3. AIR QUALITY

3.1 Introduction

3.1.1 This section assess the potential air quality impacts associated with the construction and operation of Route 16 - Alternative Alignment.

3.1.2 Dust impact upon the sensitive receivers is the key issue during construction. Mitigation measures as stipulated in the *Air Pollution (Construction Dust) Regulation* are recommended to minimise the potential impacts at the nearby sensitive receivers.

3.1.3 Vehicular emissions from the open road is the key issue during the operational phase. Moreover, exhaust gas emitted via the mid ventilation building is another key issue.

3.2 Government Legislation and Standards

3.2.1 The criteria for evaluating air quality impacts is laid out in the EIAO-TM. The relevant criteria to this Study are given below.

3.2.2 The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The whole of the *Hong Kong Special Administration Region* (HKSAR) is covered by the *Hong Kong Air Quality Objectives* (AQOs) which stipulate the statutory limits of some typical air pollutants and the maximum allowable numbers of exceedance over specific periods. The AQOs are shown in *Table 3.2a* below.

Table 3.2a Hong Kong Air Quality Objectives (μgm^{-3})[1]

Pollutant	Averaging Time			
	1 Hour [2]	8 Hours [3]	24 Hours [3]	1 Year [4]
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates [5] (RSP)	-	-	180	55
Sulphur Dioxide (SO_2)	800	-	350	80
Nitrogen Dioxide (NO_2)	300	-	150	80
Carbon Monoxide (CO)	30,000	10,000	-	-
Photochemical Oxidants (as ozone [6])	240	-	-	-

(1) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(2) Not to be exceeded more than three times per year.
(3) Not to be exceeded more than once per year.
(4) Arithmetic means.
(5) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.
(6) Photochemical oxidants are determined by measurement of ozone only.

3.2.3 The EIAO-TM stipulates that the hourly TSP of 500 μg m^{-3}, measured at 298K and 101.325 kPa, should not be exceeded for construction dust impact assessment.

3.2.4 In addition, the *Tunnel Air Quality Guidelines* (TAQG), specified under the *EPD's Practice Notes on Control of Air Pollution in Vehicle Tunnel, 1995* should be attained and maintained inside a vehicle tunnel. The TAQG is shown in *Table 3.2b* below.

Table 3.2b Tunnel Air Quality Guidelines (TAQG)

Air Pollutant	Averaging Time	Maximum Concentration	
		Micrograms per cubic metre (μgm^{-3})	Part Per Million (ppm)
Carbon Monoxide	5 minutes	115,000	100
Nitrogen Dioxide	5 minutes	1,800	1
Sulphur Dioxide	5 minutes	1,000	0.4

3.3 Baseline Conditions

3.3.1 Existing Conditions

3.3.1.1 Air quality of the West Kowloon area is considered poor mainly attributed to the industrial emissions from Cheung Sha Wan and vehicle emissions from Ching Cheung Road, Lai Chi Kok Road and associated network.

3.3.1.2 The nearest EPD air quality monitoring stations are the Sham Shui Po station (located at Yen Chow Street, Sham Shui Po). The annual averages of pollutants for the year 1997, latest data available for this Study, at the Sham Shui Po monitoring station are presented in *Table 3.3a*.

Table 3.3a Background Air Quality ($\mu g\ m^{-3}$)

Pollutant	Annual Average (1997)
	Sham Shui Po
TSP	89
RSP	58
SO_2	20
NO	56
NO_2	71
CO	1095[(1)]
O_3	28[(2) (3)]

Note:

(1) Monitored at the Mongkok Station

(2) Monitored at the Kwai Chung Station

(3) Annual average of the maximum daily level

3.3.2 Future Conditions

3.3.2.1 With the relocation of the major manufacturing activities to Mainland China, the industrial emission of the area is expected to be decreased in the future. However with the operation of the proposed Route 16 and the proposed Route 9 passing through the Study Area, the vehicular exhaust emission of the area is expected to be increased.

3.4 Air Sensitive Receivers

3.4.1 Representative air sensitive receivers (ASRs) have been identified according to the criteria set out in the EIAO-TM, through site inspections and review of landuse plans of the Study Area. The ASRs and their horizontal distances to the alignment are listed in *Table 3.4a*. Locations of the ASRs are shown in *Figure 3.4a-e*.

3.4.2 As Wai Man Tsuen (A4) and Butterfly Valley New Village (A12) will be resumed in Sept 2001 (ie prior to the construction of Route 16), air quality assessment will be excluded in this assessment.

Table 3.4a Location of Air Sensitive Receivers (ASRs)

Section	ASR	Location	Horizontal Distance to the major dust generating work site (m)	Horizontal Distance to the alignment/Vent Building (m)
Route 16 alignment	A1	Sport Area	75 (1)	138
	A2	HK Institute of Education, Black Campus I	100 (1)	150
	A3	Government Quarter	63 (1)	163
	A4	Practical School	100 (2)	50
	A5	Mei Foo Sun Chuen Phase 5 Block 1	90 (2)	55
	A6	Lai Chi Kok Indoor Sport Centre	58 (2)	43
	A7	Planned Residential Development	100 (2)	73
	A8	Lai Chi Kok Swimming Pool	200 (2)	50
	A9	Football Field at Lai Chi Kok Park	260 (2)	40
	A10	Ching Lai Court	380 (2)	115
	A11	Lai Chi Kok Hospital	190 (2)	100
	A12	Lai Chi Kok Reception Centre Staff Quarter	380 (2)	25
	A13	Hop Hing Industrial Building	510 (1)	30
	A14	Tung Yuen Industrial Building	580 (1)	45
	A15	Cheung Sha Wan Cooked Food Market	675 (1)	55
	A16	Haking Wong Technical Institute	1000 (1)	155
	A17	Planned G/IC Development	750 (1)	30
	A18	Residential Development Tower 2 at Site 10	930 (1)	58
Mid Ventilation Building	V1	Bamboo Villa	-	200
	V2	Pinehill	-	50
	V3	Residential Redevelopment	-	75
	V4	Park Mansion	-	120

Section	ASR	Location	Horizontal Distance to the major dust generating work site (m)	Horizontal Distance to the alignment/Vent Building (m)

Note:

(1) Distance between the ASR and the cut & fill works at Butterfly Valley

(2) Distance between the ASR and the excavation works at Ching Cheung Road

3.5 Construction Phase

3.5.1 Potential Sources of Impact

3.5.1.1 A number of construction activities are expected for the Route 16 construction. The major dusty activities associated with the construction of the Alternative alignment are:

- excavation of Eagle's Nest Tunnel;
- cut and fill works at Butterfly Valley;
- Ching Cheung Road widening;
- Lai Chi Kok Viaduct superstructure works; and
- construction of ventilation building.

3.5.1.2 It is expected that the construction period will last for 42 months (from Sept 2001 to Apr 2005). The tunnel works, main alignment works and the widening work at Ching Cheung Road are expected to be carried out simultaneously.

3.5.1.3 Dust generating from the cut and fill works at Butterfly Valley and a section of Ching Cheung Road widening, and tunnel excavation will be the major sources of impact. Construction activities such as material handling, wind erosion of stockpiled materials, truck movement on the unpaved haul roads are the main dust generating sources.

3.5.1.4 It is expected that there is no blasting for the tunnel works. The bridge deck of the alignment will be pre-cast, and dust emission from the works will be minimal. No on-site concrete batching plant is expected.

3.5.1.5 A total of 508,886 m^3 fill is required for the West Kowloon works at Butterfly Valley. It is expected that the fill materials will be mainly come from the cut works of Butterfly Valley and Ching Cheung Road Widening, and excavated works of Eagle's Nest Tunnel. Small amount of materials may be temporarily stockpiled in the Butterfly Valley area.

3.5.1.6 It is expected that all the excavated materials from Ching Cheung Road Widening work will be transported by truck to the Butterfly Valley. The excavated materials from the tunnel will be transported off- site via the mid ventilation building and the tunnel portal ends at Sha Tin.

3.5.1.7 SO_2 and NO_2 will be emitted from the diesel-powered equipment used. However, since the number of such plant required on-site will be limited, their gaseous emissions will be minor. With the limited number of construction plant, the AQO of these gases are not expected to be breached.

3.5.2 Evaluation of Impact

3.5.2.1 As indicated in *Table 3.4a*, ASR A1 - A7 are located within 100 m of the construction site and the dust levels at these ASRs may be high. Nevertheless, environmental control and mitigation measures as required under the *Air Pollution Control (Construction Dust) Regulation* will be implemented in this project to limit the dust emission from the site and protect the ASRs from dust impacts (Mitigation measures are described in the *Section 3.5.3*). Hence, dust impact at the nearby ASRs are not expected. In addition, to avoid dust nuisance, the haul route has been located at the bottom of the valley to locate away from the receivers (see *Figure 5.5a*).

3.5.2.2 During the construction of Route 16, no other project are expected to be carried out concurrently and therefore, cumulative impact will not be assessed.

3.5.3 Mitigation Measures

3.5.3.1 Under the *Air Pollution (Construction Dust) Regulation*, the following requirements should be followed and incorporated in the contract specification to limit the dust emission from the construction site:

- any excavated dusty materials or stockpile of dusty material should be covered entirely by impervious sheeting or sprayed with water so as to maintain the entire surface wet;
- a stockpile of dusty materials should not extend beyond the pedestrian barriers, fencing or traffic cones;
- vehicle washing facilities should be provided at every exit point;
- the area where vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;
- where a site boundary adjoins a road, street, service lane or other area accessible to the public, hoarding of not less than 2.4 m high from ground level should be provided along the entire length of that portion of the site boundary except for a site entrance or exit;
- every main haul road should be sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet;
- the portion of any road leading only to a construction site that is within 30 m of a discernible or designated vehicle entrance or exit should be kept clear of dusty materials;
- any stockpile of dusty materials should be either covered entirely by impervious sheeting, placed in an area sheltered on the top and the 3 sides or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet;
- all dusty materials should be sprayed with water or a dust suppression chemical immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;
- every vehicle should be washed to remove any dusty materials from its body and wheels immediately before leaving a construction site; and
- the working area of any excavation should be sprayed with water or a dust suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet.

3.5.4 Environmental Monitoring & Audit (EM&A)

3.5.4.1 Environmental Monitoring & Audit (EM&A) is recommended at Government Quarters (AM1) and Lai Chi Kok Indoor Centre (AM2) or in their vicinity to ensure that the dust impact is within the criteria during the alignment work at Butterfly Valley and road-widening work at Ching Cheung Road. The location of the air monitoring station is shown in *Figure 3.5a&b*. The details of the monitoring will be presented in the separate EM&A Manual.

3.6 Operational Phase

3.6.1 Potential Sources of Impact

3.6.1.1 Vehicle emissions from the road will be the major air pollutants during the operation of Route 16. NO_2, CO and RSP are the major compositions of the pollutant.

3.6.1.2 Air quality inside the Eagle's Nest Tunnel is another area of concern. Design of the ventilation system will ensure that the TAQG will be met at the tunnel. Pollutants generated within the Eagle's Nest Tunnel will be discharged via the mid ventilation building at Tai Po Road and therefore, no emission will be emitted from the portal end.

3.6.1.3 Under the Air Pollution Control (Motor Vehicle Fuel) Regulation, the sulphur content of diesel fuel is required to be less than 0.05%. With such a low level of sulphur content, adverse SO_2 impact is unlikely. NO_x, CO and RSP are the major pollutants from the tunnel emission.

3.6.2 Assessment Methodology

Open Road Vehicle Emission

3.6.2.1 The EPD approved air dispersion model, CALINE4, was used to predict the hourly pollutant levels of NO_2, RSP and CO from the open section of the Route 16 alignment and the surrounding road networks. The emission factors used for NO_x, CO and RSP, were calculated based on EURO III criteria. Exhaust emission after year 2011 are not available for this Study and it is assumed that after 2011, vehicle exhaust emission will be identical to year 2011, as a worst case assumption.

3.6.2.2 The traffic data of year 2019, 15 years after the commencement of the operation of Route 16, will be employed together with the surrounding road networks for the assessment. The 2019 forecasted traffic has been presented in Section 2.3. The NO_x emission rate for the year 2019 has been carried out and the typical NO_x emission calculation for Route 16 Mainline is shown in *Table 3.6a* below.

Table 3.6a NO_x Emission for the Route 16 Mainline

	Year 2019
Total Traffic Flow (veh/hr)	8,950
Traffic Breakdown of M/C, P/C-p, Taxi, PV, PLB, LGV, HGV, Bus[(1)]	260, 3,070, 560, 100, 100, 2,120, 2,480, 260
Fleet Emission Rate of NO_x for M/C, P/C-p, Taxi, PV, PLB, LGV, HGV, Bus (g/km/veh)[(2)(3)]	0.37, 0.71, 0.73, 1.53, 1.54, 1.23, 3.84, 6.8
Total NO_x Emission Rate (g/km)	17,291

Note:

(1) M/C, P/C-p, Taxi, PV, PLB, LGV, HGV, Bus represents Motor Cycle, Petrol Private Car, Taxi, Private Van, Public Light Bus, Light Goods Vehicle, Heavy Goods Vehicles and Public Bus.

	Year 2019
(2) Fleet emission rate based on EURO III criteria	
(3) 2019 NO_x emission rate are not available and 2011 emission rate is used	

3.6.2.3 Daytime worst case scenario meteorological conditions were assumed in the model run. Typical input parameters for the model are listed below:

- wind speed: 1 ms^{-1};
- wind direction: worst case for each receiver;
- stability class: D;
- mixing height: 500 m;
- standard deviation of wind direction: 20 degrees; and
- temperature: 298 K.

3.6.2.4 Discrete Parcel Method was used to compute NO_2 concentrations with the CALINE4 model. It is assumed that the NO_2 reactions take place within parcels. The reaction rates are assumed to be governed by the initial concentrations of NO, NO_2 and O_3, and are independent of the dispersion mechanism. Background concentration of NO and NO_2 listed in *Table 3.3a* were used in the model. The annual average of the maximum daily ozone levels monitored at Kwai Chung Station for the year 1997, 28 μgm^{-3}, was taken as the background ozone concentration of the area.

Mid Ventilation Building Emission

3.6.2.5 The exhaust pollutants (NO_2, CO and RSP) inside the tunnel will be discharged via mid ventilation building to ensure zero emission at the West Kowloon section of the Eagle's Nest Tunnel. The height of the exhausted point at the mid ventilation building is 140 mPD and the maximum height of the surrounding building is 20 m (about 7 storeys) with base elevation of 90-100 mPD. The roof elevation of receivers will be 110-120 mPD, i.e., 20 mPD lower than the mid ventilation building.

3.6.2.6 The pollutants will be directly horizontal discharged. An air jet was assumed at the northwest of the mid ventilation building. It was taken as volume sources and their dispersions will be also calculated using the ISCST3. Meteorological data at Cheung Sha Wan Station for year 1997 were employed in the assessment. It was assumed that 20% of NO_x would be converted to NO_2. The pollutant emission rates, provided by the ventilation engineer, have been used for this assessment and are presented in *Table 3.6b* below.

Table 3.6b NO_x and CO Emission from the Mid Ventilation Building[(f)]

	Parameter
Flux Velocity (ms^{-1})	3
NO_2 Emission Rate (g/s)	1.26
CO Emission Rate (g/s)	10.99

3.6.3 Evaluation of Impacts

Vehicular emission from open roads

3.6.3.1 NO_2, CO and RSP are the major pollutants in vehicle exhaust emissions. The hourly air pollutant levels at ground level and at alignment level, taking into account with the background level, are shown in Table 3.6c below.

Table 3.6c Hourly Air Pollutant Levels with background (μgm^{-3})

ASRs	Relative Height to Alignment (m)	Predicted Hourly Pollutant Level(1)		
		NO_2	CO	RSP
A1(2)	+20	113	1,525	73
A2(2)	+20	113	1,410	72
A3(2)	+20	113	1,410	72
A4	+0	132	1,870	81
	+10	113	1,870	79
A5	-10	132	2,100	85
	+0	132	2,100	85
A6	-10	188	3,135	101
	+0	188	3,365	106
A7	+0	169	2,675	94
	+10	150	2,445	91
A8	+0	132	2,215	84
	+10	113	2,100	83
A9	+0	113	1,755	77
	+10	113	1,755	76
A10	+0	113	1,640	75
	+10	94	1,640	74
A11	-10	113	1,755	76
	+0	113	1,640	76
A12	-10	169	2,790	101
	+0	150	2,330	91
A13	-10	188	2,790	103
	+0	150	2,445	94
A14	-10	169	2,790	97
	+0	132	2,330	89
A15	-10	226	4,515	125
	+0	169	3,365	105
A16	-10	150	2,330	89
	+0	132	2,215	86
A17	-10	188	2,905	103
	+0	169	2,560	95
A18	-10	132	2,100	85

ASRs	Relative Height to Alignment (m)	Predicted Hourly Pollutant Level(1)		
		NO_2	CO	RSP
	+0	132	1,985	84
AQO Criteria		300	30,000	180 (3)

Note:

(1) Background has been included in the above prediction

(2) Base elevations of A1-A3 are higher than the alignment level by 20 m and concentration at the base was presented.

(3) Since no hourly RSP criteria, a daily RSP criteria is used.

3.6.3.2 The above results indicated that there is no exceedance of AQO criteria at all ASRs. The predicted NO_2, CO and RSP levels range from 94 - 226 μgm^{-3}, 1,410 - 4,515 μgm^{-3} and 72 - 125 μgm^{-3} respectively. The highest NO_2 level is predicted at A15 (Cheung Sha Wan Cooked Food Market). The sample CALINE4 output file is shown in *Annex 3A*.

3.6.3.3 Isopleths of the critical pollutant, NO_2 at ground level and alignment level of Route 16 have been plotted and are shown in *Figure 3.6 a & b*. It is indicated that the AQO along the alignment would be satisfied.

3.6.3.4 It is understood that 3-7m acoustic barriers along the mainline of Route 16 and the slip roads and semi-enclosures near the Eagle's Nest Tunnel Portal have been proposed to mitigate the noise impact (see *Section 4.6*). With the barriers, pollutants would be dispersed above the barrier and the air quality impacts will be similar at the ASRs.

3.6.3.5 In addition, two full enclosures have also been proposed along the slip roads at the end of Lai Chi Kok Viaduct near Site 10 (also see *Section 4.6*). The cumulative air quality impacts of open road and the enclosure emissions have been modelled and presented in *Table 3.6d*.

Table 3.6d Predicted Cumulative Hourly NO_2 CO and RSP Levels at All ASRs (μgm^{-3})

ASRs	Relative Height to Alignment (m)	Predicted Hourly Pollutant Level(1)		
		NO_2	CO	RSP
A1(2)	+20	118	1584	76
A2(2)	+20	119	1472	76
A3(2)	+20	119	1473	76
A4	+0	144	2006	88
	+10	125	2003	86
A5	-10	141	2197	90
	+0	140	2196	89
A6	-10	195	3206	104
	+0	195	3436	109
A7	+0	174	2730	97
	+10	137	2508	94
A8	+0	137	2272	87

ASRs	Relative Height to Alignment (m)	Predicted Hourly Pollutant Level(1)		
		NO_2	CO	RSP
	+10	118	2156	85
A9	+0	119	1820	81
	+10	119	1819	79
A10	+0	117	1689	78
	+10	98	1697	77
A11	-10	134	1977	88
	+0	132	1852	86
A12	-10	204	3157	120
	+0	182	2724	108
A13	-10	238	3323	130
	+0	195	2981	118
A14	-10	230	3435	130
	+0	183	2931	117
A15	-10	291	5215	161
	+0	225	3999	135
A16	-10	187	2718	108
	+0	164	2656	104
A17	-10	268	3757	146
	+0	220	3370	132
A18	-10	200	2844	126
	+0	185	3089	119
AQO Criteria		300	30,000	180 (3)

Note:

(1) Background has been included in the above prediction

(2) Base elevations of A1-A3 are higher than the alignment level by 20 m and concentration at the base was presented.

(3) Since no hourly RSP criteria, a daily RSP criteria is used.

The above results indicated that the cumulative air quality impacts of open road with enlosure emissions are within the AQO criteria. Highest predicted cumulative NO_2 concentration was predicted at A15 (Cheung Sha Wan Cooked Food Market). For the air quality inside the tunnel, the design of the ventilation system should ensure that the TAQG will be met at the enclosure.

Mid Ventilation Building Emission

3.6.3.6 NO_2 and CO are the major pollutants from the ventilation emission. Vehicular emissions from Tai Po Road, will be another major pollutant sources to the ASRs. The cumulative hourly predicted NO_2 and CO levels from ventilation emission and the open road emission from Tai Po Road together with background are presented in *Table 3.6e* below.

Table 3.6e Predicted Hourly NO_2 and CO Levels at All ASRs (μgm^{-3})

ASR	Height in mPD	Predicted Hourly Pollutant Level(1)(2)	
		NO_2	CO
V1	90	208	2,476
	100	182	2,163
	110	173	2,018
	120	207	2,378
V2	90	221	2,665
	100	189	2,226
	110	182	2,129
	120	237	2,557
V3	90	197	2,362
	100	184	2,217
	110	197	2,225
	120	249	2,667
V4	90	195	2,323
	100	176	2,094
	110	173	2,055
	120	205	2,251
AQO Criteria		300	30,000

Note:

(1) Background has been included in the above prediction

(2) Vehicle exhaust of Tai Po Road has been included in the prediction.

3.6.3.7 NO_2 and CO are the major pollutants from the ventilation building. The air quality impacts at lower level of the receivers are dominated by open road emission from Tai Po Road while at the higher level, the air quality impacts at ASRs are dominated by ventilation building emission. The above results show that the air quality predicted at all ASRs with different levels are within AQO criteria. Highest air quality impacts at lower level and higher level are experienced at V2 (Pine Hill) and V3 (Residential Redevelopment) which are located opposite to the mid ventilation building. It can be concluded that the air quality at the receivers will comply with AQO criteria.

3.6.4 Mitigation Measures

3.6.4.1 Since the air qualities at all ASRs are within the AQO criteria, no further mitigation measures are required.

3.6.5 EM&A Requirements

3.6.5.1 EM&A will be required for the tunnel to ensure the acceptability of the air quality criteria. The details of the monitoring will be presented in the separate EM&A Manual.

3.7 Conclusions

3.7.1 Construction Phase

3.7.1.1 Dust generating from the cut and fill works at Butterfly Valley and a section of Ching Cheung Road widening, and tunnel excavation will be the major sources of impact. Construction activities such as material handling, wind erosion of stockpiled materials, truck movement on the unpaved haul roads are the main dust generating sources.

3.7.1.2 With the large number of construction activities in the sites and the close proximity of some ASRs to the site, the dust impact due to the construction activities would be high.

3.7.1.3 With the implementation of the mitigation measures recommended in Section3.5.3 and checked by EM&A, the dust levels at the worst affected ASRs will comply with the dust criteria.

3.7.1.4 EM&A is recommended at A3 (Government Quarters) near Butterfly Valley and A6 (Lai Chi Kok Indoor Centre) to ensure that the dust impact is within the criteria.

3.7.2 Operational Phase

3.7.2.1 The major source of pollutants come from the vehicle exhaust on the open road networks and the mid ventilation building at Tai Po Road.

3.7.2.2 The major pollutants are NO_2, CO and RSP. The predicted pollutant levels are within the AQO criteria, further mitigation measures are not required.

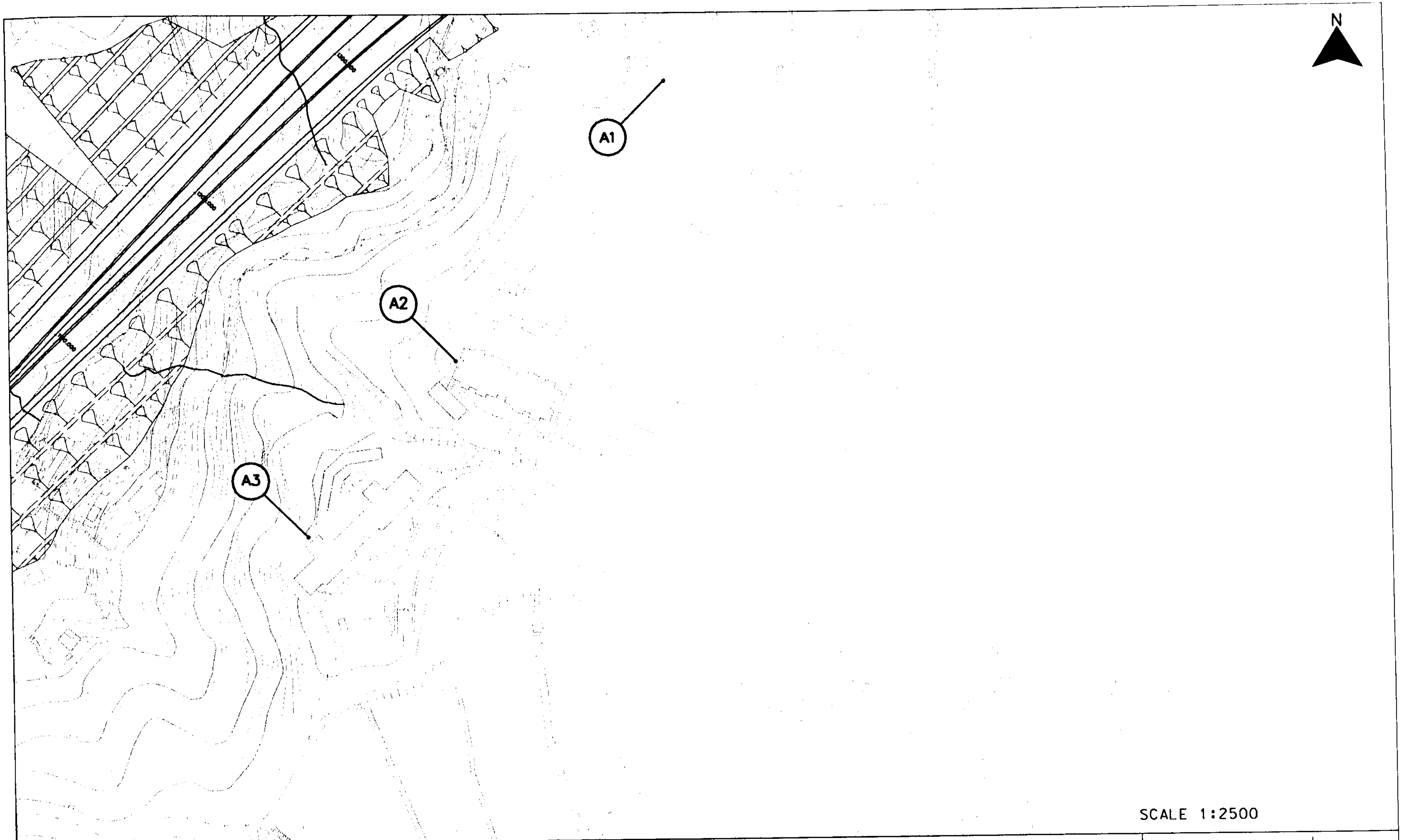

FIGURE 3.4a

LOCATION OF AIR SENSITIVE RECIEVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

Environmental Resources Management

ERM

FIGURE 3.4b

LOCATION OF AIR SENSITIVE RECEIVERS ~~DURING CONSTRUCTION~~ PHASE

Environmental Resources Management

ERM

USTN FILE: C1884_28
DATE: 03/05/99

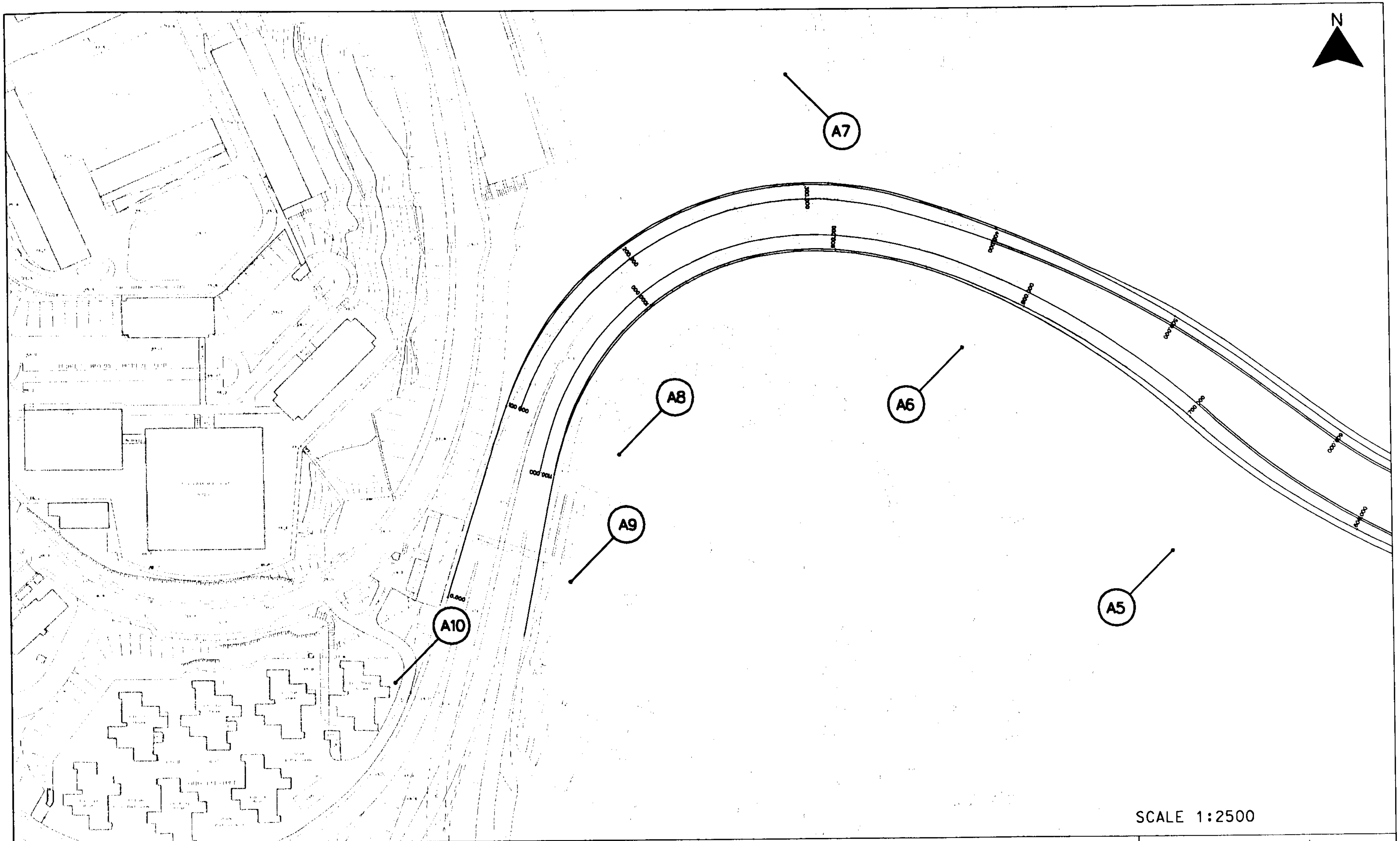

FIGURE 3.4c

LOCATION OF AIR SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

Environmental Resources Management

ERM

USTN FILE: C1884_27
DATE: 03/05/99

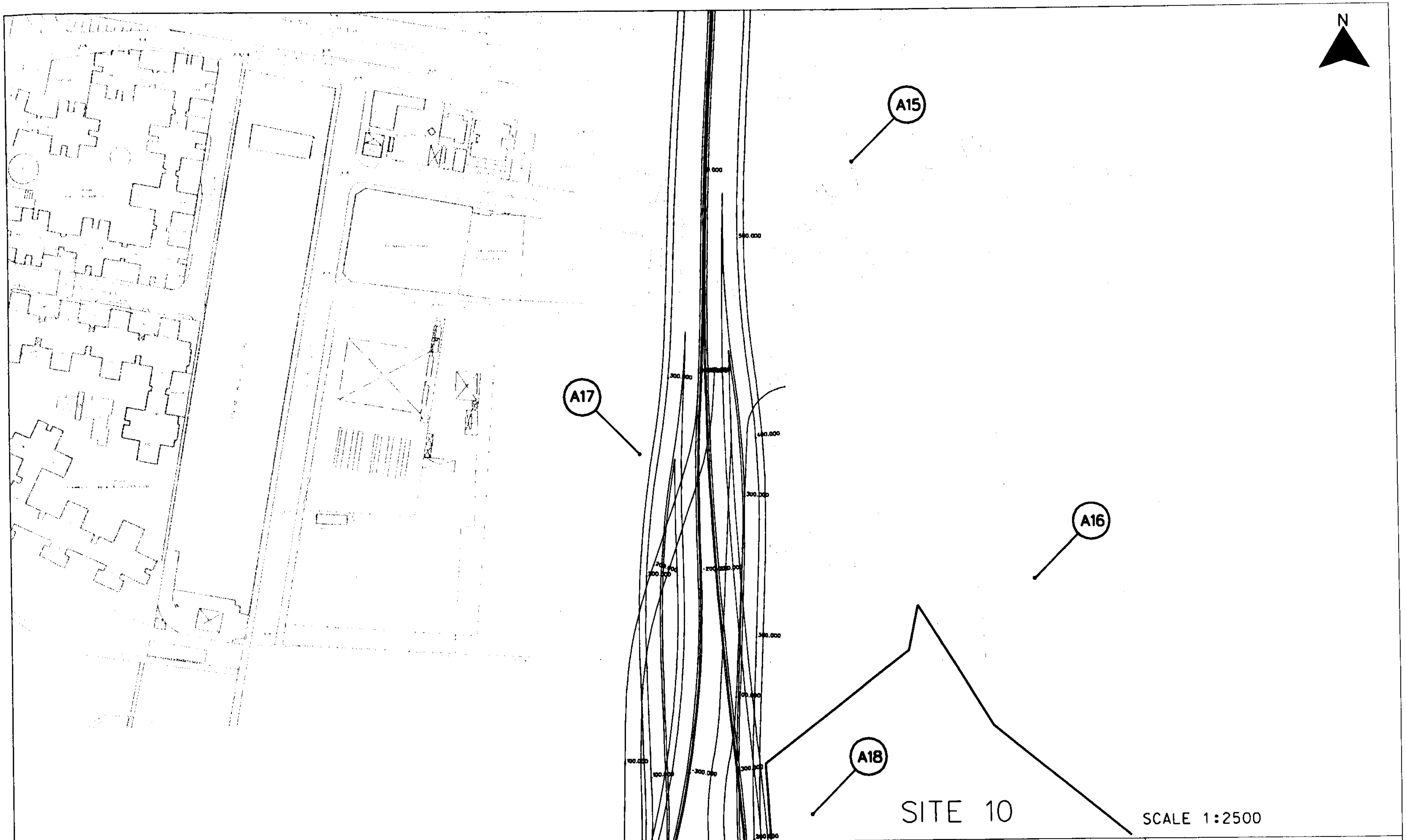

FIGURE 3.4d

LOCATION OF AIR SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

Environmental Resources Management

ERM

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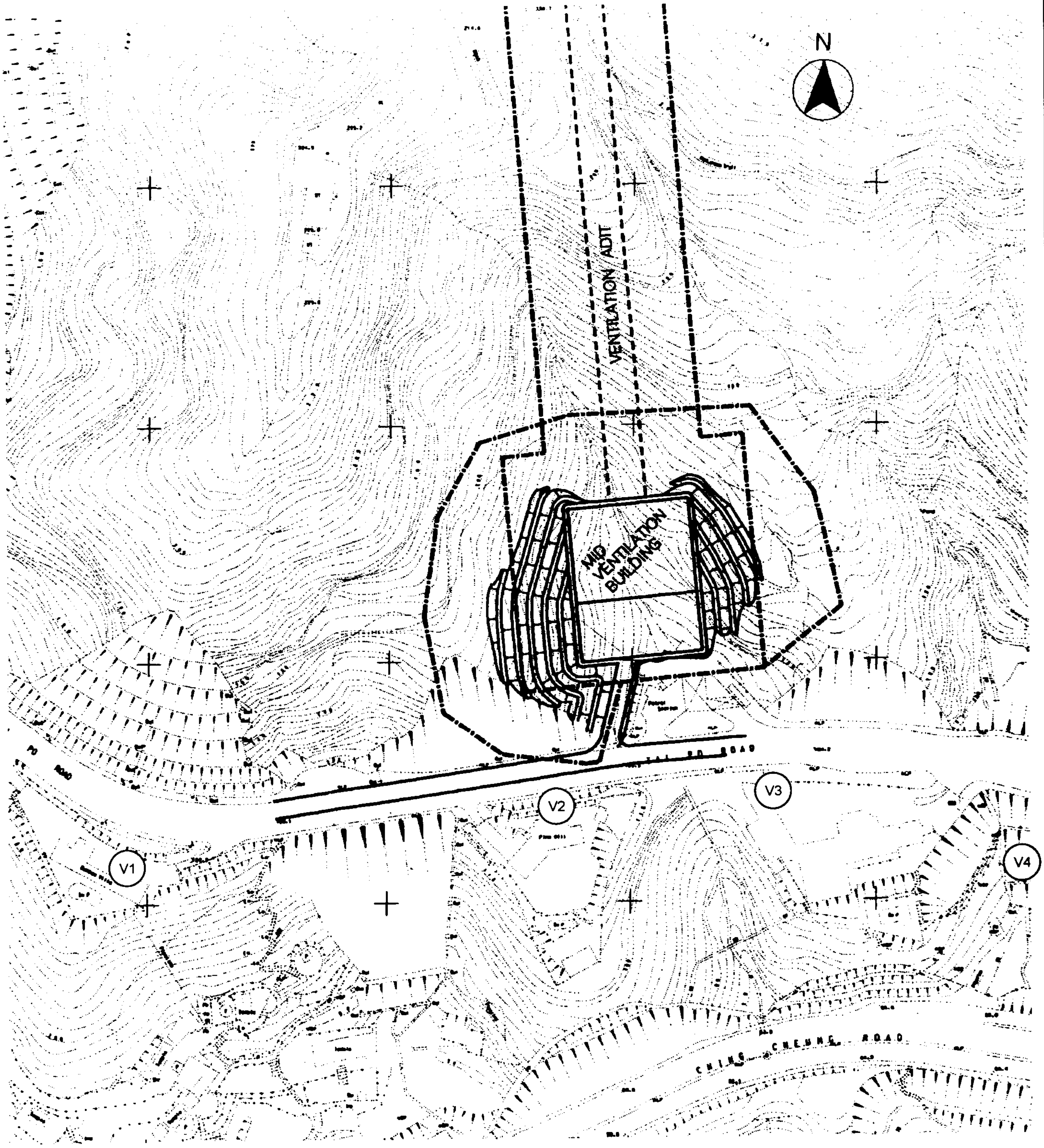
DATE: 03/05/99



NOT TO SCALE

FIGURE 3.4e LOCATION OF AIR SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

Environmental Resources Management

ERM

FILE: C1884d

DATE: 03/05/99

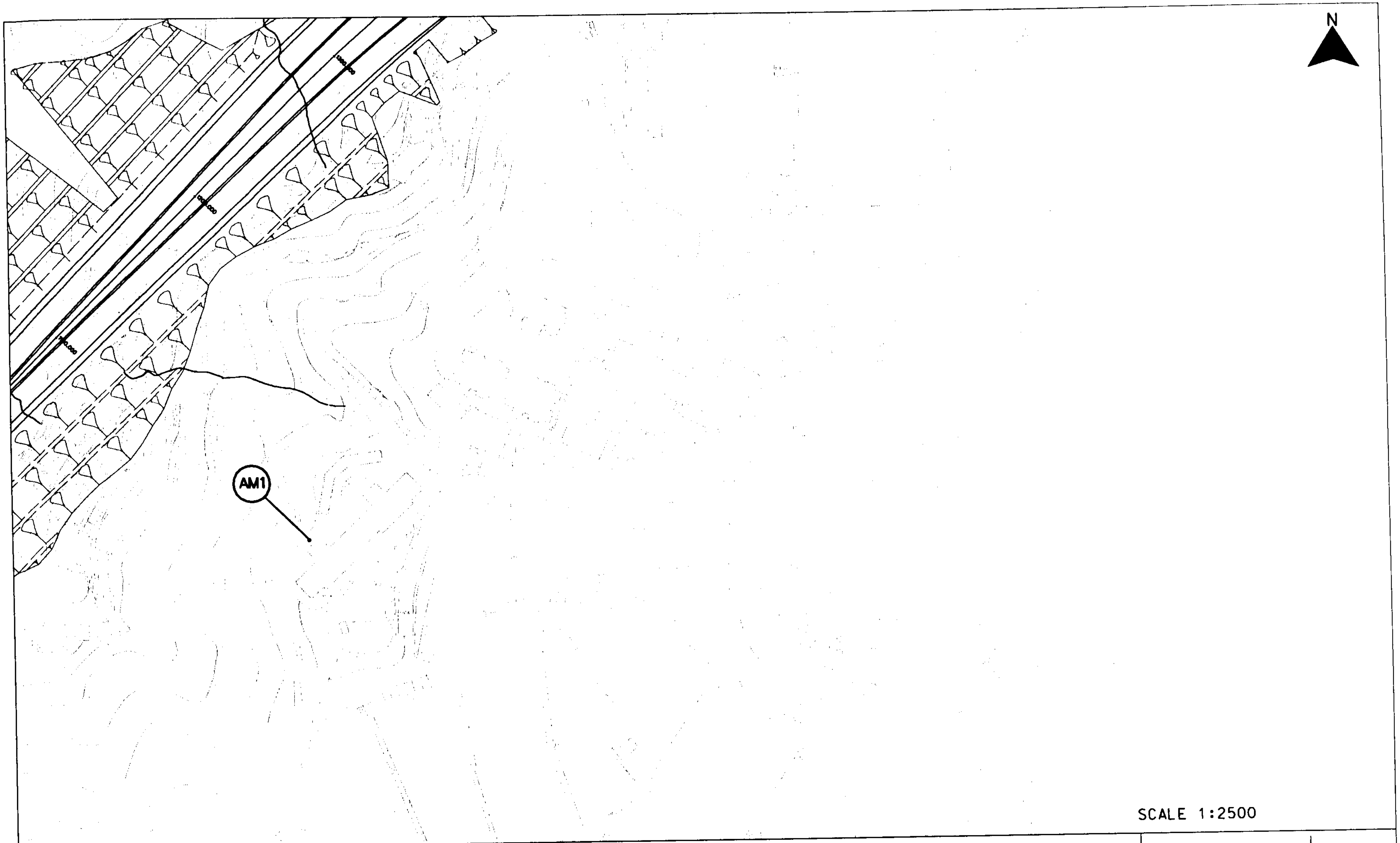


FIGURE 3.5a

LOCATION OF AIR QUALITY MONITORING STATIONS DURING CONSTRUCTION PHASE

Environmental
Resources
Management

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USTN FILE: C1884_31
DATE: 03/05/99

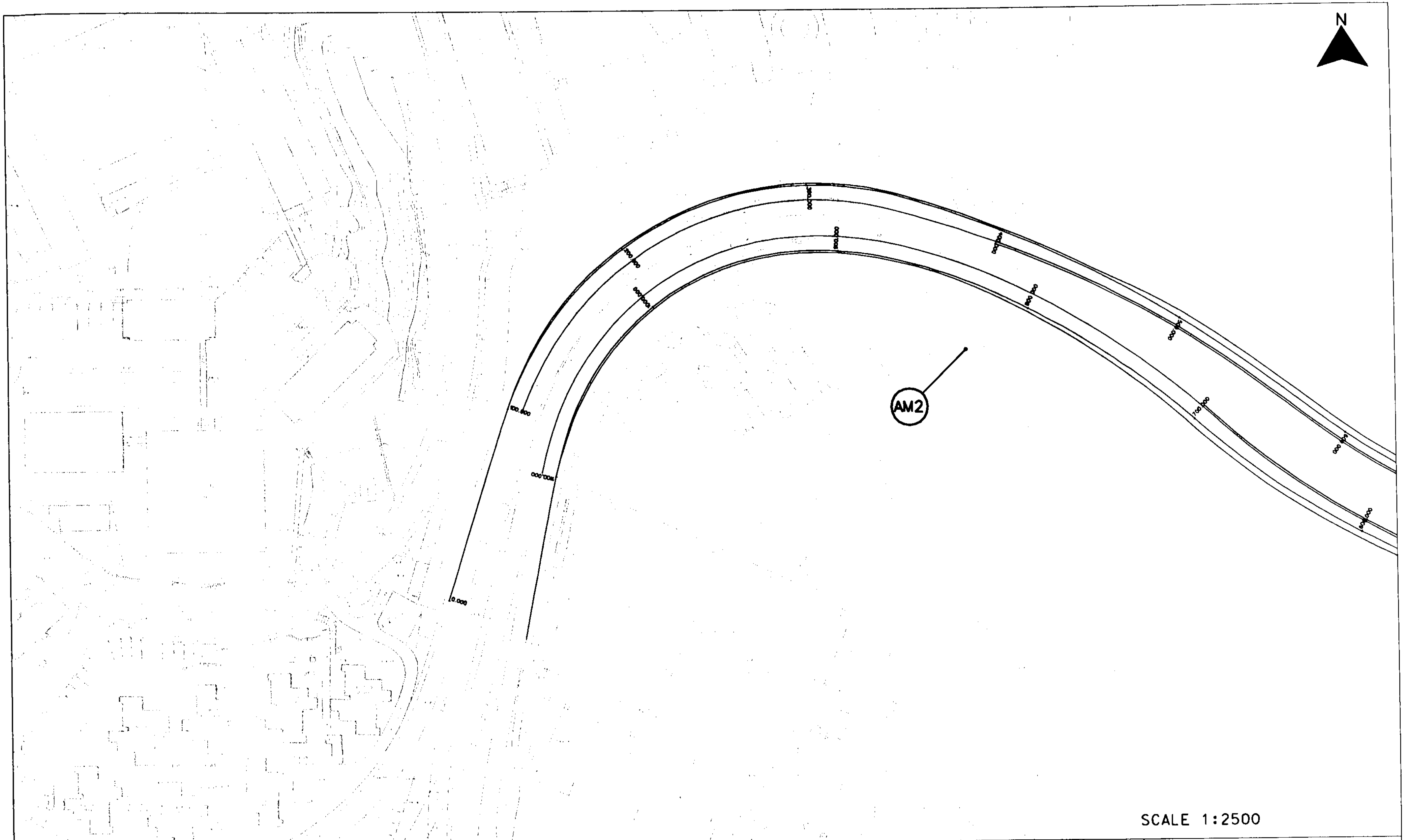

FIGURE 3.5b

LOCATION OF AIR QUALITY MONITORING STATIONS DURING CONSTRUCTION PHASE

Environmental Resources Management

ERM

USTN FILE: C1884_32
DATE: 03/05/99

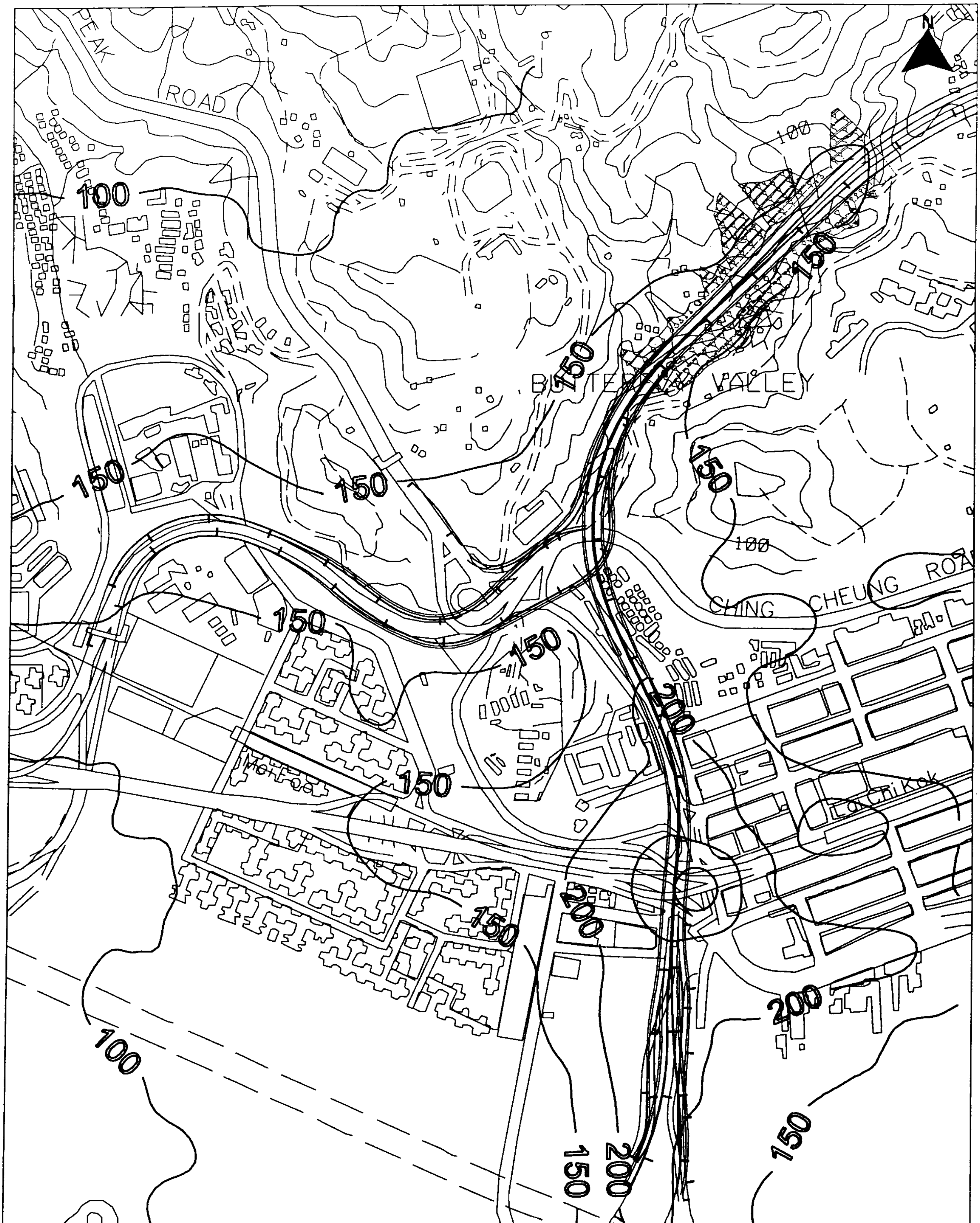

FIGURE 3.6a

ISOPLETHS OF NITROGEN DIOXIDE AT GROUND LEVEL

Environmental Resources Management

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USTN FILE: C1884_53
DATE: 28/06/99

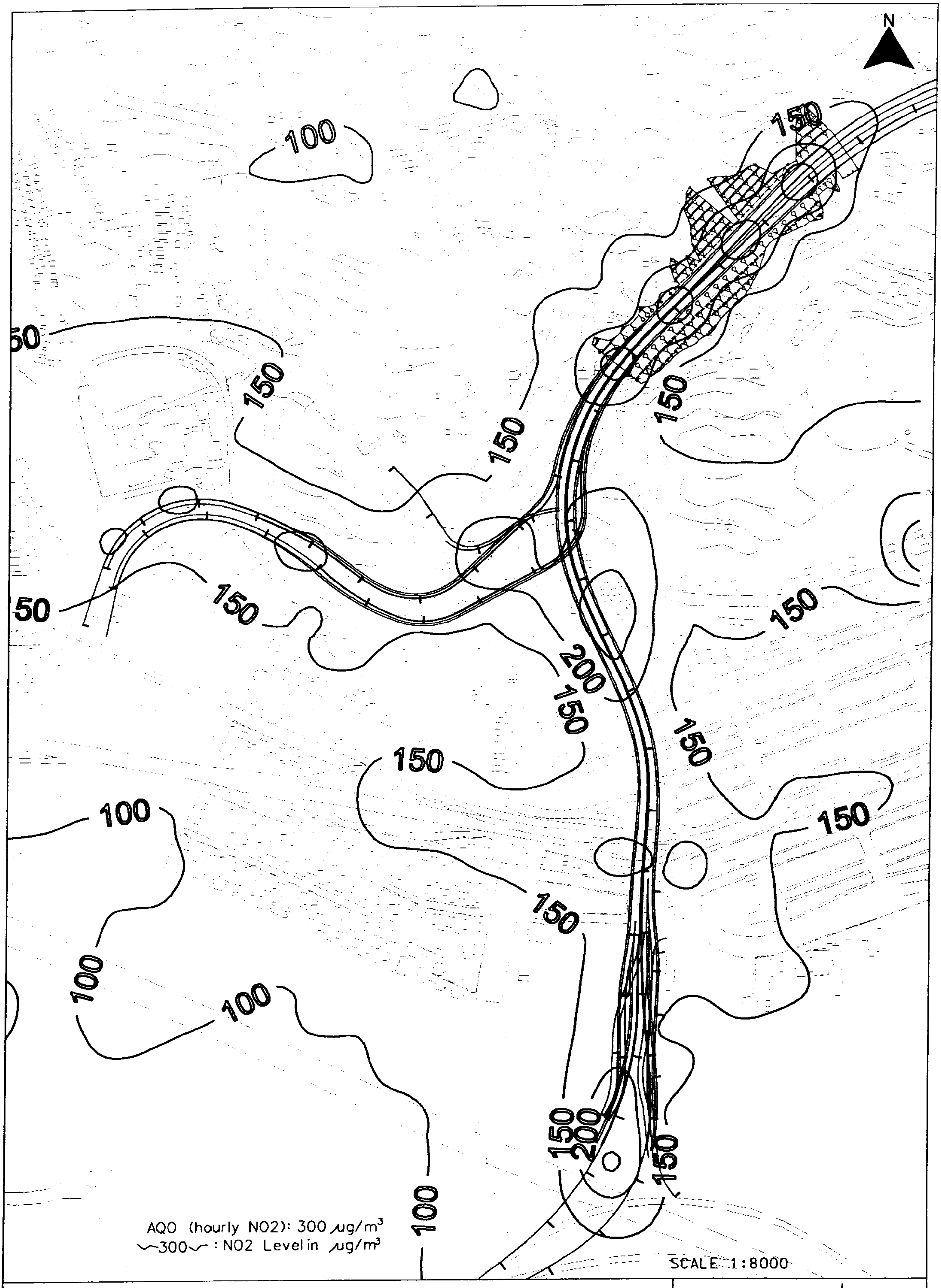

FIGURE 3.6b ISOPLETHS OF NITROGEN DIOXIDE AT ALIGNMENT LEVEL

Environmental Resources Management

ERM

USTN FILE: C1884_54
DATE: 20/06/99