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17. AIR QUALITY

This section addresses the TOR by assessing the environmental values and potential impacts relevant to air quality through:

- review of legislative requirements and ambient air quality goals;
- description of existing air quality and meteorology within the Project area;
- identification of the nearest sensitive receivers;
- emissions estimation and air dispersion modelling of air pollutants associated with construction of the dam, pipeline and associated infrastructure;
- air quality impact assessment of emissions from exposed areas cleared of vegetation; and
- description of dust mitigation measures for air quality management during construction.

17.1. Description of environmental values

This section describes the existing air quality that may be affected by the Project in context of environmental values as defined by the *Environmental Protection Act 1994* and the *Environmental Protection (Air) Policy 2008*.

17.1.1. Regulatory framework

The *Environmental Protection Act 1994* is the principal legislation enforced by the Queensland Government relating to air quality. The legislation refers to the Queensland *Environmental Protection (Air) Policy 2008*. Section 7 of the EPP (Air) states:

> *"The environmental values of the air environment to be enhanced or protected under this policy are the qualities of the air environment that are conducive to suitability for the life, health and wellbeing of humans."*

Ambient air quality goals relevant to the Project are prescribed by DERM. Provided are criteria for PM_{10} (particulate matter less than 10 microns in diameter) and TSP (total suspended particulate matter). For this study, the main pollutant of concern would be dust. Though there would be other gaseous pollutants released from plant and vehicle exhausts, their impacts are not considered to be significant.

Deposited dust is commonly used as a measure of the potential for dust nuisance. If present at high levels, deposited dust can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland, however, the former Environmental Protection Agency (now DERM) has recommended a nuisance guideline of 120 mg/m^2/day averaged over one month.

The criteria applicable to the pollutants of concern to this assessment are presented in Table 17-1.

Table 17-1 Air quality goals

Pollutant	Criteria	Averaging Time	Number of allowable exceedances
Total suspended particulate (TSP)	90 µg/m^3	1-year	-
PM_{10}	50 µg/m^3	24-hour	5 days per year
Dust deposition	120 mg/m^2/day	30 days	Nuisance guidelines

17.1.2. Methodology

17.1.2.1. Dispersion model

In order to simulate the impacts from the construction activities, dispersion modelling has been used. CALPUFF is an advanced non-steady-state 3-dimensional meteorological and air quality modelling system. The model has been adopted by the U.S. Environmental Protection Agency (U.S. EPA) in its ‘Guideline on Air Quality Models’ as the preferred model for assessing near-field applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model TAPM, which is a 3-dimensional prognostic model developed for air pollution studies by the CSIRO. The model has been verified and validated by CSIRO and Queensland EPA (now DERM). The output from TAPM was used to generate the appropriate meteorological data for CALPUFF. The model run was centred on the middle of the dam and run within four nested grids (30 km, 10 km, 3 km and 1 km). The databases included with TAPM for vegetation and terrain were used.

For the CALPUFF modelling, the domain had its origin (southwest corner) located at 25° 38’ 48.5” S and 149° 46’ 40” E and covered a region 40 km (east-west) by 30 km (north-south). The grid spacing used was 1 km and the model was run in the regulatory “Puff” mode.

TSP and PM_{10} emissions from dam construction activities have been derived for the purpose of modelling. Emissions have been estimated using emission factors derived from the following resources:

- NPI Emission Estimation Technique Manual for Mining, Version 2.3;
- NPI Emission Estimation Technique Manual for Fugitive Emissions; and
- US EPA AP-42, Chapter 13.2.2 – Unpaved Roads.

17.1.3. Water storage dam and surrounds

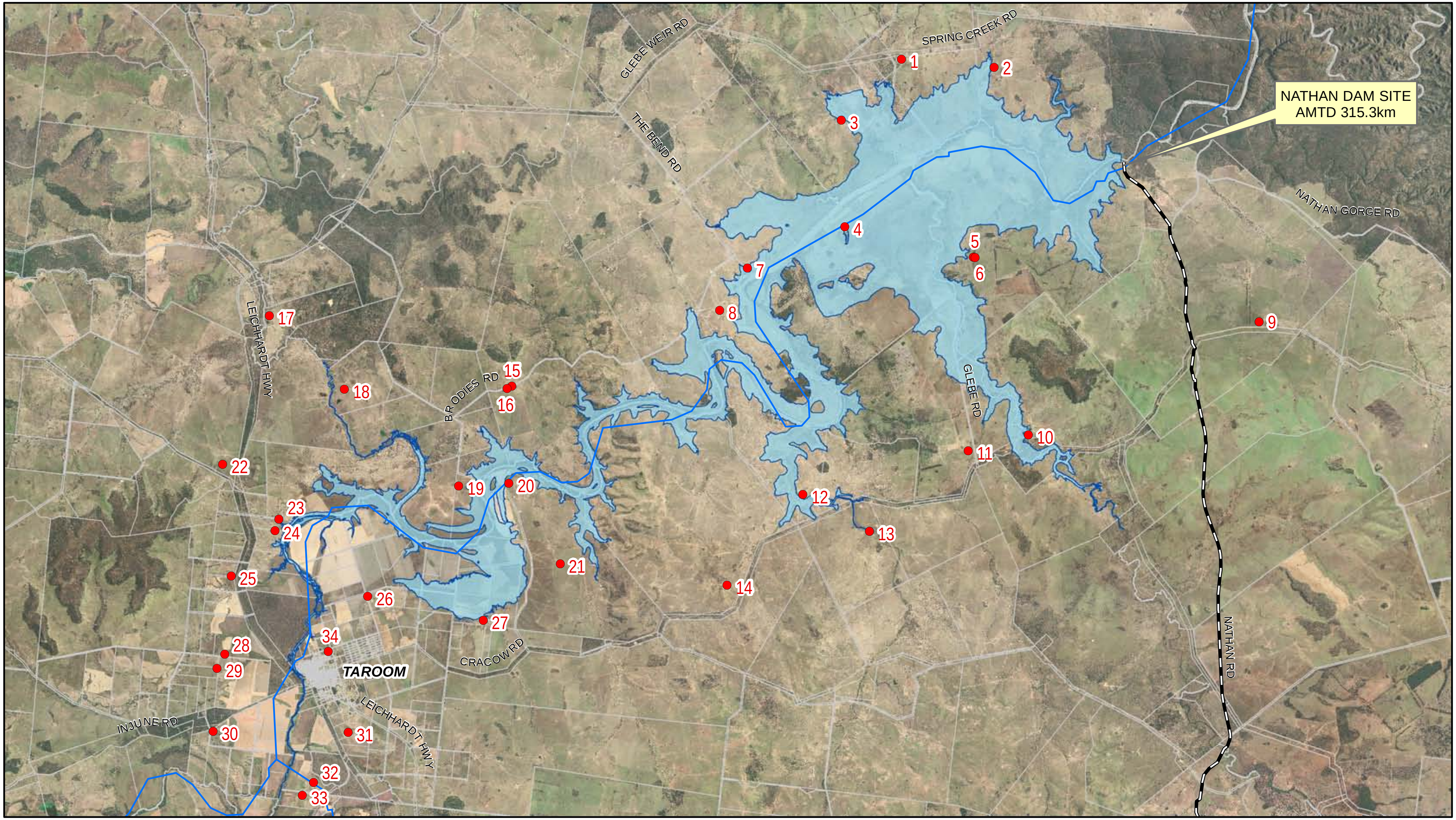
17.1.3.1. Sensitive receivers and local setting

The existing land uses within the proposed dam area and surrounds are predominantly broad acre grazing. The nearest residences to the dam site are Site 2 (6.6 km northwest) and Site 6 (6.7 km west-southwest) (Figure 17-1). However, Site 2 is currently owned by the State of Queensland and SunWater advises that it will not be occupied during construction. It was therefore not treated as a sensitive receiver. The nearest sensitive receiver to the northwest is therefore Site 1 (9.9 km distant).water storage.

17.1.3.2. *Local meteorology*

In the context of modelling, the local meteorology at the site will affect particulate transport and dispersion. Particulates are carried downwind of the source and therefore impacts will be greatest when the wind blows from the source to the receiver. Wind roses are a means of presenting a summary of wind speed and directional data for a particular time and location. Wind roses were generated for different hours of the day for a year using meteorological data generated by TAPM. Seasonal and diurnal wind roses are presented in Figure 17-2 and Figure 17-3 respectively.

From the wind roses it can be clearly seen that the predominant winds are from the east and the north-east while there are winds from the south-west and the south-east direction during spring and autumn respectively. From Figure 17-3 it can be observed that north-easterlies are the more dominant winds for most of the day, except during the afternoon period where stronger winds tend to come from the east and south-east.



LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Major Watercourse
- Full Supply Level (183.5m AHD)
- Cadastre

Projection: GDA94 Zone 56

Figure 17-1

0 1.25 2.5 5
Kilometres

N

Scale 1:200,000 (at A4)

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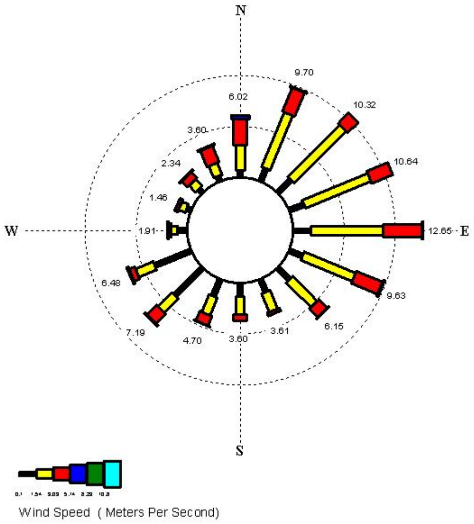
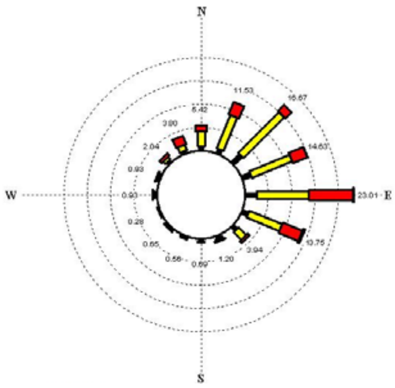
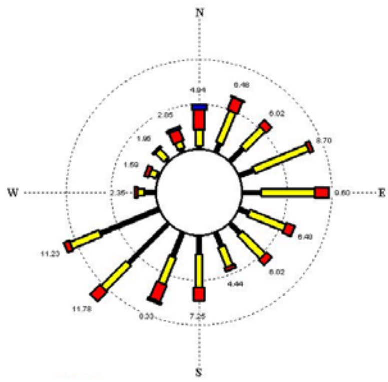
Sensitive Receivers



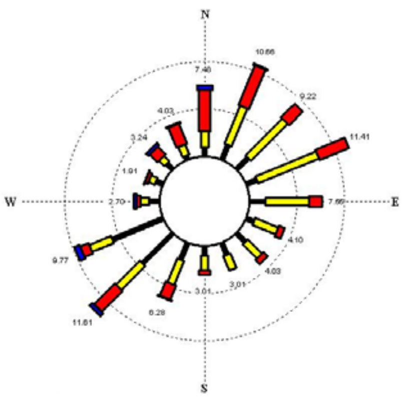
All Hours



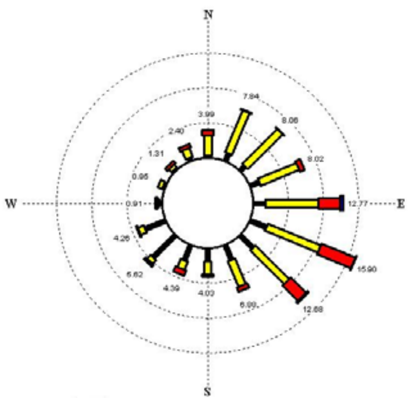
Summer



Winter



Spring



Autumn

Figure 17-2 Seasonal wind roses for Taroom by season

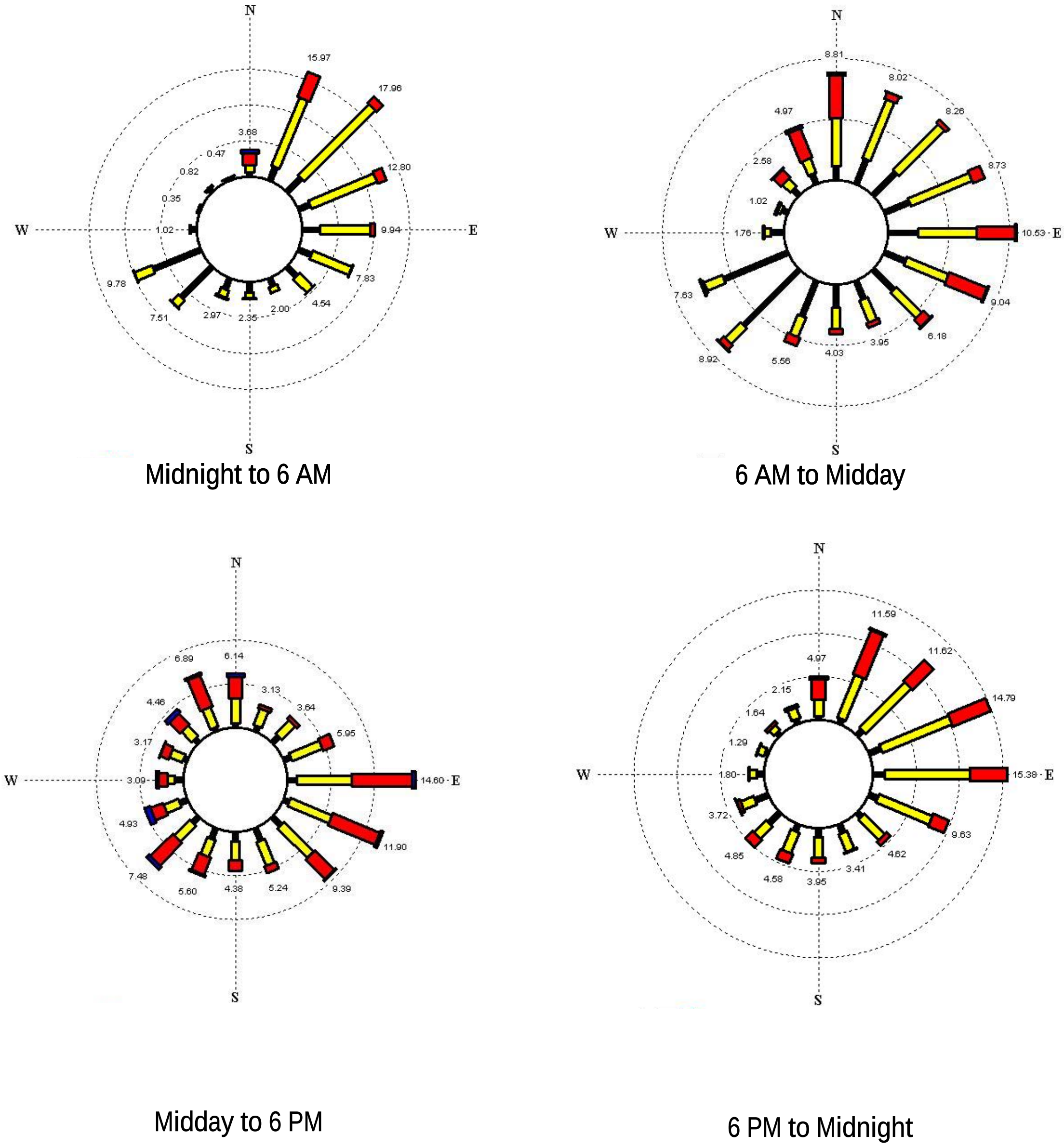


Figure 17-3 Seasonal wind roses for Taroom by time of the day

17.1.3.3. Existing air quality

Dust generation is affected by wind strength and direction and is influenced by the potential sources of dust in the area. For the dam site, surrounding rural land uses such as cultivation areas (both under bare fallow and during cultivation/ harvest operations) are potential sources. Cultivation is largely restricted to the clay soils of the floodplain upstream of the dam site and to the low undulating hills to the south of the site. Cultivation will likely continue on the floodplain for at least a period during construction until the risk of inundation precludes further use.

The majority of the surrounding area is pasture and in most seasons reasonable levels of ground cover reduce dust generation. Nevertheless, 'willy willys' are a common feature in summer and have been observed to take significant amounts of dust into the atmosphere. There is no industrial activity in the area.

Similarly, intermittent traffic along dry, unsealed roads can generate locally large volumes of dust for short periods. However, as traffic activity is intermittent and of very short duration the impacts would not be very significant.

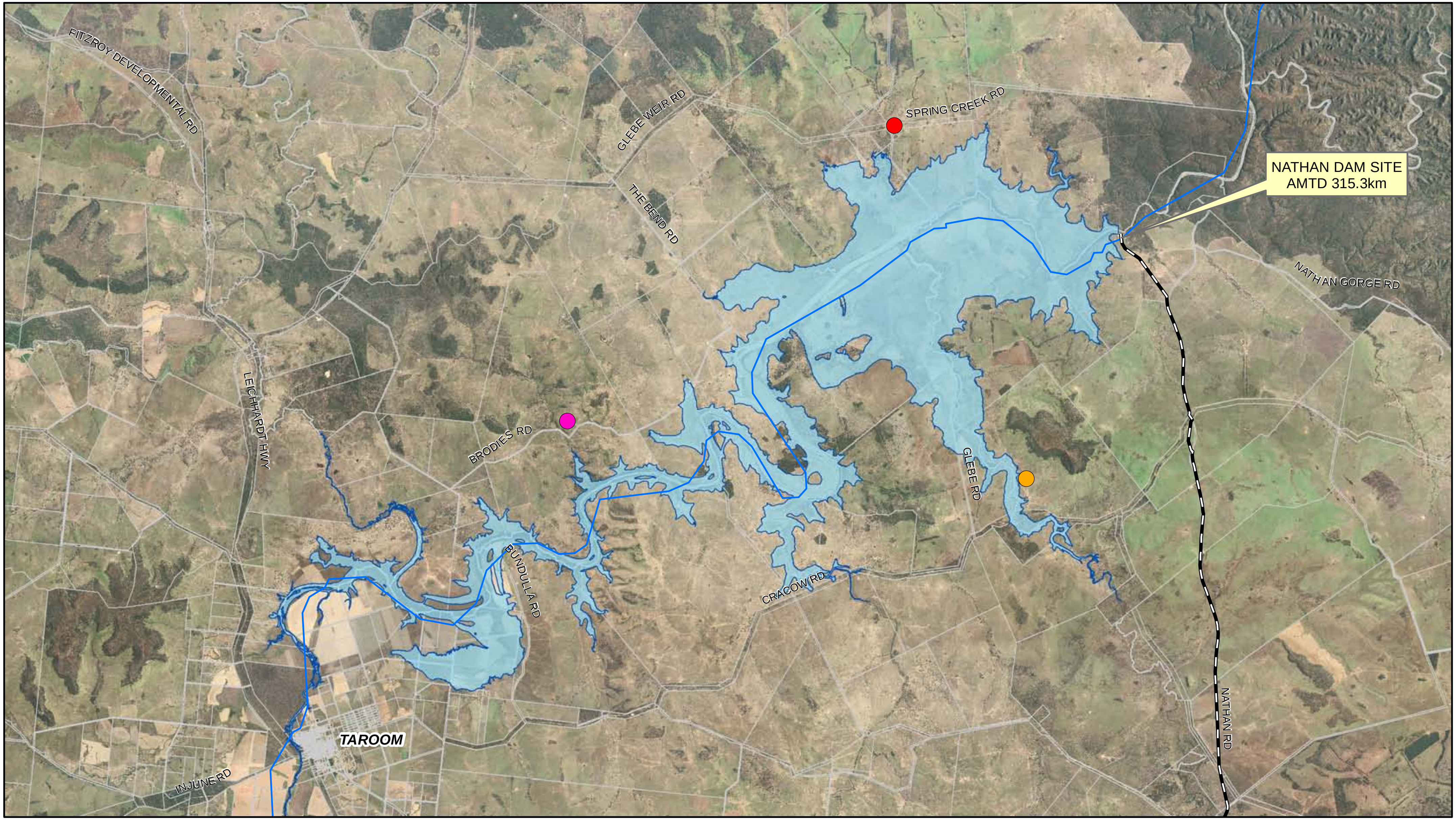
The existing air quality associated with the dam area cannot be determined with any certainty as ambient monitoring data is not available. However, based on past experiences, it is estimated that the 24-hour average background concentration for PM_{10} would be about 20 μg/m^3. This concentration is well below the air quality goal specified in Table 17-1. This background concentration has been incorporated into the model. Research in Australia has found that typically the PM_{10} fraction is approximately half that of TSP, so a background concentration for TSP of 40 μg/m^3 has been used.

To determine existing dust levels short term deposited dust monitoring was undertaken. Deposited dust levels were sampled and analysed at three representative locations between 20th October and 3rd November 2008. The locations were selected on the basis that the levels measured would be representative of the levels that would be recorded at sensitive receivers. The locations were also nominated in such a way that they would not be significantly affected by the presence of local sources such as agricultural cultivation. The sampling period chosen is considered quite conservative as spring in Taroom is quite windy with strong south-westerlies and north-easterlies. Details of the sampling locations and their distance from the dam construction site are shown in Table 17-2. The locations are shown in Figure 17-4.

Sampling and analysis for deposited dust levels was undertaken in accordance with the Australian Standard *AS 3580 – Determination of particulate matter - Deposited matter*. The levels recorded at the three locations have been accounted for in the modelling.

Table 17-2 Deposited dust sampling locations details

Sampling Location	Approximate distance to dam	Areas / Dwellings represented by deposited dust sampler
"Boggomoss" – Lot 3 on LE232	7.5 km	Properties to the north of the water storage water storage and Dam wall, adjacent to Glebe Weir Road and the Precipice National Park.
"Moorang" – Lot 12 on FT7	9.9 km	Properties to the south of the water storage and Dam wall and in the vicinity of Cracow Road.
"Riverview" – Lot 182 on SP147005	20 km	Properties to the west of the Project, not including those bounded by the Leichhardt Highway.



LEGEND

Dustfall Gauges

- Riverview
- Moorang
- Boggomoss

- Proposed Pipeline
- Major Watercourse
- Full Supply Level (183.5m AHD)
- Cadastre

Projection: GDA94 Zone 56

Figure 17-4

0 1.25 2.5 5
Kilometres

N

Scale 1:200,000 (at A4)

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Deposited dust sampling locations (approximate)

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Deposited dust levels at the three locations are detailed in Table 17-3.

Table 17-3 Deposited dust levels at the three locations

Site	Measured Deposition Rate (mg/m^2/day)
Boggomoss	83.9
Riverview	94.9
Moorang	105

The results show that existing dust deposition in the region around the proposed Nathan Dam construction site is quite high, averaging 94.6 mg/m^2/day. This is about 80 to 90 % of the air quality goal specified in Table 17-1. The high values in deposited dust levels could be attributed to local land use.

17.1.3.4. Local topography

Landform at and surrounding the site can also influence both wind strength and direction and the local potential for dust generation. Characteristics of the landforms around the dam site are as follows:

- the dam site is in a fairly steep sided valley in a relatively straight section of river;
- appreciable areas of level to gently undulating plains adjacent to the Dawson River, Cockatoo and Boggomoss Creek; and
- gently undulating rises to rolling low hills and steep hills downstream.

17.1.4. Pipeline

17.1.4.1. Sensitive receivers and local setting

The existing land use of the pipeline route consists of predominately grazing, with a number of major roads and a railway line along the route. The topography along the pipeline is relatively flat or gently undulating.

The pipeline route is described in detail in Chapter 2. From the inundation and buffer the pipeline extends along Nathan Road to Wandoan. South east from Wandoan it extends across private property to Chinchilla, then along the Warrego Highway to Dalby. Given that most balancing storages are less than 1 ha, the air impacts will be more localised and short in duration. In regards to the larger 600 ML balancing storage, which has a 20 ha footprint, the exact location is not known. Works in this area are expected to extend over 1 to 2 months. During this period, any sensitive receivers within 300 m should be notified prior to commencement of works. It is expected that a location will be nominated for this balance tank, which is not within 300 m of any sensitive receiver.

There are a small number of sensitive receivers (local residents) located near the pipeline route including residents on the north-western side of Wandoan and Chinchilla.

17.1.4.2. Meteorological influences on air quality

The dispersion meteorology is expected to be the similar to that described for the dam and surrounds.

17.1.4.3. Existing air quality

The pipeline passes various towns, so the existing air quality will be influenced by local sources such as farmlands and local traffic. However, based on previous experience, as the impacts from the local sources such as vehicular traffic on unsealed surfaces is largely intermittent, the existing air quality is expected to be similar to that described for the dam and surrounds.

17.1.5. Associated infrastructure

The associated infrastructure with the potential to generate air quality impacts includes the clay borrow areas, construction of new roads and upgrading of existing roads.

Items such as relocation of power or telecommunications facilities, provision of a temporary construction camps and provision of the recreation areas are minor issues with respect to air quality and have not been assessed.

The associated infrastructure required for the pipeline component with the potential to generate air quality impacts include the construction of unsealed roads for high trafficable areas such as access tracks, laydown areas, offices, etc.

The existing air quality for areas of associated infrastructure is expected to be similar to that described for the dam and surrounds.

17.2. Potential impacts and mitigation measures

17.2.1. Dam and surrounds

The main sources of air emissions will include dust generated from materials handling operations and wheel generated dust. Other sources of air emissions will include vehicle exhaust emissions including oxides of nitrogen, carbon monoxide and hydrocarbons.

To assess the potential air quality impacts from the dam and surrounds, air emissions have been estimated for those activities, which are likely to cause maximum impacts.

Activities with the greatest potential for air quality impacts have been identified based on the duration of the activity, plant usage for the activity (based on Project description), and nature of the activity. Air emissions have been estimated for these activities with the exclusion of blasting, which was assessed separately.

Activities having potential air quality issues:

- site establishment activities: activities include site preparation for dam construction area and water storage;
- dam construction activities: activities include blasting of the spillway, plant movement, material haulage, fugitive emissions from stockpiles, concrete and reinforced concrete cement (RCC) batch plant activities; and
- exposed areas: fugitive emissions from large areas of exposed land for inundation as a result of vegetation clearing.

17.2.1.1. *Site establishment activities*

Site establishment activities can potentially impact air quality as it involves significant plant movement and emissions from material haulage and from stockpiles.

Emissions have been derived using the equipment list available from the Project Description and the following assumptions:

- for the purpose of modelling, it has been conservatively assumed that all the plant required for site establishment will be operating simultaneously in a 1 ha area at any given point of time. In reality this is highly unlikely;
- the normal working day is for 12 hours from 6AM to 6PM, which includes preparation time for start and finish of the day's activities;
- graders and scrapers would be on the construction site area for the whole duration of a normal working day. Based on the number of hours of activity and speed of the plant, the total vehicle kilometres travelled (vkt) was calculated and thereby the emission rates from the respective plant items;
- high level watering (>2 L/m^2/h) will be used wherever there is potential for high emissions such as during very high wind speeds. Water trucks should be utilised based on visual dust inspection; and
- for dumping of overburden by the dump trucks, a 6–wheel dump truck would carry 25 t of payload.

Table 17-4 and Table 17-5 detail the TSP and PM_{10} emission factors and rates from site establishment activities.

Table 17-4 Dust emission factors from site establishment

Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Excavation of overburden	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Tub Grinder emissions	0.011 kg/ton	0.006 kg/ton	BAAQMD
Grader operation	0.19 kg/vkt	0.085 kg/vkt	AUS NPI Mining EET
Scraper operation	1.86 kg/vkt	0.60 kg/vkt	AUS NPI Mining EET
Dumping of overburden by dump trucks	0.012 kg/ton	0.043 kg/ton	AUS NPI Mining EET
Dozer operation	9.4 kg/hr	2.2 kg/hr	AUS NPI Mining EET
Wheel generated dust (tip trucks, water trucks and light vehicles)	4.61 kg/vkt/vehicle (for trucks) 1.08 kg/vkt/vehicle (for light vehicles)	1.39 kg/vkt/vehicle (for trucks) 0.33 kg/vkt/vehicle (for light vehicles)	AUS NPI Mining EET

Table 17-5 TSP and PM_{10} emission rates from site establishment

Site Establishment	TSP Emission Rate (g/sec)	PM_{10} Emission Rate (g/sec)
Total Emission Rate	39.54	11.13

In order to evaluate the impacts from site establishment, the following methodology has been adopted:

- the geographical extent of site establishment activities (light black line) was identified and established by SunWater (Figure 17-5).

- for modelling the impacts, an area of 100,000 m^2 was identified within the site establishment extent, where all the plant listed in the Project Description operated;
- the location of the modelling area was dictated by the proximity of the sensitive receivers to the site establishment extent. Based on the extent as shown in Figure 17-5 and the sensitive receivers as shown in Figure 17-1, it was identified that receivers 1, 3, 5 and 6 would be the most sensitive;
- at each of these receivers, the following were established:
  – 24-hour averaged PM_{10} concentration levels; and
  – 1-year averaged TSP concentration levels.

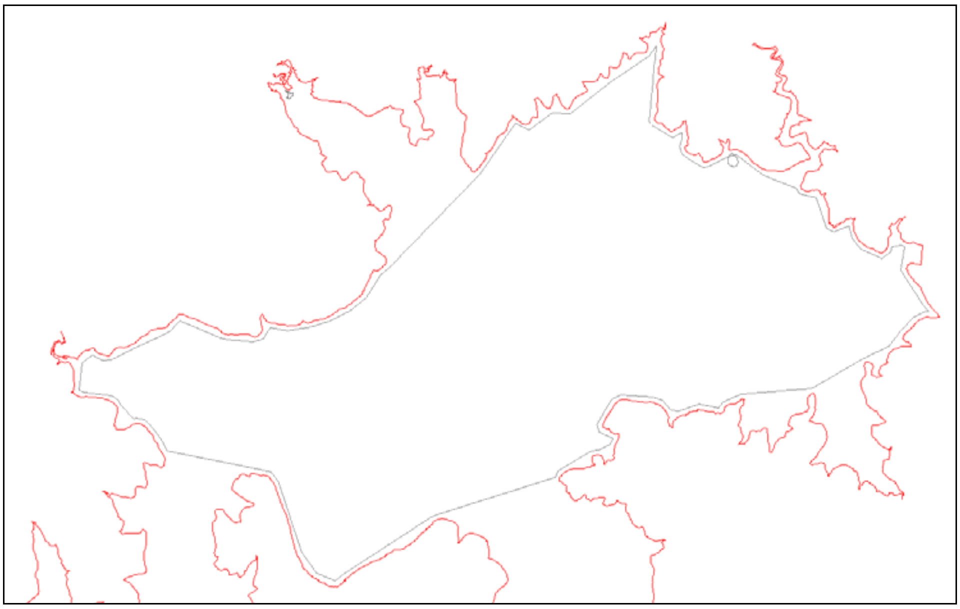


Figure 17-5 Identification of site establishment extent

Predicted dust concentrations of PM_{10} and TSP from site establishment for receivers labelled 1, 3, 5 and 6 are shown in Table 17-6. For the modelling, background dust concentrations have also been included.

Table 17-6 24 hour averaged PM_{10} impacts and 1-year averaged TSP impacts from site establishment activities

Receiver	24-hour averaged PM_{10} impacts (background included) (μg/m^3)	1-year averaged TSP impacts (background included) (μg/m^3)
Receiver 1	29.3	42.5
Receiver 3	34.6	44.0
Receiver 5	33.4	43.9
Receiver 6	29.7	42.6

From Table 17-6, it can be observed that the 1-year averaged TSP concentration levels are under the criteria as listed in Table 17-1. For the 24-hour averaged, PM_{10} concentration levels, the concentration at all receivers is well below the criteria.

Based on the results shown in Table 17-6, it can be concluded that PM_{10} and TSP impacts from site establishment activities will not have any health-based impacts on the closest sensitive receivers.

17.2.1.2. Dam construction activities

Dam construction activity mainly comprises: diverting the flow and construction of coffer dams, dewatering, laying The dam foundation, construction of the spillway and the dam wall. This intense activity extends over a considerable period of time thereby making it a potential source of air quality impacts.

Emissions have been derived using the equipment list available from the Project Description and the assumptions as per the establishment phase.

Table 17-7 and Table 17-8 detail the TSP and PM_0 emission factors and rates from dam construction activities.

Table 17-7 Dust emission factors from Dam construction

Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Excavation of overburden	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Grader operation	0.19 kg/vkt	0.085 kg/vkt	AUS NPI Mining EET
Scraper operation	1.86 kg/vkt	0.60 kg/vkt	AUS NPI Mining EET
Dumping of overburden by dump trucks	0.012 kg/ton	0.043 kg/ton	AUS NPI Mining EET
Dozer operation	9.4 kg/hr	2.2 kg/hr	AUS NPI Mining EET
Wheel generated dust (tip trucks, water trucks and light vehicles)	4.61 kg/vkt/vehicle (for trucks) 1.08 kg/vkt/vehicle (for light vehicles)	1.39 kg/vkt/vehicle (for trucks) 0.33 kg/vkt/vehicle (for light vehicles)	AUS NPI Mining EET
Stockpile emissions	0.6 kg/ha/hr	0.3 kg/ha/hr	AUS NPI Fugitive EET

Table 17-8 TSP and PM_{10} emission rates from Dam construction

Pollutant	Emission Rate (g/s)
PM_{10} (particulate matter less than 10 microns)	16.45
Total Suspended Particulate (TSP) matter	51.36

In order to evaluate the impacts from the dam construction area, the following methodology has been adopted:

- an area of 150 ha was identified where the actual dam construction would happen;
- the modelling area was located where the actual dam construction will happen;

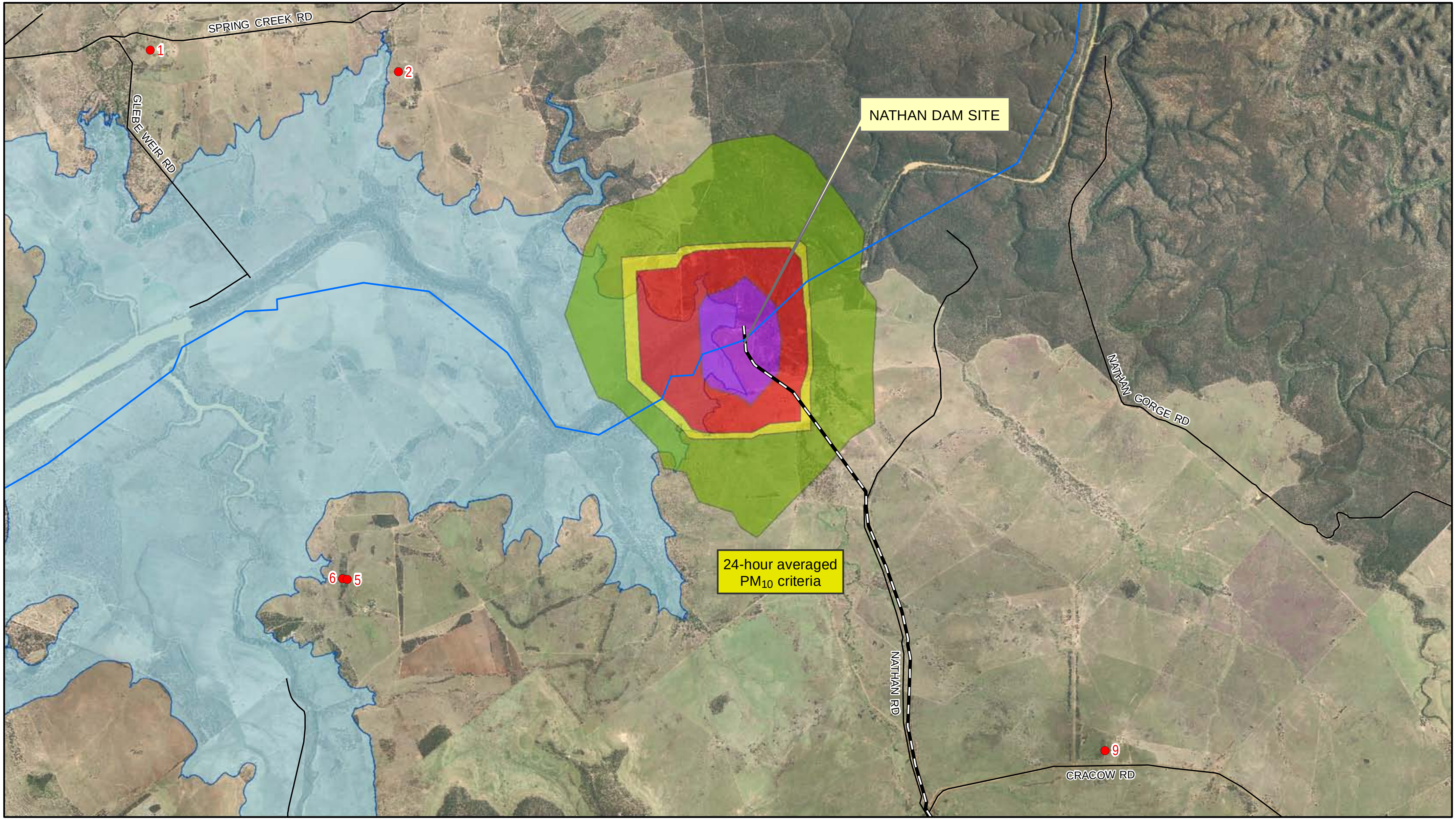
- the 1-year averaged TSP concentration levels and 24-hour averaged PM_{10} concentration levels have been illustrated via a contour plot; and
- deposited dust impacts have also been determined.

Dispersion modelling has been used to evaluate the concentration impacts of TSP and PM_{10} from dam construction upon the closest sensitive receivers. Background dust concentrations have also been included.

Dust concentration impacts of PM_{10} and TSP from dam construction activities are shown in Figure 17-6 and Figure 17-7. Figure 17-8 illustrates the deposited dust impacts.

Based on these results it can be concluded that the 24-hour averaged PM_{10} concentration, 1-year averaged TSP concentration and 24-hour averaged deposited dust levels are well under the criteria listed in Table 17-1 as a result of the distance of the receivers from the works area.

Blasting has the potential to generate significant amounts of dust, given that the emissions factor is often several times greater than that of any of the operating machinery. However, as the duration of the activity is short, and the frequency of blasts within that period is expected to be low, the average over a year will also be low. Modelling for Connors River Dam included similar blasting and the 24-hour averaged PM_{10} concentration was found to be two orders of magnitude under the air quality target at a distance of 5 km. It is not anticipated that inclusion of blasting within the models would significantly alter the results.



LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

PM_{10} Dust Concentration (µg/m²/day)

- 25 - 50
- 50 - 75
- 75 - 200
- 200 - 500

Projection: GDA94 Zone 56

Figure 17-6

0 0.5 1 2 Kilometres

N

Scale 1:75,000 (at A4)

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PM_{10} impacts from dam construction activity

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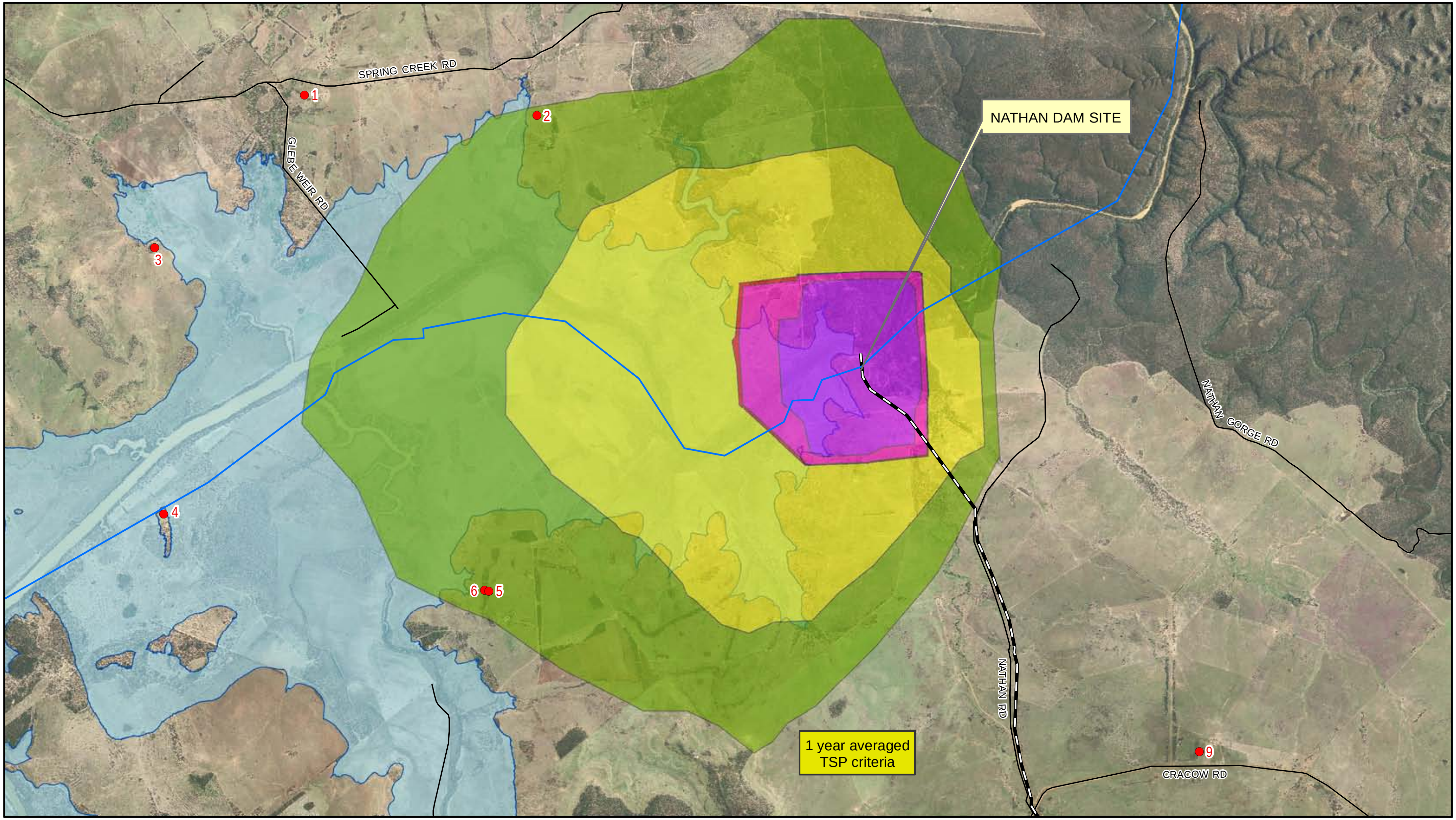

LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

TSP Dust Concentration (µg/m²/day)

- 45 - 50
- 50 - 90
- 90 - 100
- 100 - 200
- > 200

Projection: GDA94 Zone 56

Figure 17-7

0 0.5 1 2
Kilometres

N

Scale 1:80,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

TSP impacts from dam construction activity

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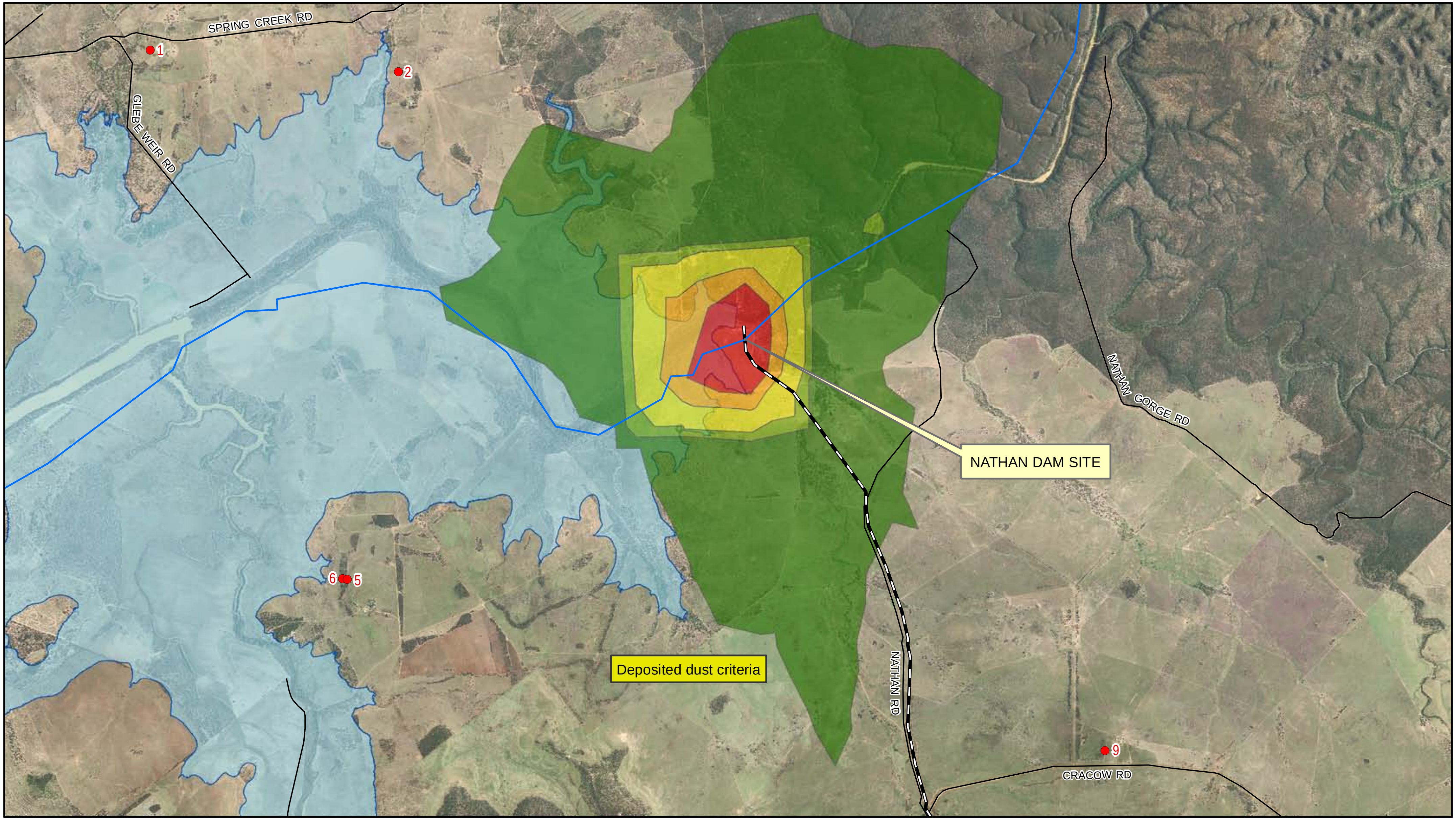


LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

Deposited Dust Concentration

- 4 - 5
- 5 - 7.5
- 7.5 - 10
- 10 - 15
- 15 - 20

Projection: GDA94 Zone 56

Figure 17-8

0 0.5 1 2
Kilometres

N

Scale 1:75,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Deposited dust impacts from dam construction activity

17.2.1.3. *Exposed areas*

Clearing of the construction site and water storage area will generate significant areas of exposed land. These areas have the potential to generate windblown dust.

The vast majority of water storage is pasture and will be left undisturbed. As the exact area of vegetation clearing is unknown, conservative assumptions have been made as follows:

- water storage TSP and PM_{10} emissions have been generated on per hectare basis;
- emissions are for 24 hours per day;
- the dust impacts from exposed areas will be maximum for 1 month of the year, as clearing of the water storage will be undertaken shortly before dam closure, only trees and bushes will be cleared and grasses will quickly re-establish;
- the location of the modelling area was dictated by the proximity of the sensitive receivers It was identified that receivers 1,3, 5 and 6 would be the most sensitive. Hence impacts from exposed areas at the above listed receivers were evaluated; and
- periodic water spraying on exposed area of land.

Table 17-9 and Table 17-10 details the TSP and PM_0 emission factors and rates from exposed areas.

Table 17-9 Dust emission factors from exposed areas

Pollutant	Emission Factor (kg/ha/hr)
PM_{10} (particulate matter less than 10 microns)	0.05
Total Suspended Particulate (TSP) matter	0.10

Table 17-10 PM_{10} and TSP Emission rates from exposed areas

Pollutant	Emission Rate (g/s)
PM_{10} (particulate matter less than 10 microns)	0.013
Total Suspended Particulate (TSP) matter	0.027

Dispersion modelling has been used to evaluate the concentration impacts of TSP and PM_{10} from exposed areas upon the closest sensitive receivers. For the modelling, background dust concentrations have also been included.

Dust concentration impacts of PM_{10} and TSP from exposed areas are shown in Figure 17-10 and Figure 17-11.

The predicted dust impacts of PM_{10} and TSP from exposed areas are shown in Table 17-11.

Table 17-11 24 hour averaged PM_{10} impacts and 1-year averaged TSP impacts from exposed areas

Receiver	24-hour averaged PM_{10} impacts (background included) ($\mu g/m^3$)	1-year averaged TSP impacts (background included) ($\mu g/m^3$)
Receiver 1	21.0	40.0
Receiver 3	21.7	40.1
Receiver 5	20.1	40.0
Receiver 6	20.1	40.0

Based on the results it can be concluded that the 24-hour averaged PM_{10} concentration levels, 1-year averaged TSP concentration levels are well under the criteria as listed in Table 17-1.

17.2.2. Pipeline construction

To assess the potential air quality impacts from the construction of the pipeline, air emissions have been generated based on the construction activity and the equipment used.

Emissions have been derived using the equipment list available for the pipeline requirements and the following assumptions:

- pipeline construction on any one day will happen over a 300 m length and a width of 30 m. This is modelled as a transect. There are other activities which could have an impact on the air quality such as material haulage from the stockpile area, pump stations and balancing storage, the most critical would be the actual pipeline construction;
- all the plants will be operating simultaneously in the above specified area at any given point of time. This scenario is considered highly conservative;
- normal working day is for 12 hours from 6AM to 6PM, which includes preparation time for start and finish of the day's activities; and
- high level watering (>2 $L/m^2/h$) is employed wherever there is a potential for high emissions such as during high wind speeds. Water trucks will be used based on visual dust observation.

Table 17-12 and Table 17-13 detail the TSP and PM_{10} emission factor and rates for pipeline construction activity.

Table 17-12 Dust emission factors from pipeline construction

Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Excavation of overburden	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Tub Grinder emissions	0.011 kg/ton	0.006 kg/ton	BAAQMD
Grader operation	0.19 kg/vkt	0.085 kg/vkt	AUS NPI Mining EET
Scraper operation	1.86 kg/vkt	0.60 kg/vkt	AUS NPI Mining EET
Dumping of overburden by dump trucks	0.012 kg/ton	0.043 kg/ton	AUS NPI Mining EET
Dozer operation	9.4 kg/hr	2.2 kg/hr	AUS NPI Mining EET

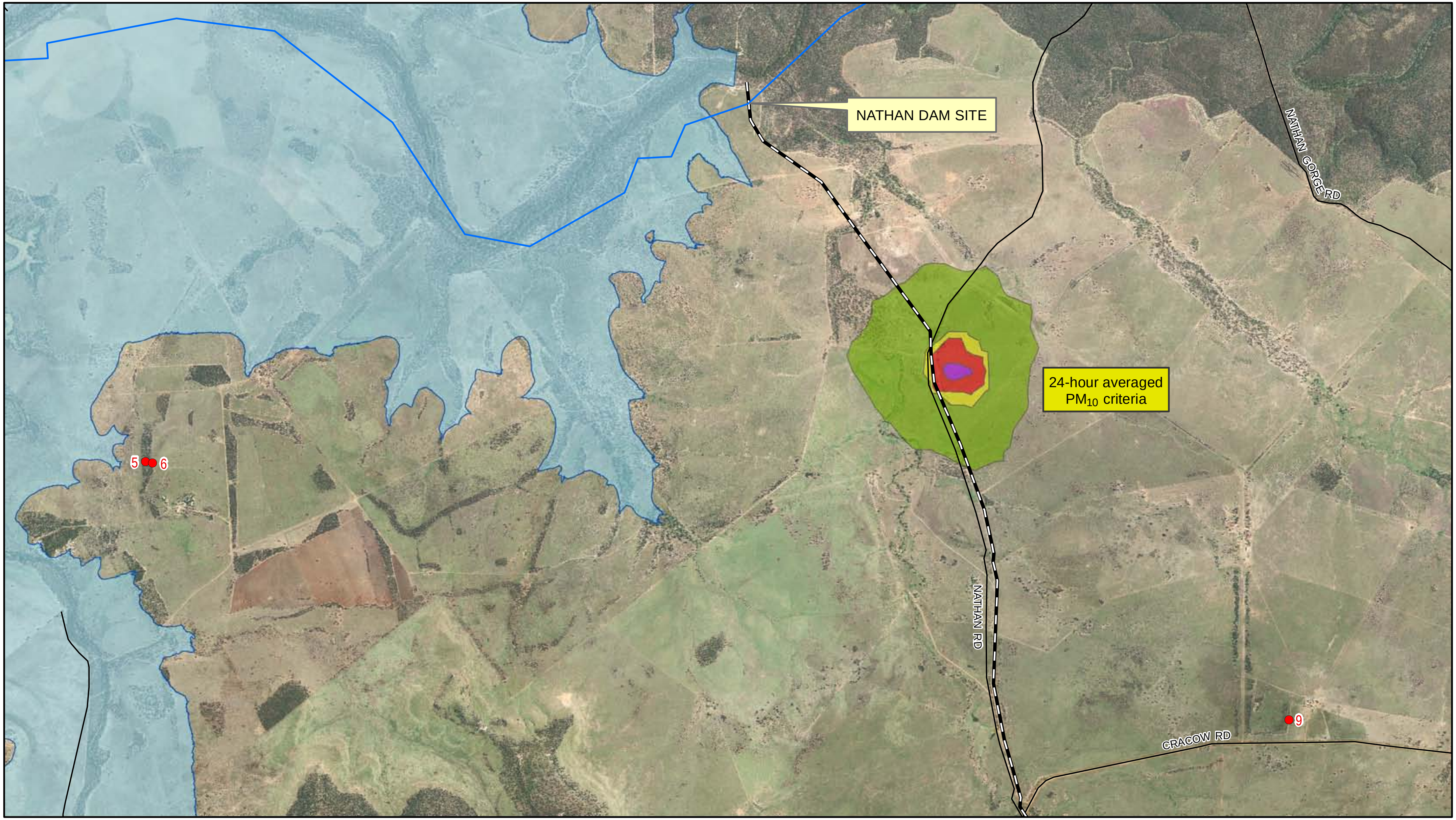
Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Wheel generated dust (tip trucks, water trucks and light vehicles)	4.61 kg/vkt/vehicle (for trucks) 1.08 kg/vkt/vehicle (for light vehicles)	1.39 kg/vkt/vehicle (for trucks) 0.33 kg/vkt/vehicle (for light vehicles)	AUS NPI Mining EET

Table 17-13 PM_{10} and TSP emission rates from pipeline construction

Pollutant	Emission Rate (g/s)	Area Based Emission Rate (g/sec/m^2)
PM_{10} (particulate matter less than 10 microns)	1.79	0.00019
Total Suspended Particulate (TSP) matter	6.96	0.00077

Dust concentration impacts of PM_{10} and TSP from pipeline construction activities are shown in Figure 17-9 and Figure 17-10.

The results show that receivers within 350 m would be affected by 24 hour averaged PM_{10} and 1- yearly averaged TSP impacts. There are a number of such receivers, particularly where the pipeline passes through towns along the highway. The duration of pipeline installation related impact at any one sensitive receiver would likely be in the order of a few days.



LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

PM_{10} Dust Concentration (µg/m²/day)

- 25 - 50
- 50 - 75
- 75 - 200
- 200 - 500

Projection: GDA94 Zone 56

Figure 17-9

0 0.3 0.6 1.2 Kilometres

N

Scale 1:50,000 (at A4)

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PM_{10} impacts from pipeline construction activities

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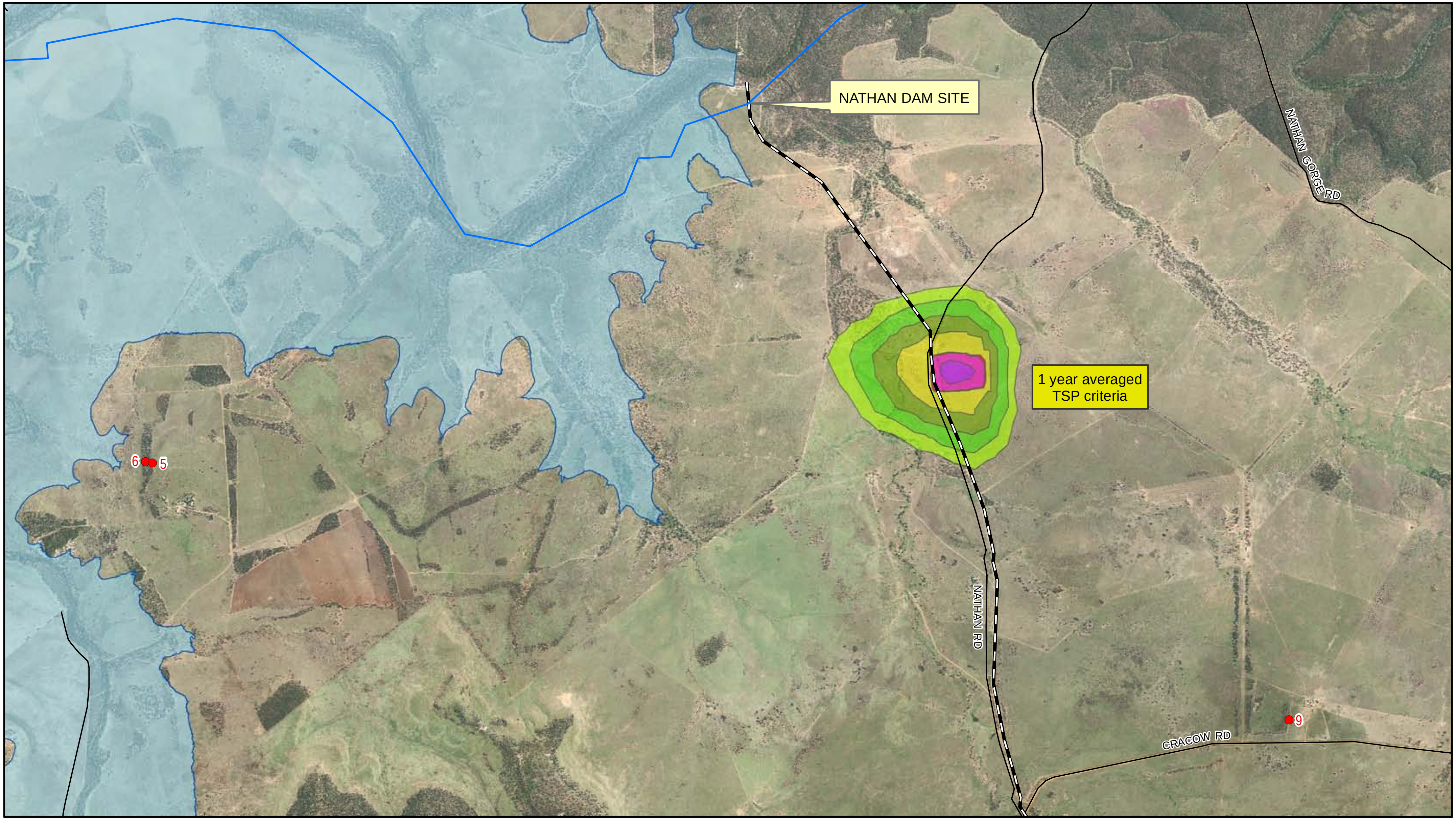

LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

TSP Dust Concentration (µg/m²/day)

- 42 - 43
- 43 - 45
- 45 - 50
- 50 - 90
- 90 - 100
- 100 - 200
- > 200

Projection: GDA94 Zone 56

Figure 17-10

0 0.3 0.6 1.2
Kilometres

N

Scale 1:50,000 (at A4)

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TSP impacts from pipeline construction activities

17.2.3. Associated infrastructure

17.2.3.1. Resource extraction areas

Based on the Project description it is understood that raw materials required for this Project would be sourced from licensed quarries and extraction areas (existing and potential). Air quality compliance at these locations will be the responsibility of the licence holder. However, clay borrow areas within FSL will likely be operated by the dam construction contractor and there is a potential for 'Potential Clay Borrow Area No 8' to have some impacts as it close to a sensitive receiver.

In order to evaluate the impacts from the clay borrow area, the following methodology and assumptions have been adopted:

- the main operations activities take place in a 1,000 m^2 area which is at a distance of 100 m from the receiver;
- as the Project Description does not list the plant used for quarry activities, based on previous experience in conducting air quality assessments on quarries, the plant list shown in Table 17-14 has been adopted; and
- normal working day, dump truck size and high level watering as per earlier activities.

Table 17-14 Assumed plant list for clay borrow activities

Plants	Quantity
Excavators	8
Dozers	4
Haul Trucks	2
Wood Chipper	1

Table 17-15 and Table 17-16 detail the TSP and PM_{10} emission factor and rates for clay borrow area activity.

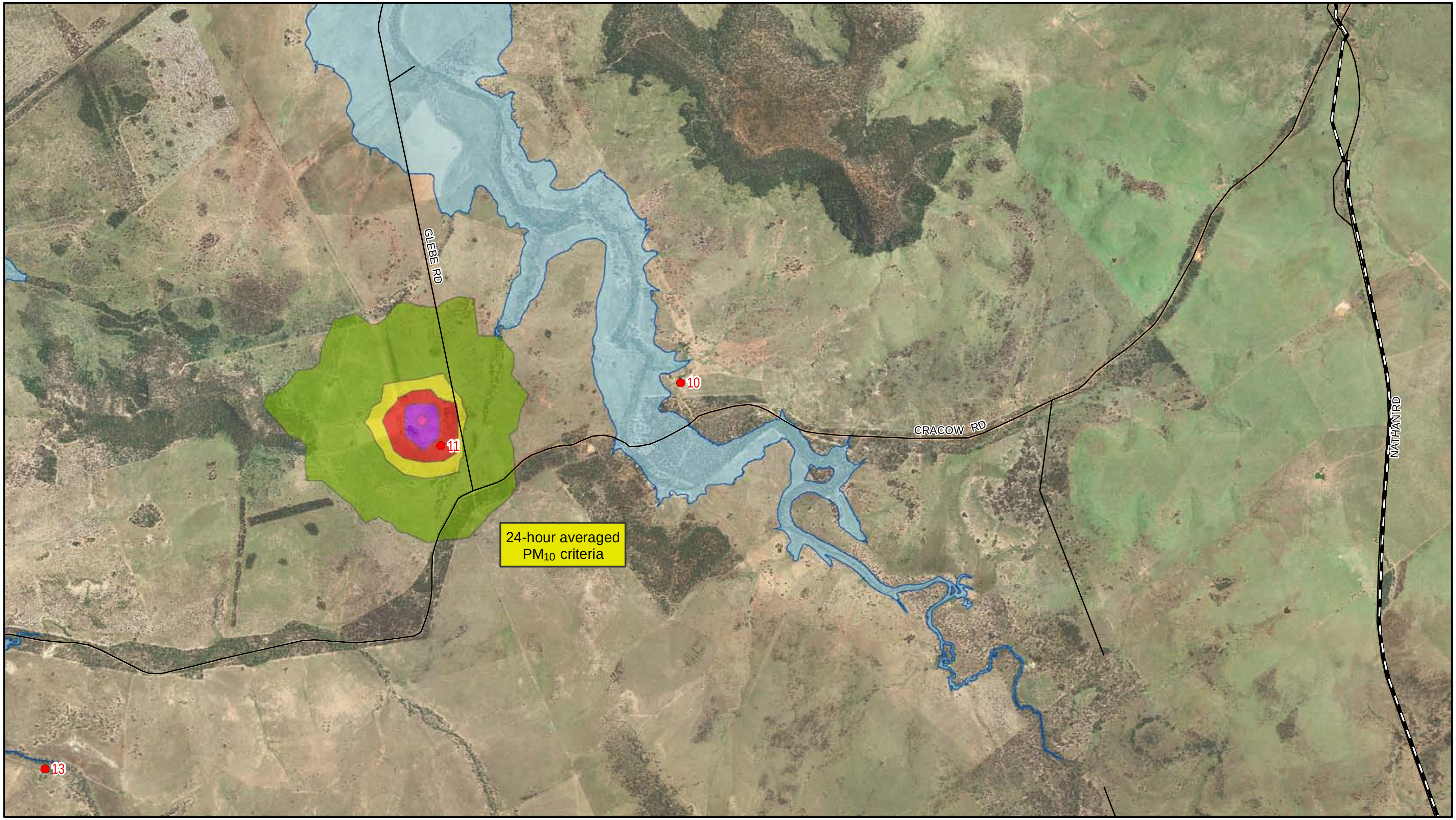
Table 17-15 Dust emission factors from clay borrow area No. 8

Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Excavation of overburden	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Tub Grinder emissions	0.011 kg/ton	0.006 kg/ton	BAAQMD
Dumping of overburden by dump trucks	0.012 kg/ton	0.043 kg/ton	AUS NPI Mining EET
Dozer operation	9.4 kg/hr	2.2 kg/hr	AUS NPI Mining EET
Wheel generated dust (tip trucks, water trucks and light vehicles)	4.61 kg/vkt/vehicle (for trucks) 1.08 kg/vkt/vehicle (for light vehicles)	1.39 kg/vkt/vehicle (for trucks) 0.33 kg/vkt/vehicle (for light vehicles)	AUS NPI Mining EET

Table 17-16 PM_{10} and TSP emission rates from clay borrow area No. 8

Pollutant	Emission Rate (g/s)
PM_{10} (particulate matter less than 10 microns)	2.65
Total Suspended Particulate (TSP) matter	10.91

Dust concentration impacts of PM_{10} and TSP from clay borrow area activities are shown in Figure 17-11 and Figure 17-12. From the results it appears that receivers within about 600 m of clay borrow areas may be impacted by levels above the criteria applicable to the Project. SunWater has advised that it is highly likely that a clay source can be identified which is not within such a distance of a sensitive receiver.



LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

PM_{10} Dust Concentration (µg/m²/day)

- 25 - 50
- 50 - 75
- 75 - 200
- 200 - 500
- 500 - 1000

Projection: GDA94 Zone 56

Figure 17-11

0 0.3 0.6 1.2
Kilometres

N

Scale 1:50,000 (at A4)

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PM_{10} impacts from clay borrow area activities

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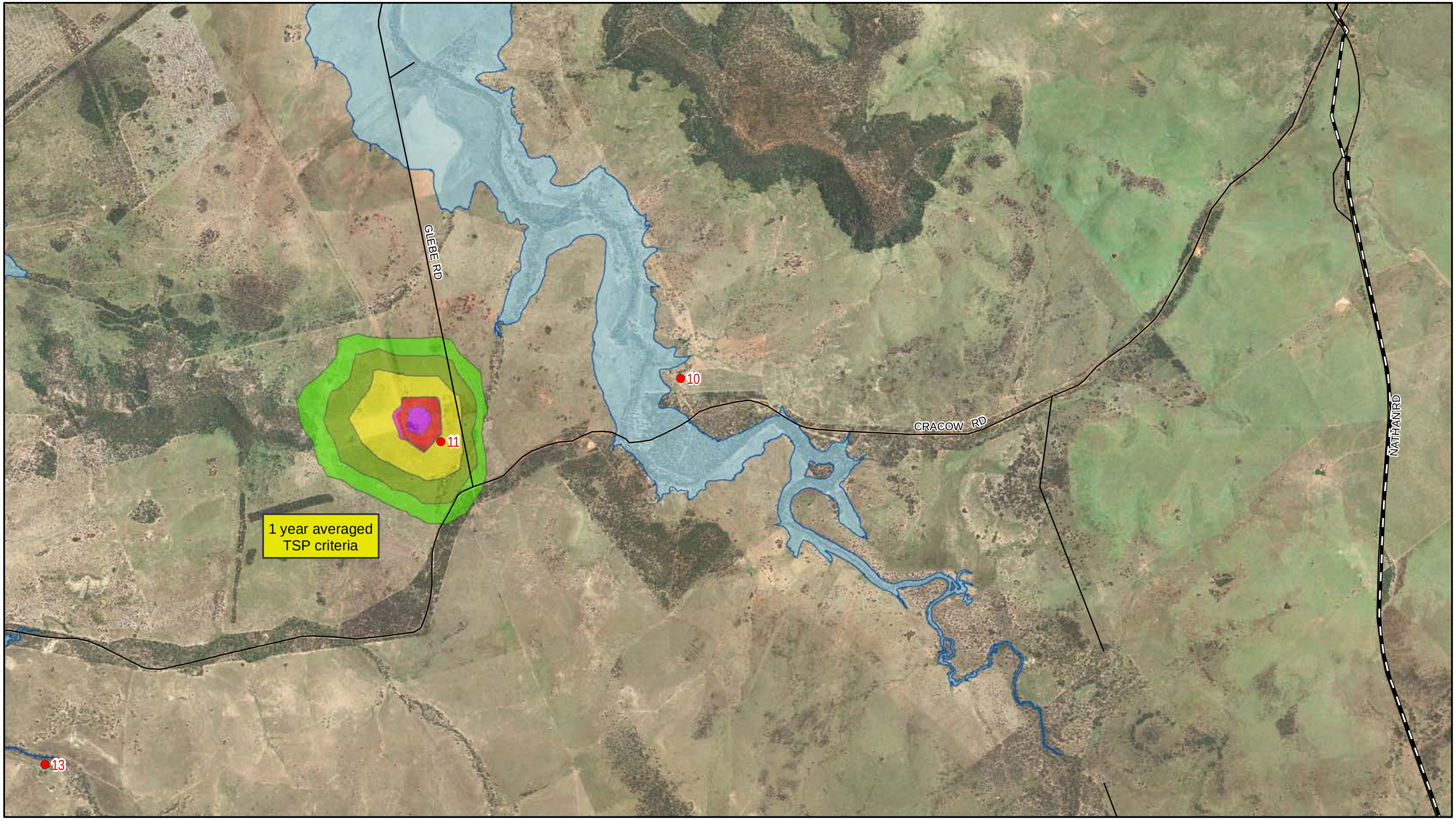

LEGEND

- Sensitive Receivers
- Proposed Pipeline
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

TSP Dust Concentration (µg/m²/day)

- 43 - 45
- 45 - 50
- 50 - 90
- 90 - 100
- 100 - 200
- > 200

Projection: GDA94 Zone 56

Figure 17-12

0 0.3 0.6 1.2
Kilometres

N

Scale 1:50,000 (at A4)

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NATHAN DAM AND PIPELINES EIS

TSP impacts from clay borrow area activities

17.2.3.2. Road construction and upgrade

From the Project description it is understood that there will be external (outside site) and internal (inside site) road construction activities. The major road works relate to the dam access road and the upgrades to the Taroom Cracow Road.

Emissions have been derived for access road construction using the equipment noted in the Project Description and the following assumptions

- emissions from road construction have been generated for a road transect which is 500 m long and has a standard width of 6 m. A section on the Taroom Cracow Road has been modelled as an example transect;
- PM_{10} and TSP impacts from this transect would be determined by identifying a buffer zone. This buffer zone signifies the extent of impacts; and
- All other assumptions align with those for previous assessments.

Table 17-17 and Table 17-8 detail the TSP and PM_0 emission factors and rates for access road construction activities.

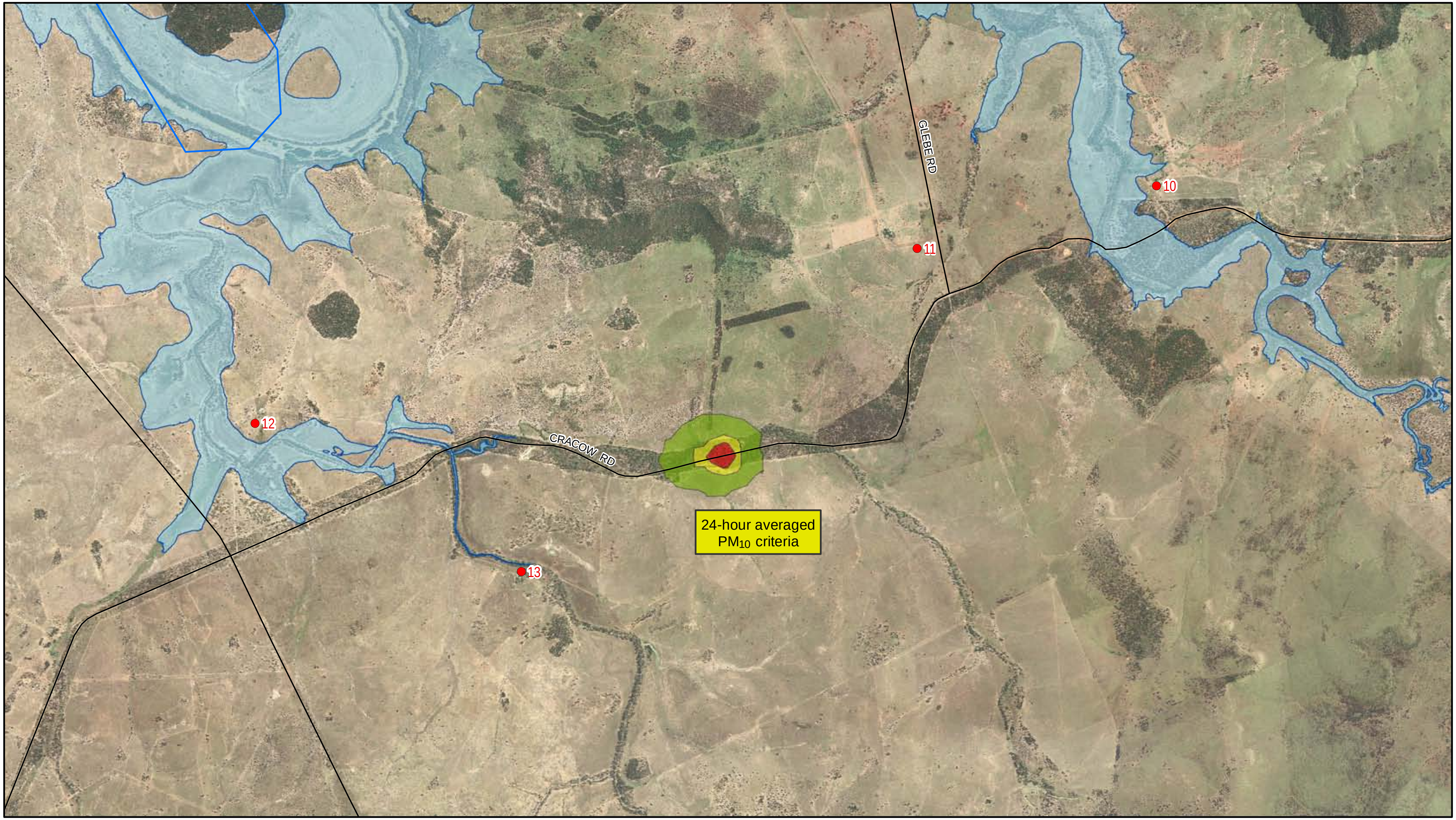
Table 17-17 Dust emission factors from road construction or upgrade activities

Activity	TSP Emission Factor	PM_{10} Emission Factor	Source
Excavation of overburden	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Backhoe	0.025 kg/ton	0.012 kg/ton	AUS NPI Mining EET
Dumping of overburden by dump trucks	0.012 kg/ton	0.043 kg/ton	AUS NPI Mining EET
Grader operation	0.19 kg/vkt	0.085 kg/vkt	AUS NPI Mining EET
Wheel generated dust (tip trucks, water trucks and light vehicles)	4.61 kg/vkt/vehicle (for trucks) 1.08 kg/vkt/vehicle (for light vehicles)	1.39 kg/vkt/vehicle (for trucks) 0.33 kg/vkt/vehicle (for light vehicles)	AUS NPI Mining EET

Table 17-18 PM_{10} and TSP emission rates from road construction and upgrade

Pollutant	Emission Rate (g/s)
PM_{10} (particulate matter less than 10 microns)	0.28
Total Suspended Particulate (TSP) matter	0.65

Dust concentration impacts of PM_{10} and TSP from road construction activities are shown in Figure 17-13 and Figure 17-14. From the results it can be noted that receivers within 200 m would be affected by 24 hour averaged PM_{10} and 1 yearly averaged TSP impacts. Receiver 1 is the most likely to be impacted by the dam access road and receiver 10 by the new bridging of Cockatoo Ck. Other receivers are beyond 200 m.



LEGEND

- Sensitive Receivers
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

PM_{10} Dust Concentration (µg/m²/day)

- 25 - 50
- 50 - 75
- 75 - 200

Projection: GDA94 Zone 56

Figure 17-13

0 0.3 0.6 1.2
Kilometres

N

Scale 1:50,000 (at A4)

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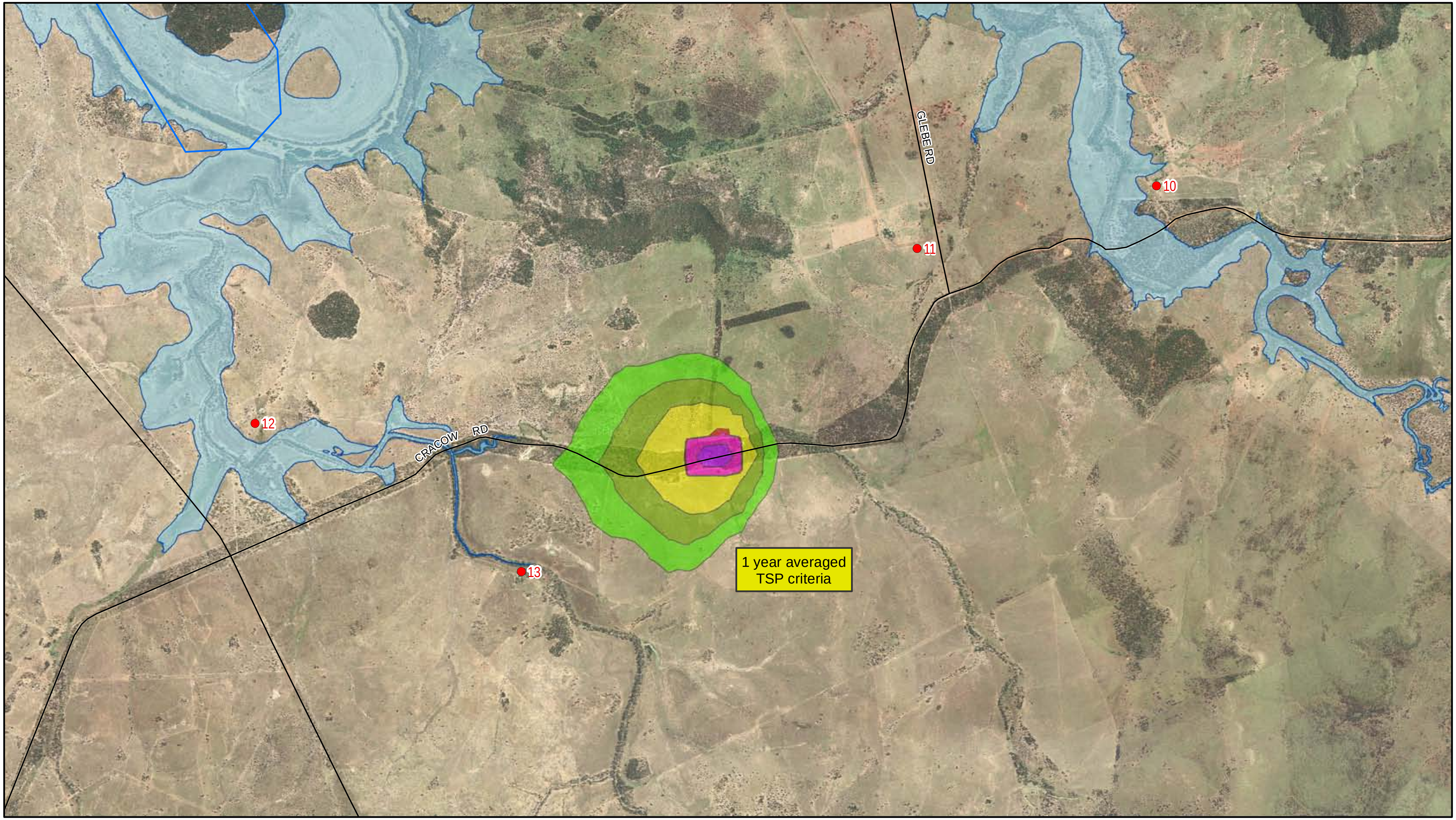
NATHAN DAM AND PIPELINES EIS

PM_{10} impacts from access road construction activities



LEGEND

- Sensitive Receivers
- Local Roads
- Major Watercourse
- Full Supply Level (183.5 m AHD)

TSP Dust Concentration (µg/m²/day)

- 43 - 45
- 45 - 50
- 50 - 90
- 90 - 100
- 100 - 200
- > 200

Projection: GDA94 Zone 56

Figure 17-14

0 0.3 0.6 1.2 Kilometres

N

Scale 1:50,000 (at A4)

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NATHAN DAM AND PIPELINES EIS

TSP impacts from access road construction activities

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17.2.4. Other air quality impacts

Vehicle exhaust and ozone depleting substances

The potential sources of ozone depleting substances associated with the Project would largely be restricted to the use of refrigerators and air conditioning plant during construction. These substances would only be emitted in the event of a leak. The potential risks relating to the emission of ozone depleting substances are considered to be minimal.

Fauna and flora

Fauna, including native wildlife and cattle, are expected to have similar responses to humans from exposure to air pollutants. Compliance with DERM air quality goals should ensure minimal impact on fauna. The predicted PM_{10} concentrations from the different activities are unlikely to have a significant impact on fauna.

Dusts that are chemically inert, or which do not markedly alter substrate pH, generally effect growth of plants if the dust load is greater than 8 g/m^2. Doley (2006) reports the equilibrium dust load (g/m^2) on leaves of several crop species may be 5 to 10 times the rate of daily deposition ($g/m^2/day$). The predicted dust deposition rates are unlikely to have a significant impact on vegetation growth.

17.2.5. Operations phase impacts

Operational air quality impacts are likely to be very minor given the access road to the dam will be sealed, low vehicle speeds at the recreation areas and generally low levels of activity. The most significant source of dust is likely to be from the light vehicle inspecting the pipeline via the maintenance track which will not be sealed. This single vehicle will result in negligible impact.

17.3. Cumulative impacts

No significant air quality cumulative impacts would be observed at the sensitive receivers during different phases of construction. In terms of air quality, cumulative impacts from the various operations happening simultaneously are not possible for any of the receivers as none of them will be downwind from more than one operation simultaneously.

With respect to cumulative impacts associated with other projects, the dam area and associated infrastructure are distant from any other proposed projects so air quality related cumulative impacts are not expected. The pipeline works will at times be in the vicinity of other active projects including Surat Basin Rail and Wandoan Coal between the dam site and Wandoan township, and a number of coal seam gas related pipeline projects, though some of the latter may be completed by the time the Nathan pipeline is being undertaken. In areas where the Projects may cause impacts on the same sensitive receivers, it is recommended that additional application of water to suppress dust is undertaken. Residents should be kept clearly informed of times of potential decreased air quality. Coordination between projects such that impacts could be minimised is also recommended. In most circumstances the pipeline work front will pass the sensitive receiver within a few days.

17.3.1. Mitigation measures

17.3.1.1. Dam, pipeline and associated infrastructure

This assessment has found while there will be an increase in the incidence of air pollution in the area from vehicle emissions and generated dust, the impacts are all within DERM criteria other than potentially near clay borrow areas. However, the following mitigation measures will minimise the potential for health issues and nuisance from an air quality perspective:

- minimising the extent of clearing which bares earth;
- minimising the extent of the pipeline laying work front near towns and ensuring stockpile sites are not placed such that repeated transport through the towns is required;
- high level watering (>2 $L/m^2/h$) to be adopted wherever there is a potential for high emissions such as during high winds. Water trucks should be used based on visual dust observation;
- water sprays should be used for excavation activities where necessary;
- water spraying of stockpiles should be done on a frequent basis in order to keep the raw material moist which suppresses fugitive dust release;
- light and heavy vehicle speed restriction should be imposed on unpaved surfaces;
- cement loading into concrete batch plant must be done using bag filters which significantly reduce fine dust emissions;
- using sealed roads where the option exists for the purpose of transporting materials;
- public sealed roads should be regularly cleaned and swept;
- haul trucks should always be covered and while unloading, care should be taken that the drop height is as low as reasonably practical to minimise dust cloud build up;
- worked areas should be stabilised as soon as possible after earthworks have been completed (example: re-vegetation, paving, mulch);
- general awareness of minimising dust levels and it's benefits should be instructed to workforce personnel;
- all vehicles should be properly maintained;
- public consultation processes that inform residents of the potential duration and extent of impacts, thereby allowing them to take appropriate action (such as not hanging out their washing on those days); and
- complaint management processes that ensure complaints are readily registered and rapidly addressed.

17.3.2. Residual risk

This section assesses the risks relevant to air quality and summarises the effectiveness of mitigation measures proposed to minimise those risks. Unmitigated and mitigated consequence and likelihood ratings for the identified construction hazards are shown with explanatory notes in Table 17-9. The risk assessment is of the Project as described in Chapter 2, in which SunWater has already incorporated a range of risk reduction and mitigation measures.

Based on this assessment, the following conclusions can be made:

- risks to air quality from the Project are low and can be effectively mitigated;
- risks of impacts to terrestrial flora and fauna are low and can be effectively mitigated;
- the impact from vehicle emissions will be negligible in terms of impact on persons;
- there will be negligible use of ozone depleting substances throughout the course of the Project ,and
- the impacts relevant to air quality can be effectively managed and the residual risks are acceptable.

Table 17-19 Risk assessment

Hazards	Factors	Impacts	Project Description Controls & Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current Risk			C	L	Mitigated Risk
Health effects to local residents	Predicted contribution from Project less than background levels or elevated for short periods. Residents will vacate some properties prior to construction.	Potential increase in PM10 concentrations is not predicted to exceed criteria other than for short periods.	RCC covered roads are to be used to reduce dust High priority placed on dust suppression Minimise the extent of clearing which bares earth Worked areas should be stabilised as soon as possible after earthworks. Minimise the extent of the pipeline laying work front near towns. Cement loading into concrete batch plant must be done using bag filters. Public sealed roads should be regularly cleaned and swept. Haul trucks should always be covered.	Minor	Unlikely	Low	N/A		Minor	Unlikely	Low
Effects to terrestrial flora and fauna	Predicted contribution from Project low.	Potential increase in PM10 concentrations and dust deposition rates.	As above	Minor	Unlikely	Low	N/A		Minor	Unlikely	Low

17.4. Summary

This section has quantitatively and qualitatively assessed the air quality impacts of the construction of the dam, pipeline and associated infrastructure. Dispersion modelling was used to predict PM_{10} and TSP concentrations and dust deposition rates at sensitive receivers.

The modelling indicated that the main activities of the Project will not cause exceedances of DERM air quality goals at the nearest sensitive receivers provided the buffer distances recommended in this report for certain activities are implemented. This may not be possible in all cases (dam access road impacts on receiver 1 for example). In these situations standard industry practices such as the use of water truck to dampen disturbed ground and reduced speed limits will be implemented to reduce residual impacts to acceptable levels.

Operational air quality impacts are likely to be very minor given the access roads will be sealed, low vehicle speeds at the recreation area and generally low levels of activity.