



26 May 2020

Responses to EPA comments on Haerses Road Quarry Mod 3 Air Quality

ERM prepared an Air Quality Impact Assessment to support a Modification Report (prepared by Umwelt (Australia) Pty Ltd) for an application by Dixon Sand Pty Ltd to modify DA 165-7-2005 for Haerses Road Quarry (Modification 3). The public exhibition of the Modification Report concluded on Wednesday 26 February 2020. The NSW Environment Protection Authority (EPA) lodged a submission (dated 25 February 2020) requesting clarification and recommending further information be provided in relation to the AQIA prior to determination. ERM responded to those submissions from the EPA in March 2020.

The EPA have now requested further information regarding the updated emissions inventory, including:

1. Presentation of updated emissions inventories and discussion on any other assumptions that have been updated or made.
2. Revision of proposed emission reductions to reflect the anticipated timeframe in which bunds are retained.

1. Presentation of updated emissions inventories

Table 1 presents the high-level comparison that was shown in ERM's March response document. EPA have asked for more information including the detail for each activity, and this is presented in Table 2. We have also included screenshots of the spreadsheet information (see Appendix A), similar to that provided in the original Air Quality Assessment.

Please note that emissions from some haulage activities have increased due to calculations being for maximum truck movements, while others have decreased due to the sealing of roads. No other assumptions were changed.

Table 1 – Total emissions comparison to original EIS

Production scenario	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)
Original 2019 assessment emissions Annual average production Unsealed roads to processing area	60,252	18,265	6,783
Re-calculated emissions Maximum daily production Sealed roads to processing area	50,593	15,433	6,744

Table 2 – Comparison for each activity for TSP, PM₁₀ and PM_{2.5} to original EIS

Activity	Original EIS inventory (annual average production)			Update inventory (maximum daily production)		
	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)
Tertiary Sand Extraction Area - Approved						
Dozer stripping topsoil - approved Stage 5	233	57	24	233	57	24
Excavator loading tertiary sand to trucks for transfer to Processing Area (from Approved Stage 5)	19	9	1	19	9	1
Hauling from Approved Stage 5 to Processing Area (unsealed - extraction to sealed road)	1,663	449	45	2,395	647	65
Hauling from Approved Stage 5 to Processing Area (sealed to processing area)	382	73	18	550	105	26
Hauling of Approved Stage 5 to and in Processing Area (sealed)	1,774	479	48	268	51	12
Tertiary Sand Extraction Area - Proposed						
Dozer stripping topsoil - Proposed	233	57	24	233	57	24
Excavator loading tertiary sand to trucks for transfer to Processing Area (from proposed extension)	19	9	1	19	9	1
Hauling from proposed to Processing Area (unsealed - extraction to sealed road)	1,663	449	45	2,395	647	65
Hauling from proposed to Processing Area (sealed to processing area)	382	73	18	550	105	26
Hauling of proposed to and in Processing Area (sealed)	1,774	479	48	268	51	12
Friable Sand Extraction Area						
Dozer stripping topsoil/ripping friable sandstone (from Cell 5A & 5B)	4,137	974	434	4,137	974	434
Excavator loading friable sand to trucks for transfer to Processing Area (from Cell 5A & 5B)	71	33	5	71	33	5
Hauling from Cell 5A & 5B to Processing Area (unsealed)	8,110	2,189	219	11,678	3,153	315

Activity	Original EIS inventory (annual average production)			Update inventory (maximum daily production)		
	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)
VENM/ENM placement in Friable area						
Hauling VENM/ENM on-site from entrance to friable extraction area (Cells 4A & 4B) (sealed)	1,090	209	51	1,596	306	74
Hauling of VENM/ENM to placement area (sealed)	5,069	1,368	137	766	147	36
Unloading VENM/ENM to cell	55	26	4	55	26	4
Dozer spreading/compacting VENM/ENM	3,036	732	319	3,036	732	319
Processing Area						
Friable Sand processing						
Unloading friable sand to stockpile at Processing Area	71	33	5	71	33	5
Loading friable sand from stockpile at Processing Area	71	33	5	71	33	5
Unloading friable sand to Dry Processing at Processing Area	71	33	5	71	33	5
Crushing friable sand (uncontrolled) at Processing area	6,240	2,400	2,400	6,240	2,400	2,400
Transfer friable sand (Crusher to Screen) [conveyor transfer point]	35	17	3	35	17	3
Screen friable sand (uncontrolled)	4,000	1,376	1,376	4,000	1,376	1,376
Transfer friable processed at plant to product stockpile	35	17	3	35	17	3
Tertiary Sand processing						
Unloading tertiary sand to stockpile at Processing Area	39	18	3	47	22	3
Loading tertiary sand from stockpile at Processing Area	39	18	3	47	22	3
Unloading tertiary sand to Dry Processing at Processing Area	39	18	3	47	22	3
Screen tertiary sand (uncontrolled)	2,188	753	753	2,669	918	918
Transfer (Screen to Wet Processing) [conveyor transfer point]	19	9	1	24	11	2
Wet Processing (no expected emissions)	0	0	0	0	0	0
Transfer tertiary processed at plant to product stockpile	19	9	1	24	11	2
Product Sand						
Loading sand from Product Stockpile to haul trucks	65	31	5	70	33	5
Hauling out of Site (sealed)	10,036	2,709	271	1,130	217	52
Hauling out of Site (sealed)	2,159	414	100	2,327	447	108
Wind Erosion						
WE - Extraction Area (Tertiary - Stage 5)	708	354	53	708	354	53
WE - Extraction Area (Tertiary - proposed)	205	102	15	205	102	15
WE - Extraction Area (Tertiary - Stage 5 part rehabilitated)	1,395	698	105	1,395	698	105
WE - Extraction Area (Friable - 5A & 5B)	942	471	71	942	471	71
WE - Extraction Area (Friable - 4A & 4B plus VENM/ENM)	1,061	531	80	1,061	531	80
WE - Extraction Area (Friable - 3A & 3B partly rehabilitated)	677	338	51	677	338	51
WE - Processing Area including Stockpile	431	215	32	431	215	32
Total	60,252	18,265	6,783	50,593	15,433	6,744

2. Revision of emission reductions to reflect bund removal

The EPA have asked the proponent to consider what the estimated increase in emissions might be if the controls that were applied to the wind erosion activities due to bunding, were removed from the calculations. Table 3 presents this comparison and associated increase calculated, for those wind erosion sources where a 55% reduction was applied in the modelling. As shown, there is a small increase in these values, when compared to the updated (March 2020) inventory. This small increase to the emissions inventory is not sufficient to suggest there would be any changes to the outcomes of the assessment. Furthermore, when the inventory with the bund controls removed is compared to the original inventory, on which the predictions of the AQIA are based, there is a reduction in TSP and PM₁₀ emissions and the increase in PM_{2.5} emissions is reduced to only 1.6%.

Table 3 – Comparison for wind erosion without controls applied for bunds

Activity	Update inventory (March 2020)			Bund controls removed		
	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)	TSP (kg/y)	PM ₁₀ (kg/y)	PM _{2.5} (kg/y)
Total from all non-wind erosion activities (as per Table 2)	45,175	12,723	6,337	45,175	12,723	6,337
Wind Erosion						
WE - Extraction Area (Tertiary - Stage 5)	708	354	53	1,573	786	118
WE - Extraction Area (Tertiary - proposed)	205	102	15	455	227	34
WE - Extraction Area (Tertiary - Stage 5 part rehabilitated)	1,395	698	105	1,395	698	105
WE - Extraction Area (Friable - 5A & 5B)	942	471	71	2,094	1,047	157
WE - Extraction Area (Friable - 4A & 4B plus VENM/ENM)	1,061	531	80	1,061	531	80
WE - Extraction Area (Friable - 3A & 3B partly rehabilitated)	677	338	51	677	338	51
WE - Processing Area including Stockpile	431	215	32	431	215	32
Total	50,593	15,433	6,744	52,860	16,566	6,914
Percentage change	-	-	-	+4.5%	+7.3%	+2.5%

We trust this provides sufficient clarification and additional information to address the comments and recommendations made by the EPA.

Yours sincerely



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Appendix A – Detailed emissions inventories

TSP Emissions Inventory



ACTIVITY	TSP (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Assumed control	
Tertiary Sand Extraction Area - Approved																			
Dozer stripping topsoil - approved Stage 5	233	25	h/y	9.3	kg/h	13	silt content in %	4.0	moisture content (%)										
Excavator loading tertiary sand to trucks for transfer to Processing Area (from Approved Stage 5)	19	87,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Hauling from Approved Stage 5 to Processing Area (unsealed - extraction to sealed road)	2,395	126,000	t/y	0.076	kg/t	40	t/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	3.38	kg/VKT	6.4	% silt content	75	% control	Level 2 watering	
Hauling from Approved Stage 5 to Processing Area (sealed to processing area)	550	126,000	t/y	0.004	kg/t	40	t/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Hauling of Approved Stage 5 to and in Processing Area (sealed)	268	126,000	t/y	0.002	kg/t	40	t/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Tertiary Sand Extraction Area - Proposed																			
Dozer stripping topsoil - Proposed	233	25	h/y	9.3	kg/h	13	silt content in %	4.0	moisture content (%)										
Excavator loading tertiary sand to trucks for transfer to Processing Area (from proposed)	19	87,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Hauling from proposed to Processing Area (unsealed - extraction to sealed road)	2,395	126,000	t/y	0.076	kg/t	40	t/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	3.38	kg/VKT	6.4	% silt content	75	% control	Level 2 watering	
Hauling from proposed to Processing Area (sealed to processing area)	550	126,000	t/y	0.004	kg/t	40	t/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Hauling of proposed to and in Processing Area (sealed)	268	126,000	t/y	0.002	kg/t	40	t/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Friable Sand Extraction Area																			
Dozer stripping topsoil/ripping friable sandstone (from Cell 5A & 5B)	4,137	570	h/y	7.3	kg/h	12	silt content in %	4.5	moisture content (%)										
Excavator loading friable sand to trucks for transfer to Processing Area (from Cell 5A & 5B)	71	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Hauling from Cell 5A & 5B to Processing Area (unsealed)	11,678	460,800	t/y	0.101	kg/t	40	t/load	52.8	Vehicle mean mass (t)	1.2	km/return trip	3.38	kg/VKT	6.4	% silt content	75	% control		
VENM/ENM placement in Friable area																			
Hauling VENM/ENM on-site from entrance to friable extraction area (Cells 4A & 4B) (sealed)	1,596	360,000	t/y	0.004	kg/t	40	t/load	52.8	Vehicle mean mass (t)	2.0	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Hauling of VENM/ENM to placement area (sealed)	766	360,000	t/y	0.002	kg/t	40	t/load	52.8	Vehicle mean mass (t)	1.0	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Unloading VENM/ENM to cell	55	250,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Dozer spreading/compacting VENM/ENM	3,036	380	h/y	8.0	kg/h	13	silt content in %	4.5	moisture content (%)										
Processing Area																			
Friable Sand processing																			
Unloading friable sand to stockpile at Processing Area	71	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Loading friable sand from stockpile at Processing Area	71	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Unloading friable sand to Dry Processing at Processing Area	71	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Crushing friable sand (uncontrolled) at Processing area	6,240	320,000	t/y	0.0195	kg/t														
Transfer friable sand (Crusher to Screen) [conveyor transfer point]	35	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays	
Screen friable sand (uncontrolled)	4,000	320,000	t/y	0.0125	kg/t														
Transfer friable processed at plant to product stockpile	35	320,000	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays	
Tertiary Sand processing																			
Unloading tertiary sand to stockpile at Processing Area	47	213,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Loading tertiary sand from stockpile at Processing Area	47	213,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Unloading tertiary sand to Dry Processing at Processing Area	47	213,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)										
Screen tertiary sand (uncontrolled)	2,669	213,500	t/y	0.0125	kg/t														
Transfer (Screen to Wet Processing) [conveyor transfer point]	24	213,500	t/y	0.00022	kg/t	0.6	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays	
Wet Processing (no expected emissions)	-																		
Transfer tertiary processed at plant to product stockpile	24	213,500	t/y	0.00022	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays	
Product Sand																			
Loading sand from Product Stockpile to haul trucks	70	533,500	t/y	0.000	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	6.5	moisture content (%)										
Hauling out of Site (sealed)	1,130	533,500	t/y	0.002	kg/t	40	t/load	52.84	Vehicle mean mass (t)	1	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Hauling out of Site (sealed)	2,327	533,500	t/y	0.004	kg/t	40	t/load	52.84	Vehicle mean mass (t)	2	km/return trip	0.09	kg/VKT	0.4	g/m2 silt loading	0	% control		
Wind Erosion																			
WE - Extraction Area [Tertiary - Stage 5]	708	3.7	ha	850	kg/ha/y											77.5	% control		
WE - Extraction Area [Tertiary - proposed]	205	1.1	ha	850	kg/ha/y											77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts	
WE - Extraction Area [Tertiary - Stage 5 part rehabilitated]	1,395	5.5	ha	850	kg/ha/y											70	% control	vegetative cover	
WE - Extraction Area [Friable - 5A & 5B]	942	4.9	ha	850	kg/ha/y											77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts	
WE - Extraction Area [Friable - 4A & 4B plus VENM/ENM]	1,061	4.2	ha	850	kg/ha/y											70	% control	vegetative cover	
WE - Extraction Area [Friable - 3A & 3B partly rehabilitated]	677	2.7	ha	850	kg/ha/y											70	% control	vegetative cover	
WE - Processing Area including Stockpile	431	3.4	ha	850	kg/ha/y											85	% control	Chemical wetting agent	
TOTAL TSP EMISSIONS	50,593																		

PM₁₀ Emissions Inventory



ACTIVITY	PM10 (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3 (hauling)	Units	Variable 4	Units	Control	Units	Assumed control
Tertiary Sand Extraction Area - Approved																		
Dozer stripping topsoil - approved Stage 5	57	25	h/y	2.3	kg/h	13	silt content in %	4.0	moisture content (%)									
Excavator loading tertiary sand to trucks for transfer to Processing Area (from Approved Stage)	9	87,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Hauling from Approved Stage 5 to Processing Area (unsealed - extraction to sealed road)	647	126,000	l/y	0.021	kg/t	40	l/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	0.91	kg/VKT	6.4	% silt content	75	% control	Level 2 watering
Hauling from Approved Stage 5 to Processing Area (sealed to processing area)	105	126,000	l/y	0.001	kg/t	40	l/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Hauling of Approved Stage 5 to and in Processing Area (sealed)	51	126,000	l/y	0.000	kg/t	40	l/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Tertiary Sand Extraction Area - Proposed																		
Dozer stripping topsoil - Proposed	57	25	h/y	2.3	kg/h	13	silt content in %	4.0	moisture content (%)									
Excavator loading tertiary sand to trucks for transfer to Processing Area (from proposed)	9	87,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Hauling from proposed to Processing Area (unsealed - extraction to sealed road)	647	126,000	l/y	0.021	kg/t	40	l/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	0.91	kg/VKT	6.4	% silt content	75	% control	Level 2 watering
Hauling from proposed to Processing Area (sealed to processing area)	105	126,000	l/y	0.001	kg/t	40	l/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Hauling of proposed to and in Processing Area (sealed)	51	126,000	l/y	0.000	kg/t	40	l/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Friable Sand Extraction Area																		
Dozer stripping topsoil/ripping friable sandstone (from Cell 5A & 5B)	974	570	h/y	1.7	kg/h	12	silt content in %	4.5	moisture content (%)									
Excavator loading friable sand to trucks for transfer to Processing Area (from Cell 5A & 5B)	33	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Hauling from Cell 5A & 5B to Processing Area (unsealed)	3,153	460,800	l/y	0.027	kg/t	40	l/load	52.8	Vehicle mean mass (t)	1.2	km/return trip	0.91	kg/VKT	6.4	% silt content	75	% control	
VENM/ENM placement in Friable area																		
Dozer stripping topsoil/ripping friable sandstone (from Cell 5A & 5B)	306	360,000	l/y	0.001	kg/t	40	l/load	52.8	Vehicle mean mass (t)	2.0	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Hauling of VENM/ENM to placement area (sealed)	147	360,000	l/y	0.0	kg/t	40	l/load	52.8	Vehicle mean mass (t)	1.0	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Unloading VENM/ENM to cell	26	250,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Dozer spreading/compacting VENM/ENM	732	380	h/y	1.9	kg/h	13	silt content in %	4.5	moisture content (%)									
Processing Area																		
Friable Sand processing																		
Unloading friable sand to stockpile at Processing Area	33	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Loading friable sand from stockpile at Processing Area	33	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Unloading friable sand to Dry Processing at Processing Area	33	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Crushing friable sand (uncontrolled) at Processing area	2,400	320,000	l/y	0.0075	kg/t													
Transfer friable sand (Crusher to Screen) [conveyor transfer point]	17	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays
Screen friable sand (uncontrolled)	1,376	320,000	l/y	0.0043	kg/t													
Transfer friable processed at plant to product stockpile	17	320,000	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays
Tertiary Sand processing																		
Unloading tertiary sand to stockpile at Processing Area	22	213,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Loading tertiary sand from stockpile at Processing Area	22	213,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Unloading tertiary sand to Dry Processing at Processing Area	22	213,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									
Screen tertiary sand (uncontrolled)	918	213,500	l/y	0.0043	kg/t													
Transfer (Screen to Wet Processing) [conveyor transfer point]	11	213,500	l/y	0.0001	kg/t	0.6	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays
Wet Processing (no expected emissions)	-																	
Transfer tertiary processed at plant to product stockpile	11	213,500	l/y	0.00010	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)							50	% control	Application of water at transfers - boom tip water sprays
Product Sand																		
Loading sand from Product Stockpile to haul trucks	33	533,500	l/y	0.000	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	6.5	moisture content (%)									
Hauling out of site (sealed)	217	533,500	l/y	0.000	kg/t	40	l/load	52.84	Vehicle mean mass (t)	1	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Hauling out of site (sealed)	447	533,500	l/y	0.001	kg/t	40	l/load	52.84	Vehicle mean mass (t)	2	km/return trip	0.02	kg/VKT	0.4	g/m2 silt loading	0	% control	
Wind Erosion																		
WE - Extraction Area (Tertiary - Stage 5)	354	3.7	ha	425	kg/ha/y											77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts
WE - Extraction Area (Tertiary - proposed)	102	1.1	ha	425	kg/ha/y											77.5	% control	
WE - Extraction Area (Tertiary - Stage 5 part rehabilitated)	698	5.5	ha	425	kg/ha/y											70	% control	vegetative cover
WE - Extraction Area (Friable - 5A & 5B)	471	4.9	ha	425	kg/ha/y											77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts
WE - Extraction Area (Friable - 4A & 4B plus VENM/ENM)	531	4.2	ha	425	kg/ha/y											70	% control	vegetative cover
WE - Extraction Area (Friable - 3A & 3B partly rehabilitated)	338	2.7	ha	425	kg/ha/y											70	% control	vegetative cover
WE - Processing Area including Stockpile	215	3.4	ha	425	kg/ha/y											85	% control	Chemical wetting agent
TOTAL PM10 EMISSIONS	15,433																	

PM_{2.5} Emissions Inventory



ACTIVITY	PM _{2.5} (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3 (hauling)	Units	Variable 4	Units	Control	Units	Assumed control		
Tertiary Sand Extraction Area - Approved																				
Dozer stripping topsoil - approved Stage 5	24	25	h/y	1.0	kg/h	13	silt content in %	4.0	moisture content (%)											
Excavator or loading tertiary sand to trucks for transfer to Processing Area (from Approved Stage	1	87,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Hauling from Approved Stage 5 to Processing Area (unsealed - extraction to sealed road)	65	126,000	1/y	0.002	kg/t	40	1/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	0.09	kg/VKT	6.4	% silt content	75	% control	Level 2 watering		
Hauling from Approved Stage 5 to Processing Area (sealed to processing area)	26	126,000	1/y	0.0002	kg/t	40	1/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Hauling of Approved Stage 5 to and in Processing Area (sealed)	12	126,000	1/y	0.000	kg/t	40	1/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Tertiary Sand Extraction Area - Proposed																				
Dozer stripping topsoil - Proposed	24	25	h/y	1.0	kg/h	13	silt content in %	4.0	moisture content (%)											
Excavator or loading tertiary sand to trucks for transfer to Processing Area (from proposed	1	87,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Hauling from proposed to Processing Area (unsealed - extraction to sealed road)	65	126,000	1/y	0.002	kg/t	40	1/load	52.8	Vehicle mean mass (t)	0.9	km/return trip	0.09	kg/VKT	6.4	% silt content	75	% control	Level 2 watering		
Hauling from proposed to Processing Area (sealed to processing area)	26	126,000	1/y	0.000	kg/t	40	1/load	52.8	Vehicle mean mass (t)	1.968	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Hauling of proposed to and in Processing Area (sealed)	12	126,000	1/y	0.000	kg/t	40	1/load	52.8	Vehicle mean mass (t)	0.96	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Friable Sand Extraction Area																				
Dozer stripping topsoil/ripping friable sandstone (from Cell 5A & 5B)	434	570	h/y	0.8	kg/h	12	silt content in %	4.5	moisture content (%)											
Excavator or loading friable sand to trucks for transfer to Processing Area (from Cell 5A & 5B)	5	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Hauling from Cell 5A & 5B to Processing Area (unsealed)	315	460,800	1/y	0.003	kg/t	40	1/load	52.8	Vehicle mean mass (t)	1.2	km/return trip	0.09	kg/VKT	6.4	% silt content	75	% control			
VENM/ENM placement in Friable area																				
Hauling VENM/ENM on-site from entrance to friable extraction area (Cells 4A & 4B) (sealed)	74	360,000	1/y	0.0002	kg/t	40	1/load	52.8	Vehicle mean mass (t)	2.0	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Hauling of VENM/ENM to placement area (sealed)	36	360,000	1/y	0.000	kg/t	40	1/load	52.8	Vehicle mean mass (t)	1.0	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Unloading VENM/ENM to cell	4	250,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Dozer spreading/compacting VENM/ENM	319	380	h/y	0.8	kg/h	13	silt content in %	4.5	moisture content (%)											
Processing Area																				
Friable Sand processing																				
Unloading friable sand to stockpile at Processing Area	5	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Loading friable sand from stockpile at Processing Area	5	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Unloading friable sand to Dry Processing at Processing Area	5	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Crushing friable sand (uncontrolled) at Processing area	2,400	320,000	1/y	0.0075	kg/t															
Transfer friable sand (Crusher to Screen) [conveyor transfer point]	3	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									50	% control	Application of water at transfers - boom tip water sprays
Screen friable sand (uncontrolled)	1,376	320,000	1/y	0.0043	kg/t															
Transfer friable processed at plant to product stockpile	3	320,000	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									50	% control	Application of water at transfers - boom tip water sprays
Tertiary Sand processing																				
Unloading tertiary sand to stockpile at Processing Area	3	213,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Loading tertiary sand from stockpile at Processing Area	3	213,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Unloading Tertiary sand to Dry Processing at Processing Area	3	213,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)											
Screen tertiary sand (uncontrolled)	918	213,500	1/y	0.0043	kg/t															
Transfer (Screen to Wet Processing) [conveyor transfer point]	2	213,500	1/y	0.00002	kg/t	0.6	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									50	% control	Application of water at transfers - boom tip water sprays
Wet Processing [no expected emissions]	-																			
Transfer tertiary processed at plant to product stockpile	2	213,500	1/y	0.00002	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	4.5	moisture content (%)									50	% control	Application of water at transfers - boom tip water sprays
Product Sand																				
Loading sand from Product Stockpile to haul trucks	5	533,500	1/y	0.00001	kg/t	0.58	average of (wind speed/2.2) ^{1.3} in m/s	6.5	moisture content (%)											
Hauling out of Site (sealed)	52	533,500	1/y	0.000	kg/t	40	1/load	52.84	Vehicle mean mass (t)	1	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Hauling out of Site (sealed)	108	533,500	1/y	0.0002	kg/t	40	1/load	52.84	Vehicle mean mass (t)	2	km/return trip	0.004	kg/VKT	0.4	g/m2 silt loading	0	% control			
Wind Erosion																				
WE - Extraction Area (Tertiary - Stage 5)	53	3.7	ha		64	kg/ha/y												77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts
WE - Extraction Area (Tertiary - proposed)	15	1.1	ha		64	kg/ha/y												77.5	% control	
WE - Extraction Area (Tertiary - Stage 5 part rehabilitated)	105	5.5	ha		64	kg/ha/y												70	% control	vegetative cover
WE - Extraction Area (Friable - 5A & 5B)	71	4.9	ha		64	kg/ha/y												77.5	% control	50% control from watering plus 55% control from fencing, bunding or shelterbelts
WE - Extraction Area (Friable - 4A & 4B plus VENM/ENM)	80	4.2	ha		64	kg/ha/y												70	% control	vegetative cover
WE - Extraction Area (Friable - 3A & 3B partly rehabilitated)	51	2.7	ha		64	kg/ha/y												70	% control	vegetative cover
WE - Processing Area including Stockpile	32	3.4	ha		64	kg/ha/y												85	% control	Chemical wetting agent
TOTAL PM_{2.5} EMISSIONS	6,744																			