MTR Corporation Limited

HONG KONG SECTION OF GUANGZHOU – SHENZHEN – HONG KONG EXPRESS RAIL LINK

(No. EP-349/2009/B)

Contingency Plan for Groundwater Drawdown for Mei Lai Road to Hoi Ting Road Tunnels (Contract 820) (Revision 1)

Verified by:	
Position:	Independent Environmental Checker
Date:	27 June 2011

MTR Corporation Limited

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(No. EP-349/2009/B)

Contingency Plan for Groundwater Drawdown for Mei Lai Road to Hoi Ting Road Tunnels (Contract 820) (Revision 1)

Certified by: Glenn Frommer

Position: Environmental Team Leader

Date: 24 JUN 2011

MTRC Express Rail Link Contract 820
Mei Lai Road to Hoi Ting Road Tunnels

Environmental Document

Document Ref. No.:

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Project Code				Works Package Code		Type of Document				Area Code +					Sequential Number				Rev. Index

Document Title:

Contingency Plan for Groundwater Drawdown

	PREPARED BY:	INTERNAL REVIEW:			INTERNAL APPROVAL:
COMPANY	DBJV	DBJV	DBJV	DBJV	DBJV
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SIGNATURE					
DATE	17 Mar 2011	17/3/2011	18/3/2011	18/3/11	

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Revision	Rev. Date	Sections	Amendment Source and/or Details
A	17 March 11	All	First Issue

CONTENTS

LIST OF APPENDICES

1.1 Background

As stated in the Particular Specification 22.5.2, the Contractor shall develop a Groundwater Monitoring and Emergency Response Plan and submit the plan to the Engineer for Approval in order to establish a mechanism on checking any excessive drawdown of groundwater level during the course of tunneling and deep excavation. This plan is prepared to fulfill the condition 2.11 of the Environmental Permit.

With the implementation of effective groundwater level monitoring programme, it is anticipated that any unusual/ significant drop of groundwater level will be identified beforehand and mitigation measures will be promptly taken when foreseeable excessive water level drawdown is encountered. As a result, any adverse effect such as ground settlement, damage of existing building service in the vicinity of works and influence to aquatic life, if any, around the works area can be minimized.

Hydrogeological impact assessment has been carried out during the EIA study for the designated project, Hong Kong Section of Guangzhou – Shenzhen – Hong Kong Express Rail Link. It is suggested in the study that the effect of groundwater drawdown due to tunneling work along the section of ecologically sensitive areas, e.g. Mai Po Area, has to be considered and preventive actions must be established to avoid the actual occurrence of significant drawdown of groundwater level during the course of the work. As there are no ecologically sensitive areas and identified stream courses along the vicinity of the Contract 820, the effect of the variation of groundwater level to the nature environment shall not be a major issue for the project.

It is anticipated that the variation of groundwater level for the Contract shall be under control with the effective implementation of approved methodology of tunneling and delivery of quality workmanship throughout the course of the work.

1.2 Programme of Monitoring

As listed in the Environmental Permit No. EP-349/2009/B and required under the P.S. 22.5.2, a groundwater monitoring programme is developed in this plan to monitor the groundwater level as part of the comprehensive ground monitoring strategy with reference to Appendix N of the Particular Specification. Responsible parties are listed in Appendix A for the implementation of the plan.

Groundwater monitoring locations will be determined on site with reference to drawings as shown in the attached drawing No. 820/W/380/ATK/C06/650 to 820/W/380/ATK/C06/656 and 820/W/380/ATK/C06/660.

The groundwater monitoring will be conducted by the following phases:

- Background monitoring:

  Conducted at initial phase to establish the existing ground water level conditions;

- Active monitoring:

  Conducted during active construction works within 50m of instrument; and

- Standard monitoring:

  Conducted during times when background and active monitoring are not required, or when works are considered minor that will unlikely caused changed to conditions of groundwater by the Engineer.

1.3 Methodology of Monitoring and Reporting

- Methodology

  The methodology of groundwater level monitoring shall follow M&W Clause 23.19.03 which details below:

  (1) A formal initial reading of an open standpipe piezometer shall consist of the average of three readings with the water level indicator. The indicator shall be removed from the riser pipe between these three readings.

  (2) Each reading other than the formal initial reading shall be a single reading with the water level indicator.

  (3) Reading accuracy shall be ±10mm and shall be referenced to the top of the riser pipe.

  (4) Field calibration of water level indicators shall consist of checking the graduated tape against a standard traceable to a national standards agency approved by the Engineer, to an accuracy of ±5mm.

  Monitoring will be undertaken by recording the water level in existing piezometers and those installed by the Contractor.

- Reporting

  The reporting of the groundwater level monitoring results shall follow M&W Clause 23.19.04 which details below:

  (1) Plots of open standpipe piezometer data shall show groundwater elevation versus time.
  (2) For standpipe piezometers in areas influenced by tidal variation, the plots of piezometer data shall also show the tide level plotted against time on the same axis.

1.4 Frequency of Monitoring

The groundwater monitoring program will be conducted by the frequencies specified in Table 1.4a and 1.4b.

Table 1.4a Groundwater Monitoring Plan along Regular Works Area

Instrument Type	Depth	Proposed Monitoring Frequency		
		Background Monitoring	Standard Monitoring	Active Monitoring
Open Standpipe Piezometer	Existing Standpipe Tip Depth	Weekly	Monthly	Daily

Table 1.4b Groundwater Monitoring Plan for the Nam Cheong Launch Shaft including Nam Cheong Ventilation Building

Instrument Type	Depth	Proposed Monitoring Frequency		
		During Wall Installation	During Excavation	Prior to Backfilling to Ground Level
Open Standpipe Piezometer	Temporary Retaining Wall Toe Level	Weekly	Daily	Twice a Week

Appendix N (Table N6) of the Particular Specification has listed the existing piezometers to be monitored. The current piezometers in monitoring are listed in Table 1.4c.

Table 1.4c Current Piezometers in Monitoring

No.	Hole No. 2108/XRL/	No.	Hole No. 2108/XRL/	No.	Hole No. 2108/XRL/
1	A053	16	D035	31	D294
2	A060	17	D037	32	D297
3	A062	18	D272	33	D298
4	A063	19	D273	34	D300
5	A065	20	D275	35	D300a
6	A067	21	D276	36	D301D
7	A068	22	D278	37	EDH-11
8	A069	23	D279	38	EDH-13
9	A070b	24	D281	39	
10	A072	25	D283	40	
11	A073	26	D287	41	
12	B031	27	D288	42	
13	D030	28	D290	43	
14	D031	29	D291	44	
15	D033	30	D292	45	

The Designer of the Contractor will advise whether additional monitoring points shall be added.

1.5 Trigger Levels

Groundwater monitoring is conducted to monitor both the works and the impact of these works on the adjacent area. Groundwater monitoring will be carried out in accordance with the monitoring plan and "Alert", "Action" and "Alarm" response values as tabulated in Table 1.5

Table 1.5 Monitoring Trigger Levels

Monitoring	Alert	Action	Alarm
Groundwater Drawdown	500mm below the lowest historical groundwater level	800mm below the lowest historical groundwater level	1000mm below the lowest historical groundwater level

1.6 Actions Taken Upon Activating of Trigger Levels

The Dragages – Bouygues Joint Venture (the JV) shall review the existing standpipes/piezometers installed by the Employer, propose and install new standpipes/piezometers and other relevant instrumentation at new underground excavation areas upon agreement with Employer. In addition, the JV will develop procedures for prompt data collection and interpretation and communication of critical readings and subsequent remedial measures, if necessary.

The JV will adopt the following framework for the actions to be taken in order to minimize the accidentally excessive drawdown of groundwater.

Table 1.6 Action Plan

Item	Action Taken	Action Party
Alert Level	• Notify the Engineer;	JV
	• Review any abnormal readings on other instrumentation monitoring points;	JV
	• Liaise all relevant land/ property owner and utility undertaker	JV and the Engineer
Action Level	• Notify the Engineer;	JV
	• Review any abnormal readings on other instrumentation monitoring points by the JV;	JV
	• Investigate any physical impact on Existing Building Structure and water mains;	JV
	• Increase the frequency of monitoring;	JV
	• Propose mitigation measures for the Engineer to consider if necessary;	JV and the Engineer
	• Implement the mitigation measures once agreed	JV
Alarm Level	• Notify the Engineer;	JV
	• Review any abnormal readings on other instrumentation monitoring points by the JV;	JV

Item	Action Taken	Action Party
	• Investigate any physical impact on Existing Building Structure and water mains;	JV
	• Carry out comprehensive condition survey and assessment	JV
	• Cease the work adjacent any Existing Building Structure and water mains under significant influence if considered necessary or once ordered by the Engineer	JV
	• Propose mitigation measures for the Engineer to consider;	JV and the Engineer
	• Implement the mitigation measures	JV

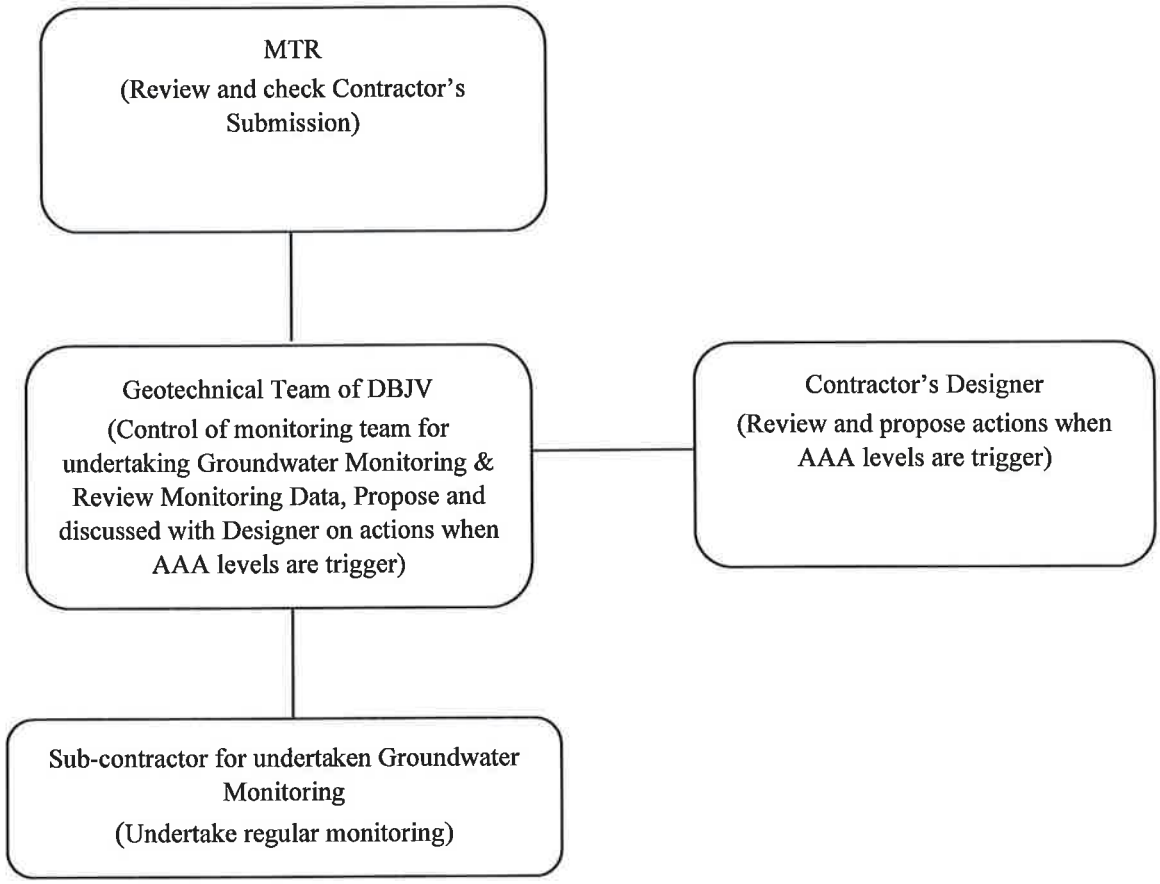
Note:

- The designer of the Contractor shall review the readings of the instruments exceeding the AAA values and those surrounding them. The designer will advise what mitigation measures are required if levels are triggered.

- Mitigation measures when reaching monitoring trigger levels can only be considered case by case. However, some typical measures may include grouting at the affected area or revise method by avoiding large scale of excavation.

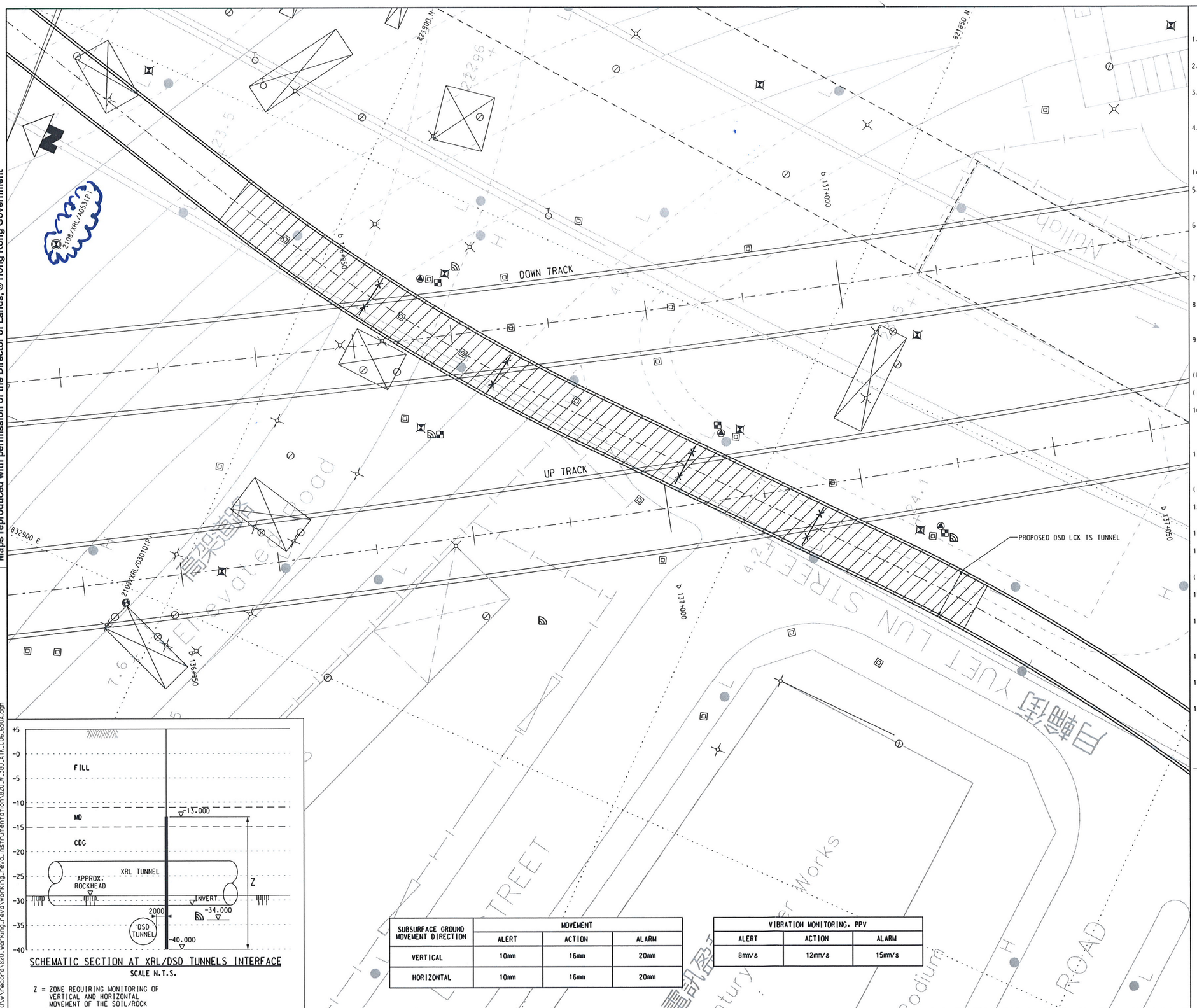
APPENDIX A

Organization Chart for Implementation of Contingency Plan for Groundwater Drawdown


MTR
(Review and check Contractor's Submission)
Geotechnical Team of DBJV
(Control of monitoring team for undertaking Groundwater Monitoring & Review Monitoring Data, Propose and discussed with Designer on actions when AAA levels are trigger)
Contractor's Designer
(Review and propose actions when AAA levels are trigger)
Sub-contractor for undertaken Groundwater Monitoring
(Undertake regular monitoring)

APPENDIX B

Monitoring Locations of Groundwater



SCHEMATIC SECTION AT XRL/DSD TUNNELS INTERFACE

SCALE N.T.S.

Z = ZONE REQUIRING MONITORING OF VERTICAL AND HORIZONTAL MOVEMENT OF THE SOIL/ROCK

SUBSURFACE GROUND MOVEMENT DIRECTION	MOVEMENT		
	ALERT	ACTION	ALARM
VERTICAL	10mm	16mm	20mm
HORIZONTAL	10mm	16mm	20mm

VIBRATION MONITORING, PPV		
ALERT	ACTION	ALARM
8mm/s	12mm/s	15mm/s

GENERAL NOTES:

1. THIS DRAWING SHOWS THE PROPOSED ARRANGEMENT FOR INSTRUMENTATION IN THE VICINITY OF THE INTERFACE BETWEEN THE XRL TUNNELS AND THE DSD LCK TS TUNNEL, AND ADJACENT AREAS.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NOS. 820/W/380/ATK/C06/647-649, 651 AND 665-671.
3. ALL INSTRUMENTS SHOWN ON THIS DRAWING (EXCEPT GROUND SETTLEMENT MARKERS AND INSTRUMENTS TO BE INSTALLED INSIDE THE DSD LCK TS TUNNEL) SHALL BE LOCATED AT A MINIMUM DISTANCE (IN PLAN) OF 2M FROM THE EXTRADOS OF THE XRL TUNNELS AND DSD LCK TUNNEL.
4. THE CONTRACTOR SHALL LIAISE WITH THE ENGINEER / DSD TO SEEK APPROVAL OF THE PROPOSED INSTRUMENTATION LOCATIONS IN THE VICINITY OF THE DSD LCK TS TUNNEL PRIOR TO INSTALLATION.

INSTRUMENTATION AND MONITORING OF DSD LCK TS TUNNEL:

(a) INSTRUMENTATION OUTSIDE THE DSD TUNNEL

5. THE CONTRACTOR SHALL INSTALL EXTENSOMETERS AND INCLINOMETERS AT THE LOCATIONS SHOWN ON THE DRAWING, AND AS REASONABLY CLOSE TO THE LIMIT OF 2M AWAY FROM THE EXTRADOS OF THE DSD LCK TS TUNNEL.
6. EXTENSOMETERS AND INCLINOMETERS SHOWN ON THIS DRAWING SHALL BE INSTALLED TO OBTAIN A CONTINUOUS VERTICAL AND HORIZONTAL MOVEMENTS PROFILE OF THE GROUND ADJACENT TO THE DSD LCK TS TUNNEL FROM ELEVATIONS -13MPD TO -40MPD. THE TYPE/DETAILS OF THE EXTENSOMETER AND INCLINOMETER SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
7. THE INCLINOMETER SHALL PROVIDE MEASUREMENTS ALONG ITS LENGTH AT 1M INTERVALS, AND THE EXTENSOMETER SHALL BE AT 2M INTERVALS, UNLESS OTHERWISE AGREED WITH THE ENGINEER.
8. BOREHOLE RECORDS SHALL BE PREPARED FOR THE HOLES CREATED TO INSTALL THE INSTRUMENTS. DETAILED DESCRIPTIONS OF THE SOIL AND ROCK ENCOUNTERED IN THE BOREHOLES SHALL BE CARRIED OUT IN ACCORDANCE WITH GEOGUIDE 3 AND AS AGREED BY THE ENGINEER.
9. TO MONITOR VIBRATIONS DUE TO XRL TUNNELLING ACTIVITIES, VIBRATION MONITORING AT THE LOCATIONS SHOWN ON THIS DRAWING SHALL BE CARRIED OUT. THE VIBRATION MONITORING POINTS SHALL BE LOCATED AT -34MPD, UNLESS OTHERWISE AGREED WITH THE ENGINEER.

(b) SURVEY AND INSTRUMENTATION INSIDE THE DSD TUNNEL

(i) GENERAL

10. THE CONTRACTOR SHALL SUBMIT A METHOD STATEMENT INCLUDING PROGRAMME DETAILS OF THE PRE- AND POST-CONDITION SURVEY AND INSTRUMENTATION TO BE INSTALLED INSIDE THE DSD TUNNEL FOR THE ENGINEER / DSD COMMENT AND APPROVAL. THE REPORTING FORMAT SHALL BE AGREED WITH THE ENGINEER / DSD.
11. THE CONTRACTOR WILL BE REQUIRED TO ADHERE TO DSD REQUIREMENTS FOR WORKING INSIDE THE DSD TUNNEL. THE CONTRACTOR WILL BE REQUIRED TO PROVIDE ALL NECESSARY AIR SUPPLY FOR HIS WORKERS AND TAKE ALL HEALTH AND SAFETY PRECAUTIONS FOR WORKING INSIDE THE TUNNEL.

(ii) CONDITION SURVEY

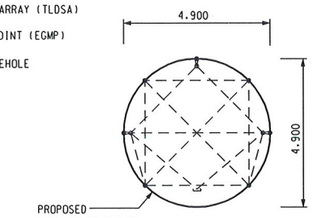
12. THE CONTRACTOR WILL BE REQUIRED TO CARRY OUT A PRE- AND POST-CONDITION SURVEY INSIDE THE DSD LCK TS TUNNEL FOR THE SURVEY EXTENT SHOWN ON THIS DRAWING.
13. THE POST CONDITION SURVEY SHALL BE CARRIED OUT UPON INSTRUCTION BY THE ENGINEER.
14. THE CONDITION SURVEY FINDINGS SHALL BE SUBMITTED TO THE ENGINEER / DSD FOR COMMENT AND APPROVAL.

(iii) INSTRUMENTS INSIDE DSD LCK TS TUNNEL

15. THE CONTRACTOR SHALL INSTALL TUNNEL LINING DEFORMATION SURVEY ARRAYS (TLDSA) ON THE INSIDE OF THE DSD TUNNEL LINING TO MEASURE ANY MOVEMENT OF THE LINING.
16. EACH TLDSA SHALL COMPRISE OF A MINIMUM 7 NOS. SURVEY POINTS LOCATED AROUND THE CIRCUMFERENCE OF THE INSIDE OF THE TUNNEL LINING. THE CONTRACTOR WILL BE REQUIRED TO PROVIDE THE REDUCED LEVEL AND CO-ORDINATES OF EACH SURVEY POINT.
17. THE INSTALLATION OF THE TLDSA SHALL BE CARRIED OUT PRIOR TO THE CONSTRUCTION OF THE XRL TUNNELS IN THIS AREA.
18. THE CONTRACTOR SHALL PROVIDE A MINIMUM OF 4 NOS. OF TLDSA. THE LOCATIONS OF THE TLDSA SHALL BE AGREED WITH THE ENGINEER / DSD PRIOR TO INSTALLATION.
19. THE RESULTS FROM THE MONITORING OF THE TLDSA SHALL BE SUBMITTED TO THE ENGINEER / DSD FOR COMMENT AND APPROVAL.

LEGEND:

- TUNNEL LINING DEFORMATION SURVEY ARRAY (TLDSA)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- VIBRATION MONITORING POINT IN BOREHOLE
- GROUND SETTLEMENT MARKER (GSM)
- EXTENSOMETER
- IN-PLACE INCLINOMETER (IVI)
- GROUNDWATER MONITORING POINT WITH VIBRATING WIRE PIEZOMETER
- TILT PLATE (TP)
- BUILDING SETTLEMENT MARKER (BSM)
- UTILITY MONITORING POINT (UMP)
- EXTENT OF CONDITION SURVEY



TYPICAL TLDSA

0 2 4 6 8 10 METRES

1 : 200

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CHECKED	KL
APPROVED	TM
DATE	09/JUL/2009

MTR

EXPRESS RAIL LINK

ORIGINATOR ATKINS

Supported by Arup, TFP Farrells, DLS Kenneth Ng

CADD REF. 820_W_380_ATK_C06_650A.dgn

TITLE

CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS
PROPOSED MONITORING AND INSTRUMENTATION PLAN FOR DSD LCK TS TUNNEL CROSSING

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NOTES:

1. FOR GENERAL NOTES FOR MONITORING, REFER TO DRAWING NO. 820/W/380/ATK/C06/647 TO 649.
2. FOR INSTUMENTATION TYPICAL DETAILS, REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
3. INSTRUMENTATION FOR LAI CHI KOK HOSPITAL AREA SHALL BE INSTALLED, MAINTAINED, MONITORED AND REMOVED BY THE 821 CONTRACTOR. THESE INSTRUMENTS WILL ALSO BE REQUIRED TO BE SURVEYED AND READ BY THE 820 CONTRACTOR DURING THE 820 WORKS. ANY DAMAGE TO THESE INSTRUMENTS CAUSED BY THE 820 CONTRACTOR SHALL BE REPAIRED/REPACED BY THE 820 CONTRACTOR AT THEIR OWN EXPENSE AND IN A TIMELY MANNER TO THE SATISFACTION OF THE ENGINEER. BOTH THE 821 CONTRACTOR AND 820 CONTRACTOR SHALL HOLD A START-UP MEETING WITH THE ENGINEER TO RESOLVE ANY INTERFACE ISSUES. ANY ADDITIONAL INSTRUMENTATION AND MONITORING REQUIRED IN THIS AREA BY THE 820 CONTRACTOR SHALL BE AT HIS OWN EXPENSE AND HE SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY ACCESS/PERMISSION FROM THE RELEVANT PARTIES.

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- IN-PLACE INCLINOMETER (IVI)
- INCLINOMETER (INC)
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- SURFACE-MOUNTED VIBRATING WIRE STRAIN GAUGE, SPOT WELDED TYPE (VWSG)
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

WORKS CONTRACT 821 | WORKS CONTRACT 820

SB072 SB073 SB074 SB075 SB076 SB077 SB078 SB079 SB080 SB081 SB082 SB083 SB084 SB085 SB086 SB087 SB088

SH016 SH017 SH018 SH019

DOWN TRACK

UP TRACK

MTR TSUEN WAN LINE

REFER TO DRAWING NO. 820/W/380/ATK/C06/650 FOR INSTRUMENTATION DETAILS OF DSD LCK TS TUNNEL

REFER TO DRAWING NO. 820/W/380/ATK/C06/660 FOR INSTRUMENTATION DETAILS OF MTR TSUEN WAN LINE TUNNELS

INSTRUMENTS SHOWN ARE TO BE INSTALLED AND MONITORED BY THE 821 CONTRACTOR, BUT ALSO MONITORED BY THE 820 CONTRACTOR.

MATCH LINE FOR CONTINUATION SEE DWG 821_P_370_ATK_C06_656

MATCH LINE FOR CONTINUATION SEE DWG 820_1_380_ATK_C06_652

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MTR

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ORIGINATOR ATKINS

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CADD REF. 820_W_380_ATK_C06_651A.dgn

TITLE

CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS

GEOTECHNICAL INSTRUMENTATION
SHEET 1

SCALE 1 : 1000 (A1)

DRAWING NO. 820/W/380/ATK/C06/651

REV. A

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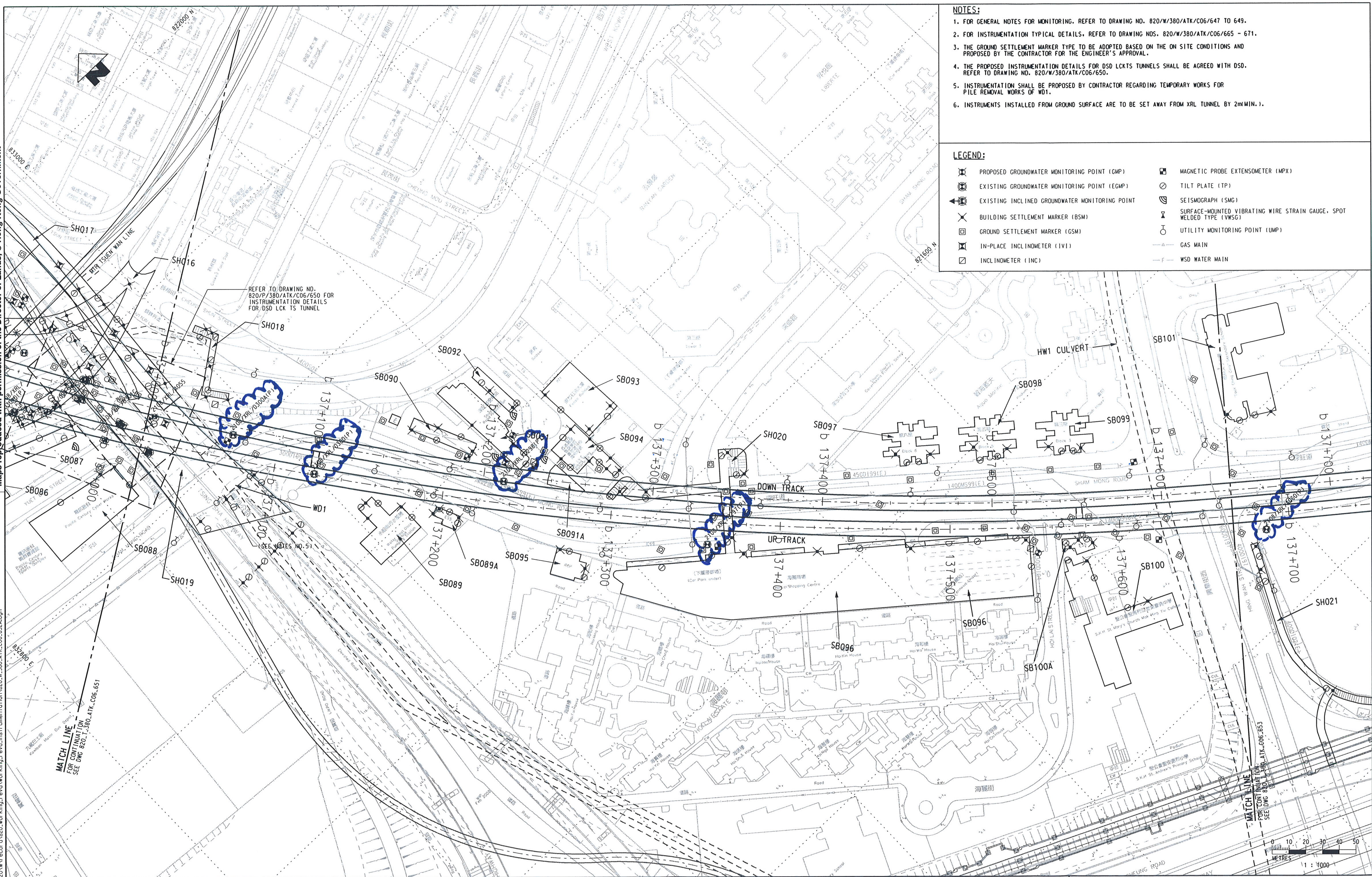

NOTES:

1. FOR GENERAL NOTES FOR MONITORING. REFER TO DRAWING NO. 820/W/380/ATK/C06/647 TO 649.
2. FOR INSTRUMENTATION TYPICAL DETAILS. REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
3. THE GROUND SETTLEMENT MARKER TYPE TO BE ADOPTED BASED ON THE ON SITE CONDITIONS AND PROPOSED BY THE CONTRACTOR FOR THE ENGINEER'S APPROVAL.
4. THE PROPOSED INSTRUMENTATION DETAILS FOR DSD LCKTS TUNNELS SHALL BE AGREED WITH DSD. REFER TO DRAWING NO. 820/W/380/ATK/C06/650.
5. INSTRUMENTATION SHALL BE PROPOSED BY CONTRACTOR REGARDING TEMPORARY WORKS FOR PILE REMOVAL WORKS OF WD1.
6. INSTRUMENTS INSTALLED FROM GROUND SURFACE ARE TO BE SET AWAY FROM XRL TUNNEL BY 2m(MIN.).

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- IN-PLACE INCLINOMETER (IVI)
- INCLINOMETER (INC)
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- SURFACE-MOUNTED VIBRATING WIRE STRAIN GAUGE, SPOT WELDED TYPE (VWSG)
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

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APPROVED	TM
DATE	09/JUN/2009

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ORIGINATOR: ATKINS — Supported by Arup, TFP Farrells, DLS, Kenneth Ng

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TITLE

CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS

GEOTECHNICAL INSTRUMENTATION
SHEET 2

SCALE: 1 : 1000 (A1)

DRAWING NO. 820/W/380/ATK/C06/652

REV. A

NOTES:

1. FOR GENERAL NOTES FOR MONITORING, REFER TO DRAWING NOS. 820/W/380/ATK/C06/647 TO 649.
2. THE TYPE OF INSTRUMENTATION USED FOR GROUND SETTLEMENT MONITORING SHALL BE PROPOSED BY THE CONTRACTOR TO THE ENGINEER FOR APPROVAL.
3. FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
4. INSTRUMENTATION AND MONITORING FOR THE TEMPORARY WORKS ASSOCIATED WITH THE PILE REMOVAL AT CHEUNG SHA WAN CARGO PIER SHALL BE CARRIED OUT BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.
5. INSTRUMENTATION AND MONITORING FOR THE TEMPORARY WORKS ASSOCIATED WITH THE PILE REMOVAL AT F.M.O. MARKET PIER(A) & (B) SHALL BE CARRIED OUT BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.
6. INSTRUMENT SYMBOL FULL TONED ARE REQUIRED TO BE TAKEN OVER BY THE 820 CONTRACTOR. UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
7. MONITORING FREQUENCY AND AAA VALUES FOR INCLINOMETERS INSTALLED IN DIAPHRAGM WALLS SHALL BE PROPOSED BY THE THE CONTRACTOR FOR THE ENGINEERS COMMENT.

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- INCLINOMETER (INC)
- INCLINOMETER IN DIAPHRAGM WALL
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

SEWAGE TRANSFER PIPELINE
TS1 CULVERT
VB7 - NCV NAM CHEONG LAUNCH SHAFT
DOWN TRACK
UP TRACK
FS1 CULVERT
SB102
SB103
SH022
SB105
SB104
SH021
(SEE NOTE NO.4)
(SEE NOTE NO.5)
SEE NOTE NO.6
MTR - NAM CHEONG STATION
MATCH LINE FOR CONTINUATION SEE DWG 820_T_380_ATK_C06_652
MATCH LINE FOR CONTINUATION SEE DWG 820_T_380_ATK_C06_654
LAI FAT STREET
YING WA STREET
SHAM MONG ROAD
LIN CHEUNG ROAD
WEST KOWLOON HIGHWAY
西九龍公路
運翔道
Elevated Road
高架道路
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1 : 1000

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APPROVED	TM
DATE	09/JUN/2009

DO NOT SCALE DRAWINGS. ALL DIMENSIONS SHALL BE VERIFIED ON SITE.

MTR
EXPRESS RAIL LINK
ORIGINATOR ATKINS
Supported by Arup, TFP Farrells, DLS Kenneth Ng
CADD REF. 820_W_380_ATK_C06_653A.dgn

TITLE
CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS
GEOTECHNICAL INSTRUMENTATION
SHEET 3

SCALE 1 : 1000 (A1)
DRAWING NO. 820/W/380/ATK/C06/653
REV. A

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REAL-TIME MONITORING NOTES FOR BUILDINGS:

1. FOR REAL-TIME MONITORING DETAILS REFER TO DRAWING NO. 820/W/380/ATK/C06/655.

LEGEND:

BUILDING REQUIRING REAL-TIME MONITORING

NOTES:

1. FOR GENERAL NOTES FOR MONITORING. REFER TO DRAWING NO. 820/W/380/ATK/C06/647 TO 649.
2. THE TYPE OF INSTRUMENTATION USED FOR GROUND SETTLEMENT MONITORING SHALL BE PROPOSED BY THE CONTRACTOR TO THE ENGINEER FOR APPROVAL.
3. FOR INSTUMENTATION TYPICAL DETAILS, REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
4. INSTRUMENTATION AND MONITORING FOR THE TEMPORARY WORKS ASSOCIATED WITH THE PILE REMOVAL AT SHUM SHUI PO FERRY PIER SHALL BE CARRIED OUT BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.
5. INSTRUMENTATION AND MONITORING FOR THE TEMPORARY WORKS ASSOCIATED WITH THE PILE REMOVAL AT YC2 SHALL BE CARRIED OUT BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.
6. INSTRUMENTATION AND MONITORING FOR THE TEMPORARY WORKS ASSOCIATED WITH THE PILE REMOVAL AT NC1 SHALL BE CARRIED OUT BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- INCLINOMETER (INC)
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

SB105 SB106 SB108 SB109 SB110 SB111 SB112 SB114 SB116 SB113 SB119 SB107
SH024 SH023 SH025
NC1 CULVERT WT1 CULVERT YC2 CULVERT
DOWN TRACK UP TRACK
(SEE NOTE NO. 4) (SEE NOTE NO. 5) (SEE NOTE NO. 6)
MATCH LINE FOR CONTINUATION SEE DWG 820_T_380_ATK_C06_653
MATCH LINE FOR CONTINUATION SEE DWG 820_T_380_ATK_C06_655
SHAM MONG ROAD LIN CHEUNG ROAD WEST KOWLOON HIGHWAY STREET WEST
NAM CHEUNG ESTATE SAI CHUEN ROAD NAM CHEUNG PARK NAM CHEUNG STATION
834100 E 833900 E 833800 E 821000 N 820900 N 820800 N 820700 N 820600 N
0 10 20 30 40 50 METRES 1 : 1000

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A	WORKING DRAWING ISSUE	SP	MAY10	TM

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CHECKED	KL
APPROVED	TM
DATE	30/JUN/2009

MTR
EXPRESS RAIL LINK
ORIGINATOR ATKINS
Supported by Arup, TFP Farrells, DLS Kenneth Ng
CADD REF. 820_W_380_ATK_C06_654A.dgn

TITLE
CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS
GEOTECHNICAL INSTRUMENTATION
SHEET 4

SCALE 1 : 1000 (A1) | DRAWING NO. 820/W/380/ATK/C06/654 | REV. A

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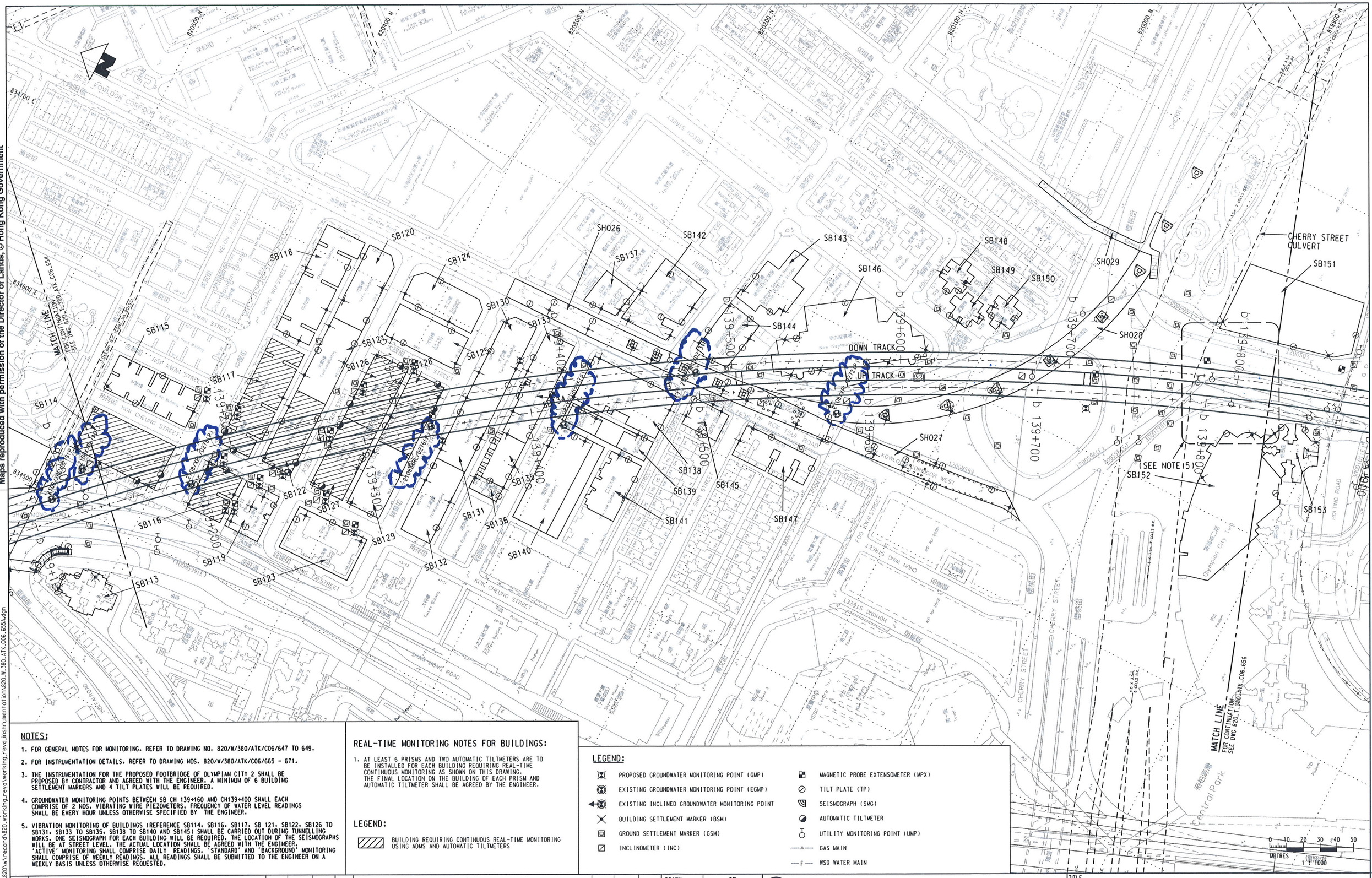

NOTES:

1. FOR GENERAL NOTES FOR MONITORING. REFER TO DRAWING NO. 820/W/380/ATK/C06/647 TO 649.
2. FOR INSTRUMENTATION DETAILS. REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
3. THE INSTRUMENTATION FOR THE PROPOSED FOOTBRIDGE OF OLYMPIAN CITY 2 SHALL BE PROPOSED BY CONTRACTOR AND AGREED WITH THE ENGINEER. A MINIMUM OF 6 BUILDING SETTLEMENT MARKERS AND 4 TILT PLATES WILL BE REQUIRED.
4. GROUNDWATER MONITORING POINTS BETWEEN SB CH 139+160 AND CH139+400 SHALL EACH COMPRISE OF 2 NOS. VIBRATING WIRE PIEZOMETERS. FREQUENCY OF WATER LEVEL READINGS SHALL BE EVERY HOUR UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
5. VIBRATION MONITORING OF BUILDINGS (REFERENCE SB114, SB116, SB117, SB 121, SB122, SB126 TO SB131, SB133 TO SB135, SB138 TO SB140 AND SB145) SHALL BE CARRIED OUT DURING TUNNELLING WORKS. ONE SEISMOGRAPH FOR EACH BUILDING WILL BE REQUIRED. THE LOCATION OF THE SEISMOGRAPHS WILL BE AT STREET LEVEL. THE ACTUAL LOCATION SHALL BE AGREED WITH THE ENGINEER. 'ACTIVE' MONITORING SHALL COMPRISE DAILY READINGS. 'STANDARD' AND 'BACKGROUND' MONITORING SHALL COMPRISE OF WEEKLY READINGS. ALL READINGS SHALL BE SUBMITTED TO THE ENGINEER ON A WEEKLY BASIS UNLESS OTHERWISE REQUESTED.

REAL-TIME MONITORING NOTES FOR BUILDINGS:

1. AT LEAST 6 PRISMS AND TWO AUTOMATIC TILTMETERS ARE TO BE INSTALLED FOR EACH BUILDING REQUIRING REAL-TIME CONTINUOUS MONITORING AS SHOWN ON THIS DRAWING. THE FINAL LOCATION ON THE BUILDING OF EACH PRISM AND AUTOMATIC TILTMETER SHALL BE AGREED BY THE ENGINEER.

LEGEND:

BUILDING REQUIRING CONTINUOUS REAL-TIME MONITORING USING ADMS AND AUTOMATIC TILTMETERS

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- INCLINOMETER (INC)
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- AUTOMATIC TILTMETER
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

REV	DESCRIPTION	BY	DATE	APPROVED
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DESIGNED	FC
CHECKED	KL
APPROVED	TM
DATE	09/JUN/2009

MTR

EXPRESS RAIL LINK

ORIGINATOR

ATKINS

Supported by
Arup, TFP Farrells, DLS
Kenneth Ng

CADD REF. 820_W_380_ATK_C06_655A.dgn

TITLE

CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS

GEOTECHNICAL INSTRUMENTATION
SHEET 5

SCALE	DRAWING NO.	REV.
1 : 1000 (A1)	820/W/380/ATK/C06/655	A

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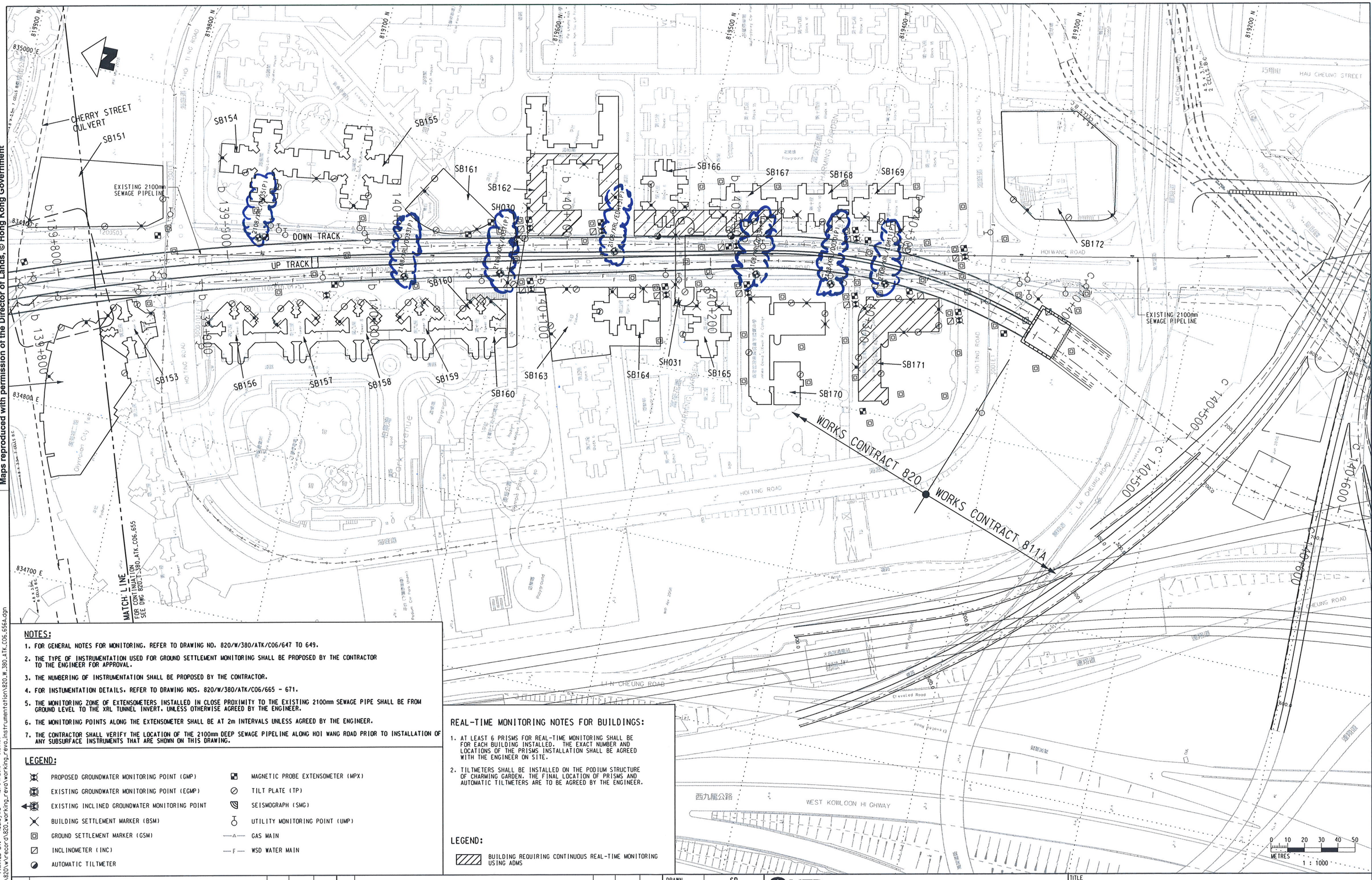

NOTES:

1. FOR GENERAL NOTES FOR MONITORING. REFER TO DRAWING NO. 820/W/380/ATK/C06/647 TO 649.
2. THE TYPE OF INSTRUMENTATION USED FOR GROUND SETTLEMENT MONITORING SHALL BE PROPOSED BY THE CONTRACTOR TO THE ENGINEER FOR APPROVAL.
3. THE NUMBERING OF INSTRUMENTATION SHALL BE PROPOSED BY THE CONTRACTOR.
4. FOR INSTUMENTATION DETAILS. REFER TO DRAWING NOS. 820/W/380/ATK/C06/665 - 671.
5. THE MONITORING ZONE OF EXTENSOMETERS INSTALLED IN CLOSE PROXIMITY TO THE EXISTING 2100mm SEWAGE PIPE SHALL BE FROM GROUND LEVEL TO THE XRL TUNNEL INVERT. UNLESS OTHERWISE AGREED BY THE ENGINEER.
6. THE MONITORING POINTS ALONG THE EXTENSOMETER SHALL BE AT 2m INTERVALS UNLESS AGREED BY THE ENGINEER.
7. THE CONTRACTOR SHALL VERIFY THE LOCATION OF THE 2100mm DEEP SEWAGE PIPELINE ALONG HOI WANG ROAD PRIOR TO INSTALLATION OF ANY SUBSURFACE INSTRUMENTS THAT ARE SHOWN ON THIS DRAWING.

LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING INCLINED GROUNDWATER MONITORING POINT
- BUILDING SETTLEMENT MARKER (BSM)
- GROUND SETTLEMENT MARKER (GSM)
- INCLINOMETER (INC)
- AUTOMATIC TILTMETER
- MAGNETIC PROBE EXTENSOMETER (MPX)
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- UTILITY MONITORING POINT (UMP)
- GAS MAIN
- WSD WATER MAIN

REAL-TIME MONITORING NOTES FOR BUILDINGS:

1. AT LEAST 6 PRISMS FOR REAL-TIME MONITORING SHALL BE FOR EACH BUILDING INSTALLED. THE EXACT NUMBER AND LOCATIONS OF THE PRISMS INSTALLATION SHALL BE AGREED WITH THE ENGINEER ON SITE.
2. TILTMETERS SHALL BE INSTALLED ON THE PODIUM STRUCTURE OF CHARMING GARDEN. THE FINAL LOCATION OF PRISMS AND AUTOMATIC TILTMETERS ARE TO BE AGREED BY THE ENGINEER.

LEGEND:

- BUILDING REQUIRING CONTINUOUS REAL-TIME MONITORING USING ADMS

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APPROVED	TM
DATE	09/JUN/2009

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ORIGINATOR ATKINS Supported by Arup, TFP Farrells, DLS Kenneth Ng

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TITLE

CONTRACT 820
MEI LAI ROAD TO HOI TING ROAD TUNNELS

GEOTECHNICAL INSTRUMENTATION
SHEET 6

SCALE	DRAWING NO.	REV.
1 : 1000 (A1)	820/W/380/ATK/C06/656	A

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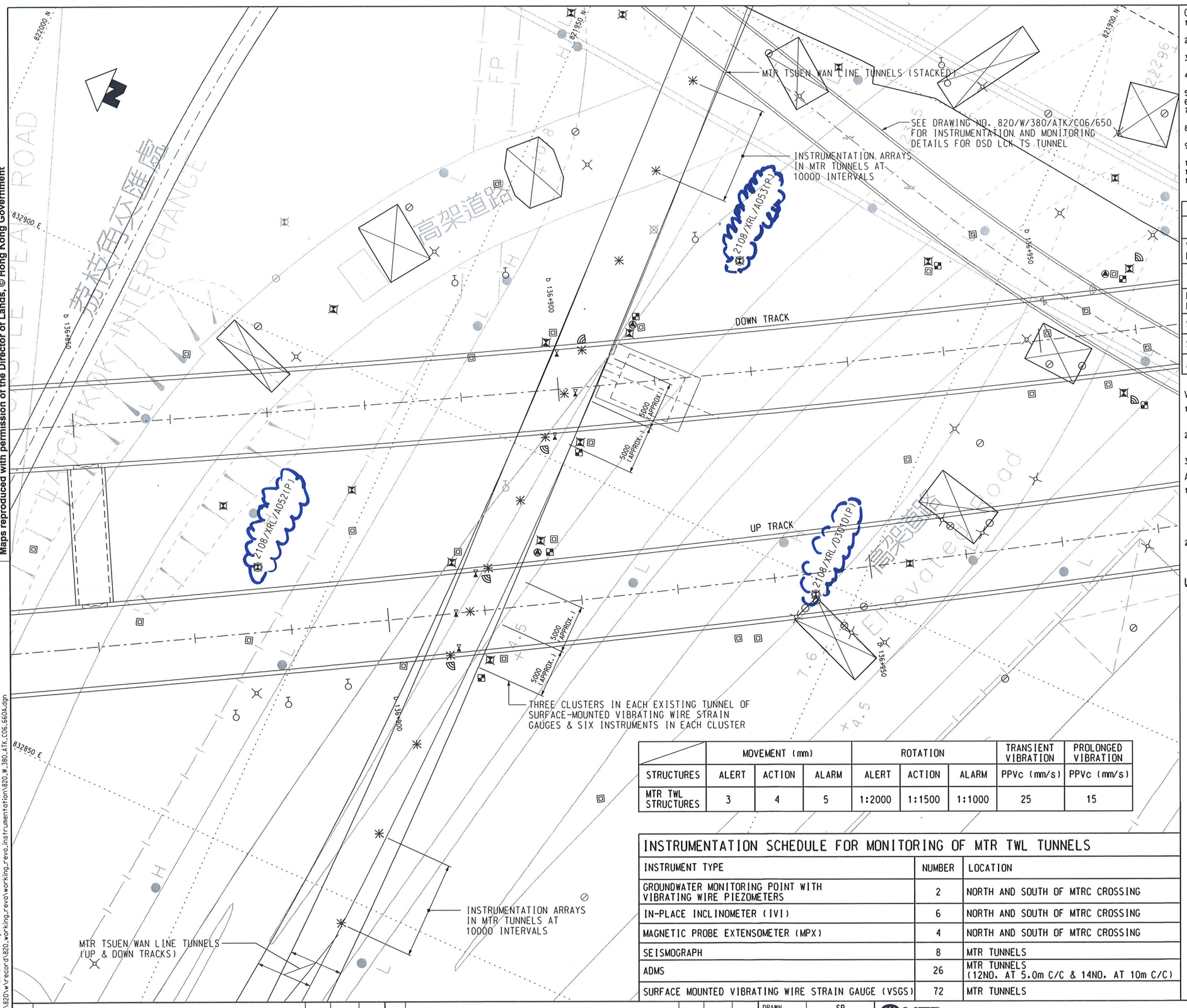


GENERAL NOTES:

1. THIS DRAWING SHOWS A PROPOSED ARRANGEMENT FOR INSTRUMENTATION AT THE CROSSING OF THE MTR TSUEN WAN LINE TUNNELS.
2. THE CONTRACTOR IS TO LIAISE DIRECTLY WITH MTRC TO SEEK APPROVAL FOR HIS PROPOSED INSTRUMENTATION LAYOUT AND MONITORING PLAN.
3. A LINE AND LEVEL AND CONDITION SURVEY OF THE MTRC TUNNELS IS TO BE UNDERTAKEN BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF THE TUNNELING WORKS.
4. CONVERGENCE ARRAYS ARE TO BE ESTABLISHED INSIDE THE MTRC TUNNELS AND ADJACENT TO THE PROPOSED ADMS SYSTEM.
5. ARRAY SPACING WITHIN THE MTR TUNNELS GENERALLY 10m. 5.0m SPACING AT CROSSING WITH XRL.
6. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING NO. 820/P/380/ATK/C06/651.
7. MONITORING AND INSTRUMENTATION SHALL BE APPLIED TO BOTH UP-TRACK & DOWN-TRACK OF THE MTR TSUEN WAN LINE TUNNELS.
8. INSTRUMENTATION FOR THE TSUEN WAN LINE TUNNELS SHALL BE INSTALLED PRIOR TO COMMENCEMENT THE TWL PROTECTION SHAFT CONSTRUCTION NEARBY.
9. ALL INSTRUMENTS SHALL BE INSTALLED 2m(MIN.) AWAY FROM THE PROPOSED XRL ALIGNMENT TO PREVENT DAMAGE DURING XRL TUNNEL CONSTRUCTION.
10. ACCESS TO MTR-TSUEN WAN LINE TUNNELS WILL NOT BE AVAILABLE DURING OPERATING HOURS.
11. THE PROPOSED INSTRUMENTS ON GROUND SHALL BE 2m (MIN.) AWAY FROM THE MTR (TWL TUNNEL).
12. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NOS.820/W/380/ATK/C06/647-649,651,665-671.

MONITORING FREQUENCY SCHEDULE FOR MTR TWL

INSTRUMENT TYPE	BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
VIBRATING WIRE PIEZOMETER	WEEKLY	DAILY	CONTINUOUS
INCLINOMETER	WEEKLY	WEEKLY	DAILY
MAGNETIC PROBE EXTENSOMETER	WEEKLY	WEEKLY	DAILY
SEISMOGRAPH	WEEKLY	WEEKLY	CONTINUOUS
STRAIN GAUGE	DAILY	EVERY 3 HOURS	REAL-TIME CONTINUOUS
ADMS	DAILY	EVERY 3 HOURS	REAL-TIME CONTINUOUS

VIBRATING WIRE STRAIN GAUGES:

1. SIX CLUSTERS OF SURFACE-MOUNTED VIBRATING WIRE STRAIN GAUGES TO BE INSTALLED WITHIN MTR TWL TUNNELS. EACH CLUSTER COMPRISE OF THREE LONGITUDINAL GAUGES AND THREE TRANSVERSE GAUGES.
2. REAL-TIME MEASUREMENT OF STRAINS REQUIRED FOR THE PERIOD DURING XRL TUNNEL CONSTRUCTION PASSING THROUGH MTR TSUEN WAN LINE & TO BE AGREED WITH MTRC.
3. INSTALLATION DETAILS OF INSTRUMENTS TO BE AGREED WITH MTRC.

AUTOMATIC DEFORMATION MONITORING SYSTEM:

1. AN AUTOMATIC DEFORMATION MONITORING SYSTEM NETWORK IS TO BE FIXED TO THE MTRC TUNNELS TO PROVIDE CONTINUOUS, REAL-TIME MONITORING OF THE MOVEMENT OF THE TUNNELS. THE NETWORK IS TO BE ESTABLISHED PRIOR TO THE COMMENCEMENT OF TUNNELLING AND SHAFT SINKING WORKS SUCH THAT THE NORMAL ENVELOPE OF MOVEMENTS CAN BE DETERMINED.
2. DATA FROM THE ADMS IS TO BE COLLATED AND PRESENTED SUCH THAT TRENDS OF THE MOVEMENTS ATTRIBUTABLE TO THE CIVIL WORKS CAN BE EASILY DETERMINED.

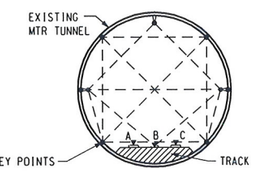
LEGEND:

- PROPOSED GROUNDWATER MONITORING POINT WITH STANDPIPE AND PIEZOMETERS
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- IN-PLACE VERTICAL INCLINOMETER (IVI)
- MAGNETIC PROBE EXTENSOMETER (MPX)
- PROPOSED GROUNDWATER MONITORING POINT WITH VIBRATING WIRE PIEZOMETER
- SEISMOGRAPH (INSIDE MTR TWL TUNNELS)
- AUTOMATIC DEFORMATION MONITORING SYSTEM (ADMS) -INSIDE MTR TWL TUNNELS
- SURFACE-MOUNTED VIBRATING WIRE STRAIN GAUGE(INSIDE MTR TWL TUNNELS).
- GROUND SETTLEMENT MARKER (GSM)
- UTILITY MONITORING POINT (UMP)
- INCLINOMETER (INC)
- TILT PLATE (TP)
- BUILDING SETTLEMENT MARKER (BSM)

	MOVEMENT (mm)			ROTATION			TRANSIENT VIBRATION	PROLONGED VIBRATION
STRUCTURES	ALERT	ACTION	ALARM	ALERT	ACTION	ALARM	PPVc (mm/s)	PPVc (mm/s)
MTR TWL STRUCTURES	3	4	5	1:2000	1:1500	1:1000	25	15

INSTRUMENTATION SCHEDULE FOR MONITORING OF MTR TWL TUNNELS

INSTRUMENT TYPE	NUMBER	LOCATION
GROUNDWATER MONITORING POINT WITH VIBRATING WIRE PIEZOMETERS	2	NORTH AND SOUTH OF MTRC CROSSING
IN-PLACE INCLINOMETER (IVI)	6	NORTH AND SOUTH OF MTRC CROSSING
MAGNETIC PROBE EXTENSOMETER (MPX)	4	NORTH AND SOUTH OF MTRC CROSSING
SEISMOGRAPH	8	MTR TUNNELS
ADMS	26	MTR TUNNELS (12NO. AT 5.0m C/C & 14NO. AT 10m C/C)
SURFACE MOUNTED VIBRATING WIRE STRAIN GAUGE (VSGS)	72	MTR TUNNELS



3 NOS. OF SETTLEMENT MARKERS AT LOCATIONS A, B AND C.

TYPICAL ARRANGEMENT FOR MONITORING OF MOVEMENTS OF THE MTR TWL TUNNEL

(N.T.S.)

0 2 4 6 8 10
METRES
1 : 200

REV	DESCRIPTION	BY	DATE	APPROVED
A	WORKING DRAWING ISSUE	SP	MAY10	TM

DRAWN	SP
DESIGNED	FC
CHECKED	KL
APPROVED	TM
DATE	09/JUN/2009

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TITLE

CONTRACT 820

MEI LAI ROAD TO HOI TING ROAD TUNNELS

PROPOSED MONITORING AND INSTRUMENTATION PLAN FOR MTR (TWL) TUNNEL CROSSING

SCALE	DRAWING NO.	REV.
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