

ENVIRONMENT PROTECTION AUTHORITY

THIS IS THE ACCEPTED Root Cause Analysis Report
REFERRED TO IN CONDITION Requirement B
OF EPA AUTHORIZATION NUMBER L17C, dated 29/01/17
REVIEWED BY Kate Williams DATE 29/2/17
DELEGATE Sophie Martin DATE 29/2/17



Ash Storage Area dust event (1st & 2nd January 2017)

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24th February 2017

Overview of events

In November 2016 Flinders Power engaged McMahon Services to seal the surface of the Ash Storage Area using Vital Bon-Matt Stonewall dust suppressant seal in accordance with the EPA-approved APS Dust Management Plan 2016 V5 (5th November 2016), the Ash Dam Interim Sealing – Proposal (7th November 2016) and Dust Suppressant Risk Assessment (21st October 2016). The work was completed by 24th November with final inspection by Vital Chemicals on the 25th November 2016.

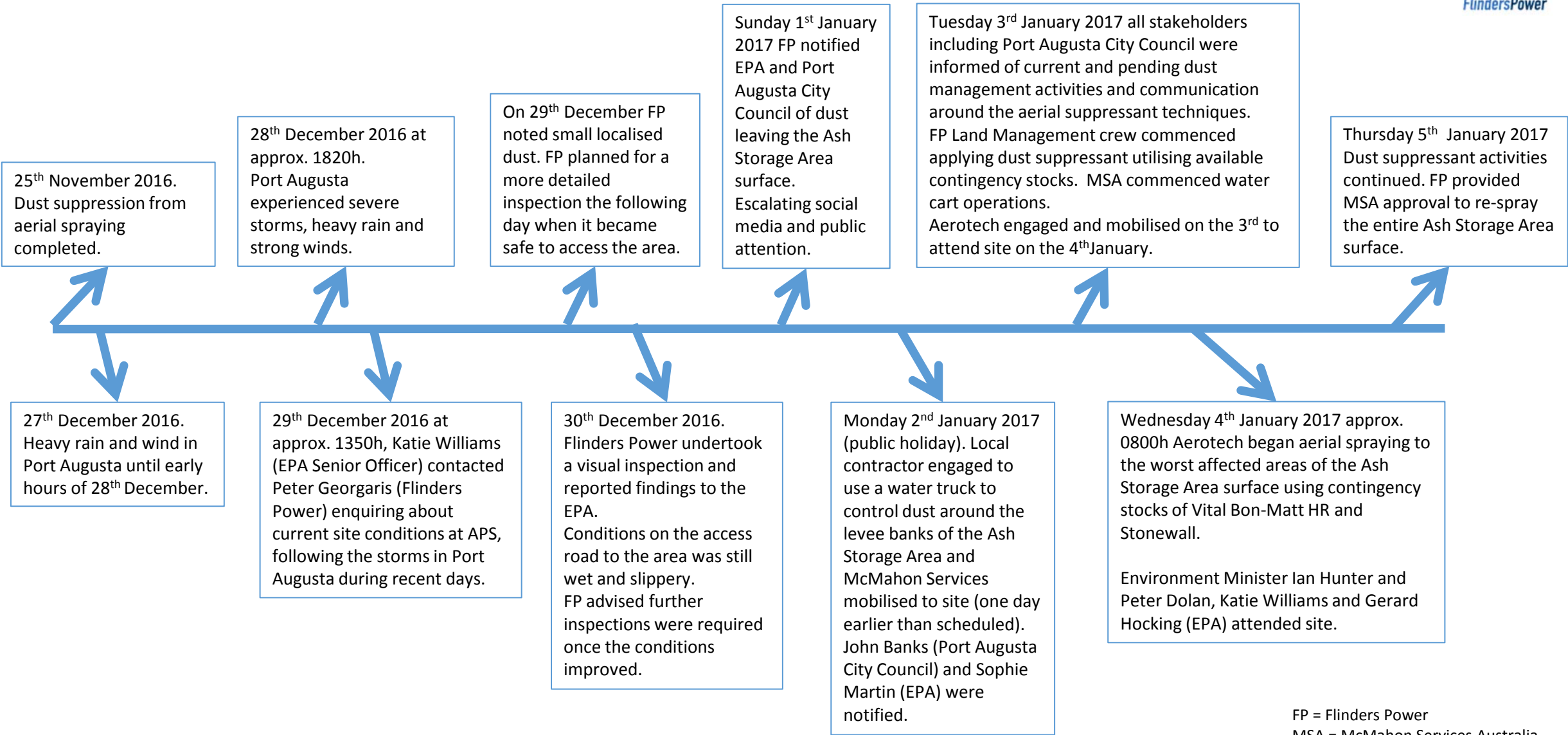
Over the period 24th to 28th December 2016 the Port Augusta region was subjected to a series of major weather events.

This resulted in significant damage to the dust suppressant seal. Following the major weather event, subsequent days of drying and wind resulted in dust emissions. Dust control commenced immediately using water trucks on the affected areas that were accessible and the re-application of the Vital Bon-Matt (Stonewall and HR) dust suppressant by water cart, hand spraying and crop-dusting aeroplane.

Investigation

Flinders Power conducted a Root Cause Analysis involving members from the Alliance Ash Project (Flinders Power and McMahon Services) and from Vital Chemical Pty Ltd. A timeline of events was established.

TIMELINE OF EVENTS



FP = Flinders Power
MSA = McMahon Services Australia

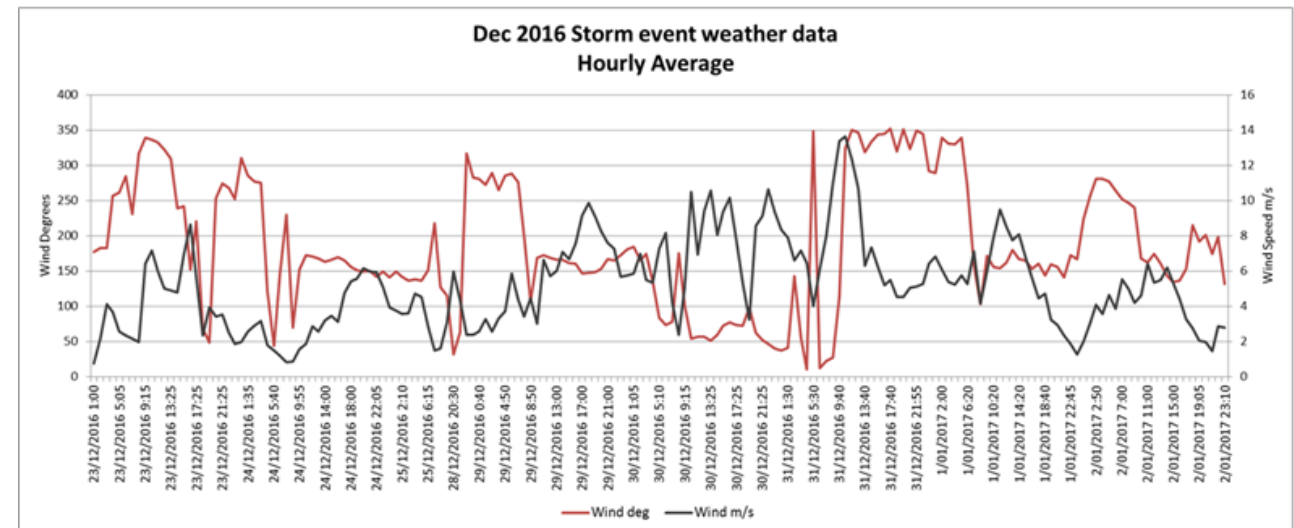
Weather summary

During the period 24th – 28th December 2016 Port Augusta experienced wind speeds over 70km/h for extended periods with especially strong gusts over 120km/h. The Bureau of Meteorology recorded two days with 25mm of rain on each day with anecdotal reports of 100mm of rain for the period being measured by community members. Strong hail was also reported during the peaks of the storms.

A report has been provided by the BOM and is presented as Appendix H to this RCA. The key conclusion from the BOM report is:

'59.6 mm of rainfall was recorded from midnight 26th to midnight 28th December 2016 at Port Augusta Aerodrome. This amount on that timeframe is close to a 20% Annual Exceedance Probability (about a 1 in 5 year Annual Recurrence Interval (ARI)) for Port Augusta.

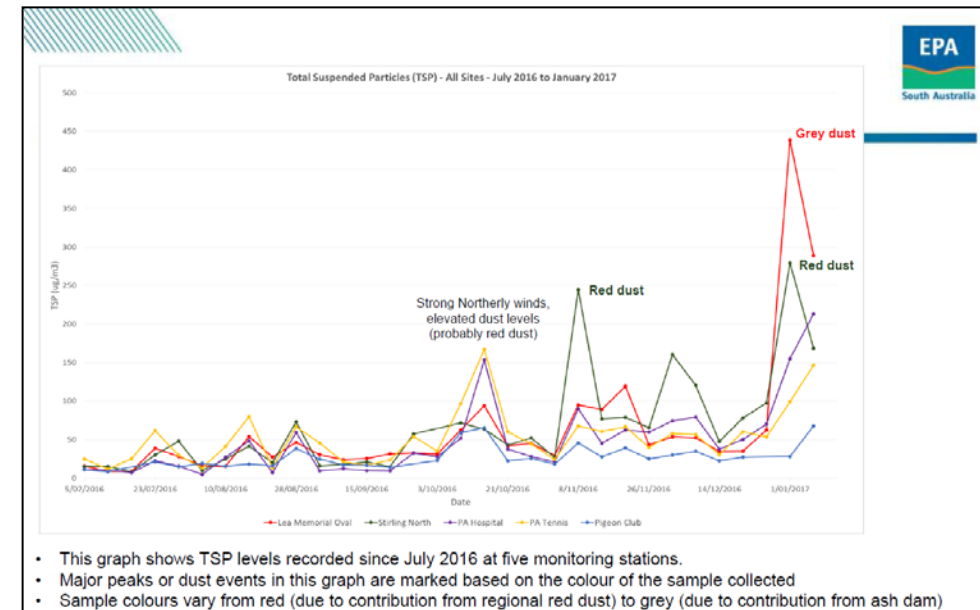
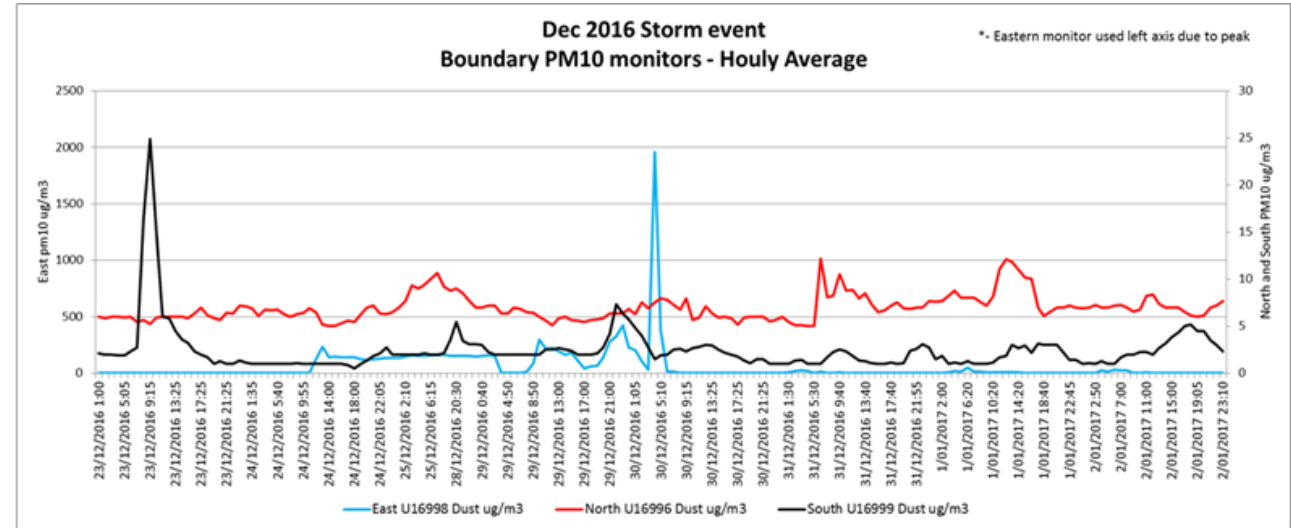
Most of the rainfall during the 28th December 2016 fell in a 30 minute period at about 6pm from severe and localised thunderstorm activity. 24.7 mm was recorded at Port Augusta Aerodrome in the 30 minutes from 5:55pm to 6:25 pm. This amount over that timeframe has between a 10 and 5% AEP (about 20 to 10 year ARI) for Port Augusta. Consistent with this is that looking at all available 30 minute rainfall data from Port Augusta (available from 2010), this was the highest 30 minute rainfall amount on record. There is some indication from radar imagery through this event that rainfall intensity may have been higher than was recorded at Port Augusta Aerodrome on the eastern side of Port Augusta as the thunderstorm activity developed and moved and eastwards' (BOM, 2017).



Dust Monitoring summary

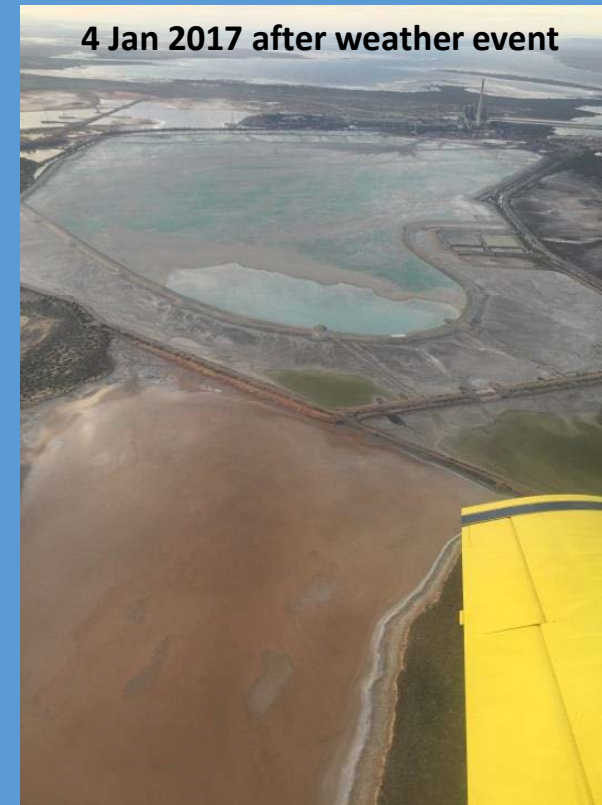
The three new Met-One PM10 Dust Monitors around the Ash Storage Area were in operation during this period. The southern monitor was subjected to harsh conditions providing erroneous results which were reviewed for QA/QC by the manufacturer/supplier and declared unusable.

On the 1st January 2017 the Total Suspended Particulate (TSP) monitoring at Lea Memorial Oval indicated 438 $\mu\text{g}/\text{m}^3$ and Stirling North at 279 $\mu\text{g}/\text{m}^3$. The Stirling North filter paper was coloured red (indicating a strong contribution from regional dust) whereas the Lea Memorial Oval was coloured grey (indicating a potential contribution from the Ash Storage Area).



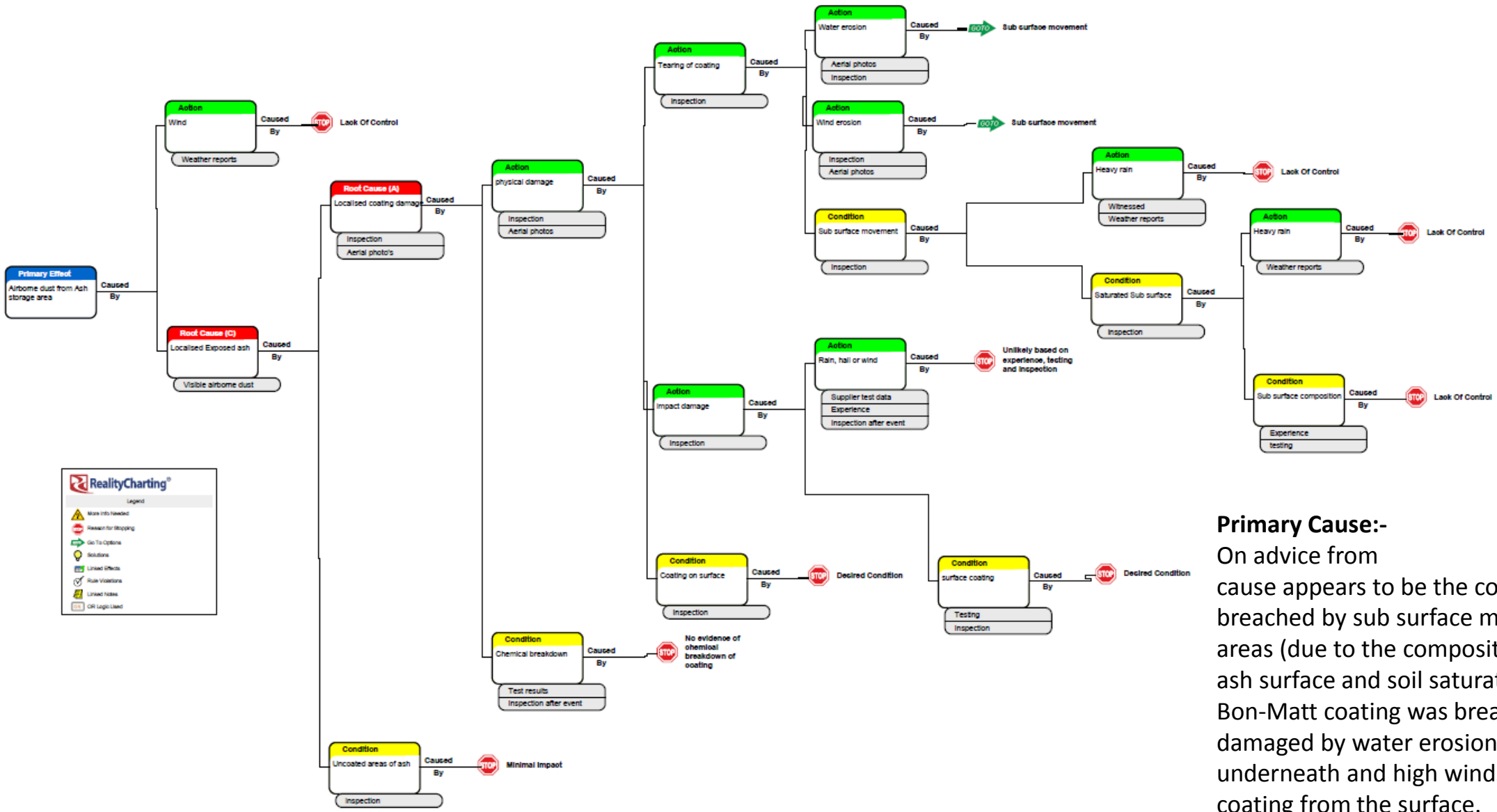
Impact Assessment

- Inspections by land and by air following the weather event were unclear as to what proportion of the dust suppressant seal had been impacted. This is due to limited access to the area by foot, and dust being deposited on top of the seal, obscuring an intact layer of sealant underneath.



RCA FLOW

(pdf version supplied as an Appendix)



RealityCharting®

Legend

- ⚠️ More Info Needed
- 🛑 Reason for Stopping
- ➡️ Go To Options
- 💡 Solutions
- 🔗 Linked Effects
- 🔍 Risk Violations
- 📄 Linked Notes
- 👤 QR Login/Logout

Primary Cause:- On advice from _____ the primary cause appears to be the coating has been breached by sub surface movement in some areas (due to the composition of the underlying ash surface and soil saturation). Once the Vital Bon-Matt coating was breached it was further damaged by water erosion of the sub surface underneath and high winds then lifting the coating from the surface.

Event Response

- FP become aware of dust leaving the dam at approximately 1400 1st January. Site presence was limited to Security staff only due to public holiday. FP Facility Manager commenced enquiries with McMahon Services and local water cart operator immediately to initiate a response as soon as possible, and soon as site conditions allowed safe access. Key stakeholders informed at 1554 1st January.
- Response on the 1st and 2nd January was limited due to public holidays and availability of third parties and access due to safety.
- Local watercart operators [REDACTED] were engaged on the 2nd January and commenced spraying water on roadways and levee banks on that day.
- McMahon Services personnel were mobilised one day earlier than planned and drove to Port Augusta on the 2nd. They commenced watercart and hand application of contingency stocks of dust suppressant on the 3rd January in conjunction with FP personnel.
- Aerotech were engaged and mobilised to Port Aug on 3rd January at their first available opportunity and commenced re-application of contingency stocks of dust suppressant on the 4th January.
- FP issued a media statement on 2nd January 2017 and continued with daily media updates throughout January. This has been the main tool used to inform the community.

RCA – Contributing Factors

- Intensity of the weather event – rain, hail and strong gusting winds
- Limited safe access to site following the weather event
- Rapid deterioration of site conditions following the initial site inspection on 30 December 2016 which was contrary to previous experience
- Large Ash Storage Area surface area
- The event occurrence (commencing 2pm 1st January) across a public holiday period with limited site resources and restricted ability for contractor parties to respond.
- Large amounts of standing surface water on the ash dam on 1st January would have prevented re-application of suppressant at that time.
- The risk assessment conducted jointly with the EPA prior to the event did not foresee the magnitude of the consequences of the risk event.
- Information that was not factually correct provided to the community during the event (beyond FP control) regarding ‘flyash’, potential asbestos contamination, the toxicity of the ash and the lack of a long-term rehabilitation plan exacerbated community concern.

Recommendations

Primary Cause	Recommendation
<p>The coating has been breached by sub surface movement in some areas (due to the composition of the underlying ash surface and soil saturation). Once the Vital Bon-Matt coating was breached it was further damaged by water erosion of the sub surface underneath and high winds then lifting the coating from the surface.</p>	<ol style="list-style-type: none">1. Conduct a review to ensure that the product is the most suitable on the market for purpose.2. Engage Vital Chemicals to attend site to review application methodology and dilution rate.3. Engage Vital Chemicals to conduct a final inspection following re-application and advise whether the treatment was suitable for purpose.

Recommendations

Contributing Factor	Recommendation
Intensity of the weather event – rain, hail and strong gusting winds	4. Instigate a long-range severe weather and dust forecast service from BOM.
Limited safe access to site following the event	5. Re-apply dust suppressant to damaged areas as soon as practicable, by air and land spraying. 6. Construction of soil access fingers across the dam to enable improved access.
Rapid deterioration of site conditions following the initial site inspection on 30 December contrary to previous experience	7. Revise the contingency plan for severe weather including a review of contingency stock levels of dust suppressant, forecasting of equipment and human resource availability, use of alternative dust suppression measures and the identification of trigger factors that will result in re-application of dust suppressant. Refer 'ASA Extreme Weather Monitoring & Response Plan' (Appendix J). <div style="background-color: white; width: 100%; height: 100%; margin-top: 10px;"></div>

Recommendations

Contributing Factor	Recommendation
Large Ash Storage Area surface area	<p>9. Fast-track the approval and implementation of the long term rehabilitation strategy to the extent reasonably practicable.</p> <p>10. Assess modifications to topsoil fingers design to provide protection of suppressant during earthworks phase (consideration of additional short fingers at the western and eastern edges of the dam – refer subsequent slide).</p> <p>11. Adopt Vital Chemicals re-application post-inspection (30th January) recommendations of:</p> <ul style="list-style-type: none"> - Continue routine visual monitoring for signs of dust and surface damage. - Avoid unnecessary traversing of the ash storage dam surface. - Undertake additional inspections/monitoring subsequent to extreme weather events (heavy rain/extreme winds). - Undertake spot-maintenance re-applications as soon as practical where monitoring and inspection has confirmed a breach of surface coating. - Avoid re-application of areas that are inundated or where the surface material is still saturated. - Treat external exposed areas with a suitable dust suppressant to minimise potential with wind-blown dust generation from other areas of the site.

Recommendations

Contributing Factor	Recommendation
<p>The event occurrence (commencing 2pm 1st January) across a public holiday period with limited site resources and restricted ability for contractor parties to respond.</p>	<p>As for recommendation #7</p>
<p>Large amounts of standing surface water on the ash dam on 1st January would have prevented re-application of suppressant at that time.</p>	<p>12. As for recommendation #7, refer to the development and implementation of the ASA Extreme Weather Monitoring & Response Plan. The plan to include an assessment of when the moisture level on the dam is suitable for re-application.</p>
<p>The risk assessment conducted jointly with the EPA prior to the event did not foresee the magnitude of the consequences</p>	<p>13. Revise the ‘Dust Suppressant Risk Assessment’, Dust Management Plan and APS Environmental Closure and Post-Closure Plan to consider learnings from the event.</p>
<p>Information that was not factually correct provided to the community during the event (beyond FP control) regarding ‘flyash’, potential asbestos contamination, the toxicity of the ash and the lack of a long-term rehabilitation plan exacerbated community concern.</p>	<p>14. Revise the FP Stakeholder and Community Engagement Plan (as outlined in Section 5 of the APS Environmental Closure & Post-Closure Plan), including the creation of a Community Liaison Group and the implementation of a communication protocol for potential dust events.</p> <p>15. Implement a community education program regarding long term rehabilitation plans.</p> <p>16. Post ambient dust monitoring sample results on the FP website.</p>

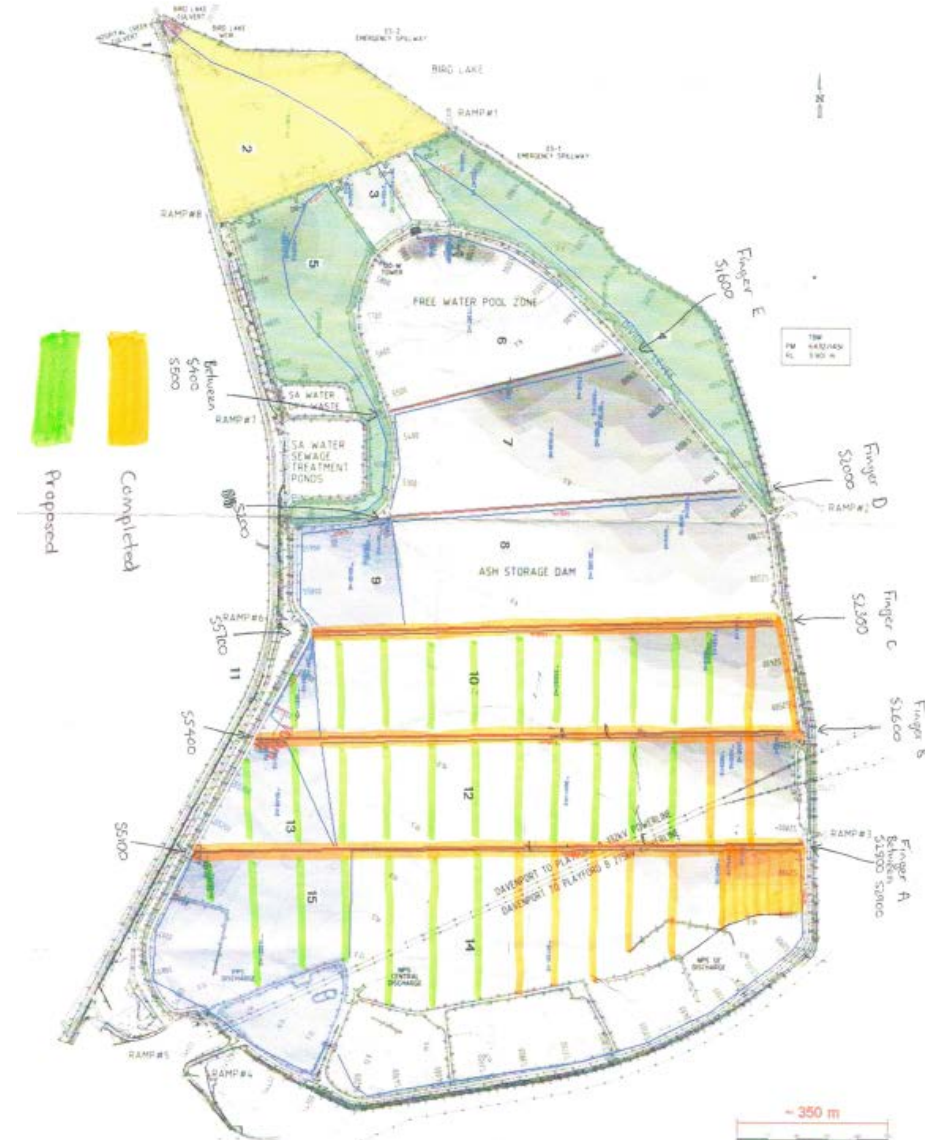


Recommendation 10 – further information

The most significant areas of damage, and subsequent areas of dust generation, were adjacent the eastern and western levee bank. Due to the dam surface contours, rainfall is shed from the central area to the outer edges.

A key control strategy to prevent water movement across the surface of the dam is to construct east-west access fingers, that will act as levee banks. On completion these fingers will remain and form macro catchment zones for the dam. During construction, additional north-south connecting levees will also be constructed to create smaller cells. These cells have two purposes: 1) to aid trafficability and enable soil to be emplaced and spread along their length, and 2) to act as sub-catchments. Should another significant rain event occur, the sub-catchments will assist to restrict and contain rainfall, and prevent surface and sub-surface erosion of the seal.

The adjacent figure shows the East/West and North/South access fingers that have been constructed to date (orange highlight) and the proposed additional fingers (green highlight). It is likely that additional North-South fingers will be required between Fingers C and D and Fingers D and E, however the design philosophy will be progressively reviewed during construction.



Dust Suppressant Bonding

Vital Bon-Matt Stonewall is a polymer-based product, diluted with water to achieve a 10% product strength prior to application. The product is designed to soak in to the substrate. Surfactants are included within the product formula and these are designed to break surface tension and allow the product to draw through the substrate. As the product dries, polymer bonds form with the substrate. Where the product does not penetrate as effectively it will remain on the surface as a skin. While this still forms a seal, it is not as robust as areas where the product has soaked through the surface layers of the substrate.

In the case of the ash dam, areas of fines that tend to be more compact inhibits product infiltration due to a lack of void space. These areas tend to be in the central and northern extremities of the dam. Areas of a coarser particle size, such as the southern end of the dam, allow for increased penetration and a greater depth of seal. However, counter to this, coarse unconsolidated material will be more susceptible to damage of the seal by traffic (vehicles, pedestrians, animals etc) and may be more susceptible to sub-seal seepage and erosion.

Surface water impacts the formation of a robust seal via two means:

1. Standing surface water will increase the dilution of the product and reduce product application strength; and
2. Water fills the pore space between particles to inhibit product penetration. This is particularly so for fine grained areas of the dam.

Ensuring the appropriate surface moisture content is complex. In fine-grained materials some surface dampness can assist with penetration. However, if the surface is saturated or has surface pooling, it may inhibit product performance. As the ash dam dries it is also increasingly susceptible to dust generation, and so applying the suppressant while there is some surface moisture, but not saturation or pooling, is considered the optimal time.

Action Plan

Recommendation	By Whom	By When	Status
1. Conduct a review to ensure that the product is the most suitable on the market for purpose.	FP Program Mgr	31/1/17	Complete. Refer Appendix I and Appendix L.
2. Engage Vital Chemicals to attend site to review application methodology and dilution rate.	FP Facility Mgr	31/1/17	Complete. Vital Chemicals Environmental Business Development Manager was engaged extensively throughout the first week of January and attended site during application on 11 th January.
3. Engage Vital Chemicals to conduct a final inspection following re-application and advise whether the treatment was suitable for purpose.	FP Facility Mgr	31/1/17	Complete. Vital Chemicals Environmental Business Development Manager conducted a final inspection on 30th January.
4. Instigate a long-range severe weather and dust forecast service from BOM.	FP Environmental Specialist	20/1/17	Complete. FP have received access to the BOM HYSPLIT dispersion forecasting tool. This information is reviewed within the daily environmental report and dust alerts are distributed to the management team.
5. Re-apply dust suppressant to damaged areas as soon as practicable, by air and land spraying.	FP Facility Mgr	30/1/17	Complete. Re-application was completed on the 25/1 with a final inspection on the 30/1.
6. Construction of soil access fingers across the dam to enable improved access.	McMahon Services Site Manager	30/6/17	In progress. Please refer slide 14.

Action Plan

Recommendation	By Whom	By When	Status
<p>7. Revise the contingency plan for severe weather including a review of contingency stock levels of dust suppressant, forecasting of equipment and human resource availability, use of alternative dust suppression measures and the identification of trigger factors that will result in re-application of dust suppressant. Refer 'ASA Extreme Weather Monitoring & Response Plan'.</p>	FP Facility Mgr	31/1/17	Draft ASA Extreme Weather Monitoring & Response Plan complete (refer Appendix J). Revision 2 to be developed to consider EPA feedback.
<p>[Redacted]</p>	<p>[Redacted]</p>	<p>[Redacted]</p>	<p>[Redacted]</p>
<p>9. Fast-track the approval and implementation of the long term rehabilitation strategy to the extent reasonably practicable.</p>	FP Program Manager, EPA and DEWNR	3/2/17	In progress. Revisions to the ash storage area rehabilitation plans following EPA and DEWWNR feedback is well progressed.
<p>10. Assess modifications to topsoil fingers design to provide protection of suppressant during earthworks phase (consideration of additional short fingers at the western and eastern edges of the dam – refer Slide 14).</p>	FP Program Mgr & McMahon Services Site Manager	31/1/17	Revised strategy agreed and works underway – refer Slide 14.

Action Plan

Recommendation	By Whom	By When	Status
<p>11. Adopt Vital Chemicals re-application post-inspection (30th January) recommendations of:</p> <ul style="list-style-type: none"> • Continue routine visual monitoring for signs of dust and surface damage. • Avoid unnecessary traversing of the ash storage dam surface. • Undertake additional inspections/monitoring subsequent to extreme weather events (heavy rain/extreme winds). • Undertake spot-maintenance re-applications as soon as practical where monitoring and inspection has confirmed a breach of surface coating. • Avoid re-application of areas that are inundated or where the surface material is still saturated. • Treat external exposed areas with a suitable dust suppressant to minimise potential with wind-blown dust generation from other areas of the site. 	FP Facility Mgr & McMahon Services Site Manager	3/3/17	In progress – these recommendations have been incorporated into the draft ASA Extreme Weather Monitoring & Response Plan and Fugitive Dust Trigger Action Response Plan, however document finalisation and approval is required.
<p>12. As for recommendation #7, refer to the development and implementation of the ASA Extreme Weather Monitoring & Response Plan. The plan to include an assessment of when the moisture level on the dam is suitable for re-application.</p>	FP Facility Mgr	31/1/17	Draft ASA Extreme Weather Monitoring & Response Plan complete (Appendix J). Revision 2 to be developed to consider EPA feedback.
<p>13. Revise the ‘Dust Suppressant Risk Assessment’, Dust Management Plan and APS Environmental Closure and Post-Closure Plan to consider learnings from the event.</p>	FP Program Mgr	3/2/17	In progress – plans have been revised and submitted to EPA on 3/2/17. FP received feedback from EPA on 20/2/17. Revised documents to be re-submitted by 3/3/17.

Action Plan

Recommendation	By Whom	By When	Status
14. Revise the FP Stakeholder and Community Engagement Plan (as outlined in Section 5 of the APS Environmental Closure & Post-Closure Plan), including the creation of a Community Liaison Group and the implementation of a communication protocol for potential dust events.	FP CEO, Program Mgr and Facility Mgr	3/3/17	In progress. The plans will be updated by 3/3/17, with the delivery of the strategy thereafter.
15. Implement a community education program regarding long term rehabilitation plans.	FP Facility Mgr	10/2/17	Complete and ongoing. A pamphlet 'Ash Storage Area Rehabilitation Project – Information Sheet No. 3' was developed, printed and letter-boxed dropped to the Port Augusta community during the week 6 th – 10 th February (refer Appendix K). Further and ongoing communication will occur throughout the program in accordance with the FP Stakeholder and Community Engagement Plan
16. Post ambient dust monitoring sample results on the FP website.	FP Program Mgr	28/2/17	In progress. Progressing the development of automatic feeds from the [redacted] on-line system [redacted] to the FP internet site.

Summary

The use of Vital Bon-Matt as an interim dust suppression measure is still considered to be the best interim option, however this is the first time it has been applied to an Ash Storage Area using an aerial application (usually applied using a water truck; this is not possible on the Ash Storage Area).

It is unclear how much of the area covered by the Vital Bon-Matt was still intact after the weather event however the thickness of the bonding of the Vital Bond-Matt to the ash surface varies depending on the ash surface composition. The extent of impact damage is also unclear following a site inspection subsequent to the event. On advice from [REDACTED] the primary cause appears to be the coating has been breached by sub surface movement in some areas (due to the composition of the underlying ash surface and soil saturation). Once the Vital Bon-Matt coating was breached it was further damaged by water erosion of the sub surface underneath and high winds then lifting the coating from the surface.

This then resulted in areas of ash becoming exposed, which once dried, was susceptible to becoming airborne on high wind days.

A review of the technical specifications following the event, and comparison with similar products available, shows that the product remains the most suitable on the market for this application.

Supporting Documents

- Appendix A: RCA flowchart
- Appendix B: APS Dust Management Plan 2016 V5 (5th November 2016),
- Appendix C: Ash Dam Interim Sealing – Proposal (7th November 2016)
- Appendix D: Dust Suppressant Risk Assessment (21st October 2016)
- Appendix E: Copy of VITAL BON-MATT STONEWALL & VITAL BON-MATT HR Safety Data Sheet
- Appendix F: Environmental Assessment of Vital Bon-Matt Stonewall (Simmonds & Bristow, August 2012)
- Appendix G: Review of Aquatic Ecosystem Risks Associated with the use of Erosion and Dust Control Products (Vital Bon-Matt P47-VR1 and Vital Bon-Matt Stonewall)in Western Queensland (Gauge Industrial and Environmental Pty Ltd, June 2015)
- Appendix H: Bureau of Meteorology (January 2017) Port Augusta 2016 weather and climate - weather extremes analysis for Flinders Power operations in the Port Augusta region
- Appendix I: FP Summary of Investigations for Alternate Dust Suppressant
- Appendix J: ASA Extreme Weather Monitoring & Response Plan 030217
- Appendix K: Ash Storage Area Rehabilitation Project – Information Sheet No. 3
- Appendix L: Landloch Pty Ltd and SEEC Pty Ltd (2013). Assessment of soil stabilisation compounds. Final report , June 2013.