HIGHWAYS DEPARTMENT
MAJOR WORKS PROJECT
MANAGEMENT OFFICE

AGREEMENT NO. CE 18/86
KENNEDY ROAD IMPROVEMENTS AND QUEEN'S LINES LINK

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

JUNE 1997

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Halcrow Fox & Associates Ltd
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Agreement No. CE 18/86
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Final Environmental Impact Assessment Report

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1 INTRODUCTION

1.1 Background

The existing hazardous bend in front of the Electric House reduces road capacity and induces road safety problems along the section of Kennedy Road between Monmouth Terrace and Borrett Road. The Kennedy Road Improvement and Queen's Lines Link project (the Project) is to straighten this hazardous bend and to provide a new road linking Kennedy Road to Justice Drive as an alternative route for traffic between Mid-Levels and Central.

In view of the close proximity of the noise sensitive receivers (NSRs) to the proposed road improvement works and the future increase in traffic flow, the Environmental Protection Department (EPD) called for an Environmental Impact Assessment (EIA) to address the construction noise and road traffic noise impacts and to propose necessary mitigation measures.

As part of the feasibility study for *Kennedy Road Improvements (MacDonnell Road to Monmouth Terrace) and Victoria Barracks Link (PWP Item 200TH)*, a preliminary environmental impact assessment was carried out in 1988 and the results, presented in the Final Preliminary Report, indicated that road traffic noise was a key issue in the road improvement works. Specifically, road traffic noise levels were predicted to exceed 70 dB(A) L_{10}(1-hr.) at many existing and planned noise sensitive receivers. On the other hand, no adverse air quality impact was anticipated from vehicle emissions and water quality was not considered an issue during the operation of the Project.

The Environmental Protection Department have also conducted an Environmental Review in December 1994 and the findings concurred with those in the Final Preliminary Report.

1.2 Study Objectives

The main purpose of the Study was to provide information on the nature and extent of the noise impacts arising from the construction and operation of the Project and all concurrent activities in the area. Notwithstanding this, the potential impacts arising from construction dust and site run-off during the construction phase were also addressed.

The noise assessment results have been used as the basis for the evaluation of the noise impacts of the proposed road improvement works on both existing and planned sensitive developments, as well as for the identification of locations where the acceptable noise level criteria are exceeded and appropriate noise mitigation measures are required.

1.3 Report Structure

This EIA Report consists of 9 sections, as follows:

(1) Introduction
(2) Proposed Road Improvement Scheme
(3) Project Site
(4) Methodology
(5) Impact Assessment
(6) Mitigation Measures
(7) Cumulative Noise Impacts
(8) Environmental Monitoring and Audit (EM&A)
(9) Conclusions and Recommendations

The proposed environmental monitoring and audit programme for the Project which forms part of the EIA is contained and described in a stand alone document, EM&A Manual.

2 PROPOSED ROAD IMPROVEMENT SCHEME

2.1 Proposed Road Improvement Works

The proposed road improvement works comprise the construction of (a) a 4-lane bridge about 135 m in length to realign Kennedy Road in front of the Electric House, (b) a dual 2-lane road connection of about 400 m in length between Kennedy Road and Justice Drive (Queen's Line Link), and (c) associated roadworks, drainage works, slope works and landscaping works. Figure 1 shows the layout of the Project.

2.2 Construction Programme

Figure 2 gives the preliminary construction programme for the road improvement works. The improvement works have been scheduled for completion in 26 months, commencing from **February 1998.**

Table 2.1 Preliminary Construction Programme

Month	Task	
	No.	Description
1 - 22	1	Mobilization and Site Clearance
1.5-18.5	2	Kennedy Road Bridge
2-21	3	Kennedy Road West
6-21	4	Queen's Lines Link (Lower Section)
1.5-24	5	Queen's Lines Link (Upper Section)
13 - 18	6	Supreme Court Road/Justice Drive Junction
22.5 - 26	7	Landscaping

2.3 Construction Activities

Road improvement works include construction of bridge foundations, caisson walls, piers, bridge deck, retaining walls and box culverts, and associated earthworks, roadworks, drainage works and landscaping works.

Equipment requirements for each activity are provided in Table 2.2, along with sound power levels (SWLs) for individual and groups of equipment. Equipment SWLs employed for this assessment are based on those contained in Table 3 of *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and Table 11 of *BS 5228: Part 1: 1984*. No percussive piling is anticipated for the construction of the Project.

Table 2.2 Typical Equipment Requirements

Activity Description		Equipment	Qty.	Assumed On-time (%) [1]	SWL, dB(A)	
					Per Piece [2]	Total
A	Mobilization and Site Clearance	Truck with crane	2	100	112	112
B	Tree Transplanting	Truck with crane Backhoe	1 1	100 100	112 112	115
C	Construction of Bridge Foundations and Abutments or Construction of Caisson Walls	Drilling rig Backhoe Truck with crane Dumptruck Concrete mixer truck Vibratory poker Concrete pump	2 2 1 2 2 2 1	100 90 100 20 80 75 100	102 [3] 112 112 110 108 112 109	121
D	Construction of Piers and Bridge Deck	Truck with crane Concrete mixer truck Vibratory poker Concrete pump	1 2 2 1	100 80 75 100	112 108 112 108	118
E	Construction of Retaining Walls or Slope Works	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker Concrete pump	1 1 1 2 2 1	90 20 100 80 75 100	112 110 112 108 112 109	120
F	Earthworks	Pneumatic breaker Backhoe Dumptruck Dozer Vibrating roller	1 1 2 1 1	70 100 20 65 100	109 112 110 113 108	119

G	Roadworks	Backhoe Dumptruck Asphalt truck Paver Roller	1 1 2 1 1	100 20 100 100 100	112 110 110 (3) 109 108	118
H	Drainage works	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker	1 1 1 1 1	90 20 100 80 75	112 110 112 108 112	118
I	Construction of Box Culverts	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker Concrete pump	2 2 1 2 2 1	90 20 100 80 75 100	112 110 112 108 112 109	121
J	Landscaping	Truck with crane	1	100	112	112

Notes: (1) "On-time" estimates are generally obtained from *BS 5228: Part 1: 1984*, using estimates shown in Appendix C of that Standard.

(2) An adjustment to sound level for equipment on-time has been allowed according to Figure 4 of *BS 5228: Part 1: 1984*.

(3) SWL based on *BS 5228: Part 1: 1984*.

2.4 Predicted Traffic Flows

A comprehensive traffic survey has been conducted in order to predict the traffic demand for the design year 2011 in the Study Area, including Kennedy Road, Kennedy Road Bridge, Victoria Barracks Link, Justice Drive, Supreme Court Road and Borrett Road.

Since traffic data is available up through year 2011 from Transport Department (TD), a proposed growth factor of 1.15, agreeable to TD, has been adopted to project the traffic beyond 2011.

According to the traffic prediction, 2015 will be the year when the traffic reaches the worst projection within a period of 15 years after opening of the Project. Traffic growth after this year will saturate. Also, the daily traffic peak in the Study Area occurs in the AM period. As such, the subsequent noise impact assessment has been based on the AM peak hour traffic in 2015.

Projected 2015 AM peak hour traffic flows and vehicle composition for the roads under consideration are given in Table 2.3 below. The breakdown of traffic flow for 2015 and 1996 are shown in Figures 3 and 4 respectively.

Table 2.3 Predicted 2015 AM Peak Traffic Flows

Road Section	Status		2-way Traffic Flow (vehicle/hour)	% Heavy Vehicles	Road Speed (kph)
	New	Existing			
Kennedy Road (W)		•	2533	10	50
Kennedy Road (EHA)		•	127	10	50
Kennedy Road (E)		•	1004	10	50
Kennedy Road Bridge	•		2599	10	50
Queen's Lines Link	•		2369	10	50
Justice Drive		•	4114	10	50
Supreme Court Road		•	898	10	50
Borrett Road		•	94	10	50

3 PROJECT SITE

3.1 Existing Noise Environment

The existing noise environment in the vicinity to the Project site is dominated by road traffic noise from Kennedy Road. According to the recent (1996) traffic survey, the highest traffic volume on Kennedy Road occurs at AM peak hours.

A baseline monitoring of the AM peak hour road traffic noise was undertaken on 7 March 1996, and the monitoring results are summarized in Table 3.1. Four noise monitoring stations, designated as M1, M2, M3, and M4 in Figure 5 were set up for the noise monitoring.

As means of calibrating the noise prediction model for this Study, traffic counts were taken from a recent surveillance survey (see Table 3.2). Using the traffic counts as input, the calculated traffic levels at stations M1, M2, M3, and M4 are respectively 73 dB(A), 64 dB(A), 62 dB(A) and 73 dB(A), which agree within 2 dB(A) of the measured levels. The discrepancies may be attributed to the traffic counts which were not taken concurrently with the noise measurements.

According to the monitoring and noise modelling results, it is apparent that the existing noise sensitive developments along Kennedy Road are being suffered from high traffic noise levels. NSRs situated further away from Kennedy Road (e.g. NSRs at Bowen Drive and Borrett Road), however, are enjoying a quieter noise environment.

Table 3.1 Existing Noise Levels during AM Peak Hour

Monitoring Station	Designation	Facade Noise Level, dB(A)		
		L_{10}	L_{90}	L_{eq}
M1	Regent On the Park (G/F)	74.6	61.9	71.4
M2	Canadian International School (G/F)	64.8	56.4	62.3
M3	Staff Quarters for WSD (G/F)	60.4	57.8	60.2
M4	Building at 62 Kennedy Road (Podium)	74.3	63.4	72.8

Table 3.2 Existing AM Peak Traffic Flows

Road Section	2-way Traffic Flow (vehicle/hour)	% Heavy Vehicle	Road Speed (kph)
Kennedy Road	905	13.0	50
Justice Drive	635	8.8	50
Supreme Court Road	722	7.1	50
Borrett Road	349	13.8	50

Source:Transport Department Updated Moratorium Assignments.

3.2 Existing Noise Sensitive Receivers

The Project site is interspersed with high, medium and low-rise residential buildings and educational establishments. The identified NSRs are briefly described in Table 3.3 and depicted in Figure 6.

From site surveys conducted in January and March 1996, the following observations are made:

- While Regent on the Park is a residential tower, the building is centrally air conditioned such that the residential units do not rely on open windows for ventilation. As such, the traffic noise assessment criterion for domestic uses stipulated in Table 4.1 of the HKPSG does not apply to this development.

- According to the Environmental Protection Department (EPD), St. Francis Canossian College located to the east of the Project site has been covered by the *Noise Abatement Measures in Schools* programme. A visit to the school confirms that all classrooms directly exposed to Kennedy Road are provided with room air conditioners and properly sealed windows.

- A care-takers' quarter was identified at the BDD/EMSD Depot at the southern end of Justice Drive during the site survey. However, the depot will be surrendered to this Project as a site office during the construction phase. As such, this site will not be considered as a NSR and has been excluded from the subsequent noise impact assessment.

- The following NSRs in the study area have been demolished: Colvin House, Robert Block, Montgomery Block and Hamilton Block.

Table 3.3 Existing Noise Sensitive Receivers

NSR ID	Name/Description	No. of Storey		
		Non-sensitive	Educational	Residential
CIS	Canadian International School	-	3	-
WEEC	Watchdog Early Education Centre	-	3	-
DH	Dragon House	-	-	22
2MMT	2 Monmouth Terrace	-	-	7
MST	Man Shun Tower	-	-	20
MMP	Monmouth Place	1 *(I)*	-	25
SUT	Suncrest Tower	-	-	24
NMMT	New Residential Development at Monmouth Terrace	-	-	34
RC	Royal Court	1 *(I)*	-	31
STT1	Tower 1 at Star Street	-	-	30
STT2	Tower 2 at Star Street	-	-	28
MC	Monticello	3	-	20
MYG	Man Yuen Garden	1	-	12
EWC	Ewan Court	4	-	12
SAC	Sakura Court	2	-	12
62KR	62 Kennedy Road	2	-	12
BWP	Bowen Place	5	-	22
10BW	10A Bowen Road	-	-	3
FT	Fung Ting	2	-	20

HV	Hong Villa	5	-	28
21BR	21 Borrett Road	4	-	20
23BR	23 Borrett Road	4	-	20
14BW	14 Bowen Road	-	-	2
15BW	15 Bowen Road	-	-	2
16BW	16 Bowen Road	-	-	3
CA	Caronia	-	-	3
WSD	Water Services Department Quarters	-	-	1
CMFA	Staff Quarters for PRC Ministry of Foreign Affairs Building	-	-	21

Note:(1)As observed from Kennedy Road.

3.3 Future and Planned Sensitive Uses

Information on future/planned sensitive uses has been obtained from the latest Outline Zoning Plan (OZP) prepared by the Planning Department as well as site survey (see Figure 7).

In accordance with the draft Mid-Levels West OZP No. S/H11/7, the site at the intersection of Kennedy Road and Borrett Road has been zoned for G/IC development. A representative receptor point at 10 m away from the edge of carriageway of Kennedy Road has been chosen for impact assessment (designated as "P1" in Figure 6).

As shown on Mid-Levels West ODP Nos. D/H4/2, the former site for Colvin House has been earmarked for the British Consulate and British Council. The development is an 8-storey building providing office spaces for the British Consulate and teaching facilities for the British Council. On the other hand, the site for the Electric House will be redeveloped into an office tower. As these two developments will be centrally air-conditioned and do not depend on open windows for ventilation, the noise assessment criterion specified in the HKPSG is not applicable to these developments and are thus excluded from this noise impact assessment.

4 METHODOLOGY

4.1 Environmental Standards and Guidelines

4.1.1 Construction Noise

Non-restricted Hours

Under the existing provisions, there is no legal restriction on noise generated by construction activities (other than percussive piling) between the hours of 07:00 and 19:00 on normal weekdays. However, EPD's *Practice Note for Professional Persons ProPECC PN 2/93* recommends non-statutory daytime

construction noise limits of L_{eq}(30 min) 75 and 70 dB(A) (65 dB(A) during examinations) at the facades of dwellings and schools respectively. This recommendation has been adopted for the assessment of construction noise during non-restricted hours.

Restricted Hours

It is expected that night works will not be required and therefore the criteria stipulated in *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, as well as in *Technical Memorandum on Noise from Construction Work in Designated Areas*, issued under the Noise Control Ordinance (NCO) are not applicable to this Project.

Percussive Piling

No percussive piling is anticipated during the construction phase and therefore the criteria stipulated in *Technical Memorandum on Noise from Percussive Piling* issued under the NCO are not applicable to this Project.

4.1.2 Construction Dust

Dust emissions from construction sites come under the control of the Air Pollution Control Ordinance, which calls for compliance with a set of health-related air quality objectives (AQOs) for seven pollutants, of which TSP is relevant to this study.

The AQOs contain no hourly criteria for concentrations of TSP. However, EPD has a Dust Suppression Guideline to indicate the maximum acceptable concentration of TSP during construction works. This Guideline, which is 500 $\mu g/m^3$ (hourly average), is used in the present assessment.

4.1.3 Site Run-off

Any liquid effluent from a construction site is subject to license control under the *Technical Memorandum, "Standards for Effluents Discharges into Drainage and Sewerage Systems, Inland and Coastal Waters"*.

4.1.4 Road Traffic Noise

The impact of road traffic noise has been assessed with reference to *Hong Kong Planning Standards and Guidelines* (HKPSG) which stipulates maximum L_{10}(1 hour) road traffic noise levels of 70 dB(A) for domestic premises and 65 dB(A) for educational establishments.

In case where no practical direct technical remedies can be applied, reference has been made to the Exco directive *Equitable Redress for Persons Exposed to Increased Noise Resulting from the Use of New Roads*. The following conditions have been adopted to test the eligibility of NSRs for indirect technical remedies.

- The predicted overall noise level from the improved road, together with other traffic noise in the vicinity, must be above L_{10} (peak hour) 70 dB(A) for sensitive residential facades or L_{10} (peak hour) 65 dB(A) for schools.

- The predicted noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic noise level existing before the commencement of the construction works.

- The contribution to the increase in the noise level from the new roads must be at least 1.0 dB(A).

4.2 Noise Assessment Methodology

4.2.1 Construction Noise

The methodology outlined in *Technical Memorandum on Noise from Construction Work other than Percussive Piling* has been used for the assessment of construction noise. Adjustments for equipment on-time have been made according to Figure 4 of *BS 5228: Part 1: 1984*.

Additionally, construction noise impact assessment has been undertaken based on the following assumptions:

- All items of powered mechanical equipment (PME) required for a particular construction activity are located at the notional source position of the segment where such activity is performed.

- The total sound power level arising from construction activities is the highest.

- A +3 dB(A) facade correction has been added to the predicted noise levels in order to account for the facade effect at each NSR.

- To represent the worst case scenario, noise impacts at the nearest sensitive facades of the residential buildings to the notional source positions (i.e. the lowest residential floors which will be the most impacted receptors) have been examined.

- Given the openness of the immediate locality of the construction site and NSRs under consideration, correction for acoustic reflection does not apply to this assessment.

4.2.2 Operational Noise

Operational noise levels have been predicted using ENPAC's in-house noise model which is developed based on the UK's Department of Transport procedures described in the "Calculation of Road Traffic Noise" published by the Welsh Office, HMSO 1988 (CRTN). Also, projected worst case morning peak hour traffic flows for the design year 2015 have been employed for operational noise assessment.

5 IMPACT ASSESSMENT

5.1 Construction Phase

5.1.1 Construction Noise

Construction of the Project will inevitably produce construction noise from the use of powered mechanical equipment on site and the haulage traffic on- and off-site. As shown in Table 2.1, the improvement works comprise a total of 7 major tasks. Each task involves a number of construction activities as depicted in Table 5.1 below. This assessment has been based on the noisiest construction activity (i.e. the representative activity) for that particular task under consideration.

As illustrated in the preliminary construction programme (Figure 2), construction activities may, during a particular period, be undertaken on an individual basis or concurrently. A set of construction noise assessment scenarios has been determined in accordance with the preliminary construction sequence and activities and is summarised in Table 5.2. The assessment scenarios describe broadly individual task and groups of overlapping tasks. The total SWLs for the identified scenarios vary from 112.0 to 127.5 dB(A). It is clear that assessment scenario E is the noisiest operation (i.e. the worst case scenario), and therefore this scenario has been adopted for impact assessment.

Construction noise calculation results for scenario E are shown in Table 5.3. The predicted construction noise levels at the most affected dwellings (DH-A, 2MMT & MMP) exceed the noise limit by more than 5 dB(A). With regard to the educational establishments, CIS and WEEC, the predicted noise levels are 77.4 and 77.1 dB(A) respectively. As a result, construction noise impacts are considered to be significant and appropriate mitigation measures are required to alleviate the impacts.

5.1.2 Construction Dust

On the other hand, the improvement works will also generate construction dust from various earth moving activities, stockpiling and haulage of construction materials. The rate of dust generation depends to some extent on the level of mechanization, rate of precipitation and the prevailing weather conditions. In general, the worst impacts occur when high level of mechanization of soil takes place under dry and windy conditions.

Large dust particles tend to fall out within 10 to 30 metres of the construction sites, but finer particles can be easily dispersed to over 100 metres from the site, causing more dust nuisances and environmental health problems to the Air Sensitive Receivers (ASR's). Given that most of the ASR's are located on higher ground than the roads, the impacts are unlikely to be adverse because of dust fallout.

There are a few isolated ASR's which are below the levels of the road works. For example, the lower floors of Dragon House, STT1 and STT2 are below the level of Kennedy Road, but these receivers are over 70m away from the road works and the dust particles should have fallen out before reaching these receivers. Regent on the Park is close to the road works, but this receiver does not rely on open windows for ventilation.

5.1.3 Site Run-off

The discharge of untreated sewage or surface run-off from the site could contaminate surface water, if uncontrolled. Accidental spillage of fuel oil and chemicals, e.g. solvent, can contaminate run-off. Likely impacts include discoloration, turbidity plumes, and depletion of dissolved oxygen and other aesthetic effects on the receiving water bodies.

Table 5.1 Representative Construction Activities for Individual Task

Task [1]	Construction Activity [2]										Representative Construction Activity	Highest Noise Level[3] dB(A)
	A	B	C	D	E	F	G	H	I	J		
1	●	●									B	115
2			●	●							C	121
3					●	●	●	●			E	120
4					●	●	●	●	●		I	121
5					●	●	●	●			E	120
6						●	●	●			F	119
7										●	J	112

Notes: (1) See Table 2.1 for task numbers.
(2) See Table 2.2 for activity numbers.
● Representative activities (i.e. the noisiest activities) for a particular task.
(3) Noise levels are in Leq(30-min).

Table 5.2 Construction Noise Assessment Scenarios

Scenario	Task [1]	Total SWL dB(A)
A	1	115.0
B	1, 3	121.2
C	1, 2, 3, 5	125.5
D	1, 2, 3, 4, 5	126.8
E	1, 2, 3, 4, 5, 6	127.5
F	1, 2, 3, 4, 5	126.8
G	1, 3, 4, 5	125.5
H	1, 5	121.2
I	1, 5, 7	121.7
J	5, 7	120.6
K	7	112.0

Notes: (1) See Table 2.1 for task numbers.

Table 5.3 Construction Noise Levels for the Worst Case Scenario (Unmitigated)

NSR	Mobilization & Site Clearance		Kennedy Road Bridge		Kennedy Road West		Queen's Lines Link (Lower Section)		Queen's Lines Link (Upper Section)		Supreme Court Road/ Justice Drive Junction		Total Noise Level dB (A)
	Intervening Distance (m)	Noise Level dB(A) (5)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	
CIS	84	71	207	70	138	72	224	69	258	67	280	65	77.4 (1)
WEEC	130	68	194	70	172	70	172	71	1884	70	302	64	77.1 (1)
DH-A (2)	83	74	109	75	227	68	140	73	90	78	140	71	81.3
2MMT	41	78	152	72	280	66	235	69	120	73	241	68	80.8
MST	45	77	167	71	295	66	250	68	135	72	256	66	79.7
MMP	40	78	177	71	300	66	260	68	145	72	272	65	80.2
SUT	69	73	165	72	295	66	241	68	130	73	241	66	78.5
RC-A	55	75	218	69	340	64	296	67	185	70	313	64	77.8
21MP	110	69	155	72	283	66	200	70	136	72	200	66	77.8
21SS	125	68	191	70	314	65	236	68	162	71	236	66	78.3
MC-C	85	71	251	66	361	64	302	66	236	67	353	63	75.1
MYG	-	- (3)	-	- (3)	-	- (3)	-	- (3)	-	- (3)	-	- (3)	- (3)
EWC	-	- (3)	-	- (3)	-	- (3)	-	- (3)	-	- (3)		- (3)	- (3)
SAC	-	- (3)	371	65	-	- (3)	457	63	358	64	468	61	70
62KR	-	- (3)	430	63	-	- (3)	511	62	410	63	522	60	68

Table 5.3 (Con't)

NSR	Mobilization & Site Clearance		Kennedy Road Bridge		Kennedy Road West		Queen's Lines Link (Lower Section)		Queen's Lines Link (Upper Section)		Supreme Court Road/ Justice Drive Junction		Total Noise Level dB(A)
	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	
BWP	105	70	206	70	197	69	159	72	174	70	314	64	77.5
10BW	89	73	164	72	165	72	122	74	154	71	274	65	79.7
FT	117	69	227	69	222	68	191	70	214	68	336	63	76.1
HV	190	64	303	66	298	66	249	68	264	67	408	62	73.7
21BR	170	65	319	66	281	66	235	69	-	- (3)	390	62	73.1
23BR	205	64	367	65	323	65	267	67	279	66	438	61	72.8
14BW	143	67	239	68	307	65	233	69	185	70	343	63	75.4
15BW	182	65	256	68	349	64	278	67	223	68	360	63	74.0
16BW	241	62	315	67	409	63	332	66	278	66	419	62	72.8
CA	205	64	384	64	472	62	392	64	347	64	425	61	71.1
NMMT	57	75	180	71	315	65	266	67	185	70	253	66	78.2
STT1	90	71	140	73	290	66	210	70	145	72	185	69	78.5
STT2	94	70	157	72	300	66	233	69	175	70	205	68	77.3
CMFA	55	75	242	68	76	77	258	68	345	64	265	65	80.0
WSD	-	- (4)	-	- (4)	-	- (4)	-	- (4)	-	- (4)	-	- (4)	- (4)

Notes: (1) Noise assessment criteria are 70 and 65 dB(A) at the facades of schools during normal school hours and examination period respectively.
(2) Stands for Facade A of NSR DH (similar for others).
(3) Noise level is negligible as NSR is completely screened by building(s).
(4) Noise level is negligible as NSR is completely screened by hill slope.
(5) Noise Levels are in Leq(30-min).

5.2 Operation Phase

Road traffic noise levels at the sensitive facades of the chosen NSRs have been modelled using the CRTN procedures. Traffic flows used in the computer simulation are shown in Tables 2.3 and 3.2.

5.2.1 Existing NSRs

A detailed traffic noise analysis for the existing NSRs is provided in Appendix A. A summary of the predicted noise levels is shown in Table 5.4, and sample calculations of operation noise are shown in Appendix E.

According to Table 5.4, the predicted L_{10} noise levels range from 53 to 73 dB(A), representing noise exceedances of between 1 to 3 dB(A) from the noise criteria, at RC-B, RC-C, MC-A, SAC and 62KR. The impacts are mainly due to high peak hour traffic flows (i.e. 2599 veh/hr) on the existing Kennedy Road in 2015.

Given that the predicted noise levels at the identified NSRs are in excess of the HKPSG criteria, appropriate noise mitigation measures should be provided to remedy the adverse noise environment.

5.2.2 Planned NSRs

With regard to the representative planned NSR in the design year 2015, the predicted traffic noise level at P1 (at 74m P.D.) is 74 dB(A). As the predicted noise level is in excess of the HKPSG criterion, direct technical remedies should be provided on the roads, where practical. In the event that these measures are deemed ineffective or impractical, appropriate noise mitigation measures should be provided in this future receiver to remedy the adverse noise environment.

Table 5.4 Summary of Current and 2015 Traffic Noise Levels (Without Mitigation Measures)

NSR ID	L_{10}(1 hour) Noise Level, dB(A)				
	Overall Noise Level at Year		Contribution from Individual Road(s) in 2015		
	1996	2015	New Roads		Existing Roads
			Kennedy Road Bridge	Queen's Lines Link	
CIS	64	65	58	61	61
WEEC	64	65	57	62	62
DH-A (1)	58 - 67	64 - 70	61 - 65	60 - 67	53 - 65
DH-B	60 - 67	68 - 70	58 - 64	63 - 68	65 - 68
2MMT	69	69 - 70	52 - 58	53 - 58	69
MST	67 - 68	68 - 69	43 - 61	46 - 61	68
MMP	67 - 69	69 - 70	53 - 61	52 - 63	68 - 69
SUT	65 - 67	68 - 69	55 - 63	63 - 68	66 - 68
NMMT	- (2)	56 - 68	29 - 59	35 - 63	56 - 65
RC-A	65 - 70	66 - 70	34 - 51	42 - 62	65 - 70
RC-B	66 - 71	68 - 71	54 - 58	56 - 64	66 - 71
RC-C	66 - 72	66 - 72	- (2)	39 - 60	65 - 72
SST1	- (2)	59 - 68	57 - 65	53 - 62	51 - 63
SST2	- (2)	67 - 68	- (2)	54 - 58	67 - 68
MC-A	67 - 71	68 - 71	37 - 49	40.1 - 52.8	68 - 71
MC-B	66 - 69	67 - 69	42 - 57	44.6 - 57.7	66 - 69
MC-C	63 - 64	63 - 66	39 - 57	43.9 - 56.3	63 - 65
MYG	65 - 67	65 - 66	- (2)	- (2)	65 - 66

Table 5.4 (Con't)

NSR ID	L_{10}(1 hour) Noise Level, dB(A)				
	Overall Noise Level at Year		Contribution from Individual Road(s) in 2015		
	1996	2015	New Roads		Existing Roads
			Kennedy Road Bridge	Queen's Lines Link	
EWC	67 - 69	67 - 69	- (2)	- (2)	67 - 69
SAC	69 - 71	69 - 71	- (2)	- (2)	69 - 71
62KR	70 - 73	70 - 73	- (2)	- (2)	70 - 73
BWP	64	67 - 68	59.3 - 59.9	63.4 - 64.5	62 - 63
10BW	66	69	61.8	66.6	64
FT	59 - 60	64 - 65	57.9 - 58.3	59.4 - 60.6	60 - 61
HV	58	63 - 64	56.8 - 57.2	57.5 - 59.8	59 - 60
21BR	58 - 61	63 - 65	56.9 - 57.3	59.0 - 58.9	58 - 60
23BR	52 - 58	60 - 63	56.1 - 56.4	55.3 - 58.9	55 - 59
14BW	59	65	57.4	61.6	59
15BW	62	63	49.5	47.3	62
16BW	54	57	39.7	38.5	57
CA	50	53	40.7	39.2	53
WSD	62	66	59.7	60.3	63
CMFA	-(1)	69 - 70	58.6 - 57.9	60.1 - 61.5	67 - 69
P1	-	74	59.1	59.8	74

Notes: (1) Stands for Facade A of NSR DH (similar for others).
(2) No prevailing noise level for new development
(3) Noise level is negligible as the NSR is completely screened by topographical barrier.
Boldfaced values indicate noise levels exceeding the noise criteria.

5.3 Impact on Existing Trees

5.3.1 General

The project site consists of steep woodlands sloping from both sides of the existing Kennedy Road, extending from its junction with Bowen Drive and the Region-On-The-Park residential development, down to the valley in front of Electric House, up to the formerly Victoria Barracks, and going as far down to the access road to Dragon House/Paget House of the Barracks.

The Queen's Lines Link is situated within the narrow valley, with a level difference between Kennedy Road and the top of Justice Drive of about 30m. Due to the site limitations and topographical constraints, the designed at-grade link road of steep gradient (about 10%) descending 30m over a 400m length which marginally meets safety requirements as set out in the Transport Planning Design Manual. Consideration has once been given to design the Queen's Lines Link by connecting it from the Justice Drive/Queen's Lines Link junction to Kennedy Road by an elevated structure, supported on piers, to minimise disturbances to existing vegetation. In doing so, the elevated structure has to ramp up over the new Kennedy Road Bridge and ramp down to its connection end or to go underneath the Bridge. Both of these options are discounted because the elevated structure will be having ascending and descending gradients greater than the at-grade option. This is absolutely undesirable from the traffic engineering point of view and totally unacceptable to road safety standards.

The vertical and horizontal alignment of all elements of each of the separate elements of the scheme, together with the proposed structural forms, have been examined in detail by the consulting team, to minimise the effect on the existing trees, within the very tight physical constraints of the existing site.

5.3.2 Tree Felling and Compensation Tree Planting

Recommendations of the felling, transplanting and retention of existing trees on site are presented in details in the Tree Survey Report and has been submitted to DLO for approval. Discussions on these proposals have been held with USD on 31 January 1997. The recommendations presented in this section will therefore be subject to the consideration of AFD and USD.

A total of some 427 nos. tree surveyed could be retained in position on site. In addition it may be possible to retain a further 87 nos. existing trees with tree surgery to their root systems or crown as described below. In the event that any of these "pruned" trees did not survive, then they would be replaced by a tree of the same species at "standard" size.

Crown Pruning	21 nos. trees, where some branches that conflict with future structures, or construction activities will need to be removed,
Root Pruning	20 nos. trees, where some roots that conflict with future structures, will need to be removed,
Root Over Filling	46 nos. trees, where the roots of the existing tree will be overfilled with rock and soil material to make up the necessary ground levels.

Any crown or root pruning works would need to be undertaken by specialist tree surgeons, with the extent of works required minimised through on-site consultation with the Contractor.

A total of 407 nos. trees will be affected by the proposed works, lying either within the area of the new carriageway, directly under the elevated bridge structure, or would have the majority of their root systems disturbed by the excavation works to build the highway and retaining structures.

As most of the trees affected are situated on steep slopes it would not be possible for them to be successfully transplanted. It is considered that only some 26 nos. small size trees which currently lie alongside Kennedy Road and Justice Drive are suitable for transplanting. In addition there are three very large banyan trees at the top of Justice Drive, which, although they are not well suited to transplanting due to their size and prominent location in the streetscape, are considered worthy of the attempt to preserve them by attempting to transplant them to adjacent area. Locations for transplanting these trees are shown in Drawing no. PP-01, Planting Plan of the Tree Survey Report (see Figure G7 of Appendix G).

Due to the relatively large size of these trees, and the limited working area available, and it is suggested that these be relocated to an alternative locations within the Study Area, rather than being held on site or within a nursery for replanting within the final landscape scheme for the project.

The remaining 378 nos. trees will need to be felled. In addition 10 nos. dead trees unaffected by the works will also be removed.

A significant number of the very large trees observed on site (over 1.0m girth), lie on the very steep slopes below Kennedy Road, they will be affected by the new Link Road. It is recognised that these trees are of significant local value so the geometry of this and the elevated bridge structure has been refined as far a possible within safety standards in order to minimise the impact on these trees, and wherever possible they have been retained accepting some root or crown pruning.

A compensation Tree Planting Proposal is enclosed in Appendix G.

5.4 Impact on Woodland Ecology

5.4.1 General

The loss of native trees due to the project and the associated potential for effects on wildlife have been identified by the Agriculture and Fisheries Department (AFD) as areas of concern. AFD expressed concern that a tree survey alone would not address the ecological implications of native tree felling in the wooded area below Kennedy Road (AFD letter to DEP of 11 January 1997).

5.4.2 Ecological Study

5.4.2.1 General

The ecological study was conducted to provide data on the faunal ecology of the site and the site's ecological importance generally, and to address AFD's concerns regarding the following :

- impacts of the project upon wildlife; and
- the adequacy of proposed mitigation measures.

5.4.2.2 Methods

Daylight field surveys were performed on 5 February 1997 and 27 March 1997. Evening fauna surveys were performed on 13 February 1997 and 1 April 1997. A literature review was also conducted to locate existing information regarding wildlife use of the site.

Flora

A field survey was performed on 5 February 1997 to record major plant species and to estimate their relative abundance within the study area (ranked as 'common', 'locally common', or 'uncommon'). The survey focused on providing a description of woodland structure and the occurrence of rare or protected species within the study area. For additional information on tree species and distribution on the site, please refer to the Tree Survey Report (see Appendix H, Halcrow 1977).

An evening survey was carried out on 1 April 1997 to determine the species of trees used by foraging fruit bats (*Cynopterus sphinx sphinx*).

Avifauna

A bird survey was conducted from 0900 to 1100 hrs on 5 February 1997, from 0800 to 1000 hrs on 27 March 1997, and from 1745 to 1930 hrs on 1 April 1997. Birds seen or heard in the woodland area were recorded and identified to species, and the number of individuals of each species was recorded. The habitat was assessed for its potential to support avifauna of conservation significance based on the complexity of its physical structure, its Territorial distribution, and knowledge of wildlife 'expected to be dependent on it. A literature search for existing information on birds at the site was also made.

Shannon's index of diversity H' and Pielou's index of evenness J' were calculated using the following formulae:

$$H' = -\sum_{i=1}^{s} p_i \ln (p_i)$$ (see Appendix H, Shannon and Weaver 1963)

and $J' = H' / \ln (s)$ (see Appendix H, Pielou 1966)

where s is the total number of species observed in a day and p_i is the percent of the total counted of the i_{th} species.

Dominance (d) was calculated using the Berger-Parker index d (see Appendix H, Berger and Parker 1970, in Magurran 1988) which expresses the proportional importance of the single most abundant species:

$$d = n_{max} / N$$

where n_{max} = the number of individuals in the single most abundant species, and N is the sample total count.

Mammals

During the field survey on 5 February 1997, searches were conducted for small mammal burrows, bat roost sites and other signs of mammal presence and activity such as droppings. The potential of the habitat to support these fauna was also assessed.

An evening-night survey for flying/foraging bats was conducted on 13 February 1997 from 1825-1930 hrs and from 1745 to 1930 hrs on 1 April 1997. The proposed project area was covered on foot while scanning the tree canopies and the sky for flying bats. Two observers participated.

Existing literature was also reviewed for records of mammals on the site.

Reptiles and Amphibians; Other Fauna

Searches were made for herpetofauna (reptiles and amphibians) during the course of the survey for mammal burrows. No observations were made.

Existing literature was reviewed for records of herpetofauna and other fauna on the site. The potential of the habitat to support these fauna was assessed.

5.4.2.3 Results

Flora

A total of 61 species, including 35 tree, 9 shrub and 8 herb species, was recorded during the field survey (see Appendix I for plant species list). Among these, 13 are exotic species. No species which are protected under local regulations or known to be rare were found on site.

Woodland patches in the study area mainly consisted of a mixture of planted and naturally established secondary woodland tree species developed on steep slopes along the existing Kennedy Road. Although these woodland patches were separated from one another by roads, buildings and nullahs, the overstorey trees formed a mature and developed canopy with a height of 10 to 13 m, representing part of the extensive mature woodlands on the north side of Hong Kong Island. Results of the tree survey showed that many trees on site were unusually large and fine specimens. Understorey species on site mainly consisted of common secondary woodland tree species with a wide range of height (from 3 to 10 m). Saplings, shrub and herb species were not common in the understorey, probably due to disturbance such as garbage dumping, previous management such as mowing and steepness of the site.

This woodland is not of particular conservation significance in terms of vegetative species composition or diversity, or woodland structure. However, the age and size of the trees together with the well developed canopy contribute to its conservation value by providing favourable habitat to wildlife, especially bats and avifauna as described in the following sections.

Avifauna

A total of 17 species was recorded during the field survey (Table 5.5). Four of the recorded species were migrants, and the remaining 13 species were residents. One species, the Yellow-crested Cockatoo, is an introduced species in Hong Kong. No recorded residents can be considered rare in Hong Kong or South China, and the recorded migrant species are also common winter visitors.

Bird abundance ranged from a low of 39 individuals during the evening of 1 April 1997 to a high of 115 individuals during the morning of 27 March 1997. Bird diversity was contrained by the small size of the study area and the relatively urbanised nature of the available habitats.

Species recorded are typically associated with large trees or stream habitat in Hong Kong. For example, Yellow-crested Cockatoos prefer to roost and nest on tall and old trees. Blue Magpies and Grey-backed Thrushes usually occur in areas with many large trees. Great Tits, although sometimes common, are lower in abundance where large trees are absent. Yellow Wagtails typically prefer stream habitats.

No existing literature or records of birds from this site were found.

Table 5.5

Avifauna Species, Species Diversity, Evenness, and Dominance Recorded at the Kennedy Road Woodland in February, March, and April 1997. Taxonomy follows Viney *et al.* (1994).

Common Name	Latin Name	Status	Count		
			5 Feb	27 Mar	1 Apr
Black-eared Kite	*Milvus lineatus*	R	2	3	4
Spotted Dove	*Streptopelia chinensis*	R	2		2
Yellow-crested Cockatoo	*Cacatua sulphurea*	I/R	11	7	9
Koel	*Eudynamis scolopacea*	R		1	1
Yellow Wagtail	*Motacilla flava*	WV	2		
Crested Bulbul	*Pycnonotus jocosus*	R	5	31	3
Chinese Bulbul	*Pycnonotus sinensis*	R	1	21	6
Magpie Robin	*Copsychus saularis*	R	1	8	1
Grey-backed Thrush	*Turdus hortulorum*	WV	1		
Common Tailorbird	*Orthotomus sutorius*	R	1	5	1
Pallas's Warbler	*Phylloscopus proregulus*	WV	1		
Yellow-browed Warbler	*Phylloscopus inornatus*	WV	1	6	1
Black-faced Laughing-thrush	*Garrulax perspicillatus*	R	7	8	5
Great Tit	*Parus major*	R	2	1	
Fork-tailed Sunbird	*Aethopyga christinae*	R	1	2	
Japanese White-eye	*Zosterops japonica*	R	10	16	3
Blue Magpie	*Urocissa erythrorhyncha*	R	2	2	3
Crested Myna	*Acridotheres cristatellus*	R		3	
Tree sparrow	*Passer montanus*	R	5	1	
Number of species			17	15	12
Number of individuals			55	115	39
H'			2.44	2.22	2.24
J'			0.86	0.82	0.90
d			0.20	0.27	0.23

Status: R : resident
R/I : resident/introduced
WV : winter visitor

The numbers of species recorded, Shannon's indices of diversity *H'* and Pielou's indices of evenness *J'* for all three survey dates were similar (Table 5.5). The difference in number of individuals recorded may be an effect of weather. It was cloudy and windy on 5 February 1997, and heavily overcast on 1 April 1997, when the lower counts were recorded. In contrast, weather conditions were sunny, warm, and clear on 27 March 1997.

The absence of the Spotted Dove, Yellow Wagtail and Grey-backed Thrush on 27 March 1997 may have been due to disturbance from the recent construction works within the study area. These species spend considerable time feeding on the ground and so are more susceptible to any increase in human disturbance. The construction works involved paving of a slope adjacent to a nullah. The nullah included part of the territory of the Yellow Wagtail which was observed on 5 February 1997, but not on the later two surveys.

Spotted Doves were observed feeding under large trees. Crested and Chinese Bulbuls, Blue Magpies and Crested Mynas were observed feeding on the figs of *Ficus microcarpa*. Territorial behaviours including calling and chasing of intruders were observed for Magpie Robins on 27 March 1997. This is evidence of territory establishment or defence, and indicates probable breeding on the site. Many species (e.g., Yellow-crested Cockatoo, Koel, Blue Magpie) were observed roosting and/or feeding in the larger trees.

Mammals

Tree squirrels (*Callosciurus* sp.) were observed on 27 March 1997. The squirrels were observed eating buds in the larger trees. Squirrels are presumed to be introduced to Hong Kong from southeast Asia through release of captives (see Appendix H, Hill and Phillipps 1981). Although an introduced species in Hong Kong, they may fill a niche anciently occupied by native squirrels (see Appenidx H, Dudgeon & Corlett 1994).

The introduced squirrel species that would be expected to frequent the study area is *Callosciurus erythraeus thai*. It has been recorded from nearby areas including Hong Kong Park and St. Francis Canossian College (see Appendix H, Ho 1992).

A rat (*Rattus sp.*) was the only other terrestrial mammal recorded on the site. It was seen near the buildings on the site.

No burrows or other signs of terrestrial mammal activities were observed. Low abundance and diversity of mammals may be due to a number of factors including the urbanised nature of the immediately surrounding environment and the barriers to mammal movements which surround the site (busy roadways, construction projects, urban areas). Hong Kong Island does, however, support a diverse mammalian fauna due to the quality of its secondary woodland habitats and the existence of protected areas (Country Parks) at higher elevations.

Fruit bats were recorded on the site on 13 February 1997 and 1 April 1997. The only fruit bat reported by Ades (1990) (see Appendix H, Ades 1990) to occur on Hong Kong Island is the Greater Short-nosed Fruit Bat (*Cynopterus sphinx sphinx*). Hong Kong's other fruit bat, Leschenault's Rousette Bat (*Rousettus leschenaulti*) has been recorded only in the New Territories (*ibid.*).

Four fruit bats were recorded on 13 February 1997 over a 1-hour survey period which began just before dark (1825-1930 hrs.). Up to 10 fruit bats were observed between 1844 hrs and 1915 hrs on 1 April. All were observed feeding in the canopies of the tallest fruit-bearing trees on the site (*Ficus variegata*). *C. sphinx* roosts in large trees (*ibid.*) and in Chinese Fan-palms *Livistona chinensis* (see Appendix H, Marshall and Hechtel 1966, Ades 1990), both of which were present on the site.

Insectivorous bats were observed on the site on 1 April 1997. Up to 9 bats were observed foraging on flying insects, primarily above *Ficus microcarpa* trees along Kennedy Road. The three species of insectivorous bats which have been recorded on the Kennedy Road site are the Large Bent-winged Bat (*Miniopterus magnater macrodens*), the Lesser Bent-winged Bat (*Miniopterus australis*), and the Great Round-leaf Bat (*Hipposideros armiger armiger*) (see Appendix H, G. Ades, pers. comm.). Each of theses species feeds and roosts in woodlands on the north slopes of Hong Kong Island. Preferred roost sites are in large trees, under roadways and bridges, in culverts, and in Chinese Fan-palms. (see Appendix H, G. Ades, pers comm.).

Reptiles and amphibians; Other fauna

Though searches were conducted, no observations of herpetofauna or other fauna were made during the course of the survey. No literature relating to herpetofauna or other fauna was found for this site.

5.4.3 Potential Impacts of the Project to Wildlife, and Mitigation Measures

5.4.3.1 Flora

Construction of the new road alignment will cause considerable loss of large trees and associated woodland habitat. 378 trees with diameter at breast height (dbh) over 95 mm, or 40% of the trees recorded on the site, will be felled for the project (see Appendix G, Figures G1 to G6 and Appendix H, Halcrow 1997). Trees to be felled are dominated by the native species *Machilus* spp. (53 nos.), *Litsea* spp. (44 nos.), *Cratoxylum cochinchinense* (39 nos.), *Ficus* spp. (27 nos.), and *Artocarpus hypargyrea* (24 nos.).

The woodland patches are not rare on Hong Kong Island in terms of composition, structure or diversity. They are not so much important in themselves as they are important as sources of food and shelter for birds and mammals. The age of the areas, together with their well developed canopy, enhance this value. Impacts to specific fauna groups are discussed in Sections 5.4.3.2 to 5.4.3.4.

Short-term Impacts

Short-term impacts to woodland habitat will be due to loss of habitat. This impact will continue for between 5-20 years, until new tree plantings mature. This impact will be partially mitigated through the planting of approximately 211 standard or heavy standard size roadside trees (see Appendix G and Appendix H, Halcrow 1997). These trees will be planted along the roadside, primarily for landscaping and visual purposes, but will also be useful in hastening the formation of a closed canopy along the road alignments. In addition, 29 existing trees will be transplanted.

All planting should take place as early as possible during the construction phase of the project, within the constraints of construction requirements. Survival and growth of the planted trees must be monitored during the first few years of establishment in order to ensure successful woodland establishment in the long term.

Long-term Impacts

Long-term impacts to woodland habitat are the loss of woodland area on the project site due to road and bridge development. This will be almost

fully mitigated through new plantings of trees and shrubs which, when they mature, will replace much of the lost area. For comparison purposes, 378 trees are scheduled to be felled for the project; new planting proposals include 1,590 no. of whips and seedlings as "woodland mix" on hydroseeded slopes; 1,200 seedlings as "infil planting" in existing woodland area; and approximately 211 standard or heavy standard size roadside trees for landscaping purposes (see Appendix G and Appendix H, Halcrow 1997).

The proposed "woodland mix" species list (see Appendix H, Halcrow 1997) includes a variety of mostly native species, similar to the mix of trees found on site, to be planted as whips and seedlings. To the species listed should be added *Ficus variegata* and *Livistona chinensis*, due to their utility to wildlife recorded on the site (see Sections 5.4.3.2 and 5.4.3.3 below). These species may also be planted as individual trees, pit planted into slopes. Consideration should also be given to increasing the proportion of *Ficus microcarpa* in the planting mix and the numbers of this species to be planted as standard trees, in view of its importance to birds and bats on the site.

Apart from the addition of these species, the Compensation Tree Planting Plan for the project (see Appendix G, Figure G7 and Appendix H, Halcrow 1997) is considered adequate to offset most of the long-term negative impacts of woodland habitat loss. This plan will create a similar landscape pattern and woodland structure to that which now exists, and will in the long term provide habitats for avifauna, bats and possibly other wildlife.

Residual Impacts

Residual impacts to woodland consist of a small area of woodland loss due to construction of new road area. Further mitigation of this impact would require creation of woodland in some area not currently wooded, i.e. an off-site area. Based on the limited nature of this residual impact and the adequacy of the mitigation measures outlined above, such off-site mitigation is not considered necessary.

5.4.3.2 Avifauna

All species of wild birds, their nests and eggs are protected under the Wild Animals Protection Ordinance Cap. 170. Impacts upon them are thus of regulatory significance.

Short-term Impacts

Short-term impacts of the project upon birds will arise from construction disturbance and from habitat loss. Felling of native trees which bear fleshy fruits, e.g. *Ficus microcarpa*, may reduce the food source for several bird species. Loss of trees in groups and/or trees which are large, tall and old will also affect bird activity patterns by removing portions of their feeding, roosting and possibly breeding habitats.

Construction disturbance can be mitigated somewhat by ensuring construction workers and equipment do not enter areas or disturb vegetation on the site except as required for project construction. The birds recorded on site are for the most part not shy and adaptable to human disturbance, reducing the requirement for mitigation of this impact.

Habitat loss due to tree felling and vegetation clearance will be mitigated in the short term to some extent by the planting of standard trees and transplanting of existing trees, as prescribed under the Compensation Tree Planting Plan.

Residual short-term impacts of the project upon birds are not predicted to be severe, as the species observed on site are not uncommon on Hong Kong Island, nor are they believed to be of particular conservation concern due to rarity or sensitivity to human disturbance.

Long-term Impacts

Long-term impacts of the project upon birds will result from traffic disturbance and from habitat loss. The impact of traffic disturbance cannot readily be mitigated. However, as noted above, the birds recorded on site are mostly adaptable to human activity, and are not expected to be significantly affected by such disturbance.

The long-term impact of habitat loss will be almost completely mitigated through the revegetation proposals contained in the Compensation Tree Planting Plan. The only residual impact may be a small area of woodland habitat loss, which is considered to be a minor impact of the project.

5.4.3.5 Bats

Field surveys showed the study area to be of use to fruit bats (*Cynopterus sphinx*) and insectivorous microchiropteran bats, which were recorded foraging over the study area. Fruit bats fed on Common Red-stem Fig *Ficus variegata* on the site. Insectivorous bats were observed foraging on flying insects, primarily above Chinese Banyan *Ficus microcarpa* trees along Kennedy Road. The site was thus shown to be of foraging importance to both fruit bats and insectivorous bats. It is also considered likely to be of roosting importance to these species.

Potential impacts upon frugivorous bats and insectivorous bats, and potential mitigation measures, are discussed separately below. All species of bats are protected under the Wild Animals Protection Ordinance Cap. 170, and impacts upon them are thus of regulatory significance.

Fruit Bats

(a) Impacts to foraging habitats are as follows :

Short-term to medium-term impacts to foraging habitats of the fruit bat *Cynopterus sphinx sphinx* will result from the felling of mature native trees producing fleshy fruits (e.g. *Ficus* spp.). The project will require the felling of 27 nos. of *Ficus* spp., some of which are mature individuals over 2 m in girth. Loss of such trees will reduce the local food source and would require fruit bats currently feeding on site to shift their feeding activities elsewhere. If surrounding woodlands are already at carrying capacity for this species, a local decline in population could result.

The short-term impact of tree felling will be mitigated to some extent by the planting of standard size *Ficus microcarpa* trees along the roadside for landscaping purposes.

Long-term impacts of tree loss will be mitigated by the replanting of a "woodland mix" of 1,590 whips and seedlings. Five percent of this mix (80 nos.) will be *Ficus microcarpa*. If a reasonable survival rate is ensured, this should provide a net increase in *F. microcarpa* on the site in the long term. However, at least 10 years will probably be required for these trees to mature to a point where they are useful to bats feeding on the site.

To better mitigate long-term impacts of foraging habitat loss, it is proposed that a higher proportion of fruit-bearing trees be used in the woodland mix. Trees selected should be those used by fruit bats foraging on the site. Based on surveys carried out during this project, the two priority tree species should be *Ficus variegata* (currently not included in woodland mix) and *F. microcarpa* (currently 5% of woodland mix).

(b) Impacts to roosting habitats are as follows :

In Hong Kong, *C. sphinx sphinx* is commonly recorded as roosting in trees, particularly Chinese Fan-palms *Livistona chinensis* (see Appendix H, Ades 1990, Marshall and Hechtel 1966). Fruit bats are known to use tree roosts in urban environments. Six Chinese Fan-palms *Livistona chinensis* were recorded on the site, 2 of which would be lost due to road construction. In addition, numerous mature trees would be lost as catalogued in the Tree Survey Report (see Appendix H, Halcrow 1997).

Short-term impacts upon fruit bats, in the form of reduced availability of roost sites, may result from the felling of mature trees on the site. It has not been confirmed whether fruit bats occupy day roosts on the site. However, as they feed at the site by night, they almost certainly use trees on the site as nighttime roosts for resting and feeding.

Bats currently roosting on the site may be able to shift to other woodlands in the vicinity. If they are unable to do so due to a paucity of suitable roosting sites, a decline in the local population may result.

In the short to medium term, the impact of loss of roost sites will be mitigated in part by the planting of standard trees for landscaping purposes and by the transplanting of a small number of trees. The remainder of the plantings will consist of seedlings and whips, which will probably not be useful as bat roost sites until they are well established in 5-10 years time.

The residual short-term impact of loss of roosting habitat can be mitigated by the addition of *L. chinensis* to the Compensation Tree Planting Plan for the project. This species is favoured by bats for roosting. Inclusion of 10-15 mature *L. chinensis* in the planting plan is recommended. Fan-palms should be planted beneath the bridge and at the periphery of the works area near the undisturbed woodland.

Long-term impacts of loss of roost sites are predicted to be fully mitigated by the planting of new trees. When the 1,590 whips and seedlings planted around the site mature, they will

provide adequate roosting sites for fruit bats.

C. sphinx sphinx is not uncommon on Hong Kong Island, nor is it known to be of particular conservation concern due to rarity or sensitivity to human disturbance. The measures outlined above are considered adequate to mitigate impacts of feeding and roosting site loss to this species.

Insectivorous bats

Basic information on the habitat requirements, territory size requirements, and population sizes of the three species of insectivorous bats recorded from the site is lacking. Therefore, it is difficult to predict project impacts upon these species with confidence. Where information on species needs is scarce, the discussion below errs on the side of the precautionary principle.

(a) Impacts to foraging habitats:

Short-term impacts of the project might result if vegetation clearance during the construction phase leads to a decrease in the numbers of flying insects using the site. The bats currently using the site may be able to shift their feeding activities to other woodlands in the vicinity. If they are unable to do so, a decline in local population may result. However, any decrease in numbers of insects is predicted to be small. This impact is therefore predicted to be minor, and no mitigation measures are proposed.

No long-term impacts from the project are predicted in terms of prey availability for insectivorous bats. In the long term, compensation tree plantings for the project will result in the restoration of a closed-canopy woodland habitat similar to that which now exists on the site. Under these conditions, insect numbers are predicted to be comparable to current levels in the absence of insect eradication measures by authorities such as the Urban Services Department.

(b) Impacts to roosting habitats:

The preferred roosting sites of the insectivorous bat species recorded on the site are in large trees, under roadways and bridges, in culverts, and in Chinese Fan-palms *Livistona chinensis* (see Appendix H, G. Ades, pers. comm.). Six individuals of *Livistona chinensis* were recorded on the site, 2 of which would be lost due to road construction. Old or abandoned buildings on the site may also provide roosts for bats. While it was not confirmed through surveys that insectivorous bats use day roosts on the site, it is almost assured that they use nighttime roosts on the site for resting and feeding.

Short-term impacts of the project will result from felling of trees and removal of vegetation, and possibly from demolition of abandoned buildings. Bats currently roosting on site may be able to shift their roosting territories elsewhere in the vicinity. If they are unable to do so, a decline in local population will result.

Installation of bat roost boxes is proposed as a short-term mitigation measure to avoid such a short-term decline in insectivorous bats on the site. Roost boxes have been used successfully elsewhere in the world to provide alternative roost sites for bats when an existing roost site becomes unavailable or is considered undesirable by humans. Information on design, siting and installation of bat roost boxes is provided in Appendix J.

Roost box sites will be chosen in sites with stands of mature trees which will be unaffected by the project. A selection of up to five sites for roost box installation will be made from among eight possible identified sites which located within and outside the project limit (see Appendix J). It is recommended that two boxes be installed at each site if possible, in order to provide different exposures, degrees of sunlight and heights. This will increase the likelihood of successful colonisation.

Installation should start as early in the project process as possible, prior to felling of trees and demolition of buildings on site, in order to allow bats time to locate and colonise the boxes. The design lifetime of the roost boxes will be at least two years, the estimated construction time for the project. The boxes would be made of wood and allowed to naturally degrade over time, encouraging bats to seek other suitable roosts on the site once construction disturbance is past.

The crevice type of roost provided by roost boxes may not be preferred by all bats which currently use the site. The Compensation Tree Planting Plan includes measures which will mitigate short-term impacts to bats which roost in trees. These include the planting of standard trees for landscaping purposes, and the transplanting of a small number of trees. These trees may provide suitable roosts for tree-roosting bats. The remainder of the plantings will consist of seedlings and whips, which will probably not be useful as bat roost sites until they are well established in 5-10 years time.

The residual short-term impact of roost site loss can be mitigated by the addition of *L. chinensis* to the Compensation Tree Planting Plan. Inclusion of 10-15 mature *L. chinensis* in the planting plan would be advisable. These palms should be planted beneath the bridge and at the periphery of the works area near the undisturbed woodland.

Long term impacts of roosting site loss are predicted to be fully mitigated by the replanting of trees specified in the Compensation Tree Planting Plan. Seedlings and whips of "woodland mix" are expected to mature sufficiently to provide roosting sites for tree-roosting bats within 5-10 years.

The only predicted residual impact upon insectivorous bats would be increased disturbance from increased human activity, due to the provision of new road links in the vicinity. The bats' nocturnal activity cycle will, however, minimise conflicts between humans and bats. Bat-human interactions are not predicted to be significant, based on the fact that many Hong Kong residents are unaware that bats even exist in the Territory (pers. obs.).

5.4.3.6 Other Fauna

The only terrestrial mammals recorded in the study area were squirrels (*Callosciurus* sp.) and a rat (*Rattus* sp.). Likely impacts of the project upon rats are not discussed, as rats are considered to be pests in urban areas and are actively exterminated.

Despite being an introduced species in Hong Kong, squirrels are protected under the Wild Animals Protection Ordinance Cap. 170. Impacts upon them are thus of regulatory significance.

Short term impacts of the project upon squirrels will arise from construction disturbance, and from loss of trees and other vegetation which provide forage and shelter for this species. Felling of fruit-bearing trees may reduce the squirrels' food source. Loss of trees in groups and/or trees which are large, tall and old will also affect squirrel activity patterns.

Construction disturbance can be mitigated to some degree by ensuring construction workers and equipment do not enter areas or disturb vegetation on the site except as required for project construction. Squirrels are, however, highly adaptable to human disturbance, thus this impact is considered to be minor.

Habitat loss due to tree felling and vegetation clearance will be mitigated in the short term to some extent by the planting of standard trees and transplanting of existing trees, as prescribed under the Compensation Tree Planting Plan.

Residual short-term impacts of the project upon squirrels are not predicted to be severe, as squirrels are not known to be of particular conservation concern due to rarity or sensitivity to human disturbance.

Long-term impacts of the project upon squirrels will result from traffic disturbance and from habitat loss. The impact of traffic disturbance cannot readily be mitigated but, as noted above, squirrels are highly adaptable to human activity, and are not expected to be significantly affected by such disturbance.

The long-term impacts of habitat loss will be almost completely mitigated through the revegetation proposals contained in the Compensation Tree Planting Plan. The only residual impact may be a small area of woodland habitat loss, which is considered to be a minor impact of the project.

5.4.4 Conclusions

Winter-spring surveys of the site revealed that the patches of mature woodland on the site provide feeding and roosting habitat for birds, bats and squirrels. No other fauna of conservation or regulatory interest was recorded on the site.

The identified ecological impacts of the project are loss of woodland fauna habitat due to tree felling, vegetation clearance and road construction. Short-term impacts of woodland loss will be partially mitigated by transplanting some trees and planting new large trees, to provide some mature woodland canopy in the short term. The long-term impacts of woodland loss and associated fauna habitat loss will be mitigated through replanting of appropriate native species on and around

the road improvement area. All planting operations will be carried out as early as possible in the project construction phase, within the constraints of construction requirements.

For insectivorous bats, the potential loss of roosting sites due to tree felling and building demolition will be mitigated in the short to medium term through provision of bat boxes. Bat boxes will be installed on trees within the site in areas which will not be disturbed by construction; installation will take place prior to the start of tree felling and building demolition. In the long term, these bats should be able to colonise new tree plantings, and possibly the Kennedy Road Bridge if suitable crevices are available. For mitigation of impacts to other fauna, the Compensation Tree Planting Plan (see Appendix G, Figure G7 and Appendix H, Halcrow 1997) is considered to be adequate, pending the addition of tree and palm species which have been shown to be important to wildlife using the site.

The only residual impact of the project will be a small area of woodland loss which cannot be compensated on site due to space limitations. This residual impact is not considered serious enough to warrant off-site mitigation.

6 MITIGATION MEASURES

6.1 Construction Phase

6.1.1 Construction Noise

As discussed in Section 5.1, most of the NSRs are likely to be exposed to significant construction noise impacts. Suitable noise mitigation measures should be provided to protect the affected NSRs throughout the construction period.

While it is not feasible to dictate the methods and exact schedule of construction to be employed by the Contractor, noise control requirements can be incorporated in the Contract Documents, specifying the noise standards to be met and requirements of noise monitoring on the site. A set of recommended pollution control clauses is provided in Appendix C for incorporation into the Contract Documents. Also, details of the proposed noise monitoring and audit (EM&A) requirements are contained in the EM&A Manual.

Potential noise control provisions to reduce noise levels from project activities include, but not be limited to, the following:

- Noisy equipment and activities shall be sited as far from sensitive receivers as is practical.

- Noisy plant or processes shall be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. Manual operations are generally quietest, but may require long periods of time.

- Noisy activities can be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic

hours). Prolonged operation of noisy equipment close to dwellings or during school examination hours should be avoided.

- Idle equipment shall be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

- Construction activities shall be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

- If possible, the numbers of operating items of powered mechanical equipment should be reduced.

- Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

- Temporary noise reducing measures (e.g. curved or inverted-L acoustic barriers) may be used to screen specific receivers. Enclosures for noisy activities such as concrete breaking should be applied where the noise impact is potentially severe.

The most effective mitigation measures for construction noise is to control noise at its source. In the case of powered mechanical equipment, this involves either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers or acoustic enclosures. In addition, construction noise along the noise path may be mitigated by the early construction of temporary noise screening structures. Given the presence of high-rise NSRs within the Study Area, the use of acoustic enclosures and curved/inverted-L noise barriers (located close to the noise source) are considered appropriate.

Though not effective in reducing noise impacts, the establishment of good community relations can be of great assistance to both the Contractor and local communities. Residents should be notified in advance of planned operations and informed of progress. If necessary, a liaison body can be established to bring together representatives of the affected communities, the Government and the Contractor. In addition, residents should be provided with a telephone number for the Engineer's office, where they may register complaints concerning excessive noise. If justified, the Engineer may authorise noisy operations to cease or to be conducted at more restricted hours.

Appendix D presents practical mitigation measures which may be applied to control noise at representative NSR locations from various construction activities. Through the proper implementation of these mitigation measures, the noise levels at all the affected NSRs can be reduced to or below the recommended construction noise criteria.

6.1.2 Construction Dust

While it is not envisaged that construction dust impacts would be adverse, appropriate dust control measures should be provided, including, but not be limited to the following measures :

- Regular watering to reduce dust emissions from exposed site surfaces and unpaved roads.

- Cleaning and watering the site to minimize fugitive dust emission.
- Use of side boards on three sides to enclose any stockpiles of sand and aggregates
- Use of tarpaulin to cover all dusty materials when transported to and from the site.
- Provision of wheel-washing facilities at the exit of the site.

Furthermore, suitable dust suppression measures should be included in the Contract Documents, specifying the dust standards to be met and the requirements for dust monitoring around the site. Appendix C has contained recommended dust suppression measures for incorporation in the Contract Documents. Details of the dust monitoring and audit requirements are contained in the EM&A Manual.

6.1.3 Site Run-off

Site run-off which could contain suspended solids and chemical has the potential to cause water pollution to the surface channels and drains. Provisions for water pollution control should be included in the Contract. The following measures are recommended :

- All stormwater run-off from the site during the construction should be routed through oil/grit separators and/or sediment basins/raps before being allowed to discharge into the nearby receiving waters.
- All stockpiles areas should be covered e.g. with tarpaulin and intercepting drains provided to prevent site run-off from washing across exposed surfaces or stockpiled areas.

In addition, any effluent generated by the site workforce should be treated before disposal. All sewage discharges from the site would have to meet the Technical Memorandum on Effluent Standards and approval from EPD through the licensing process would be required.

6.2 Operation Phase

6.2.1 Potential Noise Mitigation Measures

Traffic noise may be controlled at source, along its path, or at NSR facades. The various options available for mitigating traffic noise have been reviewed, and their suitability for use in this Project is presented below.

6.2.1.1 Control at source

Controlling traffic noise at its source involves the design of quieter vehicles, traffic management and road surface treatments, all of which result in less noise being generated.

Traffic Management

Traffic management measures may be introduced, such as reducing traffic flow or vehicle speed or limiting the use of the road by certain type of vehicles. One of primary objectives of the Project however is to provide a north-south link in the area so as to cater for the future traffic movements. Traffic management measures for traffic noise reduction would be difficult

to be effectively enforced, and would reduce the capacity of the road, thus defeating the purpose of the road improvement works. Hence, these noise mitigation measures would be impractical for this Project.

Road Surface Treatments

A pervious macadam paving surface (also known as friction course surfacing) has high acoustic absorption characteristics that can significantly reduce traffic noise levels. According to the CRTN, the presence of pervious macadam paving reduces the traffic noise levels by 2.5 dB(A) as compared to impervious bituminous and concrete road surfaces. However, recent findings show that the performance of existing noise reducing road surfacing on low speed roads has not been considered satisfactory in respect of maintenance and cost implication due to the possible short service life of the material. A Highway/EPD joint study on the feasibility of developing a suitable specification for the use of the material on low speed roads is being conducted. The study will be completed in 1997. As a result, no friction course will be recommended in this Study.

Potential sources of additional traffic noise can also be minimised by omitting manhole covers in the carriageway as far as possible during detailed design and by close supervision of finished pavement level tolerances during construction. Where possible, the existing/future utilities and drainage services should be diverted to the footpaths to avoid placing manhole covers and valve chambers in the carriageway.

6.2.1.2 Control along Noise Path

Controlling traffic noise along its path includes (a) re-alignment of the new roads and (b) the use of natural or man-made topographical barriers or purpose-built barriers of different types to intercept the noise path.

Road Alignment

Road alignment can be designed so that it incorporates features which will reduce traffic noise at sensitive developments. The alignment of the proposed bridge is however fixed by the existing road alignment, as well as the requirement to straighten the hazardous bend in front of the Electric House. For the Queen's Lines Link, in addition to the topography, the alignment is largely dictated by the spatial requirement for the provision of a wide bend connection. It would not be practical or effective to alter the road alignment to control traffic noise in this Project.

Barriers and Enclosures

Noise barriers may be used to intercept the noise path. However the use of noise barriers in this Project is not appropriate since the dominant noise contribution is from the existing roads, according to the results in Table 5.4.

6.2.1.3 Control at NSRs

Control of traffic noise at the receiver includes insulation of sensitive facades, use of self-protecting buildings, orientation of building facades, building setback, and internal arrangement of rooms to screen sensitive areas.

For the existing NSR's which are affected by traffic noise, control of noise at receivers would involve the provision of good quality glazing and air conditioning units.

Current practice in noise assessment and mitigation in Hong Kong is that the provision of noise insulation at receivers should only be considered as the last resort to be applied should the implementation of all feasible direct technical remedies prove to be impracticable and ineffective. However, the following three criteria must be satisfied for consideration of indirect technical remedies by Exco:

- The predicted overall noise level from the improved road, together with other traffic noise in the vicinity, must be above L_{10}(peak hour) 70 dB(A) for sensitive residential facades or L_{10}(peak hour) 65 dB(A) for schools.
- The predicted noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic noise level existing before the commencement of the construction works.
- The contribution to the increase in the noise level from the new and improved roads must be at least 1.0 dB(A).

6.2.2 Noise Mitigation Scenarios

6.2.2.1 Existing NSRs

Apart from a few existing NSRs as described below, all predicted noise levels in 2015 are within the HKPSG criteria for noise sensitive developments and therefore no mitigation measures are necessary.

As shown in Appendix A, a few residential properties to the east of the project site are expected to be exposed to noise levels exceeding 70 dB(A). The total number is estimated to be 29 dwelling units.

NSR RC-B and RC-C are expected to be subject to high noise levels from the existing Kennedy Road in 2015. However, no effective direct technical remedies can be provided within the scope of the Project. Mitigation of the new roads is ineffective because the noise from the new roads is less than 10 dB(A) of the overall noise levels at these receivers.

The predicted noise levels at the lower floors of MC-A, SAC, and 62KR are 1-3 dB(A) above the HKPSG criterion. As the main noise source is from the existing Kennedy Road, again no direct measures can be provided. Mitigation of the new roads is again ineffective for these receivers.

On the other hand, the predicted noise levels at the two schools, CIS and WEEC, meet the HKPSG noise limit. No noise mitigation is therefore necessary.

6.2.2.2 Planned NSRs

The planned site near junction of Borrett Road and Kennedy Road is potentially subject to unacceptable noise levels. As the main noise source is from the existing Borrett Road and Kennedy Road, no direct technical remedies can be provided. Mitigation of the new roads is ineffective for this receiver.

For future development on the site, noise mitigation options are available to reduce noise, including:

(a) Building Setback

Noise calculations have shown that the predicted facade noise level at 3m above the site formation level can be reduced to 70 dB(A) if a setback distance of 25m from the site boundary is provided.

(b) Use of carport underneath Podium

Sensitive buildings can be built on a podium with carparks underneath. Two alternative options have been investigated as described below :

(i) A four-storey carpark approximately 15m high above the site formation level to be located at 10m from the property line. If the sensitive facades are setback 10m from the edge of the podium, all residential dwellings below 25m (i.e. below 9th floor) from the podium level are properly protected from road traffic noise. However, indirect technical remedies would be required above this floor level.

(ii) A five-storey carpark approximately 20m above the site formation level to be located at 10m from the property line. If the sensitive facades are setback 10m from the edge of podium, all residential dwellings below 30m are protected from road traffic noise. However, indirect technical remedies would be required above this floor level.

6.2.3 Residual Impacts and Indirect Mitigation

As discussed above, the noise impacts at NSRs to the east of the Project site (e.g. Royal Court, Monticello Court, Sakura Court and 62 Kennedy Road) arise mainly from traffic on the existing Kennedy Road. It is apparent that even with the installation of substantial noise screening structures (e.g. partial or full enclosures) on the new roads, noise levels are unlikely to be reduced to acceptable levels. As such, consideration should be given to indirect mitigation of Royal Court, Monticello Court, Sakura Court and 62 Kennedy Road.

EPD's eligibility criteria have been applied to determine whether the above-mentioned NSRs are qualified for consideration of indirect technical remedies through the provision of building insulation and room air conditioners. Results of the eligibility assessment are presented in Appendix B. As the dominant noise source is the existing Kennedy Road, no dwellings are eligible for indirect technical remedies.

7 CUMULATIVE NOISE IMPACTS

7.1 Concurrent Projects

No concurrent infrastructure projects such as roadworks have been identified in the vicinity of the Study Area. However, the redevelopment of the Electric House is being constructed close to the Project site and may have contribution to the noise environment.

7.2 Cumulative Construction Impacts

The redevelopment of the Electric House (into an office building) has been scheduled to be commenced on January 1997 and completed by July 1998. As both the redevelopment and the Project will be constructed concurrently, cumulative construction noise impacts due to these two

projects have therefore been assessed.

For the construction of office buildings, noisiest activities normally occur during the foundation stage. Typical total equipment SWL due to foundation works for similar office projects could be in the order of 120 dB(A). The cumulative noise impacts on the NSRs that are likely to be most affected by both projects are indicated in Table 7.1. According to the noise calculation results, the potential for cumulative impacts is negligible.

Table 7.1 Cumulative Construction Noise Impacts

NSR	Noise Level[2], dB(A)		Total Noise Level dB(A)
	This Project[1]	Redevelopment of Hongkong Electric House	
BWP	62	69	70
10BW	64	71	72
FT	61	69	70
HV	59	68	69
14BW	60	67	68

Note: (1) Mitigated noise levels (see Table C.2).
(2) Noise levels are in Leq(30-min).

7.3 Cumulative Operational Impacts

No cumulative operational noise impact is envisaged as no concurrent road projects have been identified in the Project area.

8 ENVIRONMENTAL MONITORING AND AUDIT

An environmental monitoring and audit (EM&A) programme performs three functions. It ensures that noise from the construction of the project is kept within acceptable levels; it establishes procedures for checking the application and effectiveness of mitigation measures; and it provides the means by which compliance can be checked, exceedances documented, and corrective action recorded.

In view of the close proximity of the Kennedy Road Improvement and Queen's Lines Link to the identified NSRs, an EM&A programme is considered necessary during the construction period. The proposed EM&A programme for this Project which forms a part of this EIA is contained and described in a stand-alone document, Environmental Monitoring and Audit (EM&A) Manual.

Detailed monitoring schedules and audit requirements should be incorporated into the construction contract for the improvement of Kennedy Road and Queen's Lines Link. The clauses containing these schedules and requirements should be formulated in consultation with EPD.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

9.1.1 Noise

Construction of the Project has been shown to cause significant noise impacts on the noise sensitive receivers in the Study Area. The predicted maximum anticipated construction noise levels are above 75 dB(A) at many of the identified NSRs. However, the impacts can be mitigated through proper implementation of appropriate noise control measures and environmental monitoring programme during the construction of the Project.

Based on the projected traffic figures for 2015, it has been predicted that the traffic noise levels at many of the existing NSRs are within the HKPSG noise criteria and therefore no mitigation measures are required. However, a few existing NSRs to the east of the Study Area are predicted to be exposed to noise levels exceeding the HKPSG criteria by 1-3 dB(A). As the main noise contribution at these NSRs comes from the existing Kennedy Road, no direct technical remedies can be provided within the scope of the Project. On the other hand, these affected NSRs are not eligible for indirect technical remedies according to EPD's eligibility criteria.

The planned site is predicted to be adversely affected by the road traffic noise from the existing roads. Noise levels are expected to exceed the HKPSG criteria by as much as 4 dB(A). No direct technical remedies can be provided for this site within the scope of the Project. For future development on this site, development constraints have been proposed for guidance to the future developer.

Cumulative noise impacts from concurrent projects have been identified and considered. Cumulative construction noise impacts due to the construction of the Project and redevelopment of the Electric House have been assessed to be insignificant. On the other hand, no concurrent infrastructures have been identified and thus no cumulative operational impact is anticipated.

9.1.2 Trees and Woodland Ecology

9.2.1.1 Trees

The vertical and horizontal alignment of the new road sections and the design of supporting structures have been refined as far as possible to minimise the loss of existing trees, and achieve the least environmental impact possible.

However, the densely wooded nature of the existing slopes and the very tight constraints of the new highway alignment will result in some 378 nos. trees having to be removed and a further 29 nos. are considered suitable for transplanting to alternative locations.

In addition to trees to be transplanted back into the final layout, some 211 nos. new Standard and Heavy Standard size tree and some 2410 nos. seedling and whip size trees and tall shrubs can be planted within the scope of the works in compensation for those lost and to help screen the road and re-establish the existing woodland landscape pattern.

9.1.2.1 Woodland Ecology

The identified ecological impacts of the project are loss of some woodland and fauna habitat. Short-term impacts will be partially mitigated by additional tree plantings and transplantings. Long-term impacts of woodland loss and associated fauna habitat loss will be mitigated through replanting of appropriate native species on and around the road improvement area. The potential loss of roosting sites for insectivorous bats due to tree felling and building demolition will be mitigated in the short to medium term through provision of bat boxes on the site. In the long term, these bats should be able to colonise new tree plantings and possibly the Kennedy Road Bridge. The only residual impact of the project will be a small area of woodland loss which cannot be compensated on site due to space limitations. This residual impact is not considered serious enough to warrant off-site mitigation.

9.2 Recommendations

The following recommendations are made:

- Inclusion of pollution control clauses as recommended in Appendix C to the Contract Documents to control construction noise from the improvement works.
- Implementation of the EM&A programme as detailed in the EM&A Manual.
- Reduction in number of manhole covers and valve chambers in the carriageway.
- Inclusion of noise planning requirements for new sensitive developments in the Study Area.
- Inclusion of development constraints in the development of the G/IC site at junction of Borrett Road and Kennedy Road.
- Implementation of the proposed tree felling plan and compensation tree planting scheme.
- Provision of bat roost boxes within the site as a short to medium term mitigation measure.

Appendix A

CURRENT AND 2015 TRAFFIC NOISE LEVELS AT REPRESENTATIVE NSRs

Current and 2015 Traffic Levels at Representative NSRs (All Floors)

NSR ID	Floor	L_{10} (1 hour) Noise Level, dB(A)				
		Overall Noise Level at Year		Contribution from Individual Roads in 2015		
		1996	2015	New Roads		Existing Roads
				Kennedy Road Bridge	Queen's Lines Link	
CIS	2	64	65	55.9	61.2	61.3
WEEC	2	64	65	57.2	62.0	61.5
DH-A [1]	3	56	64	60.9	59.6	52.8
	5	58	65	61.3	62.2	54.5
	10	65	68	63.8	64.1	63.0
	15	67	70	64.5	66.8	65.4
	20	66	70	64.7	66.5	65.1
	22	66	70	64.5	66.4	65.0
DH-B	3	60	68	62.2	62.8	64.7
	5	61	68	56.3	64.7	64.8
	10	65	70	64.3	65.7	65.9
	15	67	70	64.4	66.2	66.2
	20	66	70	64.3	66.2	66.1
	22	66	70	64.2	66.2	66.0
2MMT	3	69	69	52.1	53.4	68.8
	5	69	69	52.8	54.3	69.2
	7	69	70	55.5	57.8	69.0
MST	3	68	68	43.0	45.9	67.7
	5	68	68	48.3	48.3	68.1
	10	68	69	58.7	54.7	68.3
	15	68	69	60.9	58.4	68.3
	20	67	69	60.3	61.1	67.6
MMP	3	69	69	52.7	51.7	68.7
	5	69	70	60.2	56.7	69.0
	10	68	70	60.1	57.0	69.0
	15	68	70	60.5	58.4	68.5
	20	67	69	60.1	60.6	68.0
	25	67	69	59.7	62.6	67.6
SUT	3	65	68	62.9	60.6	65.9
	5	65	69	62.1	61.6	66.4
	10	67	69	59.7	62.0	67.5
	15	67	69	57.9	62.5	67.3
	20	66	69	56.1	63.4	66.9
	24	66	69	55.3	63.9	66.5
NMMT	1	- [2]	56	30.2	34.9	56.0
	5	- [2]	65	30.3	35.0	64.9
	10	- [2]	65	30.1	35.0	64.7
	15	- [2]	64	29.9	34.9	64.4
	20	- [2]	64	29.6	34.7	63.8
	25	- [2]	63	29.2	38.2	63.3
	30	- [2]	65	46.7	52.7	64.3
	34	- [2]	68	58.6	62.8	66.0
RC-A	3	70	70	34.4	39.0	69.6
	5	69	69	36.9	39.9	69.2
	10	68	68	46.3	42.7	68.2
	15	68	67	51.0	45.9	67.2
	20	67	67	50.8	50.2	66.3
	25	66	66	50.5	58.3	65.2
	30	65	66	50.2	59.1	64.7
	31	65	66	50.1	59.1	64.5
RC-B	3	71	71	54.3	53.0	71.1
	5	71	71	54.3	53.5	70.5
	10	69	69	54.9	54.9	69.1
	15	68	69	58.0	55.8	67.9
	20	67	68	58.3	57.8	66.7
	25	67	68	58.1	60.1	67.0
	30	66	68	57.9	61.6	66.5
	31	66	68	57.8	61.6	66.4

Notes:

[1] Stands for Facade B of NSR DH (similar for others)

[2] No prevailing noise level for new development

[3] Noise level is negligible as the NSR is completely screened by topographical barrier.

[4] 10 m above ground

Boldfaced values indicate noise levels exceeding the noise criteria.

NSR ID	Floor	L_{10} (1 hour) Noise Level, dB(A)				
		Overall Noise Level at Year		Contribution from Individual Roads in 2015		
		1996	2015	New Roads		Existing Roads
				Kennedy Road Bridge	Queen's Lines Link	
RC-C	3	72	72	-[3]	36.2	71.9
	5	71	71	-[3]	37.1	71.0
	10	70	69	-[3]	39.5	69.4
	15	68	68	-[3]	42.5	67.5
	20	67	67	-[3]	45.7	66.6
	25	66	66	-[3]	50.0	65.8
	30	66	66	-[3]	56.5	65.2
	31	66	66	-[3]	57.4	65.1
STT1	1	-[2]	59	57.3	53.3	50.8
	5	-[2]	62	58.2	57.7	52.1
	10	-[2]	63	58.1	59.9	56.2
	15	-[2]	68	62.3	64.3	63.2
	20	-[2]	68	62.1	64.5	63.4
	25	-[2]	68	61.6	64.5	63.1
	30	-[2]	68	61.1	64.4	63.0
STT2	1	-[2]	67	-[3]	53.5	66.7
	5	-[2]	68	-[3]	56.3	67.4
	10	-[2]	68	-[3]	58.1	67.5
	15	-[2]	68	-[3]	58.1	67.6
	20	-[2]	68	-[3]	58.0	67.5
	25	-[2]	68	-[3]	58.0	67.4
	28	-[2]	68	-[3]	57.9	67.2
MC-A	3	71	71	37.4	37.6	70.6
	5	70	70	38.4	38.4	70.0
	10	69	69	41.1	40.9	68.9
	15	68	68	44.4	44.0	68.2
	20	67	68	49.1	50.3	67.5
MC-B	3	69	69	41.7	42.1	69.1
	5	69	69	43.1	43.0	68.6
	10	68	68	47.8	45.6	67.6
	15	67	67	55.7	48.9	66.9
	20	66	67	57.2	55.2	66.4
MC-C	3	63	63	39.0	41.4	62.5
	5	62	63	41.4	42.4	62.5
	10	63	64	46.5	45.3	63.4
	15	63	65	54.6	48.3	64.0
	20	64	66	56.5	53.8	65.1
MYG	3	67	66	-[3]	-[3]	66.4
	5	66	66	-[3]	-[3]	66.1
	10	66	66	-[3]	-[3]	65.6
	12	65	65	-[3]	-[3]	65.3
EWC	3	69	69	-[3]	-[3]	68.9
	5	69	69	-[3]	-[3]	68.6
	10	68	68	-[3]	-[3]	67.6
	12	67	67	-[3]	-[3]	67.2
SAC	3	71	71	-[3]	-[3]	71.0
	5	70	70	-[3]	-[3]	70.3
	10	69	69	-[3]	-[3]	69.0
	12	69	69	-[3]	-[3]	68.6
62KR	3	73	73	-[3]	-[3]	72.8
	5	72	72	-[3]	-[3]	71.8
	10	70	70	-[3]	-[3]	70.1
	12	70	70	-[3]	-[3]	69.5

Notes:

[1] Stands for Facade B of NSR DH (similar for others)

[2] No prevailing noise level for new development

[3] Noise level is negligible as the NSR is completely screened by topographical barrier.

[4] 10 m above ground

Boldfaced values indicate noise levels exceeding the noise criteria.

NSR ID	Floor	L_{10} (1 hour) Noise Level, dB(A)				
		Overall Noise Level at Year		Contribution from Individual Roads in 2015		
		1996	2015	New Roads		Existing Roads
				Kennedy Road Bridge	Queen's Lines Link	
BWP	3	64	68	59.9	64.5	62.7
	5	64	67	59.9	64.4	62.7
	10	64	67	59.7	64.1	62.6
	15	64	67	59.6	63.8	62.5
	20	64	67	59.4	63.5	62.4
	22	64	67	59.3	63.4	62.6
10BW	3	66	69	61.6	66.6	63.9
FT	3	59	64	58.3	60.6	59.7
	5	60	65	58.3	60.4	60.7
	10	60	65	58.2	60.1	60.7
	15	60	64	58.1	59.7	60.5
	20	59	64	57.9	59.4	60.3
HV	3	58	63	57.2	57.5	59.5
	5	58	63	57.2	58.1	59.5
	10	58	63	57.1	59.0	59.6
	15	58	64	57.0	59.8	59.5
	20	58	64	56.9	59.6	59.4
	25	58	63	56.8	59.4	59.3
	28	58	63	56.8	59.2	59.3
21BR	3	56	63	57.3	59.0	58.3
	5	58	64	57.2	59.4	59.6
	10	60	64	57.2	60.0	60.2
	15	61	65	57.1	61.1	60.3
	20	61	64	56.9	60.9	60.3
23BR	3	52	60	56.4	55.3	55.1
	5	53	61	56.3	55.6	56.1
	10	57	62	56.3	57.0	58.6
	15	58	63	56.2	57.9	58.8
	20	58	63	56.1	58.9	58.9
14BW	2	59	65	57.4	61.6	59.2
15BW	2	62	63	49.5	47.3	62.3
16BW	3	54	57	39.7	38.5	57.3
CA	3	50	53	40.7	39.2	53.0
WSD	1	62	66	59.7	60.3	63.0
CMFA	1	-[2]	70	57.9	60.1	69.3
	5	-[2]	70	57.7	60.8	68.9
	10	-[2]	69	57.3	61.0	68.4
	15	-[2]	69	57.0	61.4	67.8
	20	-[2]	69	56.7	61.5	67.4
	21	-[2]	69	56.6	61.5	67.3
P1	-	10[4]	74	59.1	59.9	73.5

Notes:

[1] Stands for Facade B of NSR DH (similar for others)

[2] No prevailing noise level for new development

[3] Noise level is negligible as the NSR is completely screened by topographical barrier.

[4] 10 m above ground

Boldfaced values indicate noise levels exceeding the noise criteria.

Appendix B

ELIGIBILITY ASSESSMENT FOR INDIRECT TECHNICAL REMEDIES

Table B1 Royal Court (RC)

NSR ID	Floor	L_{10}(1 hour) Noise Level, dB(A)							Eligible for Indirect Technical Remedies (Yes/No)
		Overall Noise Level at Year			Contribution from Individual Road(s) in 2015				
					New Roads		Existing Roads	New Roads: Contribution to Overall Noise Levels [3]	
		1996	2015 [1]	Exceedance [2]	Kennedy Road Bridge	Queen's Lines Link			
RC-B	3	71.2	71.2	< 1.0	54.3	53.0	71.1	0.1	No
	5	70.7	70.7	< 1.0	54.3	53.5	70.6	0.1	No
RC-C	3	71.8	71.9	< 1.0	-@	36.2	71.9	0.0	No
	5	70.9	71.0	< 1.0	-@	37.1	71.0	0.0	No

Table B2 Monticello Court (MC)

NSR ID	Floor	L_{10}(1 hour) Noise Level, dB(A)							Eligible for Indirect Technical Remedies (Yes/No)
		Overall Noise Level at Year			Contribution from Individual Road(s) in 2015				
					New Roads		Existing Roads	New Roads: Contribution to Overall Noise Levels [3]	
		1996	2015 [1]	Exceedance [2]	Kennedy Road Bridge	Queen's Lines Link			
MC-A	3	70.6	70.6	< 1.0	37.4	37.6	70.5	0.1	No

@ Noise level is negligible as the NSR is completely screened by topographical barrier.

Notes: Eligibility Criteria

(1) The predicted overall noise level from the new roads together with other traffic noise in the vicinity must be above 70 dB(A) L_{10}(1 hour).

(2) The predicted overall noise level is at least 1.0 dB(A) more than the prevailing noise level.

(3) The contribution to the increase in the overall noise level from the new road must be at least 1.0 dB(A).

Table B3 Sakura Court (SAC) and 62 Kennedy Road (62KR)

NSR ID	Floor	L_{10}(1 hour) Noise Level, dB(A)							Eligible for Indirect Technical Remedies (Yes/No)
		Overall Noise Level at Year			Contribution from Individual Road(s) in 2015				
					New Roads		Existing Roads	New Roads: Contribution to Overall Noise Levels [3]	
		1996	2015 [1]	Exceedance [2]	Kennedy Road Bridge	Queen's Lines Link			
SAC	SAC	71.0	71.0	< 1.0	-*	-*	71.0	0.0	No
62KR	3	72.8	72.8	< 1.0	-*	-*	72.8	0.0	No
	5	71.8	71.8	< 1.0	-*	-*	71.8	0.0	No

Notes: * Noise level is negligible as the NSR is completely screened by topographical barrier.

Eligibility Criteria

(1) The predicted overall noise level from the new roads together with other traffic noise in the vicinity must be above 70 dB(A) L_{10}(1 hour).

(2) The predicted overall noise level is at least 1.0 dB(A) more than the prevailing noise level.

(3) The contribution to the increase in the overall noise level from the new road must be at least 1.0 dB(A).

Appendix C

RECOMMENDED POLLUTION CONTROL CLAUSES

APPENDIX C RECOMMENDED POLLUTION CONTROL CLAUSES RECOMMENDED POLLUTION CONTROL CONDITIONS FOR CONSTRUCTION CONTRACTS

1. AVOIDANCE OF NUISANCE

(a) All works are to be carried out in such a manner as to cause as little inconvenience as possible to nearby residents, property and to the public in general, and the Contractor shall be held responsible for any claims which may arise from such inconvenience.

(b) The Contractor shall be responsible for the adequate maintenance and clearance of channels, gullies, etc., and shall also provide and maintain such pedestrian and vehicular access as shall be directed within the works site.

(c) Water shall be used to prevent dust rising and the Contractor shall take every precaution to prevent the excavated materials from entering into the public drainage system.

(d) The Contractor shall carry out the Works in such a manner as to minimize adverse impacts on the environment during execution of the Works.

2. NOISE POLLUTION CONTROL

(a) The Contractor shall comply with and observe the Noise Control Ordinance and its subsidiary regulations in force in Hong Kong.

(b) The Contractor shall provide an approved integrating sound level meter to IEC 651:1979 (Type 1) and 804:1985 (Type 1) and THE manufacturer's recommended sound level calibrator for the exclusive use of the Engineer at all times. The Contractor shall maintain the equipment in proper working order and provide a substitute when the equipment are out of order or otherwise not available.

The sound level meter including the sound level calibrator shall be verified by the manufactures every two years to ensure they perform the same levels of accuracies as stated in the manufacturer's specifications. That is to say at the times of measurements, the equipment shall have been verified within the last two years.

(c) In addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 07:00 to 19:00 hours on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:

(i) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (L_{eq}) of 75 dB(A).

(ii) The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (L_{eq}) of 70 dB(A) [65 dB(A) during school examination periods].

The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

(iii) Should the limits stated in the above sub-clauses (i) and (ii) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

(d) Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

(e) The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

The noise reduction methods shall include, but not be limited to, scheduling of works; Siting of facilities; selection of quiet equipment; and use of purpose-built acoustic panels and enclosures.

(f) The Contractor shall ensure that all plant and equipment to be used on site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers.

(g) Notwithstanding the requirements and limitations set out in clause (c) above and subject to compliance with clauses (e) and (f) above, the Engineer may, upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

(h) No excavator mounted breaker shall be used within 125 m from any nearby noise sensitive receivers. The Contractor shall use hydraulic concrete crusher wherever applicable.

(i) The only equipment that shall be allowed on the Site for rock drilling works will be quiet drilling rigs with a sound power level not exceeding 110 dB(A). Conventional pneumatically driven drilling rigs are specifically prohibited.

(j) For the purposes of the above clauses, any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, or performing arts centre or office building shall be considered a noise sensitive receiver.

(k) The Contractor shall, when necessary, apply as soon as possible for a construction noise permit in accordance with the Noise Control (General) Regulations, display the permit as required and copy to the Engineer.

3. DUST SUPPRESSION MEASURES

(a) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. The air pollution control system installed shall be operated whenever the plant is in operation.

(b) The Contractor shall at his own cost, and to the satisfaction of the Engineer, install effective dust suppression equipment and take such other measures as may be necessary to ensure that at the Site boundary and any nearby sensitive receiver the concentration of air-borne dust shall not exceed 0.5 milligrams per cubic meter, at standard temperature (25°C) and pressure (1.0 bar) averaged over one hour, and 0.26 milligrams per cubic metre, at standard temperature (25°C) and pressure (1.0 bar) averaged over 24 hours.

(c) In the process of material handling other than cement and the like, any material which has the potential to create dust shall be treated with water or spraying with wetting agent.

(d) Where dusty materials are being discharged to a vehicle from a conveying system at a fixed transfer point, a three-sided roofed

enclosure with a flexible curtain across the entry shall be provided. Exhaust should be provided for this enclosure and vented to a fabric filter system.

(e) Any vehicle with an open load carrying area used for moving materials which have the potential to create dust shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

(f) Stockpiles of sand and aggregate greater than 20 m^3 shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile. In addition, water sprays shall be provided and used, both to dampen stored materials and when receiving raw material.

(g) The Contractor shall frequently clean and water the site to minimize the fugitive dust emissions.

(h) The Contractor shall restrict all motorized vehicles to a maximum speed of 8 km per hour and confine haulage and delivery vehicles to designated roadways inside the site. Areas of roadway longer than 100 m where movement of motorized vehicles exceeds 100 vehicular movements per day, or as directed by the Engineer, shall be furnished with a flexible pavement surfacing.

(i) Wheel washing facilities shall be installed and used by all vehicles leaving the site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel washing facility shall be usable prior to the commencement of any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between the washing facility and the public road.

(j) Conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize emission of dust. All conveyors carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

4. CONSENT TO EQUIPMENT AND PROCESSES

(a) The Contractor shall not install any furnace, boiler or other plant or equipment or use any fuel that might in any circumstance produce smoke or any other air pollution without the prior consent of the Engineer. Unless specifically instructed by the Engineer, the Contractor shall not light fires on site for the burning of debris or any other matter.

(b) The Contractor's attention is drawn to the Air Pollution Control Ordinance and its subsidiary legislation, particulary the Air Pollution (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations and the Air Pollution Control (Smoke) Regulations.

5. REMOVAL OF WASTE MATERIAL

(a) The Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the site onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the Site or onto any adjoining land and shall have all such matter removed from the Site.

(b) The Contractor shall be liable for any damages caused to adjoining land through his failure to comply with clause 5(a).

(c) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(d) The Contractor shall be responsible for adequately maintaining any existing site drainage system at all times, including removal of solids in sand traps, manholes and stream beds.

(e) Any proposed stream course and nullah temporary diversions shall be submitted to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition or as agreed by the Engineer after the permanent drainage system has been completed.

(f) The Contractor shall furnish, for the Engineer's information, particulars of the Contractor's arrangements for ensuring that material from any earthworks does not wash into the drainage system. If at any time such arrangements prove to be ineffective the Contractor shall take such additional measures as the Engineer shall deem necessary and shall remove all silt which may have accumulated in the drainage system whether within the Site or not.

(g) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at such public dumping area(s) as may be specified from time to time by the Director of Civil Engineering Services.

(h) All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be disposed of at a public landfill.

(i) The Contractor's attention is drawn to the Waste Disposal

Ordinance, the Public Health and Municipal Services Ordinance, and the Water Pollution Control Ordinance.

6. DISCHARGE INTO SEWERS AND DRAINS

(a) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea any effluent or foul or contaminated water or cooling or hot water without the prior consent of the Engineer who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water. The design of such treatment works shall be submitted to the Engineer for approval not less than one month prior to the commencement of construction or as agreed by the Engineer.

(b) If any office, site canteen or toilet facilities are erected, foul water effluent shall be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of pumping or other means approved by the Engineer.

(c) The Contractor's attention is drawn to the Buildings Ordinance and to the Water Pollution Control Ordinance.

Appendix D

MITIGATION OF CONSTRUCTION NOISE

APPENDIX D MITIGATION OF CONSTRUCTION NOISE

In order to reduce the maximum anticipated construction noise to an acceptable level, the following noise control measures may be used:

	Mitigation Measures	*Anticipated Noise Reduction*
A	Fit more efficient exhaust or sound reduction equipment, and keep closed the machine's enclosure panels	10 dB(A)
B	Erect inverted-L acoustic barrier between the equipment and NSRs, and locate the barrier right adjacent the equipment	15 dB(A)
C	Enclose the equipment in acoustic enclosure	20 dB(A)

Table D.1 shows the effect of applying the above measures to the noisiest construction activities in the Project. Table D.2 shows how construction noise could be mitigated at the adversely affected NSRs by providing the above-mentioned mitigation measures.

Table D.1 Mitigation of Construction Activities

Task (1)	Noisiest Activity		Equipment	Mitigation	Mitigated SWL, dB(A) (Per piece) (2)
2	C	Construction of Bridge Foundations and Abutments or Construction of Caisson Walls	Drilling rig Backhoe Truck with crane Dumptruck Concrete mixer truck Vibratory poker Concrete pump	B A B B B C C	87 102 97 95 93 92 89
3	E	Construction of Retaining Walls or Slope Works	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker Concrete pump	A B B B C C	102 95 97 93 92 89
4	I	Construction of Box Culverts	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker Concrete pump	A B B B C C	102 95 97 93 92 89
5	E	Construction of Retaining Walls of Slope Works	Backhoe Dumptruck Truck with crane Concrete mixer truck Vibratory poker Concrete pump	A B B B C C	102 95 97 93 92 89
6	F	Earthworks	Pneumatic breaker Backhoe Dumptruck Dozer Vibrating roller	C A B B B	89 102 95 98 93

Notes: (1) See Table 2.1 for task numbers.
(2) An adjustment to sound level for equipment on-time has been allowed according to Figure 4 of *BS 5228 Part 1: 1984*.

Table D.2 Mitigated Construction Noise Levels for the Worst Case Scenario

NSR	Kennedy Road Bridge		Kennedy Road West		Queen's Lines Link		Queen's Lines Link		Supreme Court Road		Total Noise Level dB(A)
	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	
CIS	207	58	138	57	224	55	258	52	280	51	62 (1)
WEEC	194	58	172	55	172	57	1884	55	302	50	62 (1)
DH-A	109	61	227	53	140	59	90	61	140	57	66
2MMT	152	58	280	51	235	55	120	58	241	52	63
MST	167	57	295	51	250	54	135	57	256	52	62
MMP	177	57	300	51	260	54	145	57	272	51	62
SUT	165	58	295	51	241	54	130	58	241	52	63
RC-A (2)	218	55	340	49	296	53	185	55	313	50	60
21MP	155	58	283	51	200	56	136	57	200	54	63
21SS	191	56	314	50	236	54	182	56	236	52	61
MC-C	251	54	361	49	302	52	236	52	353	49	59
MYG	-	- (3)	-	- (3)	-	- (3)	-	- (3)	-	- (3)	- (3)
EWC	-	- (3)	-	- (3)	-	- (3)	-	- (3)	-	- (3)	- (3)
SAC	371	51	-	- (3)	457	49	358	49	468	47	55
62KR	430	49	-	- (3)	511	48	410	48	522	46	54
BWP	208	58	187	54	159	58	174	55	314	50	62
10BW	184	58	185	57	122	60	154	56	274	51	64
FT	227	55	222	53	191	56	214	53	336	49	61

Table D.2 (Con't)

NSR	Kennedy Road Bridge		Kennedy Road West		Queen's Lines Link (Lower Section)		Queen's Lines Link (Upper Section)		Supreme Court Road		Total Noise Level dB(A)
	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	Intervening Distance (m)	Noise Level dB(A)	
HV	303	52	298	51	249	54	264	52	408	48	59
21BR	319	52	281	51	235	55	-	- (3)	390	48	58
23BR	367	51	323	50	287	53	279	51	438	47	58
14BW	239	54	307	50	233	55	185	55	343	49	60
15BW	256	54	349	49	278	53	223	53	380	49	59
16BW	315	53	409	48	332	52	278	51	419	48	58
CA	384	50	472	47	392	50	347	49	425	47	56
NMMT	180	57	315	50	268	53	185	55	253	52	61
STT1	140	59	290	51	210	58	145	57	185	55	63
STT2	157	58	300	51	233	55	175	55	205	54	62
CMFA	242	54	76	62	258	54	345	49	285	51	64
WSD	-	- (4)	-	- (4)	-	- (4)	-	- (4)	-	- (4)	- (4)

Notes: (1) Noise assessment criteria are 70 and 65 dB(A) at the facades of schools during normal school hours and examination period respectively.

(2) Stands for Facade A of NSR DH (similar for others).

(3) Noise level is negligible as NSR is completely screened by building(s).

(4) Noise level is negligible as NSR is completely screened by hill slope.

(5) Noise levels are in Leq(30-min.).

Appendix E

SAMPLE CALCULATION FOR OPERATION NOISE

Sample Calculation for Road Traffic Noise at Representative Facade

ROAD	Q	kph	%p	Level (m)	Gradient	Friction	BNL
Kennedy Road West (KRW)	2533	50	10	64.2	1.7	No	75.4
Kennedy Road Bridge (KRB)	2599	50	10	63.8	1.0	No	75.6
Kennedy Road East (KRE)	1004	50	10	62.9	1.8	No	71.4
Queen Lines Link (QLL)	2369	50	10	53.1	7.5	No	75.2
Justice Drive (JUD)	4114	50	10	27.8	10.9	No	77.6
Supreme Court Road (SCR)	898	50	10	32.1	1.6	No	70.9
Borrett Road (BOR)	94	50	10	90.9	9.1	No	61.1
Electric House Access (EHA)	127	50	10	64.0	0.0	No	62.4

Canadian International School (CIS) - 3/F
Height = 141.2 m

Road ID	Distance	Angle of View	BNL	GC	DC	AC	BC	FC	CNL
KRW	111	72	75.4	0.5	-10.1	-4.0	-8.1	2.5	56.3
KRB	36	7	75.6	0.3	-8.1	-14.4	-0.1	2.5	55.9
KRE	248	27	71.4	0.5	-12.9	-8.2	-6.2	2.5	47.1
QQL	229	61	75.2	2.2	-12.7	-4.7	-1.3	2.5	61.2
JUD	87	3	77.6	3.3	-10.3	-18.4	0.0	2.5	54.6
SCR	224	41	70.9	0.5	-12.7	-6.4	-0.7	2.5	54.1
BOR	83	192	61.1	2.7	-8.7	0.3	-3.7	2.5	54.2
EHA	173	61	62.4	0.0	-11.5	-4.7	-1.7	2.5	47.0
									64.8

Dragon House Facade A (DH-A) - 22/F
Height = 94.8 m

Road ID	Distance	Angle of View	BNL	GC	DC	AC	BC	FC	CNL
KRW	129	14	75.4	0.5	-10.0	-11.0	0.0	2.5	57.4
KRB	50	34	75.6	0.3	-6.6	-7.3	0.0	2.5	64.5
KRE	50	71	71.4	0.5	-6.6	-4.1	0.0	2.5	63.7
QQL	90	65	75.2	2.2	-8.8	-4.4	0.0	2.5	66.7
BOR	235	55	61.1	2.7	-12.5	-5.2	0.0	2.5	48.7
EHA	95	57	62.4	0.0	-8.8	-5.0	0.0	2.5	51.1
									70.2

Man Shun Tower (MST) - 20/F
Height = 111.5 m

Road ID	Distance	Angle of View	BNL	GC	DC	AC	BC	FC	CNL
KRW	288	19	75.4	0.5	-13.4	-9.8	1.6	2.5	56.9
KRB	49	14	75.6	0.3	-7.2	-11.0	0.1	2.5	60.3
KRE	39	128	71.4	0.5	-6.8	-1.5	-0.5	2.5	65.7
QQL	173	82	75.2	2.2	-11.4	-3.4	-4.0	2.5	61.1
JUD	218	18	77.6	3.3	-12.4	-9.9	0.1	2.5	61.0
SCR	148	14	70.9	0.5	-11.0	-11.2	0.5	2.5	52.2
BOR	313	41	61.1	2.7	-13.7	-6.4	1.5	2.5	47.8
EHA	157	75	62.4	0.0	-10.9	-3.8	-5.4	2.5	44.8
									69.1

BNL = Basic Noise Level
GC = Gradient Correction
DC = Distance Correction
AC = Angle Correction
BC = Barrier Correction
FC = Facade Correction
CNL = Corrected Noise Level

Appendix F

(NOT USED)

Appendix G

COMPENSATION TREE PLANTING PROPOSALS

APPENDIX G COMPENSATION TREE PLANTING PROPOSALS

Compensation tree planting proposals have been prepared as part of the overall landscape proposals for the scheme. The design proposed extensive planting of under-storey tree and large woodland shrub species to promote the long term development of a mature woodland structure and to screen the new highway structures, and to tie the scheme into the surrounding landscape pattern.

The planting proposals comprise the following (see Figures G1 to G7):

Vegetation Type	Description	Approximate Area/Numbers
Woodland Mix	whip and seedling size tree species planted at 1.0m centres into disturbed areas, that have initially been hydroseeded with grass to prevent possible soil erosion, and to give an immediate green appearance to the site.	1590 nos. whips and seedlings
Individual Trees	standard size tree species, planted into slopes, and roadside planter beds.	153 nos.
Street Trees	Heavy standard size tree species, planted in pavement tree pits with HyD standard tree guards and grilles.	58 nos.
Transplanted Trees	existing trees proposed for transplanting will be relocated to roadside planter beds along Kennedy Road.	29 nos.
Low Shrubs and Groundcover	planted alongside all carriageways and footpaths as an edge to woodland and as amenity shrub planting under trees.	
Trailing Plants	planted in 1.0m wide strip along the top of retaining walls.	
Climbing Plants	planted along the base of retaining walls.	

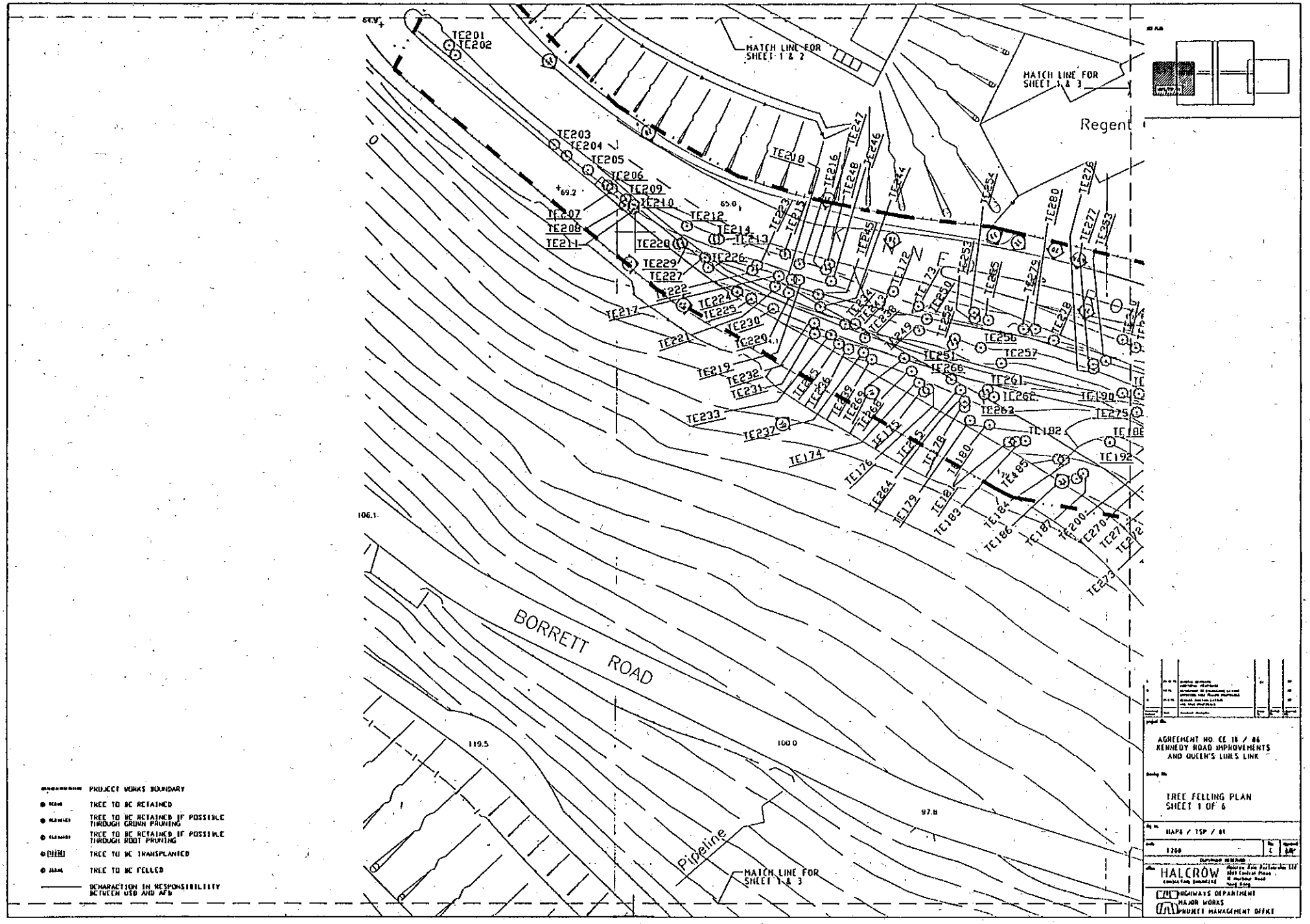

Figure G1 **Tree Felling Plan (Sheet 1 of 6)**

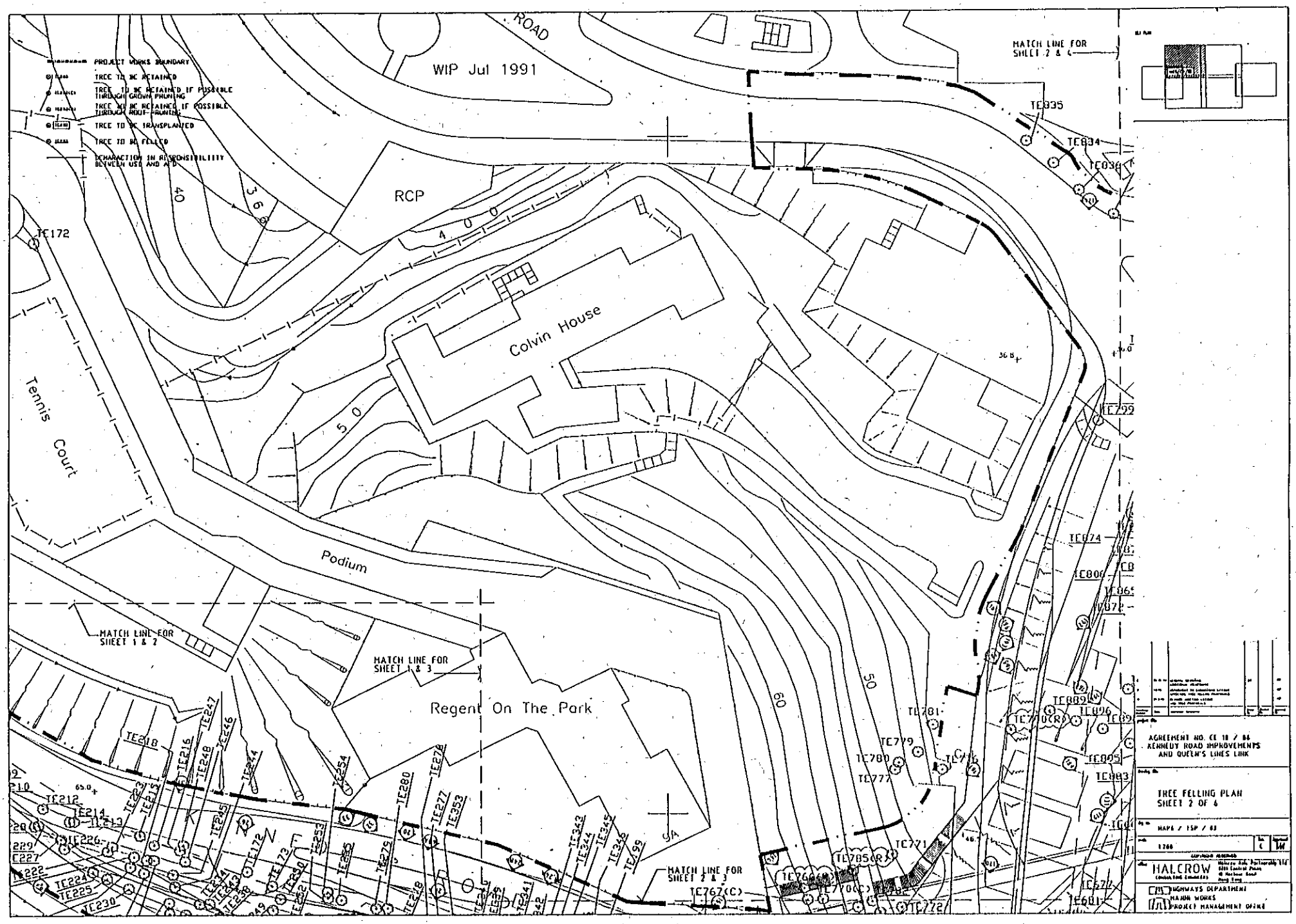

Figure G2 **Tree Felling Plan (Sheet 2 of 6)**

Figure G3 **Tree Felling Plan (Sheet 3 of 6)**

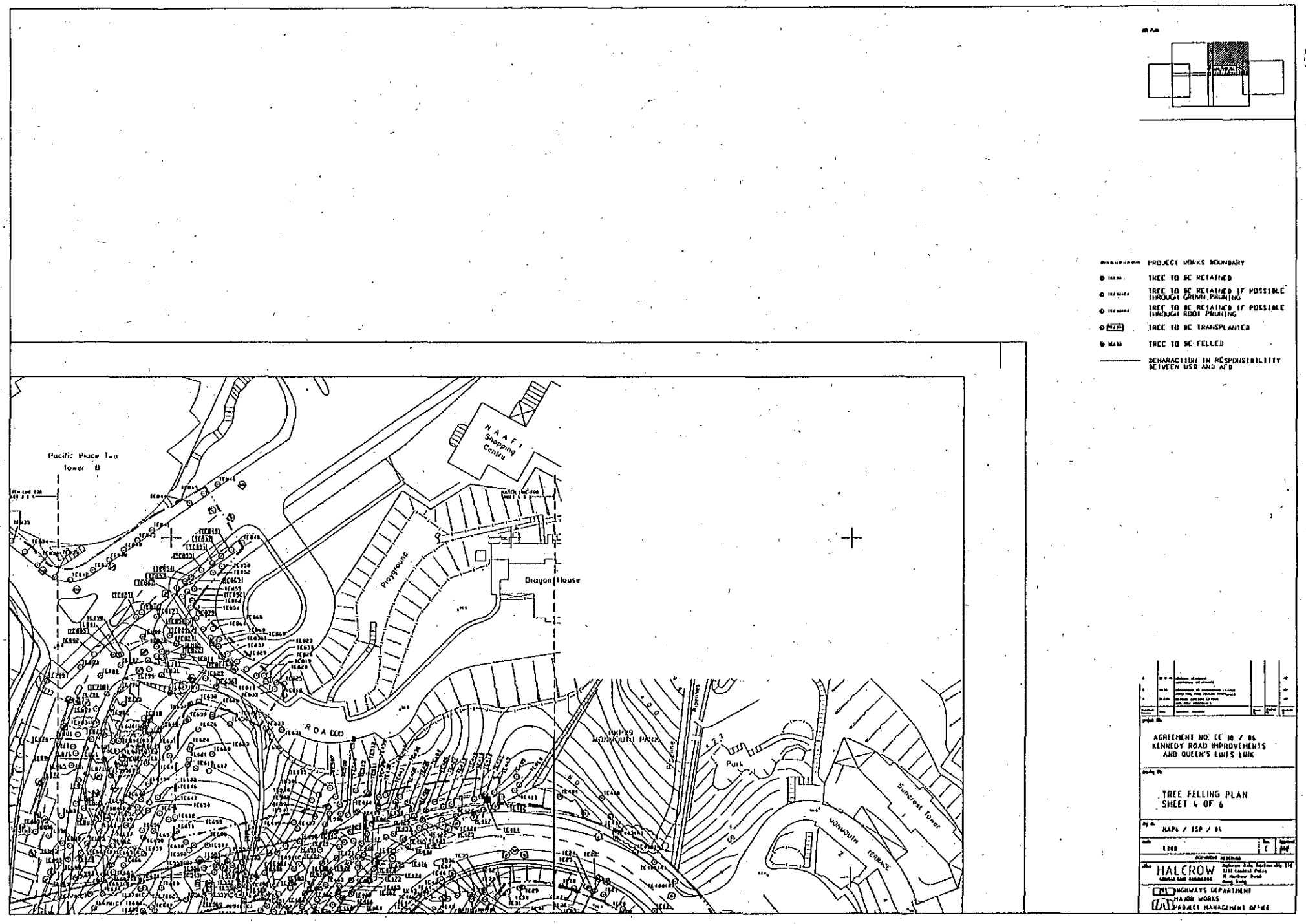

Figure G4 **Tree Felling Plan (Sheet 4 of 6)**

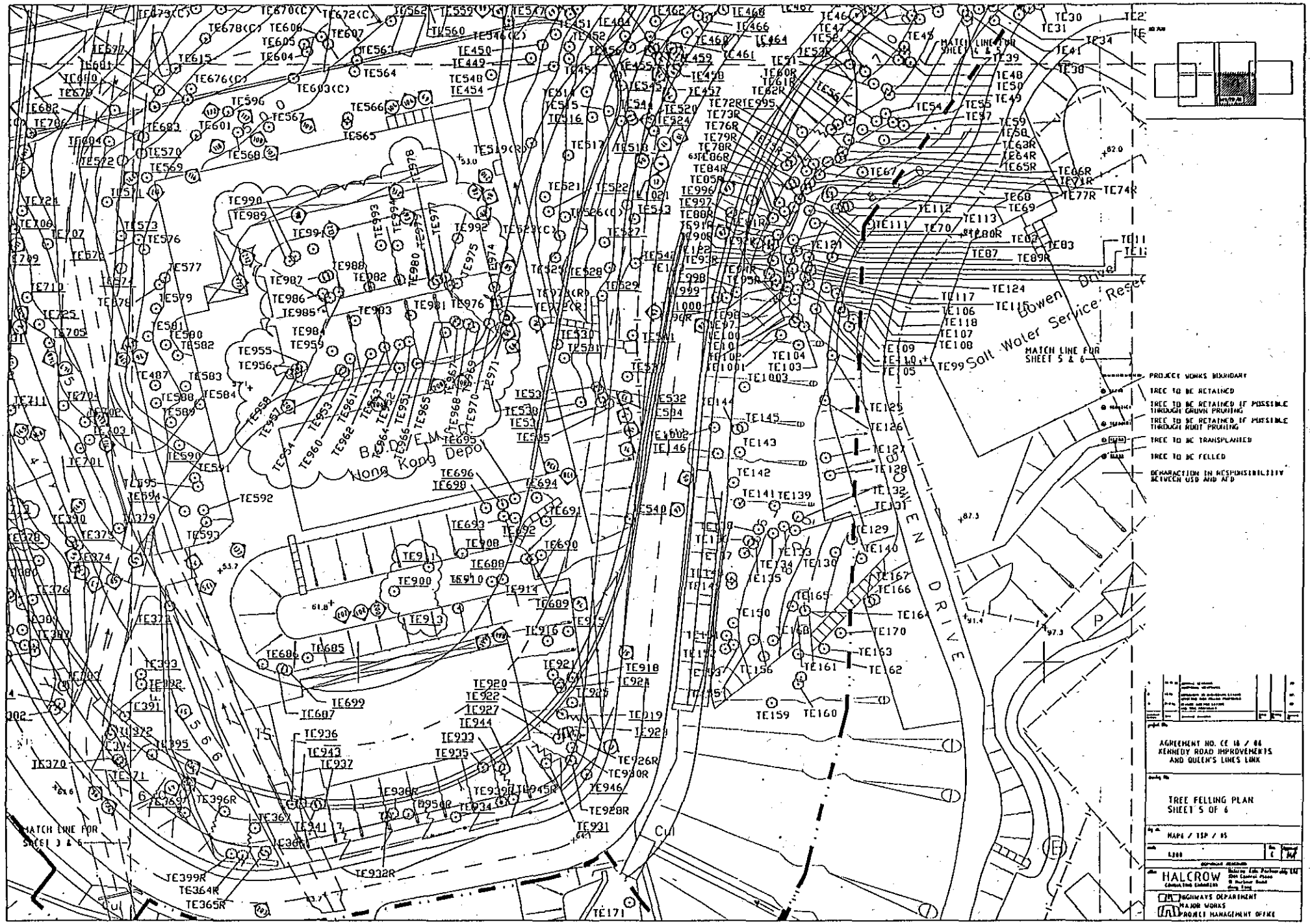

Figure G5 **Tree Felling Plan (Sheet 5 of 6)**

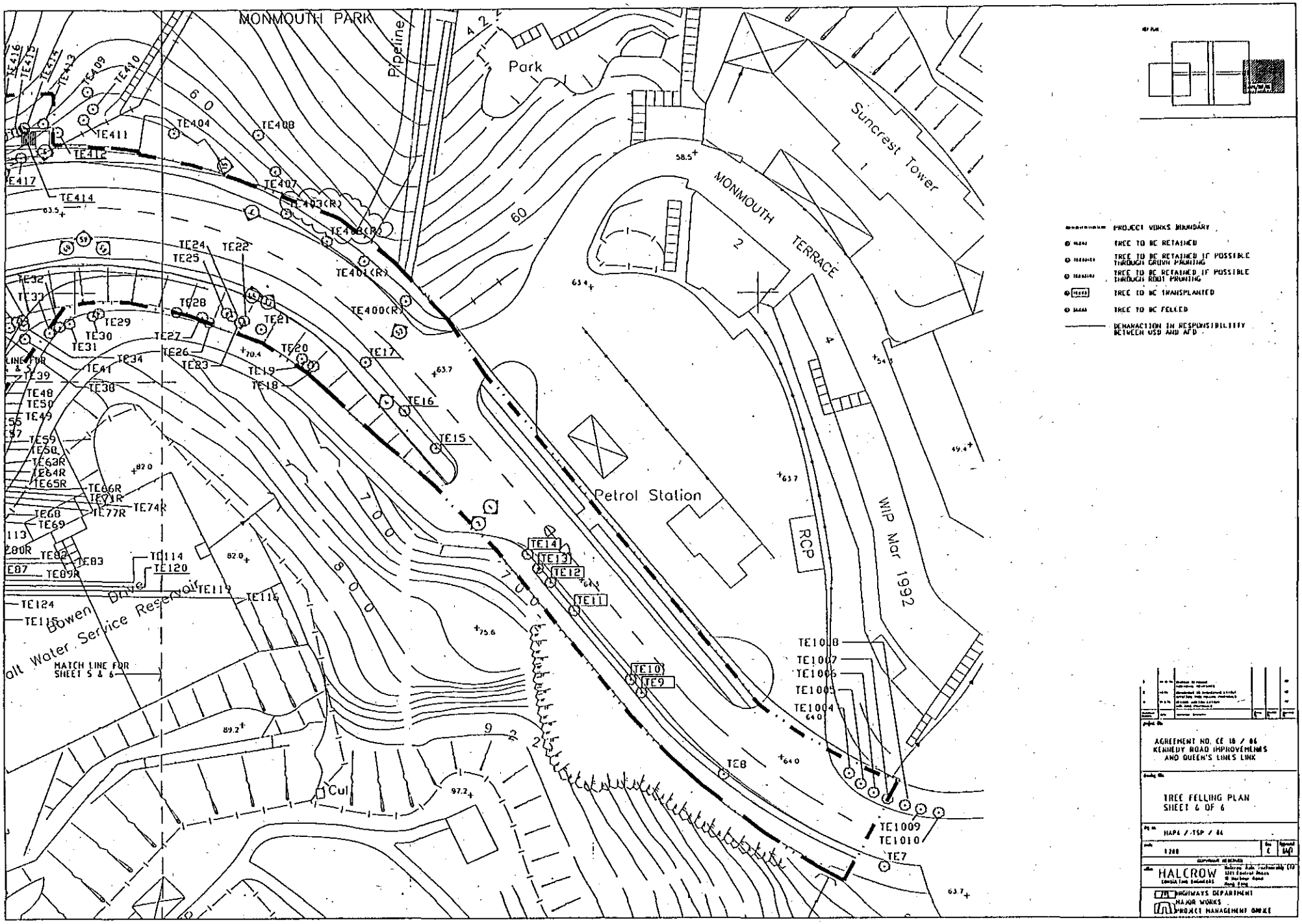

Figure G6 **Tree Felling Plan (Sheet 6 of 6)**

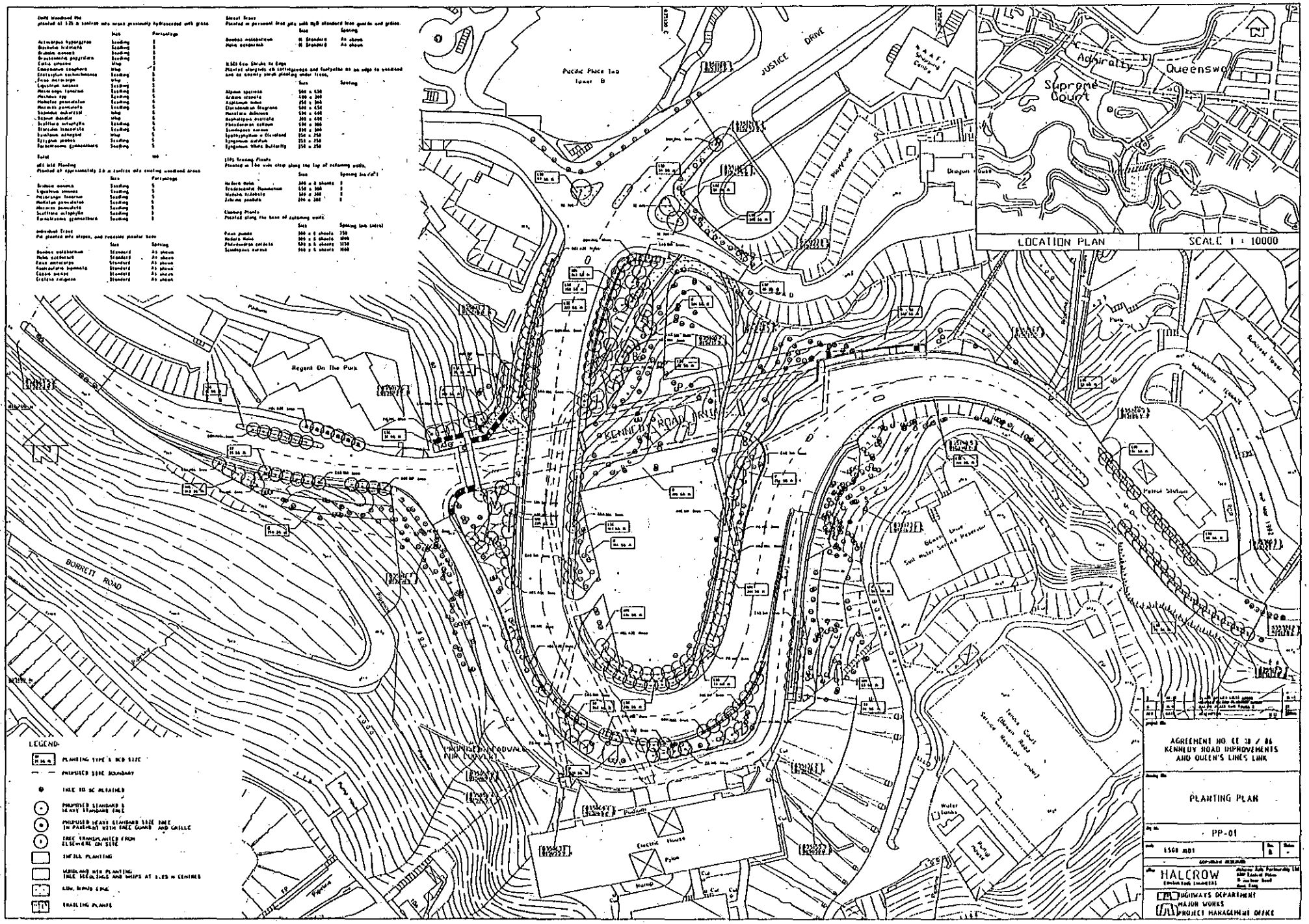

Figure G7 **Planting Plan**

Appendix H

LIST OF REFERENCES FOR ECOLOGICAL STUDY

APPENDIX H LIST OF REFERENCES FOR ECOLOGICAL STUDY

1 References

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2 Personal Communications Cited

Gary Ades. Conservation Officer, Kadoorie Farm.

Appendix I

PLANT SPECIES LIST FOR KENNEDY ROAD SITE, FEBRUARY 1997

APPENDIX I PLANT SPECIES LIST FOR KENNEDY ROAD SITE, FEBRUARY 1997

Species	Habit	Exotic	Relative Abundance
Acacia confusa	T	E	+ +
Aleurites moluccana	T	E	+
Aquilaria sinensis	T		+
Prunus sp.	T		+
Bauhinia sp.	T		+ +
Bischofia javanica	T		+
Bridelia tomentosa	T		+ +
Broussonetia papyrifera	T		+
Carica papaya	T	E	+
Celtis sinensis	T		+
Cinnamomum burmanii	T		+
Cinnamomum camphora	T		+
Cratoxylum cochinchinensis	T		+ + +
Dimocarpus longan	T	E	+ +
Eucalyptus tereticornis	T	E	+ +
Ficus hispida	T		+
Ficus microcarpa	T		+ + +
Ficus spp.	T		+
Ficus superba	T		+
Ficus variegata	T		+
Gossampinus malabaricum	T	E	+
Litsea glutinosa	T		+
Litsea monopetala	T		+ +
Livistona chinensis	T	E	+
Leucaena leucocephala	T		+ +
Macaranga tanarius	T		+ +
Machilus sp.	T		+ +
Mallotus paniculatus	T		+ +
Microcos paniculata	T		+
Musa paradisiaca	T	E	+ +
Phoenix roebelenii	T	E	+
Pinus massoniana	T		+
Schefflera octophylla	T		+
Sterculia lanceolata	T		+ +
Syzygium jambos	T	E	+
.....	.....	.....	.....
Alchornea trewioides	S		+
Desmos cochinchinensis	S		+
Lantana camara	S		+ +
Ligustrum sinensis	S		+ +
Maesa perlarius	S		+ +
Melastoma candidum	S		+
Mussaenda pubescens	S		+
Psychotria rubra	S		+
Solanum nigrum	S		+
.....	.....	.....	.....
Alocasia macrorrhiza	H		+ + +
Alpinia sp.	H		+ +
Justicia sp.	H		+
Liriope spicata	H		+
Oxalis corymbosa	H		+ +

Appendix I (Cont.)

Species	Habit	Exotic	Relative Abundance
Praxelis clematidea	H	E	+
Sagittaria sagittifolia	H		+
.....	.....	.....	.....
Cyrtococcum patens	G		+
.....	.....	.....	.....
Adiantum flabellulatum	F		+
Christella parasitica	F		+
Pteris semipinnata	F		+
.....	.....	.....	.....
Lygodium japonicum	C		+
Mikania micrantha	C	E	++
Rubus reflexus	C		+
Wedelia sp.	C	E	++
.....	.....	.....	.....
Bamboo	B		+

T = tree, S = shrub, H = herb, G = grass, F = fern, C = climber, B = bamboo

+++ = common, ++ = locally common, + = uncommon

Appendix J

SPECIFICATIONS FOR BAT BOXES TO BE USED IN TREES ON KENNEDY ROAD IMPROVEMENTS AND QUEEN'S LINES LINK PROJECT SITE

APPENDIX J SPECIFICATIONS FOR BAT BOXES TO BE USED IN TREES ON KENNEDY ROAD IMPROVEMENT AND QUEEN'S LINES LINK PROJECT SITE

1 Bat Roost Box Specifications

Target species:	Large Bent-winged Bat (*Miniopterus magnater macrodens*), Lesser Bent-winged Bat (*Miniopterus australis*), Great Round-leaf Bat (*Hipposideros armiger armiger*), other microchiropteran bats
Design:	see Figure J1 for sketch plan.
No. of boxes:	5-10
Material:	untreated plywood or other lumber (do not use treated wood, as some chemicals used in wood treatment are harmful to bats)
Height:	up to 60 cm (or slightly smaller if required)
Width:	40 - 50 cm (or slightly smaller if required)
Depth:	approximately 10 cm
Partitions:	Boxes can be constructed with internal vertical partitions to increase the amount of roosting area. 2 - 2.5 cm of space should be left between each partition.
Internal surface:	Internal surfaces of the box must afford an easy grip for bats. This can be achieved by using rough wood in construction, by making shallow horizontal saw cuts on internal surfaces, or by stretching plastic or fibreglass screening tightly over internal surfaces. The landing board should also be rough or tightly covered with screening.
Side slits:	For ventilation, cut a slit in each side of the box, extending one-quarter to one-third of the way up the side.
Lid:	Lid can be hinged for inspection from above if boxes are to be installed in positions where such inspection will be feasible. Otherwise inspection can be conducted from below with torch and field glasses.

J2 Siting of Bat Boxes on the Project Site

Figure J2 shows 8 possible sites for installation of bat boxes. These sites were selected using the following criteria:

- located on the project site but not immediately adjacent to active works areas;
- having clumps of trees which are marked on the Tree Felling Plan (Halcrow, Drgs. No. HAP6 / TSP / 01 - 06) as "to be retained"; and
- located on the edge of a larger patch of contiguous woodland, where possible.

Trees at these sites, where identified to species in the Tree Survey Report (see Appendix H, Halcrow, May 1997), were native species typical of secondary woodland on Hong Kong Island. They included *Machilus* sp., *Ficus microcarpa*, *Cratoxylum cochinchinense*, *Schefflera octphylla* and *Artocarpus hypargyrea*.

It is proposed that 5 sites from the 8 proposed be selected by Highways Department, based on feasibility, accessibility and safety considerations. Sites which are likely to be less disturbed by construction activities are preferred. The consultant will accompany Highway Department staff onto the site if requested to assist in selection of sites.

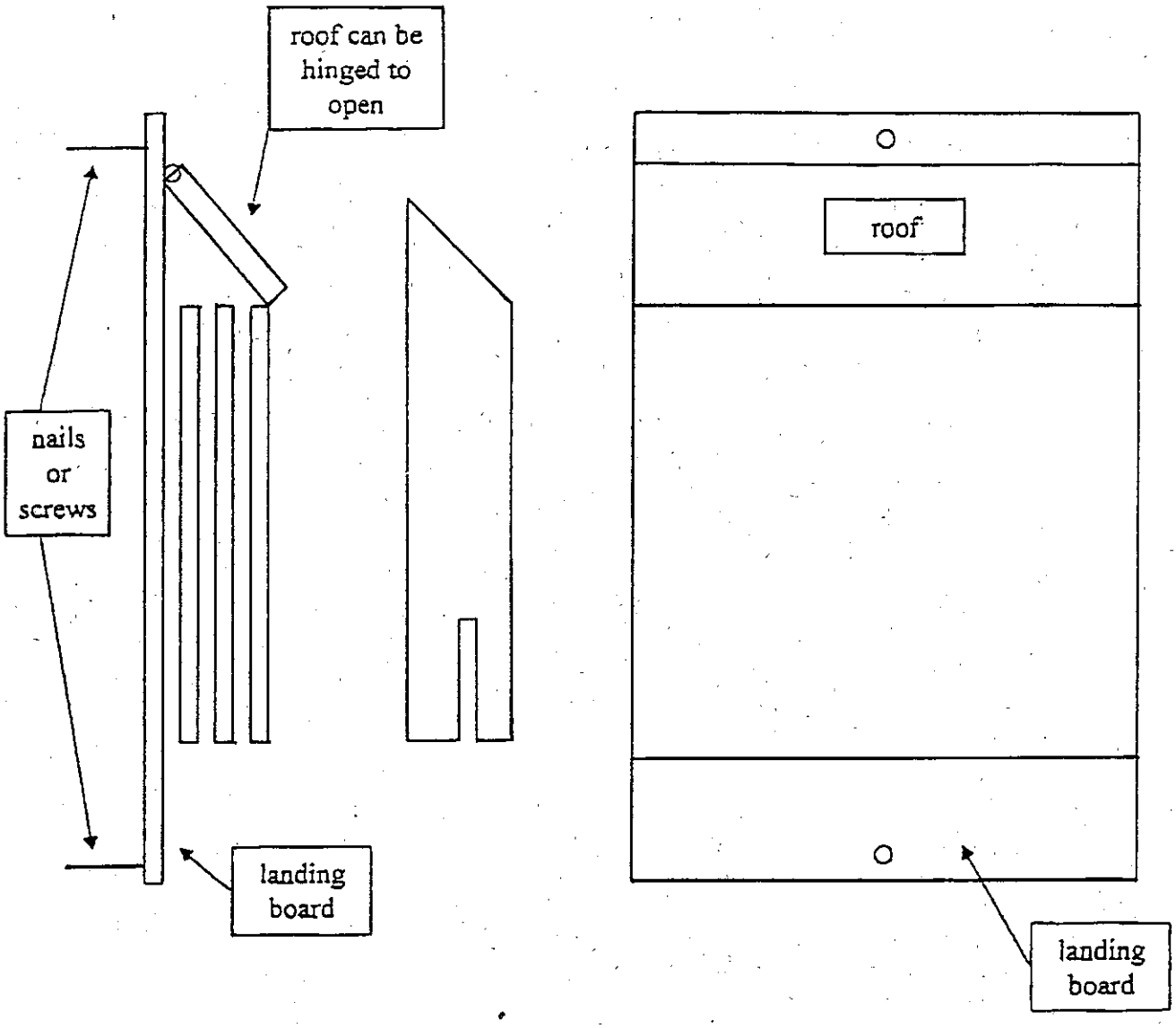
Any tree at these sites which is sufficiently high and free from works disturbance (including root overfilling, root pruning or crown pruning) will be acceptable as a base on which to install a box. Boxes may be installed facing outward from the centre of a clump of trees, as this will make them easier for bats to locate.

Two bat roost boxes should be installed at each of the 5 sites selected. The two boxes should be installed on neighbouring trees and at different exposures, and different heights if feasible. Small differences in temperature and exposure have been shown to be significant to bats choosing a roosting site. Small-scale variation in siting will thus increase the likelihood of colonisation.

Installation: Should be 4-5 m or higher up on tree trunk. Do not place directly on or above a major limb that will make access difficult for flying bats.

Attachment: Attachment to the tree with rust-proof screws is recommended. Shorter screws can be used which do not penetrate below the bark, as long as the box is securely fastened. Such attachment will not be harmful to a healthy, mature tree. Brackets and wire attachment can be used but are more likely to constrict tree growth.

Exposure: A southern or partly southern exposure is recommended to allow a moderate amount of sun exposure. A maximum of four hours of morning sun is recommended, and no direct sun during rest of day, in tropical latitudes.

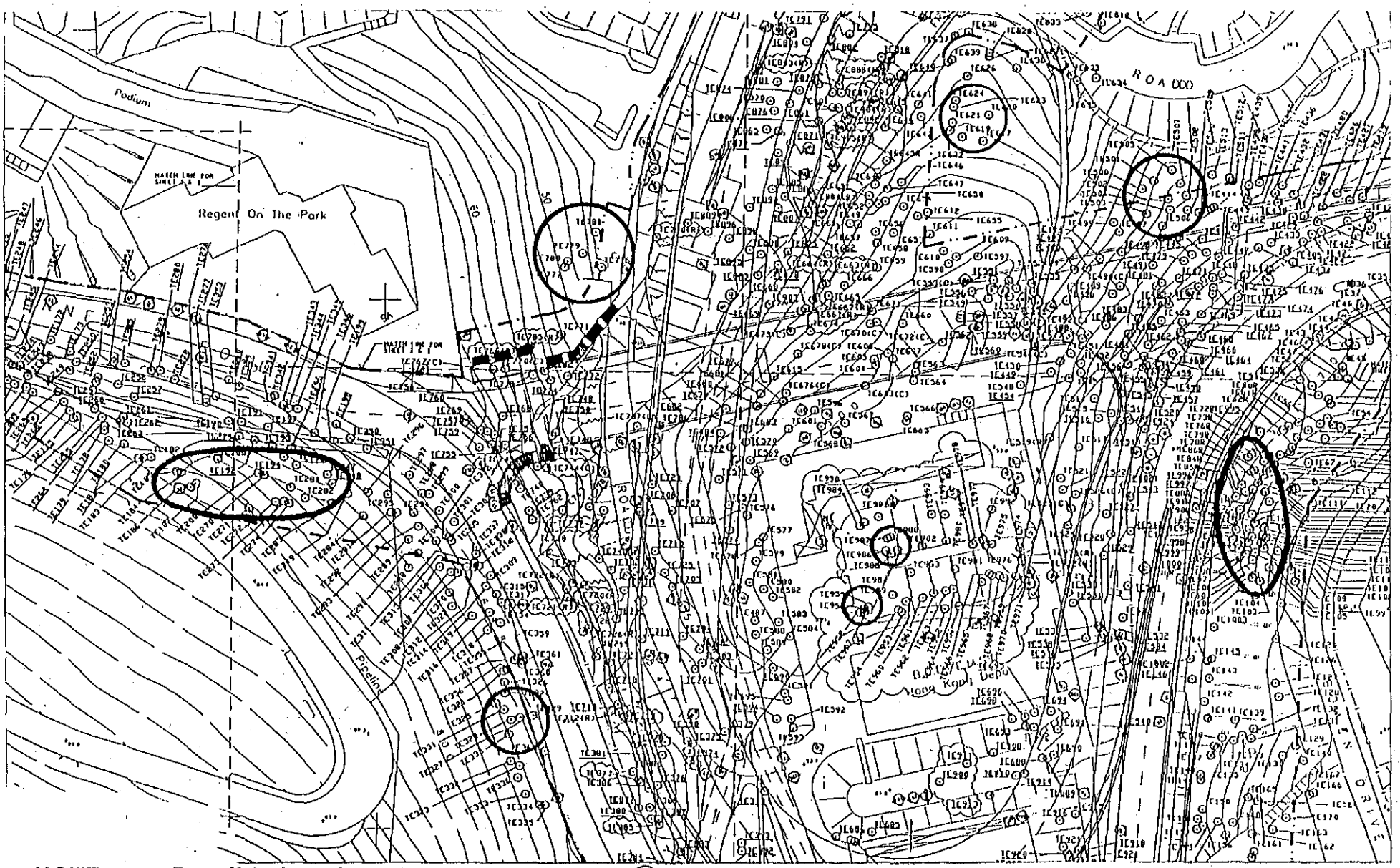


Side view without side board in place, showing partitions (optional)

Side board showing ventilation slit

Front view

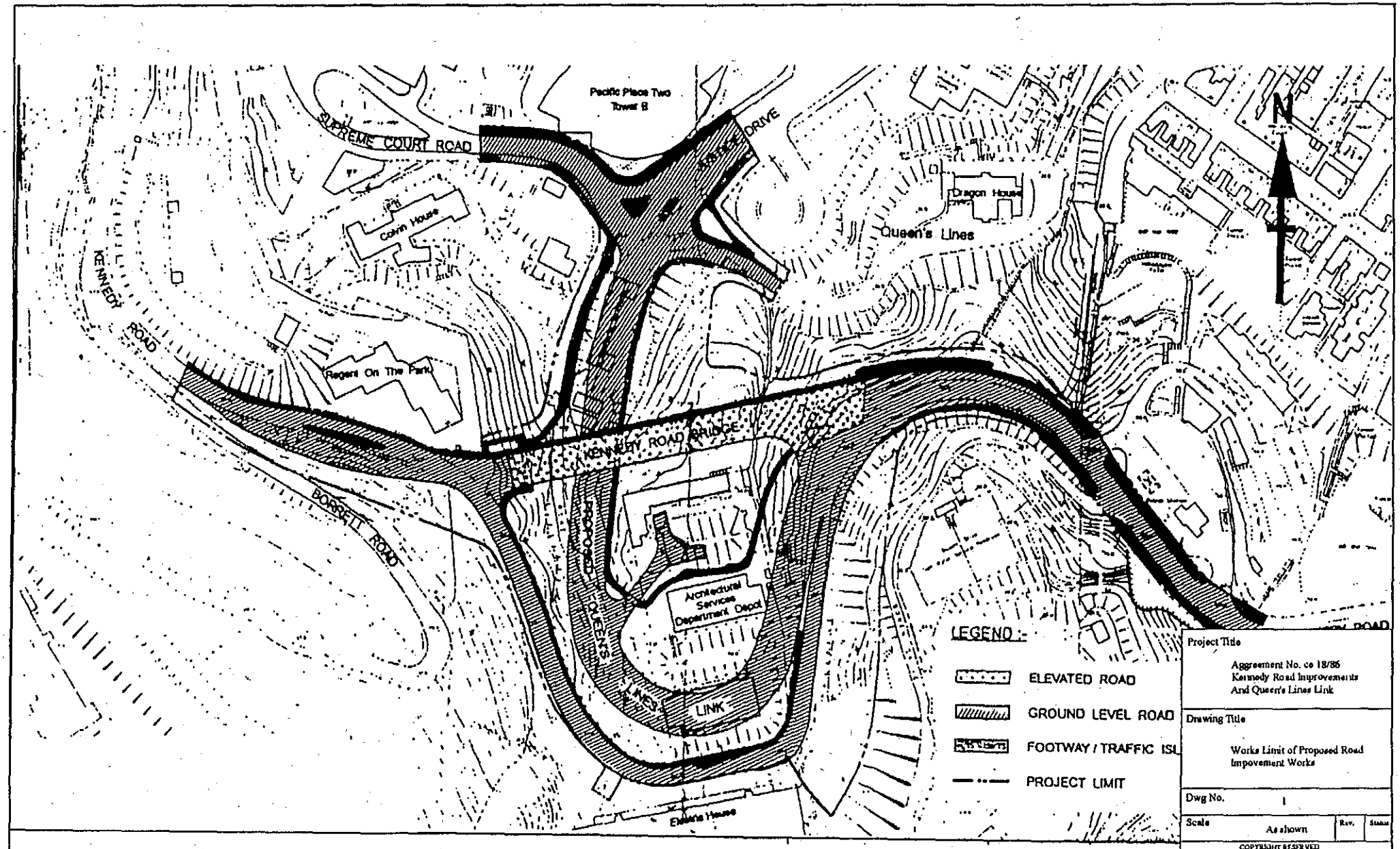
Figure J1 Sketch Plan for Bat Roost Box



NOTE: **Possible locations for bat roost boxes ○ indicates a cluster of trees suitable for placement of boxes**

Figure J2 **Possible Sites for Installing Bat Roost Boxes**

FIGURES



Project Title

Agreement No. ce 18/86
Kennedy Road Improvements
And Queen's Lines Link

Drawing Title

Works Limit of Proposed Road
Improvement Works

Dwg No. 1

Scale As shown | Rev. | Status

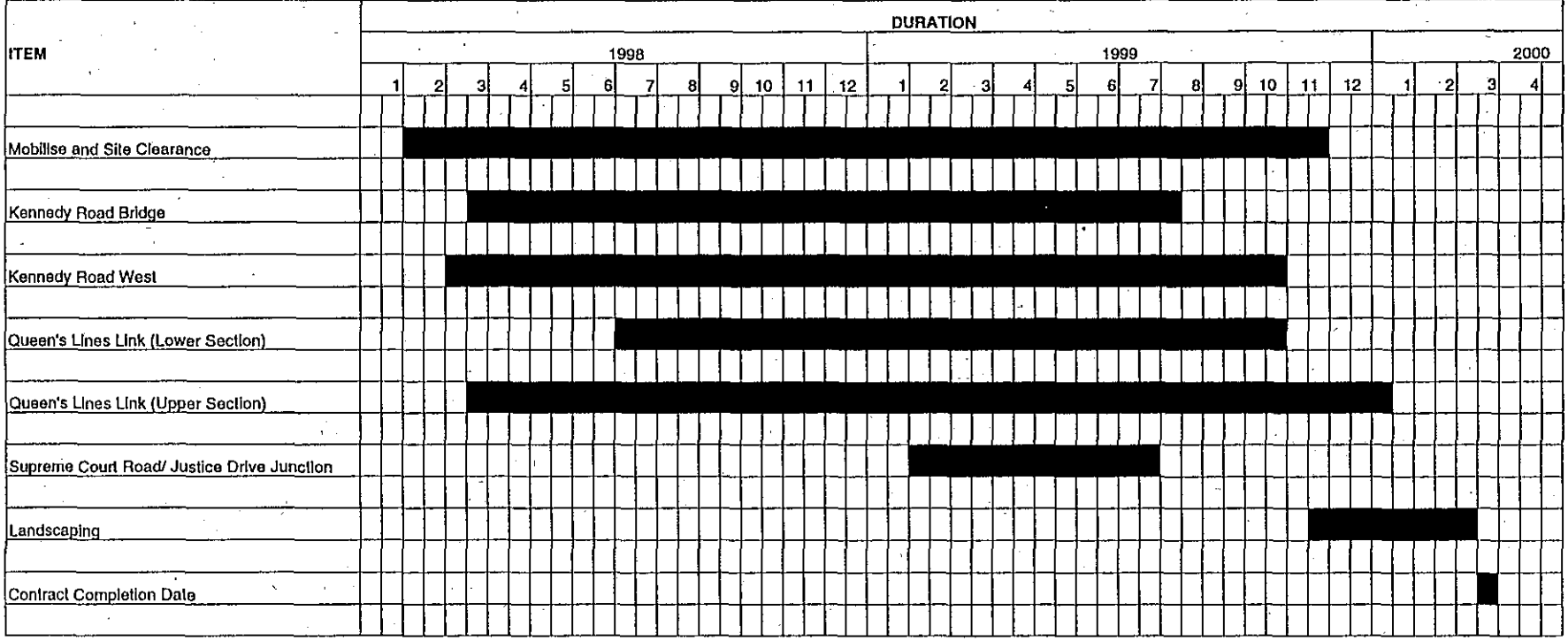
Office HALCROW CONSULTING ENGINEERS

HIGHWAYS DEPARTMENT
MAJOR ROAD
PROJECT MANAGEMENT OFFICE

AGREEMENT NO. 18/96

KENNEDY ROAD IMPROVEMENT & QUEEN'S LINES LINK

CONSTRUCTION PROGRAMME



Project Title

Agreement No. ce 18/96
Kennedy Road Improvements
And Queen's Lines Link

Drawing Title

Preliminary Construction Programme

Dwg No. 2

Scale N.T.S

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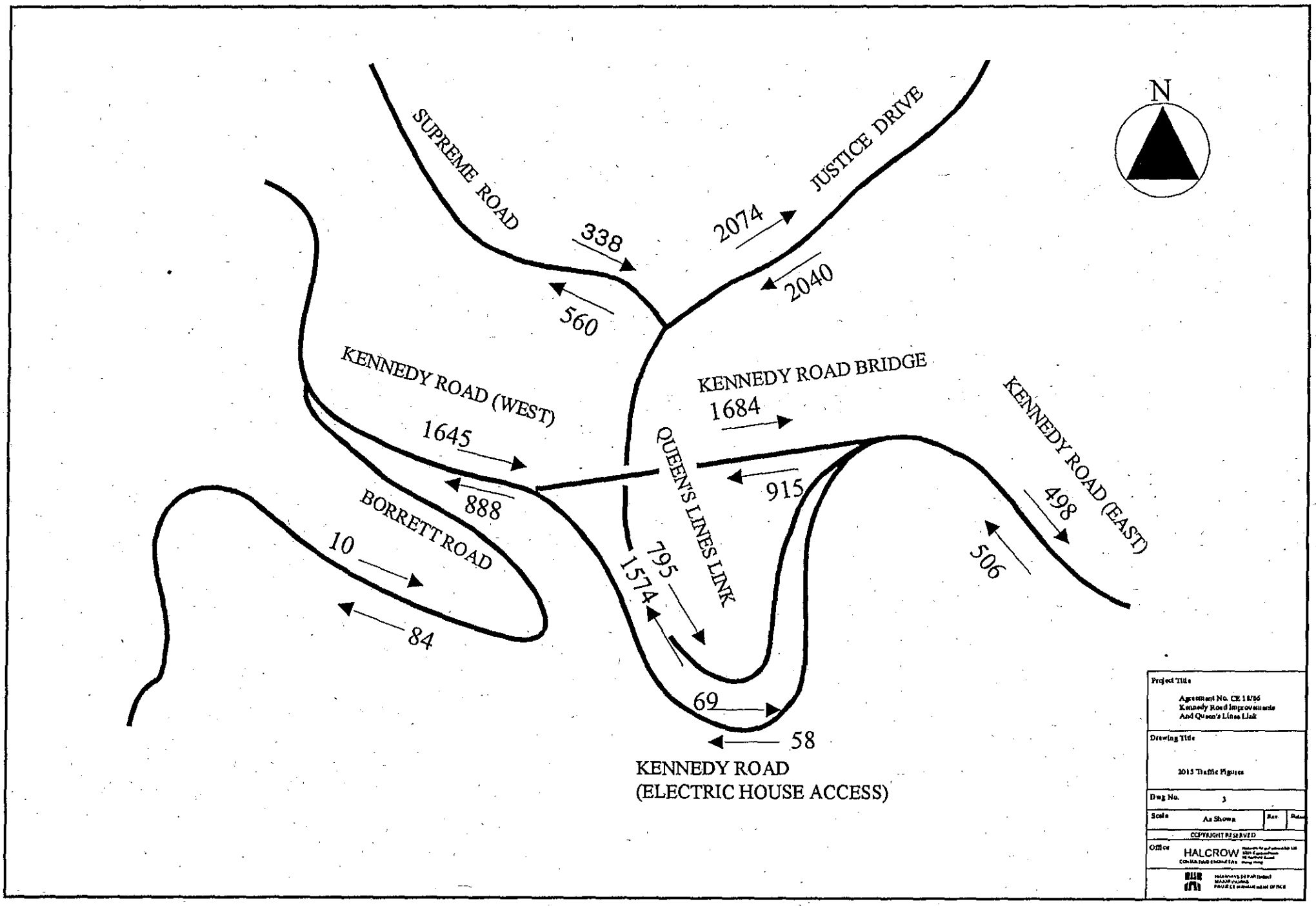
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JUSTICE DRIVE
338
2074
2040
560
KENNEDY ROAD (WEST)
KENNEDY ROAD BRIDGE
1684
1645
888
915
QUEEN'S LINES LINK
KENNEDY ROAD (EAST)
498
506
BORRETT ROAD
10
84
795
1574
69
58
KENNEDY ROAD
(ELECTRIC HOUSE ACCESS)
N
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Kennedy Road Improvements
And Queen's Lines Link
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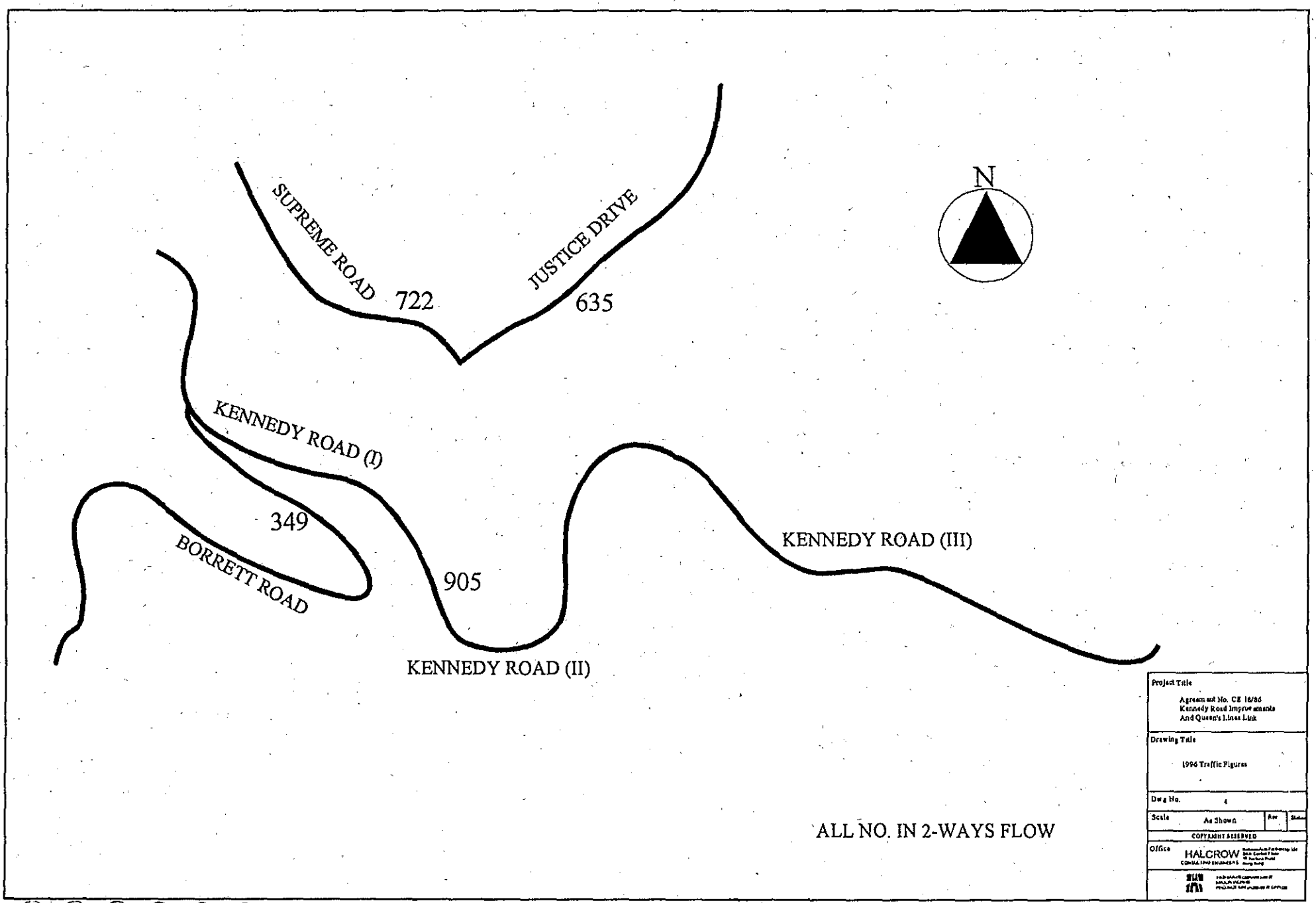
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JUSTICE DRIVE
635
N
KENNEDY ROAD (I)
349
BORRETT ROAD
905
KENNEDY ROAD (III)
KENNEDY ROAD (II)
ALL NO. IN 2-WAYS FLOW
Project Title
Agreement No. CE 16/96
Kennedy Road Improvements
And Queen's Lines Link
Drawing Title
1996 Traffic Figures
Dwg No. 4
Scale As Shown
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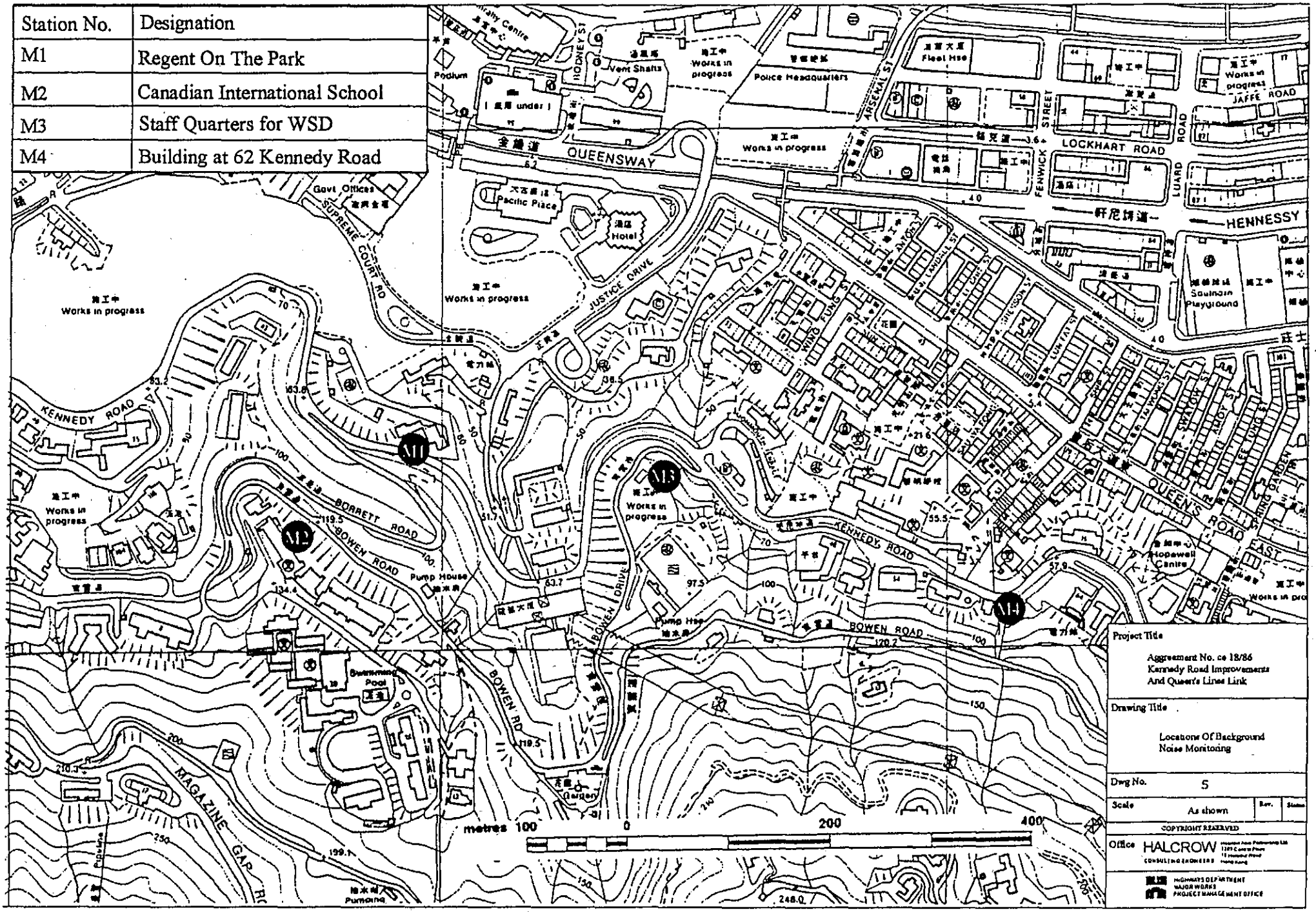
Office
HALCROW

Station No.	Designation
M1	Regent On The Park
M2	Canadian International School
M3	Staff Quarters for WSD
M4	Building at 62 Kennedy Road



Project Title

Agreement No. ce 18/86
Kennedy Road Improvements
And Queen's Lines Link

Drawing Title

Locations Of Background
Noise Monitoring

Dwg No. 5

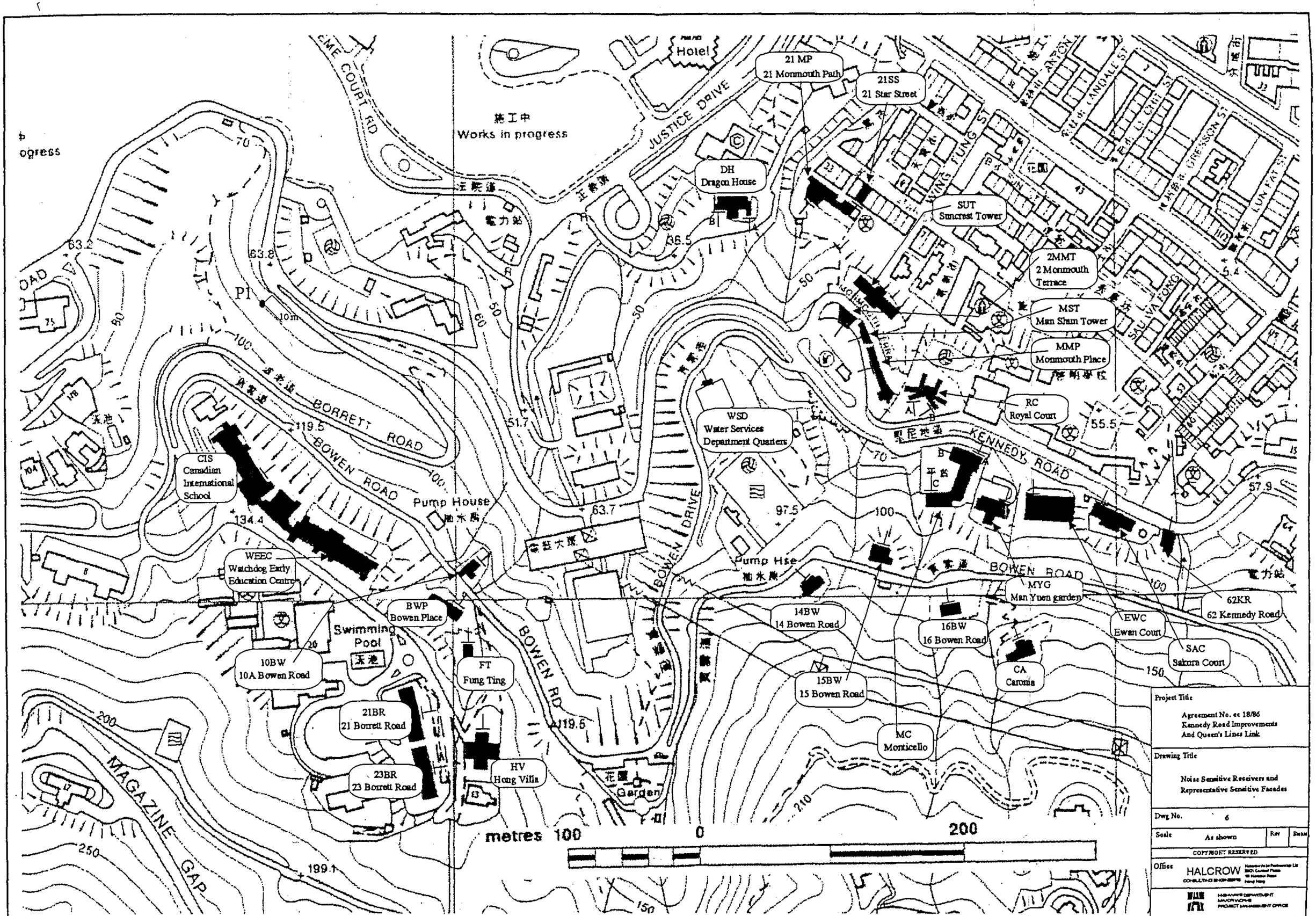
Scale As shown

Rev.

Status

Office HALCROW CONSULTING ENGINEERS

HIGHWAYS DEPARTMENT
MAJOR WORKS
PROJECT MANAGEMENT OFFICE



Project Title

Agreement No. ec 18/86
Kennedy Road Improvements
And Queen's Lines Link

Drawing Title

Noise Sensitive Receivers and Representative Sensitive Facades

Dwg No. 6

Scale As shown | Rev | Status

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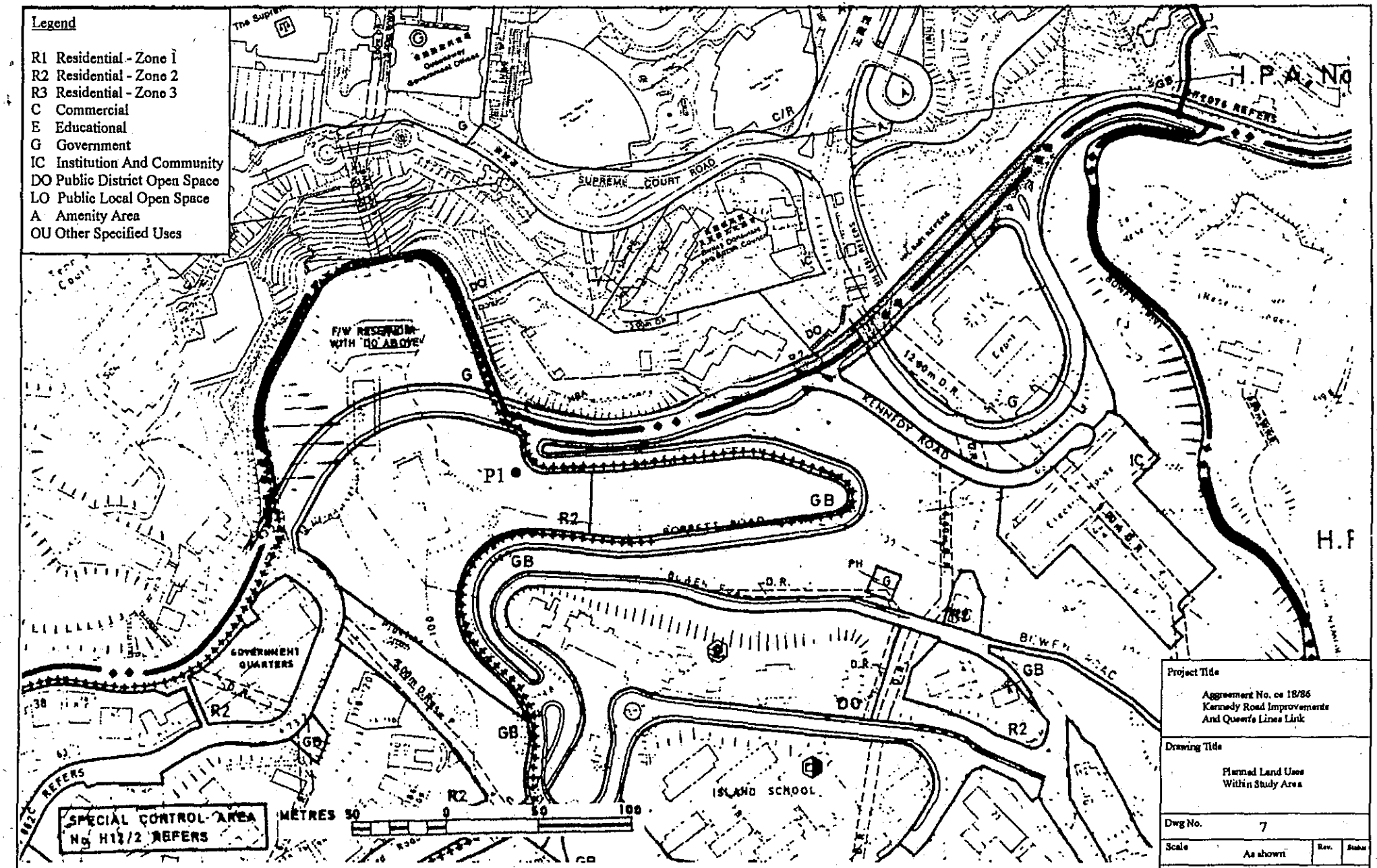
HIGHWAYS DEPARTMENT
MAJOR WORKS
PROJECT MANAGEMENT OFFICE



Sources: O.D.P. Nos D/H4/2 and D/H11/1A