



FIRE INVESTIGATION REPORT

Shuttle Drive, Bromley, Christchurch City



Incident Information:

F3350186
High Value Loss
3:07 p.m. 1 November 2021

Report completed by:

Bruce Irvine, Specialist Fire Investigator
Fire and Emergency New Zealand, Te Ihu

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Author's brief

My full name is Bruce Tolmie Irvine. I am a Specialist Fire Investigator for Fire and Emergency New Zealand (Fire and Emergency).

I have served with the New Zealand Fire Service, now Fire and Emergency, since 1986. I have been responsible for determining the origin and cause of fires since 1996 as a career officer.

I have completed the following training courses:
Fire Investigation 1 at the Royal NZ Police Collage, Porirua.
Fire Investigation 2 NZFS training course in 2015

I have attained the following tertiary level qualification:
Master of Business Administration 2002 (Auckland University)
National Diploma Fire and Rescue Operations Level 5 Structural Fire-fighting

I have attained the following qualifications by examination:
Graduate of the Intuition of Fire Engineers

I have the following memberships:
Membership of Fire Investigators Association of New Zealand

I was appointed as a Fire and Emergency New Zealand Inspector under Section 166 of the Fire and Emergency New Zealand Act 2017 on 1 July 2017.

As a Specialist Fire Investigator for Fire and Emergency I am required to respond to significant fires in accordance with Operational Instructions with the principal objectives being to co-ordinate, supervise or undertake investigations into major and serious fires, including fatal fires, by determining the point of origin of a fire and from this establishing the cause of a fire.

I have previously given testimony in the District Court, relating to fire origin and cause determination.

I have read the Code of Conduct for Expert Witnesses, Schedule 4 of the High Court Rules 2016, and agree to abide with them.

Executive summary

On 1 November 2021 at approximately 3.07pm a 111 call was made to Police indicating that a fire had occurred at the waste treatment plant at Shuttle Drive Bromley, Christchurch. The Christchurch City Council (CCC) operates the Waste Treatment plant at this address. The 111 information was transferred to Fire and Emergency who responded several fire appliances.

The fire was significant and resulted in multiple appliances attending a fire for several days at the site. The fire resulted in the destruction of the roof and damage to the Trickling Tanks 1 and 2.

The Christchurch City Council operates a maintenance program on all equipment and facilities and engages contractors to perform specialist or generalist works for maintenance. They utilise the CCC Permit to work system to manage hazards within the plant and complete maintenance programs of work. Work relating to Trickling Tanks 1 and 2 were underway for some months relating to the maintenance of the roof structure, this included cleaning, painting and also the application of a seal tape to the connections between the roofing segments that formed the dome structure.



Image 1: Drone image taken from the east side of the tanks showing Trickling Tank #2 as the area of origin. (From video supplied by yt5s.com)

An investigation was started on the day of the fire and occurred over a prolonged period. Interviews of the staff at the site have not been able to occur.

The fire cause has been classified as Accidental with the most likely cause being the ignition of the maintenance tape "Sika MultiSeal" or roof structure with an open flame heating tool in use at the time.

Testing concluded that there would be a requirement to have an open flame type tool to produce sufficient ignition energy for the tape or roof structure. No tool was identified in the fire debris due the extent of the damage to the tanks involved. The staff who were working at the point of origin are yet to be interviewed to confirm method of ignition. The investigation relied on witness interviews and the information supplied to the NZ Police 111 by the first caller.

The weather at the time of fire and operation of the trickling plants during the roof maintenance have been eliminated as possible causes.

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Terms of reference

Sponsor

David Stackhouse – District Manager.

Incident background

The Officer in Charge (OIC) of this incident considered the circumstances of the fire met the criteria requiring the attendance of a Specialist Fire Investigator (SFI) as per National Commander's Instruction P3. The OIC made this request through the Fire and Emergency Communications Centre who summoned the author of this report to attend the incident as an SFI.

The reason for the attendance of a SFI was: High Value Loss.

Objectives

Determine the origin and cause of the fire through best practice analysis and investigative processes.

Scope

- Focus on this incident specifically but consider historical data and information from this site and other similar incidents, and other incident information that may have a bearing or contributed to the outcome.
- Analysis of the circumstances and factors, including the occupant(s) actions, building fire loading and design, fire protection/suppression systems performance, circumstances of the fire, and result of the fire.
- Where evidence or suspicion of a deliberate fire start is discovered, the matter is to be referred to the Police who will then have the responsibility for further investigation. The Police may request that the Fire and Emergency SFI assist with the origin and cause determination.
- Produce a completed report for the report sponsor outlining all relevant findings.

Description and use of building

The property is a sewerage waste treatment plant for the City of Christchurch. The fire involved two biological treatment plants both being concrete structures with a fibreglass roof.

The specific tank that was first involved in fire was Trickling Tank # 2 being the southern most of the two tanks.



Image 2: Google aerial image of the CCC Waste Treatment Plant Shuttle Drive. The circle indicating the Tank of origin being "Trickling Tank # 2"

The size of the tank was approximately 52m in diameter and 9m in height at the wall to roof joint. It was constructed in the 1960s of concrete panels on a ring foundation of concrete. During the 1980's a roof was added to the structures to contain the smells from the treatment process. This roof was constructed of multiple fibreglass segments. The design of the roof was of a self-supporting structure utilising the interlocking overlap of the roof segments and the security of the roof to the concrete ring plate as support.

Inside the tank was a "Plastic Filter Medium" that the effluent ran over creating a biological process for effluent filtration management. The effluent was supplied by a pump that forced wastewater products through 6 rotating arms connected to a central pivot. Movement of the arms was via water pressure spinning the arms at a rate of approximately 1 full rotation per 3 to 4 minutes.



Image 3: The internal structure during a maintenance project several years prior to the fire. Circa 2016. Detail showing the central pivot and supports. (Photo supplied by CCC).

The two trickling tanks were connected by a central metal access staircase between the two structures. This also contained ventilation (fibreglass) and other services elements. There was a walkway around the rim of the tanks that provided access for servicing of the roof.

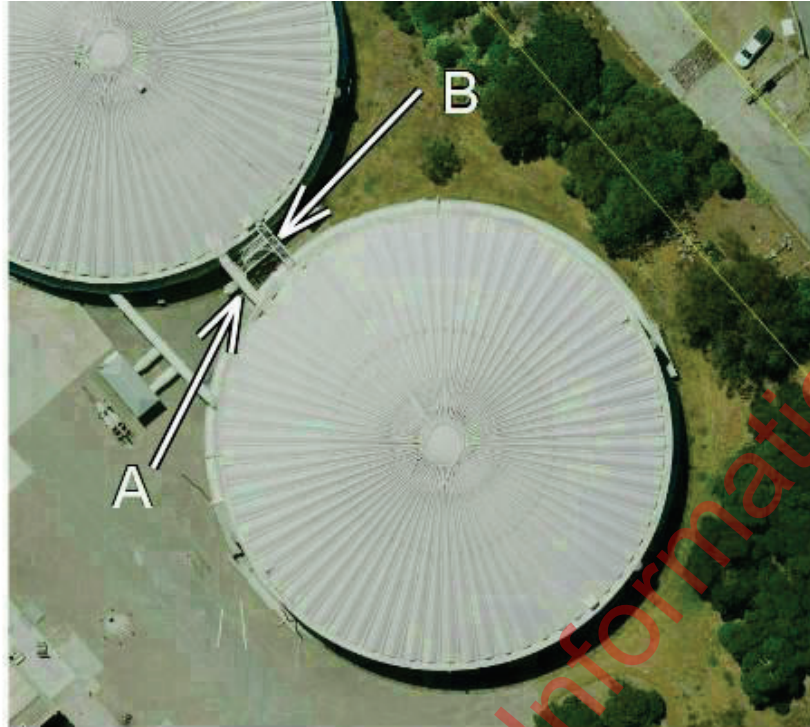


Image 4: Detail of roof and connection between the two trickling tanks. "A" is an inflow ducting air vent between the tanks. "B" is the shared maintenance staircase use for accessing the tank rim. Image supplied from FENZ Smart Map.

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Pre-incident events

In the preceding 12 months there was a series of work projects relating to the roof of the 2 trickling tanks. These involved cleaning, maintenance and repair of the fibreglass segments by a contractor. These phases involved the Chemical washing of the roof including water blasting, repair of fibreglass that was flaking or needed replacement and painting of the surface. The final phase of the maintenance was the replacement of a sealing tape used to form an air-tight seal between the sections of the roofing segments.

This final phase was covered by a "Permit to work" #3394 issued by CCC processes with the Maintenance Manager (Witness 1) signing the document as Permit issuer. This permit was supported by a Goleman Group Job Hazard Analysis Job # 4558.1.1. This JHA was supplied to CCC by Goleman Group Operations Manager (Witness 2).

Discovery of fire

Fire and Emergency New Zealand received a 111 call from NZ Police Communication Centre from a person identified as Witness 4 being the first caller, this information was identified from the Fire and Emergency NZ incident report "Message Log". The NZ Police 111 first caller tape has been transcribed and is referenced in this report.

Witness 4 identified the "Wastewater treatment plant" as at Christchurch, Cuthberts Rd for access and the response as the structure on fire, stating "it is going to collapse soon".

Witness 3 observed the fire from the Southwest corner of the site by an entry gate. He stated he called Witness 1 and advised them of the fire. They then proceeded to the south western side of the tank and took a video of the fire at an early stage, 4 minutes after the first call received.



Image 5: A snip image from the video footage taken by Witness 3 identified at 15:11 hours by time stamp. Location is identified as South west corner of Trickle tank #2. (Image supplied by Witness 3 Video 20211101_51003.mp4)

The fire appeared to be at a location near the apex of the roof structure, near where the Goleman Group Staff had been working.

Further 111 calls were received as the fire grew rapidly over the following minutes producing a large volume and column of black smoke blowing to the west from the east side of the tank.



Image 6: The roof of the Tank #2 has collapsed at this point due to the design of the interlocking roof panels and the failure of the supporting ring at the apex of the dome. (Image supplied by Witness 3 Video 20211101_51407.mp4)

Fire and Emergency New Zealand response

Information sourced from Fire and Emergency Computer Aided Despatch Incident Report.

Incident Number	F3350186	
Call Type	Structure Fire	
Method call received	Police Call	
Incident date	1 Nov 202	
Incident time	3:07:27 p.m.	
1st Arrival	ANZA271	3:15:08 p.m.
2nd Arrival	ANZA272	3:22:25 p.m.

The initial response to the fire was a 3 fire appliance response with 2 fire appliances from Anzac Station and a third fire appliance from Redwood Station. The Officer in charge of ANZA271 requested a greater 2nd alarm response on route, at 03:13 pm. This involved a further two fire appliances from Woolston Station and Lyttleton Station respectively, and an aerial appliance from Spreydon station, CHRI216, was also responded.

The OIC on arrival to the Shuttle Drive entrance was guided around the site to the Trickle Tank area and then initiated a defensive fire attack. A subsequent message was to direct responding appliances to Cuthberts Road to access the fire.

Additional response requests were transmitted for Police and Ambulance attendance.

The OIC stated that in the early stages the fire was only in the Southern of the two tanks, identified as Trickle Tank #2. However the fire progressed to Trickle Tank #1 via a ventilation connection (Fiberglass pipe) between the two tanks (Refer to Image 2 marker "A"), encouraged by radiated heat being wind driven from the east towards the south west corner of the second tank.



Photo 1: Firefighting operations later in the incident showing the use of aerial monitors to extinguish the fire. (Photo from FENZ Command Unit)

During the incident Christchurch command unit and other supporting resources were responded. Requests for Christchurch City Council (CCC) water mains pressure to be increased was also made.

Firefighters from ANZA271 ^{9(2)a}

I was notified at 4:35 p.m. on the day of the fire and responded to the incident arriving at 4:45 pm. My initial investigation activity was to liaise with CCC Plant management about the likely duration of the incident being multiple days. I had initial discussion with Witness 1 about the permit to work relating to the activities on the Trickle Tank # 2. This was followed up with a formal interview on the 9th May 2022.

Firefighting operations concluded on 3 November 2021 at approximately 3:00 p.m.

Process of investigation

Interviews

I attended the fire the day of the event and completed initial discussion with CCC Waste Treatment Plant Managers. This was to assess the significance of the fire in relation to their operation and to provide operation information to the incident commander on extinguishment support.

As the fire operation was ongoing into the evening, I arranged to return to the scene the following morning to interview further staff and take photographs.

I was advised that Goleman Groups Ltd had contract staff working on the Trickling Tank #2 at the time of the fire. These staff were accounted for during the fire and 9(2)a [REDACTED] 9(2)a [REDACTED] I sent an email request to Goleman Group Ltd and their legal representation from Chapman Tripp requesting an opportunity to interview staff involved with the work being conducted on the Trickling Tank # 2 under the permit to work issued by CCC and managed by Witness 1. To date these staff have not been made available for an interview.

The First Caller being Witness 4 as identified in the SMS incident log, is identified as being a member of the Goleman Group Ltd in the 111 First Caller transcript, being one of the workers involved the day of the fire. I have yet to be able to interview this person. I obtained from NZ Police the 111 first caller tape for the incident. This recording has been transcribed by FENZ staff and is identified as "F3350186 First Caller Transcript-Waste Water Treatment Plant.Pdf" Refer Appendix 2.

I coordinated an interview of the first responding appliance from Anzac station for the insurance and CCC appointed fire investigators. The interviews of three staff were undertaken on 27 November 2021 at the Woolston Training Centre. These staff had also provided witness statements prior to the interviews.

Witness 5 [REDACTED]

Witness 6 9(2)(ba)(i) [REDACTED]

I interviewed Witness 1 for the second time on 9 May 2022, I recorded the interview with their permission. We discussed the series of works that had been undertaken on the Trickling Tank # 2 and the engagement of Goleman Group Ltd as the contractor of the work. We discussed the specifics of issuing of the Permit to work and the Job Hazard Analysis as provided by Goleman Group Ltd employee being Witness 2. The fact that the "Hot works permit" section of the Permit to Work (PTW) had been crossed out. As this was not identified in the Job Hazard Assessment as provided by Goleman Group. No "Hot works" were to be undertaken in the process of applying the sealing tape.

Scene Examination

I attended the incident at 4.45 p.m. the evening of the fire. I reported to the Incident Commander Dave Berry and District Commander Dave Stackhouse. As the incident was still in progress with extinguishing operations, I proceeded to interview plant managers present to assist with information for the incident command team. I was advised that Insurance Fire Investigators were appointed, and I liaised with them for scene examination to occur later the following day.



Image 7: FENZ Smart Map clip image of the two tanks. Arrow indicating North. The southern of the two tanks was the area of origin. The two arrows identify a connecting air duct between the two tanks.

I completed a photographic review of the tanks including the roof top and central air duct connection between the two tanks. I identified burnt roof and piping strictures in the fire debris both within the tank and outside the tank. I believe that the fire that originated in the southern tank (Trickling Tank #2) progressed to the northern tank (Trickling Tank #1) via this air duct connection pipe. I have excluded the motor and fan as an ignition source as this area was intact and not on fire during the early stages of the fire.

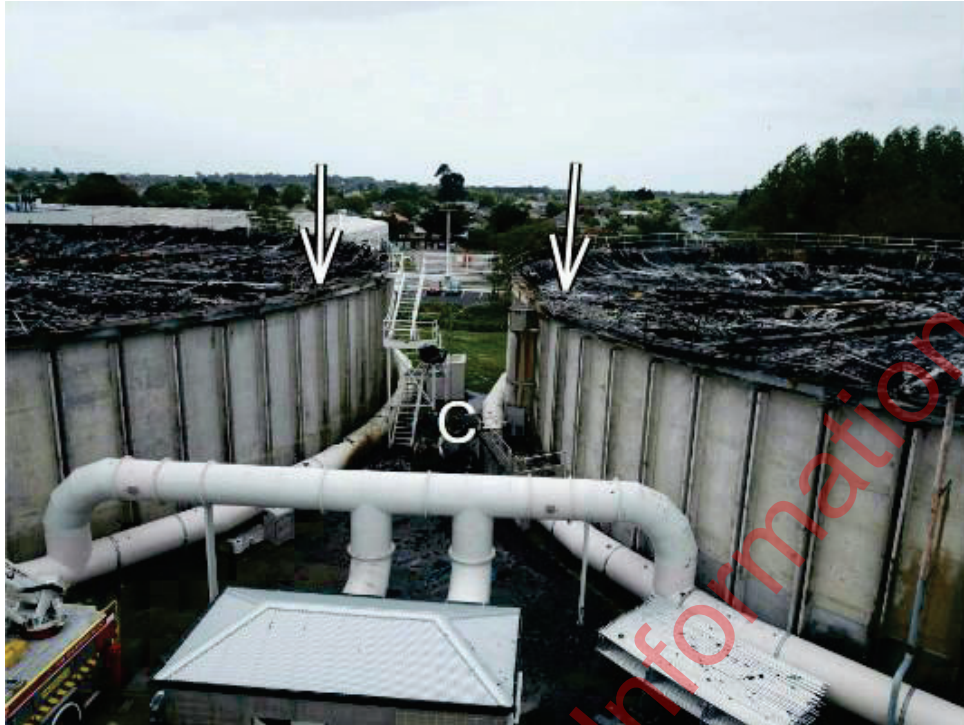


Photo 2: In foreground is the ventilation pipework for the Tanks. The service stairway connecting the two tanks. A ventilation pipe connected the tanks at rim level, identified by the arrows. "C" indicates a ventilation fan at ground level.

A review of the southern tank burnt out area was completed using a FENZ aerial appliance. This was supported by drone footage taken by the FIS Investigator. The roof elements were identified in some areas of the tank, however no detailed inspection of the surface of the filtration structure was undertaken due to risks presented by both biological hazards and structural instability of the surface of the trickling filter remnants.



Photo 3: Aerial image of Tank #2 in the foreground. (Photo supplied by FIS from drone footage).



Photo 4: Ventilation fan area at the base of the access stair between the tanks identified as "C" in Photo 2. This area was consumed by fire after the fire was discovered on the roof of Tank #2.

A box of "Sika MultiSeal" tape was identified by one of the investigation team on the east side of the stairway connection between the tanks. This was identified as the product being used under the permit to work system for providing a weather seal on the roofing structure. The operating instructions for the product identified ambient temperature of application to be between +5° Celsius to +40° Celsius. On the day of the fire the ambient air temperature was within this range within Christchurch City. (I estimated the temperature was between 15° and 20° Celsius at the time of fire.) The Temperature at Christchurch International Airport weather station at 3:00pm the day of the fire was recorded as between 14.4° - 15.5° Celsius, for the time period leading up to the first 111 call. The temperature on the surface of the tank was not recorded as a microclimate consideration. Wind was predominantly from the east nor east direction, being a cooling sea breeze.



Photo 5: Operating instructions for the Sika MultiSeal product being used.

On 21 December 2021, because of witness statements, the investigation team including myself conducted several tests relating to the use of the Sika MultiSeal tape. This included application of the tape on sloped surfaces including examples of the roof structure. Testing also included the heating of the tape using both an "Electric Air heat Gun" and a "flame producing heat butane torch". These tests were indicative only, as to the potential effects of heat applied to the tape and structure components. In general, the tape could be ignited using an open flame heat source but not a hot air heat source, discolouration occurred of the tape and melting of the contact material in this case. Prolonged exposure of a flame could ignite both the tape and the roof element tested including fibrous elements. These tests were conducted due to the absence of witness interviews of the people at the site of the fire and those who discovered the fire.

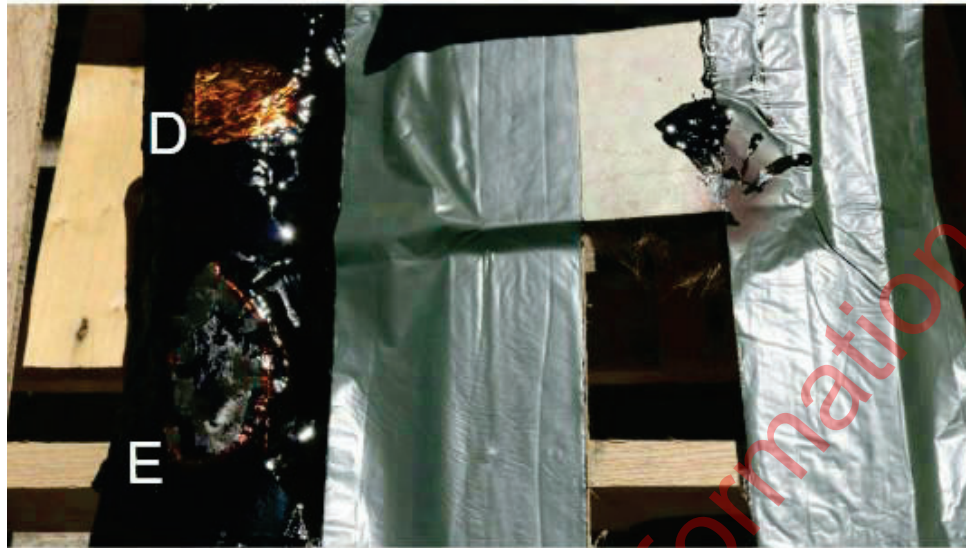


Photo 6: Test result of the tape as applied to an element of the roof structure with sustained open flame exposure. Tests self-extinguished due to wind present removing heat from the products/tape when ignited. "D" indicates an Electric Heat Gun application to the tape resulting in melting. "E" Indicates an open flame application to the tape resulting in burnt product.



Image 8: After the removal of an open flame heat torch the structure of the roof continued to burn for a minute. This indicates and confirms the roof structure could be ignited and sustain combustion. (Image taken from video-clip IMG_9066.MP4 from FIS Testing)

On 27 January 2022, further testing by a group of fire investigators, was conducted on the exemplar material identified as it being "similar" to the air seal product between the two surfaces of the roofing structure. This testing was inconclusive as to the effect heat would have on this product and resulting effects on the structure, as the observers believed it was a significantly more modern product than the one at the site at the time of fire. Two observations were noted about the product tested, 1) the product would be consumed by the fire but would self-extinguish when the heat source was removed. 2) Compressing the product between surfaces would make ignition more difficult, due to the limited availability of oxygen within and around the product.

On 30 June 2022, I undertook analysis of 8 fan motors that had been removed from the base of the two trickling tanks with a further group of fire investigators representing interested parties. This analysis included a visual inspection of the motor, fan drive, fan cowling, fan blade and electrical resistance testing using an electrical multimeter of the electrical motor circuit. The results were conclusive that the 8 electrical motors and fans were operating correctly at the time of fire and with minor servicing (Cleaning) could operate effectively post fire. Burnt fire products, (Fibre based organic material) being a build-up of contamination material was evident on some of the motors and fans. This material was burnt from the outside surface and this has been put down to the fire itself dropping embers onto the fans once they stopped operation as part of an isolation/shut down process during the fire.

We identified two styles of fan unit. One with the fan motor situated outside the cowling of the fan blades as in Fan #5. The other was where the fan motor was in-line with the fan blade and was housed within the Fan cowling as in Fan #8.



Photo 7: Motor and fan #5 showing burnt product within the cowling of the fan unit. Motor was unaffected by fire when electrically tested. Drive belt intact and unaffected by fire. Fan #5 was located Trickling Tank#2 North West corner.



Photo 8: Motor and Fan #8 showing burnt fibrous product on the outside of the motor below the fan. This is a direct drive system from motor to fan blade. It is believed that this fan was from Trickle Tank #2 West side.

No chafing of the cowlings was observed eliminating friction or sparks as a potential cause. The motors turned freely indicating that no internal winding damage had caused an overload in the motor windings.

SFI Gavin Lack, who holds a New Zealand diploma in Engineering electrical/electronics, Auckland University of Technology 1992, states in his report "

1. With the multimeter set to resistance setting the insulation between windings and earth were checked. This was done by stripping the 3 phase wires and the earth wire going to each motor. Monitoring on the multimeter the resistance between earth and each phase wire was checked. All 8 motors gave open circuit readings (infinite resistance) which is consistent with insulation still intact.

2. With the multimeter set to resistance setting the phase wires were checked across the phases with which a 0-ohm reading is expected for winding's to be intact. All 8 motors gave 0-ohm readings.

Conclusions: From my observations and basic electrical testing I would be confident in documenting that a point of fire origin was not connected to the failure of the 8 motors investigated."

My observation of the burn indicators to the cowlings and fans, concur with this statement also being that the burning observed was as a result of the fire and not the cause of the fire.

Area and point of origin

Area of Origin

The area of origin was identified as Trickling tank #2 by video footage of the scene taken by Witness 3 at an early stage of the fire growth, and by Witness statements of the first caller and Witness 1.

It was clear that the fire started on the Trickling tank #2 to the south of the complex as observed by many people at the site. FENZ crews on their arrival also supported this with their statements that whilst the roof had collapsed the fire was predominantly within the southern tank and spreading to the northern tank due to wind conditions from the east.



*Image 9: This drone image at the time of the fire shows the fully involved southern tank on fire with fire progressing to the northern tank via a ventilation pipe connecting the tanks at the roof rim level.
(Supplied by independent source yt5s.com)*

It is also believed that the Goleman Group staff were working on the eastern side of the Trickling Tank #2 and smoke at an early stage was seen rising from this location.

Point of Origin

In referring to "F3350186 First Caller Transcript-Waste Water Treatment Plant.Pdf", the initial 111 call the caller identifies who they are to the NZ Police call taker. They identify themselves as an employee of "Goleman Group". The caller states "Yep we were doing some heat taping on the building, and it obviously must have caught underneath and then it was too late" so from this I believe the fire started in a location associated to the working location of the Goleman Group employees.



Image 10: Image taken from a video footage, taken at 3 12pm by witness 3 standing in the south west corner of the tank looking north. Smoke rising from the central cap with a leading edge to the east as indicated by the arrow. (Image from 20211101-151003.mp4)



Photo 9: Two areas of significant damage in the Trickling Tank #2 were identified. Circle "F" is believed to be where the first collapse of the roof occurred. Circle "G" is downwind from this location at an intensified area of burning. (Photo supplied by FIS DJI_0226.jpg)

In the above photo I identified an area on the north eastern side of the trickling tank #2 "F" that has sustained more damage than most of the rest of the tank surface. I believe that the workers were somewhere in this area of the roof above this location, based on this being an area of most damage. Witnesses have yet to confirm where they were working on the tank at the time, but I have excluded the western side of the tank. The arrow indicates a box of Sika MultiSeal tape found at the site as per Photo 6 below this location where the workers vehicle had been parked during work operations.

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Conclusions

Supposed Cause

Based on the evidence available at the time of this investigation, the classification of this incident has been recorded as Accidental.

The cause of this fire is believed to be the accidental ignition of the roof structure whilst the application of Sika MultiSeal tape was being undertaken as per the work contracted to Goleman Group Ltd.

The fire cause was out-lined by Witness 4 during the 111 call to NZ Police from the caller in answering a question from the NZ Police communication officer "do you know how it might have started?" the response was "Yep we were doing some heat taping on the building, and it obviously must have caught underneath and then it was too late"

Elimination of Other Possible Causes

Electrical sources have been eliminated as these only relate to the operation of the ventilation fans that have been tested by SFI Lack in support of my investigation. The central rotation arms spreading effluent were regularly serviced and used the hydraulic forces to rotate on a greased spindle. No electric power was involved.

Weather conditions were within normal parameters for the site with normal ambient temperature for the time of year and the trickling tanks were operating at the time of fire.

Biological conditions within the tank were normal and no exothermic reaction was evident. (Top down burning) Fans were in operation and there is little to no risk of a flammable gas being present within the dome or within the range of flammability for a biologically produced gas such as methane being between 5.5 - 15% in air. "Methane is emitted from a variety of anthropogenic (human-influenced) and natural sources. Anthropogenic emission sources include landfills, oil and natural gas systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial processes." excerpt from <https://www.epa.gov/ghgemissions/overview-greenhouse-gases#methane>.

Incendiary or a deliberately lit fire has been eliminated, due to the immediate actions of the staff in the area of ignition, in attempting to use an extinguisher to suppress the fire and then calling 111 for assistance.



Image 11: The internal structure of the roof dome. No forms of electrical hazards were present within this area of the processing plant.

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Report approvals

Investigation and report completed by:

Investigator

Name: Bruce Irvine

Job Title: Specialist Fire Investigator

Date: 19 October 2022 04:45p.m.

I confirm the truth and accuracy of this statement. I make the statement with the knowledge that it is to be used in court proceedings. I am aware that it is an offence to make a statement that is known by me to be false or intended by me to mislead.

A technical review of this report has been completed by:

Name: Peter Gallagher

Job Title: Senior Specialist Fire Investigator

Date: 02 November 2022 12:56p.m.

This report has been approved by:

Name: David Stackhouse

Job Title: District Manager

Date: 09 November 2022 07:12a.m.

Appendix 1: Witness Details

Removed in compliance with the Privacy Act 2020 and the Official Information Act 1982

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Appendix 2: F3350186 First Caller Transcript-Waste Water Treatment Plant.Pdf

F3350186: CCC Waste Treatment Plant Shuttle Drive

First Caller Voice recording: Transcript by FENZ

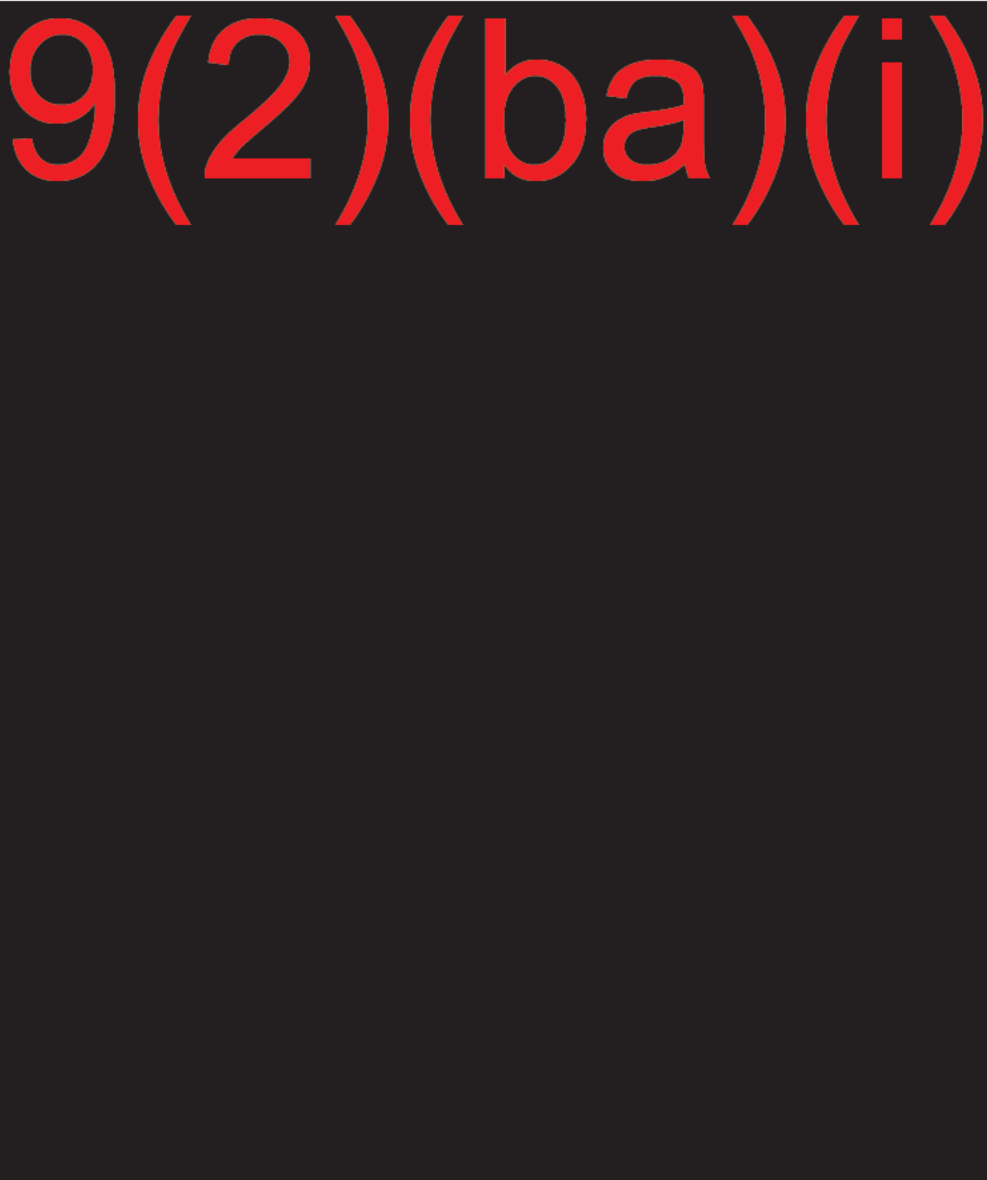
Time of Call: Prior to incident transfer from NZ Police to Fire at 15:09:40

Date of Call: 01/11/2021

Phone number identified: [REDACTED]

Length of transcript recording: 8 minutes 14 seconds

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