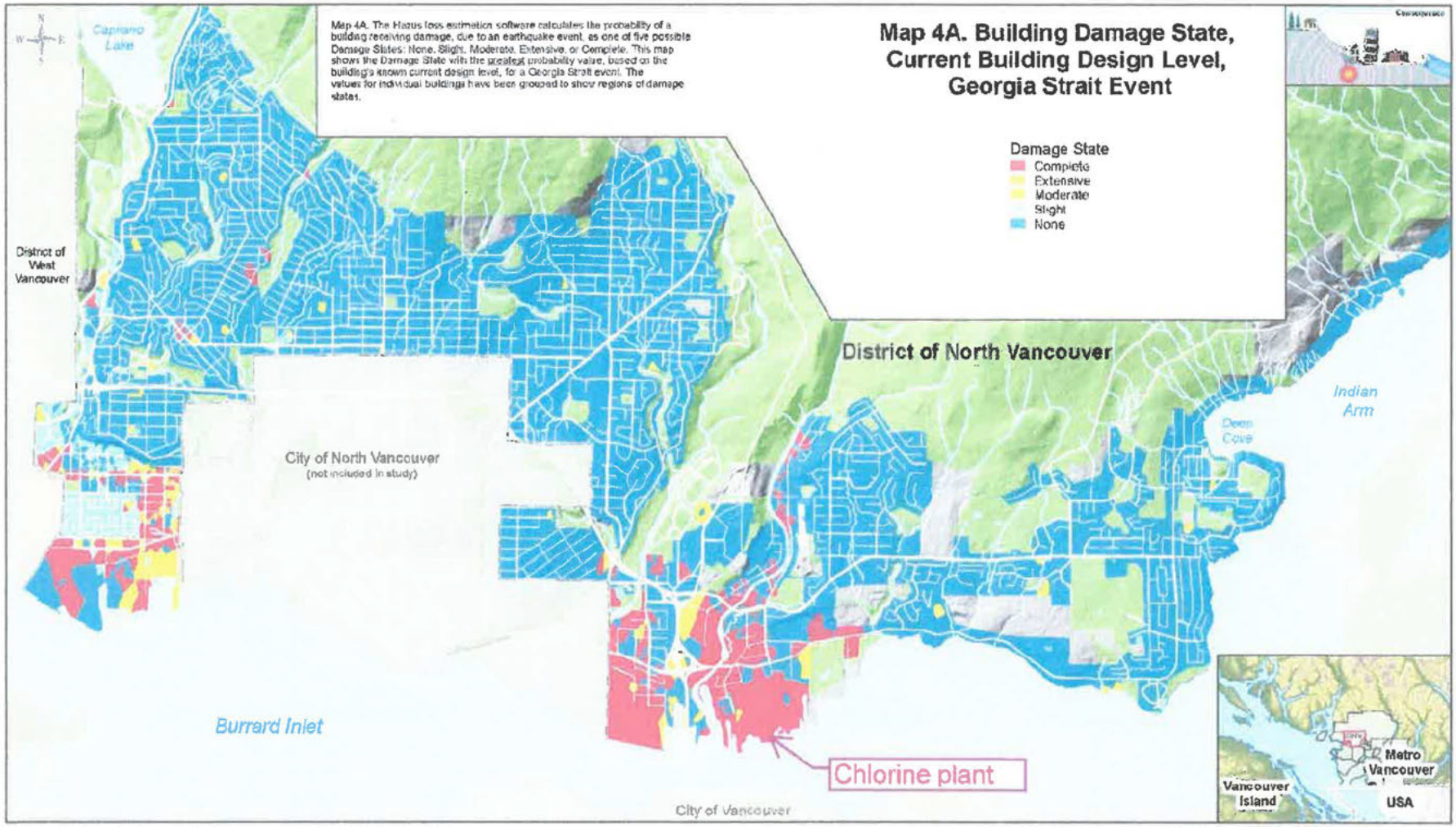
IDLH for Cl_2 is 10ppm

Hazard Distance to the IDLH Concentration	H_2S Kg	SO_2 Kg	Cl_2 Kg
1 Km	979	1,748	203
2 Km	3,915	6,991	811
3 Km	8,808	15,729	1,825
Resulting Probability (high end) = 4.15×10^{-5}			



Immediately Dangerous to Life or Health *Concentrations* (*IDLH*)

Note that for a chlorine cloud only a portion of the area within the circular vulnerability zone can be affected by a unique accident –see Fig 2 of ref 10 (cjk)



Disclaimer: Her Majesty the Queen in right of Canada, as represented by the Minister of Natural Resources ("Canada"), does not warrant or guarantee the accuracy or completeness of the information ("Data") on this map and does not assume any responsibility or liability with respect to any damage or loss arising from the use or interpretation of the Data. The Data on this map are intended to convey regional trends and should be used as a guide only. Results do not replace the need for site specific geotechnical investigations for specific design, construction, and/or engineering purposes.

Natural Resources Canada | Ressources naturelles Canada

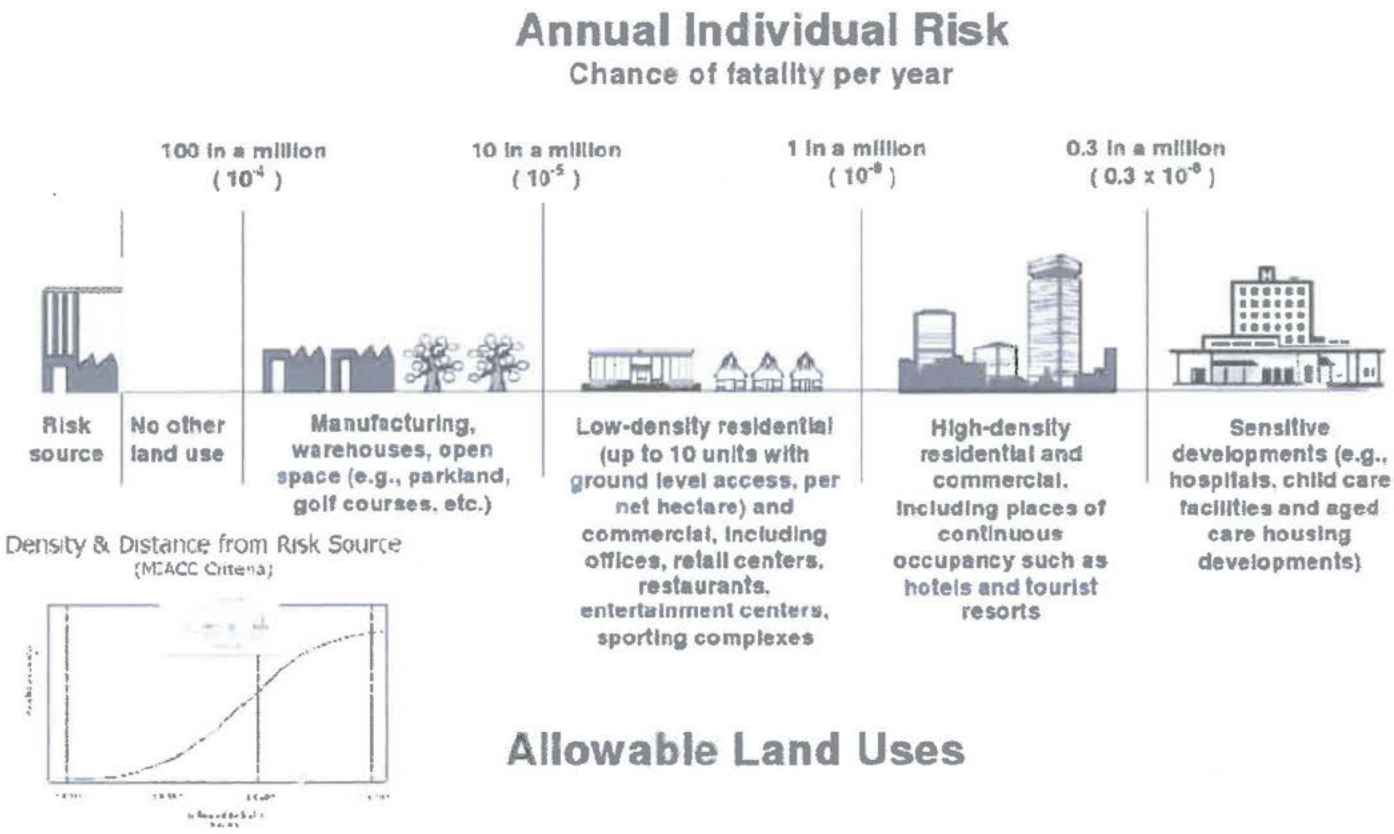
Credits: Building location, occupancy, and infrastructure provided by the District of North Vancouver. Building details provided by the Earthquake Engineering Research Facility, Department of Civil Engineering, University of British Columbia. All results were generated by Natural Resources Canada in consultation with other seismic risk assessment experts, using best available data, current scientific and engineering knowledge, and reasonable assumptions. Earthquake impacts were modelled with Hazus loss estimation software. Estimates were generated for a specific earthquake scenario using limited hazard information.

Canada

Figure 32

Figure 3

Figure 3: MIACC Land Use Planning Criteria



Additional Reading Material

a) http://www.epd.gov.hk/eia/register/report/eiareport/eia_2242014/EIA/text_html/S12_Hazard.htm

b) http://www.praxair.com/-/media/documents/sds/chlorine-cl-2safety-data-sheet-sds-p4580.pdf see page 4 for IDLH of 10ppm

c) http://onlinelibrary.wiley.com/doi/10.1002/9780470552940.app2/pdf

d) https://www.worksafebc.com/en/resources/health-safety/books-guides/chlorine-safe-work-practices?lang%3Den%26direct

Some useful information

If all the liquid chlorine in a 68 kg (150 lb.) container escaped, it would release so much pure chlorine gas that it would take 24 times the amount of air in BC Place stadium to dilute the gas concentration to 0.5 ppm, the maximum allowable concentration a person can be exposed to in an eight-hour period. (page 2 ref d)

Chlorine gas is not visible as a greenish-yellow cloud at concentrations below 1000 ppm. (page 3 ref d)

not required to make this public!

C. KOST

What is the volume of 5 kg of chlorine at a density of 1 part per million. For clarity the 1ppm refers to chlorine gas in air. Please go ahead and compute that volume now.

Perfect — thank you for clarifying that 1 ppm refers to **chlorine gas in air**.

Let's carefully go step-by-step.

Step 1. Define 1 ppm by volume in air

For gases, **1 ppm = 1 molecule (or volume) of gas per 10^6 molecules (or volumes) of air**.

So the **volume fraction** of chlorine is:

$$f = \frac{1}{10^6} = 10^{-6}$$

Step 2. Air density under typical conditions

At 25 °C and 1 atm, dry air density ≈ 1.184 kg/m³.

Step 3. Average molecular weights

- M(air) ≈ 28.97 g/mol
- M(Cl_2) = 70.90 g/mol

Step 4. Convert 1 ppm (v/v) into a mass fraction

Because the ratio is by **volume**, the **mass fraction** of chlorine in air is:

$$w = f \times \frac{M_{Cl_2}}{M_{air}} = 10^{-6} \times \frac{70.90}{28.97}$$
$$w = 10^{-6} \times 2.448 = 2.448 \times 10^{-6}$$

That's **2.448 ppm by mass**.

Step 5. Compute the mixture density contribution of chlorine

$$\rho_{Cl_2,mixture} = w \times \rho_{air} = (2.448 \times 10^{-6}) \times (1.184\,\text{kg/m}^3)$$
$$= 2.897 \times 10^{-6}\,\text{kg/m}^3$$

So:

👉 **Density of chlorine in air at 1 ppm ≈ 2.9 × 10⁻⁶ kg/m³**

Step 6. Compute the volume containing 5 kg of chlorine

$$V = \frac{m}{\rho} = \frac{5}{2.897 \times 10^{-6}} = 1.725 \times 10^6\,\text{m}^3$$

☑ **Final Answer:**

Quantity	Value	Units
Density of Cl_2 in air (1 ppm)	2.9×10^{-6}	kg/m³
Volume containing 5 kg Cl_2	**1.7×10^6**	m³
Equivalent cubic dimension	Cube ≈ **120 m per side**	

Interpretation:
At only 1 ppm, 5 kg of chlorine gas would be dispersed through roughly **1.7 million m³ of air** — about the volume of a large sports stadium or ~700 Olympic-size swimming pools.

What is the radius of a circle with an area of 288,000 sq-m

ChatGPT said:

Let's calculate carefully step by step.

Step 1. Formula

$$A = \pi r^2$$

So,

$$r = \sqrt{\frac{A}{\pi}}$$

Step 2. Substitute

$$A = 288{,}000\ \text{m}^2$$
$$r = \sqrt{\frac{288{,}000}{\pi}}$$

Step 3. Compute

$$\frac{288{,}000}{\pi} = \frac{288{,}000}{3.1416} \approx 91{,}587.3$$
$$r = \sqrt{91{,}587.3} \approx 302.63$$

✅ **Final Answer:**

$$r \approx 303\ \text{m}$$

Check:
Area = $\pi \times (303)^2 \approx 3.1416 \times 91{,}809 \approx 288{,}000\ \text{m}^2$ ✔

Now for 5kg of chorine spread to a density of 10 parts per billion can you verify a radius of ~ 3000 m when uniformly spread over a cylindrical volume with a height of 6 m

ChatGPT said:

Thought for 9s

Yes — your ~3,000 m radius is correct. I'll show the arithmetic and assumptions so you can verify.

Assumptions

- 10 ppb means a volume fraction $f = 10 \times 10^{-9} = 1 \times 10^{-8}$(v/v).
- Molar masses: $M_{\text{air}} \approx 28.97$ g/mol, $M_{\text{Cl}_2} = 70.90$ g/mol.
- Air density $\rho_{\text{air}} = 1.184$ kg/m^3(≈25 °C, 1 atm).
- Chlorine mass $m = 5$ kg.
- Cylinder height $h = 6$ m.

Step-by-step calculation

1. Mass fraction of Cl_2 at 10 ppb (v/v):

$$w = f \cdot \frac{M_{Cl_2}}{M_{air}} = 1 \times 10^{-8} \times \frac{70.90}{28.97} = 1 \times 10^{-8} \times 2.4473593 = 2.4473593 \times 10^{-8}$$

2. Effective mass density of Cl_2 in the air mixture:

$$\rho_{Cl_2} = w \times \rho_{air} = 2.4473593 \times 10^{-8} \times 1.184 \approx 2.8976735 \times 10^{-8}\ \text{kg/m}^3$$

3. Total air volume required to contain 5 kg of Cl_2 at that concentration:

$$V = \frac{m}{\rho_{Cl_2}} = \frac{5}{2.8976735 \times 10^{-8}} \approx 1.72552224 \times 10^{8}\ \text{m}^3$$

4. For a cylinder of height $h = 6\text{m}$, its volume is $V = \pi r^2 h$. Solve for r:

$$r = \sqrt{\frac{V}{\pi h}} = \sqrt{\frac{1.72552224 \times 10^{8}}{\pi \times 6}} \approx 3025.59\ \text{m}$$

Final result:
$r \approx 3.026 \times 10^3$ m— about **3.03 km** (so your estimate of ~3000 m is correct).

If you want, I can also give the diameter, the surface area covered, or compare this result to the 1 ppm case you previously asked about.

You said:

This all came about that the chlorine plant is not obliged to report a chlorine spill below 5 kilograms.

ChatGPT said:

Ah — that context makes the numbers make much more sense.

Let's put it in perspective:

- Even **5 kg of chlorine**, which sounds small, when dispersed at **10 ppb in air**, would spread over a **cylindrical area of radius ~3 km** and height 6 m (or a volume of ~172 million m³).
- At **1 ppm**, 5 kg would occupy only ~1.7 million m³, about ten times smaller, but still a very large volume.
- This illustrates why a **5 kg release can be practically undetectable in the atmosphere** over large areas if diluted, yet it could still have **local safety implications** if released in a confined space.

The "no reporting below 5 kg" threshold is a regulatory number, but physically even a tiny mass can affect air quality over wide areas — it just won't reach the reporting threshold.

If you want, I can **illustrate the actual local concentration risk** for 5 kg being released in a smaller, more realistic volume (say the immediate plant area) to see why even "minor" releases can be hazardous. It's a stark difference from uniform dilution assumptions. Do you want me to do that?

You said:

Please do that.

ChatGPT said:

Great — let's model a **more realistic "local" release scenario** for 5 kg of chlorine at a plant. We'll assume it doesn't instantly dilute to 10 ppb over kilometers but instead spreads over the **immediate vicinity**, where exposure matters.

Step 1: Assumptions

- Chlorine gas mass: $m = 5$ kg
- Chlorine molar mass: $M = 70.90$ g/mol
- Local release volume: assume **a cylindrical plume 100 m radius, 10 m high** (a reasonable near-ground dispersion around a plant).
  - Volume $V = \pi r^2 h = \pi(100)^2(10) \approx 314{,}159$ m^3
- Air density: $\rho_{\text{air}} = 1.184$ kg/m^3
- Molecular weights: $M_{\text{air}} = 28.97$ g/mol

We want **local chlorine concentration in ppm**.

Step 2: Chlorine density in the plume

$$\rho_{Cl_2} = \frac{m}{V} = \frac{5}{314{,}159} \approx 1.59 \times 10^{-5} \text{ kg/m}^3$$

Step 3: Convert to ppm by volume

For gases:

$$\text{ppm (v/v)} \approx \frac{\rho_{Cl_2}}{\rho_{\text{air}}} \cdot \frac{M_{\text{air}}}{M_{\text{Cl2}}} \cdot 10^6$$

$$\text{ppm} \approx \frac{1.59 \times 10^{-5}}{1.184} \cdot \frac{28.97}{70.90} \cdot 10^6$$

Step-by-step:

1. Mass fraction: $1.59 \times 10^{-5} / 1.184 \approx 1.342 \times 10^{-5}$
2. Multiply by MW ratio: $1.342 \times 10^{-5} \times (28.97/70.90) \approx 5.48 \times 10^{-6}$
3. Convert to ppm: $5.48 \times 10^{-6} \times 10^6 \approx 5.48$ ppm

---

✅ Step 4: Interpretation

- **Immediate plume concentration:** ~5.5 ppm
- **Comparison:**
  - OSHA / ACGIH short-term exposure limit for Cl_2: ~1 ppm (15 min)

- Threshold for eye/nose irritation: ~1–3 ppm
- Lethal concentration (LC50, 30 min): ~1000 ppm

So even a **"minor" 5 kg release in a local plume** could cause **strong irritation in the plant or nearby area**, well above safety limits, even if it would be undetectable if diluted over kilometers.

If you want, I can make a **table showing concentrations vs. radius for different plume heights** — it's a striking visualization of how "reportable thresholds" can miss dangerous local exposures. Do you want me to do that next?

You said:

Please do so.

ChatGPT said:

Perfect — let's make a **clear table showing how local chlorine concentration varies with plume radius** for a **5 kg release**. We'll assume a **cylindrical plume of height 10 m**, and calculate approximate **ppm concentrations**.

Step 1: Formula

For a cylinder:

$$V = \pi r^2 h$$
$$\rho_{Cl_2} = \frac{m}{V} = \frac{m}{\pi r^2 h}$$
$$\text{ppm (v/v)} \approx \frac{\rho_{Cl_2}}{\rho_{\text{air}}} \cdot \frac{M_{\text{air}}}{M_{\text{Cl2}}} \cdot 10^6$$

Where:

- $m = 5$ kg
- $h = 10$ m
- $\rho_{\text{air}} = 1.184$ kg/m^3
- $M_{\text{air}}/M_{Cl2} = 28.97/70.90 \approx 0.4089$

Step 2: Compute ppm for different radii

Radius (m)	Volume (m³)	Cl_2 density (kg/m³)	ppm
10	3,142	0.00159	548
25	7,854	0.000636	219
50	7.85×10^3? wait let's calculate carefully.		

Let's do **step-by-step for each radius**.

Radius 10 m

$$V = \pi r^2 h = 3.1416 \times 10^2 \times 10 = 3{,}141.6 \text{ m}^3$$
$$\rho_{Cl_2} = 5/3{,}141.6 \approx 0.00159 \text{ kg/m}^3$$
$$\text{ppm} = 0.00159/1.184 \times 0.4089 \times 10^6 \approx 548 \text{ ppm}$$

Radius 25 m

$$V = \pi(25)^2 10 = 3.1416 \times 625 \times 10 \approx 19{,}635 \text{ m}^3$$
$$\rho_{Cl_2} = 5/19{,}635 \approx 0.0002547 \text{ kg/m}^3$$
$$\text{ppm} = 0.0002547/1.184 \times 0.4089 \times 10^6 \approx 88 \text{ ppm}$$

Radius 50 m

$$V = \pi(50)^2 10 = 3.1416 \times 2{,}500 \times 10 \approx 78{,}540 \text{ m}^3$$
$$\rho_{Cl_2} = 5/78{,}540 \approx 6.37 \times 10^{-5} \text{ kg/m}^3$$
$$\text{ppm} = 6.37 \times 10^{-5}/1.184 \times 0.4089 \times 10^6 \approx 22 \text{ ppm}$$

Radius 100 m

$$V = \pi 100^2 10 = 314{,}159 \text{ m}^3$$
$$\rho_{Cl_2} = 5/314{,}159 \approx 1.59 \times 10^{-5} \text{ kg/m}^3$$
$$\text{ppm} \approx 5.48 \text{ ppm}$$

Radius 200 m

$$V = \pi 200^2 10 = 1{,}256{,}637 \text{ m}^3$$
$$\rho_{Cl_2} = 5/1{,}256{,}637 \approx 3.98 \times 10^{-6} \text{ kg/m}^3$$
$$\text{ppm} \approx 1.37 \text{ ppm}$$

Radius 300 m

$$V = \pi 300^2 10 = 2{,}827{,}433 \text{ m}^3$$
$$\rho_{Cl_2} = 5/2{,}827{,}433 \approx 1.77 \times 10^{-6} \text{ kg/m}^3$$
$$\text{ppm} \approx 0.61 \text{ ppm}$$

✅ Step 3: Summary Table

Radius (m)	ppm Cl_2	Exposure interpretation
10	548	Extremely dangerous, lethal locally
25	88	Severe irritation, potentially life-threatening
50	22	Strong irritation, hospital visits likely
100	5.5	Eye/nose irritation, short-term exposure limit exceeded
200	1.37	Mild irritation, just above OSHA short-term limit
300	0.61	Below short-term exposure limit, minor irritation possible

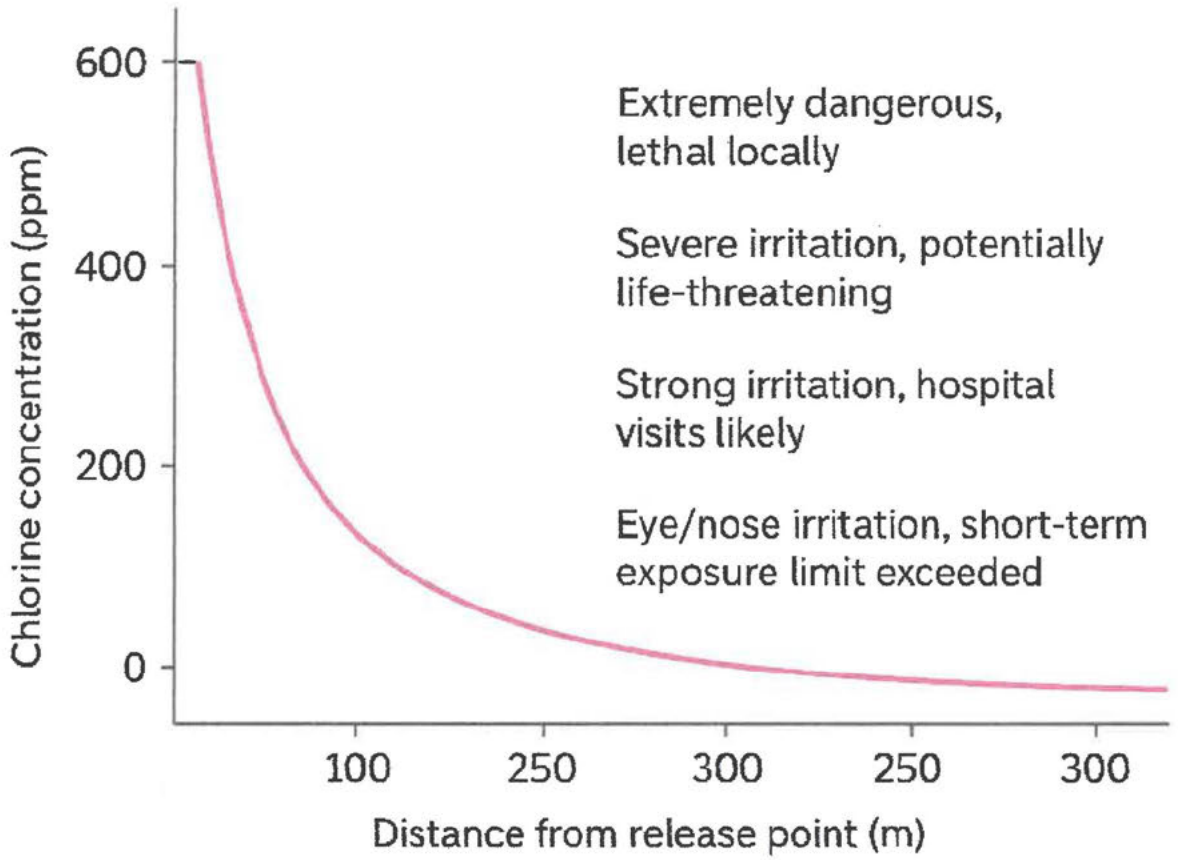
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Insight:

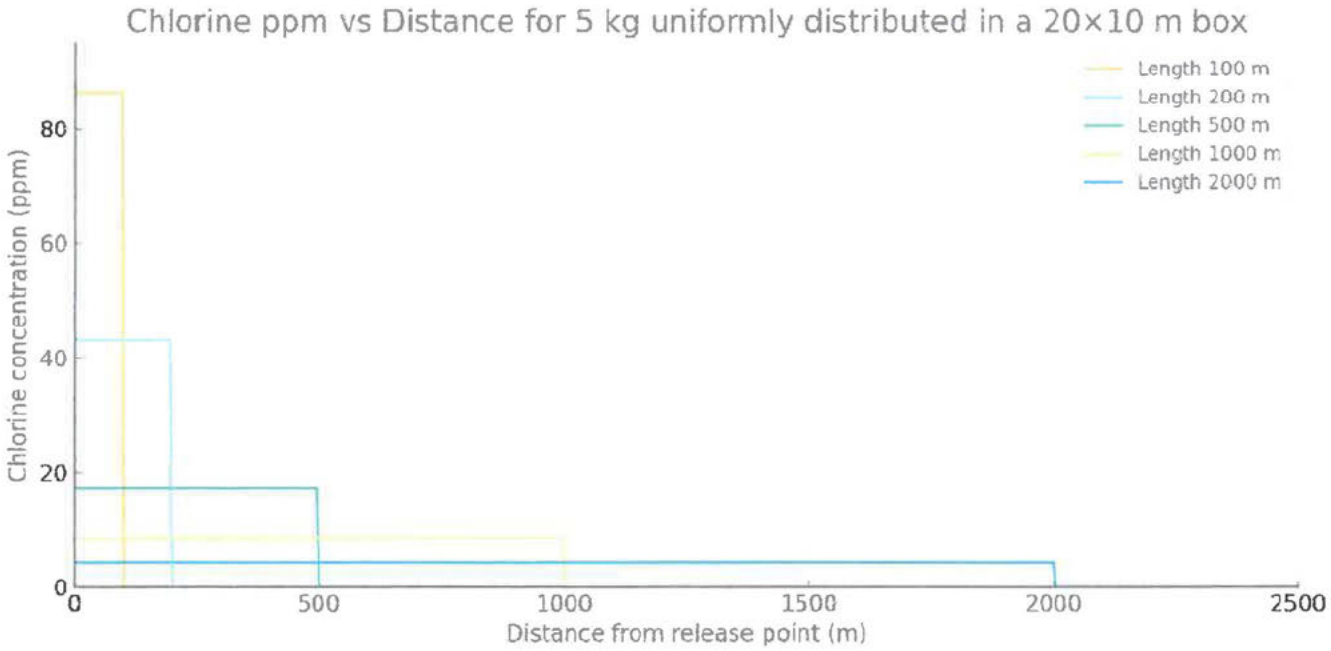
Even **5 kg**, while below the "reportable" 5 kg threshold, can create **dangerous concentrations locally** within ~100–200 m of the release point. Beyond ~300 m, it becomes less immediately hazardous if the plume spreads uniformly.

If you like, I can make a **quick schematic diagram** showing ppm vs. distance — it's visually striking how the hazard drops sharply with distance. Do you want me to do that?

Yes please.



Continue with a 5kg release of chlorine but this time but this time as a box of fixed height of 10 meters, width of 20 meters, and a length from 100 meters to 2000 meters. Graph ppm vs distance from release point.



Done — I created the plot and a summary table.

Key points from the chart and table:

- Box cross-section = 20 m × 10 m = 200 m².
- For a 5 kg release uniformly distributed along the box length:
  - Length 100 m → ppm ≈ **86.3 ppm** (constant from 0–100 m, then 0 beyond)
  - Length 200 m → ppm ≈ **43.1 ppm**
  - Length 500 m → ppm ≈ **17.3 ppm**
  - Length 1000 m → ppm ≈ **8.63 ppm**
  - Length 2000 m → ppm ≈ **4.31 ppm**

Interpretation:

- Short, concentrated boxes (100–200 m) create very high local concentrations (tens of ppm) — likely to cause severe irritation and acute effects near the plant.
- Long spread (1000–2000 m) reduces ppm to single digits, but still above typical short-term exposure limits (≈1 ppm) for many lengths.
- The plot shows each case as a flat plateau up to the box length, then concentration drops to (assumed) zero beyond the box.

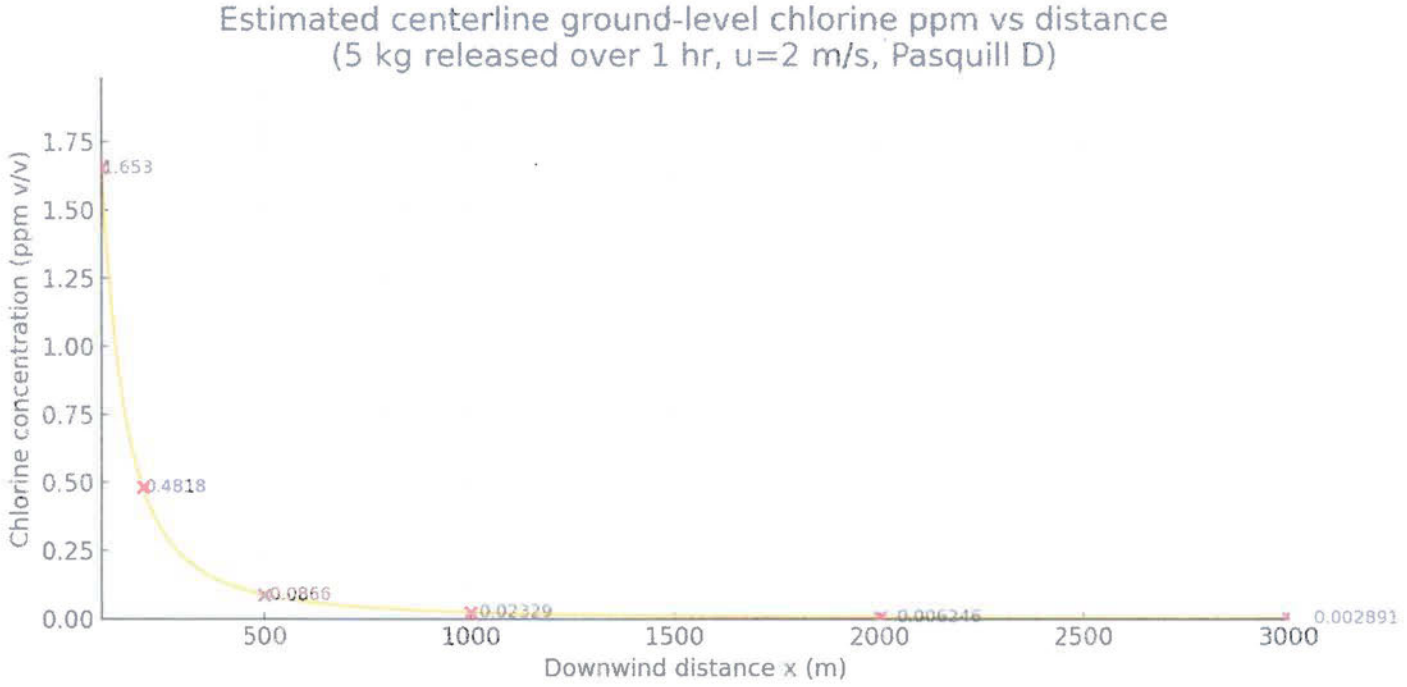
Files:

- I saved the plot to **/mnt/data/chlorine_box_ppm_vs_distance.png** and a CSV summary to **/mnt/data/chlorine_box_summary.csv**. If you'd like, I can provide those as downloadable links or export a printable figure or table

Now comes the hard part. What is the most probable plume configuration for the typical wind conditions of the area where the Chlorine plant is located in North Vancouver and show the graph of ppm over the range 100m to 3000m for that configuration, again for a 5kg release.

ChatGPT said:

Thought for 1m 0s



I modeled a **plausible "most probable" plume** for the North-Vancouver site and produced the requested graph (100–3,000 m) for a **5 kg chlorine release** under reasonable assumptions. I also saved a table of key values and the plot — both are visible in the output I generated.

Short answer (summary of assumptions + results)

- **Most-probable conditions chosen for North Vancouver (justified below):**
  - Wind speed $u = 2.0$ m/s(light–moderate coastal wind; typical hourly averages in North Vancouver are a few km/h to ~10 km/h). Weather Spark+1
  - Stability: **Pasquill Class D (neutral)** — typical for overcast or coastal conditions and moderate winds, and a reasonable "most likely" neutral choice for daytime/average conditions. NOAA Ready
- **Model setup (explicit so you can judge):**
  - I treated the 5 kg release as a **continuous release over 1 hour** (Q = 5/3600 = 0.001389 kg/s). This makes the steady-state Gaussian plume approximation reasonable for the 100–3,000 m range (travel time at 2 m/s is on the order of 25–1500 s). (If you prefer an instantaneous puff model I can do that — but I chose steady plume to produce a simple, conservative centerline estimate without asking for more detail.)
  - Source height $H = 2$ m, receptor (breathing) height $z = 1.5$ m, centerline $y = 0$.
  - Pasquill/Turner empirical dispersion approximations used (D class): $\sigma_y = 0.128\,x^{0.90}$, $\sigma_z \approx 0.051\,x$. (These are standard approximations used in Gaussian plume calculations; see Turner/Pasquill references). hazopmalaysia.files.wordpress.com+1
- **Conversion to ppm (v/v):** mass concentration C(kg/m³) → ppm via $\text{ppm} = (C/\rho_{air}) \times (M_{air}/M_{Cl_2}) \times 10^6$, with $\rho_{air} = 1.184$ kg/m³, $M_{air} = 28.97$, $M_{Cl_2} = 70.90$.
- **Key centerline ppm results (ground, y=0, z=1.5 m):**
  - 100 m → **~1.65 ppm**
  - 200 m → **~0.48 ppm**
  - 500 m → **~0.087 ppm**
  - 1000 m → **~0.023 ppm**
  - 2000 m → **~0.0062 ppm**
  - 3000 m → **~0.0029 ppm**

(The full plotted curve from 100–3,000 m was generated and is shown in the figure I produced.)

Interpretation

- Under these "typical neutral / light wind" assumptions the **centerline ground-level concentrations are small beyond a few hundred metres** — e.g., already below 0.1 ppm by 500 m and below 0.01 ppm by 2 km — because the plume disperses (σy, σz grow) and the source flowrate Q is small (5 kg spread over 1 hour).
- The ~1.65 ppm at 100 m is above common short-term exposure thresholds (~1 ppm), meaning **local effects near the plant would still be plausible** if the release persisted long enough and wind carried the plume toward receptors.
- These results are **sensitive** to several choices:
  - **Release duration** (I used 1 hour). A shorter, more abrupt release (puff) produces higher short-term peaks downwind; a longer, slower leak dilutes more before reaching downwind receptors.
  - **Wind speed**: lower wind speeds increase concentrations (because plume is less diluted by advection). If winds fall below ~1 m/s you can reach substantially higher ppm near the source.
  - **Stability class**: more stable nights (E/F) give smaller σz and σy and much higher ground concentrations downwind; unstable (A/B) daytime convection spreads the plume faster and reduces concentrations.

    - **Terrain and buildings**: urban/industrial structures, complex shoreline topography (fjords, channels), and valley drainage flows around Burrard Inlet can strongly modify dispersion vs the simple Gaussian model.
- Because of those sensitivities, this plot is best interpreted as a **reasonable neutral-day, light-wind scenario**, not a definitive worst-case or regulatory hazard assessment.

Sources and why I chose these assumptions

- Typical wind speeds and seasonal patterns for North Vancouver (average hourly winds of a few km/h up to ~10 km/h in winter). WeatherSpark and Vancouver climate summaries are good references for typical coastal wind ranges. Weather Spark+1
- Pasquill stability guidance and standard dispersion parameterizations (Turner / Pasquill-Gifford / EPA/ISC approximations) for σy and σz and for deciding D as a typical neutral class. NOAA Ready+1

Files & visuals

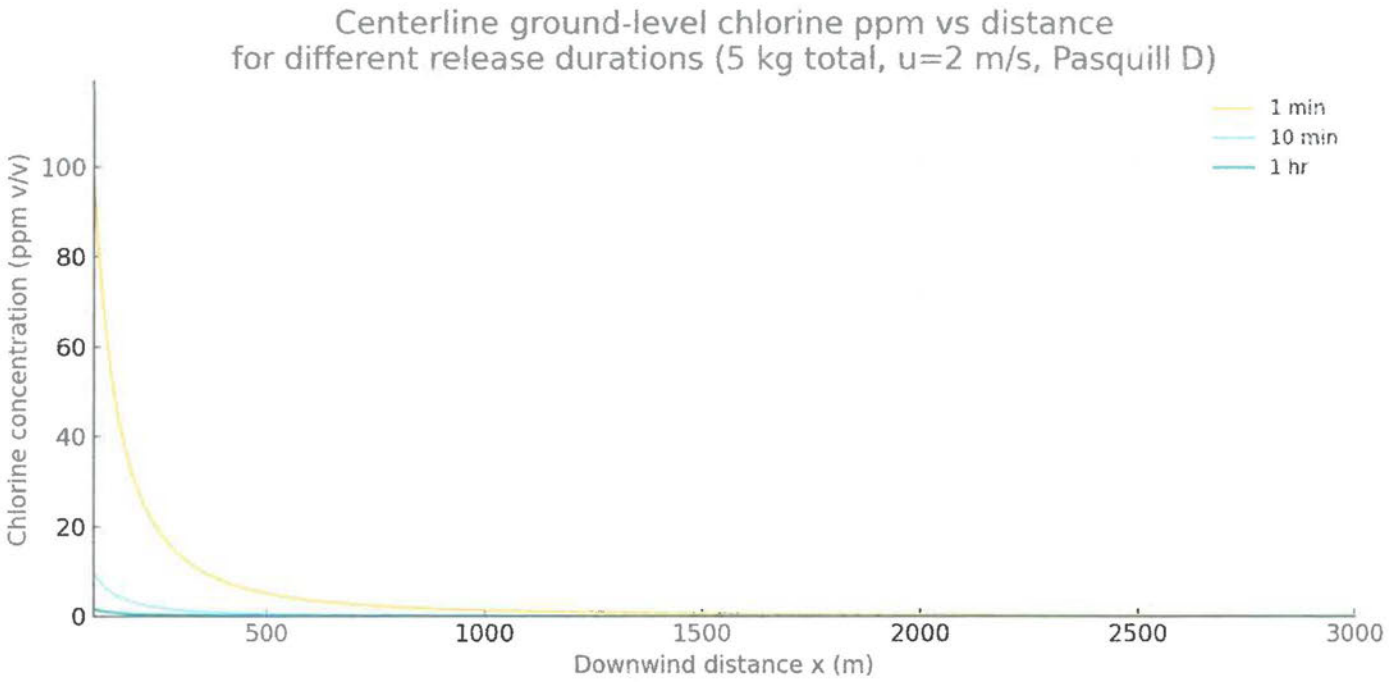
- I created and displayed a graph of **ppm vs distance (100–3,000 m)** and a small table of selected points (100, 200, 500, 1000, 2000, 3000 m). The plot image was written to the session at:
    - `/mnt/data/chlorine_gaussian_plume_ppm_vs_distance.png`
- I also presented a data table via the notebook UI (you should see it above).

Next steps (I can do any of the following on your instruction)

- Repeat the calculation using an **instantaneous puff** model (likely to show larger short-term peaks close to the plant).
- Run the same steady/plume model but **change assumptions** (e.g., wind = 1 m/s or 4 m/s; stability classes E or C; release durations of 1 min, 10 min, 1 hr). I can produce comparative plots that show sensitivity.
- Use a more site-specific approach: if you can give a **typical wind direction** at the plant or a preferred stability/time (night vs day), or if you want me to use observed hourly wind statistics from a specific nearby station (I can fetch Environment Canada station data and re-run the model), I'll re-run with those inputs and produce updated graphs. (If you want me to fetch hourly station data I will pull it now.)

Which of those would you like next?

Please run the same steady/plume model but change release durations of 1 min, 10min, 1hr



Done — I ran the steady Gaussian-plume calculation for the three release durations (1 min, 10 min, 1 hr) using the same dispersion assumptions as before (u = 2 m/s, Pasquill D, H = 2 m, receptor z = 1.5 m). I plotted centerline ground-level ppm vs downwind distance from 100–3,000 m and provided a table of selected points.

Key results (centerline, breathing height)

- **1 minute release (Q = 0.0833 kg/s):**
  - 100 m → **~99.2 ppm**
  - 200 m → **~28.9 ppm**
  - 500 m → **~5.20 ppm**
  - 1000 m → **~1.40 ppm**
  - 2000 m → **~0.375 ppm**
  - 3000 m → **~0.174 ppm**
- **10 minute release (Q = 0.00833 kg/s):**
  - 100 m → **~9.92 ppm**
  - 200 m → **~2.89 ppm**
  - 500 m → **~0.52 ppm**
  - 1000 m → **~0.14 ppm**
  - 2000 m → **~0.0375 ppm**
  - 3000 m → **~0.0174 ppm**
- **1 hour release (Q = 0.001389 kg/s):**
  - 100 m → **~1.65 ppm**
  - 200 m → **~0.482 ppm**
  - 500 m → **~0.0866 ppm**
  - 1000 m → **~0.0233 ppm**
  - 2000 m → **~0.00625 ppm**
  - 3000 m → **~0.00289 ppm**

Interpretation

- Short, abrupt releases (1 min) create very high short-term peaks—over ~**100 ppm** near 100 m — which are acutely hazardous.
- A 10-minute release still produces multi-ppm concentrations near the plant (e.g., ~10 ppm at 100 m).
- A 1-hour slow release dilutes much more and gives only ~1.65 ppm at 100 m (still above many short-term exposure limits).
- All curves fall off rapidly with distance because σy and σz increase with x and the small total mass (5 kg) and advection by wind spread the material thinly.

Files

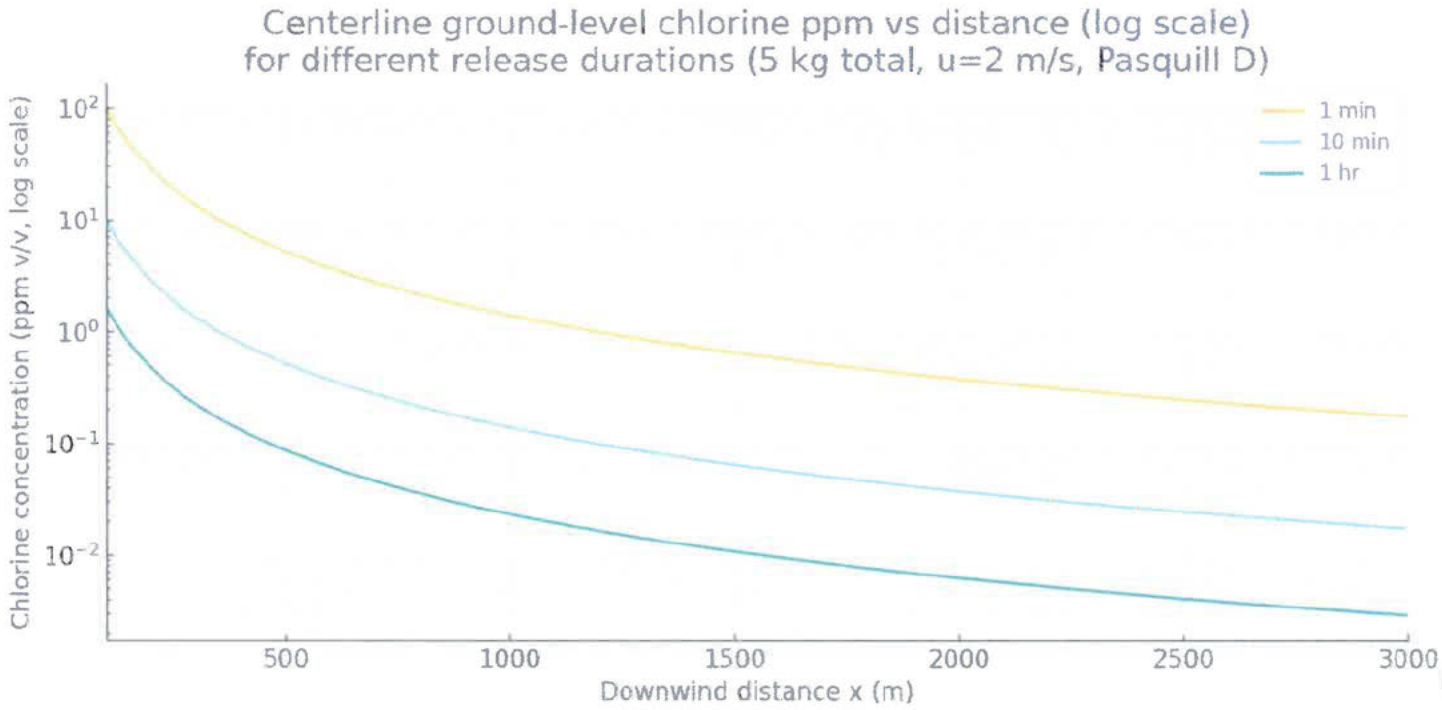
- Plot saved to: `/mnt/data/chlorine_plume_durations_ppm_vs_distance.png`
- Summary table saved/displayed in the notebook UI. I can provide the plot and table as downloadable links or embed them in a PDF if you want.

Notes & caveats

- The steady Gaussian plume with Q = m/duration is a simplified way to compare durations. For very short releases (1 min) the **instantaneous puff model** can produce different peak/time behavior — often higher peaks at certain distances — because the plume travel time and temporal dispersion matter. If you want, I can run an instantaneous puff estimate for the 1-minute case and compare peak concentrations at selected downwind distances.
- Terrain, buildings, and real meteorology (gusts, direction shifts, inversion layers at night) can increase or decrease concentrations dramatically; these results are indicative, not definitive for emergency response.

Would you like me to run the instantaneous-puff calculation for the 1-minute release as a next step, or produce downloadable versions (PNG/CSV/PDF) of these outputs?

Can you present the latest graph by having a log scale for the ppm (y axis)



Here's the updated plot — the **y-axis is on a logarithmic scale**, making it easier to see how chlorine concentration (ppm) decreases over several orders of magnitude as distance increases.

Would you like me to include this graph (and the linear one) together in a single comparative figure or PDF summary?

Time to digest today's results. Thank you.

ChatGPT said:

You're very welcome, Corrie. Here's a concise summary of **today's results and takeaways**:

Scenario examined

- A **5 kg chlorine gas release** at the North Vancouver plant.
- Modeled as a **steady Gaussian plume** under **typical local conditions**:
  - Wind ≈ 2 m/s, Pasquill stability D (neutral).
  - Release height 2 m, receptor height 1.5 m.
  - Uniform terrain and open exposure (no buildings or channeling).

Findings

Duration	Peak (100 m)	200 m	500 m	1000 m	2000 m	3000 m
1 min	~99 ppm	29 ppm	5 ppm	1.4 ppm	0.38 ppm	0.17 ppm
10 min	~10 ppm	2.9 ppm	0.52 ppm	0.14 ppm	0.04 ppm	0.02 ppm
1 hr	~1.6 ppm	0.48 ppm	0.09 ppm	0.02 ppm	0.006 ppm	0.003 ppm

(values are centerline ground-level averages, steady-state equivalent)

- The **shorter the release**, the higher the local concentration spike.
- Concentrations **drop by roughly two orders of magnitude** between 100 m and 1 km.
- The **log-scale plot** clearly shows this rapid decay over distance.

Interpretation

- For neutral, light-wind conditions, **measurable chlorine (ppm-level)** likely extends **hundreds of metres** downwind — but **hazardous levels** (> 1 ppm) fall off within **a few hundred metres** for the slower releases.
- A sudden 1-minute vent or rupture could yield **acutely dangerous concentrations** (> 10 ppm) close to the source.
- Real-world effects depend strongly on wind, terrain, and stability: night-time inversions (class E/F) would **trap the plume and raise ground levels**, while daytime convection (class B/C) would **dilute it faster**.

Files created

- `chlorine_plume_durations_ppm_vs_distance.png` — linear-scale plot
- `chlorine_plume_durations_ppm_vs_distance_logscale.png` — logarithmic-scale plot
- `Gaussian plume summary for different durations` — data table

Next logical step (optional)

If you wish to deepen this, we could:

1. Model an **instantaneous puff** (to capture short-term peaks).
2. Use **actual hourly wind and stability data** from the nearest Environment Canada station for a location-specific run.
3. Compare **neutral (D)** vs **stable (E/F)** conditions to see the worst-case.

Would you like me to prepare a short **technical summary or PDF brief** of today's results (graphs + commentary) suitable for sharing with DNV officials or colleagues?

End of today's discussion - references follow

- R

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uwo.ca

Self-study notes - GAUSSIAN PLUMES

PLUME MODEL STUDIES on YOUTUBE

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C. KOST

Q to ChatGPT: Why would municipal councils compromise safety over more taxes and employment

Municipal councils rarely think of their decisions as "compromising safety." In most cases they believe they are balancing **several competing obligations**. From decades of municipal governance research, a few recurring forces explain why councils sometimes approve projects that residents view as risky.

1. Fiscal pressure on municipalities

Cities depend heavily on **property taxes, development charges, and business activity** to fund services. Unlike senior governments, they usually cannot run deficits easily.

- Industrial or commercial facilities can significantly increase the tax base.
- More revenue helps pay for infrastructure, policing, fire services, and amenities without raising residential taxes.

For some councils the calculation becomes:
manageable risk vs. financial sustainability.

2. Employment and local economic stability

Councils often feel responsible for protecting or creating jobs.

- A plant, port facility, or industrial operation may support hundreds of direct and indirect jobs.
- Local businesses may depend on it.
- Closing or rejecting it can have visible economic consequences.

Even if the safety risk is low-probability but high-impact, the **economic impact is immediate and visible,** which politically weighs heavily.

3. Regulatory reliance on higher governments

Municipal councils frequently assume that **provincial or federal regulators ensure safety**.
For example in British Columbia, oversight may involve agencies like:

- WorkSafeBC
- Technical Safety BC
- Environment and Climate Change Canada

Council members often believe:
"If the project meets provincial and federal regulations, it must be acceptably safe."
That can lead them to defer to technical regulators rather than challenge risks themselves.

4. Risk framing and probability bias

Humans—including elected officials—tend to discount **low-probability catastrophic risks**.
A council report may emphasize:

- compliance with codes
- mitigation plans
- engineering assurances

This can psychologically convert a controversial risk into a "managed" one.
Your scientific instincts likely notice the difference between:

- **risk being low probability**
- **risk being acceptable**

Those are not the same.

5. Institutional incentives

Municipal politics has structural pressures:

- Staff recommendations carry weight.
- Economic development is often an explicit council objective.
- Rejecting projects can lead to legal challenges or compensation claims.
- Short election cycles favour visible benefits over long-term risks.

6. Information asymmetry

Councils depend heavily on:

- consultant reports
- staff summaries
- company-provided risk assessments

Independent analysis is rare unless residents push for it.

7. Political optics

Approving development can be framed as:

- supporting workers
- strengthening the tax base
- preventing tax increases

Opposing it can be portrayed as **anti-business or alarmist**, which some councillors want to avoid.

An important nuance

Most councils **do not consciously choose danger**. Instead they convince themselves that:
The risk is small, regulated, and worth the benefits.
Where conflicts arise is when residents believe the **risk analysis itself is incomplete or biased**.

In communities like the North Shore

Situations involving hazardous materials (chlorine, hydrogen, fuels, etc.) often become flashpoints because they combine:

- dense residential areas
- legacy industrial zoning
- new population growth

This tension forces councils into difficult trade-offs.

If you're interested, I can also explain **the three warning signs that a council may actually be underestimating a safety risk**. In many public hearings those signals appear very clearly.
Yes please.
Here are **three reliable warning signs**—seen in many municipalities—when a council may be **underestimating or unintentionally sidelining safety risks**.

1. Safety authority is shifted away from the council

A common phrase in council discussions is something like:
"Safety is regulated by the province / federal government."
While technically true, this can become a **decision escape hatch**.
Municipalities still control:

- zoning
- land-use compatibility
- proximity of hazardous activities to homes, schools, or parks

If council relies entirely on outside regulators such as
WorkSafeBC or
Technical Safety BC
without examining **site-specific community risk**, it is a warning sign.
Regulators usually certify **compliance**, not **appropriateness of location**.
In risk engineering terms:
"Permitted" is not the same as "prudent."

2. Catastrophic scenarios are minimized as "very unlikely"

Another signal appears in staff reports and presentations:

- focus on probability
- little discussion of consequences

For hazardous facilities the proper framework is:

Risk = Probability × Consequence

A one-in-a-million event may still deserve attention if the consequence includes:

- large toxic release
- evacuation of thousands
- long-term environmental damage

Public discussions sometimes quietly slide from:

"What happens if it fails?"

to

"Failure is extremely unlikely."

That shift often indicates the **wrong variable is dominating the decision**.

3. Emergency response is treated as the solution

When councils become uncomfortable with the hazard itself, discussion often moves toward:

- evacuation plans
- emergency response capability
- coordination with fire departments

These are important—but they are **secondary controls**.

In safety science the preferred hierarchy is:

1. **Eliminate the hazard**
2. Reduce the hazard
3. Contain the hazard
4. Manage emergencies

If most of the reassurance is about response rather than prevention, the risk may not be fully confronted.

A subtle fourth sign (often the most telling)

Public risk experts or independent reviewers are **not invited early**.

Instead the information pipeline becomes:

company → consultant → staff → council

That chain can unintentionally narrow the analysis.

Why this happens even with well-meaning councils

From long experience in municipal governance, the pattern usually arises from:

- time pressure
- trust in staff
- economic incentives
- lack of technical expertise at the council table

Very rarely from deliberate disregard for safety.

A constructive way citizens can raise the issue

One of the most effective approaches—especially in public hearings—is to ask **structured questions rather than oppositional ones**, for example:

- Has an **independent quantitative risk assessment** been done?
- What is the **worst-case release radius**?
- How many residents fall inside that zone?

- Is the facility **grandfathered** under old zoning assumptions?
- What alternatives reduce the hazard?

Those questions shift the conversation from **politics to analysis**.

Given your scientific background and your long involvement with North Vancouver civic issues, you are actually in a **rare position to ask the kinds of questions councils find hardest to ignore.**

If you wish, I can also show you the **two questions that most effectively change the tone of a public hearing** when safety is involved.

Yes Please

Two questions tend to change the tone of a public hearing because they are **calm, factual, and very difficult to deflect**. They move the discussion from general assurances to measurable responsibility.

---

1. "What is the quantified worst-case scenario for this site, and how many residents fall inside it?"

Why this question works:

- It forces discussion of **consequences**, not just probability.
- It requires numbers rather than reassurance.
- It reveals whether a proper **Quantitative Risk Assessment (QRA)** has been done.

A useful follow-up:

"Has this assessment been independently reviewed, and can the public see it?"

If the answer is vague, council and the audience immediately sense that a key piece of analysis may be missing.

In many cases this also exposes whether municipal land-use decisions are aligned with guidance from agencies such as
WorkSafeBC or
Technical Safety BC.

Those bodies regulate safety standards, but they usually **do not determine acceptable residential proximity**—that responsibility often falls back to local government.

---

2. "If this facility were proposed on this site today, under current knowledge and population density, would staff recommend approving it?"

This question is powerful because it reveals:

- whether the situation exists mainly due to **historical zoning**
- whether today's planning principles would allow it

- whether the community is relying on **legacy decisions**

Councils frequently pause at this point because it reframes the issue from:

"Is the facility compliant?"

to

"Is this the right place for it now?"

Why these questions shift the room

They subtly introduce three concepts without sounding confrontational:

1. **Evidence**
2. **Accountability**
3. **Modern standards**

Even councillors who support the project often begin asking staff for clearer explanations after these questions are posed.

A small strategic tip from many hearings

Tone matters enormously. The most effective phrasing is something like:

"I'm not opposing or supporting at this point. I'm trying to understand the risk envelope for residents."

That approach tends to keep councillors listening rather than becoming defensive.

Given your many years around District of North Vancouver issues, you've probably seen how quickly a hearing can pivot once the discussion moves from **general assurances to measurable risk**.

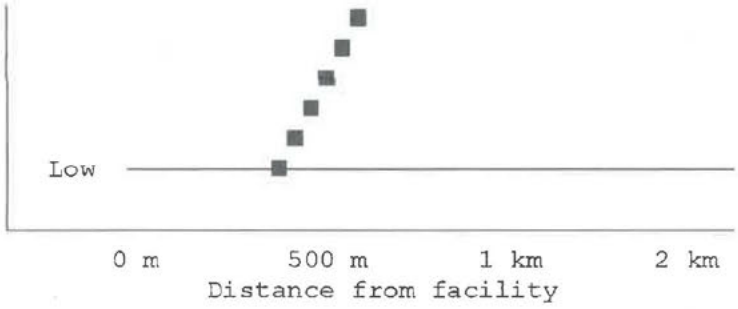
If you like, I can also show you the **single chart or piece of information that most quickly clarifies these debates for both council and the public.** It's surprisingly simple but very revealing.

Yes please. A chart would be useful.

A single chart often used in safety engineering quickly clarifies these debates. It's called a **risk vs. distance (or consequence) profile**. Even a simplified version can be very revealing.

Conceptual Example





What this chart illustrates:

- **Close to the facility:** consequences are severe if something goes wrong.
- **Further away:** risk drops rapidly.
- Overlaying **population density** immediately shows how many residents fall inside each zone.

Engineers often map:

- toxic exposure zones
- blast overpressure
- thermal radiation

This makes the discussion concrete.

Why this chart is powerful in a council meeting

It visually connects three things councils often consider separately:

- The hazard itself
- Where people live
- Emergency planning assumptions

Once combined, the policy question becomes clearer:

"Is this land-use pattern acceptable?"

What is often added to make it even clearer

A second layer is usually placed on the same chart:

Population





When councillors see **risk contours crossing dense neighbourhoods**, the conversation tends to change quickly.

The version regulators often use

Professional risk studies frequently use what is called an **F-N curve** (societal risk curve). It shows:

- probability of an event
- number of people potentially affected

Many governments use these curves to judge acceptable risk.

Canada uses approaches influenced by international frameworks such as those from the Health and Safety Executive, which pioneered land-use planning around hazardous sites.

Why this matters locally

Communities like those in the District of North Vancouver have an additional complication:

- older industrial zoning
- rapidly increasing residential density

A simple hazard-distance chart sometimes reveals that **population growth has quietly changed the risk picture**, even if the facility itself hasn't changed.

The key question such a chart raises

A very calm but powerful question is:

"At what population level does this risk become unacceptable?"

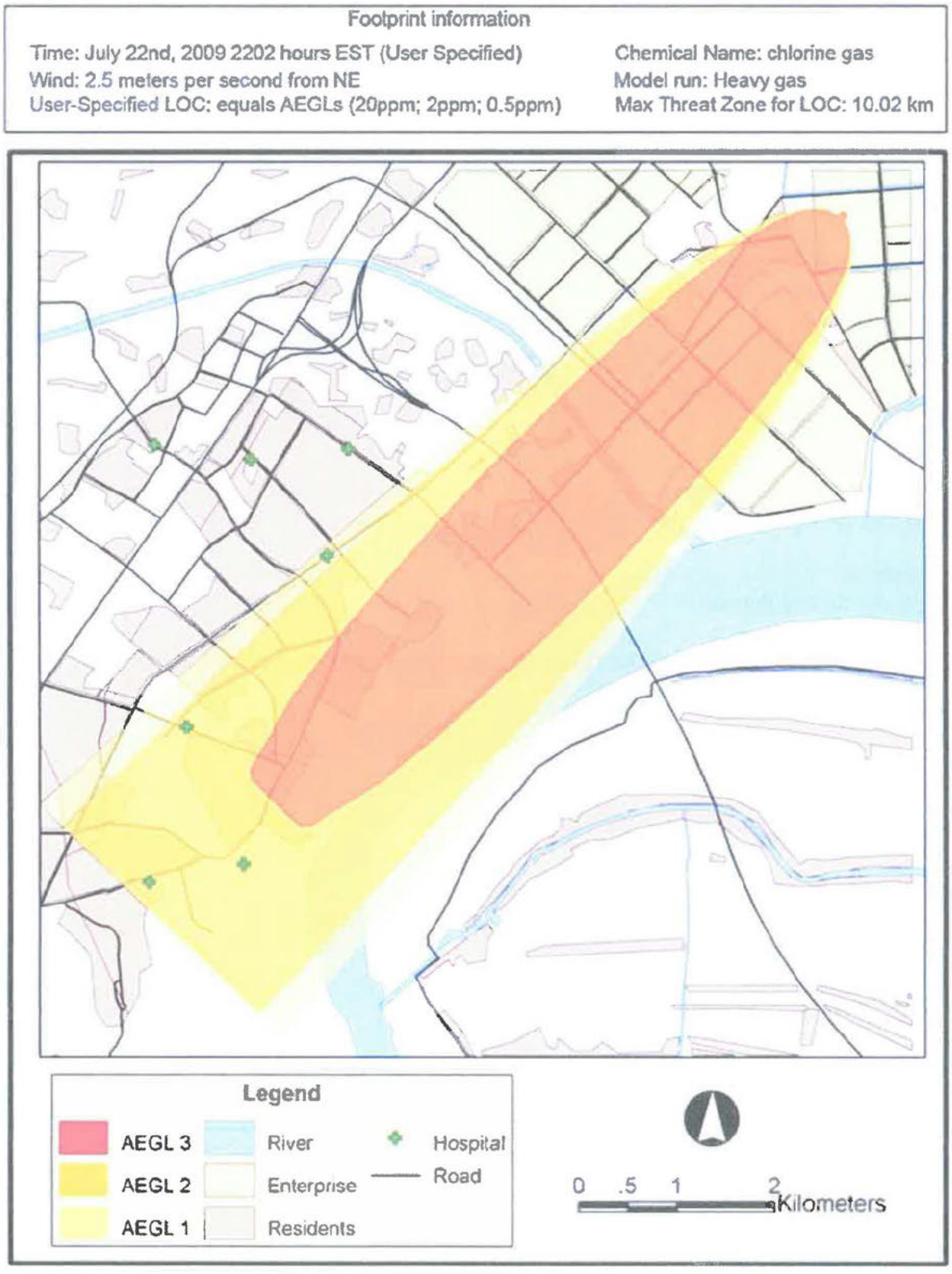
Many councils have never explicitly answered that.

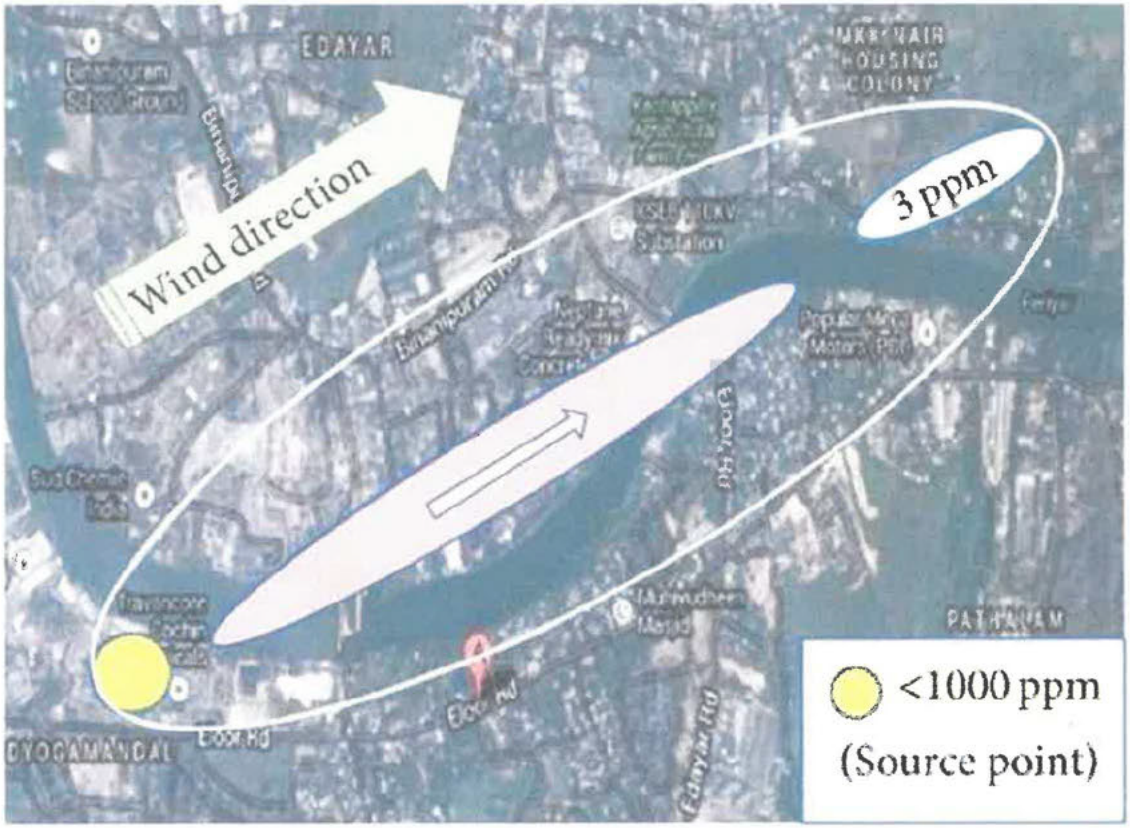
If you'd like, I can also show you a **real-world example of a hazard-radius map** (similar facilities, chlorine or hydrogen storage). Those visuals are often what finally gets council and the public talking about the same thing.

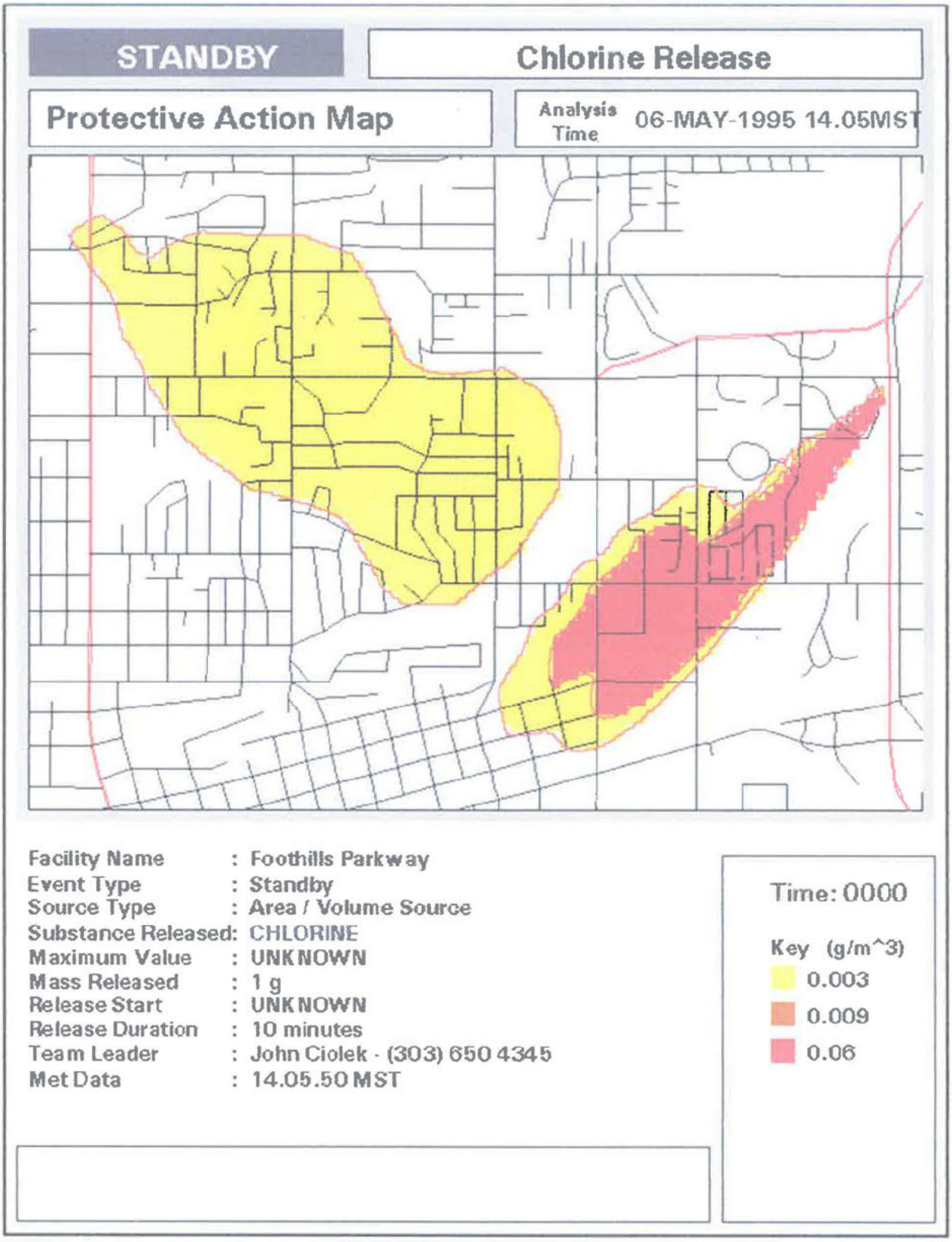
Yes please.

Here are examples of **real hazard-radius maps** used in chemical risk assessments. These are the kinds of visuals that often change the tone of municipal discussions because they connect the facility directly to neighbourhood exposure.

Chlorine Gas Release Plume Example




EDAYAR
Wind direction
3 ppm
<1000 ppm
(Source point)



What these maps show:

Colored zones represent exposure levels

Typical interpretation used in safety modelling:

- **Red** – potentially life-threatening exposure
- **Orange** – severe or irreversible health effects
- **Yellow** – irritation or temporary injury possible

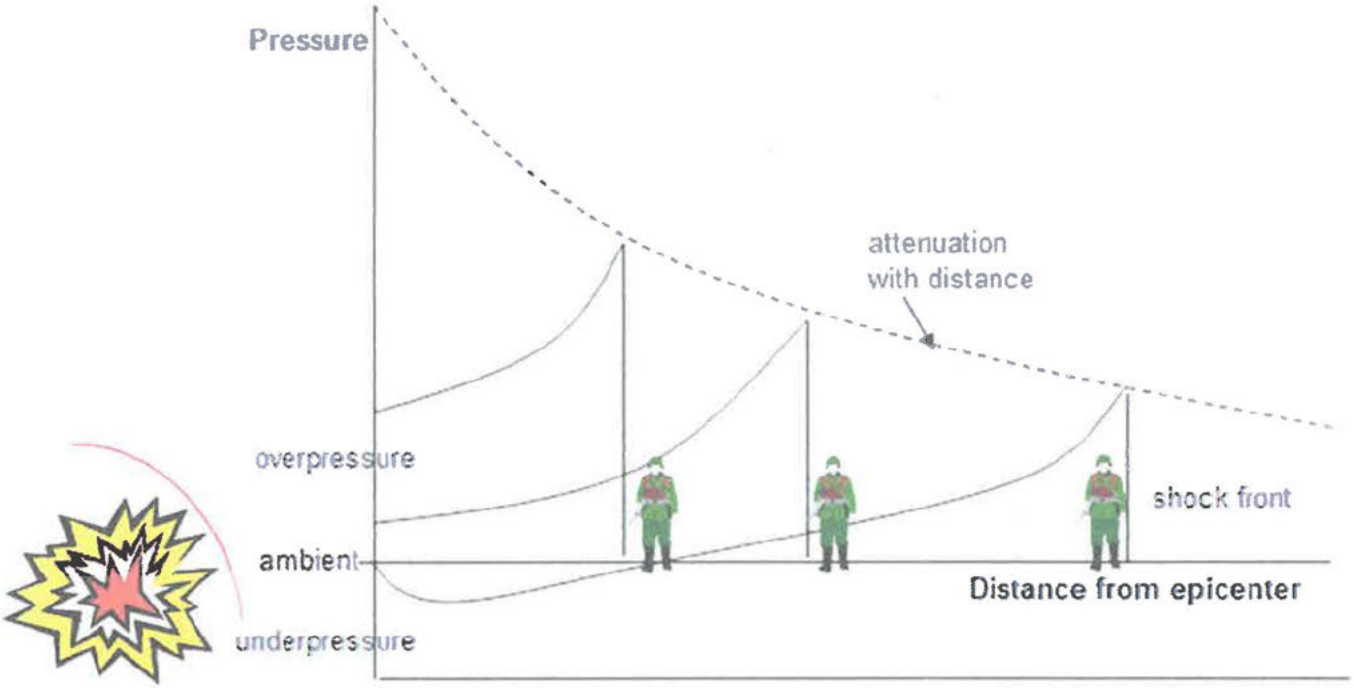
These zones are generated using atmospheric dispersion models such as **ALOHA** (used by emergency planners).

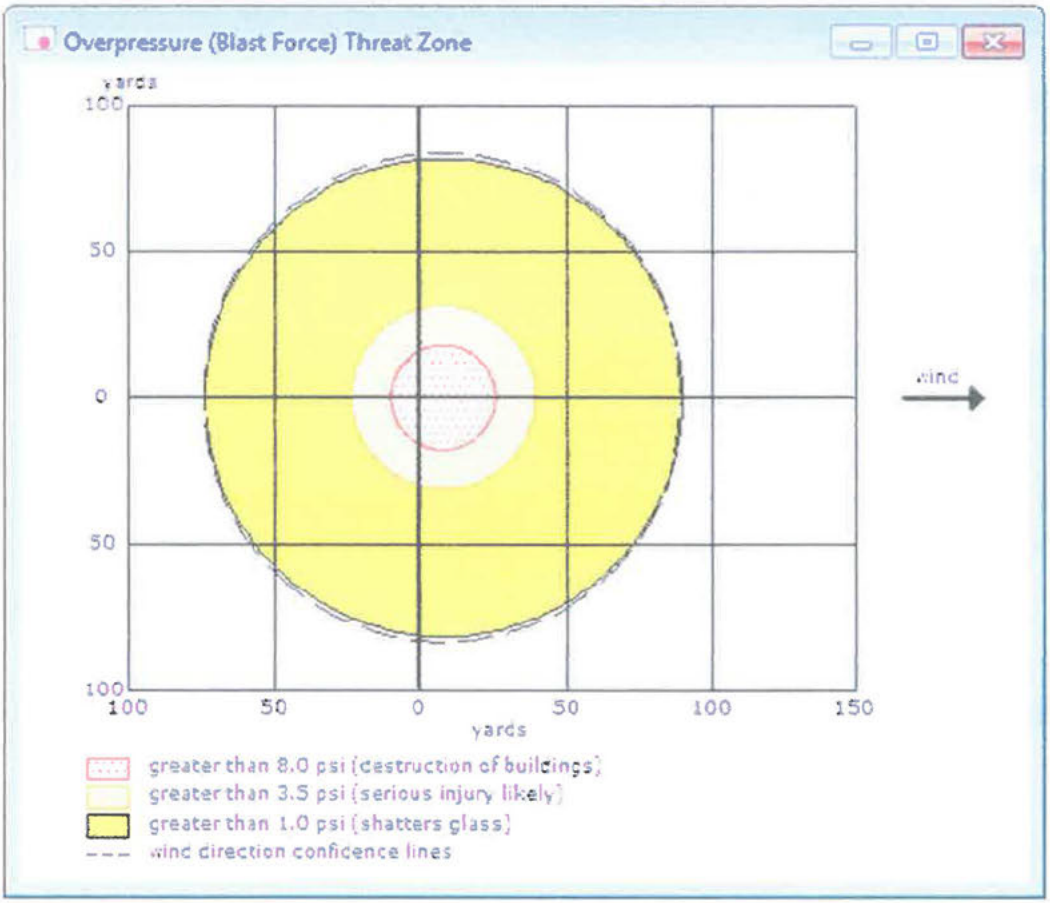
Important observations from real studies:

- The plume usually travels **downwind**, not evenly in all directions
- Terrain and buildings distort the shape
- The highest risk area can extend **hundreds of meters to several kilometres**

For dense gases like chlorine, the plume often **stays low and follows valleys or streets**, which is particularly relevant in coastal or mountainous cities.

Explosion / Blast Hazard Zones





Explosion modelling typically uses **overpressure zones**:

Approximate effects used by emergency planners:

- **8 psi** – destruction of buildings
- **3–5 psi** – severe injury likely
- **1 psi** – windows shatter and flying glass injuries

Risk maps show concentric zones around the source, though wind can shift them.

Why these maps matter in public policy

When planners overlay these zones onto a city map, three questions immediately appear:

1. **Population exposure**
    - How many people live inside each zone?
2. **Critical infrastructure**
    - schools
    - hospitals
    - evacuation routes
3. **Future growth**
    - Will rezoning increase the exposed population?

This is why land-use planning around hazardous facilities is such a major issue in places like the District of North Vancouver.

Population density can change dramatically even when the industrial site remains the same.

A very useful question for council

When these maps are shown, one question often clarifies everything:

"What is the current population inside the red and orange zones, and what will it be under the proposed zoning?"

Councils sometimes realize they are **approving density increases inside existing hazard footprints**.

One more interesting point scientists often notice

Many municipal discussions rely on **average conditions**.

But real accidents occur under:

- worst-case weather
- nighttime temperature inversions
- unusual wind shifts

Professional risk assessments normally model **both average and worst-case scenarios**.

The difference can be very large.

If you like, I can also show you something quite relevant to your local situation:

What the hazard footprint of a typical chlorine railcar or storage tank looks like in a North American urban area.

Those numbers tend to surprise even experienced councils.

C. KOST

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

PERMIT GVA0010

Pursuant to:

Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008
and the BC Environmental Management Act, S.B.C 2003, c.53

Issued to:

Chemtrade Electrochem Inc.
(the "Permittee")

To Authorize:

the discharge of air contaminants to the air from
a Chlor-alkali manufacturing plant

Located at:

100 Amherst Avenue, North Vancouver, BC V7H 1S4

Effective Period:

The terms and conditions set out in the Permit apply to the existing or planned works as of October 25, 2023 and this Permit will expire on January 31, 2026.

All previous versions of this Permit are invalid.

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

SECTION 1 – AUTHORIZED EMISSION SOURCES

Authorization to discharge air contaminants from the authorized Emission Sources and Works listed below is subject to the specified terms and conditions

Approximate locations of the emission sources are shown on the Site Plan in section 4.

EMISSION SOURCE 01: Welding area (maintenance building) discharging through a Vent(s).

MAXIMUM EMISSION FLOW RATE: **90** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **2496** h/y

MAXIMUM EMISSION QUALITY:
1. 30 mg/m^3 Particulate Matter
2. 10% Opacity

WORKS AND PROCEDURES:
Good operating practices.

EMISSION SOURCE 04: Chlorine processing disposal and sodium hypochlorite storage tanks discharging through a Vent(s).

MAXIMUM EMISSION FLOW RATE: **The authorized maximum rate of discharge is that resulting from vapour venting during chlorine system maintenance or natural draft from storage tanks**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine

WORKS AND PROCEDURES:
Consisting of three tanks that are used for the following services:

- sodium hypochlorite storage;
- surge tank for vent downs of chlorine system equipment during maintenance; or
- stand-by tank for sodium hypochlorite storage.

When a tank is used for vent downs of chlorine, the purge line inlet must be below the sodium hypochlorite solution level.

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

EMISSION SOURCE 09: Le Carbone Lorraine hydrochloric acid plant (center plant) discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **5** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Primary packed tower water scrubber, a secondary water spray scrubber operating in series and related appurtenances together with good operating practices.

The Permittee must monitor and record the scrubber operating parameters for water flow and temperature in a manner approved by the District Director. These records must be kept and made available for inspection by Metro Vancouver staff.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

On start-up and during the first hour of operation of the hydrochloric acid plant, the Permittee must not allow the concentration of chlorine to exceed 22.5 mg/m^3 (one hour average).

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.15
Exit Temperature (°C): 50

EMISSION SOURCE 10: Le Carbone Lorraine hydrochloric acid plant (east plant) discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **5** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Primary packed tower water scrubber, a secondary water spray scrubber operating in series and related appurtenances together with good operating practices.

The Permittee must monitor and record the scrubber operating parameters for water flow and temperature in a manner approved by the District Director. These records must be kept and made available for inspection by Metro Vancouver staff.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

On start-up and during the first hour of operation of the hydrochloric acid plant, the Permittee must not allow the concentration of chlorine to exceed 22.5 mg/m^3 (one hour average).

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.15
Exit Temperature (°C): 50

EMISSION SOURCE 11A: Centre Acid Plant Surge Tank discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling of surge tank, tanker trucks and HCl storage tanks**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Surge tank (EN09) equipped with packed tower water scrubber operating at >99% efficiency, with related appurtenances together with good operating practices:

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.10
Exit Temperature (°C): 20

EMISSION SOURCE 11B: East Acid Plant Surge Tank discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling of surge tank**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m³ Chlorine
2. 20 mg/m³ Hydrogen Chloride

WORKS AND PROCEDURES:
Surge tank (EN10) equipped with packed tower water scrubber operating at >99% efficiency, with related appurtenances together with good operating practices.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.10
Exit Temperature (°C): 20

EMISSION SOURCE 11C: #1 Acid Plant Transfer Tank discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **0.05** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Packed tower water scrubber operating at >99% efficiency, with related appurtenances together with good operating practices.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.05
Exit Temperature (°C): 20

EMISSION SOURCE 11D: #2 Acid Plant Transfer Tank discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **0.05** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Packed tower water scrubber operating at >99% efficiency, with related appurtenances together with good operating practices.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.05
Exit Temperature (°C): 20

EMISSION SOURCE 11E: #3 Acid Plant Transfer Tank discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **0.05** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Packed tower water scrubber operating at >99% efficiency, with related appurtenances together with good operating practices.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 20
Internal diameter at stack top (m): 0.05
Exit Temperature (°C): 20

EMISSION SOURCE 11F: Hydrochloric Acid Railcar Loading discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling of rail cars**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Equipped with primary water ejector venturi scrubbers in series with secondary packed tower water scrubbers operating at >99% efficiency.

The duplicated packed tower water scrubbers also control emissions for the HCl storage tank vents and can be utilized independently or in parallel.

Stack Information:
Height above ground (m): 15
Internal diameter at stack top (m): 0.20
Exit Temperature (°C): 15

EMISSION SOURCE 11G: Hydrochloric Acid Railcar Cleaning Station discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling rail cars and HCl storage tanks**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:

WORKS AND PROCEDURES:
Equipped with primary water ejector venturi scrubbers in series with secondary packed tower water scrubbers operating at >99% efficiency.

The duplicated packed tower water scrubbers also control emissions for the HCl storage tank vents and can be utilized independently or in parallel.

Stack Information:
Height above ground (m): 10
Internal diameter at stack top (m): 0.10
Exit Temperature (°C): 20

EMISSION SOURCE 11H: Hydrochloric Acid Truck Loading discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling of tanker trucks and HCl storage tanks**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 20 mg/m³ Hydrogen Chloride

WORKS AND PROCEDURES:
Equipped with primary water ejector venturi scrubbers in series with secondary packed tower water

scrubbers operating at >99% efficiency.

The duplicated packed tower water scrubbers also control emissions for the HCl storage tank vents and can be utilized independently or in parallel.

Stack Information:
Height above ground (m): 8
Internal diameter at stack top (m): 0.15
Exit Temperature (°C): 20

EMISSION SOURCE 11I: Hydrochloric Acid Storage Tanks discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **The rate of discharge is that resulting from vapour venting during filling of HCl storage tanks**
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 20 mg/m³ Hydrogen Chloride

WORKS AND PROCEDURES:
Equipped with primary water ejector venturi scrubbers in series with secondary packed tower water scrubbers operating at >99% efficiency.

The duplicated packed tower water scrubbers also control emissions for the HCl storage tank vents and can be utilized independently or in parallel.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident

Stack Information:
Height above ground (m): 8
Internal diameter at stack top (m): 0.15
Exit Temperature (°C): 15

EMISSION SOURCE 12: #1 Acid Plant - Mersen Hydrochloric Acid Plant discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **15** m³/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m³ Chlorine
2. 20 mg/m³ Hydrogen Chloride

WORKS AND PROCEDURES:
Primary packed tower water scrubber and a secondary Fabricated Plastics (TT18-16.5) water or caustic spray scrubber operating in series and related appurtenances together with good operating practices.

The Permittee must monitor and record the scrubber operating parameters for water flow and temperature in a manner approved by the District Director. These records must be kept and made available for inspection by Metro Vancouver staff.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 26
Internal diameter at stack top (m): 0.25
Exit Temperature (°C): 50

EMISSION SOURCE 13: #3 Boiler - Victory hydrogen and natural gas fired boiler discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **500** m³/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y
MAXIMUM PRIMARY BURNER INPUT FIRING RATE: **95** GJ/h

MAXIMUM EMISSION QUALITY:
1. 5% Opacity

WORKS AND PROCEDURES:
The firing of the boiler with hydrogen and natural gas using flue gas recirculation together with good combustion practices and operating procedures.

Oxygen Correction:

The emission quality and flow are corrected to 3% Oxygen.

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

Stack Information:
Height above ground (m): 18.2
Internal diameter at stack top (m): 0.91
Exit Temperature (^{0}C): 257

EMISSION SOURCE 14: Emission Control System (ECS) discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **70** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 10% Opacity

WORKS AND PROCEDURES:
Two C.P.F. Dualam Inc. fume scrubbers (50 cm, PVC lined FRP packed towers in series as a primary and secondary tower configuration) using 18% (w/v) caustic solution and related appurtenances together with good operating practices.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 26
Internal diameter at stack top (m): 0.25
Exit Temperature (^{0}C): 50

EMISSION SOURCE 15: #2 Acid Plant - Mersen hydrochloric acid plant Model# U5800-22 discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **15** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Primary packed tower water scrubber and a secondary Fabricated Plastics (TT18-16.5) water or caustic spray scrubber operating in series and related appurtenances together with good operating practices.

The Permittee must monitor and record the scrubber operating parameters for water flow and temperature in a manner approved by the District Director. These records must be kept and made available for inspection by Metro Vancouver staff.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Stack Information:
Height above ground (m): 26
Internal diameter at stack top (m): 0.25
Exit Temperature (^{0}C): 50

EMISSION SOURCE 16: #3 Acid Plant - Mersen hydrochloric acid plant Model#U5800-22 discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **15** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUALITY:
1. 15 mg/m^3 Chlorine
2. 20 mg/m^3 Hydrogen Chloride

WORKS AND PROCEDURES:
Primary packed tower water scrubber and a secondary Fabricated Plastics (TT18-16.5) water or caustic spray scrubber operating in series and related appurtenances together with good operating practices.

The Permittee must monitor and record the scrubber operating parameters for water flow and temperature in a manner approved by the District Director. These records must be kept and made available for inspection by Metro Vancouver staff.

In the event that chlorine is released directly to the atmosphere, in addition to the requirements in Section 2.E of this permit, a written report of each incident including the duration, the cause of the chlorine release, quantity of chlorine released and the remedial action taken, must be submitted within 5 working days of the incident.

Issued: November 14, 1992
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Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

Stack Information:
Height above ground (m): 26
Internal diameter at stack top (m): 0.25
Exit Temperature (°C): 50

EMISSION SOURCE 17: Salt handling on stock pile discharging through a Storage Pile(s).

MAXIMUM EMISSION FLOW RATE:
MAXIMUM ANNUAL OPERATING HOURS: **8760** h/y

MAXIMUM EMISSION QUANTITY:
1. 2.7 t/y Particulate Matter

MAXIMUM EMISSION QUALITY:
1. Particulate: Particulate restriction is based on a maximum annual salt throughput of 500,000 tonnes/year.

WORKS AND PROCEDURES:
Good operating practices.

EMISSION SOURCE 18: Indeck/OT-60 Natural Gas Fired Backup Boiler discharging through a Stack(s).

MAXIMUM EMISSION FLOW RATE: **600** m^3/min
MAXIMUM ANNUAL OPERATING HOURS: **2208** h/y
MAXIMUM PRIMARY BURNER INPUT FIRING RATE: **82.2** GJ/h

MAXIMUM EMISSION QUALITY:
1. 10% Opacity

WORKS AND PROCEDURES:
A natural gas fired boiler for backup use with NO_x emissions reduction by flue gas recirculation system together with good operating practices. 15% of flue gases from the boiler exhaust duct into the main combustion chamber.

Oxygen Correction:

The emission quality and flow are corrected to 3% Oxygen.

Stack Information:
Height above ground (m): 9.8
Internal diameter-at-stack top (m): 0.94
Exit Temperature (°C): 600

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Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

SECTION 2 – GENERAL REQUIREMENTS AND CONDITIONS

A. POLLUTION NOT PERMITTED

Notwithstanding any conditions in this permit, no person may discharge or allow or cause the discharge of any air contaminant so as to cause pollution as defined in the Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008 and the Environmental Management Act.

B. AUTHORIZED WORKS, PROCEDURES AND SOURCES

Works and procedures, which this permit authorizes in order to control the discharge of air contaminants, must be employed during all operating periods of the related sources. The Permittee must regularly inspect and maintain all such works, procedures and sources.

The District Director must be provided with reasonable notice of any changes to or replacement of authorized works, procedures or sources. Any changes to or replacement of authorized works, procedures or sources must be approved by the District Director in advance of operation. For certainty, this does not include routine maintenance or repair.

The discharge criteria described in Section 1 of this permit are applicable on the issued or last amended date of this permit unless specified otherwise. If a date different to the issued or last amended date is specified, the existing works, procedures and sources must be maintained in good operating condition and operated in a manner to minimize emissions.

C. NOTIFICATION OF MONITORING NON-COMPLIANCE

The District Director must be notified immediately of:

1. Any emission monitoring results, whether from a continuous emissions monitor or periodic testing, which exceed the quantity or quality authorized in Section 1 of this permit;
2. Any (a) interruption, (b) damage or (c) interference to any (i) continuous ambient air analyzer, (ii) meteorological sensor or (iii) related equipment required in Section 1 or Section 3 of this permit that would cause the continuous ambient air analyzer or meteorological sensor to be offline for a period greater than 48 hours; and
3. Any exceedance of a Metro Vancouver ambient air quality objective measured by an ambient monitoring station required in Section 1 or Section 3 of this permit.

Notification must be made to Metro Vancouver's 24-hour number: 604-436-6777, or to EREnotifications@metrovancouver.org.

D. BYPASSES

The discharge of air contaminants that have bypassed authorized control works is prohibited unless advance approval has been obtained and confirmed in writing from the District Director.

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

E. EMERGENCY PROCEDURES

In the event of an emergency or condition beyond the control of the Permittee that prevents effective operation of the authorized works or procedures or leads to unauthorized discharge, the Permittee must:

1. Comply with all applicable statutory requirements;
2. Immediately notify the District Director of the emergency or condition and of contingency actions invoked or planned to mitigate adverse impacts and restore compliance. Notification must be made to Metro Vancouver's 24-hour number: 604-436-6777 or EREnotifications@metrovancouver.org; and
3. Take appropriate remedial action for the prevention or mitigation of pollution.

The District Director may specify contingency actions to be implemented to protect human health and the environment while authorized works are being restored and/or corrective actions are being taken to prevent unauthorized discharges.

If an emergency situation results in a "spill" as defined in the Environmental Management Act Spill Reporting Regulation, the spill must also be reported immediately to the Provincial Emergency Program by telephoning 1-800-663-3456.

F. AMENDMENTS

The terms and conditions of this permit may be amended, as authorized by applicable legislation. New works, procedures or sources or alterations to existing works, procedures or sources must receive authorization in advance of operation.

G. STANDARD CONDITIONS AND DEFINITIONS

Unless otherwise specified, the following applies to this permit:

1. Gaseous volumes are corrected to standard conditions of 20 degrees Celsius (°C) and 101.325 kilo Pascals (kPa) with zero percent moisture.
2. Contaminant concentrations from the combustion of specific fuel types are corrected to the following Oxygen content, unless specified otherwise:
   - 3% O_2 for natural gas and fuel oil; or
   - 8% O_2 for wood fuel
3. Where compliance testing is required, each contaminant concentration limit in this permit will be assessed for compliance based on a valid test using test methods approved by the District Director.
4. Visual opacity measurements are made at the point of maximum density, nearest the discharge point and exclude the effect of condensed, uncombined water droplets. Compliance determinations are based on a six-minute average in accordance with the United States Environmental Protection Agency (US EPA) Method 9: Visual Determination of the Opacity of Emissions from Stationary Sources. Continuous Emission Monitor System (CEMS) opacity compliance determinations are based on a one-hour average (taken from the top of each hour).
5. If authorized in Section 1 of this permit, standby fuel use is restricted to a maximum of 350 hours per year and to those periods during which the primary authorized fuel is not available. Fuel oil sulphur

content must not exceed 15 milligrams per kilogram (mg/kg) and emissions during fuel oil firing must not exceed 10% opacity.

6. Definitions in the Environmental Management Act and Air Quality Management Bylaw apply to terminology used in this permit.
7. Threshold Limit Values (TLV) refer to the Time Weighted Average (TWA) exposure limits for substances specified in the American Conference of Governmental Industrial Hygienists Threshold Limit Values handbook, current on the latest date that this permit issuance or amendment came into effect.
8. Sulphur Oxides (SO_x) are expressed as Sulphur Dioxide.
9. Nitrogen Oxides (NO_x) are expressed as Nitrogen Dioxide.
10. The Canadian Council of Ministers of the Environment (CCME) "Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks (PN1180)" must be adhered to for all applicable tanks unless otherwise stated in this permit.
11. Authorized 'Maximum Annual Operating Hours' of 8760 hours per year for an emission source is equivalent to authorization for continuous operation of the emission source for an entire calendar year, including leap years.

H. RECORDS RETENTION

All records and supporting documentation relating to this permit must be kept for at least three years after the date of preparation or receipt thereof, and be made available for inspection within 48 hours of a request by an Officer.

I. HEATING, VENTILATION, AIR CONDITIONING AND INTERNAL COMBUSTION ENGINES

Any natural gas-fired heating, ventilation or air conditioning system for buildings and any internal combustion engine located at the discharge site must be maintained and operated in a manner prescribed by the manufacturer to ensure good combustion of the fuel with minimum discharge of air contaminants.

SECTION 3 – REPORTING REQUIREMENTS

A. MONITORING REQUIREMENTS AND REPORTING

Unless otherwise approved in writing by the District Director prior to any sampling or analysis, all measurements must be performed by an independent agency in accordance with Metro Vancouver Air Emissions Sampling Program Manual of Methods and Standard Operating Procedures and the BC Ministry of Environment Field Sampling Manual, as they may be amended from time to time. Any variance from these procedures must receive prior written approval from the District Director.

A minimum of 5 working days advance notice must be given prior to taking measurements required by this Monitoring and Sampling Program. Notification must be given to the Metro Vancouver Environmental Regulation & Enforcement Division (phone 604-436-6777, Fax 604-436-6707, email regulationenforcement@metrovancouver.org).

Unless otherwise specified, sampling must be performed under operating conditions representative of or greater than the previous 90 calendar days of operation. All field data and calculations must be submitted with monitoring results and they must be reported in the metric units that are used in this permit. These submissions must include process data relevant to the operation of the source of the emissions and the performance of the emission control works.

Unless otherwise specified or approved in writing by the District Director, stack sampling must not occur more than 120 calendar days prior to the due dates specified below.

The Permittee must conduct the following monitoring and sampling and submit electronic reports of the results to the District Director by the due dates specified in the following table using a password enabled web based application provided by Metro Vancouver.

EMISSION SOURCE	INITIAL DUE DATE	SUBSEQUENT DUE DATES	REQUIREMENT	PARAMETER(S)	TEST METHOD	REPORT TYPE
12, 09, 10, 15, 16	October 31, 2023	On or before October 31 for each subsequent year, ending January 31, 2026.	Submit a written report detailing the measured discharge rate and concentration of chlorine and hydrogen chloride.	Chlorine, Hydrogen Chloride	EPA Test Method 26	Stack
14	October 31, 2024	On or before October 31 for each subsequent year.	Submit a written report detailing the measured discharge rate and concentration of chlorine.	Chlorine	EPA Test Method 26	Stack

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

B. INFORMATION REPORTING REQUIREMENTS

The Permittee must submit electronic reports containing the required information to the District Director by the due dates specified in the following table using a password enabled web based application provided by Metro Vancouver.

EMISSION SOURCE	INITIAL DUE DATE	SUBSEQUENT DUE DATES	REQUIREMENT	REPORT TYPE
14, 12, 09, 10, 11A, 15, 16, 11B, 11C, 11D, 11E, 11F, 11G, 11H, 11I	March 31, 2024	On or before March 31 for each subsequent year, ending January 31, 2026.	Submit a written report summarizing frequency and results of all inspections and maintenance carried out on the scrubber(s). The report must also include any actions, taken or proposed, to solve identified problems.	Scrubber
Facility	March 31, 2024	On or before March 31 for each subsequent year, ending January 31, 2026.	Submit a written report providing details of the types and amounts of fuel burned in the preceding calendar year.	Fuel Use
Facility	March 31, 2024	On or before March 31 for each subsequent year, ending January 31, 2026.	Submit a written report providing details of the types and amounts of principle products produced and principal raw materials used in the preceding calendar year.	Materials and Products
01, 18	March 31, 2024	On or before March 31 for each subsequent year, ending January 31, 2026.	Submit a written report providing details of the total number of hours and days operated in the preceding calendar year. Detailed records are to be maintained in a format approved by the District Director.	Operating Period

Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

C. AMENDED OR ADDITIONAL REQUIREMENTS

Based on the results of the monitoring program, including the stack sampling results or any other information, the District Director may:

1. Amend the monitoring and reporting requirement of any of the information required by this Permit including plans, programs and studies.
2. Require additional investigations, tests, surveys or studies.

Issued: November 14, 1992
Amended: October 25, 2023

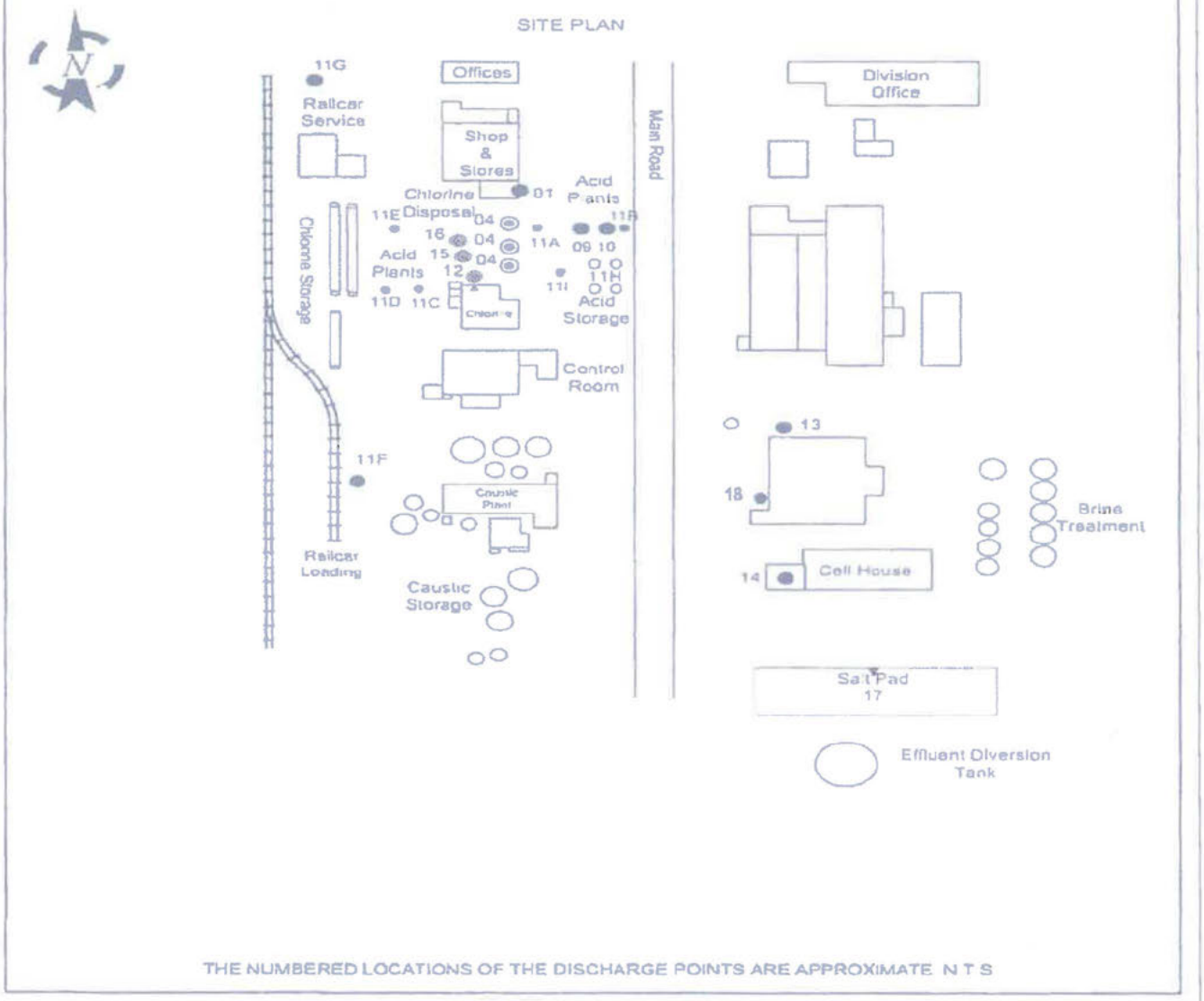
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District Director

Permit GVA0010

SECTION 4 – SITE PLAN

LEGAL DESCRIPTION OF DISCHARGE SITE: **Municipality of North Vancouver, Parcel Identifier: 007-253-265 Lot 5 Block H District Lots 193 and 611 Plan 17801**

The following site plan is not to scale and the locations of the discharge points are approximate.



Issued: November 14, 1992
Amended: October 25, 2023

Kathy Preston, Ph.D., P.Eng.
District Director

Permit GVA0010

E. KOST

Potential Questions

The report repeatedly notes the modelling is based on preliminary design information and must be redone if designs change.

Question
If the risk results depend on preliminary engineering, will the municipality require an updated independent QRA once final engineering is complete before any approvals or rezoning take effect?
Why it matters
A lot of risk studies look safe **because the final engineering hasn't happened yet**.

The study relies heavily on information provided by the client.
Question
What independent verification was performed on the process data, equipment specifications, and operational assumptions provided by the proponent?
Why it matters
The disclaimer explicitly says the consultant relied on client-supplied information.

The report admits something unusual:
The region has **higher than typical seismic activity**, which is **not captured in the failure rate data**.
That is a significant statement.
Question
If the standard failure rates do not account for the region's seismic activity, what quantitative adjustment was made to reflect North Vancouver's earthquake risk?
Why it matters
They say mitigation will occur through design criteria — but the **risk numbers themselves may not include that hazard**.

The study explicitly states onsite risk was **not evaluated**.
Question
Why was the risk to workers, truck drivers, rail operators, and emergency responders excluded from the scope of this assessment?
Why it matters
Industrial incidents often become community incidents **after something goes wrong onsite**.

The LSIR metric assumes a person stands outdoors **24 hours a day all year**.
This sounds conservative but can actually distort planning.

Question

Why was only the LSIR metric used instead of societal risk metrics that evaluate real population exposure during daytime and peak activity?

Why it matters

Many modern risk frameworks consider **societal risk (FN curves)** rather than individual exposure.

A subtle line in the report is important:
Release frequency during railcar loading is **subject to assumptions in a separate fault tree analysis.**

Question

How sensitive are the results to assumptions about operator response time and loading procedures?

Why it matters

Loading operations are historically **the highest failure point** in chlorine facilities.

The report does not clearly describe backup power for mitigation systems.

Question

If power is lost during a chlorine release, what systems continue operating and for how long?

Why it matters

Real accidents often involve **loss of utilities**.

The report states receptor boundaries were **not precisely known**.

Question

How sensitive are the risk contours to the exact location of residential and public receptors?

Why it matters

Small mapping changes can shift whether risk thresholds are exceeded.

The disclaimer is unusually strong.

Question

If the study's conclusions later prove inaccurate due to incomplete information, who bears responsibility — the operator, the consultant, or the municipality?

The quantitative risk assessment relies largely on **industry-average equipment failure rates**, while acknowledging that the North Vancouver area has **higher-than-typical seismic activity** that those databases do not capture.

In simple terms:

- The probability of a chlorine release is calculated using **historical averages from other facilities**.
- But earthquakes are a **major local hazard**.
- The report itself notes that seismic effects are **not included in those failure statistics**.

Risk = **Probability × Consequence**

If the probability side is understated, the entire risk contour map can look safer than reality.

Typical failure databases used in chemical QRAs:

- Mostly reflect plants in **low-seismic regions**
- Do **not include cascading failures from earthquakes**
- Rarely include **simultaneous equipment failures**, which earthquakes can cause.

Yet chlorine systems are particularly sensitive to:

- Pipe shear
- Valve failure
- Railcar movement
- Structural damage to containment buildings.

The study effectively says:

"The equipment will be designed for seismic conditions."

But the **risk numbers themselves are not recalculated for earthquake-driven failures**.

That means the QRA mixes:

- probabilistic statistics (from other regions)
  with
- engineering assurances (future design intent).

The report states that industry failure-rate data were used, while also noting that the local region has higher seismic activity not captured in those statistics. Were the final risk contours adjusted quantitatively for earthquake-induced failures, or are they based on standard industry averages?

The page most likely to be **misunderstood — but very important — is the table comparing calculated risk to the MIACC guidelines.**
Specifically the section showing **LSIR (Location-Specific Individual Risk)** values versus the thresholds from Major Industrial Accidents Council of Canada.
Why this page matters
At first glance it appears reassuring because every number is **below the guideline limits**.
Example pattern from the table:

Receptor	Calculated Risk	MIACC Guideline
Apartments	~1×10^{-7}	1×10^{-6}
Childcare	~6×10^{-9}	3×10^{-7}

So the report concludes the risk is acceptable.
But three technical subtleties are easy to miss

MIACC thresholds are **planning limits**, not targets for safety.
A facility can technically pass even if:

- risk increases significantly
- population nearby grows
- operations expand.

Many council members assume passing the threshold means **"safe"**, when it really means **"within planning tolerance."**

The study reports **individual risk only**, not the probability of **multiple casualties**.
Many jurisdictions now require FN curves (societal risk) for chlorine facilities.
Why this matters in the District of North Vancouver:

- dense nearby residential areas
- marina and recreation
- rail corridor
- port workers.

A single event could affect **many people simultaneously**, which LSIR does not show

The report shows individual risk compared with MIACC thresholds, but does not appear to present societal risk (FN curves). Was the probability of multi-fatality events evaluated?

Some receptors show **zero risk** for certain hazards.
Technically that rarely means zero — it means:

- below reporting threshold
- outside modelled scenario
- rounded down.

That distinction matters in public interpretation.

Back to the issue of a chlorine plant within about 1km from a residential area in the District of North Vancouver. "Safety is our priority" says the plant officials. But if that is the case why, no matter how low the calculated risk, maintain the chlorine plan in the area. Some say it's because of the jobs and taxes. Perhaps I am being unreasonable. Your thoughts?

ChatGPT said:

You're not being unreasonable at all — your instinct makes sense.

When a company says *"safety is our priority"*, they are usually referring to mitigation measures: engineering controls, emergency response plans, regulatory compliance, and audits. But the deeper question you raise — *why locate a chlorine plant so close to homes in the first place?* — is a land-use and risk-acceptance issue rather than just a safety one.

Here are some perspectives to consider:

1. Historical siting vs. modern standards

- Many chlorine or chemical plants were built decades ago, often when the surrounding land was industrial or less populated. Over time, urban growth expanded toward them.
- Today, if someone proposed siting a chlorine facility within 1 km of dense residential housing, it would likely face strong opposition and stricter risk assessments.

2. Risk vs. benefit tradeoff

- Chlorine is essential in water treatment, disinfection, and industry. Having a local plant reduces transport risks (rail or truck accidents can be just as dangerous as storage).
- On the other hand, having large storage tanks in proximity to thousands of residents means that the "low-probability, high-consequence" risk falls unevenly on nearby communities.

3. Economics and inertia

- As you noted, jobs and tax revenues can be part of why a facility stays.
- But also: relocation or re-engineering would be enormously costly. Unless regulators or governments mandate a move, industry tends to stick with the status quo.

4. Community right-to-know

- The ethical issue is whether residents are *fully informed* about the risks and emergency plans.
- Transparency and independent safety audits go a long way in building trust, but many communities feel left out of the decision-making process.

5. The precautionary angle

- From a strict "safety first" perspective, the safest option would indeed be to eliminate the hazard altogether (relocation, smaller on-site volumes, or alternative processes).
- Keeping it in place means officials and operators are accepting a *calculated level of risk*, which can feel like double-speak when paired with "safety is our priority."

So no — you're not being unreasonable. You're highlighting the gap between *safety as mitigation* (what industry means) and *safety as avoidance of hazard* (what residents reasonably want).

Would you like me to outline some **practical ways residents in North Vancouver could push for stronger assurances** — like third-party safety reviews, risk communication forums, or exploration of safer alternatives — without being seen as simply "anti-industry"?

You said:

Yes please.

ChatGPT said:

Great — here are some **practical, constructive ways residents near the chlorine plant in the District of North Vancouver could push for stronger assurances** without being dismissed as simply "anti-industry":

---

1. Ask for independent, third-party safety audits

- Request that the District (or Metro Vancouver) commission safety reviews by an independent engineering or risk-management firm, not paid for solely by the company.
- These audits should include not only compliance checks, but *worst-case scenario modeling* (gas release, explosion, transport accident, etc.) with clear communication of results to the public.

---

2. Strengthen "right-to-know" and emergency preparedness

- Push for full transparency on:
  - What volumes of chlorine are stored on-site.
  - What emergency procedures exist for nearby residents (evacuation routes, shelter-in-place instructions).
  - How often drills are conducted, and how community members are involved.
- Encourage the creation of **community advisory panels** where residents can ask questions directly of plant officials and regulators.

---

3. Explore safer alternatives and risk reduction

- Advocate for studies on whether *on-site chlorine production in smaller volumes* (e.g., on-demand electrolysis of saltwater) could replace bulk storage. Some water-treatment plants have already switched.
- Ask if storage volumes can be reduced or dispersed to multiple smaller, lower-risk facilities.

---

4. Leverage land-use and planning authority

- Municipal councils often feel stuck with "grandfathered" facilities. But zoning bylaws and provincial safety regulations can be used to require risk-reduction over time.
- Residents can press for **long-term transition planning**: if the facility is redeveloped or upgraded, insist that relocation be considered.

5. Frame advocacy around fairness, not opposition

- Instead of "shut the plant down," frame concerns as:
  - *"Residents deserve the same level of safety and transparency as newer communities where such plants wouldn't be approved today."*
  - *"We want jobs and taxes too — but with modern risk standards."*
- This approach makes it harder for officials to dismiss concerns as purely "anti-industry."

---

6. Engage multiple levels of government

- District of North Vancouver Council: local zoning and emergency planning.
- Metro Vancouver: water treatment policies (chlorine is critical to their system).
- BC Ministry of Environment: hazardous materials storage regulations.
- Work with all three, since responsibility is fragmented.

---

7. Build a coalition

- Partner with schools, parent groups, and seniors' organizations who have the most at stake.
- Broader community voices often carry more weight than a small group of concerned citizens.

👉 In short: you don't need to argue that the plant is "unsafe" (which industry will push back against). Instead, argue that **risk, no matter how small, should be managed with maximum transparency, independent oversight, and modern alternatives.**

Would you like me to **draft a sample letter or resolution** that could be used with DNV Council or Metro Vancouver to request an independent safety audit and risk communication plan?

You said:

A draft sample letter would be welcomed.

ChatGPT said:

Here's a **draft sample letter** you could adapt for the District of North Vancouver (DNV) Council or Metro Vancouver officials. I've kept the tone constructive and focused on *risk transparency and fairness*, so it's less likely to be dismissed as anti-industry:

[Your Name]
[Your Address]
[City, Postal Code]
[Date]

Mayor and Council
District of North Vancouver
355 West Queens Road
North Vancouver, BC V7N 4N5

Re: Request for Independent Safety Review of Chlorine Storage Facility in the District of North Vancouver

Dear Mayor Little and Members of Council,

I am writing as a resident of the District of North Vancouver to express concern about the continued presence of a chlorine storage facility located within close proximity to residential neighbourhoods. While I recognize that the company states "safety is our priority," the community deserves independent confirmation of that commitment, given the potential consequences of a chlorine release.

Many of these facilities were originally sited when surrounding areas were less populated. Today, with significant residential growth nearby, the standards of acceptable risk and community right-to-know should also evolve. In 2025, most municipalities would not approve a new chlorine storage site so close to homes, schools, and community spaces.

I respectfully request that the District of North Vancouver work with Metro Vancouver and the Province to:

1. **Commission an independent, third-party safety audit** of the chlorine plant, including worst-case release modeling and assessment of emergency response capacity.
2. **Strengthen public communication and preparedness**, ensuring residents know what to do in the event of an incident, and that community drills are practiced regularly.
3. **Explore safer alternatives** such as on-demand chlorine generation or reduced on-site volumes, which other jurisdictions have adopted to lower risk.
4. **Develop a long-term transition plan**, so that as the facility ages or redevelops, relocation or modernization is seriously considered.

My request is not intended to undermine the jobs or taxes associated with the facility. Rather, it is based on the principle of fairness: residents today should enjoy the same level of safety and transparency as communities where such facilities would not be permitted under modern standards.

Thank you for your attention to this important matter. I would welcome the opportunity to participate in any community forums or consultations that arise from this request.

Sincerely,

[Your Full Name]
[Phone / Email]

C KOST

Chlorine Risk Comparison: Large Release Event vs. Chronic Low-Level Exposure

Aspect	Large Release Event	Chronic Low-Level Exposure
Nature of Risk	Acute, short-duration, potentially high-consequence event.	Continuous or intermittent exposure at low concentrations.
Exposure Duration	Seconds to minutes.	Weeks, months, or years.
Primary Hazards	Toxic inhalation, chemical burns, possible fatalities, environmental contamination.	Respiratory irritation, corrosion of equipment, cumulative worker or neighbourhood health effects.
Detection & Monitoring	Immediate alarms from sensors; visible gas cloud likely; public alert possible.	Often undetected without sensitive continuous monitoring; odour may be below detection threshold.
Health Thresholds	IDLH = 10 ppm; ERPG-3 (life-threatening) = 20 ppm for 1 hour; concentrations can exceed 100 ppm near source.	Chronic exposure effects begin near 0.1–0.3 ppm for sensitive individuals; workplace limits (TLV-TWA) = 0.5 ppm.
Typical Consequences	Requires evacuation or shelter-in-place; emergency response activation; regulatory reporting mandatory.	Usually confined to workplace or plant perimeter; long-term nuisance or health concern if persistent.
Public Communication	High media visibility; may erode trust if not promptly disclosed.	Low visibility; public may remain unaware unless cumulative effects or odour complaints occur.
Regulatory Focus	Emergency preparedness, containment design, incident reporting, plume modelling.	Occupational hygiene, emissions permits, ventilation and scrubbing efficiency.
Frequency vs. Severity	Very low frequency but very high severity.	High frequency but low severity per occurrence.
Prevention / Mitigation / Communication	**Engineering controls:** robust containment, automatic shutoffs, leak detectors, and secondary barriers. **Procedural controls:** emergency drills, incident reporting, real-time air monitoring. **Communication:** public notification protocols, transparent post-event disclosure, community engagement. **For chronic risks:** continuous emission tracking, third-party audits, routine health surveillance, and open data on long-term air quality trends.	

2044 (I will be 102) Preamble – Who am I, my education, my passions → community payback lived in DNV since 1973 Mid 50's

Key Issues about the Chlorine plant future plans

Ernie Crist worked at TRIUMF 1971–2009

- ✓ The plant has had no serious chlorine releases since it started in 1957
- ✓ If such a Chlorine plant were proposed to be here today it would not be permitted
- IMHO the future vision for Maplewood can never be fulfilled so long as this plant exists
- The DNV taxes/fees collected by this facility should not be a factor in deciding this issue
- ✓ The plant's liability insurance of $300million(1) in the 1990's should be about $1Billion today
- ✓ If there is no such insurance currently in place then it speaks volumes about the risks!
- ✓ The proposed Bylaw 8778 does not have an expiry date for the production of chlorine
- ✓ A global survey indicated no chlorine plant in the world lies this close to housing
- The BakerRisk report that the latest 10^{-6} contour **does not lie within the site boundary.** ← see Nov 22 2017 input
- No results for a "worst-case" situation (say during an extreme earthquake) was ever studied.
- LIQUID CLORINE plays only a small role in making our water safe – which uses Ultra-violette light as primary disinfectant and bleach or chlorine? distribution network
- TAX increase to compensate would be? %
- Shelter in place works poorly WITH Earthquake

SAFETY IS PARAMOUNT

(1) See Aug 25 1998 Public Hearing that Canadian Occidental Petroleum carried a $300m US funds of liability insurance.

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Jes G G R ? C

silence

studied plum releases of ~ 5 kgm to → several km

Voluntary RISK ≠ Involuntary RISK

↑ CHEMTRADE

99% reliably in deliveries by rail – but planes are safer than chlorine plant

PLEASE RELEASE ME

WALL between H facility would be blown away upon an H explosion!

Has the company met recently with DNV council in camera ?

2088
1942
78

From: Law, Jennifer <Jennifer.Law@portvancouver.com>
Sent: February 26, 2026 8:46 AM
To: DNV Input
Subject: Chemtrade Re-zoning Application - Feb 25 Public Hearing

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Understand that a question came in from Council last night during Chemtrade's hearing last night. Providing a written response from VFPA that can be referenced during the session continuation tonight.

Question:
Although rezoning would be enduring, what would happen if Port decided to not renew the lease with CT after Dec 31, 2044? Can the District coordinate our approval with the Port decision?

Response:
VFPA cannot seek approval for lease term ending any further than 2044 given the current decision framework. We also have a mandate to facilitate Canada's trade priorities, and it is beyond our powers to decide what those products should be. Our job is to ensure products are moved safely through port managed land in accordance with federal regulations.

Jennifer Law (she/her/hers)
Senior Real Estate Specialist, Real Estate

PORT of vancouver | Vancouver Fraser Port Authority Canada

Vancouver Fraser Port Authority
100 The Pointe, 999 Canada Place
Vancouver, B.C. Canada V6C 3T4

P: 778.229.7951 portvancouver.com

The Vancouver Fraser Port Authority's Vancouver offices sit on the traditional territory of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations.

From: Lisa Muri
Sent: February 26, 2026 9:53 AM
To: Mayor and Council - DNV
Subject: Clarification
Attachments: IMG_6065.PNG

Follow Up Flag: Follow up
Flag Status: Completed

The question " how much of chlorine and chlorine gas is destined for markets outside of canada " was not answered, I understand the need to not disclose markets but Chemtrades own website says 40 % of the chlorine product stays in canada but the answer last night was 70%? The answers have been challenging, my question in regards to systems within the community on emergency procedures and a log of the regularity of those procedures was also not answered. The protocol as to how to shelter in place was not what I was seeking. Council needs to understand what the regular protocol is in regards to educating businesses and residents on a regular basis in case of emergency, currently other than a siren, that many do not hear, how are regular training exercises conducted and with who that are beyond the plant, and how are these exercise resourced, this is the information required, my understanding is nothing on a regular basis occurs. Please confirm and clarify the above.

Lisa Muri
Councillor, District North Vancouver

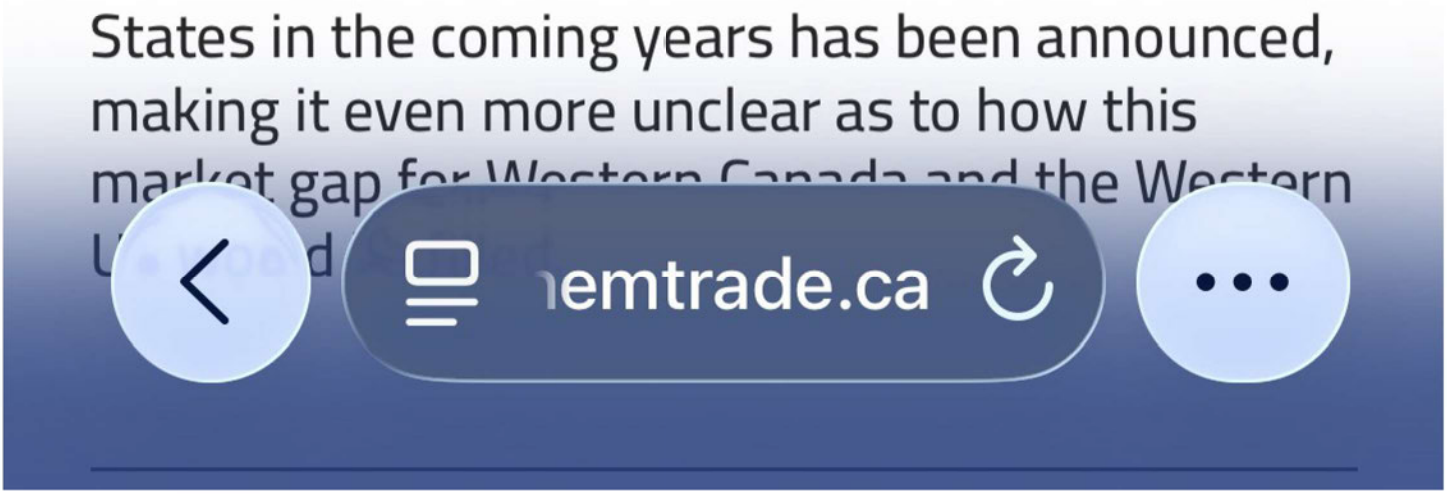
Mobile: 604 209 9770
Muril@dnv.org

improvements, which would dramatically reduce risk for the community – bringing our current risk curves to near or at our property line, while also improving overall facility safety.

When we engaged with the District regarding our planned safety improvements for the facility, they advised us that in order to provide the building permits required for the improvements, we would need to go through the rezoning process to have the manufacturing of liquid chlorine listed as an exemption within the bylaw.

There are a few things that are important to note. The first is that if the rezoning application is approved, there will be no change in how we operate, the products we produce, and the volume of our production. The second is that the facility has been operating safely and reliably in the current location since 1957. And the third is that we are the largest producer of liquid chlorine in Canada, providing over 40 per cent of the chlorine used to treat drinking water in Canada. We know from a 2015 Stats Canada survey, that 96 per cent of Canadian municipalities use chlorine to treat their municipal water supplies.

If the District does not approve our rezoning application, we would be unable to move ahead with our planned safety improvements. This leaves the future of the facility uncertain beyond 2030 and would leave a large gap in the supply chain in both Canada and the US, particularly in Western Canada as the next closest chlor-alkali facility is in Saskatchewan. Recently, the closure of several chlor-alkali facilities across the United States in the coming years has been announced, making it even more unclear as to how this market gap for Western Canada and the Western U[illegible]d [illegible]



From: Mike Little, Mayor
Sent: February 26, 2026 10:29 AM
To: Lisa Muri; Mayor and Council - DNV
Subject: Re: Clarification

Follow Up Flag: Follow up
Flag Status: Completed

I think Allan said that 70% of ALL products produced at the site stay in Canada so it would seem he included caustic soda in the Canadian number.

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From: Lisa Muri <MuriL@dnv.org>
Sent: Thursday, February 26, 2026 9:53:17 AM
To: Mayor and Council - DNV <Council@dnv.org>
Subject: Clarification

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Councillor, District North Vancouver

Mobile: 604 209 9770
Muril@dnv.org

From: Lisa Muri
Sent: February 26, 2026 10:29 AM
To: Mike Little, Mayor; Mayor and Council - DNV
Subject: Re: Clarification

Follow Up Flag: Follow up
Flag Status: Completed

That was not my question though.

Lisa Muri
Councillor, District North Vancouver

Mobile: 604 209 9770
Muril@dnv.org

From: Mike Little, Mayor <LittleM@dnv.org>
Sent: Thursday, February 26, 2026 10:28:47 AM
To: Lisa Muri <MuriL@dnv.org>; Mayor and Council - DNV <Council@dnv.org>
Subject: Re: Clarification

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Lisa Muri
Councillor, District North Vancouver

Mobile: 604 209 9770
Muril@dnv.org

From: Mike Little, Mayor
Sent: February 26, 2026 10:32 AM
To: Lisa Muri; Mayor and Council - DNV
Subject: Re: Clarification

Follow Up Flag: Follow up
Flag Status: Completed

It was right after he said that he couldn't share specifics for competitive purposes so I don't think he was trying to mislead. Having said that, whether it is 1% or 100% the amount is irrelevant to the suitability of the site for the purpose. We have to stay focused on that.

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From: Lisa Muri <MuriL@dnv.org>
Sent: Thursday, February 26, 2026 10:29:17 AM
To: Mike Little, Mayor <LittleM@dnv.org>; Mayor and Council - DNV <Council@dnv.org>
Subject: Re: Clarification

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Councillor, District North Vancouver

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Muril@dnv.org

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Sent: Thursday, February 26, 2026 10:28:47 AM
To: Lisa Muri <MuriL@dnv.org>; Mayor and Council - DNV <Council@dnv.org>
Subject: Re: Clarification

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Subject: Clarification

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Lisa Muri

Councillor, District North Vancouver

Mobile: 604 209 9770
Muril@dnv.org

From: Lisa Muri
Sent: February 26, 2026 10:35 AM
To: Mike Little, Mayor; Mayor and Council - DNV
Subject: Re: Clarification

Follow Up Flag: Follow up
Flag Status: Completed

I understand, however, if the suitability of the site creates unnecessary risk/liability that the community endures to benefit areas outside of our borders, we have a duty to consider those impacts.

Lisa Muri
Councillor, District North Vancouver

Mobile: 604 209 9770
MuriL@dnv.org

From: Mike Little, Mayor <LittleM@dnv.org>
Sent: Thursday, February 26, 2026 10:31:59 AM
To: Lisa Muri <MuriL@dnv.org>; Mayor and Council - DNV <Council@dnv.org>
Subject: Re: Clarification

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Councillor, District North Vancouver

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MuriL@dnv.org

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To: Mayor and Council - DNV <Council@dnv.org>
Subject: Clarification

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Lisa Muri
Councillor, District North Vancouver

Mobile: 604 209 9770
Muril@dnv.org

From: [redacted]
Sent: February 27, 2026 12:25 PM
To: Dan Milburn; DNV Input; 'Corrie Kost'
Subject: Follow Up on Public Hearing - 100 Amherst

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Dear Mr. Milburn,

I understand from the Mayor's instructions at the closing of the Public Hearing that we are no longer permitted to reach out to Council on this matter – but free to interact with staff.

I wish to follow up on the issue of the risks associated with a seismic event at the site and also on your analysis in response to the presentation of the DNV Publication "When the Ground Shakes" (WTGS).

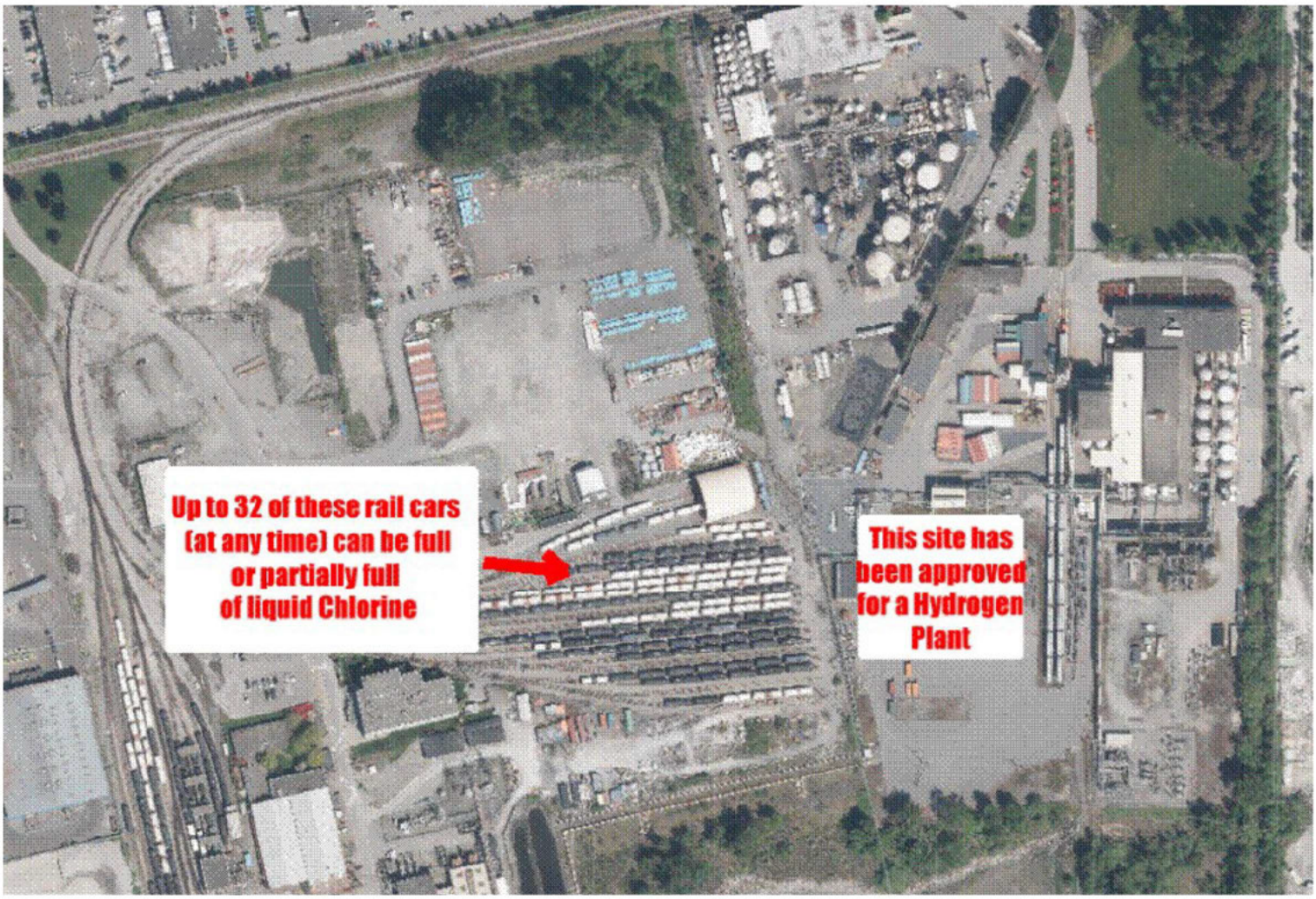
In your follow up you seemed to be explaining that the WTGS document and analysis was referring to existing buildings, but any new building on the site would be designed and built under modern building codes and seismic mitigation designs (my words here – not yours verbatim).

But I hope your follow up analysis to Council on this topic will include this:

I am not concerned about the 1 or 2 rail cars that might fit inside the future building's filling bays.

I am concerned about these: the "up to 32 rail cars (full) of Chlorine" that are outside in the yard.

To me, I see those as the greater risk. And what, in the event of a failure of Seymour Dam, would happen to those rail cars? Would they be crushed? Swept into the inlet?



I hope you and your team will investigate this and report back to Council in your following recommendations and reports.

Sincerely,

Peter Teevan

From: [redacted]
Sent: March 09, 2026 6:13 AM
To: DNV Input
Subject: Error in Public Record for 2026.02.24 Public Hearing
Attachments: 2026.02.24 Rezoning Hearing - Chris Bowcock - Presentation Slides ; RE: 2026.02.24 Rezoning Hearing - Chris Bowcock - Presentation Slides

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello DNV Input,

In reviewing every document from the Public Record Documents related to the DNV 2026.02.24 Public Rezoning Hearing I have noted that my presentation speaking notes (Chris Bowcock - Public Presenter #1 Video time log 41:00 - 46:10) have **not** been included.

At 37:30 on the Video recording of the 2026.02.24 Public Rezoning Hearing, Mayor Little identifies that if presenters provide a copy of their speaking notes in the black tray on the presenters desk, that those notes will be added to the public record.

On the Video recording log of the 2026.02.24 Public Hearing time mark 46:20 it is clear to see the submission of my speaking notes package to the presenter tray for formal inclusion to the record.

Additionally, prior to the meeting and submission cut-off time, I provided my speakers notes by email as noted in the attachment provided, and note the response from the DNV confirming reception of that correspondence also attached.

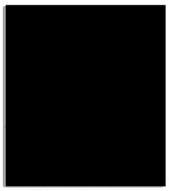
This error in the Public Record is concerning.

I question the exclusion of my speaking notes from the public record, even though they were submitted within (2) separate, independent and distinct regular submission process steps. I have concern to the point of questioning the wholesome and full representation of the public record for this Public Hearing.

With the knowledge you now have before you with regard to this issue, I expect that:

1. The DNV confirm receipt of my concern via a formal email response, and
2. The Public Record is corrected to include the speaking notes I provided representing my presentation,
3. That the error by omission is noted with regard to this process, and
4. That the accounting for accuracy in the Public Record for this Public Hearing is fully and comprehensively reviewed and corrected as necessary.

Thank you in advance



Chris Bowcock

[redacted]

From: [redacted]
To: Signup
Sent: February 24, 2026 1:13:08 PM
Subject: 2026.02.24 Rezoning Hearing - Chris Bowcock - Presentation Slides
Attachments: Outlook-jviko1ev.png (24 KB); Chris Bowcock - DNV Rezoning Public Hearing 2026.02.24.pptx (4727 KB);

Hello District of North Van,

This email is to provide the Slide Package associated with tonight's Public Rezoning Hearing related to 100 Amherst - Chemtrade.

I ask that you please confirm you receipt of the attachment, by providing me with a standard response email.
Thank You

Chris Bowcock
[redacted]

Liquid Chlorine Rail Car Release



Liquid Chlorine Rail Cars



- Pure Chlorine Cl_2
- Inside the Rail Car at pressure: Liquid
- During Release expands 460:1 Gas

- **Poses a significant risk to Life**
- Massively Expanding Gas
- Incapacitating Victims

Scope of Release – Rail Car



2004/2009 report and testimony to the
US House Homeland Security Committee

Modelled - Chlorine rail car rupture

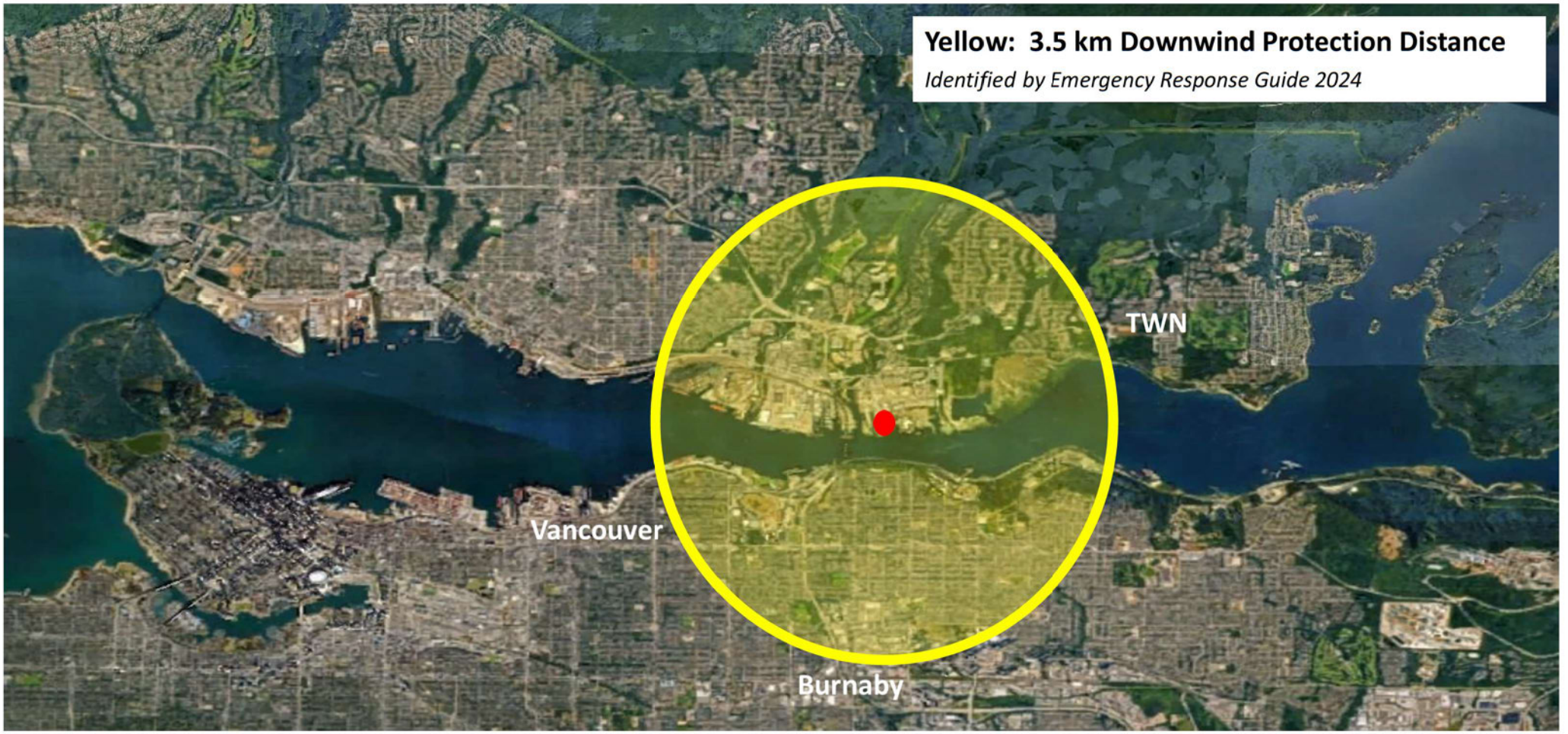
in densely populated Washington, DC area could result in:

- 17,500 fatalities
- 10,000 severe injuries,
- 100,000 hospitalizations, and
- 40 km downwind chemical exposures

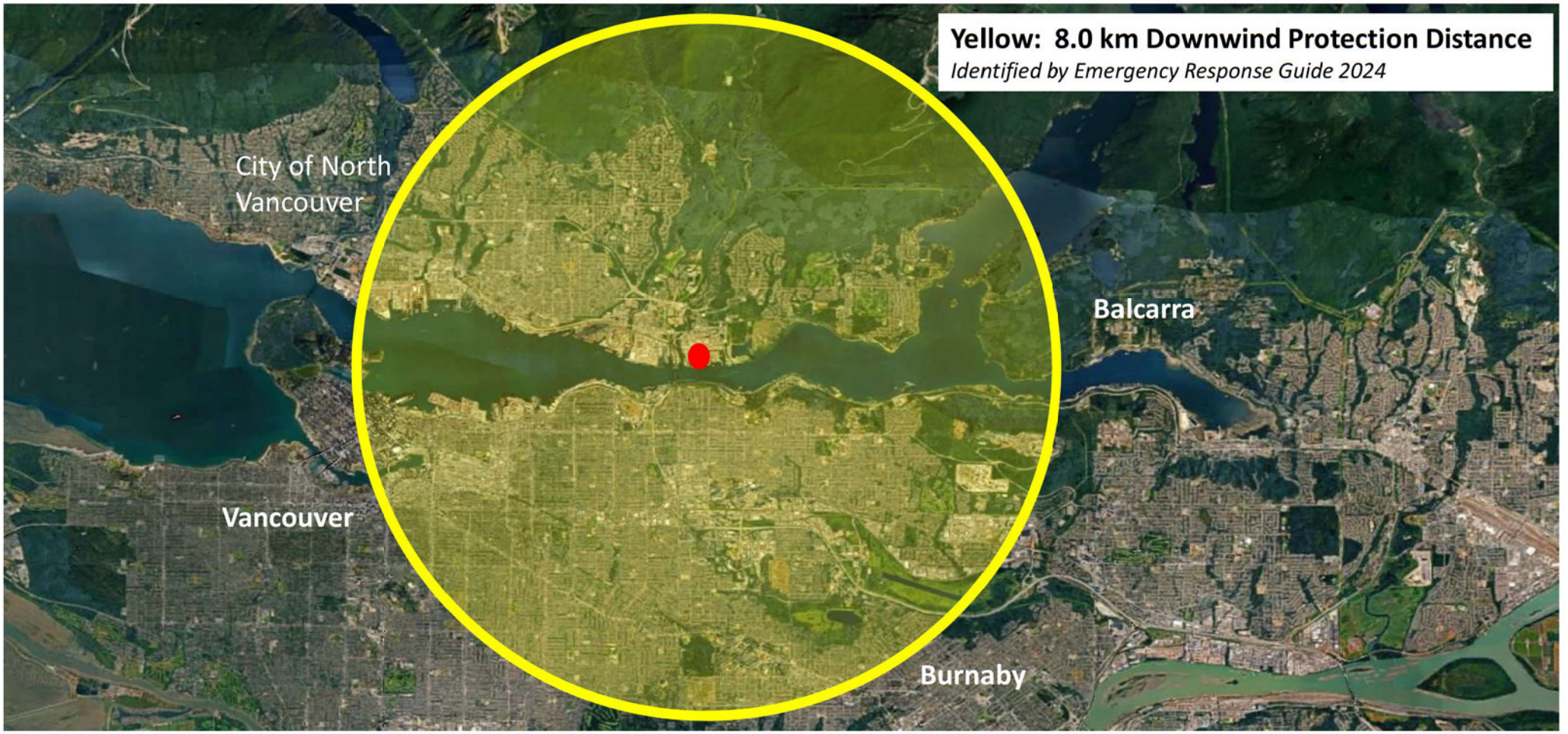
North Shore Rail Car Release - Scope

Washington DC - Dense Urban by Study	**North Shore -** Urban Population Center by extrapolation to scale
Population Density: 4,440 per km^2	Population Density: 550 per km^2
• 17,500 potential fatalities	• **2,000 potential fatalities**
• 10,000 severe injuries	• **1,230 severe injuries**
• 100,000 hospitalizations	• 12,300 hospitalizations
• 40 km downwind exposures	• 40 km downwind exposures

Inhalation Hazard – Day Time



Inhalation Hazard – Night Time



Mass Casualty Incident



Within the Urban Density of a Population Center

- Magnitude of the Emergency Response:

Firefighters	**150**
Paramedics	**50**
RCMP Officers	**30**

Based on:

- Hazardous Materials – Mass Casualty Event
- 3:1 minimum Work Cycle required for extended SCBA operations

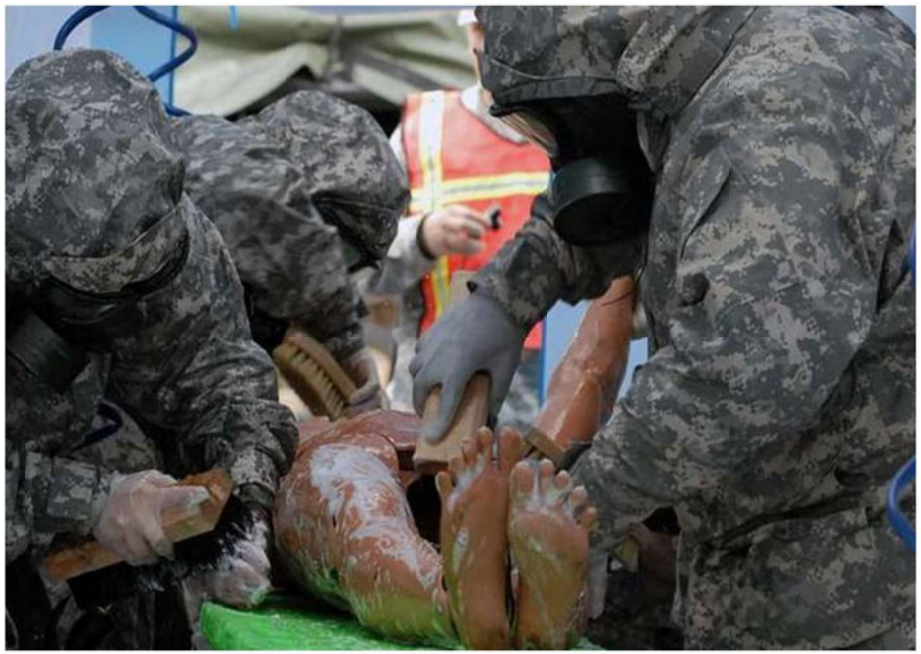
Respiratory Threat of Chlorine Gas



Immediately Fatal	**1,000 ppm Cl_2**
Lethal in 30 minutes	**450 ppm**
1% Fatality in 10 minutes	**100 ppm**
Breathing Difficulty causing Death:	30 ppm
Immediately Dangerous to Life & Health:	10 ppm

ppm: parts per million

Victims Unable to Escape without Rescue



Mass Casualty Incident with victims requiring:

- Decontamination
- High Flow Oxygen
- Rapid transportation to hospital

- Respiratory distress requiring **Rescue & removal by firefighters**
- Difficult breathing, leading to suffocation
- Impaired vision, severe vomiting & pain
- Chemical burns: Lungs, Throat, Eyes, Nose, Moist Skin
- Lung Damage: Can be Immediate and Irreparable

I hope this presentation helps you
better understand:

- The **Incident Scope** of a Chlorine Rail Car Release
- The **Medical Threats** citizens will be exposed to
- The **Magnitude** of the Emergency Response
- The **Fatality Risks** of a Chlorine Gas Release

From: Signup [signup@dnv.org]
To: [redacted]
Sent: February 24, 2026 1:25:11 PM
Subject: RE: 2026.02.24 Rezoning Hearing - Chris Bowcock - Presentation Slides
Attachments: image001.png (24 KB);

Thank you for your email. There is a computer at the presentation desk where you may plug in a USB drive with a copy of your presentation or, if you are attending virtually, you may show your slides via Zoom.

From: [redacted]
Sent: February 24, 2026 1:13 PM
To: Signup <signup@dnv.org>
Subject: 2026.02.24 Rezoning Hearing - Chris Bowcock - Presentation Slides

Hello District of North Van,

This email is to provide the Slide Package associated with tonight's Public Rezoning Hearing related to 100 Amherst - Chemtrade.

I ask that you please confirm you receipt of the attachment, by providing me with a standard response email.
Thank You

[redacted]

Chris Bowcock

[redacted]

From: Council Liaison
Sent: March 13, 2026 3:18 PM
To: Mayor and Council - DNV
Subject: Has anyone reviewed safety plans with nearby residential?

Follow Up Flag: Follow up
Flag Status: Completed

Dear Mayor and Council,

Please see the response by Planning to Kelly Bond regarding the Public Hearing for Bylaw 8778:

> This correspondence was received during the Public Hearing for Bylaw 8778 and forms part of the Public Hearing record. As the Public Hearing has now closed, staff can follow up with a response after Council has completed its consideration of the bylaw.

Warm regards,

Council Liaison Office

District of North Vancouver
355 West Queens Road
North Vancouver, BC V7N 4N5

From: Kelly Bond <[redacted]
Sent: February 25, 2026 8:05 PM
To: DNV Input <input@dnv.org>; Mayor and Council - DNV <council@dnv.org>
Subject: Has anyone reviewed safety plans with nearby residential?

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good Evening,

I heard last night from Staff that "notification" of any safety compromise from Chemtrade would be required to be conveyed to tenants by developer of said residential and was written into development covenants. I couldn't quickly find the development covenants to read the phrasing.

While this concern may be slightly outside the scope of thr Chemtrade rezoning itself, I'm curious about previous rezonings made prior to this change to Chemtrade site and if "new" saftey sessions and protocols would be required with approval of this application.

Have these safety sessions written into covenants been monitored consistently for compliance at the residences in questions by DNV? For instance [redacted]? Do "safety sessions" take place whenever there is tenant changeover? How are you protecting citizens on an ongoing basis?

Attached are screenshots from one document from the 2013 Front Street/Dollarton rezoning that I very hastily found in the council agendas.

Thank you.

Kelly Bond

From: Mark [redacted]
Sent: April 06, 2026 3:48 PM
To: Mayor and Council - DNV
Cc: ajonsson@chemtradelogistics.com
Subject: Improvements - Rezoning

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hi,

I can smell Chlorine in my area, especially strong at night. I live [redacted] in the City of North Vancouver and while this issue is not directly in my district, it still effects me.

I would support upgrade to the facility if that means I will no longer smell the chlorine.

Cheers

Mark

From: Sk Lai [redacted]
Sent: April 12, 2026 10:03 AM
To: Infoweb; DNV Input; Mayor and Council - DNV; Mike Fox
Cc: Brent Richter; Newsroom, North Shore News
Subject: DNV Regular Council Meeting : 8.4. Bylaw 8778 – Text Amendment Rezoning

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear DNV Council, CAO and All.

I am writing you all relating to April 13, 2026 Meeting Agenda Item 8.4.
I am writing you as a concerned resident .
I have been living on the North Shore pretty much my whole life.
We often hear about the 60 years reference during this Chemtrade discussion.
Things are always safe until the day they become unsafe.
Our focus is always about immediate cost benefits and typically lacking of prudence which we often are aware of but failing to disclose.
Look at the gasket blew up the first space shuttle or the falling chucks of ice damaged the tiles of the 2nd shuttle loss.
Fukushima Daichi was safe until the tsunami triggered the core meltdown.
Last week, there was a Chlorine accident in Victoria Crystal pool and it sent over half dozen people to hospital plus having people nearby sheltered in place.
Some have forgotten the 1975 Burrard Terminal Explosion with multiple fatalities.
We have too many people, instead of providing specific details plus data, producing Gobbledygook.
How would an EIT representing the risk management people during your February 24 hearing work?
An EIT does not have expertise as the person is still practicing under the umbrella of a mentor, a professional.
I am urging you all to vote either Option 2 or Option 3.
Before you cast your vote…..ask this fundamental question "In the worst case scenario, how many people will die or be injured and what are the environmental damages to surrounding areas, streams & inlet?".
You all can also ask "What is the real mitigation plan??" as I could only locate talking points from our talking heads.
Please enlighten us if you are prepared to vote Option 1.

Thank you for reading my request.

SK Lai, P.Eng. (Retired), LEED® AP
[redacted]

From: Steven [redacted]
Sent: April 12, 2026 1:00 PM
To: Mayor and Council - DNV
Subject: Please vote no in the Chemtrade vote on Monday April 13

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear DNV Mayor and Council,

I understand that you will be voting on Bylaw 8778 – Text Amendment Rezoning – 100 Amherst Avenue (Chemtrade) on Monday.

I would strongly discourage you from approving the bylaw and would instead encourage you to abandon it entirely or proceed to debate/amendments at second reading.

I have reviewed the arguments for and against and would like to share the following perspective:

1) The risk of terrorism has not been adequately considered. The words "terror" and "terrorism" were not used a single time in the public hearing. A liquid chlorine manufacturing plant is an inherently dangerous facility. One must assume that the plant would be a potential target. It plays an important role in the drinking water supply chain, is very easy to access (any bad actor can get close from land or water,) and an attack could result in a significant loss of life due to its proximity to a residential neighbourhood. As we can see from recent global events, the use of drones means that traditional security measures (background checks, physical gates, etc.) are no longer effective and almost any facility is now at risk. As far as I can tell, the proponent has not proposed the installation of any type of drone counter-measures. This needs further evaluation and discussion.

2) It appears that the importance of liquid chlorine for customers across Canada is being used as an argument for the continued operation of this plant. That is a federal concern. A municipal district should not be taking that into consideration when making a decision for what is best for residents within the district. **If the federal government was so concerned about the supply chain of Chlorine, they would not be evicting the plant from federally regulated land.** At the very least, if this is a federal priority, then the DNV should use that as negotiating leverage (e.g. for increased investments in port safety and emergency response from the federal government.)

3) Local jobs and economic impact are another argument that have been put forward for allowing the construction of this plant within the DNV. The reality is that port-adjacent industrial land is in extremely short supply. Although I am sympathetic that some people may lose their jobs or need to relocate to a new location, I **would not anticipate a net-loss in local jobs or economic activity. Another business will take their place and run an operation that is more appropriate in that location.**

4) One of the arguments for the continued operation of the plant is that it has operated safely so far. I would note that during the period of operation, it has not had to withstand a single severe earthquake. I also note that although the risk of earthquakes was discussed, **I was not able to find any answers on the level of earthquake that the design is managed to withstand** with a gaurantee of no fatalities. Will we be OK if the earthquake is 8.0 or lower but suffer hundreds of deaths if it is an 8.5?

5) There is a reason that people are so concerned about the location of a facility of this type. **Chlorine is an extraordinarily dangerous material. Even a tiny leak can cause fatalities at a distance.** Consider this story: *"At a holiday camp, a strong chlorine release occurred inside the swimming pool utility room. In escaping via the pipe ducts, gaseous emanations engulfed the lavatories located 25 m from the utility room harming a young girl. Hospitalised with serious burns to her lungs despite the rapid emergency response, the child unfortunately succumbed 5 days later. Some 10 other campers fell ill."*

That was a very small leak that occured inside of a room and killed someone 25 meters away.

6) One of the case studies that engineers learn about is the chemical leak in Bhopal. **One of the take-aways from that case study is that some facilities simply should not be located in residential areas.**
From Wikipedia: *"On 3 December 1984, over 500,000 people in the vicinity of the Union Carbide India Limited pesticide plant in Bhopal, Madhya Pradesh, India, were exposed to the highly toxic gas methyl isocyanate, in what is considered the world's worst industrial disaster. A government affidavit in 2006 stated that the leak caused approximately 558,125 injuries, including 38,478 temporary partial injuries and 3,900 severely and permanently disabling injuries. Estimates vary on the death toll, with the official number of immediate deaths being 2,259. Others estimate that 8,000 died within two weeks of the incident occurring, and another 8,000 or more died from gas-related diseases."*

7) Canada is a vast country. The majority of Canada is very sparsely populated. There are countless locations across the country in which it would be possible to manufacture liquid chlorine close to railway tracks but a long distance from densely populated residential neighbourhoods. This is probably one of the single-worst locations to make a significant investment in building a plant of this type.

Sincerely,
Steven Jones

From: Jim Caruth [redacted]
Sent: April 13, 2026 12:10 PM
To: Mayor and Council - DNV
Subject: Bylaw 8778

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

I am a long term resident of the DNV [redacted]

I recently became aware of the Bylaw 8778 - which would have the effect of allowing Chemtrade to continue producing chlorine on the North Shore including modernizing their facilities and potentially expanding their business.

I support this bylaw for the following reasons:

Chlorine is needed for drinking water production in our community and in most places worldwide. Although we use UV at the Seymore plant, chlorine disinfection is still part of our mix. We either make it here and ship via railcar to others or make it somewhere else and import it via railcar into our community and other places.....either way chlorine will be moving through our community by rail. We might as well make it here.

- Reviews describe Chemtrade as "safety oriented" and a "good employer" - this sounds like a company we should encourage.

- Chemtrade has been part of our community for over 70 years.....they are a proven community member

- We have lived close to this plant for over 30 years and never been aware of them in any negative way.....they are clearly not a "bad actor". We have no concerns about them expanding / modernizing their facilities.

- We need to encourage local industry and jobs. Legitimizing Chemtrade's production of chlorine and helping facilitate the success of this business in our community just makes sense!

I urge you to ignore the nimby's and smear campaign against this company and approve bylaw 8778.

Best,

Jim Caruth, PEng - Retired
[redacted]

From: Dave Hutchinson [redacted]
Sent: April 14, 2026 6:47 AM
To: Mayor and Council - DNV
Subject: Chemtrade facility

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello,

I would like more information on how Council decided it was in the best interest to not renew the lease for Chemtrade facility in the maplewood flats region. The decision will remove 180 good paying jobs to a sustainable industry required across western Canada. We'll now rely more upon Chinese imports for critical chemicals.

This is hands down the stupidest decision made by council. I am ashamed to call myself a resident of North Vancouver.

Please send me your analysis report which you rendered your illogical decision.

Dave

Yahoo Mail: Search, Organize, Conquer

From: Website Notifications <notifications@simplicitycms.ca>
Sent: April 14, 2026 7:35 AM
To: Mayor and Council - DNV
Subject: Share your thoughts with Mayor and Council form

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

New Form Submission: Share your thoughts with Mayor and Council form

A copy of their response is shown below.

https://dnv-admin.simplicitycms.ca/forms/request/results/3799cb37-3298-4e13-be22-8e318dc4f491?resultId=1953641b-187e-473b-bc41-4d44156876a5

My feedback is about

A general comment or question about a current project, plan, or process

Your name

Tracey Hallam

Your phone number

[redacted]

Your email address

[redacted]

What would you like to tell Mayor and Council?

Hi,

I can't believe the District was swayed by a scam to shut down Chemtrade.

From what I understand from the North Shore News, the District was too lazy to figure out what was really going on with a fake campaign initiated by a competitor. You need to get your act together.

Tracey Hallam (a real person living in North Vancouver)

District of North Vancouver, infoweb@dnv.org

Built with SimpliCity™

From: Ted Bancroft [redacted]
Sent: April 14, 2026 9:11 AM
To: Mayor and Council - DNV
Subject: Chemtrade Decision

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council Members,

I read the account of the rejection of the Chemtrade proposal in the North Shore News this morning with disbelief. In a period of struggle to expand the BC economy, increase independence upon other jurisdictions and provide decent jobs when opportunities are shrinking for our youth and others, I thought that this project would receive enthusiastic support from Council and reflect the attitude of the community towards approval of the project. I know that there has been vocal opposition from fearful people, a Chemtrade competitor, and others, but I had confidence that Council would weigh the evidence provided by history, new technology, and careful and caring plant management, combined with the need for the products (chlorine AND hydrogen) and conclude that the advantages of maintaining this facility would far outweigh the fears of a few.

Silly me. It seems that fear is the great motivator and risk mitigation is a driving force in both local and national decisions. It gives disproportionate weight to unlikely scenarios and ignores the benefits, both economic and societal, in the decision-making process. I must confess to a feeling of overwhelming disappointment and a sense of hopelessness that progress to enhance the lives of everyone is severely constrained by misplaced caution that does not reflect the general views of the citizenry.

I should add a vote of thanks to dissenting Council members Bach, Hansen and Mah for taking a responsible and balanced view in the exercise of their mandate.

With respect,
Edward Bancroft, [redacted] DNV

From: DNV Input
Sent: April 14, 2026 1:11 PM
To: Mayor and Council - DNV
Subject: FW: Rezoning Application North Vancouver Chlor-Alkali Facility

Follow Up Flag: Follow up
Flag Status: Completed

The below is provided for information.

From: [redacted]
Sent: 2026-04-14 12:20:24 PM
To: infoweb@dnv.org

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good Afternoon Council

I am reaching out today to voice my disappointment in your decision to reject the Application for rezoning of the North Vancouver Chlor-Alkali Facility. Over the past two and a half years Chemtrade's engagement with the District and local community has been overwhelmingly positive and supportive. I believe this decision is not in the best interest of the District, but also for all Canadians. 40% of the countries liquid chlorine which is used in the treatment of drinking water is produced by Chemtrade and they have been safely operating for almost 70 years. This is significant as 96 % of Canadian Municipalities use liquid chlorine, or a chlorine derivative, to treat their municipal water supplies. It is imperative that this decision be approved so Chemtrade can continue to safely play a major role in ensuring safe drinking water, not only in Western Canada but the entire country as well. Supporting the strategic goals and priorities of government and securing production of critical products and industries are crucial to Canadas economic independence.

Thanks Rob Tomlinson
(Peachland BC)

From: DNV Input
Sent: April 14, 2026 4:48 PM
To: DNV Input
Subject: FW: Chemtrade Zoning Decision

From: Rob Reynolds [redacted]
Sent: April 14, 2026 11:54 AM
To: Mayor's Office DNV <mayor@dnv.org>; Jordan Back <backj@dnv.org>; Betty Forbes <forbesb@dnv.org>; James Hanson <hansonj@dnv.org>; Herman Mah <mahh@dnv.org>; Lisa Muri <Muril@dnv.org>; Catherine Pope <popec@dnv.org>
Subject: Chemtrade Zoning Decision

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

All,

It is with regret that I find myself compelled to write to you to express my disappointment in your recent decision to deny the Chemtrade rezoning request.

DNV's NIMBYism and anti-development stance is regrettable. The facility has operated safely where it stands for longer than any of you have been alive. In addition to providing a much needed product for the security of Canada's water supply, Chemtrade provides well paying jobs and a significant tax contribution to the community.

In a national period where we are supposed to be coming together and "build at a rate not seen since the Second World War" as per our PM, DNV has taken it upon itself to be as obstructionist as possible. Your decision was shameful.

It's decisions like yours that are the problem in Canada, not the solution. Do better.

The municipal election is coming this fall and I'll be doing what I can to help your rivals sweep you from office.

Disappointedly,
Rob Reynolds

From: Sean Watkins [redacted]
Sent: April 15, 2026 10:09 AM
To: Mayor and Council - DNV
Subject: Chemtrade re-zoning decision.

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

I'd just like to express my disappointment in the outcome of the vote to allow Chemtrade to continue to produce liquid Chlorine past 2030. I am a long time North Van resident, and 10 year employee of Chemtrade (who recently moved his family [redacted] the plant).

You could say I have an intricate understanding of the safety profile of the plant and couldn't feel more comfortable moving my family in close proximity.

It was challenging to listen to all the misinformation and fear mongering by a competitor who would directly benefit from this proposal being voted down. This decision will have a direct impact on many employees and families who also reside in the district. Thank you to the council members who supported the application. We are still hopeful something can be done.

Kind Regards,

Sean Watkins

Sent from my iPhone

From: Steven [redacted]
Sent: April 15, 2026 11:23 AM
To: DNV Input
Subject: Re: Please vote no in the Chemtrade vote on Monday April 13

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Now that the vote has happened, will my note be forwarded to Mayor and Council? I would still like them to see it and I don't believe the restriction is still on place.
Cheers,
Steve

On Mon, Apr 13, 2026, 12:21 p.m. DNV Input <input@dnv.org> wrote:

> Thank you for your email. Please note that the public hearing for 100 Amherst Avenue closed on February 25th therefore Council may not receive any new information or submissions on the matter. You may review relevant meeting materials at the following link:
>
> https://www.dnv.org/government-administration/meeting-agendas-and-minutes
>
> ---
>
> **From:** Steven [redacted]
> **Sent:** April 12, 2026 1:00 PM
> **To:** Mayor and Council - DNV <council@dnv.org>
> **Subject:** Please vote no in the Chemtrade vote on Monday April 13
>
> Dear DNV Mayor and Council,
>
> I understand that you will be voting on Bylaw 8778 – Text Amendment Rezoning – 100 Amherst Avenue (Chemtrade) on Monday.
>
> I would strongly discourage you from approving the bylaw and would instead encourage you to abandon it entirely or proceed to debate/amendments at second reading.
>
> I have reviewed the arguments for and against and would like to share the following perspective:
>
> **1) The risk of terrorism has not been adequately considered.** The words "terror" and "terrorism" were not used a single time in the public hearing. A liquid chlorine manufacturing plant is an inherently dangerous facility. One must assume that the plant would be a potential target. It plays an important role in the drinking water supply chain, is very easy to access (any bad actor can get close from land or water,) and an attack could result in a significant loss of life due to its proximity to a residential neighbourhood. As we can see from recent global events, the use of drones means that traditional security measures (background checks, physical gates, etc.) are no longer effective and almost any facility is now at risk. As far as I can tell, the proponent has not proposed the installation of any type of drone counter-measures. This needs further evaluation and discussion.
>
> 2) It appears that the importance of liquid chlorine for customers across Canada is being used as an argument for the continued operation of this plant. That is a federal concern. A municipal district should not be taking that into consideration when making a decision for what is best for residents within the district. **If the federal government was so concerned about the supply chain of Chlorine, they would not be evicting the plant from federally regulated land.** At the very least, if this is a federal priority, then the DNV should use that as negotiating leverage (e.g. for increased investments in port safety and emergency response from the federal government.)

3) Local jobs and economic impact are another argument that have been put forward for allowing the construction of this plant within the DNV. The reality is that port-adjacent industrial land is in extremely short supply. Although I am sympathetic that some people may lose their jobs or need to relocate to a new location, **I would not anticipate a net-loss in local jobs or economic activity. Another business will take their place and run an operation that is more appropriate in that location.**

4) One of the arguments for the continued operation of the plant is that it has operated safely so far. I would note that during the period of operation, it has not had to withstand a single severe earthquake. I also note that although the risk of earthquakes was discussed, **I was not able to find any answers on the level of earthquake that the design is managed to withstand** with a gaurantee of no fatalities. Will we be OK if the earthquake is 8.0 or lower but suffer hundreds of deaths if it is an 8.5?

5) There is a reason that people are so concerned about the location of a facility of this type. **Chlorine is an extraordinarily dangerous material. Even a tiny leak can cause fatalities at a distance.** Consider this story:
"At a holiday camp, a strong chlorine release occurred inside the swimming pool utility room. In escaping via the pipe ducts, gaseous emanations engulfed the lavatories located 25 m from the utility room harming a young girl. Hospitalised with serious burns to her lungs despite the rapid emergency response, the child unfortunately succumbed 5 days later. Some 10 other campers fell ill."
That was a very small leak that occured inside of a room and killed someone 25 meters away.

6) One of the case studies that engineers learn about is the chemical leak in Bhopal. **One of the take-aways from that case study is that some facilities simply should not be located in residential areas.**
From Wikipedia: *"On 3 December 1984, over 500,000 people in the vicinity of the Union Carbide India Limited pesticide plant in Bhopal, Madhya Pradesh, India, were exposed to the highly toxic gas methyl isocyanate, in what is considered the world's worst industrial disaster. A government affidavit in 2006 stated that the leak caused approximately 558,125 injuries, including 38,478 temporary partial injuries and 3,900 severely and permanently disabling injuries. Estimates vary on the death toll, with the official number of immediate deaths being 2,259. Others estimate that 8,000 died within two weeks of the incident occurring, and another 8,000 or more died from gas-related diseases."*

7) Canada is a vast country. The majority of Canada is very sparsely populated. There are countless locations across the country in which it would be possible to manufacture liquid chlorine close to railway tracks but a long distance from densely populated residential neighbourhoods. This is probably one of the single-worst locations to make a significant investment in building a plant of this type.

Sincerely,
Steven Jones

From: Website Notifications <notifications@simplicitycms.ca>
Sent: April 15, 2026 2:19 PM
To: Mayor and Council - DNV
Subject: Share your thoughts with Mayor and Council form

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

New Form Submission: Share your thoughts with Mayor and Council form

A copy of their response is shown below.

https://dnv-admin.simplicitycms.ca/forms/request/results/3799cb37-3298-4e13-be22-8e318dc4f491?resultId=8b870920-d14b-4783-a1eb-f6895a317305

My feedback is about

A general comment or question about a current project, plan, or process

Your name

Tracey Hallam

Your phone number

[redacted]

Your email address

[redacted]

What would you like to tell Mayor and Council?

See below the letter I sent to Mr. Eby and Mr. Carney regarding the recent Chemtrade vote.

I am writing to express my strong opposition to the District of North Vancouver's recent decision not to extend Chemtrade's lease.

It is concerning that this outcome appears to have been influenced by a smear campaign from a competitor. Chemtrade has maintained an excellent safety record and has operated at this location without issue since the 1950s. To see a long-standing Canadian business effectively forced out by a single vote is unacceptable and sets a worrying precedent for the local economy.

I believe it is vital that the province and federal governments intervene to support established businesses and promote a stable economic environment. We cannot afford an anti-business mindset that prioritizes unscrupulous competition over proven community contributors.

I urge you to look into this matter and find a way to work with Chemtrade to reverse this decision.

Best regards,

Tracey Hallam

District of North Vancouver, infoweb@dnv.org

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SimpliCity™

From: Jan Steyn de Beer [redacted]
Sent: April 15, 2026 4:37 PM
To: Mayor and Council - DNV
Subject: Chemtrade

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Your Worship and Members of Council,

I read with disappointment in the *North Shore News* of your decision not to allow Chemtrade to produce liquid chlorine on Amherst Avenue. While it is commendable that you have placed weight on reducing risk to the community, I believe that you have underestimated the importance of maintaining a complex and varied local economy, and of maintaining North Vancouver's place within a much larger network of trade. No use of that land would be without risk. Furthermore, gestures are being made at the federal level to build domestic industries. What a shame it would be for a municipal decision to reduce or jeopardise the production of important chemicals in the region. I therefore invite you to reconsider your decision, or at least to give Chemtrade some indication of the sort of proposal or alternative location on which you would look favourably.

Although I live in the District of West Vancouver, I have taken the liberty of writing to you because I feel that the loss of specialised knowledge and industry would be detrimental to the economy and society of the North Shore as a whole.

I appreciate your taking the time to consider this letter.

Yours sincerely,
Jan S. de Beer

From: mike armstrong [redacted]
Sent: April 15, 2026 5:09 PM
To: Mayor and Council - DNV
Subject: Chemtrade decision!

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear council:
I suppose you have already recieved substantial feedback expressing the discontent with the recent decision not to renew Chemtrade. I also belive council's decision wa a very porr one for the following reasons:

1. We need the product they make, its critical for clean water etc.. This is critical to Western Canada.
2. Getting rid of it weakens our supply chain resiliency and increases our dependency on foreign actors (USA!!!).
2. Chemtrade has been there for almost 70 years with an impeccable safety record, much longer than the vast majority of north van people who chose to move here with Chemtrade already in operation. It's like moving to Richmond and asking the airport to leave. We live in a port city! We can never eliminate all risk, but clearly the risk here has been mitigated to miniscule and acceptable risk.
3. It provides numerous good jobs for the local community.

I could go on and on about how Canada needs to get its act togther and stop chasing things away, but you get the picture.

Rgrds,
Mike Armstorng, North Van District resident and voter.

[redacted]

From: LegislativeServices <LegislativeServices@burnaby.ca>
Sent: April 16, 2026 1:54 PM
To: Mike.Farnworth.MLA@leg.bc.ca; premier@gov.bc.ca; anne.kang.MLA@leg.bc.ca; rohini.arora.mla@leg.bc.ca; janet.routledge.MLA@leg.bc.ca; paul.choi.mla@leg.bc.ca; raj.chouhan.MLA@leg.bc.ca; wade.chang@parl.gc.ca; Beech, Terry - M.P.; jake.sawatzky@parl.gc.ca; CAOAdministration@metrovancouver.org; Peter.Xotta@portvancouver.com; Mayor and Council - DNV; mayorandcouncillors@newwestcity.ca; mayor@surrey.ca; npachal@langleycity.ca
Subject: Item 3.1 - Chris Bowcock - Burnaby Citizens Exposures to Chlorine Release Incidents
Attachments: Ltr to Hon. Steven MacKinnon Minister of Transport - Chemtrade Chlorine Production V2.pdf

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good Afternoon,

Please find attached letter from Burnaby Mayor Mike Hurley arising from the Special Burnaby City Council Meeting held on April 1, 2026.

Regards,

City of Burnaby
Legislative Services
Phone: 604-294-7290
City of Burnaby | Corporate Services
4949 Canada Way | Burnaby, BC V5G 1M2

Our Purpose: To create the city that we all want to live in and be in.

The City of Burnaby respectfully acknowledges that Burnaby is located on the ancestral and unceded homelands of the hən̓q̓əmin̓əm̓ and Sḵwx̱wú7mesh speaking peoples.

The contents of this email message are solely the writings, thoughts and/or ideas of the account holder and may not necessarily reflect those of the City of Burnaby. If you have any concerns regarding inappropriate use of this account please e-mail the postmaster@burnaby.ca

Any information (verbal and written) including personal information such as your name and address, submitted to Council, Committees, or heard and discussed at a public meeting is public information and will become part of the public record. This information may be published on the web unless the author specifically requests confidentiality. Any meetings broadcasted live on television, via the internet or via any other communication medium cannot be edited.

Item 3.1 - Chris Bowcock - Burnaby Citizens Exposures to Chlorine Release Incidents->Ltr to Hon. Steven MacKinnon Minister of Transport - Chemtrade Chlorine Production V2.pdf

CITY OF BURNABY
OFFICE OF THE MAYOR
MIKE HURLEY
MAYOR

April 14, 2026

The Honourable Steven MacKinnon
Minister of Transport
330 Sparks Street
Ottawa, ON K1A 0N5

Dear Minister MacKinnon,

I am writing on behalf of Burnaby City Council regarding the rail transport of liquid chlorine through Burnaby. At the April 1, 2026 Special Open Burnaby City Council meeting, Council adopted the following motion:

> **THAT** the Mayor, on behalf of Council, write a letter to the Honourable Steven MacKinnon, Minister of Transport Canada, expressing safety concerns with Chemtrade Chlorine Facility in the District of North Vancouver, and addressing issues with the transport of liquid chlorine via rail through densely populated areas in the Lower Mainland because of its intolerable risk to residents; and
>
> **THAT** a copy of the letter be provided to:
>
> - BC Minister of Transportation
> - Premier of BC
> - Burnaby MLAs
> - Area MPs
> - Rail
> - Metro Vancouver
> - Port of Vancouver
> - District of North Vancouver
> - City of New Westminster
> - City of Surrey
> - City of Langley
> - Chemtrade Chlorine Facility

For decades, liquid chlorine has been produced at Chemtrade (100 Amherst Avenue) in the District of North Vancouver, loaded onto rail cars, and transported through Burnaby.

The Port of Vancouver had indicated this practice would end in 2030. We have since learned that the Port intends to allow continued production and rail transport until at least 2044, conditional on Chemtrade moving production fully onto its site in the District of North Vancouver.

.....2

Although the manufacture of hazardous materials is prohibited under District of North Vancouver Zoning Bylaw, the District is considering a rezoning that would allow chlorine operations at the Chemtrade site, as an exception, on a permanent basis. This would extend liquid chlorine shipments through Burnaby for decades.

Burnaby is an increasingly urbanized city in Metro Vancouver. Our population density was 2,750 people per square kilometre in the 2021 Census and continues to rise. A derailment and chlorine release in Burnaby could have severe consequences for public health and safety. Chlorine is highly toxic and corrosive, with serious inhalation hazards.

Burnaby's limited land base means growth is being directed to transit-oriented areas in denser housing forms, such as multiplexes, townhouses, and high-rise towers. The Province of British Columbia has mandated minimum densities around SkyTrain stations and the Frequent Transit Network, and many high-growth residential areas in Burnaby are adjacent to the rail corridor—placing more residents in proximity to the risk from a derailment.

Despite the serious potential impacts on Burnaby residents, the City of Burnaby was not notified of the plan to continue production of liquid chlorine and its transport through our city. The City was not provided information or an opportunity to comment prior to the decision.

We request that Transport Canada:

1. Commit to informing the City of Burnaby of decisions that materially affect the transport of liquid chlorine through our community and provide an opportunity for municipal input.
2. Set out the regulatory requirements and enforcement approach for liquid chlorine rail movements through Burnaby.
3. Describe how Transport Canada supports municipal emergency planning, training, and resourcing for low-probability, high-consequence events involving chlorine.
4. Provide a presentation to Burnaby City Council on liquid chlorine transportation safety measures at the earliest opportunity.

The City of Burnaby recognizes the role that liquid chlorine production plays in safeguarding the nation's drinking water, as well as the importance of goods movement to our regional and national economy. However, as Burnaby and the region continue to grow, the routine transport of liquid chlorine through increasingly dense, transit-oriented neighbourhoods presents a risk that cannot be justified indefinitely. Over the long term, the potential consequences of a release in our community outweigh the benefits of continuing this practice.

.....3

We want to be a full partner in our national economy, and that must include a meaningful role for municipalities in decisions that place our residents in harm's way. Burnaby needs transparency about what is being moved through our community, and a clear plan—developed with affected municipalities—for how the federal government will reduce and ultimately eliminate the long-term risk associated with transporting liquid chlorine through densely populated areas.

Thank you for your attention to this matter of serious concern to Burnaby residents, now and into the future.

Yours Sincerely,

Mike Hurley
MAYOR

cc: Honourable Mike Farnworth, BC Minister of Transportation
Honourable David Eby, Premier BC
Honourable Anne Kang, MLA - Burnaby Centre
Rohini Arora, MLA - Burnaby East
Janet Routledge, MLA - Burnaby North
Paul Choi, MLA - Burnaby South-Metrotown
Raj Chouhan, MLA - Burnaby-New Westminster
Honourable Gregor Robertson – Vancouver Fraserview-South Burnaby
Honourable Terry Beech, MP – Burnaby North-Seymour
Wade Chang, MP - Burnaby Centra
Jake Sawatzky, MP - New Westminster-Burnaby-Maillardville
CN & BCRC Railway
Metro Vancouver
Port of Vancouver
Mayor & Council, District of North Vancouver
Mayor & Council, City of New Westminster
Mayor & Council, City of Surrey
Mayor & Council, City of Langley
Chemtrade Chlorine Facility

From: Pat Trainner [redacted]
Sent: April 16, 2026 3:58 PM
To: Mayor and Council - DNV
Subject: Decision re: Chemtrade electrochem

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello council members,

I would like to ask the question " Have you sourced another supplier for our drinking water"?
I would assume that you have, and the 40% of Canadians, and the 70% of Western Canadians that rely on this company to supply us with chlorine to treat our water supply will be privy to the new supplier you have?
I sincerely hope that this council is not naive to think that our neighbors to the south will readily supply us with chlorine?
Look at what has happened to Venezuela and Cuba! Don't think for a minute the US wouldn't stop delivering a much needed product to Canada! Maybe you plan on everyone boiling water before use?
I see this decision akin to removing the Iron Workers Bridge without an alternative solution.
I would appreciate everyone's thoughts and opinions. Maybe I'm just being paranoid.

Regards,

Pat

From: Michelle Castano [redacted]
Sent: April 17, 2026 11:30 AM
To: Mayor and Council - DNV
Cc: [redacted]
Subject: clean drinking water

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello Councillor,

During a time, when Canadian businesses, governments and consumers should be doing everything in their power to;

1. Stay local
2. Stay national
3. Embark on ensuring that every Canadian has fair and equal access to clean drinking water

Your level of government has decided to create what appears to be an unnecessary and complicating barrier to ALL 3 of these aspects.

I implore you to ensure that you work with the staff of this company to ensure that Canadians everywhere, continue to have safe and clean drinking water.

There is a solution to every problem- it is your role and responsibility to find it.

Best of luck in a quick resolve.

Thank you and have a good day,

Michelle Castano

From: DNV Input
Sent: April 20, 2026 2:01 PM
To: Mayor and Council - DNV
Subject: District of North Vancouver council has voted to stop a major waterfront industrial business from producing liquid chlorine at its site. Chemtrade and its predecessors have been making the chemical at the Amherst Avenue plant in Maplewood since 195...

Follow Up Flag: Follow up
Flag Status: Completed

The below is provided for information.

From: [redacted]
Sent: 2026-04-20 12:59:28 PM
To: infoweb@dnv.org;bowinn.ma.mla@leg.bc.ca
Cc: [redacted]

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Greetings, Mayor Little and Council.

Thank you for taking on the roles you have on behalf of the people of The North Shore.

TOPIC: District Council Votes To Stop Chlorine Production at Chemtrade Waterfront Location by 2030.

OBSERVATION:
My understanding is that the council and its members must consider all the facts and consult with credentialed internal and external experts, affected and Government officials, on issues where staff or council members lack the academic credentials to obtain and record factual information, thereby not enabling an informed decision.

COMMENT:
Everyone is entitled to an opinion, as well as to offer hearsay.
Everyone wants to be heard, recorded, and recognized for their contribution to the final decision.

RECOMMENDATION:
May I respectfully suggest that this matter be brought before the council again for a full review by experts who can withstand critical examination.
This would allow the council to vote again on the direct evidence concerning the needs and requirements of all parties involved.

Best Regards
Dave Brewer [redacted]

Dave Brewer

From: Pat Trainner [redacted]
Sent: April 22, 2026 6:44 PM
To: Mayor and Council - DNV
Subject: Chemtrade electrochem

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello councilors,

Last week I asked questions regarding the decision to deny Chemtrade electrochem, I'm bitterly disappointed that I've received no replies!
I decided to investigate the catalyst behind the scare tactics, K2 solutions, and boy talk about pulling the wool over councilors, sorry people's eyes!
Let me guess, K2 solutions will be the new chlorine supplier via their California plant. I wonder if they have a secret mode of transport that will appease the Burnaby mayor, and his ex fire chief? As we know the Burnaby mayor is worried about rail cars, maybe they'll fly the chlorine in?
Can someone please give me an answer, and put my mind to rest.

Regards,

Pat

From: Pamela Baxter [redacted]
Sent: April 22, 2026 8:59 PM
To: Mayor and Council - DNV
Cc: [redacted]
Subject: Chemtrade

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council

I was shocked that Chemtrades's application to move its production to land in the District was rejected.

Chemtrade has been a responsible and good corporate citizen. They pay taxes, they employ hundreds of people, and they value safety. They are important suppliers to the Canadian economy, the safety of the water we use.

I fear that lobbying efforts by Chemtrade's competitor have swayed Council.

I think that more investigation into Chemtrade's safety history and safety planning for the future is in order.

Please do not close the door on Chemtrade. You have time to re-think all the facts.

Sincerely,

Pamela Baxter

[redacted]

From: Zinner, Carolyn <CZinner@chemtradelogistics.com>
Sent: April 24, 2026 6:54 AM
To: Premier@gov.bc.ca
Cc: Mayor and Council - DNV; JEDI.Minister@gov.bc.ca; INF.Minister@gov.bc.ca; susie.chant.mla@leg.bc.ca; jonathan.wilkinson@parl.gc.ca; Rook, Scott; Jonsson, Amy; Robinson, Alan
Subject: Chemtrade - Taking steps to secure the future of our North Vancouver chlor-alkali facility
Attachments: Securing ongoing operations (Premier Eby) 04-26-2026.pdf

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good morning,

Please see the attached correspondence from Scott Rook, President & CEO, Chemtrade.

Many thanks,

Carolyn Zinner
Corporate Office Manager
Executive Assistant to Scott Rook, President & CEO
czinner@chemtradelogistics.com | Mobile: 647-972-2156
www.chemtradelogistics.com



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CHEMTRADE

The Honourable David Eby, M.L.A. and Premier of BC
Office of the Premier
PO Box 9041, Station Provincial Government
Victoria, BC V8W 9E1
Premier@gov.bc.ca

April 24, 2026

Dear Premier Eby,

Re: Taking steps to secure the future of our North Vancouver chlor-alkali facility

We would like to thank you for your ongoing support for our efforts to secure ongoing operations of our chlor-alkali facility, located in North Vancouver. As you know, the facility produces liquid chlorine that is used to protect drinking water for 70% of BC and Alberta. It's the largest chlorine producing plant in Canada representing 40% of Canadian capacity. We also produce hydrochloric acid and sodium hydroxide (caustic soda) which support several industries in BC and Canada that have a significant role to play in securing Canada's economic independence – like mining, the energy sector, technology and innovation, manufacturing, and pulp and paper.

Knowing the critical role we play in both securing safe drinking water and supporting key industries, as well as the broad support we have for our ongoing operations from the community and stakeholders, we were deeply disappointed with the decision by the District of North Vancouver Council, when they rejected our rezoning application at the April 13 Council meeting.

Since this decision, we have been working closely with members of the Provincial government to find ways to align with the Government of BC's priorities – like strengthening the economy, and securing safe drinking water for British Columbians, and finding ways to secure our long-term operations.

Enclosed is a letter signed by our North Vancouver employees, in support of our continued operations.

Given the province-wide and national importance of this issue, we urgently request an opportunity to meet with you to discuss our options moving forward, and potential next steps. We would also be happy to answer any question you may have or provide additional information on how the chemicals produced by our facility contribute to our economy at the local, provincial, and national levels.

Yours sincerely,

Scott Rook

Scott Rook
President and CEO
Chemtrade
Srook@chemtradelogistics.com

CHEMTRADE

CC: The District of North Vancouver Mayor and Council
council@dnv.org
The Honourable Minister Ravi Kahlon, Minister of Jobs and Economic Growth
JEDI.Minister@gov.bc.ca
The Honourable Minister Bowinn Ma, Minister of Infrastructure
INF.Minister@gov.bc.ca
Susie Chant, M.L.A. for North Vancouver- Seymour
susie.chant.mla@leg.bc.ca
Jonathan Wilkinson, M.P. for North Vancouver – Capilano
jonathan.wilkinson@parl.gc.ca

Enclosure (1)



CHEMTRADE

The Honourable David Eby, M.L.A. and Premier of BC
Office of the Premier
PO Box 9041, Station Provincial Government
Victoria, BC V8W 9E1
Premier@gov.bc.ca

April 24, 2026

Dear Premier Eby,

We are writing you this letter on behalf of the 118 employees of the Chemtrade North Vancouver chlor-alkali facility, asking for your government's support for our ongoing operations, and ability to secure long-term certainty.

The facility has been a safe, and responsible operator since 1957, and it isn't uncommon to see several generations of the same family working here. People have come to work here knowing they could build a good career, with a livable wage, and support families.

The employees of this facility not only work to secure products which are critical to securing safe drinking water for millions of Canadians, but products that support critical Canadian industries like the energy sector, mining, manufacturing, technology and innovation, and pulp and paper.

To have the future of the facility decided by a seven-member Council, without consultation with other communities, the Province, or the industries that rely on the products produced at the North Vancouver facility is shameful, and we – the undersigned - are respectfully asking for the support of the Province of BC to help us secure long-term operations.

Sincerely –

Chemtrade North Vancouver Employees

CHEMTRADE

Name	Signature	Address
Randy Baker	[redacted]	
R.D. Hampton		
Jason Feenstra		
Brodie Pulles		
Shawn Sauer		
Cody Maas		
Cliff Pipe		
JEFF CASWELL		
Devin Webb		
Lex Kao		
MARS Poon	[redacted]	
Mitch Danforth		
Julie Fang		
Rose Azarifar		
Lukee Gulka		
Jerrod Scribner		
Rutik Kamani		

CHEMTRADE

Name	Signature	Address
Ricky Mundt	[redacted]	
TIM HOGETERP		
ADAM WIFFEN		
Marco Bulfone		
Caden Roth		
JARED ANDERSON		
Sammy Tu		
Dino Facchin		
Zach Kyk		
Pawel Parowicz		
Patsy Choong		
Allen Hone		

CHEMTRADE

Name	Signature	Address
Abhishek Malik	[redacted]	
David Perdue		
Vince Dimisa		
Shashi Gaur		
EhsanNARAGHIAN		
Aadrita Anjishu		
Sean Lavoie		
JUSTIN RAMAK		
Dan DeCook		
Ryan Picard		
Andreas Biniaris		

CHEMTRADE

Name	Signature	Address
Paul Dobray	[redacted]	
TREVOR CAWDELL		
Chelsea Pothier		
Dylan Shymko		
Sahad Vasanji		
Fury Brooks		
Pavanee Bhular		
Bert Wager		
Alvin Lo		
Payam Farahbakhsh		
MARK MIOR		
DON SCHULTHEISS		
SIMON LEWIS		
Marie Sirois		
SHARON RAMONS		
DUNCAN JOHNSON		
RUSS SINCLAIR		

CHEMTRADE

Name	Signature	Address
Jen Vandenbrink		
Randie McAllister		
Konstantine Filis		
Andrew Kan		
Phoebe Yap		
KRIS PETTERSON		
DAN GINEA		
Kevin Dodd		
Daniel Auras		
KHAIRUL ANAM		
John Meredith		
Robert Bowen		
Travis Ciofani		
Tomas O Stowe		
Andrew Noeth		
Angelo Soh		
Seth Grotkin		

[redacted]

CHEMTRADE

Name	Signature	Address
NEVIN THANDI	[redacted]	
Tai Choi		
Mohamed Ali		
EWAN MACADIE		
Harpreet Johal		
Roman Alexandrov		
Mykola Lyfar		
Glenn Sweflishoff		
Chuck Ritchie		
CHARLES AUBE		
Nick Malchuk		
Devon Choma		
Sean Watkins		
Lucas Franssen		
Anthony Buksa		
Farshad Foroughi		
Julian Russell		

CHEMTRADE

Name	Signature	Address
Logan Pilipow	[redacted]	

CHEMTRADE

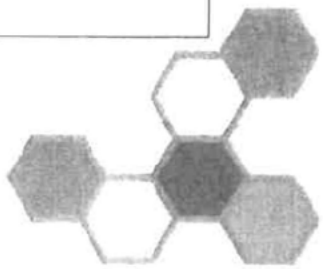
Name	Signature	Address
George Pinkernell	[redacted]	
Sam Salari		

CHEMTRADE

Name	Signature	Address
PETER FILIPOWSKI	[redacted]	

CHEMTRADE

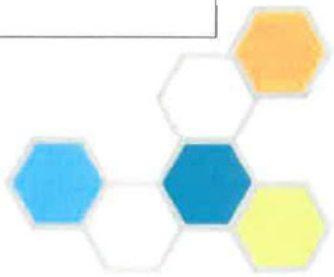
Name	Signature	Address
DAVID SCOTT MASTER	[redacted]	



Name	Signature	Address
Murray Hames	[redacted]	

CHEMTRADE

Name	Signature	Address
Chris Poskitt	[redacted]	



CHEMTRADE

Name	Signature	Address
MAEK MIOR	[redacted]	
KAIN EBERLE		
Jeff Motuzas		
Aaron Lim		
Andrew Robb		
Lucas Fraser		
ROB BUTT		

From: Andrea Davidson [redacted]
Sent: April 26, 2026 10:02 AM
To: Mayor and Council - DNV
Subject: Chlorine plant

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello,

I am a North Vancouver District member, and I am against the decision to not renew Chemtrade's facility operations.

The company has been open since 1957. They employ 120-180 people. These are well paying, blue collar jobs. Exactly what we need to stay here.

There was clearly a hit job by a competitor in Toronto to have the council come to the very decision to reject the proposal.

https://www.cbc.ca/news/canada/british-columbia/north-van-chlorine-plant-campaign-1.7319259

I do remember seeing those ads and feeling worried. But knowing what I know now it is clearly obvious a competitor would want this plant to close. We have to think critically about this. Of course safety is of utmost concern. But there is 4 years to come up with valid safety protocols in order to keep everyone safe. I went through the proposal for the community, and it states it would have less chlorine on site than previous with the ship model.

Not to mention that their company supplies 40% of the chlorine for CANADIAN DRINKING WATER. Even if you think the risks outweigh the benefits, the only thing that should get you to reconsider in order to find ways to make it safe is for our drinking water!

I would like to see the report that one council person described as "scary". It should be made public. Because how strong is everyone's science background on the council? I would be interested in knowing this. Until you can describe with perfect knowledge how this new model is so much more dangerous than the previous one that has been going on for decades I would love to know.

Thank you for your time.

Andrea Davidson
[redacted]

From: Lana Payne <Lana.Payne@unifor.org>
Sent: May 11, 2026 11:53 AM
To: Mayor's Office DNV; Mayor and Council - DNV
Cc: arobinson@chemtradelogistics.com; INF.Minister@gov.bc.ca; JEDI.Minister@gov.bc.ca; WLRS.Minister@gov.bc.ca; Susie.Chant.MLA@leg.bc.ca; jonathan.wilkinson@parl.gc.ca; Community.Feedback@portvancouver.com; ajonsson@chemtradelogistics.com; Gavin McGarrigle
Subject: Request for Review of Chemtrade Logistics
Attachments: Request for review of Chemtrade Logistics lease extension decision_05112026.pdf

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good day,

Please see attached correspondence on behalf of Lana Payne, Unifor National President.

Kind regards,

Iulia Dumitru-Scott

Executive Administrative Assistant
National President's Office

UNIFOR

/idscope343
Mobile: 647-376-5939
115 Gordon Baker Road, Toronto, ON, M2H 0A8

Request for Review of Chemtrade Logistics ->Request for review of Chemtrade Logistics lease extension decision_05112026.pdf

National Office
115 Gordon Baker Road
Toronto, ON M2H 0A8

UNIFOR
theUnion | lesyndicat

Bureau National
115 chemin Gordon Baker
Toronto (Ontario) M2H 0A8

Len Poirier
National Secretary-Treasurer
Secrétaire-trésorier national

Lana Payne
National President
Présidente nationale

Daniel Cloutier
Quebec Director
Directeur québécois

May 11, 2026

Via Email

To: Mayor and Council, District of North Vancouver

From: Unifor Energy and Chemical Industry Council

RE: Request for review of Chemtrade Logistics lease extension decision

Dear Mayor and Council,

We are writing to express our support for the continued operation of the Chemtrade Logistics facility in North Vancouver. We are requesting a review of Council's April 14 decision that rejected the company's rezoning and lease extension application.

Members of Unifor Locals 601 and 697 operate and maintain the North Vancouver Chemtrade facility.

Unifor represents 3,000 workers in over 60 collective agreements in Canada's chemical products industry.

In addition, our 9000 rail members ensure the safe loading, inspection, and transportation of these essential products in Canada and make specialized tank cars that transport these types of chemicals by rail safely.

We believe that the rejection of this lease extension should be reconsidered. The decisions will have negative impacts on both local safety and national supply chain security of products produced at the facility.

Unifor urges your Council to consider the following:

Our members believe worker and community safety are directly linked.

Our members work at the Chemtrade facility, but they also live in North Vancouver and the surrounding neighbourhoods. They have vested and personal interests in ensuring this facility operates safely.

Our Unifor locals maintain active joint Health and Safety (H&S) committees at the site. Our national union provides staff and information supports directly to our locals on health and safety.

As a union, we act as an independent, organized voice that is never afraid to point out problems or demand rigorous maintenance standards. The planned investments and upgrades by Chemtrade were actively supported by our members because they represent a commitment to modernized infrastructure, enhanced operational safety, and the long-term well-being of the facility and community.

Sovereignty and regulatory integrity is supported by continued operation of the facility.

The North Vancouver facility is Canada's largest producer of chlorine products, supplying over 40% of the country's drinking water treatment needs.

Unifor thinks it is essential to retain this production in Canada under our modern regulatory frameworks. The closure of this facility does not eliminate the need for chlorine products, it simply shifts or offshores its production.

By continuing to produce these chemicals locally, we maintain the institutional capacity to regulate hazardous materials properly within both government and industry. In doing so, we keep this critical supply chain under the rigorous oversight of Canadian labour and environmental standards.

Safe production and transport is what our members do.

The Unifor Energy and Chemical Council's philosophy is that community safety is guaranteed by the workers who maintain and operate the infrastructure. This is outlined in our "Keep It in the Pipe" campaign, where our focus in on safe and reliable production, storage, and transport of all energy and chemical products through proper investment in workers who ensure that.

In addition, Unifor rail members ensure the safe shipment of these chemicals across the country every single day.

A localized, unionized workforce operating an upgraded, well-maintained facility represents the safest possible method for producing and distributing the chemicals that keep our drinking water safe.

Given the above, we ask that you reconsider this decision. Denying the lease extension halts critical investments that would make the facility safer and more efficient.

We would welcome the opportunity to meet with Council to discuss our perspective as the workers who maintain this critical infrastructure.

Sincerely,

Lana Payne
National President

Dirk Tolman
Chairperson, Unifor Energy Council

Cc: Alan Robinson, GVP Commercial, Chemtrade

District of North Vancouver Council

Minister Bowinn Ma

Minister Ravi Kahlon

Minister Randene Neill

MLA Susie Chant

MP Jonathan Wilkinson

Vancouver Fraser Port Authority

Amy Jonsson, Director, Corporate Communications, Chemtrade Logistics

Gavin McGarrigle, Western Regional Director, Unifor

/idscope343

From: Esther Chase [redacted]
Sent: May 11, 2026 6:30 PM
To: Mayor and Council - DNV
Subject: the proposed shipment of chlorine.

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Members of Council,
I urge you to uphold the former decision not to allow the shipment of chlorine through North vancouver.
Any spill of any kind would be a disaster; especially given that we have only 2 bridges that currently do not meet even regular needs without backups and occasional gridlock.
No potentially dangerous chemicals should transit the North Shore given the lack of infrastructure and continual developments.
Please use your positions of responsibility to uphold avery thoughtful former decision,
Thank you,
Esther Chase

From: Kathy McGrenera [redacted]
Sent: May 12, 2026 5:43 AM
To: Mayor and Council - DNV
Subject: Chemtrade extension

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello,

I'm writing to oppose the extension to the Chemtrade and to ask you to uphold your previous decision. We don't need such a dangerous production do near a large population centre.

Thanks for your consideration.
Kathy McGrenera
[redacted]

From: Ken Harrison [redacted]
Sent: May 12, 2026 10:56 AM
To: Mayor and Council - DNV
Subject: Chemtrade Electrochem Inc.

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Council:
As a resident of the North Shore for over 80 years, the past 35 in North Vancouver, and a weekly walker in the Wild Bird Trust area of Maplewood Flats, I commend you on your recent decision to reject the proposal from Chemtrade Electrochem Inc. to extend its permitted operation.

I urge you to reject the revised application from Chemtrade.

When I was a child here, there was no Highway 1, nor the Ironworkers' Memorial Bridge. The population of the North Shore was far, far lower and the establishment of the original plant over 65 years ago (by Hooker Chemical?) had very little impact on the surrounding area.

It's not a question of whether an accident will occur, it's a question of when. This is no longer a suitable location for the production and transportation of chlorine. Traffic is heavy all day, every day, on both Highway 1, Dollarton Highway and Mount Seymour Parkway. Housing in the area has greatly increased, and is now being further expanded with apartments under construction near the site. A large shopping centre and restaurants are well established in the neighbourhood. In the event of a gas escape, traffic would impede both efforts to evacuate the area and to permit emergency services to access it. Prevailing winds would carry the deadly gas quickly into the residential area east of Highway 1, including the First Nations community along Dollarton Highway.

Re-zoning the area to accede to Chemtrade's application would forever prevent the area from changing to a more acceptable use.

Please uphold your earlier decision to reject Chemtrade's proposal.

Ken Harrison
North Vancouver, BC

From: DNV Input
Sent: May 13, 2026 9:54 AM
To: DNV Input
Subject: Chemtrade / District Decision article and editorial

From: [redacted]
Sent: 2026-04-12 2:27:55 PM
To: infoweb@dnv.org

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Can you please Make sure that Mayor and Council get this before they make the decision on the chlorine plant. Thank you

-------- Forwarded Message --------
Subject: Chemtrade / District Decision article and editorial
Date: Sun, 12 Apr 2026 14:23:54 -0700
From:G C [redacted]
To: North Shore News <editor@nsnews.com>

Dear Editor:

I just read your editorial 'Element of concern' and Brent Richter's article that details concern the Burnaby council has about Chemtrade plant in North Vancouver and chlorine. So I decided to do a web search on the two opposing companies, Chemtrade and K2 Pure Solutions, in order to do a comparison.

My first reaction was that I feel sorry for all those people at Burnaby's council meeting. The sadness I feel is that their instilled fear of chlorine is going to do more harm to their health then chlorine is going to do.

Now the comparison:

Both companies are headquartered in Toronto. K2 has one plant in Pittsburg, California while Chemtrade has plants located in the North Vancouver;Prince George ,BC; Saskatoon ,SK; Anacortes, WA; and Brazil. From an employment point of view, Chemtrade employs more Canadian and way more in BC. My sympathies are always with Canadians whether its Trump or K2.

Both Pittsburg and North Vancouver us electrolysis to produce chlorine. North Van liquefy chlorine whereas Pittsburg combines it the liquid sodium hydroxide to produce a bleach the is about 12% chlorine. Both products are shipped widely. Both when spilled release chlorine gas that poses the same hazard to people. It is foolhardy to believe that ones product is more dangerous than the other. A look at the shipping container specification show that liquefied chlorine has a higher standard that the 12% chlorine bleach one, that is, chlorine tank cars are a lot stronger and can withstand more pressure . I find it a strange coincidence with the 12% product that on April11,2026 released chlorine as a result of an accident at Victoria's Crystal Pool that sent eight people to hospital, none with life threatening injuries. I will leave this for readers- we should respect all chemicals as they can all cause harm. Chlorine has the advantage that is can be smelled at low concentrations when it is invisible and causes little harm, so turn around walk away and up wind. Should a greenish gas be visible, immediately walk upwind and consider sheltering in place, if in a house, close all doors and turn of any equipment bringing air int the

house. If in a vehicle,turn around if possible and keep windows closed and air conditioning off. Both vehicle and houses have enough breathable air to keep you safe for hours and days while emergency responders' actions will make it safe again. Whereas an odourless, colourless gas like carbon monoxide can kill us without giving notice.

In making decisions, one must consider historical data. Does it happen regularly or once in a blue moon? This determines the relative safety. I have not seen big areas around the North Vancouver plant evacuated. Like earthquakes it can happen and all we can do is to have a mental plan of what to do if, so should we be in the situation, our fast decisions will give us the greatest safety.

The other concern is that adversaries use every tactic to gain an advantage. This often happens by presenting their interpretation of studies' result. Most of us are not equipped to interpreting data in different ways. This is very damaging to listeners as it instills fear that can have adverse medical consequences. Both of these companies use salt to produce their products. We should learn to take what they say with the proverbial grain of salt. Watch it though that medically, too much salt is bad for us.

From: Alex Jamieson [redacted]
Sent: May 22, 2026 10:55 PM
To: Mayor's Office DNV; Jordan Back; Catherine Pope; Betty Forbes; James Hanson; Herman Mah; Lisa Muri; Mayor and Council - DNV
Subject: Chemtrade rezoning - opposition

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council:

As a City Planner, I am am writing to Council simply to state that it is poor land use planning to zone a property for a chlorine plant in a populated area, period. The Chemtrade Chlorine plant is a legal non-conforming use which the District should work towards phasing out.

Please use your power to end this dangerous situation.

Alex Jamieson, B. Arch, Registered Planner (retired).

[redacted]
North Vancouver

From: Eoin Finn [redacted]
Sent: May 23, 2026 1:32 PM
To: Mayor and Council - DNV
Subject: Chemtrade Application - we are opposed

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Mayor & Council May 23, 2026

District of North Vancouver

Via email to council@dnv.org

We, Force of Nature (North Shore), are opposed to the production of toxic chemicals on the North Shore.

On April 14, 2026, the District of North Vancouver rejected a proposal from Chemtrade to continue operating its chlorine plant past 2030, a decision largely driven by safety risks associated with the rail transport of liquid chlorine through areas like Burnaby. Chemtrade, is a longtime heavy industry in the Maplewood area of the North Shore, and, citing new evidence, has again applied to the District for an extension of its property lease. District Council will hear the revised application at its May 25th meeting.

The key issue in Council's decision is the safety of Chemtrade's chlor-alkali product. Widely used in treating municipal water supplies to achieve public health standards, it is highly toxic, as are some of the by-products – caustic soda, chlorine and hydrogen- of the manufacturing process. The product is shipped in railcars to customers in the BC Interior and beyond.

Mindful of indications that chlor-alkali water treatment produces harmful by-products, many municipalities, including all of Metro Vancouver, have switched to using UV irradiation and other methods to treat water to potable standards.

Critics have argued that manufacturing such dangerous chemicals has no place in a densely populated area of the Lower Mainland, and is better located elsewhere. The city of Burnaby has expressed concern with railcar-loads of chlor-alkali transiting through its neighbourhoods. Burnaby cited a risk assessment report indicating that a chlorine release from a rail car could kill over 2,000 people in Burnaby (on average, four liquid chlorine rail cars travel through Burnaby daily). Chemtrade has cited its safety record and proposed to implement some new safety measures if granted the extension.

We at Force of Nature Alliance (North Shore) are concerned that Council is being unduly pressured to reverse its previous rejection decision. We request that you (Council) uphold your earlier decision on the matter. It is well past time to cease the production / transit of toxic chemicals in/through densely-populated areas.

Yours truly

Eoin Finn B.Sc.,

Ph.D., MBA

Chair, Force of Nature
Alliance (North Shore Community Action Team)

From: Peter Teevan [redacted]
Sent: May 23, 2026 1:41 PM
To: Mayor and Council - DNV
Subject: Chemical tank in California - right now

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

I wonder how long this one was “deemed safe” by some limited QRA before it was not safe?

At least they have some warning there…40,000 people evacuated so far…

You have the opportunity Monday night to avoid this - but with your names on it.



California governor declares state of emergency due to overheating chemical tank | CBC News
cbc.ca

Peter Teevan
Sent from my iPad

From: Marcia Stephenson [redacted]
Sent: May 23, 2026 2:35 PM
To: Mayor and Council - DNV
Subject: May 25 Agenda Item 8.2: Bylaw 8778, Reconsideration of Chemtrade 100 Amherst Avenue

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

To Mayor and Councillors:

RE: May 25, 2026 Agenda Item 8.2: Bylaw 8778, Reconsideration of 100 Amherst Avenue (Chemtrade)

We are homeowners in Lynn Valley, living within the margin of a 4-kilometre radius of potential risk from an escape of deadly chlorine gas at the Chemtrade plant on Amherst Avenue. As concerned voters, we urge you to uphold the April 14th decision by Council to reject the rezoning proposal brought by Chemtrade, a proposal requesting Council rescind its longstanding prohibition against manufacturing hazardous substances on DNV lands. After reading the Council meeting minutes and reports related to this decision, we've concluded that this facility is much too dangerous to continue operating in a densified urban area.
Our reasons for reaching this conclusion are summarized below:

1. The fact that the Vancouver Fraser Port Authority will prohibit the production of liquid chlorine by Chemtrade on land under VFPA jurisdiction beyond 2030 should be a red flag to our municipal representatives, who are charged with protecting the safety of the citizens who elect them. We should not be weakening our civic environmental safety regulations to allow expansion by a private corporation whose federal lease is expiring.

2. When this plant was first opened by the former Hooker Chemical in 1957, the pulp mills of BC were booming, requiring a supply of bleaching compounds to turn forest industry wood waste into paper. As the population of North Vancouver District was only 26,000 that year, we surmise that a comparatively isolated location near the harbour and rail systems must have seemed an ideal spot for manufacturing chlorine products. The Ironworkers' Memorial Bridge and highway over it were still under construction. But none of these historical conditions holds true today. BC forestry and wood fibre processing are in decline, bridge traffic backs up for hours each day near the plant, and DNV population has quadrupled. Our OCP calls for continued residential densification in the nearby Lynn Creek and Maplewood areas. The Chemtrade plant is an anachronism from an extractive era, a hazardous operation that should be relocated far away from an urban area. The company should save the money it has promised to spend on upgraded security measures and redirect those funds to build a new plant elsewhere.

3. Across the Inlet, the City of Burnaby has cited a risk assessment that estimated a chlorine release from a rail car could kill over 2,000 people. On average, four liquid chlorine rail cars per day associated with Chemtrade's activities are moving along local tracks. I remind Council that in June 2022, a cloud of toxic chlorine gas leaked by equipment failure was released over the port of Aqaba, Jordan, killing thirteen people and injuring more than 265. While we may reassure ourselves that official investigative findings of "*deficiency and negligence in safety protocols for dealing with hazardous materials"* are rare in North America, accidents do happen. As we write, 40,000 people in southern California have been forced to evacuate while fire crews monitor the potential explosion of toxic chemicals at a plastics factory where safety systems have failed.

4. Chemtrade's presentation for the April 14 meeting included technical reports from consultants who calculate risk, attempting to reassure a skeptical public with probability figures predicting that accidents would be rare. The company cited their investment in newer, more reliable technology and upgraded processing safeguards. I respect the expertise of these consultants and credit Chemtrade for their conversion to more modern equipment. But there is no such thing as a risk of zero. We need only recall the tragic accident at the Cleveland Dam in 2020, resulting in the deaths of 2 North Vancouver residents and the emergency evacuation of others. The investigation by Metro Vancouver concluded that a primary contributing factor was human error related to programming of the spillway gate control system.

5. While some have argued against closing a facility that supplies a form of chlorine used in water purification, our region does not buy Chemtrade's products to treat the drinking water flowing in Metro Vancouver pipes. A process involving ultraviolet light and ozone is used instead. The lead-up to the VFPort Authority closure deadline would give this company time to scout new sites for manufacturing a product used in other parts of Canada. Chemtrade refuses to disclose their customer list or the countries they ship to, citing trade secrets they prefer to keep shielded from competitors. Perhaps one of those mystery customers could recommend a site for a new plant in a more suitable location.

6. Some speakers on April 14th cited the negative economic impact on local employment and tax revenue as a reason to exempt Chemtrade from DNV's prohibition on hazardous manufacturing operations. We maintain that the potential risk to human health and safety is too high a price to pay for 120 jobs in this risky business. That very risk factor may have a negative impact on investment and employment in other enterprises in the Maplewood area, newly alerted to the potential jeopardy of permitting Chemtrade operations to expand in their neighbourhood. As homeowners in either the City or District of North Vancouver for 43 years, we are acutely aware of the forces causing fiscal strain on local government, resulting in rising taxes. Our children and their young families live here too, caught up in a cost-of-living crunch that our generation of retirees did not have to face. But we refuse to barter away their safety for the promised payoff of tax dollars from Chemtrade or a successor company. It's our understanding that once we ease the restriction on hazardous activity at this site, it must remain legally open to such operations in perpetuity. Let's not cross that line.

7. An evacuation plan involving North Shore Emergency Management and North Shore Fire & Rescue Services was cited at the April 14 meeting. A disaster management scheme would be co-ordinated by CHLOREP, a cross-border industry association of Canadian and US companies. Shelter-in-place orders and the Alertable phone app were mentioned as components of this strategy. As residents of a condominium in Lynn Valley, we were shocked and saddened to witness the nearby fire at Silverlynn apartments just over a year ago in May 2025. All three North Shore municipal fire departments were required to deploy crews and specialized vehicles to the scene for over 24 hours, with firefighters aiming high-pressure water nozzles from ladder trucks equipped with articulated aerial "buckets." What if an incident at Chemtrade had spiraled out of control simultaneously, perhaps due to an earthquake? Where would excess manpower and equipment have come from? The shelter-in-place order is not reassuring either. While we keep a small stockpile of emergency food and water in our unit, air circulation and temperature control in a multi-storey building are vital to our survival as seniors, especially during heat domes. What happens when air intake and cooling systems are shut down for hours to reduce exposure to toxic fumes or smoke?

8. Lastly, the terrorism factor. In 2009, Canexus (former operator of the plant acquired by Chemtrade in 2017) planned to relocate around 50 rail cars carrying toxic chlorine gas to train tracks in a small town in Washington. The scheme, which was met with opposition on both sides of the border, was part of a regional security plan to prevent accidents or potential terrorist targeting of hazardous materials in locations near venues of the 2010 Vancouver Olympics. Canexus made the decision to shut down its North Vancouver operations for over a month, timing this work stoppage to overlap with the Olympics. With both international and domestic terrorism on the rise since 2010, along with new threats from drones, weaponized vehicles, AI takeovers of automated systems, and ransom threats from computer hackers, why have we heard nothing about safety preparations for sites such as Chemtrade during the impending influx of visitors for the FIFA tournament? Perhaps the silence is part of risk management.

Thank you for your continued close scrutiny of the consequences of this rezoning decision,

James and Marcia Stephenson

[redacted]

From: Alex Jamieson [redacted]
Sent: May 23, 2026 7:51 PM
To: Mayor's Office DNV; Jordan Back; Catherine Pope; Betty Forbes; James Hanson; Herman Mah; Lisa Muri; Mayor and Council - DNV
Subject: objection to Chemtrade rezoning in light of and recent California chemical tank emergency

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council:

This is in addition to my previous email in which I opposed the continued production and transportation of Chloral-alkali by Chemtrade in North Vancouver. Since then there has been widespread news reporting of an ongoing incident regarding a dangerous chemical product in Southern California which resulted in evacuation of about 40,000 people. See attached news report. California governor declares state of emergency due to overheating chemical tank | CBC News

The chemical is methacrylate, which has medical consequences but probably not death unless there is an explosion, unlike Chlorine gas which has potential to kill 2000 people in Burnaby.

Please do whatever you can to eliminate the production and transport of hazardous chemicals on the north shore. Take a warning from California.

Alex Jamieson
North Vancouver

> On May 22, 2026, at 10:54 PM, Alex Jamieson [redacted] wrote:
>
> Dear Mayor and Council:
>
> As a City Planner, I am am writing to Council simply to state that it is poor land use planning to zone a property for a chlorine plant in a populated area, period. The Chemtrade Chlorine plant is a legal non-conforming use which the District should work towards phasing out.
>
> Please use your power to end this dangerous situation.
>
> Alex Jamieson, B. Arch, Registered Planner (retired).
>
> [redacted]

From: Michelle Sheardown [redacted]
Sent: May 24, 2026 5:41 PM
To: Mayor and Council - DNV
Subject: Opposition to 8.2 Bylaw Reconsideration

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Mayor Little and Councillors,

Before commenting on 8.2, I wish to express my admiration and support for the North Shore Young Civic Forum and their proposals, all of which are very well prepared and deserving of Council's consideration.

With respect to item 8.2, there is no good reason to reconsider the previous decision made. In fact, there are many reasons not to.

1. Risks from deadly chlorine gas are unacceptable. The risks are so great that during the 2010 Olympics, the rail cars were sent from North Vancouver to Washington State because they presented a security threat. See Chlorine and Olympics a Dangerous Mix? (Tyee/Vancouver Observer, 30 Nov. 2009).

The entire Maplewood Village Centre falls well inside the toxic endpoint distances modelled for even small industrial chlorine releases.

A gas cloud, which could, for example, be caused by earthquake, human error, or acts of terrorism, is dangerous enough to cause irreversible injury or death to someone exposed to it at 400-500 m. The closest Maplewood Village Centre residential development is approximately 400–500 m from 100 Amherst Avenue.

The chlorine alternative release toxic endpoint is 1,800 m and the chlorine worst-case toxic endpoint is 5,300 m. That is over 5 km away from the plant. I understand the District has taken the position that matters which are geographically beyond the municipality's boundary are outside of its jurisdiction. If a gas leak originates within the District with potential consequences 5 km away, it is no wonder Burnaby Council felt it necessary to review the issue.

2. Zoning for a non-conforming use is a poor planning decision generally, and is also inconsistent with the District's OCP. Within the Vision of the OCP Action Plan at p. 1, the District writes "Our young have safe and healthy environments in which to grow and succeed...Our network of well designed, livable centres provides a wide range of housing options...". And included in the Goals on p. 3 is to "Foster a safe, socially inclusive and supportive community that enhances the health and well-being of all residents." Rezoning to allow for a facility that produces deadly chlorine gas is inconsistent with these values.

While California declares emergency as fire crews race to contain toxic leak (BBC, 24 May 2026), all is currently well in Maplewood Village. It is incumbent on this council to keep it so.

3. The supply issue is a non-starter. This issue appears to be a red herring. Much has been made of the importance of what Chemtrade produces when, in fact, no facility in Metro Vancouver uses their product and water disinfection is increasingly using alternatives such as UV.

Please do not reconsider the decision you made on April 13, 2026. Chemtrade does not deserve a second kick at the can and residents don't deserve to have this facility in their backyards.

Sincerely,

Michelle Sheardown
DNV resident

From: Jel Coward [redacted]
Sent: May 24, 2026 6:16 PM
To: Mayor and Council - DNV
Subject: Chlorine plant

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and council

I write to express my concern around the issue of the chlorine plant.

I was reassured and delighted when I heard your previous decision which seemed it would lead to an end to chlorine manufacturing in our urban area.

Now, I'm hearing that this could possibly be reversed.

I implore you to think deeply about this and ensure an end to chlorine manufacturing in, and transport from, this populated area.

Kind regards

Jel Coward MD

From: Charlene Wood [redacted]
Sent: May 24, 2026 6:27 PM
To: Mayor and Council - DNV
Subject: Re: Chlorine plant extension

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Council,

I am against extending Chemtrade's existence on the North Shore. As a long time resident, the manufacturing and transportation of a dangerous chemical in a densely populated area has always been a concern.

I urge you to vote no on this application.

Regards,

Charlene Wood
[redacted]
North Vancouver

From: Rebecca Lindley [redacted]
Sent: May 24, 2026 8:32 PM
To: Mayor and Council - DNV
Subject: reject the proposal re Chemtrade... please

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

as a parent, healthcare provider and environmentalist
i implore you to reject the Chemtrade proposal being reviewed on May 25th

this cannot continue in our communiyt and should NOT receive rezoming approval, as DNV would never be able to require a different business in this location in the future.

please take the right stance on this important issue

Rebecca Lindley
Physician
North Vancouver

From: BETTY OSLER [redacted]
Sent: May 24, 2026 11:05 PM
To: Mayor and Council - DNV
Subject: Chlorine Plant

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Council, I am writing with regards to Chemtrade's proposal to extend their working hours past 2030. I live in the Dollarton area and thus am downwind of this plant. I have always had concerns about this plant due to the toxicity of chlorine gas. I would like council to vote against allowing Chemtrade's proposal.
Regards
Betty Ann Osler
Sent from my iPhone

From: KALEDEN IRRIGATION DISTRICT <kaledenirrigation@gmail.com>
Sent: May 25, 2026 8:34 AM
To: Mayor and Council - DNV
Subject: Re: Chemtrade Logistics

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor Little and City Councillors,

I'm writing to you on behalf of the Kaleden Irrigation District, a South Okanagan drinking water purveyor.

The Kaleden Irrigation District Board of Trustees read with dismay recent news concerning the District of North Vancouver's council close decision to reject a proposal to allow Chemtrade Logistics to continue producing liquid chlorine at their North Vancouver facility beyond the end of this decade.

While we fully respect concerns related to the transport of chlorine and other risks associated with chlorine production, we also note reported expressions of interest by Chemtrade Logistics to continue working with local and provincial governments to find solutions to the problems being dealt with by North Vancouver council.

We also understand Chemtrade Logistics has operated safely in North Vancouver since 1957.

We are very concerned about the broader implications of council's decision, as we understand that 70 per cent of Western Canada's supply of chlorine used for water purification comes from this facility.

The Kaleden Irrigation District Board of Trustees respectively urges North Vancouver council to see their way to continuing further discussions with Chemtrade Logistics in the hopes of finding a workable solution that will ensure Western Canada a continued and reliable supply of water purification chlorine in the years to come.

Sincerely,

Steve Arstad,
Chair, Kaleden Irrigation DIstrict
250-497-5407

Kaleden
Irrigation District

119 PONDEROSA AVE. KALEDEN, BC V0H 1K0
PH & FAX 250-497-5407
email: kaledenirrigation@gmail.com
web: kaledenirrigation.org

Sign up for Voyent Alert to receive water system notifications:
https://voyent-alert.com/community/

From: [redacted]
Sent: May 25, 2026 9:48 AM
To: Mayor and Council - DNV
Subject: Chemtrade's Revised Application

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

I was dismayed to read in the North Shore News that a motion will be put forward tonight to reconsider a revised version of Chemtrade's application to continue to manufacture the deadly chlorine gas on District lands.

Council has a duty to protect the health and welfare of its residents and this should come before any other so called 'benefits' argued by proponents. Is council aware that there are other methods to purify water? Many municipalities, including all of Metro Vancouver are using ultraviolet light and ozone for this purpose.

Please uphold your decision to reject Chemtrade's proposal.

Thank you,
Patricia Mason
District Resident

From: Trey Bell [redacted]
Sent: May 25, 2026 12:03 PM
To: Mayor and Council - DNV; Mayor's Office DNV
Subject: Opposition to Chemtrade Rezoning Application and Continued Chlorine Production Past 2030

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

I am writing to express my strong opposition to approving Chemtrade Electrochem Inc.'s application to continue chlorine production operations past 2030 in the District of North Vancouver.

I appreciate Council's previous decision on April 14, 2026, to reject the rezoning application, particularly given the significant public safety concerns surrounding the production and transport of liquid chlorine in densely populated urban areas.

As you know, liquid chlorine rapidly vaporizes into chlorine gas if released from pressurized containment. Chlorine gas is extremely hazardous and can travel considerable distances depending on wind and weather conditions. The daily transportation of liquid chlorine rail cars near the residential neighbourhoods of Lower Lynn, Maplewood Village, and through Burnaby creates a level of risk that many residents find unacceptable.

Many residents and local governments have raised concerns that transportation risks associated with chlorine rail transport were not sufficiently addressed in the application materials. Reports referenced during public discussion in Burnaby suggested that a worst-case chlorine rail car release could have catastrophic impacts, potentially resulting in thousands of casualties.

I also share concerns that approving this rezoning would significantly limit the District's future ability to transition this site toward safer and more community-compatible industrial or economic uses.

While I recognize Chemtrade's historical safety record and proposed safety upgrades, I do not believe these measures outweigh the inherent risks associated with manufacturing and transporting chlorine through populated areas. Many regions, including Metro Vancouver, now incorporate ultraviolet and ozone treatment systems alongside chlorine-based disinfection methods, demonstrating that modern alternatives and complementary technologies are available.

I respectfully urge Council to uphold its April 14 decision and reject Chemtrade's renewed application. The long-term safety, health, and future planning interests of residents should remain the priority.

Thank you for your consideration and for your continued service to our community.

Sincerely,

Trey Bell
District of North Vancouver Resident

From: Michael Graveson
To: DNV Input
Cc: Michael Graveson
Subject: Michael Graveson presentation on Chemtrade Reconsideration May 25, 2026
Date: May 25, 2026 2:56:58 PM
Attachments: image001.png
Michael Graveson May 25 DNV.pptx

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Please find my presentation attached. Thank you.

Michael C. Graveson

M: 702-232-9918

E: OMG.Consulting@outlook.com

OMG
CONSULTING LLC

Michael C. Graveson

BSc. Chemistry, MBA

OMG

CONSULTING LLC

NO TO THE STATUS QUO

- *The Council for the District of North Vancouver continues to support the key strategy and related policies of the Maplewood Local Plan, 2002, as outlined in Attachment 1 to the February 27, 2007 report of the Director, Sustainability, Planning and Development, to* ***plan for the replacement of the chemical industry in the long term*** *with a range of industrial uses, including light industry, opening opportunities for public access to the waterfront.;*
- *The Council for the District of North Vancouver* ***does not support the continued operation of a Canexus plant on the current site regardless of any technology employed***
- *THE DNV SAID* ***NO TO THE STATUS QUO***

A HISTORY OF CONCERNS, MEETINGS, STUDIES, AND STATUS QUO

- In 2007, the lease was to expire in 2018
- The lease was extended to 2032, with the condition to remove liquid chlorine off the Port lands by 2030.
- Canexus completed the TCP
- Chemtrade acquired Canexus in 2017
- Now Chemtrade is trying to keep the **status quo** through 2044-2046.

WHAT DID WE LEARN SO FAR?

1. **Drinking water is treated with bleach**, not chlorine.
2. Bleach is made with chlorine
3. Most of Chemtrade's liquid chlorine **(over 90%) goes to the US**
4. **Less than 5%** of their chlorine is used for drinking water treatment in western Canada, and what is used is first turned into bleach
5. Water **would continue to be treated** with or without Chemtrade (**preferably with**)
6. **Domestic chlorine is readily and abundantly available, no need to import**
7. The proposed safety improvements **would not materially reduce** community risk

WHAT ARE THE RISKS?

1. The chlorine gas process
2. Liquifaction
    - Loading railcars
    - Storing railcars
    - Shipping railcars

COUNCIL CONCERNS WERE ABOUT

1. **Perpetuity**
   - Not just about replacing infinity with a fixed date
   - It's about Council's **ability to retain meaningful authority to revisit compatibility**, reassess community risk, and require changes as residential density and surrounding **land uses continue to evolve**.
2. Risk of a catastrophic **mass casualty** event

THE FRAMEWORK

- **Approval is time limited**
  - Status quo for another 20 years
- **Conditional**
  - Multiple reviews to show that they are at least as good as the current status quo.
- For another 20 years, the DNV has **no ability to make any changes**. This does not satisfy Councils first concern.
- **They didn't even attempt** to address Councils second concern.

THE SOLUTION

- Add one more condition to the **Section 219 Covenant** that is the same core restriction already imposed by the Port:
- A **restriction on the receipt, manufacture, storage and distribution of liquid chlorine** **commencing July 1, 2030**
- Chemtrade would **stay open**
- We **won't lose the jobs or the tax revenue**
- **Water** will continue to get **treated**
- But the **risk** will once and for all be all but **eliminated** because: **no large volume storage of liquid chlorine** onsite, **no transportation of liquid chlorine railcars** through the community

LOWER PRODUCTION ≠ LESS WORKERS

- What if Chemtrade has to run at reduced rates?
- Running a chlor-alkali plant at lower production rates generally **requires the same baseline staffing** levels because the same process systems, safety monitoring, and operational coverage are still required.

IS THIS A VIABLE BUSINESS MODEL?

- Bleachtech (Ohio and Virginia)
- Carbon Free (Texas)
- Covestro (Texas)
- CPS (Colorado)
- Eddyville Chlor-Alkali or Chlorum Solutions USA (Iowa)
- Hasa (Texas)
- H. Krevit & Company (Connecticut)
- Kuehne (New Jersey)
- K2 Pure Solutions (California)
- Odyssey Manufacturing Co. (Florida)
- Sentry Industries (Florida)
- Trinity Manufacturing Inc. (North Carolina)

EVEN THE ANALYSTS AGREE

- BMO Capital markets
- CIBC
- National Bank of Canada
- Financial analysts understand that Chemtrade has viable downstream alternative to liquid chlorine.
- They all agree that if liquid chlorine operations were restricted, the company could redirect more chlorine gas into downstream products like bleach, hydrochloric acid, and other chlorine derivatives

From: Heather Drugge
To: DNV Input
Subject: Chemtrade
Date: May 25, 2026 6:37:41 PM

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Mayor and Councillors,

I am speaking tonight about the Chemtrade zoning. Here's the longer form of the same speech. Thanks for the opportunity to address council on this important topic.

I'm here tonight to urge you not to reopen Chemtrade's rezoning application.

I want to start by addressing something that creates confusion about this issue. When most of us hear "chlorine," we think of swimming pools. We think of safe drinking water. And in those contexts, chlorine is a public health tool.

That is not what Chemtrade makes and it's not what Metro uses to purify our water.

Chemtrade manufactures and distributes deadly chlorine gas, liquefied under pressure and transported by train through our community and many others. This is a fundamentally different substance. At 3 parts per million in the air, a level you can barely smell, it begins causing irreversible lung damage. At 10 parts per million, it's immediately dangerous to life.

Under Canada's Major Industrial Accidents Council of Canada (MIACCs) land use planning guidelines — the framework specifically designed for making decisions like this one — a chlor-alkali manufacturing facility is classified as a Type 4 risk. That is the HIGHEST risk category in the entire framework, reserved for the most hazardous

industrial uses. Modelling using US EPA methods shows that even a relatively small release of less than two tonnes of deadly chlorine gas produces a danger zone extending 1.8 kilometres downwind. A single railcar carries more than 10 times that amount. A worst-case release extends the danger zone to over five kilometres.

The closest edge of Maplewood Village Centre is 500 metres from Chemtrade. The Lynn Creek Town Centre — where the District has just built a new community recreation centre, a library, childcare facilities, and residential buildings is 1.6 kilometres away. Both are well inside the danger zone for even a moderate chlorine release. The District is not planning one residential community in the shadow of a Type 4 chlorine facility. It’s planning two.

If you reopen this rezoning and it leads to allowing Chemtrade to continue operating, do you also intend to continue building out Maplewood and Lynn Creek as residential areas? Because proceeding with all three — a Type 4 chlor-alkali facility, and two planned residential areas well within the danger zone as defined by MIACCs — would be frankly irresponsible. You can’t plan family-oriented communities directly beside a Type 4 industrial hazard and call that good governance. Just ask the 40,000 people being evacuated from Garden Grove in California, where the governor declared a state of emergency due to an industrial chemical leak, which is far less deadly than chlorine gas.

Chemtrade's original smokescreen was the suggestion that we needed their facility for drinking water purification — implying that refusing the rezoning would somehow put our water supply at risk. But that argument doesn't hold.

With this new request to reopen the matter, Chemtrade now proposes that a risk assessment firm confirm that the facility meets the Major Industrial Accidents Council of Canada standards. But the Major Industrial Accidents Council of Canada framework is not a facility safety certification. It's a land-use planning tool. Its purpose is to help planners establish how far apart a Type 4 chlorine facility should be from residential development. No engineering upgrade and no risk assessment can make 500 metres compliant with a framework that **indicates** 1.8 to 5 km residential separation from a type 4 hazard.

Council made the right decision on April 13th. Chemtrade is betting that it will be able to manage a new public hearing better than last time. Do NOT re-open this matter to allow them to do that.

--



From: DNV Input
Sent: May 26, 2026 3:28 PM
To: Yan Zeng
Cc: DNV Input
Subject: FW: As per tonight's public input comment
Attachments: Michael Graveson May 25.pptx

From: Colin Metcalfe <colin.metcalfe@wellingtonadvocacy.com>
Sent: May 25, 2026 8:14 PM
To: Mayor and Council - DNV <council@dnv.org>
Subject: As per tonight's public input comment

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Get Outlook for iOS

Colin Metcalfe
Senior Advisor

T: 236-999-9171 | **E:** colin.metcalfe@wellingtonadvocacy.com

Wellington ADVOCACY

Michael C. Graveson

BSc. Chemistry, MBA

OMG

CONSULTING LLC

NO TO THE STATUS QUO

From DNV archives March 5, 2007 meeting

- *The Council for the District of North Vancouver continues to support the key strategy and related policies of the Maplewood Local Plan, 2002, as outlined in Attachment 1 to the February 27, 2007 report of the Director, Sustainability, Planning and Development, to* ***plan for the replacement of the chemical industry in the long term*** *with a range of industrial uses, including light industry, opening opportunities for public access to the waterfront.;*
- *The Council for the District of North Vancouver* ***does not support the continued operation of a Canexus plant on the current site regardless of any technology employed***

A HISTORY OF CONCERNS, MEETINGS, STUDIES, AND STATUS QUO

- In 2007, the lease was to expire in 2018
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1. **Drinking water is treated with bleach**, not chlorine. (Metro Vancouver)
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4. **Less than 5%** of their chlorine is used for drinking water treatment in western Canada, and what is used is first turned into bleach
5. Water **would continue to be treated** with or without Chemtrade (**preferably with**)
6. **Domestic chlorine is readily and abundantly available, no need to import.** Just call the other 3 producers to confirm. (US Census Bureau)
7. The proposed safety improvements **would not materially reduce** community risk

THE RISKS WOULD CONTINUE

- Chlorine would **continue to be manufactured**
- Chemtrade would **continue to store and ship the same amounts of liquid chlorine in railcars**
- The new building would only capture the equivalent of **one chlorine railcar**, assuming that the leaking railcar was the one inside the building, not the 32 cars outside. (1 out of 33 cars…not great odds)

COUNCIL CONCERNS ON APRIL 13th

1. **Perpetuity**
   - Not just about replacing infinity with a fixed date
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- Carbon Free (Texas)
- Covestro (Texas)
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- Hasa (Texas)
- H. Krevit & Company (Connecticut)
- Kuehne (New Jersey)
- K2 Pure Solutions (California)
- Odyssey Manufacturing Co. (Florida)
- Sentry Industries (Florida)
- Trinity Manufacturing Inc. (North Carolina)

EVEN THE ANALYSTS AGREE

- Financial analysts understand that **Chemtrade has viable downstream alternative to liquid chlorine.**
- They all agree that if liquid chlorine operations were restricted, the company could redirect more chlorine gas into downstream products like bleach, hydrochloric acid, and other chlorine derivatives and **remain a profitable and commercially successful company.**
- **I can get you these reports**

BMO Capital Markets

CIBC CAPITAL MARKETS

NATIONAL BANK OF CANADA CAPITAL MARKETS

From: DNV Input
Sent: May 28, 2026 10:53 AM
To: DNV Input
Subject: FW: Share your thoughts with Mayor and Council form

From: Website Notifications <notifications@simplicitycms.ca>
Sent: May 28, 2026 9:26 AM
To: Mayor and Council - DNV <council@dnv.org>
Subject: Share your thoughts with Mayor and Council form

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

DISTRICT OF NORTH VANCOUVER

New Form Submission:
Share your thoughts with Mayor and Council form

A copy of their response is shown below.

https://dnv-admin.simplicitycms.ca/forms/request/results/3799cb37-3298-4e13-be22-8e318dc4f491?resultId=11165665-c368-4440-a4f8-40b3e6a8e48f

My feedback is about

An upcoming Council agenda item

Your name

Tobias Hoeschele

Your phone number

[redacted]

Your email address

[redacted]

What would you like to tell Mayor and Council?

I would like to voice that I am in favour of continued production of chlorine at the Chemtrade chlor-alkali plant, if they are taking appropriate steps to ensure process safety at the plant, which it appears they are.

For this type of application I would expect that Chemtrade is using a quantitative risk analysis approach to ensure the safety of their process and a strong management of change procedure including a risk assessment on all process and operational changes that depending on the nature of the change would require an update to their quantitative risk assessment. These risk assessment should also be facilitated by an independent facilitator and I would think be independently audited as well.

If Chemtrade is meeting these types of obligations I believe they would be in a strong position to continue operations, and I believe they would also be in a strong position to bring a lawsuit against the DONV if their application is rejected.

I say this as a North Shore Resident who lives less than 5km from the Chemtrade plant, and as a practicing engineer with over 15 years of experience in industrial facility design. I have never worked on this facility or for Chemtrade in any capacity, but these are the types of things I would expect to see in a facility with this level of consequence in close proximity to the public.

I hope you consider this matter carefully and take the time to consult with experts in the field prior to making a decision.

District of North Vancouver, infoweb@dnv.org

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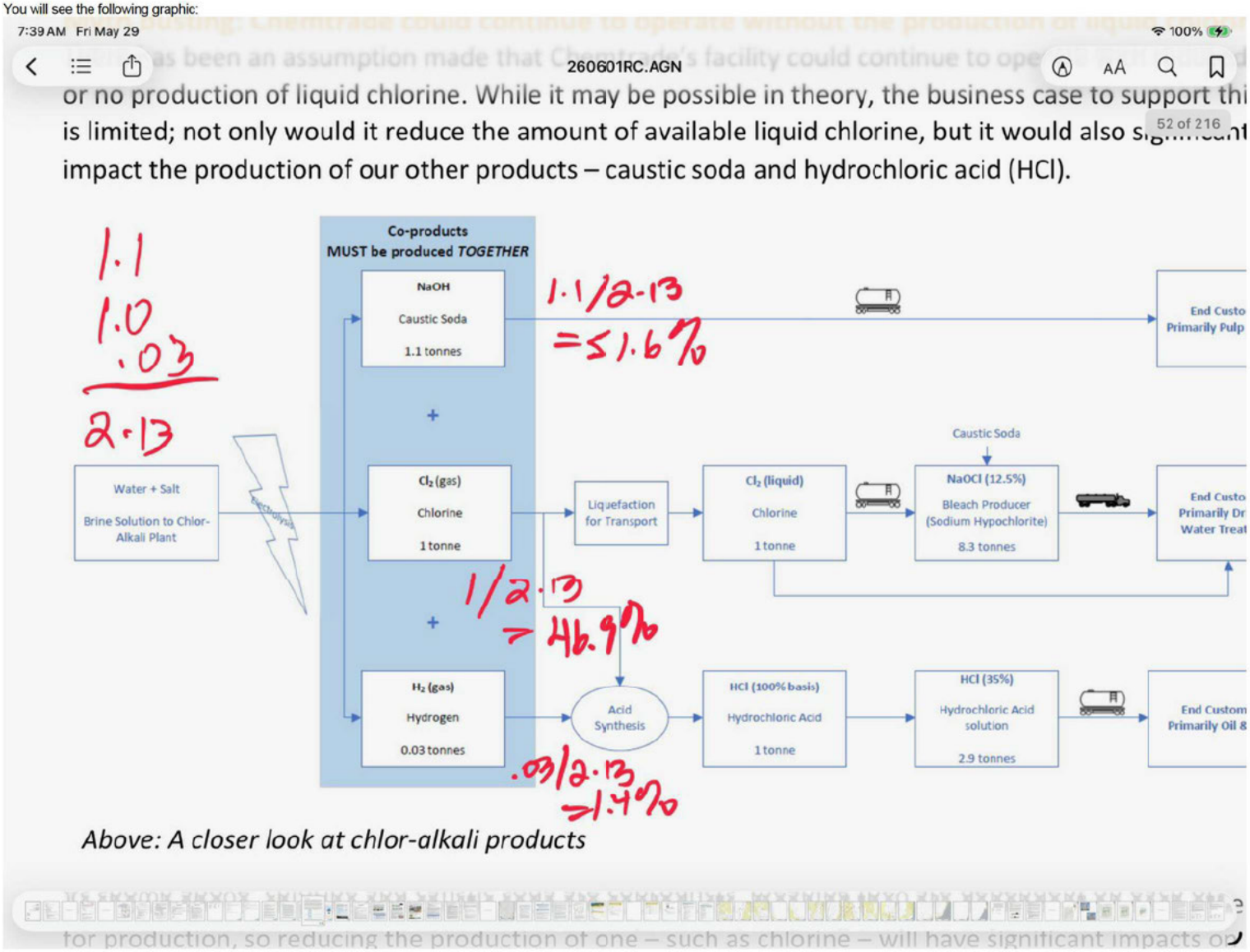
From: Peter Teevan [redacted]
Sent: May 29, 2026 1:35 PM
To: Mayor and Council - DNV; DNV Input
Subject: Chemtrade "New Information"

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good afternoon Mayor & Council,

I am not sure if you have all had time to read through this coming Monday's Council agenda package yet - but allow me to direct your attention to page 52 of 216 of the package…

You will see the following graphic:



You can see that I have converted the tonnage figures from tonnes to percentages.

Do you recall these figures? They are the same ones I sent to you all by email a week ago when I asked to speak with you.

Another thing to look for in this package is the following: Chemtrade concedes that they ship over 90% of their liquid chlorine to the USA, and that it is bleach, NOT pure chlorine used in water sterilization. And that their focus is NOT on the Chlorine market, but on the rest of their products.

So the narrative that this was about "drinking water safety" is, as opponents said all along, a false narrative, a red herring. Chemtrade now admits this to you all.

What is their real concern? 1) their profits. 2) fracking for natural gas (hydrochloric acid) and 3) pulp and paper (caustic soda). In my opinion, these are NOT reasons to put our citizens a risk! And you need to decide whether you want to reward a corporation who, at worst; lied to you, or at best; pushed an over-hyped "spin". Either way, they have not been forthcoming with you.

My paraphrasing of this new information is as follows (Chemtrade speaking): "everything our opponents have been saying, we now admit is true, but here is how we want you to look at it".

And their argument that they are substantially reducing onsite storage - they now claim that "the 32 full 80 tonne railcars don't count" - they want them counted as "in transit". The reality? That means they may not have to be included in future QRA's.

Who has been straight with you all along?

But there is another aspect for you to look at - the propriety of accepting this "new information" now.

Last week - you voted in majority to send the Chemtrade application back to a Public Hearing based on the "new information" that you had last week. But the information from this coming Monday's meeting was withheld from you and we, the public.

Tell me - if you had the "new information" for the June 1st meeting back in the May 25th meeting - would each of you voted the same? In my opinion, Chemtrade just admitted they have been lying to you!

I accept that certainly this information is entitled to be submitted by Chemtrade during the future public hearing - but by accepting it for official receipt this coming Monday - that authorizes Staff to now work with this new information and adapt their pre-public hearing reports and recommendations based on this.

Was not the opportunity for Chemtrade to do that last week? Why now, and not then?

This strikes me as highly irregular - improper even.

The staff report is dated May 20th - 5 days before your May 25th vote! That was ample time to prepare an agenda addendum.

If I were at your table I would have taken exception to this deceptive tactic - and if I were, I would put forward a motion to re-examine last week's vote to reconsider and ask that it be taken again.

My recommendation is that you vote NOT to accept this "new information" and then direct staff and Chemtrade to submit it to the Public Hearing Binder along with the rest of future input.

I am not being facetious.

Sincerely,

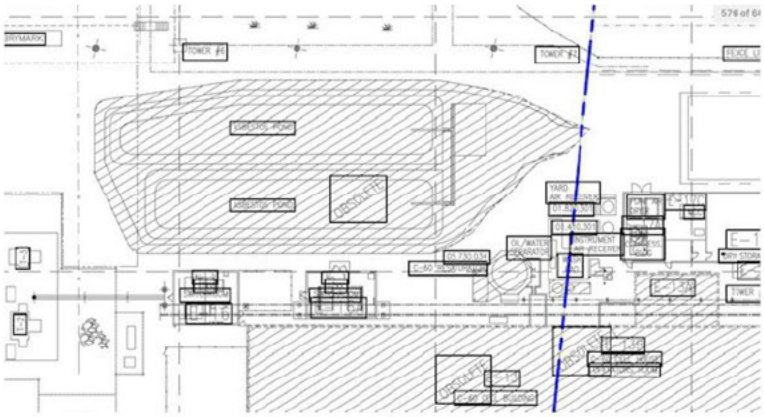
Peter Teevan

From: Peter Teevan [redacted]
Sent: May 29, 2026 7:51 PM
To: Mayor and Council - DNV; DNV Input
Cc: Corrie Kost
Subject: Asbestos ponds at Chemtrade?

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

In my examinations of the submitted materials regarding the Chemtrade application I took note of the existence of two large Asbestos Ponds from a bygone era in the history of the site. They are denoted in a site drawing here:



For your information - those ponds still exist, even though asbestos membranes are no longer likely used in Chemtrade's current processes.



And you will see from the below map graphic that these asbestos ponds lie within DNV boundaries and are therefore within your jurisdiction:



And they are just 63 metres from the sensitive marine ecosystems of Maplewood mud flats.



What is the status and condition of these ponds? I have discussed this with several community members who are more familiar with the site than I am, and one source reported “oh I am sure that are fine now”, while another source had claimed the opposite.

Does DNV have records of toxicology inspections done and remediation completed? Do we have a recent inspection report?

I think it would not only be incumbent on our District to know the answers to these questions, but also for the public to know the answers as a sign of Chemtrade’s good faith and responsible stewardship.

If we cannot receive such assurances before the Public Hearing to be held - **perhaps one of you could raise the question of staff during the public hearing and ensure we are safe?**

For your benefits, if any are not familiar with the dangers of asbestos, here is a link to a Government of Canada webpage on asbestos: https://www.canada.ca/en/health-canada/services/air-quality/indoor-air-contaminants/health-risks-asbestos.html

And here is what appears to be a credible source on the risks of asbestos contamination of water bodies: https://pmc.ncbi.nlm.nih.gov/articles/PMC10256854/

Thank you for your continued attention and work as you address this complex series of questions.

Sincerely,

Peter Teevan

Sent from my iPad

From: Peter Teevan [redacted]
Sent: May 31, 2026 1:00 PM
To: Mayor and Council - DNV; DNV Input
Cc: Corrie Kost
Subject: Pertinent Article from Los Angeles - the perils of Residential Development around Industrial Chemical Sites
Attachments: LA Times Article Garden Grove Crisis.pdf

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Please see the attached article I noticed from the Los Angeles times - it speaks of the warning given by experts about fast-tracking housing development near industrial sites.

I thought this was particularly pertinent to our Maplewood Town Centre...

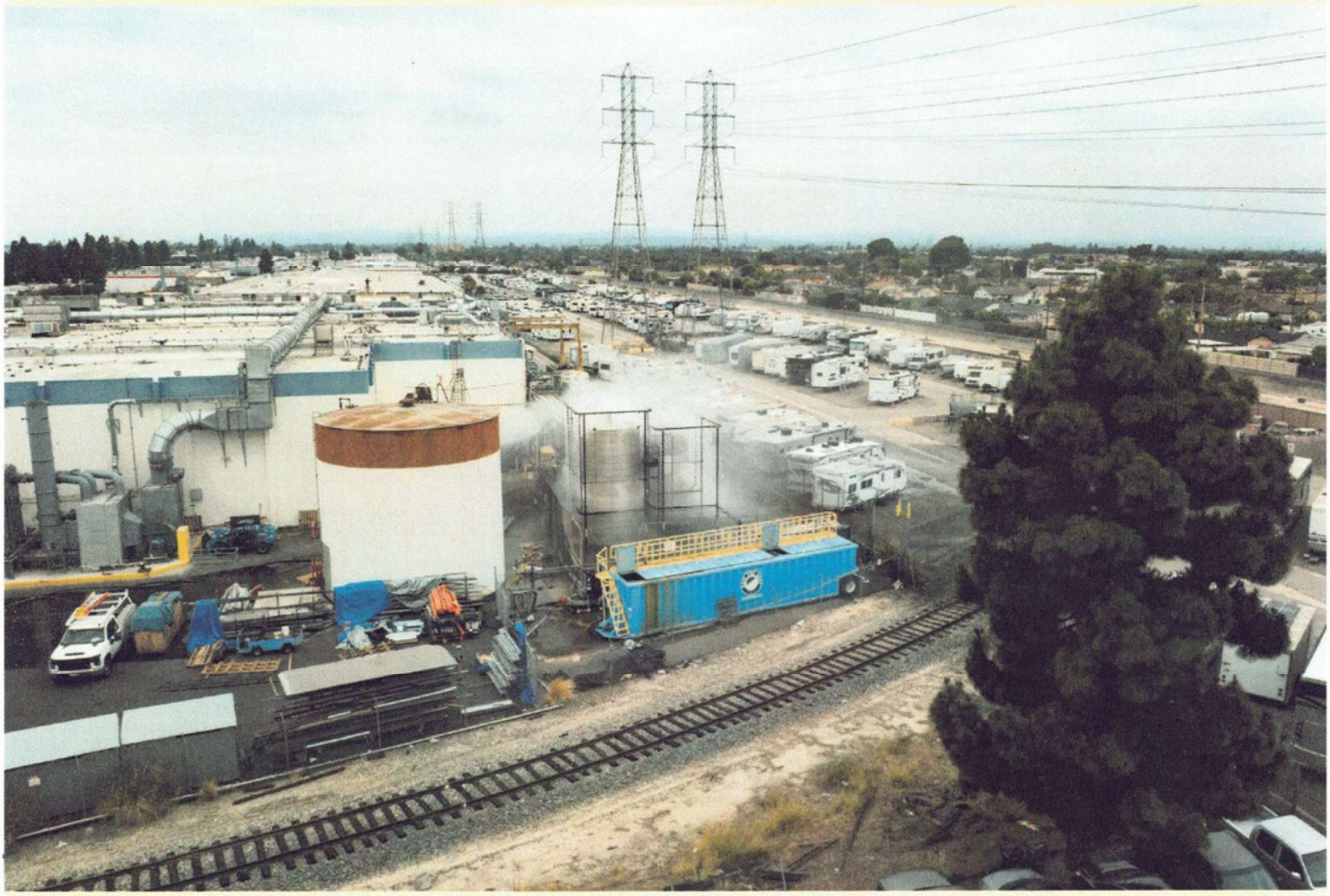
Peter Teevan

Sections

Los Angeles Times

CLIMATE & ENVIRONMENT

Garden Grove crisis exposes Southern California's hidden industrial risks



An aerial image of water being sprayed on large storage tanks at the GKN Aerospace facility in Garden Grove, where thousands of people were evacuated after a 34,000-gallon tank of methyl methacrylate threatened to explode recently. (Kayla Bartkowski / Los Angeles Times)



By Hayley Smith
Staff Writer | 𝕏 Follow

May 27, 2026 11:07 AM PT

- The near-disaster in Garden Grove serves as a reminder of the widespread but overlooked industrial risks embedded in Southern California neighborhoods.
- Experts warn that fast-tracked housing development near industrial sites is raising the odds of more chemical emergencies, often in low-income communities already burdened by pollution.
- Federal and state regulatory rollbacks geared toward housing development and industrial emissions are also putting more people in harm's way, they say.

The days-long threat of a catastrophic chemical explosion in Garden Grove has exposed the pervasive yet often ignored industrial risks hidden amid daily life in Southern California, where aerospace plants and petrochemical facilities are interwoven among homes, schools and parks.

Now, experts say this aging infrastructure is converging with population growth and regulatory rollbacks that are increasing the likelihood that similar incidents will happen again.

The greater Los Angeles area became a global hub for aerospace and defense manufacturing around the start of World War II, with companies here

producing military aircraft, electronics, plastics, petroleum products and other specialized materials that helped transform the region into a dense manufacturing zone even as its suburban footprint was expanding.



CALIFORNIA

Industry knew about chemical 'runaway' dangers for years. Then came near-catastrophe in O.C.

May 27, 2026

Many of those operations used petrochemical products and solvents such as resins, adhesives and acrylic compounds like methyl methacrylate, the chemical at the center of the Orange County crisis. While some of that work has slowed since the end of the Cold War, many industrial sites remain active and tucked among communities.

That makes the possibility of another Garden Grove incident a matter of "if," not when, said Seth Shonkoff, executive director at the science research institute PSE Healthy Energy.

"It's not really whether industrial accidents are possible in the L.A. Basin — they are," he said. "The important question is whether regulatory systems, emergency preparedness and land use decisions are keeping pace with changing industrial hazards and growing urban densities."

While the Garden Grove incident was in some ways an outlier driven by specific system failures, there are several factors that make it likely to now occur more often, said Shonkoff, who is also an associate researcher at the UC Berkeley School of Public Health.

They include global warming, which is increasing the average number of extreme heat days in Southern California, putting more strain on storage tanks and industrial processes that rely on the need to keep production materials cool.

At the same time, a lot of the region's industrial infrastructure is aging, which also heightens the risk of leaks, cracks or failure.

But perhaps most critical is the push to build more housing in places where housing has not typically been constructed. Sometimes that means more people are moving into undeveloped areas along the wildland-urban interface, which can put them at greater risk for wildfires, but other times, it means they are moving closer and closer to industrial zones.

"When you increase the population density around these types of facilities, you are increasing the hazard that if something goes mechanically wrong, more people are going to be at risk," Shonkoff said.

Many of these areas are home to low-income communities and communities of color that already experience disproportionate harms from pollution and other environmental hazards, said Deja McCauley, land use and health program manager with the nonprofit Physicians for Social Responsibility Los Angeles.

This has already been evidenced by previous environmental disasters, such as the decades of lead contaminants that spewed from the Exide battery plant in Vernon, or toxic dust and explosions from the Atlas Metals recycling plant in Watts.

Just last week, while emergency crews responded to the chemical crisis at GKN Aerospace facility in Garden Grove, 2,400 gallons of crude spilled into the Los Angeles River near East Los Angeles, and a fire burned at a tire recycling center in South Gate, prompting a shelter-in-place order.

CLIMATE & ENVIRONMENT

Federal EPA moves to roll back recent limits on ethylene oxide, a carcinogen

March 13, 2026

But while some communities are moving closer to existing industrial facilities, there are also regulatory changes that are making it easier for industrial facilities to be built closer to communities, McCauly said.

Last year, Gov. Gavin Newsom passed two controversial bills that overhauled the California Environmental Quality Act, or CEQA. The legislation exempted a broad array of housing development and infrastructure from environmental review in an effort to streamline construction and help address housing scarcity in California.

While some hailed it as a necessary cutting of red tape, critics said the move will expose more vulnerable communities to potential harms: The legislation included an exemption for advanced manufacturing facilities, such as semiconductor plants, nuclear facilities, industrial factories and other places that handle high-risk hazardous material, to be permitted in some communities without any environmental review.

At the same time, the Trump administration has taken steps to roll back

regulations on emissions from industrial facilities, such as mercury and other toxics emitted from coal plants. Earlier this year, the administration said it will loosen limits on emissions of ethylene oxide, a cancer-causing chemical often used in the sterilization of medical devices, including at multiple facilities in Los Angeles.

"What's happening at Garden Grove — we're going to see a lot more of that due to these environmental rollbacks," McCauly said.

A new state bill, SB 954, is now advancing through the legislature and would restore some of the CEQA protections that were removed last year, including narrowing the types of facilities that can bypass environmental review and providing more guidelines for siting sensitive places such as schools, homes and daycares, among other changes.

CALIFORNIA

Potential crack found on Garden Grove chemical tank, reducing explosion risk

May 24, 2026

But part of the reason communities here remain vulnerable to incidents like Garden Grove is that many people aren't aware of the region's long history of industrial manufacturing, said Peter Westwick, an adjunct history professor at USC and director of the Aerospace History Project.

"Its association with Hollywood, which is what most people probably think of as 'the industry' in L.A., has probably obscured the manufacturing presence, along with L.A.'s suburban image," Westwick said.

Even before the manufacturing and aerospace boom, L.A.'s industrialization started with natural resource extraction driven by the oil industry, he said — a legacy that also continues to pose threats such as the Chevron refinery explosion in El Segundo last year.

From the 1940s to the 1960s, L.A. also had a thriving auto industry that was second only to Detroit, producing half a million cars at its peak.

"All this manufacturing provided a lot of jobs and drove L.A.'s remarkable growth in the early and mid 20th century, but it had a major legacy in air pollution, groundwater contamination and so on," Westwick said.

He added that "the current emergency in Garden Grove is just an example of this longer embedding of industry around L.A."

For now, much of the responsibility for managing the risk falls to individuals. Tools such as CalEnviroScreen or PSE's methane risk map can help people locate pollution sources, toxic facilities and other threats in their area.

State agencies such as the California Air Resources Board, the California Environmental Protection Agency and the Office of Environmental Health Hazard Assessment also offer various guidelines or enforcement mechanisms, but their jurisdictions are fractured and disjointed, said Shonkoff, of PSE Health Energy.

He said the biggest factor that will determine when the next Garden Grove happens is not individual actions, but how industry and regulators approach the safety of these facilities, including where they should be sited.

"The onus should be put on the facilities to manage their risk," he said, "and also on regulators to make the important decisions of when 'close' is too close."

More to Read

'We need answers.' Politicians demand accountability from GKN Aerospace after hazmat crisis

33 minutes ago

Aerospace company behind Garden Grove chemical leak scare faces court cases, supply disruption

May 27, 2026

O.C. chemical crisis prompts safety-record review, Newsom says

May 27, 2026



Hayley Smith

Hayley Smith is an environment reporter at the Los Angeles Times focused on climate policy, technology and solutions. She previously worked on the breaking news team. Originally from Miami, she holds a master's degree in journalism from USC.

From: Corrie Kost [redacted]
Sent: May 31, 2026 8:13 PM
To: Mayor and Council - DNV
Subject: Vancouver's Tsunami Threat

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Your Worship and Members of Council,

The subject YouTube can be found at:
https://ca-central-1.protection.sophos.com?d=youtu.be&u=aHR0cHM6Ly95b3V0dS5iZS9QR1Bac2NibHd6az9zaT1MV0M4S0FEWkpYdmF3Wjk5&i=Njk4NTI3YzgwNDJjZTQ0NmVkMGIxZTJm&t=TGVtWVhWVlg1dDZxYmNhWGE2S1p4TnlXRnIwRXZMNndidUd3VWxiOWJhZz0=&h=d35921e7d27648e48818f2076b5c140d&s=AVNPUEhUT0NFTkNSWVBUSVaVSM4Eus8L7Pg40DEEA64c
It is important to study, not only for the impacts on the Maplewood Chlorine Plant but also for the construction/completion of the new North Vancouver Sewage Plant.

Yours truly,
Corrie Kost
[redacted]

From: Michelle Sheardown [redacted]
Sent: June 01, 2026 2:23 PM
To: Mayor and Council - DNV
Subject: June 1, Item 8.3

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Mayor Little and Councillors,

I am deeply concerned about
the safety of our community while Chemtrade continues to operate within it and
have 3 brief comments in this regard:

1. First,
   prior to last week's reconsideration, I shared with all of you an article from 2009, entitled "Chlorine and Olympics a Dangerous Mix?" In it, the authors describe how 50 of Chemtrade's (then Canexus) rail cars full of liquid chlorine were sent to Washington State because the cars were considered to be a security threat and a potential terrorist target during the 2010 Olympic Games. The fact that these rail cars are so deadly should be the end of any consideration of their location within the District.
2. These
   safety and security issues are of such importance that they will remain under lock and key were it up to Chemtrade to draft its own s. 219 covenant, which surely it should not. See the last bullet at number 2 of Appendix A. This fact alone, makes it abundantly clear that the plant poses a security risk and should not be located here.
3. Finally,
   how can we not overlook the recent evacuations in California and heart-wrenching deaths in Washington State at chemical facilities. Please let this be a wake up call to you all that hazardous materials, especially those as deadly as the ones produced by Chemtrade, do not belong anywhere near people.

This email, though, is in
regards to item 8.3 and Council's receipt of any "new information" from
Chemtrade. A brief chronology is helpful.

May 15, 2026: **Letter**
from Chemtrade Re: Rezoning Application Reconsideration
May 20, 2026: Staff Report
on May 15 letter
May 25, 2026:
Reconsideration vote,
neither of above included in the agenda
June 1, 2026: May 20, 2026
Staff Report on May 15 letter put forward to be received for information

IF Council agrees to receive
this new information, it is my submission that there should be a re-vote on reconsideration because this information should rightly have been before Council last week. Indeed, it is directly relevant to the vote, even stating so in the title, pre-dates the vote and may have made a difference to the outcome.

Alternatively, no new
information should be received from Chemtrade at this time. Why should Chemtrade be given any leeway in regards to when and how materials are filed if a public hearing is in the near future. This information should form part of the materials for the public hearing.

Thank you,

Michelle Sheardown
DNV resident

[redacted]

From: Michael Graveson <OMG.Consulting@outlook.com>
Sent: June 01, 2026 5:06 PM
To: DNV Input
Subject: MG Presentation
Attachments: Michael Graveson June 1 with notes rev.pptx

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Michael C. Graveson

M: 702-232-9918

E: OMG.Consulting@outlook.com

OMG
CONSULTING LLC

Michael C. Graveson

BSc. Chemistry, MBA

[redacted]

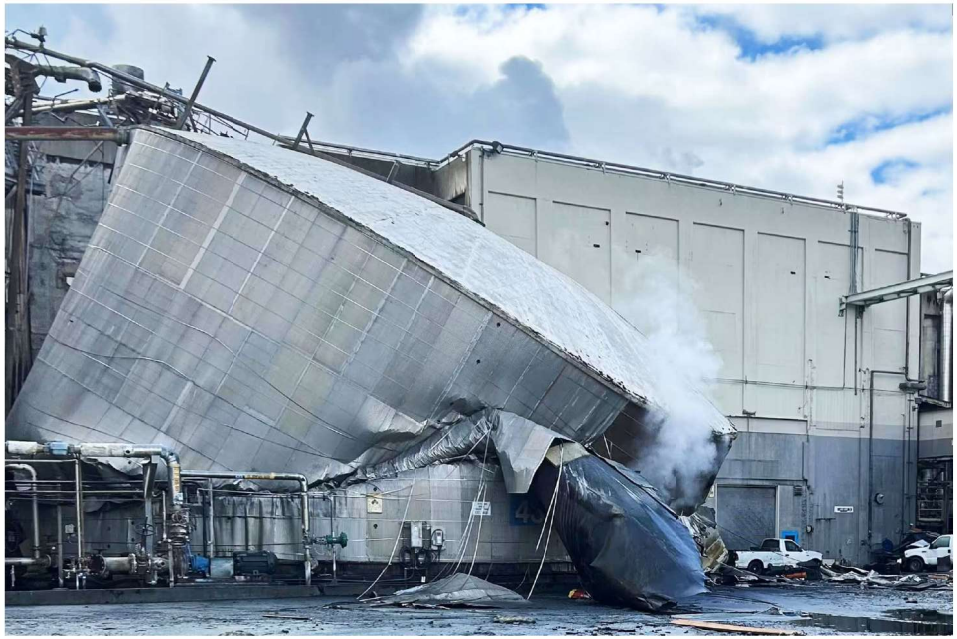
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THE UNTHINKABLE HAPPENS





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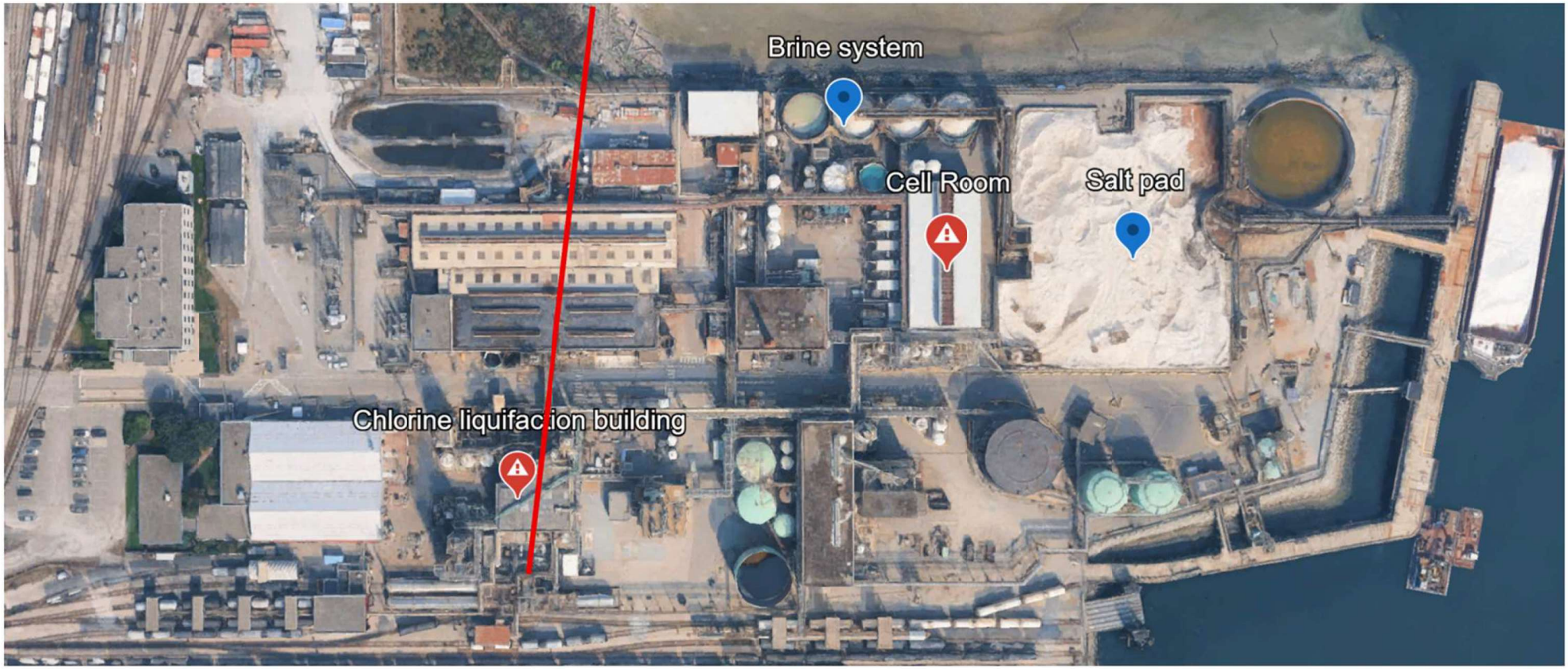
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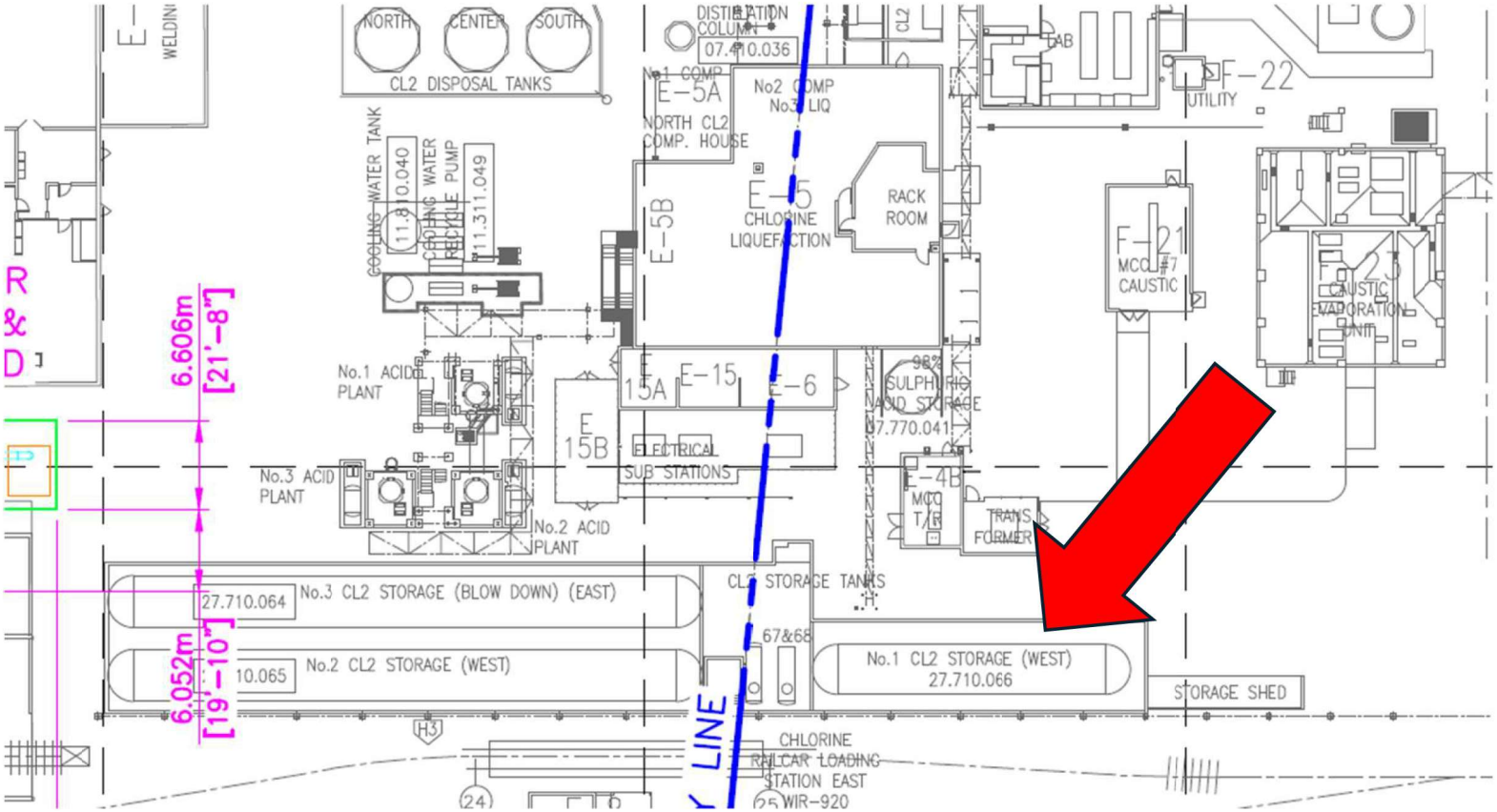
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From: Corrie Kost [redacted]
Sent: June 01, 2026 7:01 PM
To: Mayor and Council - DNV
Subject: Verbal presentation of the attached mater...
Attachments: Earthquake.pdf

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Your Worship and Members of Council,

I will give a short verbal presentation tonight as speaker #6

Yours truly,
Corrie Kost

Vancouver's Tsunami Threat Just Took A Dangerous Turn — 7 Millions Could Be Affected
https://youtu.be/PGPZscblwzk?si=LWC8KADZJXvawZ99
https://www.youtube.com/watch?v=PGPZscblwzk
https://www.youtube.com/watch?v=PGPZscblwzk&t=319s&pp=ugUHEgVlbi1DQQ%3D%3D

The 'Big One' just got more complicated
https://youtu.be/fzo2WiWeVV4?si=rKUBQkYVAsedLdPa

The Cascadia Megaquake Is Inevitable. And It Will Reshape America Forever
https://youtu.be/bZwB7kRhLIc?si=hjat-QSrL9vA9m6G

Seismic risk in the chemical process industry: A semi-quantitative methodology for critical equipment identification
https://www.sciencedirect.com/science/article/pii/S095042302400010X

For a council whose paramount mandate is the physical safety of its immediate constituents, the alleged 90% export figure of liquid chlorine to the US changes the plant's profile from an **essential public utility** into a **commercial export operation dealing in highly hazardous materials**. In municipal governance, a council can rationally justify exposing its residents to some level of managed risk if it directly secures their own critical survival needs (like their own drinking water). However, forcing residents to live under the shadow of a worst-case scenario plume for an export product fundamentally shatters that compromise, providing a powerful, rational catalyst to vote for a permanent shutdown of liquid chlorine production.

From: Peter Teevan [redacted]
Sent: June 01, 2026 7:28 PM
To: Mayor and Council - DNV; DNV Input
Subject: Michael Graveson slides from June 1st meeting
Attachments: Michael Graveson June 1 with notes.pptx

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Please see attached.

Sent from my iPhone... Pardon the typos! :)

Michael C. Graveson

BSc. Chemistry, MBA

[redacted]

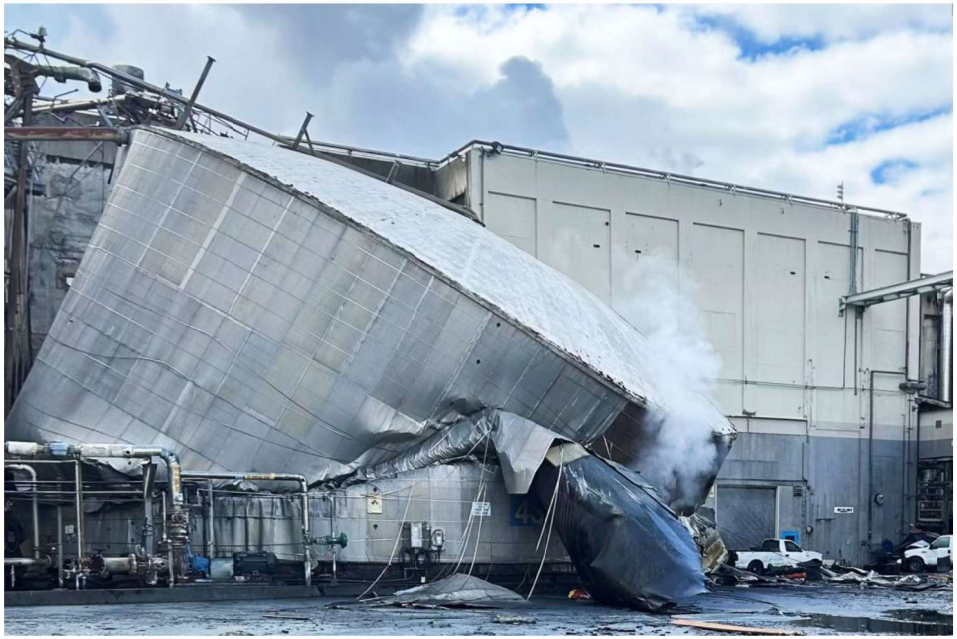
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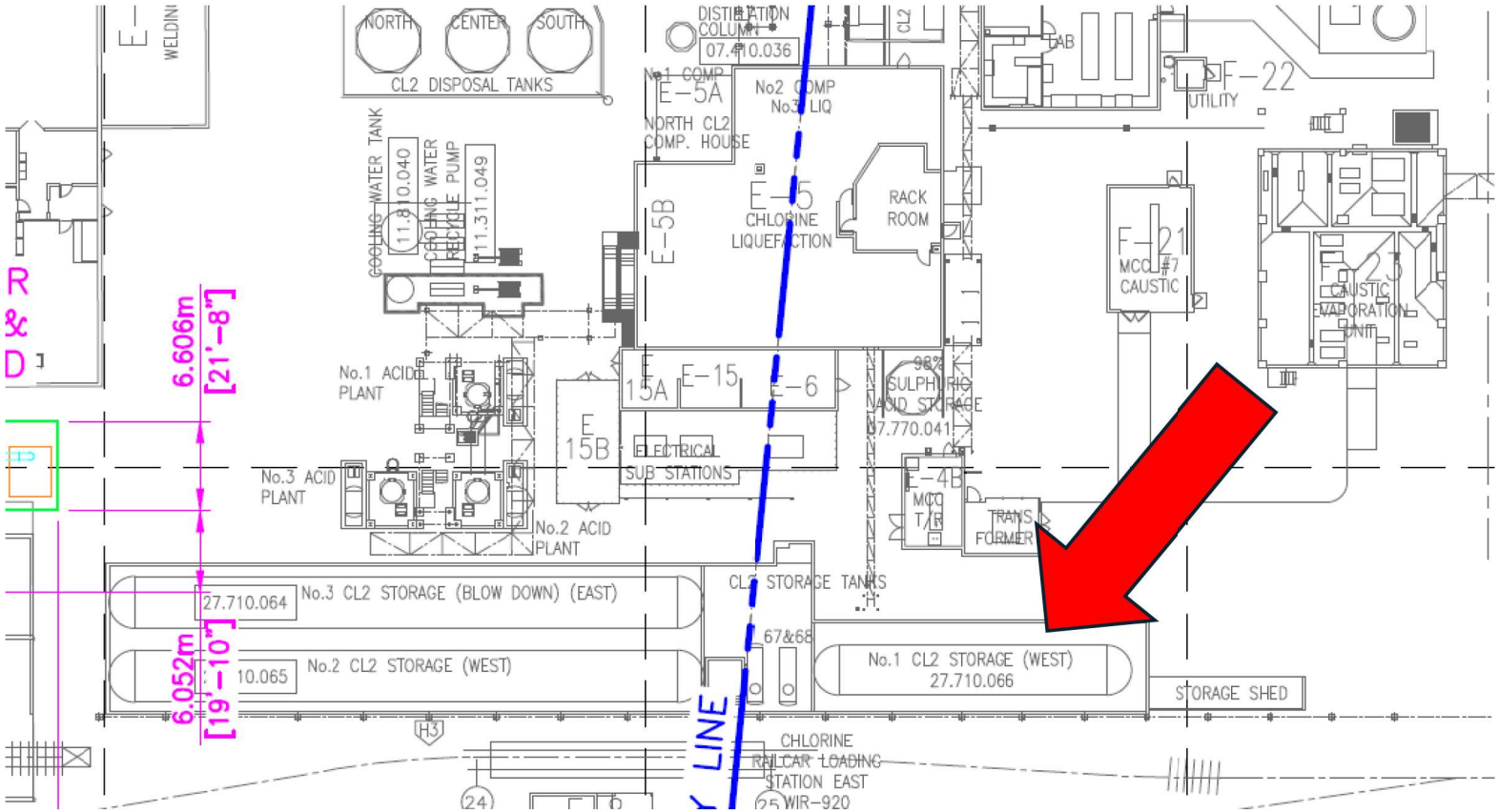
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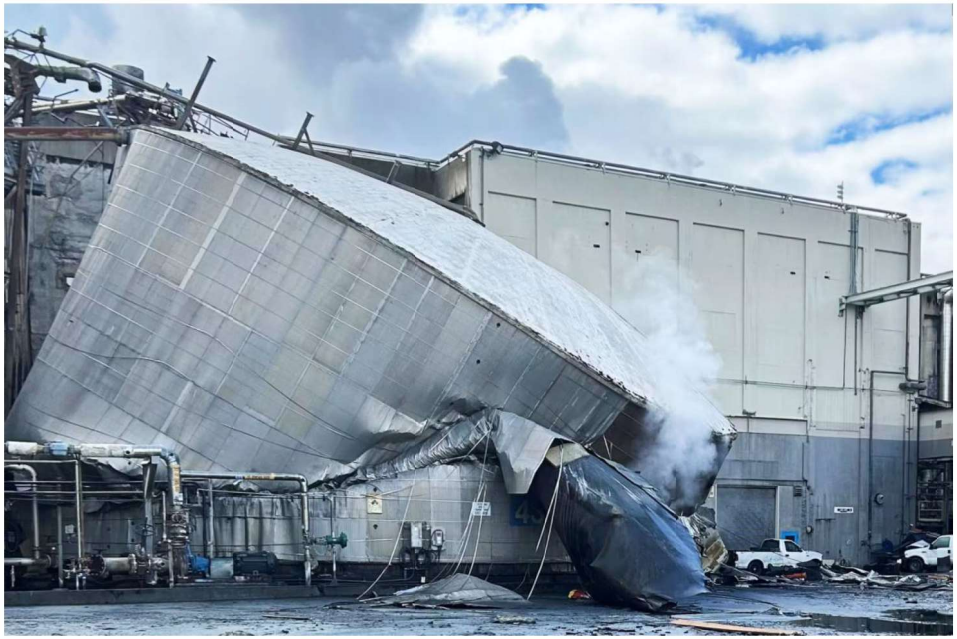
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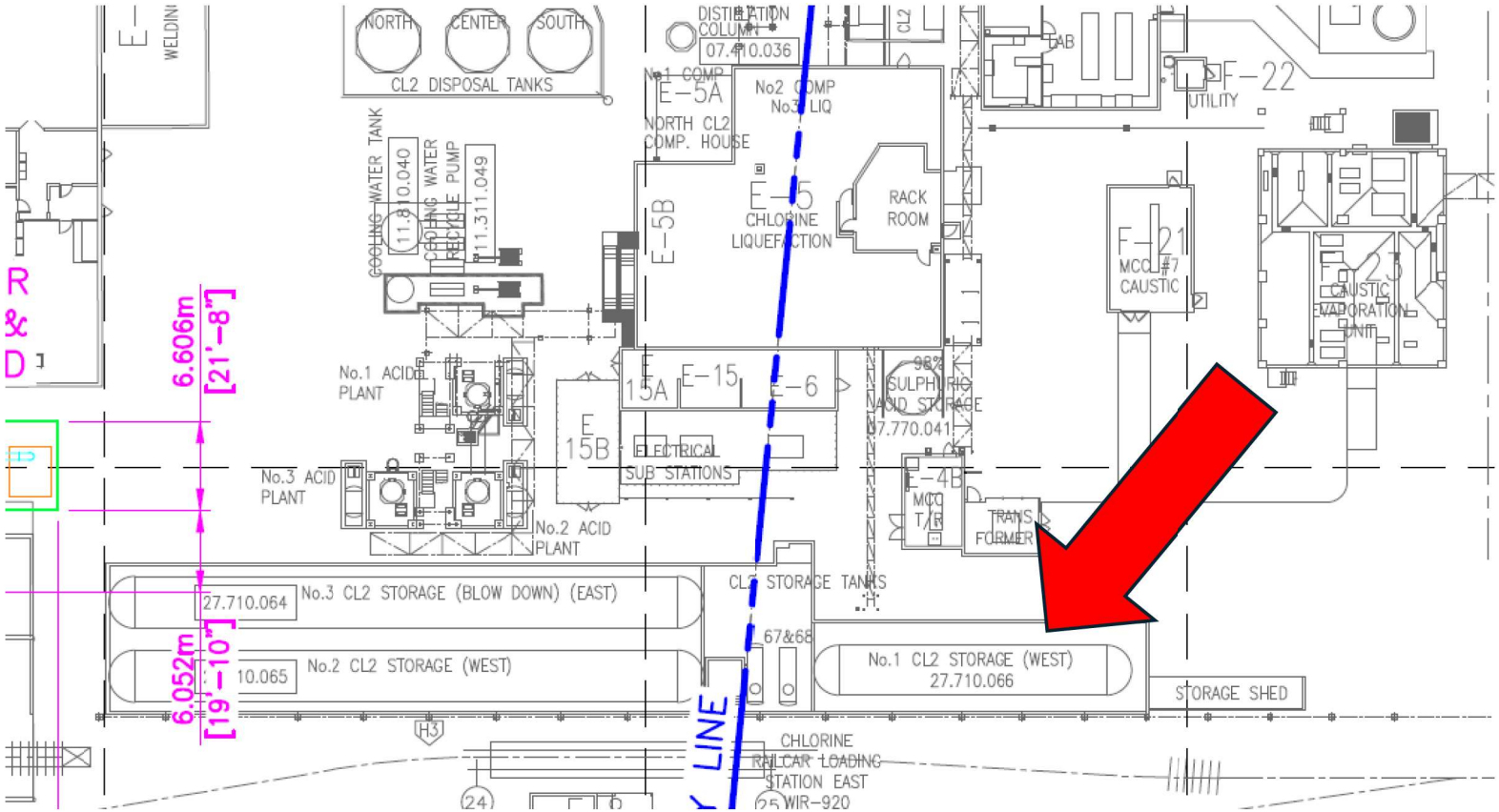
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From: Colin Metcalfe [redacted]
Sent: June 01, 2026 7:53 PM
Subject: [SUSPECT SENDER] Overview of Financial Analysts on Chemtrade's business operations
Attachments: CHE Analyst Coverage Excerpts.pptx

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

As I mentioned in my presentation to DNV Council tonight. Please see excerpts from multiple analysts confirming Chemtrade's future viability WITHOUT the need to manufacture and ship deadly liquid chlorine.

Regards,

Colin Metcalfe
[redacted]

NATIONAL BANK OF CANADA
CAPITAL MARKETS

Analyst Coverage – Chemtrade Logistics Income Fund
April 19, 2026

Impact manageable if no resolution achieved

If CHE is unable to continue producing liquid chlorine, it can increase conversion into derivatives like HCl or bleach. Our sensitivity analysis suggests a ~$3/unit impact to our target if no political resolution is found (*see Figures 4 and 5*).

If the production of liquid chlorine is no longer permitted onsite, the plant could be kept running by converting gaseous chlorine to derivative products such as hydrochloric acid, bleach, or ferric chloride. Management has indicated that currently, ~40% of chlorine production is typically converted to HCl, and that existing hydrochloric acid synthesis capacity (burners) onsite could support the conversion of up to 60%.

NATIONAL BANK OF CANADA
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Analyst Coverage – Chemtrade Logistics Income Fund
April 19, 2026

We believe the capex required would be less than the cost of the safety upgrades Chemtrade planned to undertake in support of the rezoning application, meaning no additional FCF burn vs. our base case (Scenario 3). It is also our understanding that this would be a quick project, a few months at most, and could therefore be undertaken just before the liquid chlorine deadline, allowing for maximum FCF harvesting before H2/2030.

regional resistance may further complicate the issue. As outlined in our Initiation Report, in the event liquid chlorine production must cease, the impact would likely be partially mitigated by producing alternative chemicals (although at lower profitability) at the plant such as ferric chloride and bleach. Additionally, the mix of HCl can be increased, with current capacity to convert 60% of chlorine to HCl, with potential for 80% with incremental changes. The plant is located on commercially attractive land and Chemtrade could monetize the portion of the complex it owns.

Chemtrade may potentially further mitigate the impact by converting chlorine into alternative products such as bleach or ferric chloride (although at lower profitability).

BMO Capital Markets

Analyst Coverage – Chemtrade Logistics Income Fund
April 14, 2026

What happens next? Unclear but in our view there's a path that perhaps it's only a ~5% hit to company earnings (i.e., upgrade all gaseous chlorine to hydrochloric acid and produce no liquid chlorine). In our aforementioned primer, we wrote the North Van bear case might be stopping liquid chlorine upgrading, reducing plant economics. This could be accomplished perhaps by scaling down the entire chlor-alkali operation ~20% but adding HCl acid burner capacity, so all chlorine gas can be converted into HCl (i.e., no liquid chlorine production). Or instead, CHE could produce other chemicals like bleach or ferric chloride (but likely lowering earnings more and requiring capital).

From: Peter Teevan [redacted]
Sent: June 02, 2026 3:38 PM
To: Mayor and Council - DNV; DNV Input
Cc: Corrie Kost
Subject: Chemtrade newsletter today
Attachments: Community Newsletter June 2026 Issue 12.pdf

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

Despite you receiving confirmation last night that Chemtrade acknowledges that it is bleach and not chlorine that is used in municipal water sanitation, and them saying "we have corrected our website" for the misinformation,

This went out just today in the attached newsletter - quoting a 2015 study and continuing to propagate the myth that it is chlorine, with no mention of bleach, that is used in Canada .

And, failing to mention that, as per their own admissions, that over 90% of the Chlorine they produce gets shipped to the USA.

One updated message for Council, a different one for the public.

Throughout this all - whose message hasn't changed?

And in another claim, they report " Since 2010, over $500 million has been invested in the facility to ensure safe and responsible
operations"… $500 million?

Do you think that includes the purchase of the site? How much was that transaction? And therefore how much net has actually been invested in "ensuring safe and responsible operations"?

These claims are taking "poetic license" to new extremes I think?

Peter Teevan

Chemtrade North Vancouver Community Update

June 2026 *Issue 12*

Knowing the significant role that Chemtrade liquid chlorine plays in supporting safe drinking water for millions of Canadians, and the growing uncertainty in North American trade relationships and uncertain geopolitical conditions, we are having conversations regarding how to maintain our potential future operations and secure our Canadian supply chain of this critical product.

In this issue:

- *An update on our rezoning application*
- *Next steps*
- *Ways to stay in touch*

About Chemtrade

Chemtrade's North Vancouver chlor-alkali facility is one of Canada's largest providers of liquid chlorine – accounting for 40 per cent of all chlorine available in Canada. Regionally, this equates to over 70 per cent of the liquid chlorine available in BC and Alberta. **Why is this important?** A study conducted by Statistics Canada in 2015 found that 96 per cent of Canadian communities relied on chlorine to treat their municipal water supply, which supplies over 30.7 million Canadians.

Changes to our rezoning application in response to District of North Vancouver Council concerns

In response to concerns voiced by the District of North Vancouver (District) Council, we have made further changes to our application, to address them.

1.) ***QRA, security, and technology audits and oversight:*** *Visibility and opportunity to review regularly updated QRAs, as well as audit finding for both physical and cybersecurity security audits, and best achievable technology audits, at an agreed upon cadence*
2.) ***Partnering to deliver shelter-in-place training:*** *Improved measures and tools, to be delivered in partnership with area first responders regarding public safety information and training*
3.) ***Oversight into continued land use decisions:*** *Tools that allow future District of North Vancouver Council the opportunity to review land-use and rezoning covenants for the facility, tied to the lease agreement between the Vancouver Fraser Port Authority (the Port) and Chemtrade*

All other components of the application, including our commitment to move ahead with significant capital projects aimed at reducing potential risk to at or near our property line, remain in place.

At the May 25 regular District Council meeting, based on these proposed changes, the Council voted in support of reconsidering our application.

What's next?

We will be restarting the rezoning application process at the public hearing stage. **The hearing has been set for 7:00 p.m. on June 16, 2026**, and you can either attend in person or join virtually. Please watch the District of North Vancouver website (www.dnv.org) for more information about the meeting, including reports and instructions on how to submit your feedback.

CHEMTRADE

Why are we applying for a rezoning? *Securing safe drinking water for millions of Canadians and supporting critical Canadian industries*

We are Canada's largest producer of liquid chlorine. Our liquid chlorine is used by over 70 per cent of the municipalities right here in BC and in Alberta to treat municipal water supplies. We have a critical role to play in securing your safe drinking water, and with this in mind, we need to secure our long-term ability to operate.

But did you know that the other products we produce – caustic soda and hydrochloric acid – are a critical link in the supply chain for many Canadian industries, too? These industries play a significant role in supporting Canadian economic independence such as the energy sector, pulp and paper, technology and innovation and manufacturing.

Since 2010, over $500 million has been invested in the facility to ensure safe and responsible operations, and we continue to have ongoing conversations on achieving best available technologies at our facility. As part of our rezoning application, we are committing to further improvements, which would help reduce potential risk to the community to at, or near, our property line.

The facility itself has been safely operating since 1957, but due to a bylaw passed in 1984, our facility has been operating as a legal non-conformity since that time and has been grandfathered up until this point.

As part of our efforts to secure long-term operations, we are proposing several major capital improvements at our site that will not only increase safety but also reduce risk to the community, such as building an enclosure around the rail loading area equipped with air scrubbing technology, and the installation of seismic sensors. ***To move forward with construction, we need a development permit from the District of North Vancouver. This will trigger the need for rezoning to allow for the production of chlorine at our facility.***

To confirm, we are not increasing our output of liquid chlorine. In fact, once the improvements are completed, we will be moving to a "produce and ship" model, effectively removing almost all on-site storage of liquid chlorine. The application is to ensure we are correctly zoned so we can continue operations and move forward with planned safety and risk reduction projects.

Ways to contact us

- **Visit www.AskChemtrade.ca** to submit questions, find information, and send a message
- Reach out directly to Amy Jonsson at ajonsson@chemtradelogistics.com
- Visit our Facebook page (https://www.facebook.com/chemtrade) and send us a message

From: Peter Teevan [redacted]
Sent: June 03, 2026 1:28 PM
To: Dan Milburn
Cc: Mayor and Council - DNV; DNV Input
Subject: Question for Port Authority

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mr. Milburn,

I am writing to you to ask that the District seek clarification in writing from the Port Metro Vancouver Authority on the matter that I am about to describe. I write to you now hoping to give time to get a response in time for the returning Public Hearing on the 100 Amherst application commencing on June 16th.

You may recall that during the first public hearing a question was asked (and I am paraphrasing here): "is the Port asking Chemtrade to move off Port Lands in order to shift liability for a hazardous substance?". And the response given was along the lines of "no The Port is not concerned about liability or liquid chlorine - they simply want to ensure the Port Metro Vancouver properties are used for trade and not manufacturing or production".

Now here I will cite a graphic image which is from page 51 of 60 from the document "8.3 Bylaw 8778 - Text Amendment Rezoning - 100 Amherst Avenue (Chemtrade)".



Figure 3 – Rendering of proposed railcar loading building, emergency vent system and condenser tower

Proposed safety upgrades would improve overall site safety and bring operations in line with industry best practices and guidelines by reducing risk to the neighbouring community with risk contours near or at the site property boundary. No changes to chlorine production are planned in terms of quantity or the process. All unit operations upstream of the pre-liquefier remain unchanged.

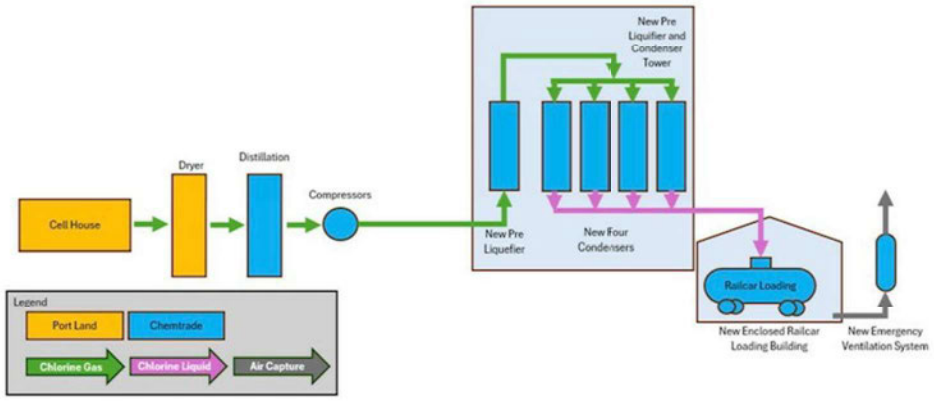


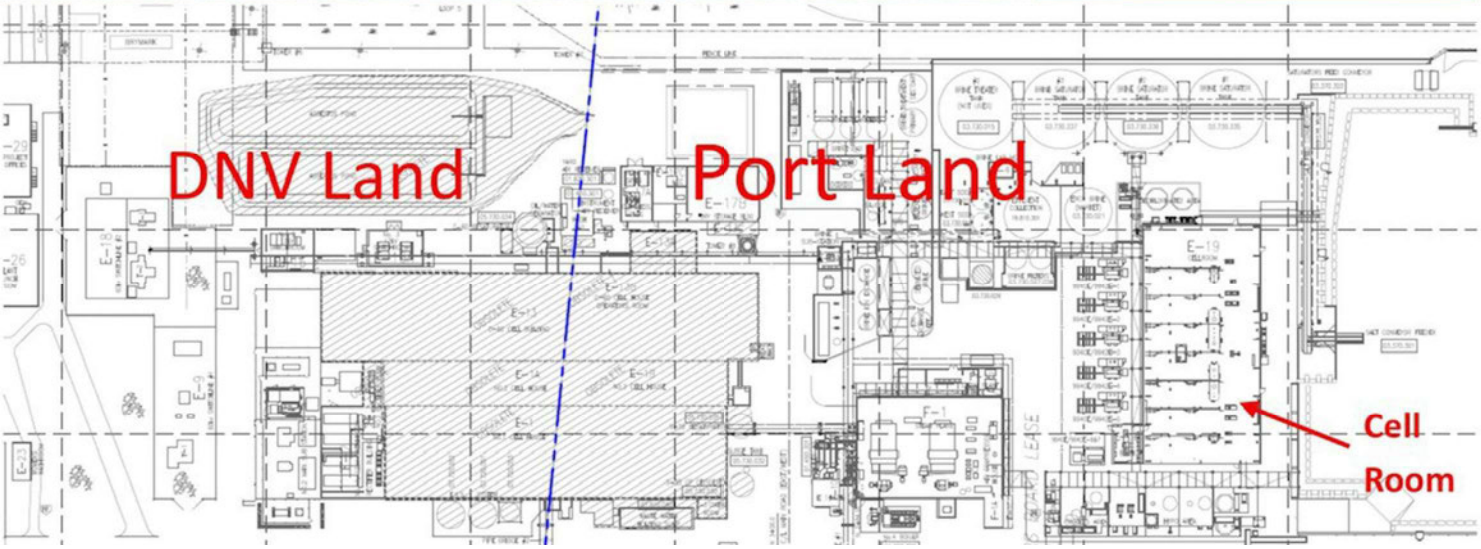
Figure 4 – Chlorine production process diagram (after proposed upgrades)

After the proposed upgrades, the chlorine gas would flow to a new pre-liquefier and four new chlorine condensers that would be located 80 feet above ground to allow for the gravity flow of liquid chlorine down to railcar loading. This

The legend for this image clearly shows that buildings coloured in orange are to remain on Port Lands, while buildings in blue will be located on Chemtrade (DNV Fee Simple) lands.

I have come to learn that the Cell House/Room (and the dryer) are the core or "heart" of production - this is where the brine pool goes through the electrolysis process that separates out the caustic, hydrogen and chlorine gas.





So clearly, Chemtrade intends for production to remain on Port Lands, with the only change being that liquid chlorine will move off Port Lands and into our District.

Please seek clarification on this issue from the Port - are they aware that the "heart of production" will be remaining on their lands? If yes, why is it only liquid chlorine that the Port Authority wants moved off their lands?

I trust that Mayor and Council will communicate with you directly if there are other questions they wish to be answered.

Certainly this question will be asked before the end of the next public hearing. Perhaps Port Metro Vancouver officials can be present at the public hearing as a key party to this issue?

I ask, through you, that the District ask the Port for clarification in writing on this key issue.

Very sincerely,

Peter Teevan

From: Peter Teevan [redacted]
Sent: June 03, 2026 2:56 PM
To: Mayor and Council - DNV; DNV Input
Subject: 'Shelf life" of bleach

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

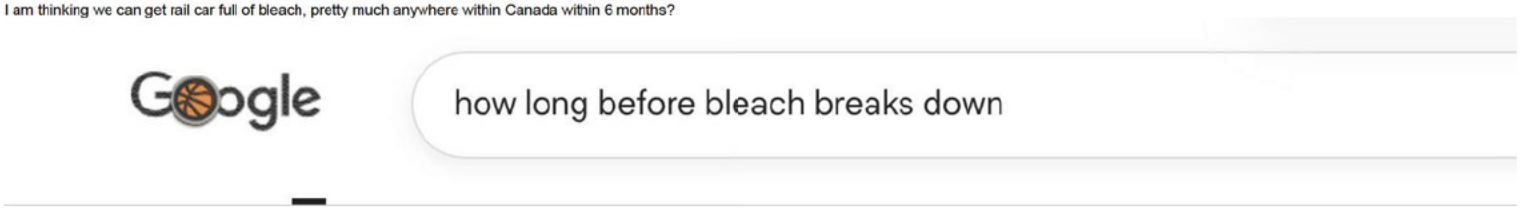
Dear Mayor & Council,

For my own education, I googled "how long before bleach starts to break down".

I found the answer interesting and I am thinking you may find so as well..

Note; when it finally does break down, it becomes something non toxic! Salt and water.

I am thinking we can get rail car full of bleach, pretty much anywhere within Canada within 6 months?



AI Overview

Household bleach typically begins to degrade after **about 6 months** from its manufacturing date. It breaks down into water, salt, and oxygen, losing roughly 20% of its effectiveness per year. Clorox +3

The exact timeline depends on its state:

- **In the original bottle:** It remains potent for 6 to 12 months. After one year, it loses too much active ingredient (sodium hypochlorite) to safely disinfect.
- **Diluted with water:** A mixed bleach solution degrades extremely fast and loses most of its disinfecting power within **24 hours**.
- **Factors that speed up breakdown:** Heat, direct sunlight, and exposure to air. Reddit · r/chemistry +5

How to check if your bleach is still good:
Because bleach does not have an expiration date (only a manufacturing code), check by smelling it—if it has a strong, pungent chlorine scent, it is still active. You can also verify the production code on the bottle using the Clorox Manufacture Date Guide to see if it is older than 6 months. Reddit · r/YouShouldKnow +2

If you are checking to see if a specific bottle is expired, or if you need help calculating a proper daily dilution for a cleaning task, tell me:

Sent from my iPad

From: Jeff Powell [redacted]
Sent: June 04, 2026 1:09 PM
To: Mayor and Council - DNV
Subject: My position on Chemtrade has finally become clear

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Hello Mayor
and Council,

You all
know me, and so I must state here that I am writing today only representing my personal position and nothing related to any organization I volunteer with.

I have
finally come to a conclusion about whether I support or oppose the Chemtrade rezoning. For the longest time I was uncertain what position to take. And even at the time of your April 13 meeting, I was undecided. But during your discussions at the May 26 meeting, my position finally solidified.

To be
clear, I oppose Chemtrade's rezoning request.

Here is why
that is the case.

Point 1 -----

This is a
list of a few key points gathered over time:

- At
  the May 26 meeting, Councillor Muri stated that a previous owner of the Chemtrade plant told the DNV council that chlorine production would stop. And Council made decisions about many things, including developments in Maplewood, working on the assumption that production of chlorine would end.
- As
  I understand it, the current OCP does not allow the production of hazardous materials on that property. That's a key controlling document of the District indicating that this is not a permitted activity.
- The
  Port of Vancouver has determined they do not want Chemtrade producing chlorine on their land anymore and will not renew their lease to let them do so.
- On
  April 13, 2026, your Council effectively voted to end the production of chlorine by 2030.

In view of
all that, I ask:

How many

times do we have to say "no" before it sticks?

It seems
like once a decision gets made, it can simply be ignored. That is not a good
look.

Point 2 -----

It was
stated by a public speaker at the June 1 meeting that a primary duty of the
Mayor and Councillors is to protect the safety of the citizens of the District
of North Vancouver. I fully agree with that assessment. Public safety is among
the highest and most critical duties of elected officials. And considering that
point, I ask:

How does the continuation of the production of an extremely hazardous chemical in our midst make anyone safe?

I believe
it is intuitively obvious that the industrial production of any hazardous
chemical a mere stone's throw away from schools and residential areas actively
undermines our collective safety. Yes, back when the plant was first built and
began operation, that wasn't the case, but it is the case now, and I believe
your job obligates you to put human safety above corporate profits.

Point 3 -----

Recent
information released by Chemtrade admits that 90% of the liquid chlorine
manufactured at their Ameherst Avenue plant is shipped to the USA. Keeping this
in the style of the previous points:

Why are
District (and Metro Vancouver) residents subject to the risks of having such a plant in our midst, and rail cars full of a toxic substance travelling through our cities, when the product isn't used here?

The risk
involved with the production should be minimized. And if someone must be
subject to it, it should be born by the people who benefit from the production
of the product. Anything else is patently unfair.

Point 4 -----

Imagine
that Chemtrade did not operate in the DNV but was instead requesting a rezoning
to create an entirely new plant at 100 Amherst Avenue to produce liquid
chlorine.

Would the Council approve a request for an entirely new chlorine plant at the Amherst Avenue site?

Clearly

such an approval would simply not be an option. No standards or industry monitoring organization would agree with such a decision, and the political backlash to doing so would be swift. Putting such a facility into a crowded area is simply not done.

So why are
we even considering approving this request now? Particularly given (as mentioned above) that the plant has been told "no" repeatedly.

Point 5 -----

Here I
admit that I am entering into significant speculation, but bear with me.

Chemtrade
must make a ***LOT*** of money on the production and sale of liquid chlorine. If I understand their current plan, they need to move all of the chlorine production equipment off land owned by the Port of Vancouver and onto their own land within the District. That's effectively creating an entirely new production facility, though they can move the actual equipment rather than purchase new. In addition, they are going to build a new containment facility to better secure the process of loading chlorine into railcars. And they are willing to do all of that and still risk the potential shutdown of the facility in 2046. That means they need to make a handsome profit off the production and amortize all of those costs in just 20 years.

How much
money are they making on this product to make that worthwhile? It must be astronomical.

Given that,
I suggest an alternate approach to the situation.

Chemtrade
should find and purchase some land along the train line leading to the USA, but well outside any city limits. There they should build that new production and loading facility, where any accidental release will have far less severe consequences, and from which the loaded railcars will simply pass into the USA with minimal risk to Canadians.

In this
model they would retain their lease on the Port of Vancouver land. They would use it to have salt delivered by ship and loaded onto train cars and taken to their new facility. Salt isn't a particularly hazardous substance, and so it could be shipped without concern.

This would
eliminate the 2046 shutdown potential, the land would probably be cheaper than the 100 Amherst Avenue property (which they could sell at a profit), and the costs of constructing the new facility would be very similar. In addition, the Port of Vancouver land would be used for the actual import and shipment of goods, and there would be no production of anything hazardous on the Amherst Avenue site.

Is that a

pipe dream? Almost certainly. But I
suggest that Chemtrade is making so much money from their chlorine production that it is entirely possible. If they were not, they would not be trying so hard to keep the current plant operating, despite the obvious risks to the community it creates.

----- Conclusion -----

I understand wanting to support local businesses, but in this case, Chemtrade is bringing risk to our community, and we do not benefit from the chemical they produce. That risk belongs elsewhere. At the very minimum it belongs well outside any populated area.

I encourage you to set aside the Chemtrade rezoning permanently, as you did on April 13th for the following reasons:

- They've already been told no repeatedly.
- You have a duty to keep your constituents safe.
- Your constituents do not deserve to be put at risk to create profits for Chemtrade.
- You would never approve a new facility doing the same thing at this site.
- Chemtrade has alternatives available.

Thank you for your consideration.

Jeff Powell
DNV Resident

From: Collette Martin [redacted]
Sent: June 06, 2026 8:01 AM
To: Mayor and Council - DNV; DNV Input
Subject: Opposition to Chemtrade Chlorine Plant Expansion in Maplewood

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor and Council,

I am writing to strongly oppose the proposed Chemtrade chlorine plant expansion in Maplewood.

The fact that residents are now being directed to review provincial hazardous materials emergency procedures should be a wake-up call for all of us. If this facility is truly safe, why are nearby families being told to prepare for shelter-in-place orders and hazardous chemical incidents?

Many residents live, work, attend school, and raise their children within the potential impact zone of a chlorine release. Chlorine gas is not a minor industrial nuisance, it is a highly toxic substance capable of causing serious injury or death. The consequences of a major incident may be low probability, but they are unquestionably high impact.

The question before Council is not whether Chemtrade has operated in the past. The question is whether increasing chlorine production and storage is appropriate in a densely populated urban area surrounded by homes, schools, businesses, parks, and critical transportation routes.

If a chlorine release occurred, would residents realistically have enough warning to seal their homes, shut down ventilation systems, and protect vulnerable family members? Would seniors, children, people with disabilities, and those away from home be adequately protected? These questions remain deeply concerning.

The District's first responsibility is the health and safety of its residents. Economic benefits cannot outweigh the potentially catastrophic consequences of a significant chlorine release.

I urge Council to reject this proposal and prioritize public safety over industrial expansion. Future generations will live with the consequences of this decision long after the vote is cast.

Please vote against the Chemtrade chlorine plant expansion.

Sincerely,

Collette Martin
District of North Vancouver Resident

From: george reynard [redacted]
Sent: June 07, 2026 10:32 AM
To: DNV Input
Subject: Zoning bylaw 100 Amherst - June 16

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Good day Mayor and Council members - re 100 Amherst Avenue

I support this application; the council **should approve it** on June 16.

Reasons:
1. Most of Western Canada relies on the chlorine produced in N Van to treat drinking water, an essential municipal public health.service.
2. Under various operators, the Amherst Street plant has operated safely for more than 50 years.
3. During an "open house " visit last summer I was impressed with the company's attention to safety rules.

regards George Reynard [redacted] DNV resident [redacted]

From: DNV Input
Sent: June 08, 2026 9:14 AM
To: Yan Zeng
Cc: DNV Input
Subject: FW: Chemtrade

-----Original Message-----
From: Dianne Stojak [redacted]
Sent: June 05, 2026 4:24 PM
To: Mayor and Council - DNV <council@dnv.org>
Subject: Chemtrade

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

As a concerned senior citizen in the deep cove area that already worries about safety evacuations and safety concerns with our transportation gridlock I need to share my Chemtrade concern for lease renewal.

There is no condition that you as a council could hold that can put Chemtrade ahead of citizen safety and long term potential dangers by continuing to renew the Chemtrade location in our residential area.

I beg you to vote NO to Chemtrade lease renewal for my safety and the future safety of generations to come. It's time Chemtrade moved to a non residential location. Please vote in support of the people.
Dianne Stojak
[redacted]

From: DNV Input
Sent: June 08, 2026 9:14 AM
To: Yan Zeng
Cc: DNV Input
Subject: FW: Chemtrade

From: Pat Stojak [redacted]
Sent: June 05, 2026 5:21 PM
To: Mayor and Council - DNV <council@dnv.org>
Subject: Chemtrade

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

To whom it may concern

As a concerned senior citizen in the deep cove area that already worries about safety evacuations and safety concerns with our transportation gridlock I need to share my Chemtrade concern for lease renewal.

There is no condition that you as a council could hold that can put Chemtrade ahead of citizen safety and long term potential dangers by continuing to renew the Chemtrade location in our residential area.

PLEASE VOTE NO to Chemtrade lease renewal for my safety and the future safety of generations to come. It's time Chemtrade moved to a non residential location. Please vote in support of the people.
Patrick Stojak
[redacted]

From: DNV Input
Sent: June 08, 2026 11:00 AM
To: Info Package
Cc: Yan Zeng; DNV Input
Subject: FW: Chemtrade

From: Oliver Webbe <oliver@darwin.ca>
Sent: June 08, 2026 9:04 AM
To: Lisa Muri <MuriL@dnv.org>; Mayor's Office DNV <mayor@dnv.org>; Jordan Back <backj@dnv.org>; Betty Forbes <forbesb@dnv.org>; James Hanson <hansonj@dnv.org>; Herman Mah <mahh@dnv.org>; Catherine Pope <popec@dnv.org>
Subject: Chemtrade

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Dear Mayor & Council,

I am writing to express my strong support for the Chemtrade Expansion Project in Maplewood.

Darwin, along with its parters own multiple residential, office and industrial buildings in the neighbourhood. The upgrades will significantly reduce the risk contours which will improve the safety of people living and working in the Maplewood neighbourhood.

Regards,

Oliver Webbe
CEO Darwin Group
Darwin Properties Ltd.
#404 - 197 Forester Street,
North Vancouver, BC V7H 0A6

Office: 604-929-7944
www.darwin.ca

From: Patrick Stafford-Smith <patrick@nvchamber.ca>
Sent: June 08, 2026 11:09 AM
To: DNV Input
Subject: NV Chamber Public hearing input for 100 Amherst Avenue - June 16th
Attachments: NV Chamber Letter of Support to DNV - Chemtrade Rezoning June 2026.pdf

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Attn: Corporate Officer

Please accept our attached submission of input for the Public hearing for 100 Amherst Avenue on Tuesday, June 16, 2026.

Thanks so much,

Patrick

Patrick Stafford-Smith MBA, B.Eng. (he/him)
CEO - North Vancouver Chamber
Suite 102 - 124 West 1st Street | North Vancouver, BC | V7M 3N3
c: 778.987.0110 | w: 604.987.4488 x 102
nvchamber.ca | Facebook | Instagram | LinkedIn

Written with gratitude on unceded traditional territories of the Skwxwu´7mesh (Squamish), S?l?i´lw?ta?/Selilwitulh (Tsleil-Waututh) and xwm??kw?y??m (Musqueam) Nations.

NORTH VANCOUVER CHAMBER

June 5th 2026

Mayor and Council
District of North Vancouver
355 West Queens Road
North Vancouver, BC, V7N 4N5

Dear Mayor and Council,

RE: Support for Chemtrade Re-Zoning Application

Dear Mayor and Council,

The North Vancouver Chamber strongly supports Chemtrade's rezoning application.

Chemtrade's continued investment ensures that North Vancouver remains home to a major employer and a critical regional supplier supporting essential services, including water treatment across British Columbia. Chemtrade's North Vancouver site has operated safely for more than 65 years and is a modern chlor-alkali facility producing chlorine, sodium hydroxide, and hydrochloric acid for a wide range of important regional industrial and public service uses.

This project will secure more than 120 well-paid, skilled jobs, sustain a network of local suppliers and contractors, and strengthen the municipal tax base that helps fund vital community infrastructure. Chemtrade's products support major sectors across British Columbia and Canada, including water treatment, pulp and paper, oil and gas, steel processing, chemical manufacturing, mining, and emerging battery-related applications.

In the current climate of global trade uncertainty and U.S. tariffs, this investment also strengthens Canada's domestic industrial capacity and safeguards supply chains that are vital to public utilities and regional industries. Chemtrade's North Vancouver site supplies a significant share of liquid chlorine in Canada and a major share in British Columbia and Alberta, helping protect a domestic source for a product that is essential to safe drinking water treatment. Metro Vancouver's own water treatment system relies on chlorine as part of its treatment and distribution process, including secondary disinfection to preserve water quality as water travels through the region. Statistics Canada has also reported that chlorination remained the most common drinking-water disinfection process in 2015, applied to 96% of all drinking water produced.

Chemtrade also plays an important role in supporting downstream industrial users across Canada. Its caustic soda serves pulp and paper, water and wastewater treatment, oil and gas, mining, chemical processing, and other manufacturing applications, while hydrochloric acid supports oil and gas, steel, water treatment, chemical processing, mining, and battery-related uses. This means the site is not

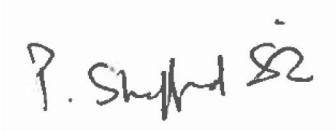
simply a local industrial asset; it is part of a wider network of inputs that keep essential services and value-added production operating efficiently across the country.

This project reflects a forward-looking approach to job protection and creation, industrial modernization, and regional economic and community stability. These are priorities that align closely with the long-term prosperity of North Vancouver, the North Shore, and Metro Vancouver.

For these reasons, the North Vancouver Chamber urges Council to approve the rezoning application and support the continued operation and modernization of Chemtrade's North Vancouver facility.

Should you wish to discuss this further, please contact me at 604.987.4488 or patrick@nvchamber.ca

Sincerely,



Patrick Stafford-Smith MBA, B.Eng.
CEO, North Vancouver Chamber

From: Michael Graveson <OMG.Consulting@outlook.com>
Sent: June 08, 2026 2:48 PM
To: Mike Little, Mayor; Lisa Muri; Betty Forbes; Herman Mah; Catherine Pope; James Hanson; Jordan Back; Mike Fox; Dan Milburn; Yan Zeng; DNV Input
Cc: Michael Graveson
Subject: Section 219
Attachments: Section 219 Covenant.docx

EXTERNAL: Do not click links or open attachments unless you trust the sender and content.

Mayor Little, Members of Council, and District Staff,

I am writing to respectfully provide additional information regarding the use of Section 219 covenants in relation to the Chemtrade facility at 100 Amherst Avenue.

During Council's consideration of this matter, there appeared to be questions regarding whether a Section 219 covenant could legally be used to restrict activities involving liquid chlorine, including its manufacture, storage, receipt, and distribution. Given the importance of this issue, I sought independent legal advice.

I have been advised that Section 219 covenants can be used to restrict, prohibit, limit, or condition specific land uses and activities where such restrictions serve a valid planning, safety, environmental, compatibility, or public interest purpose. I have further been advised that restrictions relating to the manufacture, storage, receipt, and distribution of liquid chlorine may be secured through a properly drafted Section 219 covenant.

Several members of Council expressed concern that municipalities may not have the right tools to provide ongoing oversight of hazardous industrial activities. Based on the legal advice I received, Section 219 covenants appear to be one of the tools available to local governments to manage, condition, and restrict specific land uses over time.

Importantly, a restriction on liquid chlorine manufacturing, storage, receipt, and distribution would not require the closure of the Chemtrade facility. The facility could continue to manufacture and distribute chlorine derivatives and other products, preserving employment and economic activity while substantially reducing the risks associated with bulk liquid chlorine production, storage, and transportation.

For reference only, I have attached a sample Section 219 covenant containing restrictions on hazardous materials and industrial activities. I am not suggesting that the attached covenant should be adopted by the District or applied directly to the Chemtrade property. Rather, it is provided solely as an example of the breadth of restrictions that may be secured through this legal instrument.

I hope this information is helpful to Council and staff.

Thank you for your time and consideration.

Respectfully submitted,

Michael C. Graveson

M: 702-232-9918

E: OMG.Consulting@outlook.com

OMG
CONSULTING LLC

TERMS OF INSTRUMENT - PART 2
SECTION 219 COVENANT – District of North Vancouver Rezoning Bylaw 1462 (Bylaw 8778)

THIS COVENANT dated for reference the _____day of _____, 2000

BETWEEN:

CHEMTRADE ELECTROCHEM INC

(the "Covenantor")

AND

DISTRICT OF North Vancouver, a municipality incorporated under the *Local Government Act*, R.S.B.C. 1996, c.323

("DNV")

WHEREAS

A. The Covenantor is the registered owner in fee simple of those lands and premises at 100 Amherst Avenue, North Vancouver, British Columbia which are legally described as:

Parcel Identifier Legal Description

123 456 789 Lot X, Section XX, ABC District, Plan Covenantor

(collectively, the "Lands");

B. The Covenantor proposes to revitalize and operate the Facility the Lands in accordance with the provisions of the District of North Vancouver Official Community Plan and the District of North Vancouver Zoning Bylaw No. 3210, 1965 as amended by District of North Vancouver Rezoning Bylaw 1462 (“Bylaw 8778”).

C. Section 219 of the Land Title Act of British Columbia permits the registration of a covenant of a negative or positive nature in favour of a municipality, in respect of the use of land, the building on land, the subdivision of land and the preservation of land or a specific amenity on the land;

D. **DNV** is willing to amend the bylaw to permit the use of the Lands as set out in Schedule "A", subject to the registration of this restrictive covenant on title, including: (i) an express "**End Date of Chlorine Operations**" of the earlier of **December 31, 2046** or termination of the Port Lease for "Chlorine Operations", defined as the manufacture, processing, distribution and storage of dry chlorine; with an "**End Date of Liquid Chlorine**" manufacture, processing, distribution, reception and storage of **June 30, 2030**; (ii) review and oversight opportunities for **DNV** at meaningful milestones; and (iii) the restriction of the manufacture, processing, distribution, or storage of liquid chlorine (on the Lands

E. The DNV wishes to grant and Covenantor wishes to accept these covenants over the Lands restricting the use and subdivision of the Lands in the manner herein provided;

NOW THEREFORE in consideration of the premises and the covenants herein contained, the payment of the sum of One ($1.00) Dollar paid by The DNV to the Covenantor, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties covenant and agree, pursuant to Section 219 of the Land Title Act of British Columbia as follows:

1. **Grant of Section 219 Covenant** – The Covenantor hereby covenants, promises and agrees, pursuant to Section 219 of the Land Title Act, as amended, that the Covenantor shall use or not use the Lands, as the case may be, as provided for in Schedule "A" attached hereto.

2. **Municipal Permits** – The Covenantor agrees that the DNV may withhold building permits with respect to any building or other structure from time to time proposed to be constructed on the Lands, as the DNV may, in its sole discretion, consider necessary to ensure compliance with this Agreement.

3. **Bylaws to Apply** – The Covenantor agrees for the purposes of Section 943 of the *Local Government Act* that the 1462 Bylaw and such bylaws pursuant to Section 938 of the *Local Government Act* as the DNV may adopt and that establish servicing standards for the Lands that are in accordance with generally accepted civil engineering practice, shall have application to the Lands.

4. **No Effect on Powers** – Nothing in this Agreement shall:
   a) affect or limit the discretion, rights or powers of the DNV or the DNV's Approving Officer under any enactment or at common law, including in relation to the use, development or subdivision of the Lands;

   b) affect or limit any enactment relating to the use, development or subdivision of the Lands; or

c) relieve the Covenantor from complying with any enactment, including in relation to the use, development or subdivision of the Lands.

5. **Representative -** Any opinion, decision, act or expression of satisfaction provided for in this Agreement is to be taken or made by the DNV's Director of *[Public Works/Engineering/Planning]* or his or her delegate authorized as such in writing.

6. **Indemnity** – The Covenantor hereby releases, indemnifies and saves harmless the DNV, its elected officials, officers, employees, agents and others for whom the DNV is responsible at law from and against any and all manner of actions, causes of actions, claims, costs, expenses (including actual legal fees), losses, damages, debts, demands and harm, by whomsoever brought, of whatsoever kind and howsoever arising out of or in any way due to or relating to the granting or existence of this Agreement or the carrying out of the transactions contemplated by it.

7. **Costs –** The Covenantor shall perform its obligations under this Agreement and comply with all requirements (including all subdivision and building pre-requisites) under this Agreement at its own expense and without compensation from the DNV.

8. **Specific Relief** – The Covenantor agrees that the public interest in ensuring that all of the provisions of this Agreement are complied with strongly favours the award of a prohibitory or mandatory injunction, or an order for specific performance or other specific relief, by the Supreme Court of British Columbia at the instance of the DNV, in the event of an actual or threatened breach of this Agreement.

9. **Discretion** – Where the DNV or a representative of the DNV is required or permitted under this Agreement to form an opinion, exercise a discretion, express satisfaction, make a determination or give its consent:

a) the relevant provision shall not be considered fulfilled unless the approval, opinion, determination, consent or expression of satisfaction is in writing signed by the DNV or the representative, as the case may be;

b) the approval, opinion, determination, consent or satisfaction is in the sole discretion of the DNV or the representative, as the case may be; and

c) the DNV or the representative, as the case may be, is under no public law duty of fairness or natural justice in that regard and the DNV or the representative may do

any of those things in the same manner as if it were a private person and not a public body or employee or officer thereof.

10. **No Obligation to Enforce** – The rights given to the Covenantor under this Agreement are permissive only and nothing in this Agreement shall give rise to any legal duty of any kind on the DNV to anyone or obligate the DNV to enforce this Agreement or to perform any act or incur any expense.

11. **Severance** – If any part of this Agreement is for any reason held to be invalid by a decision of a court with the jurisdiction to do so, the invalid portion is to be considered severed from the rest of this Agreement and the decision that it is invalid shall not affect the validity or enforceability of the remainder of this Agreement.

12. **Runs with Lands** - The covenants set forth herein shall charge the Lands pursuant to Section 219 of *the Land Title Act* - and shall be covenants the burden of which shall run with the Lands and bind the Lands and every part or parts thereof, and shall attach to and run with the Lands and each and every part to which the Lands may be divided or subdivided, whether by subdivision plan, strata plan or otherwise howsoever. The covenants set forth herein shall not terminate if and when a purchaser becomes the owner in fee simple of the Lands but shall charge the whole of the interest of such purchaser and shall continue to run with the Lands and bind the Lands and all future owners of the Lands and any portion thereof.

13. **Waiver** – No waiver by the DNV of any requirement or breach of this Agreement shall be effective unless it is an express waiver in writing that specifically references the requirement or breach and no such waiver shall operate as a waiver of any other requirement or breach or any continuing breach of this Agreement.

14. **Remedies** - No reference to or exercise of any specific right or remedy by the DNV shall prejudice or preclude the DNV from exercising any other right or remedy, whether allowed at law or in equity or expressly provided for in this Agreement, and no such right or remedy is exclusive or dependent upon any other such remedy and the DNV may from time to time exercise any one or more of such remedies independently or in combination.

15. **Modification** – This Agreement may not be modified except by an agreement or instrument in writing signed by the Covenantor or its successor in title and the DNV or a successor or assignee.

16. **Further Assurances** - The parties hereto shall execute and do all such further deeds, acts, things, and assurances as may be reasonably required to carry out the intent of this Agreement.

17. **No Public Law Duty** - Wherever in this Agreement the DNV is required or entitled to exercise any discretion in the granting of consent or approval or is entitled to make any determination, take any action or exercise any contractual right or remedy, the DNV may do so in accordance with the provisions of this Agreement and no public law duty, whether arising from the principles of procedural fairness or the rules of natural justice, shall have any application.

18. **References** - Every reference to each party is deemed to include the heirs, executors, administrators, personal representatives, successors, assigns, servants, employees, agents, contractors, officers, licensees and invitees of such party, wherever the context so requires or allows.

19. **Interpretation** - In this Agreement:

a) reference to the singular includes a reference to the plural, and vice versa, unless the context requires otherwise;

b) article and section headings have been inserted for ease of reference only and are not to be used in interpreting this Agreement;

c) the term "enactment" has the meaning given to it under the *Interpretation Act* (British Columbia) on the reference date of this Agreement;

d) reference to any enactment includes any regulations, orders or directives made under the authority of that enactment;

e) reference to any enactment is a reference to that enactment as consolidated, revised, amended, re-enacted or replaced from time to time, unless otherwise expressly provided;

f) reference to a particular numbered section, or to a particular lettered schedule, is, unless otherwise expressly provided, a reference to the correspondingly numbered section or lettered schedule of this Agreement;

g) time is of the essence; and

h) where the word "including" is followed by a list, the contents of the list are not intended to limit or otherwise affect the generality of the expression preceding the word "including".

20. **Governing Law** – This Agreement shall be governed by and construed in accordance with the laws of the Province of British Columbia, which shall be deemed to be the proper law hereof.

21. **Enurement** – This Agreement hereof shall enure to the benefit of the parties and their respective successors and assigns, as the case may be.

22. **Entire Agreement** – This Agreement is the entire agreement between the parties regarding its subject.

23. **Execution in Counterparts & Electronic Delivery** - This Agreement may be executed in any number of counterparts and delivered by e-mail, each of which shall be deemed to be an original and all of which taken together shall be deemed to constitute one and the same instrument, provided that any party delivering this Agreement by e-mail shall also deliver to the other party an originally executed copy of this Agreement.

As evidence of their agreement to be bound by this Agreement, the parties have executed the General Instrument – Part 1 (*Land Title Act* Form C) attached to and forming part of this Agreement.

SCHEDULE "A"
COVENANT TERMS

The following covenant terms are to apply to the Lands.

1. **Specific Provisions: The Manufacture, Processing, Distribution and Storage of Liquid Chlorine**
   a) The Covenantor shall cease the manufacture, processing, distribution or storage of liquid chlorine no later than June 30, 2030, after which;

   b) The Covenantor shall not use or permit the use of the Lands for the manufacture, processing, distribution, or storage of liquid chlorine, as defined under "hazardous substances", in the District of North Vancouver, by-law No 3210, *District of North Vancouver Zoning Bylaw, 1965* (1965); classified as a Class 2.3 Toxic Gas in *Transportation of Dangerous Goods Regulations*, SOR/2001-286, schedule 1 "UN1017"; which is classified in *Transportation of Dangerous Goods Regulations*, SOR/2001-286, s 2.14.

2. **Completion of Committed Safety Upgrades**
   a) As a precondition to adoption of the zoning amendment bylaw, the Covenantor will secure performance of and compliance with all conditions, limitations, and requirements set out in the BakerRisk facility siting study/quantitative risk assessment ("QRA") and Risktec peer review relating to construction of the proposed project and to Chlorine Operations, including all safety upgrades.

   b) As a precondition to issuance of any building permit for the Covenantor's construction and revitalization project, the Covenantor will obtain and provide to the DNV a detailed validation quantitative risk assessment prepared by BakerRisk based on the detailed project plans and specifications, confirming that the Facility (including Chlorine Operations) as designed meets current standards in accordance with the Process Safety Management Division ("**MIACC**") or then-comparable and recognized industry land use planning guidelines (the "**MIACC Standards**").

   c) The Covenantor will provide to the DNV, on a confidential basis, a security vulnerability assessment prepared by an independent qualified professional in relation to the project. The assessment shall be clearly marked as confidential and shall be used by the DNV solely for the purpose of evaluating the building permit application. The DNV shall not disclose the assessment and shall treat it as confidential information, including as information the disclosure of which could reasonably be expected to compromise public safety or security.

3. **Establishment of Baseline Quantitative Risk Assessment (QRA)**
   a) Following completion of the safety upgrades, and prior to issuance of any occupancy permit or final inspection in relation to the Facility, the Covenantor will provide a further QRA from BakerRisk (the "Baseline QRA") confirming that the Facility (including Chlorine Operations) as constructed meets the MIACC Standards.

   b) The risk contours in the Baseline QRA will establish the approved baseline for ongoing Chlorine Operations under the covenant.

   c) The Baseline QRA will form a reference point for future compliance assessments.

4. **Periodic QRA**
   a) The Covenantor will engage BakerRisk or another qualified independent professional engineering firm (the "Independent Risk Manager") to undertake an updated QRA 8 years after the establishment of the Baseline QRA.

   b) The 8-year QRA must recommend measures to address Baseline QRA compliance issues, if any, with the Facility and its operation, including Chlorine Operations. The Covenantor will then again engage the Independent Risk Manager to undertake a further updated QRA which must be provided to Chemtrade on the date that is 10 years after the establishment of the Baseline QRA. The 10-year QRA must establish that the Facility and its operation, including Chlorine Operations, continue to meet or exceed the Baseline QRA. The 10-year QRA must be provided to the DNV as soon as it is provided by the Independent Risk Manager to the Covenantor.

   c) If the 10-year QRA meeting the above requirements is not provided to the DNV within the time stipulated, then Chlorine Operations at the Facility must cease until such time as it is provided.

   d) In preparing each of the QRA's required under this framework, the Independent Risk Manager must employ applicable then-current industry standard methodologies and must ensure that each of the QRA's satisfies reasonable criteria and requirements as set out herein.

5. **Best Achievable Technology ("BAT") Review**
   a) At a defined mid-term milestone following bylaw approval, the Covenantor engages an independent engineering firm to assess whether the Facility continues to reflect Best Achievable Technology for risk mitigation and operational safety.

b) The independent reviewer is selected by the Covenantor, subject to the DNV's approval not to be unreasonably withheld.

c) The resulting BAT report is provided to the DNV and serves as a resource to assist in Council's consideration, in its discretion, of whether or not to extend the Chlorine Operations End Date.

6. End-of-Term Review

a) Chlorine Operations must terminate on the Chlorine Operations End Date at the earlier of December 31, 2046 or termination of the Port Lease, unless Council in its sole discretion after receipt of the BAT report and on or before the Chlorine Operations End Date agrees, in accordance with all applicable statutory processes, to an extension of the Chlorine Operations End Date.