

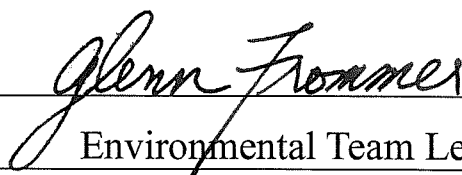
MTR Corporation Limited

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

(No. EP-349/2009/B)

Contingency Plan for Groundwater Drawdown
for Shek Yam to Mei Lai Road Tunnels
(Contract 821)

Certified by:



Position:

Environmental Team Leader

Date:

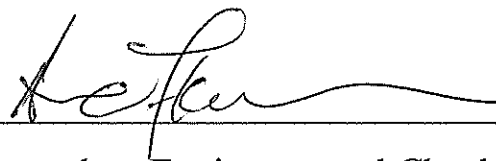
22 MAR 2011

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 Shek Yam to Mei Lai Road Tunnels
(Contract 821)

Verified by:



Position:

Independent Environmental Checker

Date:

28 March 2011

**MTRC Express Rail Link Contract 821
Shek Yam to Mei Lai Road Tunnels**

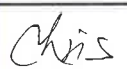

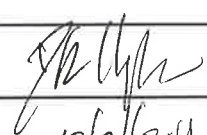


Environmental Document

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:
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SIGNATURE					
DATE	16 Mar 2011	17/3/2011	18/3/2011	18/3/11	18/3/2011



Dragages - Bouygues Joint Venture
實業 - 布依格聯營



MTRC Express Rail Link Contract 821 – Shek Yam to Mei Lai Road Tunnels

DOCUMENT STATUS

Details of Revision:

Revision	Rev. Date	Sections	Amendment Source and/or Details
A	16 March 11	All	First Issue

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1.1 Background

As stated in the Particular Specification 22.6.2, 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. 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 821, 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. 22.6.2, 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. 821/W/373/DBJ/C06/313, 821/W/374/DBJ/C06/301, 821/W/374/DBJ/C06/311 and 821/W/378/DBJ/C06/101 to 821/W/378/DBJ/C06/106.

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 $\pm 10\text{mm}$ 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 $\pm 5\text{mm}$.

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 Kwai Chung Portal including 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	A040	16	D317	31	D347
2	A046	17	D320	32	
3	A048	18	D321	33	
4	B015a	19	D327	34	
5	B021	20	D329	35	
6	B023	21	D330	36	
7	B025	22	D330a	37	
8	B025a	23	D331	38	
9	B026	24	D335	39	
10	B027	25	D337	40	
11	B028	26	D339	41	
12	C008	27	D340	42	
13	D310	28	D343	43	
14	D312	29	D345	44	
15	D315	30	D346	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;	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
	• Investigate any physical impact on	JV

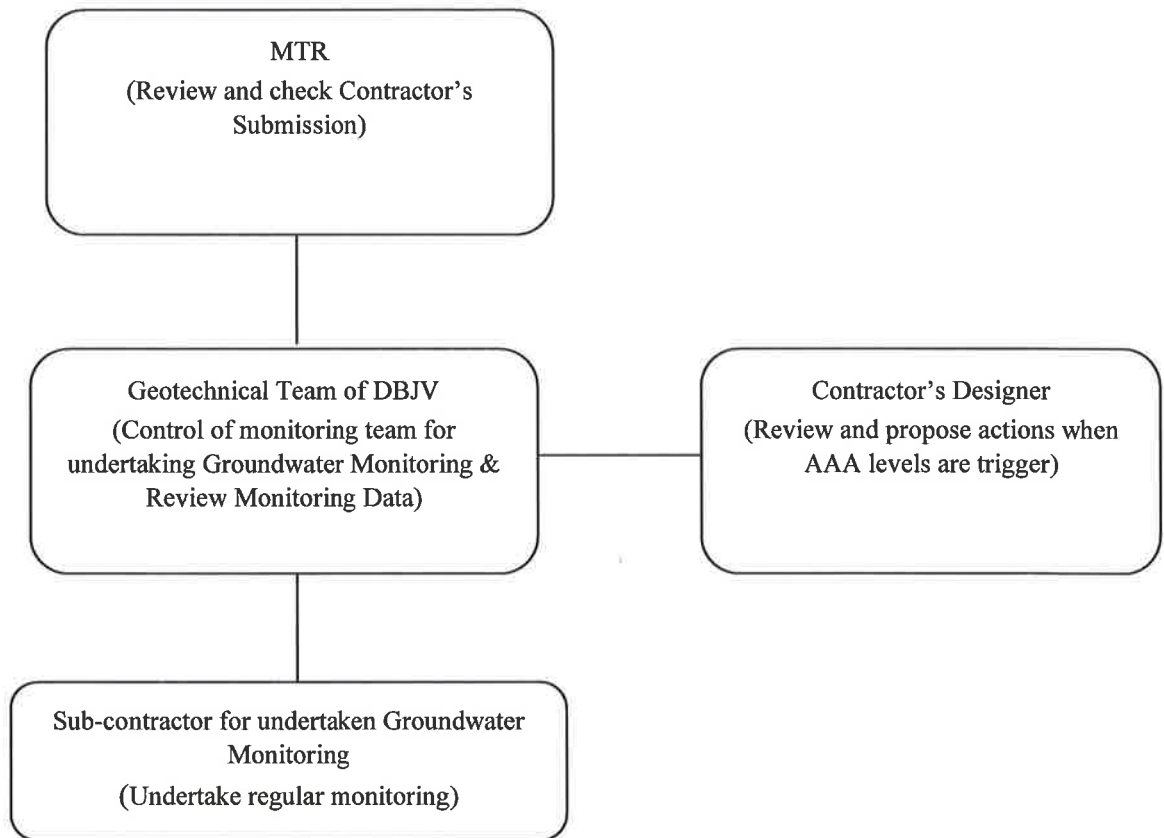
Item	Action Taken	Action Party
	Existing Building Structure;	
	<ul style="list-style-type: none"> Carry out comprehensive condition survey and assessment 	JV
	<ul style="list-style-type: none"> Cease the work adjacent any Existing Building Structure under significant influence if considered necessary or once ordered by the Engineer 	JV
	<ul style="list-style-type: none"> Propose mitigation measures for the Engineer to consider; 	JV and the Engineer
	<ul style="list-style-type: none"> 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



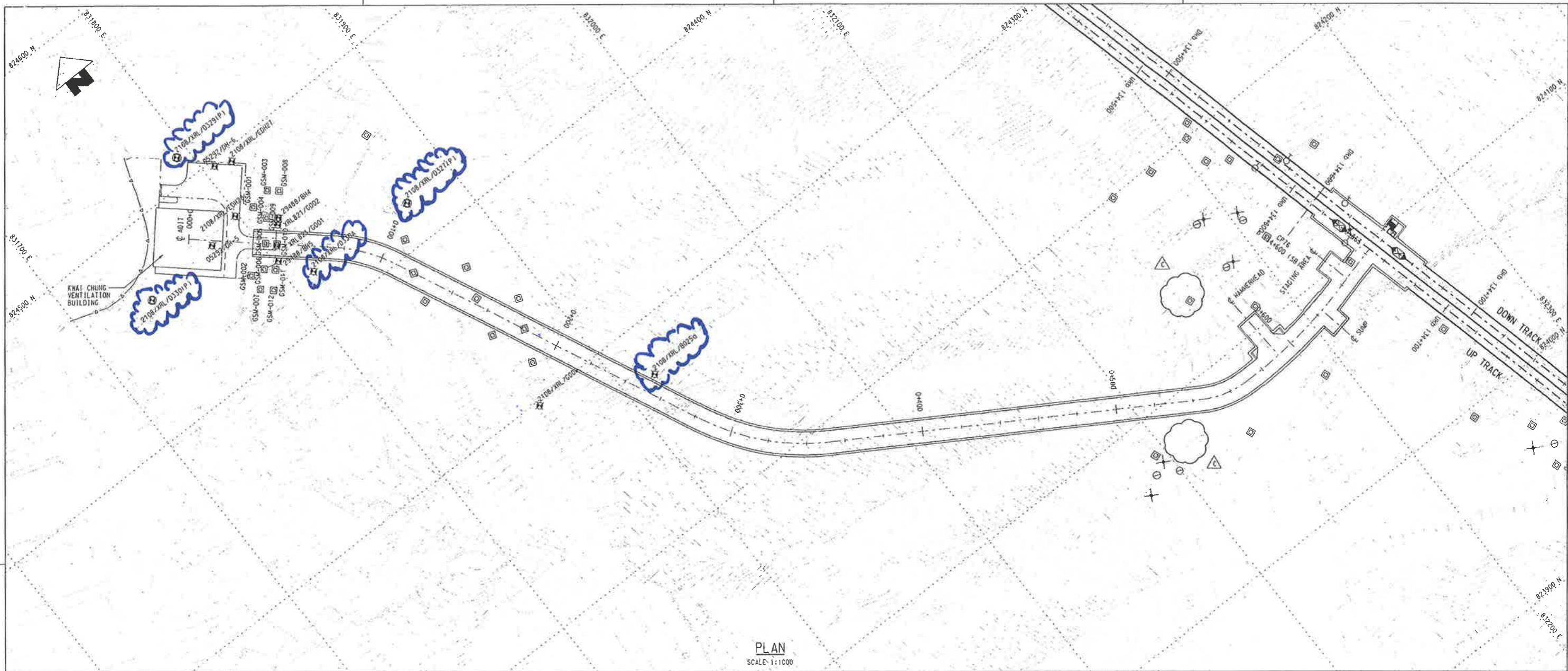


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MTRC Express Rail Link Contract 821 – Shek Yam to Mei Lai Road Tunnels

APPENDIX B

Monitoring Locations of Groundwater



PLAN
SCALE: 1:1000

GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

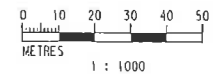
ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DROWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # (SETTLEMENT)	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300

LEGEND

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING BOREHOLE
- IN-PLACE INCLINOMETER (IVI)
- INCLINOMETER (INC)
- GROUND SETTLEMENT MARKER (GSM)
- UTILITY MONITORING POINT (UMP)
- BUILDING SETTLEMENT MARKER (BSM)
- TILT PLATE (TP)

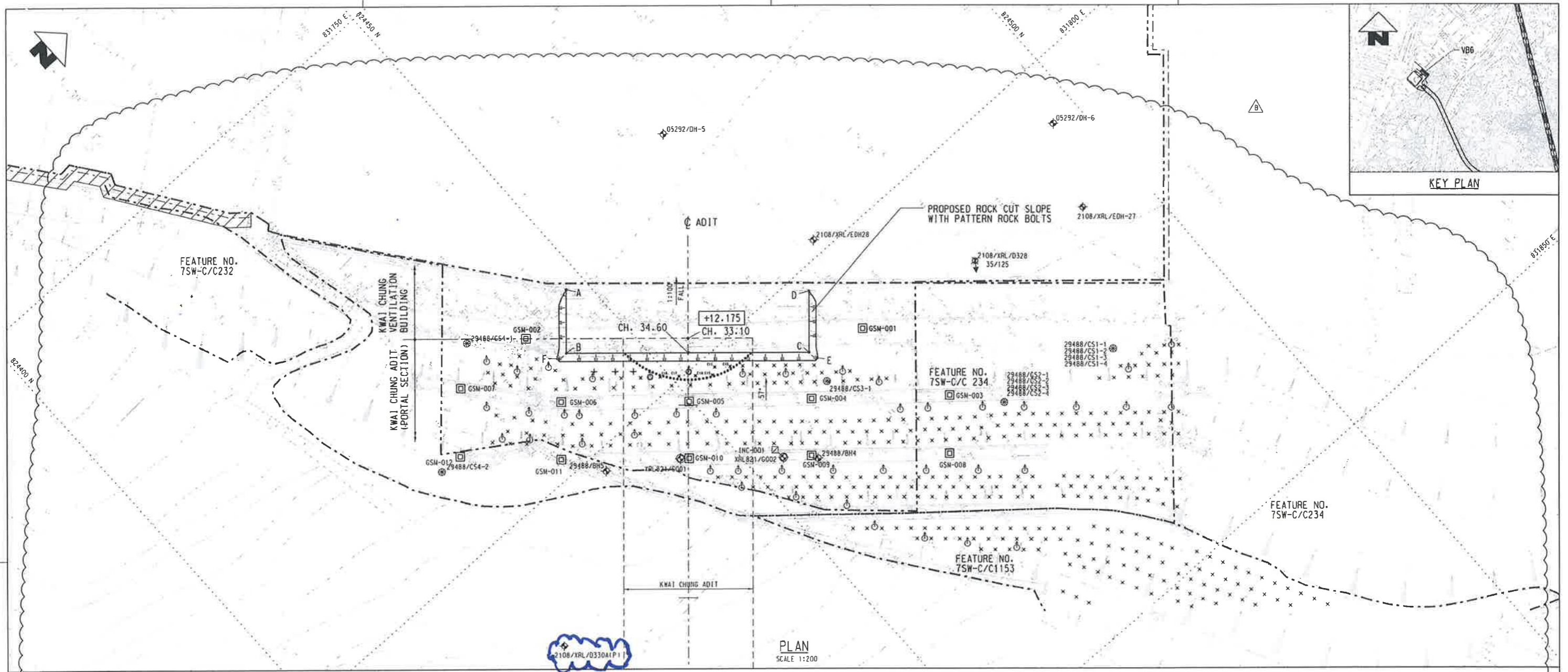
NOTES

1. FOR GENERAL NOTES REGARDING MONITORING BY OTHERS, REFER TO DRAWING NO. 821/W/378/DBJ/C06/001.
2. ALL MEASUREMENTS SHALL BE REPORTED AND REVIEWED IN ACCORDANCE WITH PROCEDURES SPECIFIED IN THE CONTRACT PARTICULAR SPECIFICATIONS.
3. FOR SURFACE INSTRUMENTATION DETAILS, REFER TO DRAWINGS 821/W/378/DBJ/C06/341-343.



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PLAN
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GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	PURPOSE	PROPOSED MONITORING FREQUENCY		
		BACKGROUND MONITORING (SEE NOTE 2)	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS	WEEKLY / DAILY	WEEKLY	DAILY
INCLINOMETER	TO MONITOR SUBSURFACE LATERAL GROUND MOVEMENT	WEEKLY / DAILY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	TO MONITOR GROUND SETTLEMENT	WEEKLY / DAILY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

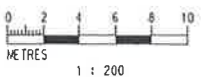
STRUCTURE/FEATURE	GROUND MOVEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRAINAGE	500mm BELOW THE LOWEST GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST GROUNDWATER LEVEL
REGISTERED FEATURE 75W-C/C234	12mm	20mm	25mm

LEGEND

- PROPOSED GROUNDWATER MONITORING POINT (GWP)
- EXISTING GROUNDWATER MONITORING POINT (EGWP)
- EXISTING BOREHOLE
- IN-PLACE INCLINOMETER (IPI)
- INCLINOMETER (INC)
- GROUND SETTLEMENT MARKER (GSM)
- UTILITY MONITORING POINT (UMP)
- BUILDING SETTLEMENT MARKER (BSM)
- TILT PLATE (TP)
- CHUNAM STRIPS (CS)

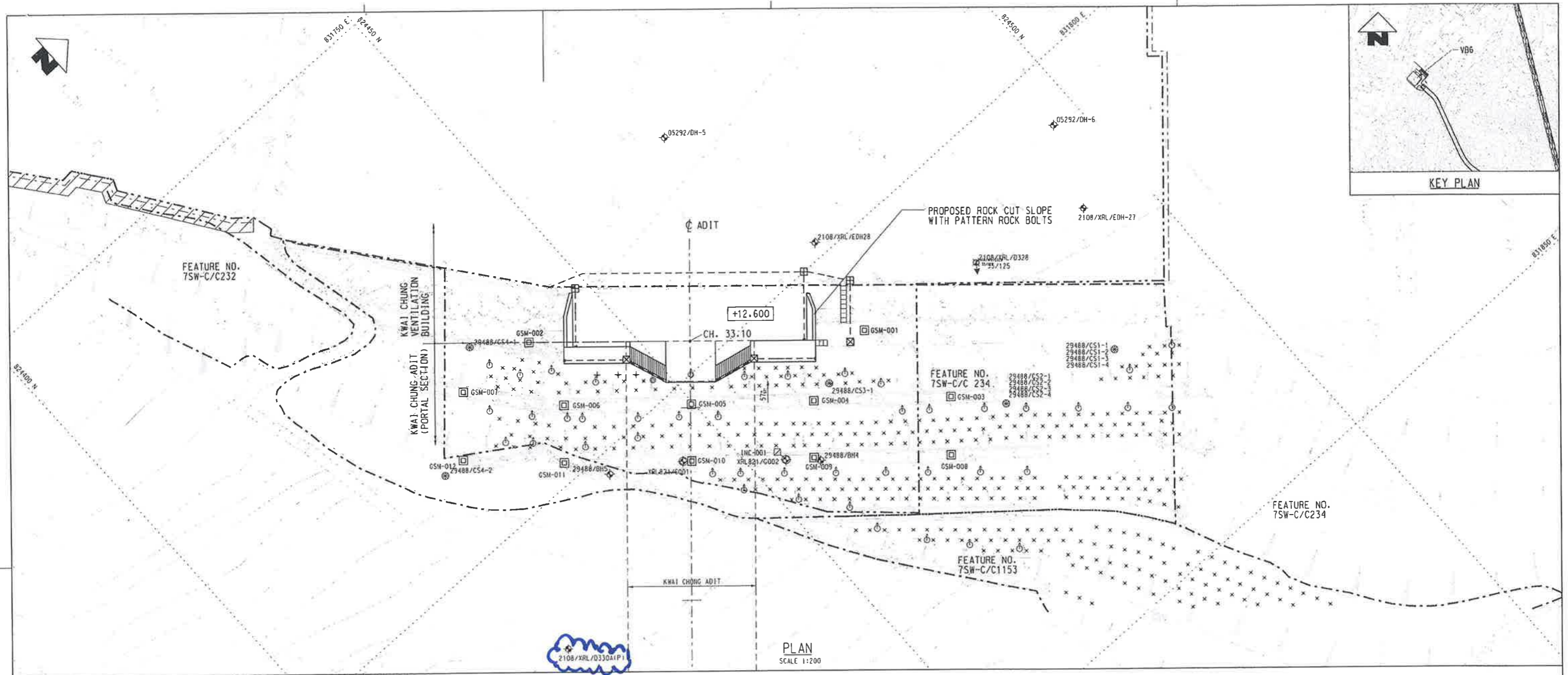
NOTES

- FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO DRAWING NO. 821/W/374/DBJ/C06/001.
- FOR DETAILS OF INSTRUMENTS, REFER TO DRAWING NO. 821/W/371/DBJ/C06/341.
- INCLINOMETER INC-001 TO BE INSTALLED WITHIN DRILLHOLE XRL821/G002.



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PLAN
SCALE 1:200

GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	PURPOSE	PROPOSED MONITORING FREQUENCY		
		BACKGROUND MONITORING (SEE NOTE 2)	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS	WEEKLY / DAILY	WEEKLY	DAILY
INCLINOMETER	TO MONITOR SUBSURFACE LATERAL GROUND MOVEMENT	WEEKLY / DAILY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	TO MONITOR GROUND SETTLEMENT	WEEKLY / DAILY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

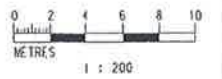
STRUCTURE/FEATURE	GROUND MOVEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRANDOWN	500mm BELOW THE LOWEST GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST GROUNDWATER LEVEL
REGISTERED FEATURE 7SW-C/C234	12mm	20mm	25mm

LEGEND

- PROPOSED GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (EGMP)
- EXISTING BOREHOLE
- IN-PLACE INCLINOMETER (IVI)
- INCLINOMETER (INC)
- GROUND SETTLEMENT MARKER (GSM)
- UTILITY MONITORING POINT (UMP)
- BUILDING SETTLEMENT MARKER (BSM)
- TILT PLATE (TP)
- CHUNAM STRIPS (CS)

NOTES

1. FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO DRAWING NO. 821/W/374/DBJ/C06/001.
2. FOR DETAILS OF INSTRUMENTS, REFER TO DRAWING NO. 821/W/378/DBJ/C06/341.
3. INCLINOMETER INC-001 TO BE INSTALLED WITHIN DRILLHOLE XRL821/G002.

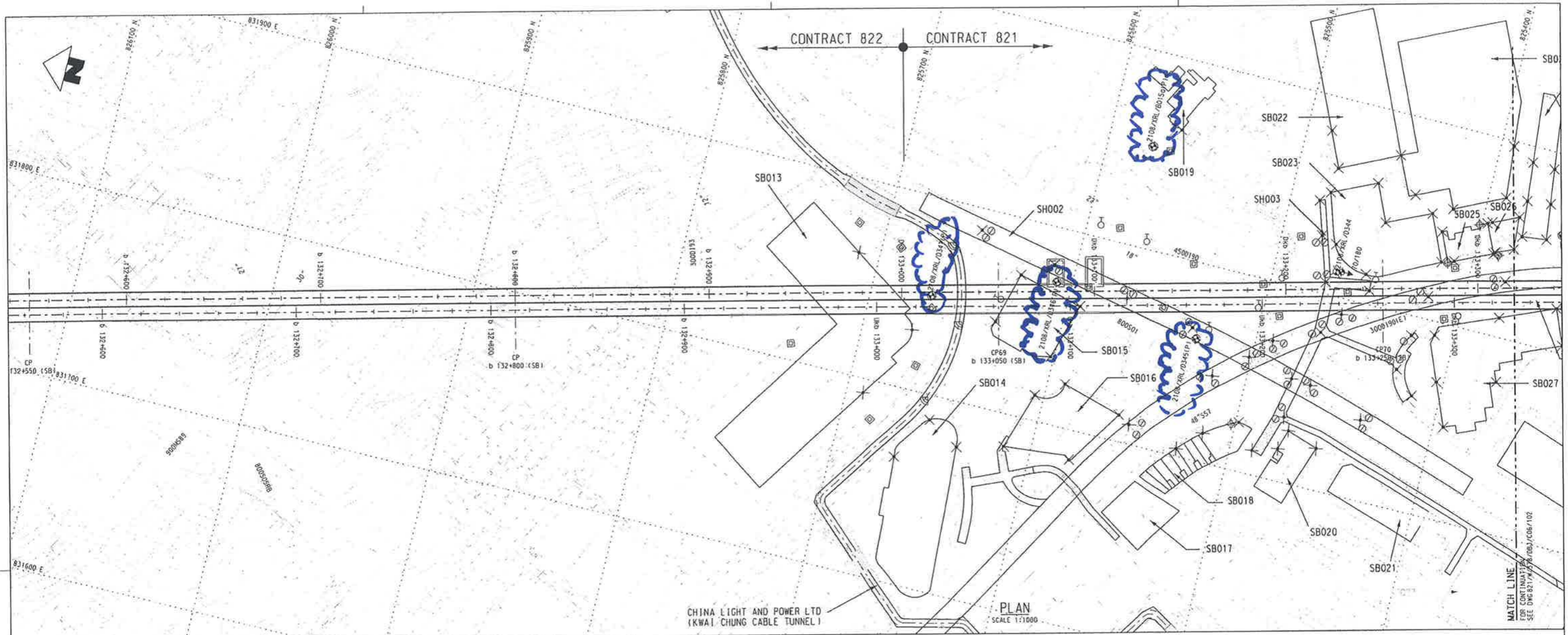


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CHECKED	PAT
APPROVED	JBE
DATE	01/DEC/2010
EXPRESS RAIL LINK CONTRACT 821	
ORIGINATOR	Supported by:
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TITLE CONTRACT 821 SHEK YAM TO MEI LAI ROAD TUNNELS KWAI CHUNG VENTILATION BUILDING (VB6) PERMANENT SITE FORMATION WORKS INSTRUMENTATION AND MONITORING PLAN		SCALE 1 : 200 (A1)	DRAWING NO. 821/W/374/DBJ/C06/311	REV. A
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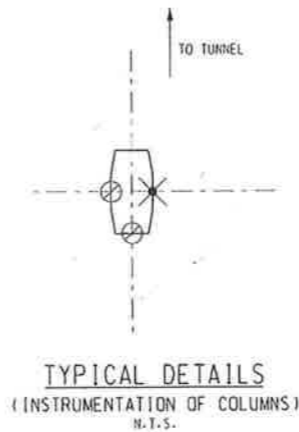


GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRAWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS #1 (SETTLEMENT)	13mm OR 1:600	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300

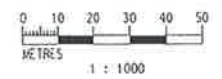


LEGEND OF MONITORING POINT

- ⊕ GROUNDWATER MONITORING POINT (GMP)
- ⊕ EXISTING GROUNDWATER MONITORING POINT (EGMP)
- ⊕ EXISTING BOREHOLE
- ⊕ GROUND SETTLEMENT MARKER (GSM)
- ⊕ UTILITY MONITORING POINT (UMP)
- ⊕ BUILDING SETTLEMENT MARKER (BSM)
- ⊕ CRACK GAUGES
- ⊕ TILT PLATE (TP)
- ⊕ SEISMOGRAPH (SMG)
- SB013 PROJECT/BUILDING REFERENCE

NOTES

1. FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO 821/W/378/DBJ/C06/001 TO 003.
2. FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO 821/W/378/DBJ/C06/341 TO 343.
3. PRIOR TO COMMENCEMENT OF CONSTRUCTION, BACKGROUND MONITORING SHALL BE CARRIED OUT WITH FOUR SETS OF READINGS FOR ALL EXISTING AND PROPOSED INSTRUMENTS TAKEN ON WEEKLY BASIS. THE READINGS SHALL BE SUBMITTED TO THE ENGINEER FOR AGREEMENT AT LEAST ONE WEEK PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. TILT PLATE INSTALLED ON COLUMNS SHALL BE INSTALLED PERPENDICULAR TO ONE ANOTHER WHEN IN PAIRS. WHEN INSTALLED SINGLET, IT SHOULD BE AS FAR AS POSSIBLE AND INSTALLED PERPENDICULAR TO THE TUNNEL AXIS.

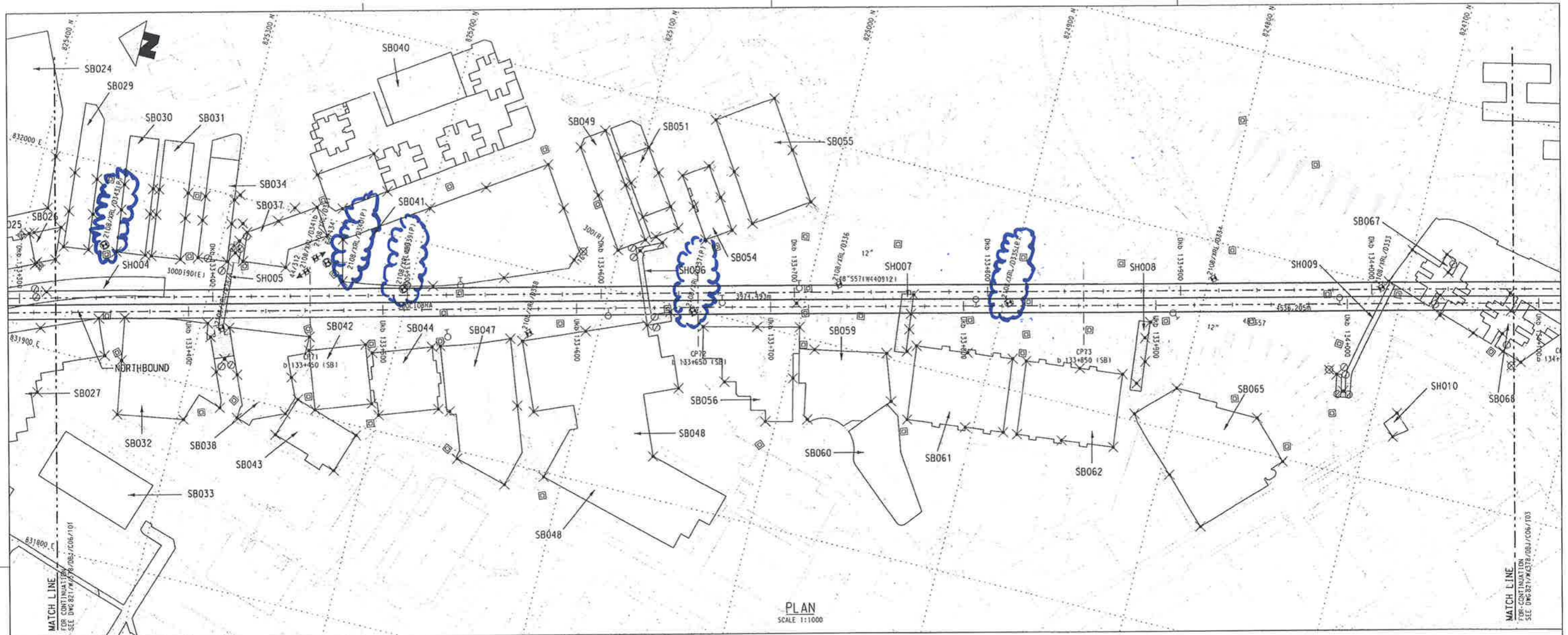


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DRAWN: FM DESIGNED: DL CHECKED: PAT APPROVED: JBe DATE: 25/OCT/2010	<p>EXPRESS RAIL LINK CONTRACT 821</p> <p>ORIGINATOR: Ove Arup & Partners Hong Kong Limited</p> <p>Supported by: ARUP</p> <p>CADD REF: 821_W_378_DBJ_C06_101B.dgn</p>
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CONTRACT 821 SHEK YAM TO MEI LAI ROAD TUNNELS GEOTECHNICAL INSTRUMENTATION LOCATIONS SHEET 1		SCALE: 1:1000 (A1) DRAWING NO: 821/W/378/DBJ/C06/101 REV: B
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A	FIRST ISSUE	FM	07Jan11	JBe



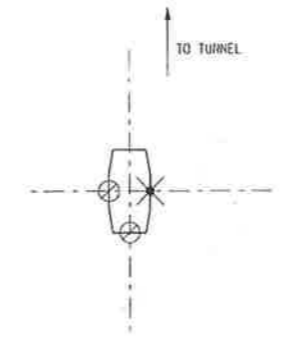
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GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRAWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # (SETTLEMENT)	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300



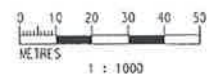
TYPICAL DETAILS
(INSTRUMENTATION OF COLUMNS)
N.T.S.

LEGEND OF MONITORING POINT

- ⊕ GROUNDWATER MONITORING POINT (GMP)
- ⊗ EXISTING GROUNDWATER MONITORING POINT (EGMP)
- ⊕ EXISTING BOREHOLE
- ⊗ GROUND SETTLEMENT MARKER (GSM)
- ⊕ UTILITY MONITORING POINT (UMP)
- ⊗ BUILDING SETTLEMENT MARKER (BSM)
- ⊕ CRACK GAUGES
- ⊗ TILT PLATE (TP)
- ⊕ SEISMOGRAPH (SMG)
- SB013 PROJECT/BUILDING REFERENCE

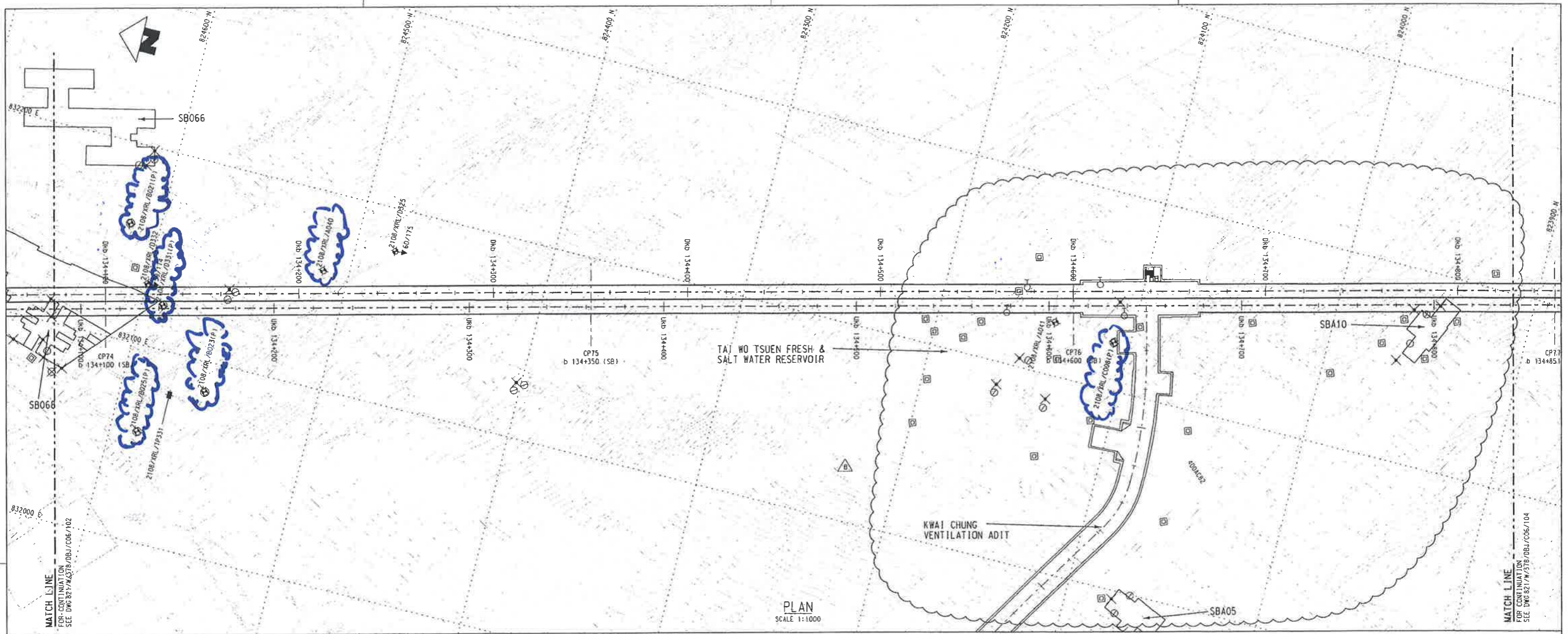
NOTES

1. FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO 821/W/378/DBJ/C06/001 TO 003.
2. FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO 821/W/378/DBJ/C06/341 TO 343.
3. PRIOR TO COMMENCEMENT OF CONSTRUCTION, BACKGROUND MONITORING SHALL BE CARRIED OUT WITH FOUR SETS OF READINGS FOR ALL EXISTING AND PROPOSED INSTRUMENTS TAKEN ON WEEKLY BASIS. THE READINGS SHALL BE SUBMITTED TO THE ENGINEER FOR AGREEMENT AT LEAST ONE WEEK PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. TILT PLATE INSTALLED ON COLUMNS SHALL BE INSTALLED PERPENDICULAR TO ONE ANOTHER WHEN IN PAIRS. WHEN INSTALLED SINGLY, IT SHOULD BE AS FAR AS POSSIBLE AND INSTALLED PERPENDICULAR TO THE TUNNEL AXIS.



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DRAWN: FM DESIGNED: DL CHECKED: PAT APPROVED: JBE DATE: 25/OCT/2010				 EXPRESS RAIL LINK CONTRACT 821 ORIGINATOR: Ove Arup & Partners Supported by: Hong Kong Limited				TITLE: CONTRACT 821 SHEK YAM TO MEI LAI ROAD TUNNELS GEOTECHNICAL INSTRUMENTATION LOCATIONS SHEET 2			
B WORKING DRAWING A FIRST ISSUE				FIN 19 Jan 11 JBE FIN 07 Jan 11 JBE				SCALE: 1:1000 (A1) DRAWING NO.: 821/W/378/DBJ/C06/102 REV: B			



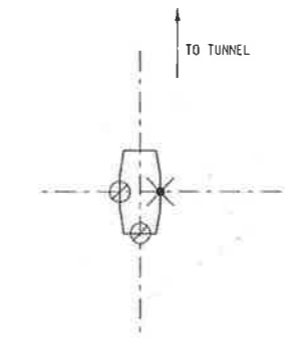
PLAN
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GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRAWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # (SETTLEMENT)	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300



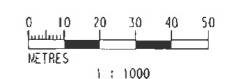
TYPICAL DETAILS
(INSTRUMENTATION OF COLUMNS)
N.T.S.

LEGEND OF MONITORING POINT

- ⊕ GROUNDWATER MONITORING POINT (GMP)
- ⊗ EXISTING GROUNDWATER MONITORING POINT (EGMP)
- ⊕ EXISTING BOREHOLE
- ⊗ GROUND SETTLEMENT MARKER (GSM)
- ⊕ UTILITY MONITORING POINT (UMP)
- ⊗ BUILDING SETTLEMENT MARKER (BSM)
- ⊕ CRACK GAUGES
- ⊗ TILT PLATE (TP)
- ⊕ SEISMOGRAPH (SMG)
- ⊗ SBO13 PROJECT/BUILDING REFERENCE

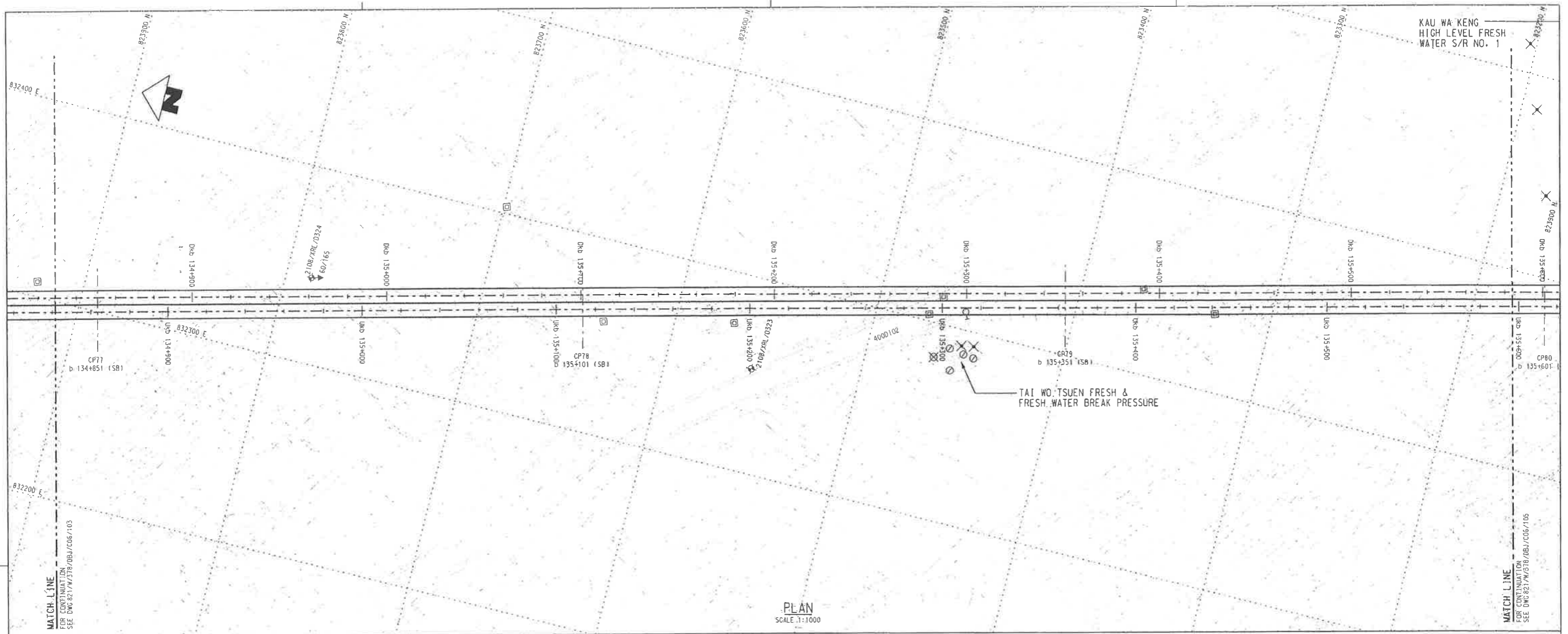
NOTES

1. FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO 821/W/378/DBJ/C06/001 TO 003.
2. FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO 821/W/378/DBJ/C06/341 TO 343.
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4. TILT PLATE INSTALLED ON COLUMNS SHALL BE INSTALLED PERPENDICULAR TO THE OTHER WHEN IN PAIRS, WHEN INSTALLED SINGLY, IT SHOULD BE AS FAR AS POSSIBLE AND INSTALLED PERPENDICULAR TO THE TUNNEL AXIS.



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REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED	SCALE	DRAWING NO.	REV.
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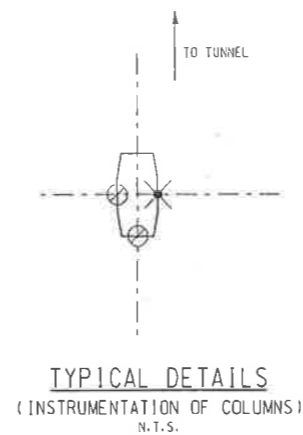
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GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DROWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # (SETTLEMENT)	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300



LEGEND OF MONITORING POINT

- GROUNDWATER MONITORING POINT (GMP)
- EXISTING GROUNDWATER MONITORING POINT (GEMP)
- EXISTING BOREHOLE
- GROUND SETTLEMENT MARKER (GSM)
- UTILITY MONITORING POINT (UWP)
- BUILDING SETTLEMENT MARKER (BSM)
- CRACK GAUGES
- TILT PLATE (TP)
- SEISMOGRAPH (SMG)
- PROJECT/BUILDING REFERENCE

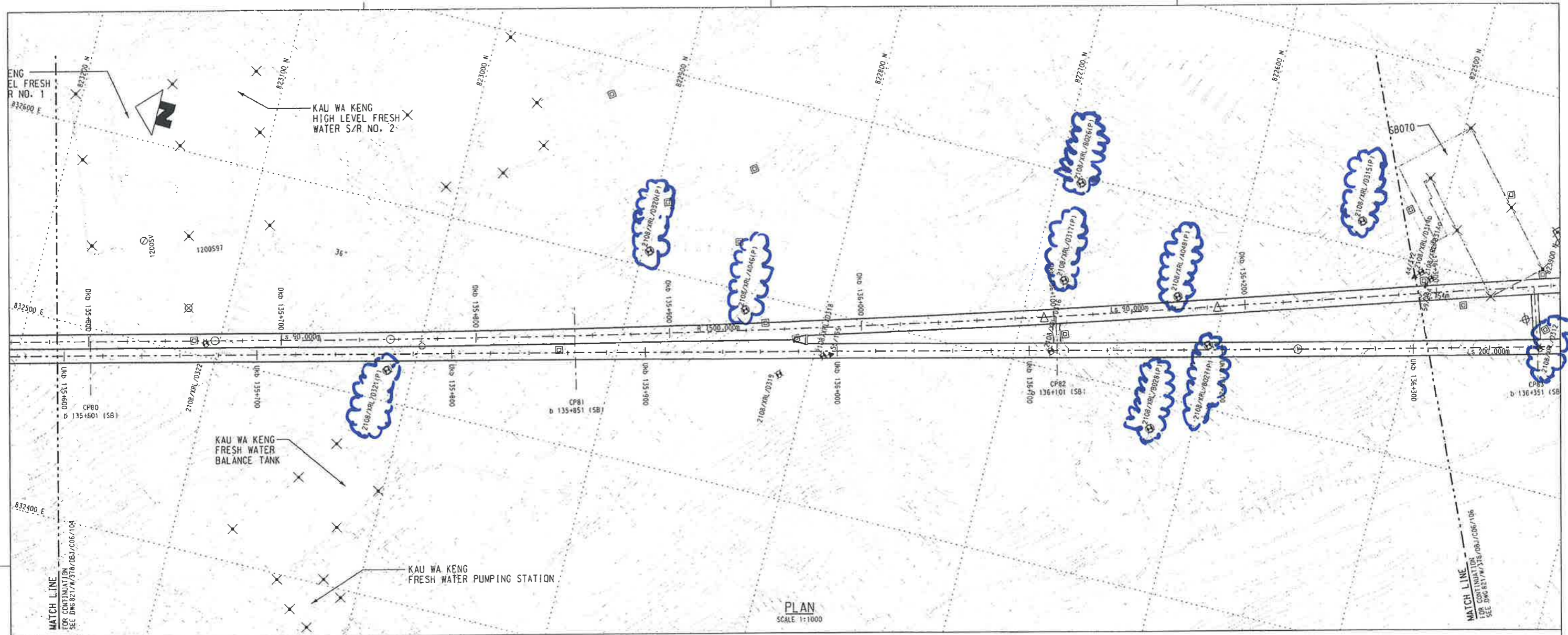
NOTES

- FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO 821/W/378/DBJ/C06/001 TO 003.
- FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO 821/W/378/DBJ/C06/341 TO 343.
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B WORKING DRAWING A FIRST ISSUE			FM 19Jan11 JBe FM 07Jan11 JBe			SCALE: 1 : 1000 (A1) DRAWING NO.: 821/W/378/DBJ/C06/104 REV: B			
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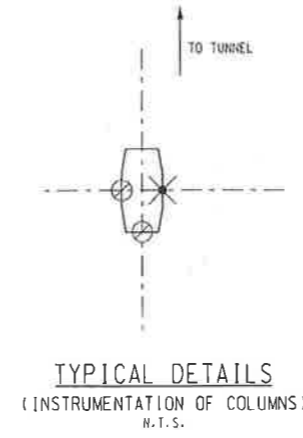
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SCALE 1:1000

GEOTECHNICAL INSTRUMENTATION MONITORING SCHEDULE

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIEZOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

ALERT/ACTION/ALARM LEVELS

ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DRAWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # SETTLEMENT!	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300



LEGEND OF MONITORING POINT

- ⊕ GROUNDWATER MONITORING POINT (GMP)
- ⊗ EXISTING GROUNDWATER MONITORING POINT (EGMP)
- ⊕ EXISTING BOREHOLE
- ⊗ GROUND SETTLEMENT MARKER (CSM)
- ⊕ UTILITY MONITORING POINT (UMP)
- ⊗ BUILDING SETTLEMENT MARKER (BSM)
- ⊕ CRACK GAUGES
- ⊗ TILT PLATE (TP)
- ⊕ SEISMOGRAPH (SMG)
- SB013 PROJECT/BUILDING REFERENCE

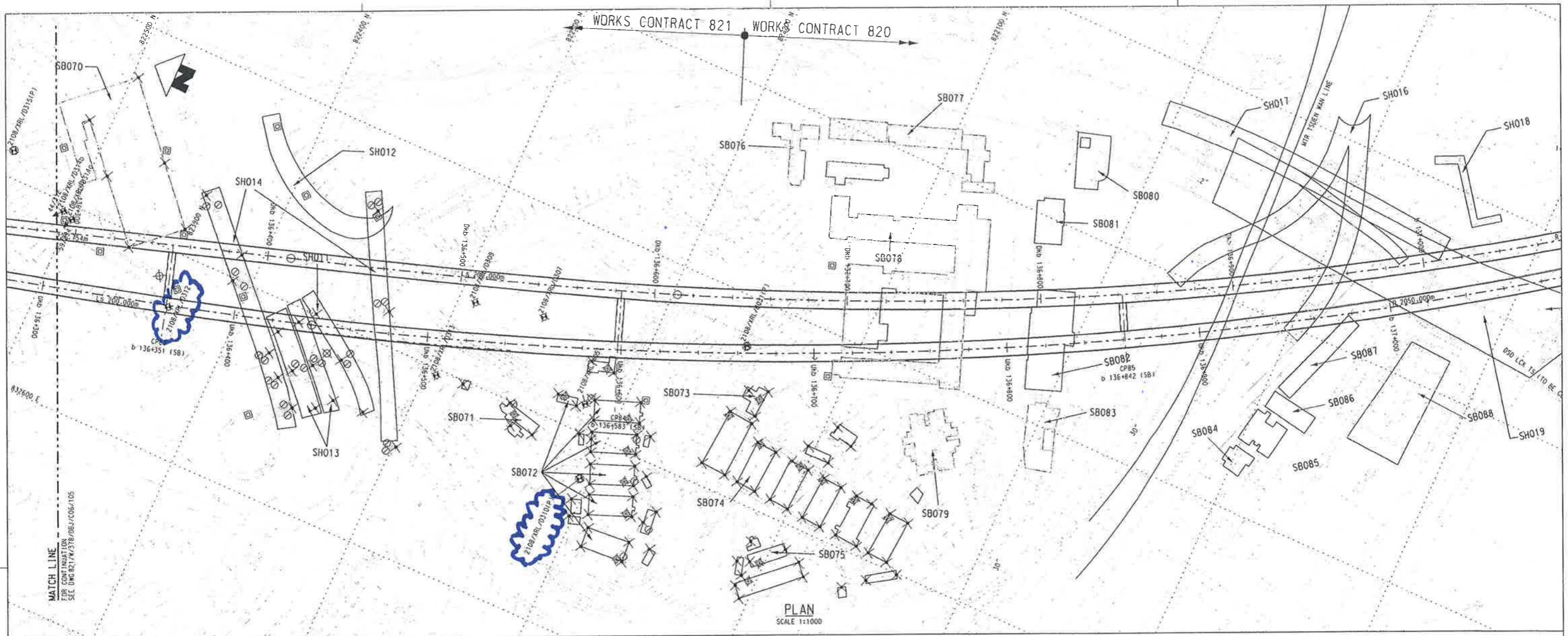
NOTES

1. FOR GENERAL NOTES OF INSTRUMENTATION AND MONITORING, REFER TO 821/W/378/DBJ/C06/001 TO 003.
2. FOR INSTRUMENTATION TYPICAL DETAILS, REFER TO 821/W/378/DBJ/C06/341 TO 343.
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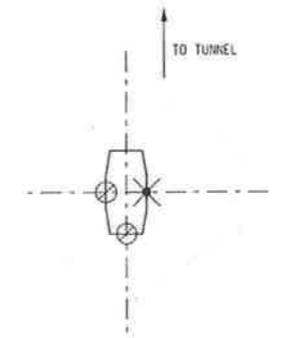
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B WORKING DRAWING A FIRST ISSUE				FM 19Jan11 JBe FM 07Jan11 JBe				SCALE: 1:1000 (A1) DRAWING NO.: 821/W/378/DBJ/C06/105 REV: B			
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PLAN
SCALE 1:1000

INSTRUMENT TYPE	GENERAL LOCATION	PURPOSE	MINIMUM FREQUENCY OF MONITORING		
			BACKGROUND MONITORING	STANDARD MONITORING	ACTIVE MONITORING
STANDPIPE / PIEZOMETER	TO BE DETERMINED ON SITE	TO MONITOR CHANGE IN GROUND WATER LEVEL AND PIETOMETRIC HEADS IN SOILS / ROCK	WEEKLY	WEEKLY	DAILY
GROUND SETTLEMENT MARKER	ON GROUND SURFACE	TO MONITOR GROUND SETTLEMENT	WEEKLY	WEEKLY	DAILY
UTILITY MONITORING POINT	ON SELECTED UTILITIES	TO MONITOR UTILITY SETTLEMENT	WEEKLY	WEEKLY	DAILY
BUILDING SETTLEMENT MARKER	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING SETTLEMENT	WEEKLY	WEEKLY	DAILY
TILT PLATE	ON SELECTED BUILDINGS & STRUCTURE	TO MONITOR BUILDING TILTING	WEEKLY	WEEKLY	DAILY

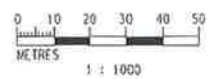
ITEM TO BE MONITORED	SETTLEMENT/ANGULAR DISTORTION		
	ALERT	ACTION	ALARM
UTILITIES	13mm OR 1:600	20mm OR 1:375	25mm OR 1:300
GROUNDWATER DROWDOWN	500mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	800mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED	1000mm BELOW THE LOWEST RECORDED GROUNDWATER LEVEL OBTAINED
GROUND SETTLEMENT MARKER	25mm OR 1:350	40mm OR 1:280	50mm OR 1:175
EXTENSOMETER	25mm	40mm	50mm
EXISTING BUILDINGS # (SETTLEMENT)	13mm OR 1:800	20mm OR 1:500	25mm OR 1:400
REGISTERED FEATURES (SLOPE AND RETAINING WALL)	25mm OR 1:600	40mm OR 1:375	50mm OR 1:300



TYPICAL DETAILS
(INSTRUMENTATION OF COLUMNS)
N.T.S.

- LEGEND OF MONITORING POINT**
- ⊕ GROUNDWATER MONITORING POINT (CMP)
 - ⊗ EXISTING GROUNDWATER MONITORING POINT (EGMP)
 - ⊕ EXISTING BOREHOLE
 - ⊕ GROUND SETTLEMENT MARKER (CSM)
 - ⊕ UTILITY MONITORING POINT (UMP)
 - ⊕ BUILDING SETTLEMENT MARKER (BSM)
 - ⊕ CRACK GAUGES
 - ⊕ TILT PLATE (TP)
 - ⊕ SEISMOGRAPH (SMG)
 - SB013 PROJECT/BUILDING REFERENCE

- NOTES**
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DRAWN: FM DESIGNED: DL CHECKED: PAT APPROVED: JBe DATE: 25/OCT/2010				 EXPRESS RAIL LINK CONTRACT 821 ORIGINATOR: Supported by: Ove Arup & Partners Hong Kong Limited				TITLE: CONTRACT 821 SHEK YAM TO MEI LAI ROAD TUNNELS GEOTECHNICAL INSTRUMENTATION LOCATIONS SHEET 6					
B WORKING DRAWING A FIRST ISSUE				FM 19Jan11 JBe FM 07Jan11 JBe				SCALE: 1:1000 (A1) DRAWING NO.: 821/W/378/DBJ/C06/106 REV: B					
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