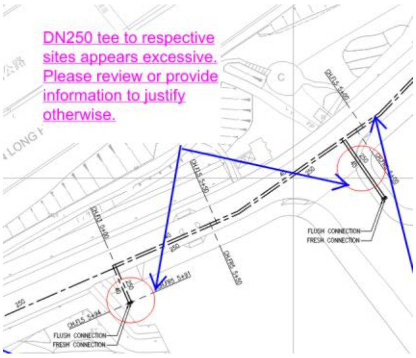
Responses to Comments on
Final Water Impact Assessment Report for S16 Planning Application
(Intensification Scheme) (Issue 1)

1. Water Supplies Department, Supply and Distribution (NT) Branch, New Territories West Region, Distribution (Tin Shui Wai and Yuen Long West) [from Mr. POON Kam Lung via email dated 19 April 2023] 1
2. Secretary for Education [from Miss. Carol LAM via email dated 17 May 2023] 3

1. Water Supplies Department, Supply and Distribution (NT) Branch, New Territories West Region, Distribution (Tin Shui Wai and Yuen Long West) [from Mr. POON Kam Lung via email dated 19 April 2023]

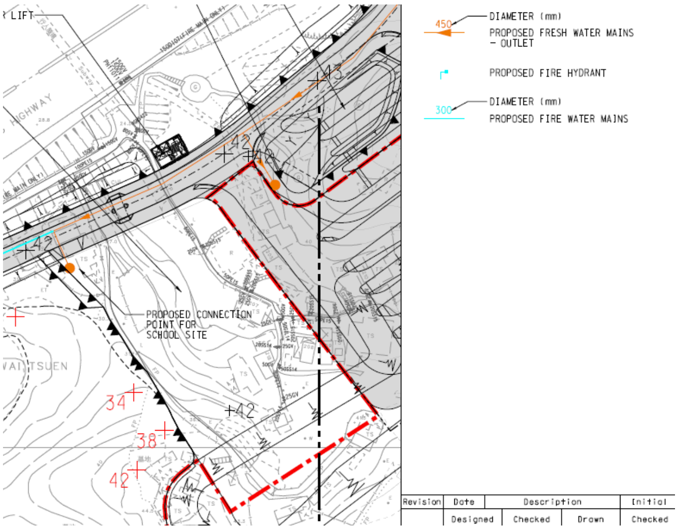
Comments	**Responses**
Proposed Fresh Water System	
1. The pumping main (fresh water) of the proposed pumping station should be designed as 1.5x MDD. Please revisit your proposed size of pumping main (fresh water) and provide a system characteristic curve for our consideration.	Noted. Referring to table 2.1, the fresh water is used as 1.5MDD. The proposed pump curve of the selected pumps is attached in Annex G.
2. Two inlets should be designed to supply water to two chambers of the proposed service reservoir. Similarly, two outlets are required to deliver water to the proposed site from the chambers of the proposed service reservoir.	Noted and revised accordingly. Please refer to revised Drawing no. 199086/BIN/WIA/016.
3. The inlet (fresh water) of the proposed pumping station is suggested to be branched off from the existing DN1000 outlet of TKTS FWSR	Noted and revised accordingly. Please refer to revised Drawing no. 199086/BIN/WIA/015.
4. The proposed DN450 pipes (circled in the sketch below) are for Phase 1, 2, and 3 with MDD of 1472m^3/day, 1787m^3/day and 2276m^3/day respectively. The proposed sizes are excessive. In addition, a long section of dead end DN250 pipe is identified. Please revise and justify.	Noted and revised respectively. Please refer to updated calculation in Appendix C for the detail of the proposed pipe size.
5. Along the proposed carriageway, DN250 pipe is proposed to distribute the fresh water to premises near Yuen Long Highway. We recommend DN300 pipe instead. Please refer to our email dated 30/6/2022 and sketch below.	Noted and revised respectively. Please refer to revised Drawing no. 199086/BIN/WIA/016.
6. Please also consider providing the lead-in along the proposed carriageway, rather than across the slope for ease of O&M.	The proposed alignment of the lead-in is the more effective option, as the water mains flow from high to low meanwhile the length of the mains is shortened.

Proposed flushing water system	
1. Supply of flushing water to the proposed site is from existing TKT SWSR. The pumping main (flushing water) of the proposed pumping station should be designed as 1.2x MDD and connected to the existing DN1000 outlet of TKT SWSR. Please You provide a system characteristic curve for our consideration. You are also reminded that a constant head supply system is proposed instead of balancing-tank system will be adopted for the flushing water supply.	Noted and revised accordingly. The balancing-tank system is adopted for the emergency water supply. Please refer to Drawing no. 199086/BIN/WIA/016. 
2. Please refer to our email dated 30/6/2022 and sketch below above. 	Noted and revised accordingly. Other comments are revised accordingly. Please be advised that while detailed design drawings of watermains of TKT are not under Section 16 application, they will be addressed in the detailed design submission of waterworks separately.
3. Please also consider providing the lead-in along the proposed carriageway, rather than across the slope for ease of O&M.	The proposed alignment of the lead-in is the more effective option, as the water mains flow from high to low meanwhile the length of the mains is shortened.

Drawings 199086/BIN/WIA/502 & 602	
4. Drawings show that the existing DN1400 trunk main and DN1800 distribution main will be affected and diverted. Your proposal will critically affect the water supply to Tin Shui Wai and Lau Fau Shan area., large scale water suspension could be resulted. Please review your design to avoid direct conflict and proposed suitable protection measures feasible for maintenance.	Due to site constraints, it is necessary to divert the existing DN1400 trunk main and DN1800 distribution main. As the diversion area is far from the housing site, a detailed diversion scheme for the affected mains will be submitted separately.

2. Secretary for Education [from Miss. Carol LAM via email dated 17 May 2023]

Comments	**Responses**
In consultation with our works agent, ArchSD, please adjust the location of the water mains lead-in, flush and fresh water connection. All lead-in and underground pipes should be placed away from the run-in/out of the school site. Due consideration should also be given to other utilities. The waterworks proposals shown in the report under the application have not addressed the comments that are provided to CEDD via email dated 28 June 2022.	Noted and revised accordingly. Please refer to revised Drawing no. 199086/BIN/WIA/017.



Agreement No. CE 92/2017 (CE)

Site Formation and Infrastructure Works for Public Housing Development near Tan Kwai Tsuen, Yuen Long – Investigation, Design and Construction

FINAL WATERWORKS IMPACT ASSESSMENT REPORT FOR S16 PLANNING APPLICATION (INTENSIFICATION SCHEME)

199086/BIN/089/Issue 2

MAY 2023

土木工程拓展署
Civil Engineering and Development Department

binnies

Agreement No. CE 92/2017 (CE)

Site Formation and Infrastructure Works for Public Housing Development near Tan Kwai Tsuen, Yuen Long - Investigation, Design and Construction

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Final Waterworks Impact Assessment Report for S16 Planning Application (Intensification Scheme)

199086/BIN/089/Issue 2

May 2023

	Name	Signature	Date
Prepared	Tommy CHUNG		May 2023
Reviewed	Kim LEUNG		May 2023
Authorized	Edwin LO		May 2023

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1 INTRODUCTION

1.1 General

1.1.1 As a prevailing policy to increase land supply to meet the housing demand in the short, medium and long terms, the Government has identified sites in various districts with the potential to be developed for residential use. Amongst others, a site near Tan Kwai Tsuen (the Site), Yuen Long for public housing developments. The location of the Site is shown on ***Drawing No. 199086/BIN/GEN/001***.

1.1.2 In view of the acute shortage of housing, the domestic plot ratio of the Application Site is proposed to be intensified to 6.5 with an aim to increase flat production. The Application Site will provide a total of 7,420 public housing units with planned population intake from 2030 by phases. The site formation layout plan is shown on ***Drawing No. 199086/BIN/SFAI/001***. An "Application for Permission under Section 16 of the Town Planning Ordinance" is being prepared for the Proposed Development in order to obtain planning permission from the Town Planning Board for minor relaxation of the following restrictions:

- Maximum plot ratios:
  - Phase 1: from 6.5 to 7.0 (i.e. domestic PR of 6.5 and non-domestic PR of 0.5)
  - Phase 2: from 6.5 to 7.2 (i.e. domestic PR of 6.5 and non-domestic PR of 0.7)
  - Phase 3: from 6.5 to 7.3 (i.e. domestic PR of 6.5 and non-domestic PR of 0.8)
- Maximum building heights:
  - Phase 1: from 205 mPD to 240 mPD
  - Phases 2 and 3: from 205 mPD to 235 mPD

1.2 Project Description

1.2.1 Binnies Hong Kong Limited was requested by the Civil Engineering and Development Department (CEDD) to prepare necessary technical assessments of Section 16 (S16) planning application for minor relaxation of PR and building height restriction for the agreement of the Town Planning Board (TPB).

1.3 Interfacing Projects

1.3.1 Notable potential interfacing projects include:

– CE 2/2011 (CE) - Hung Shui Kiu (HSK) New Development Area (NDA) Planning and Engineering Study

– CE 19/2015 (TP) - Preliminary Land Use Study for Lam Tei Quarry and the Adjoining Areas – Feasibility Study

- CE 35/2012 (CE) - Planning and Engineering Study for Housing Sites in Yuen Long South – Investigation
- CE 32/2017 (CE) – Yuen Long South Development – Stage 1 – Design and Construction
- PWP Item 7259RS and 7279RS - Cycle Tracks connecting North West New Territories with North East New Territories
- CE 46/2007 (DS) - Review of Drainage Master Plans (DMP) in Yuen Long and North Districts – Feasibility Study
- PWP Item 4223DS - Yuen Long and Kam Tin sewerage treatment upgrade – Upgrading of San Wai Sewage Treatment Works
- CE 26/2015 (CE) - Site Formation and infrastructural works for the Development at Long Bin, Yuen Long – Feasibility Study
- CE 56/2016 (CE) - HSK NDA Stage 1 Works – Design and Construction
- CE 39/2016 (CE) - HSK NDA Advance Works, Phases 1 & 2 – Design and Construction
- CE 42/2016 (CE) - Environmental Friendly Transport Services in HSK - NDA and Adjacent Areas – Feasibility Study
- CE 86/2017 (CE) - Fostering a Pedestrian and Bicycle-friendly environment in HSK NDA and YLS Development – Feasibility Study
- CE 41/2015 (GE) – Landslip Prevention and Mitigation Programme, 2015, Package G – Landslip Prevention and Mitigation Works and Provision of Emergency Works Services for Natural Terrain Landslides Occurring in Mainland West (North) – Investigation, Design and Construction
- CE 51/2016 (HY) - Route 11 (between North Lantau and Yuen Long) - Feasibility Study
- CE 65/2016 (CE) – Further Study on Tuen Mun Western Bypass – Investigation
- CE 39/2018 (WS) – Strategic Cavern Areas to Accommodate Existing and Proposed Service Reservoirs in Lam Tei and Adjoining Areas – Feasibility Study
- CE 6/ 2019 (DS) – Hung Shui Kiu Effluent Polishing Plant and Yuen Long South Effluent Polishing Plant– Investigation
- CE 1/2020 (CE) - Hung Shui Kiu/Ha Tsuen New Development Area Package A Works for Second Phase Development - Design and Construction
- CEDD's project "Greening Master Plan"
- EDB/ ArchSD's primary school projects
- Relocation of Existing Services Reservoirs to Cavern and Proposed Service Reservoirs in Cavern in Lam Tei – Feasibility Study by Project Management Division of WSD

- Holistic Review Study on the Use of Reclaimed Water in Northwest New Territories by West Development Office of CEDD
- Other utilities supply to the Development
- Other relevant projects of planned/committed developments as advised by PlanD, HKHA/ HD, CEDD and other Government B/Ds
- Any other relevant projects and assignments, which may arise during the course of the Assignment.

1.4 Purposes and Scope of this Report

1.4.1 The purpose of this report is to evaluate the potential waterworks impacts associated with the proposed housing development due to the proposed increase in maximum plot ratio and building height.

1.5 Structure of the Report

1.5.1 This report comprises the following sections: -

Section 1 introduces the project background and project description.

Section 2 describes the methodology ad design criteria for the report.

Section 3 presents the existing and planned waterworks facilities around the Site.

Section 4 conducts the water demand estimate of fresh water and salt water supplies by the Site.

Section 5 assesses the potential impact to waterworks facilities arising from the Site.

Section 6 proposes the mitigation and water supplies schemes due to the Site.

Section 7 presents the preliminary design of the water supply system.

Section 8 concludes the findings and makes recommendations.

2 METHODOLOGY AND DESIGN CRITERIA

2.1 Information Available for WIA Study

2.1.1 To conduct the study on the waterworks, we have adopted the following available information:

- Existing water mains records provided by WSD;
- As-built drawings on existing waterworks; and
- WSD's Planning Report.

2.2 Methodology

2.2.1 The Development will generate water demands of fresh and flushing waters. The expected impact on the existing water supplies system and their requirement for any upgrading works or new facilities to meet such demands and the correspondence implementation programme, if necessary, will be discussed in this report.

2.2.2 Coordination with Water Supplies Department (WSD) was conducted to acquire relevant information and data, including but not limited to existing capacities of water supplies systems and etc. serving the Site. Meetings with PlanD, CEDD and WSD and other relevant departments will be conducted for further discussion if needed.

2.2.3 Under this report, the following approach has been adopted to carry out the study:

- To identify the scope of the developments at the Site;
- To determine the water demands of the developments at the Site;
- To assess the adequacy of the existing and planned water supply facilities within and in the vicinity of the proposed development boundary;
- To examine the impact arising from additional water demands from the developments at the Site on the existing source of supply and the system capacity; and
- To propose the required water mains layout.

2.2.4 The estimation of the water demands of the Development is based on the latest development parameters provided by Housing Department (HD) and relevant government departments as indicated in ***Table 2.2*** and are generally with reference to the unit water demands as recommended under WSD's Departmental Instruction (DI) No. 1309 and "Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning" published by EPD.

2.2.5 This report has been undertaken in accordance with the following standards, Code of Practice and Design Manuals:

- WSD's Civil Engineering Design Manual;
- EPD's Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning;

- WSD's Manual of Mainlaying Practice (2012 Edition); and
- WSD's Departmental Instruction (DI) No. 1309.

2.3 Design Parameters

2.3.1 In accordance with WSD's DI 1309, Review of Planning Standards - Part I: Balancing Storage for Fresh Water Service Reservoir and Review of Planning Standards – Part V: Fire Fighting Water Requirements, and AD/Dev's memo of ref. (8) in WSD 3608/50/3/02 Pt.2 dated 11 May 2006, the following design parameters and peak demand factors are adopted for the design of proposed water supply system for the Development. ***Table 2.1*** lists the relevant design criteria to be used for the assessment.

Table 2.1 – Design Criteria from WSD's DI 1309 and AD/Dev's memo of ref. (8) in WSD 3608/50/3/02 Pt.2

Waterworks / Facilities	Requirements
Service Reservoir Capacity	• Fresh water system (i) Supply Zone – Interconnected Supply System: 0.75MDD – Isolated Supply Zone: 0.85MDD (ii) Fire-fighting Requirements – For R1 = [0.4MDD + 9,900/2] / 0.9 – For R2 = [0.4MDD + 6,600/3] / 0.9 – For R1 = [0.4MDD + 3,300/4] / 0.9 (iii) With Critical Customer – Add 0.05MDD Storage Capacity • Flushing water system – 64% of MDD (for reclaimed water)
Pumping Station Capacity	• Fresh water system (i) Pump Rate – 1.5MDD • Flushing water system (ii) Pump Rate – 1.2MDD
Peak Flow Rates in Distribution Main	• Fresh water system – 3 times mean daily demand • Flushing water system – 2 times mean daily demand

Waterworks / Facilities	Requirements
Residual Head	• Fresh water system – 20m • Fresh water system for firefighting – 17m • Flushing water system – 15m
Fire Fighting	• Fire-fighting requirements for Zone R1 = 9,900 m^3/d for 12 hours; Zone R2 = 6,600 m^3/d for 8 hours & Zone R3 = 3,300 m^3/d for 6 hours.

2.4 Development Parameters

2.4.1 The latest development parameters of the Development is shown below in ***Table 2.2*** and ***Table 2.3***.

Table 2.2 - Latest Development Parameters

Domestic	
Plot Ratio	6.5
Total No. of Flats	7,420
Non-domestic	
GFA for Welfare Facilities (m^2)	15,849
GFA for Retail Complex (m^2)	5,912
GFA for Car Parking (m^2)	42,850
GFA for Ancillary Facilities(1) (m^2)	1,098
GFA for Other Facilities(1) (m^2)	8,800
Total GFA(2) (m^2)	31,658
School	
No. of Kindergarten	2
No. of Primary School	1

Notes:
(1) Ancillary facilities and other facilities include office, workshop, PTI and covered walkway etc.
(2) Excluding GFA for carparking.

Table 2.3 – Design Populations

Domestic	
No. of Population	20,034(1)
Retail and Welfare	
No. of Employees (2)(3)	1,986
Primary School and Kindergarten	
No. of students and teachers (4)(5)	1,223

Notes:

(1) Person per flat = 2.7

(2) Worker densities of 3.5 workers (Retail Trade) and 3.3 workers (Community, Social & Personal Services) per 100m^2 GFA are adopted based on Table 8 of Commercial and Industrial Floor Space Utilization Survey published by Planning Department for the estimation of employees in retail and welfare / ancillary facilities, respectively.

(3) The provision of welfare facilities is subject to the approval of Social Welfare Department.

(4) Two kindergartens was planned with 180 students per kindergarten; 25.5 students per class for primary school are assumed based on Chapter 3 of Hong Kong Planning Standards and Guidelines.

(5) Pupil-Teacher ratios of 8.6:1 (kindergarten) and 13.8:1 (primary school) are assumed based on Education Bureau's 2017/18 figures and statistics available on Education Bureau's website.

2.4.2 The latest Preliminary Layout Plan of the Development at the Site provided by HD is enclosed in ***Appendix E*** for reference.

3 EXISTING AND PLANNED WATERWORKS FACILITIES

3.1 Existing Water Treatment Works

3.1.1 Au Tau Water Treatment Works (ATWTW) is the current major water source to the Tan Kwai Tsuen area. Treated fresh water is transferred from ATWTW via Au Tau Primary Service Reservoir to Tan Kwai Tsuen South Fresh Water Service Reservoir (TKTS FWSR).

3.2 Existing Service Reservoirs

Fresh Water Service Reservoirs

3.2.1 The Site is located adjacent to the TKTS FWSR which supplies fresh water to Tan Kwai Tsuen and the surrounding areas.

3.2.2 The Site is located within the fresh water supply zone of the existing TKTS FWSR. The above key waterworks and fresh water service reservoir supply zones are shown in ***Appendix A.***

3.2.3 ***Table 3.1*** summarizes the information on the capacity, top water level and invert level of the existing TKTS FWSR.

Table 3.1 – Information on Existing Tan Kwai Tsuen South Fresh Water Service Reservoir

Service Reservoir	Capacity (m^3)	Top Water Level (mPD)	Invert Level (mPD)
Tan Kwai Tsuen South FWSR	77,742 (1)	67.00	60.00

Notes:
(1) The capacity of the service reservoirs is obtained from the record plans provided by WSD.

Salt Water Service Reservoirs

3.2.4 The Site is located in close proximity of the salt water supply zone of the existing Tan Kwai Tsuen Salt Water Service Reservoir (TKT SWSR) which is sourced from Lok On Pai Salt Water Pumping Station (LOP SWPS). The above key waterworks and salt water service reservoir supply zones are shown in ***Appendix B***.

3.2.5 ***Table 3.2*** summarizes the information on the capacity, top water level and invert level of the existing TKT SWSR.

Table 3.2 – Information on Existing Tan Kwai Tsuen Salt Water Service Reservoir

Service Reservoir	Capacity (m^3)	Top Water Level (mPD)	Invert Level (mPD)
Tan Kwai Tsuen SWSR	18,100(1)	67.50	60.00

Notes:
(1) The capacity of the service reservoirs is obtained from the record plans provided by WSD.

3.3 Existing Water Mains

Fresh Water Supply

3.3.1 With reference to WSD's mains record plans (MRPs), the alignment of the existing fresh water mains in the vicinity of the Site are shown in ***Drawing Nos. 199086/BIN/WIA/002 to 005***. The existing fresh water supply services in the vicinity of the Site are described as follows:

3.3.2 There are three existing fresh water mains, including DN1400 and DN1800 trunk mains and DN150 pipe, running along the future alignment of the northern section of the proposed road. The interface between the DN1400 and DN1800 trunk water mains and the proposed road ends near the north tunnel portal of the WSD tunnel, while the DN150 pipe continues to run along the future alignment of the proposed road.

3.3.3 There are existing DN50 to DN80 galvanized iron pipes serving the cottages within the Site. A DN150 ductile iron fire main is also located along Yuen Long Highway at the west of the Site connecting the fire hydrants on the carriageway.

3.3.4 There are three existing fresh water mains, including DN300, DN150 and DN1400 fresh water mains, along the future alignment of the proposed road near the North West N.T. Refuse Transfer Station.

Salt Water Supply

3.3.5 With reference to the WSD's MRPs, the existing salt water mains in the vicinity of the Site are shown in ***Drawing Nos. 199086/BIN/WIA/006 to 008***. The existing salt water supply services in the vicinity of the Site are described as follows:

3.3.6 A section of DN1000 trunk salt water main is identified crossing the future alignment of the proposed road at Shui Fu Road connecting to Tan Kwai Tsuen Salt Water Service Reservoir.

3.3.7 No existing salt water main is identified within the Site.

3.4 Planned Waterworks Facilities

Planned Waterworks

3.4.1 The interfacing projects are summarized in ***Table 3.3*** as follows:

Table 3.3 – Summary of Interfacing Projects and Planned Waterworks

Projects/ Planned Waterworks
1. CE 39/2018 (WS) Strategic Cavern Areas to Accommodate Existing and Proposed Service Reservoirs in Lam Tei and Adjoining Areas – Feasibility Study
2. CE 56/2016 (CE) HSK NDA Stage 1 Works – Design and Construction
3. CE 39/2016 (CE) HSK NDA Advance Works, Phase 1 & 2 – Design and Construction
4. CE 35/2012 (CE) Planning and Engineering Study for Housing Sites in Yuen Long South - Investigation
5. CE 71/2020 (CE) Hung Shui Kiu/Ha Tsuen New Development Area Package B Works for Second Phase Development – Design and Construction

Projects/ Planned Waterworks
6. CE 78/2020 (WS) Ngau Tam Mei WTW PSR Ext – IDC
7. CE 1/2020 (CE) - "Hung Shui Kiu/Ha Tsuen New Development Area Package A Works for Second Phase Development - Design and Construction"

Planned Fresh Water Supply System

3.4.2 According to the advice of WSD, the feasibility study for relocating the proposed service reservoirs and existing service reservoirs in Lam Tei and adjoining areas to strategic cavern areas has just been awarded in July 2019. Close liaisons with WSD will be carried out to address the interface issues.

3.4.3 There are also potential interfaces with the water supply systems proposed under HSK NDA and Yuen Long South (YLS) Development. Close liaisons with the project offices of HSK NDA and YLS Development projects will be conducted to address the interface issues.

Planned Salt/Flushing Water Supply System

3.4.4 In the coordination meeting held on 18 February 2019 with the project team of the YLS Development Project and PlanD, CEDD/WDO advised the latest arrangement on the storage and reuse of reclaimed water from the planned YLS Effluent Polishing Plant (EPP). The reclaimed water from the YLS EPP would be conveyed and stored in a proposed service reservoir named Tan Kwai Tsuen East Reclaimed Water Service Reservoir (TKT RWSR) in the vicinity of the TKT Development for serving the HSK NDA and the surrounding areas. Close liaisons with HSK NDA project team to confirm the location of branching off their proposed reclaimed water main is underway.

4 ESTIMATED WATER DEMAND AND VOLUME OF PROPOSED SERVICE RESERVOIRS FOR THE DEVELOPMENT

4.1 Design Parameter

4.1.1 With reference to WSD's DI No. 1309 and EPD's Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, WSD's consumer classifications, fresh water and flushing water unit demands as shown in ***Table 4.1*** were assumed for the estimation of water demands of the Development.

Table 4.1 – Unit Demands Assumed for the Development

Unit Demand	The Site (for PRH & SSF)	School	Non-domestic [3]		
WSD's Consumer Classification	R1	School[1]	Retail	Welfare Facilities	Ancillary Facilities and Others
Fresh Water Unit Demand (l/h/d)	230	25	-	200	40
Service Trade Unit Demand [2] (l/h/d)	40	-	-	-	-
Flushing Water Unit Demand (l/h/d)	70	30	70	70	70

Notes:
(1) A 30-classroom of primary school has been proposed
(2) In accordance with Table 2 of Departmental Instruction No. 1309 issued by WSD
(3) Calculated from data in Guidelines for Estimating Sewage Flows issued by EPD

4.2 Estimated Water Demand

4.2.1 According to the development parameters as advised in paragraph 2.4.1, the water demands and the required capacity of the proposed service reservoirs for the Development are summarized in ***Table 4.2*** and ***Table 4.3*** below respectively. Detailed calculation is annexed in ***Appendix C***.

Table 4.2 – Summary of Water Demands

Anticipated Population (h)	Fresh Water MDD (m^3/day)	Flushing Water MDD (m^3/day)	Peak Fresh Water MDD (m^3/day)	Peak Flushing Water MDD (m^3/day)
19,575	5,554	1,508	17,554	3,016

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Table 4.3 - Summary of Water Service Reservoir

	Fresh water reservoir	**Flushing water reservoir**
Required Capacity (m^3)	7,970	969
Design Capacity (m^3)	8,100	1,000
TWL(mPD)	123	113.5
IL(mPD)	115	110

5 POTENTIAL IMPACT TO EXISTING AND PLANNED WATERWORKS

5.1 Impact on Existing Water Treatment Works and Existing Water Service Reservoirs

Fresh Water Supply

5.1.1 The Site is located near Tan Kwai Tsuen in Yuen Long which is within the fresh water supply zone of the existing ATWTW. As such, it is considered that there will be no adverse impact on the current zoning of the ATWTW due to development of the Site.

5.1.2 The existing TKTS FWSR is at +60mPD while the proposed public housing development will be formed at +42mPD to +82mPD. Direct supplying water from the existing TKTS FWSR is not feasible due to insufficient head.

5.1.3 Mitigation measures to resolve the residual head problem is necessary which will be discussed in Section 6.

Flushing Water Supply

5.1.4 The existing capacity of LOP SWPS does not cater for the flushing demand of the proposed public housing development at the Site.

5.1.5 In view of the above, mitigation measures are required and details are presented in Section 6.

5.2 Impact on Existing and Planned Water Mains

Within the Site

5.2.1 As mentioned in Section 3.3, there are some existing fresh water mains within or in vicinity of the Site. It is anticipated that only minor diversion/relocation/removal to these existing mains (e.g. the galvanised iron FW mains connecting the cottages at the western part of the Site) will be required, and hence there will be no major impact to the existing water mains.

Outside the Site

5.2.2 A WSD tunnel and the associated tunnel portals and no-blasting zone are identified to the north of the Site. An access road will be constructed to connect the Site to the Tin Shui Wai West Interchange. No blasting would be carried out within the 120m no-blasting zone for the construction of this access road to avoid affecting the WSD tunnel.

5.2.3 It is anticipated that diversions of existing water mains are required for the construction of access road from the Site to the Tin Shui Wai West Interchange and Shun Tat Street. The sections of existing fresh water mains with potential conflicts are shown in ***Drawing Nos. 199086/BIN/WIA/009 to 012***, while preliminary diversion plan is enclosed in ***Appendix D***. The sections of existing salt water mains with potential conflicts are shown in ***Drawing No. 199086/BIN/WIA/013***. Detailed design of the diversion will be proposed in the detailed design stage of the project.

5.2.4 In addition, the existing DN300 ductile iron washout pipe will be in conflict with the proposed pumping station and is proposed to be relocated. The detailed relocation scheme will depend on findings of the utility survey and be proposed in the later stage of the project.

5.3 Water Gathering Ground

5.3.1 According to WSD's record drawings on water gathering ground enclosed in ***Appendix F***, the Site does not fall into WSD's Water Gathering Ground and hence both short-term and long-term impacts on the Water Gathering Ground are not anticipated.

6 PROPOSED WATER SUPPLIES SCHEMES AND MITIGATION PROPOSALS

6.1 Proposed Fresh Water Supply and Fresh Water Service Reservoir

6.1.1 Considering that the Site is located adjacent to the fresh water supply zone of TKTS FWSR, it is proposed to incorporate the Site into the above zone to avoid substantial rezoning arrangement.

6.1.2 The existing TKTS FWSR is at +60mPD while the proposed public housing development will be formed at +42mPD to +82mPD. Direct supplying water from the existing TKTS FWSR is not feasible due to insufficient head. As such, a high-level fresh water service reservoir is required. Fresh water will be sourced from the existing TKTS FWSR and pumped to the proposed high-level fresh water service reservoir via a booster pumping station.

6.1.3 A high-level fresh water service reservoir to be located at +115mPD near the Site will be provided to accommodate the fresh water demand of the Development. An access road will be provided to facilitate the operation and maintenance of the above waterworks facilities.

6.1.4 According to the Review of Planning Standards – Part I Storage Capacity for Fresh Water Service Reservoir published by WSD, the capacity of the proposed fresh water service reservoir shall be calculated in accordance with WSD's Review of the Prevailing Planning Standards for DI 1309, including scenarios of isolated supply zone and fire-fighting requirement. The calculation for the capacity of the proposed fresh water service reservoir is presented in ***Appendix C***.

6.1.5 As presented in ***Appendix C***, the proposed public housing development and its ancillary facilities will require mean daily demand of fresh water of about 5,554m^3/day to accommodate the anticipated fresh water consumption in domestic, non-domestic and service trade uses.

6.1.6 Based on the water demand forecast, the proposed fresh water service reservoir will have a design capacity of about 8,100m^3 and will be located at +115mPD with invert level also at +115mPD to meet the water demand of the Development and provide sufficient residual head.

6.1.7 The location and level of the proposed fresh water supply facilities are shown in ***Drawing Nos. 199086/BIN/WIA/014 to 017***.

6.1.8 As the Project had been included in Category C of the Public Works Programme subsequent to the approval of its Technical Feasibility Statement in August 2017, DEVB TC(W) No. 8/2017 with the effective date on 22 Dec 2017 should not be applicable. Nevertheless, reasons for not constructing the proposed service reservoirs in caverns under this Project are explained in the following paragraphs.

6.1.9 In order to meet the housing demand, the population intake of this Project was planned to be from 2030 by phases. In view that more than 10 years lead time is necessary for constructing reservoirs in cavern, the proposed fresh water and flushing water service reservoirs would be necessary to be constructed in open areas instead of inside caverns to cater water demand arisen from the Development before the planned population intake.

6.2 Proposed Flushing Water Supply and Flushing Water Service Reservoir

Interim Scenario

6.2.1 With reference to the latest tentative implementation programme of YLS Development, the planned Tan Kwai Tsuen Reclaimed Water Service Reservoir (TKT RWSR) will be commissioned in 2033 while the proposed public housing development under this Assignment will have population intake from 2030 by phase. Programme mismatch exists between the commissioning of the reclaimed water supply facilities and the population intake of the Development.

6.2.2 The design capacity of LOP SWPS is 83MLD for delivering salt water to areas including Tin Shui Wai and Yuen Long Town. When the supply of reclaimed water to be available later, we understand that WSD will switch the FLW supply from salt water to reclaimed water for areas including Tin Shui Wai and Yuen Long Town so that the loading on LOP SWPS will be reduced significantly. In this connection, the existing pumps in LOP SWPS for the proposed development may only upgrade if the progress of reclaimed water supply for Tin Shui Wai and Yuen Long Town would be delayed.

6.2.3 With the expected availability of salt water supply from LOP SWPS, salt water supply from TKT SWSR is proposed as the interim flushing water supply before reclaimed water will be available.

6.2.4 As reclaimed water is the ultimate flushing source for the proposed public housing development, a high-level flushing water service reservoir is proposed at +110mPD with invert level also at +110mPD. The design capacity is 1,000m^3 to supply reclaimed water with sufficient residual head to the proposed housing sites. Before reclaimed water is available, salt water will be supplied by the existing TKT SWSR to the proposed high-level flushing water service reservoir via a booster pumping station.

6.2.5 Storage requirement of the proposed flushing water service reservoir is controlled by the ultimate scenario which adopt reclaimed water for flushing water supply as discussed in the following paragraphs.

6.2.6 The proposed interim flushing water supply arrangement is shown in ***Drawing Nos. 199086/BIN/WIA/018 to 020***.

Ultimate Scenario

6.2.7 With reference to the Holistic Review Study on the Use of Reclaimed Water for Flushing in Northwest New Territories, the flushing water for the Development is proposed to be supplied by reclaimed water from the planned YLS EPP via the planned TKT RWSR considering the cost-benefit.

6.2.8 Derivation of the required capacity needed for the proposed flushing water service reservoir is presented in ***Appendix C***. The total anticipated flushing water MDD required for domestic and non-domestic uses of the proposed public housing development would be 1,508 m^3/day. The design capacity of the proposed high-level flushing water service reservoir would be 1,000 m^3 (i.e. 1,508 x 0.64) [1].

6.2.9 It is understood that further coordination with WSD and the project teams of YLS Development project, HSK NDA project and YLS EPP project are required to ascertain the detailed arrangement of reclaimed water supply.

6.2.10 Locations and levels of the proposed ultimate flushing water supply facilities are shown in ***Drawing Nos. 199086/BIN/WIA/021 to 023***.

6.3 Proposed Distribution Mains

Proposed Fresh Water Mains (FWM)

6.3.1 It is proposed to source the Development from the proposed fresh water service reservoir as detailed in Section 6.1. Fresh water mains of size DN450 to DN300 are proposed to be laid.

6.3.2 The proposed network of fresh water mains connecting the proposed fresh water service reservoir with the proposed pumping station and the Development will be discussed in Section 7.2.

6.3.3 To enhance the reliability of the proposed flushing water supply system, a 200mm diameter fresh water augmentation main will be laid branching off from the inlet main of the proposed high-level fresh water service reservoir to the proposed flushing water service reservoir as an alternative supply source for flushing supply to the proposed housing development in the event that the proposed flushing water pumping station has to be shut down due to operational reasons or as a result of other unforeseeable events. The invert level of the concerned fresh water main should be set at a level higher than the crown level of the overflow pipe to avoid accidental contamination of the fresh water supply system by flushing water.

Proposed Flushing Water Mains

Interim scenario

6.3.4 It is proposed to supply the Development by the existing TKT SWSR via the proposed booster pumping station as detailed in Section 6.2. Flushing water mains of size DN200 to DN100 are proposed to be laid. The proposed flushing water mains should meet the requirement of conveying reclaimed water such that it could be easily converted to reclaimed water in the future.

6.3.5 The proposed network of flushing water mains connecting the proposed flushing water service reservoir with the proposed pumping station and the Development will be discussed in Section 7.3.

Ultimate scenario

6.3.6 It is proposed to supply the Development by the proposed flushing water service reservoir to be fed by the proposed reclaimed water from YLS Development via the

[1] The storage requirement is similar to the requirement of proposed treated grey water service reservoir for flushing under Anderson Road Quarry development. The capacity of treated grey water service reservoir for flushing is 64% of the MDD, which consists of 25% for balancing, 33% for breakdown and allow 10% capacity as ineffective storage (i.e. [25+33]/0.9% of MDD).

proposed pumping station as detailed in Section 6.2. The proposed DN200 flushing water mains laid for the interim scenario would be used for supplying reclaimed water and thus no additional water mains would be laid.

6.3.7 In order to minimize the risk of cross-connections between the fresh water supply system and reclaimed water supply system, the flushing water pipes with reclaimed water should have distinctive features different to those pipes used for the fresh water supply system including but not limited to the use of purple pipe coating, labelling and different pipe sizes.

6.4 Proposed Firefighting Water Supply

6.4.1 The locations of fire hydrant and corresponding distribution mains are shown in the ***Drawing Nos. 199086/BIN/WIA/014 to 017***.

Along the proposed access road

6.4.2 Distribution mains of size DN 300 supplying fresh water is proposed to be laid with fire hydrants staggered every 300m along alternate sides of the proposed access road to be connected to Tin Shui Wai West Interchange (TSWWI) slip road and Shun Tat Road, as well as the access road between housing platforms.

6.4.3 The above distribution mains will be connected to the proposed DN450 fresh water main to be fed by the proposed fresh water service reservoir.

Within the proposed housing sites

6.4.4 Sufficient water capacity for firefighting has been reserved in the proposed fresh water service reservoir and the associated fresh water mains.

6.4.5 Firefighting water supply for the Development site will be provided by the fresh water mains along the proposed public access road between the housing platforms. Exact position of fire hydrants within the Development site should be determined together with the detailed layout design of the by the relevant departments.

6.5 Proposed Pumping Station

6.5.1 As aforementioned, two high-level reservoirs for supplying fresh water and flushing water would be required to support the Development. In view of the elevation difference between the existing TKT SWSR and the proposed flushing water service reservoir (for interim scenario of flushing water supply); the planned TKT RWSR and the proposed flushing water service reservoir (for ultimate scenario of flushing water supply); the existing TKTS FWSR and the proposed fresh water service reservoir, pumping facilities are required to provide sufficient pressure to feed the fresh water and flushing water to the proposed service reservoirs.

6.5.2 To minimize the footprint of the pumping station, the proposed fresh water and flushing water pumping stations are proposed to be combined and co-located at the level of about +52.5mPD.

6.5.3 A single-storey pumping station with headroom of about 4m to 7m is proposed to be located near the south side of the junction between Shui Fu Road and the proposed access road, which is bounded by the existing drainage channel to the south and existing trunk water mains to the east.

6.5.4 The inlet for fresh water supply is proposed to be branched off from the existing DN1000 mild steel fresh water mains (FWM), located on the east of the proposed pumping station near Shui Fu Road. While as the outlet is proposed to be emanated from the north of the pumping station. Fresh water will be pumped along the existing WSD's access road and further along the proposed access road to reach the proposed fresh water service reservoir.

6.5.5 The inlet for flushing water supply is proposed to be branched off from the existing DN1000 salt water mains (SWM) at the junction between Shui Fu Road and the proposed access road. Both inlet and outlet are proposed at the north side of the pumping station in the interim stage to facilitate the future switching process from the use of salt water for interim stage to the use reclaimed water for the ultimate scenario. Similar to the fresh water supplies, flushing water would be pumped along the existing WSD's access road and further along the proposed access road to reach the proposed flushing water service reservoir.

6.5.6 Various auxiliary rooms including switch rooms, control room, E&M plant room are proposed in the pumping station. The location and preliminary layout of the pumping station is indicated in ***Drawing No. 199086/BIN/WIA/024***.

Pumps

6.5.7 Kinetics pump in the form of centrifugal pumps are proposed due to the small scale in nature. To cater for emergency situation and facilitating the maintenance, three pumps (two duties and one standby) sizing at peak flow are proposed for both flushing water and fresh water.

6.5.8 Automatic pump operation system based on the water level in the service reservoir is recommended. Level sensing equipment will be provided for the purpose of pump control and emergency alarm. The standby pump will cut in when the duty pump fails to operate.

Electricity Power Supply

6.5.9 Dual feed power supply is proposed to enhance the stability of the power supply. CLP Power (CLPP) will be liaised for providing the dual feed system.

Ventilation and Air-conditioning

6.5.10 Apart from the control room, ventilation will be provided to all the remaining plant rooms in order to maintain and limit the temperature rise inside the pumping station such that the maximum ambient temperature in pump hall will not exceed 40°C.

6.5.11 The fresh air inlets and exhaust air outlets will be at the lowest and the highest possible levels respectively. Air inlets, outlets and ducts, if any, will be arranged to minimize stagnant air pockets inside the plant room and ensure no exhaust air is re-circulated. Fixed louvres with removable wire mesh screens will be provided for the air inlets and outlets.

6.5.12 Independent compact air-conditioning units will be installed in the control room in accordance with WSD current practice.

6.5.13 The ventilation system will be designed to comply with ASHRAE and all equipment will comply with relevant British Standards.

<u>Monitoring and Control</u>

6.5.14 SCADA/PLC system will be provided for the electrical equipment and the pumping system with adequate input and output (I/O) points. Hot standby PLC shall be provided with redundant configuration for a safe, secure and trouble–free condition in the event of any malfunction in a PLC in the network.

6.6 Proposed District Metering Areas and Pressure Management Areas

6.6.1 District Metering Areas (DMA) and Pressure Management Areas (PMA) are proposed in accordance with the clauses 1.2.4 / 1.2.5 of the Manual of Mainlaying Practice (2012 Edition). The DMA and PMA for proposed fresh and flushing water service reservoir are indicated in ***Drawing No. 199086/BIN/WIA/025 and 026*** respectively.

6.7 Smart Water Initiatives

6.7.1 The adoption of Automatic Meter Reading and the aspect of smart initiatives will be taken into consideration in the design stage. Development (1) Division of WSD will be consulted on smart initiatives during design stage, including but not limited to:

- Intensive metering and real-time monitoring for Water Intelligent Network (WIN);
- Smart/Intelligent pressure management;
- Hydraulic modelling for leak pin-pointing and network operation;
- Water suspension notification system;
- On-line water quality monitoring at the distribution networks; and
- Leak pin-pointing with fibre optic technology.

7 PRELIMINARY HYDRAULIC DESIGN OF PROPOSED DISTRIBUTION MAINS

7.1 Hydraulic Analysis

7.1.1 It is proposed to feed the fresh water and flushing water to the proposed Development site by laying water mains to connect the proposed water service reservoirs and the existing water supply networks. ***Tables 7.1*** and ***7.2*** below summarize the diameters and capacities of the proposed water mains. It is revealed that all the proposed pipes will have sufficient capacities for the peak flows.

Table 7.1 – Summary of Proposed Fresh Water Mains Capacities

Size of Main (mm)	Available Peak Flow Velocity (m/s)	Required Peak Flow Velocity (m/s)	Available Peak Flow Capacity (m^3/day)	Required Peak Flow Capacity (m^3/day)
450	2	1.28	27483	17,534
300	1.5	0.99	9,161	6,020
250	1.5	1.42	6,362	6,020

Table 7.2 – Summary of Proposed Flushing Water Mains Capacities

Size of Main (mm)	Available Peak Flow Velocity (m/s)	Required Peak Flow Velocity (m/s)	Available Peak Flow Capacity (m^3/day)	Required Peak Flow Capacity (m^3/day)
200	1.5	1.11	4,072	3,016
100	1.5	1.49	1018	1,008
80	1.5	0.12	651	50

7.1.2 Preliminary hydraulic calculations have been carried out for the proposed water supply systems. It is noted that minimum residual heads of the proposed fresh water system and flushing water system fulfill the WSD's requirements. The calculations are annexed in ***Appendix C***.

7.2 Preliminary Design - Fresh Water

Inlet of the Proposed Pumping Station

7.2.1 DN450 FWM is proposed to be branched off from the existing DN1000 FWM before inlet to the existing Tan Kwai Tsuen Fresh Water Service Reservoir (SR216) and to be connected to the inlet of the proposed pumping station.

Outlet of the Proposed Pumping Station and Inlet of the Proposed FWSR

7.2.2 DN600 FWM is proposed as the outlet of the proposed pumping station and to be laid along the existing and proposed WSD's maintenance access road to feed fresh water to the proposed fresh water service reservoir.

Outlet of the Proposed FWSR

7.2.3 DN450 FWM is proposed as the outlet of the proposed FWSR and also the distribution main to the proposed Development. In order to save energy and minimize the pressure within the water supply network, it is proposed that the distribution main will directly running down the proposed slopes behind the upper platform to provide fresh water supply to the Development at the upper platform. The distribution main will then pass through the upper platform and run along the proposed public access road to connect to the Development at the lower platform. Since a section of the FWM would need to be laid within the upper platform near the slope toe, a designated Waterworks Reserve (WWR) would be required to facilitate future maintenance of the water mains by WSD. HD has been consulted on the above arrangement of the distribution mains and has expressed no objection to such arrangement.

7.2.4 The preliminary layout of the proposed fresh water system is shown in ***Drawing Nos 199086/BIN/WIA/014 to 017***.

7.3 Preliminary Design – Flushing Water

Inlet of the Proposed Pumping Station

Interim scenario

7.3.1 DN200 SWM is proposed to be branched off from the existing DN1000 SWM output from the existing TKT SWSR and to be connected to the inlet of the proposed pumping station.

Ultimate scenario

7.3.2 DN200 flushing water main is proposed to be branched off from the planned reclaimed water main output from the planned TKT RWSR under YLS Development and HSK NDA and to be connected to the inlet of the proposed pumping station. The exact connection point is to be confirmed with the project teams of YLS Development/ HSK NDA.

Outlet of the Proposed Pumping Station and Inlet of the Proposed FLWSR

7.3.3 DN200 flushing water main/ DN200 SWM is proposed as the outlet of the proposed pumping station and to be laid along existing and proposed WSD's maintenance access to reach the proposed FLWSR.

Outlet of the Proposed FLWSR

7.3.4 DN200 flushing water main/ DN200 SWM is proposed as the outlet of the proposed flushing water service reservoir as well as the distribution main to the Development. In order to save energy and minimize the pressure within the water supply network, the DN200 flushing water main/ DN200 SWM is proposed to be directly running down the proposed slopes behind the upper platform to provide flushing water supply to the Development at the upper platform. The DN200 flushing water main/ DN200 SWM is then proposed to be passing through the upper platform and running along the proposed public access road to connect to the Development at the lower platform. Since a section of the SWM would need to be laid within the upper platform near the slope toe, a designated Waterworks Reserve (WWR) would be required to facilitate future maintenance of the water mains by WSD. The location of the WWR can be referred to ***Drawings Nos. 199086/BIN/WIA/016 and 022.***

7.3.5 The proposed interim flushing water supply system is shown in ***Drawing Nos. 199086/BIN/WIA/018 to 020***.

7.3.6 The preliminary layout of the proposed ultimate flushing water mains is shown in ***Drawing Nos. 199086/BIN/WIA/021 to 023***.

7.4 Cost Estimation and Programme of Works

7.4.1 Detailed cost estimation and programme of works are discussed in the "Implementation Programme, Cash Flow Schedule, Recurrent Consequence and Cost Estimate" respectively which were submitted under separate cover.

8 CONCLUSION AND RECOMMENDATION

8.1.1 An impact assessment on the existing and planned water supplies system due to the additional water demand arising from the Development was conducted.

8.1.2 Based on the latest development parameters, it is estimated that the fresh and flushing water demands due to the Development are 5,554 and 1,508 cubic meters per day in total respectively.

8.1.3 According to the as-built records, there would be insufficient residual head for both fresh water and flushing water supplies for the Development with high level building platforms by the existing water supply facilities. In addition, there would also be a shortfall in capacity of LOP SWPS for salt water supply for the Development.

8.1.4 The design capacity of LOP SWPS is 83MLD for delivering SW to areas including Tin Shui Wai and Yuen Long Town. When the supply of reclaimed water to be available later, we understand that WSD will switch the FLW supply from salt water to reclaimed water for areas including Tin Shui Wai and Yuen Long Town so that the loading on LOP SWPS will be reduced significantly. In this connection, upgrading of LOP SWPS for the proposed development may only be required if the progress of reclaimed water supply for Tin Shui Wai and Yuen Long Town would be delayed. Fresh water augmentation for flushing will be adopted as the last resort in emergency situation when the supply from salt water is not available.

8.1.5 A high-level fresh water service reservoir with design capacity of approximately 8,100m^3, a high-level flushing water service reservoir with design capacity of approximately 1,000m^3 and an associated pumping station have been proposed to provide sufficient residual head and reliable water supplies for the proposed Development site. Access roads will be provided to facilitate the operation and maintenance of the new water supply facilities.

8.1.6 It is anticipated that diversion/relocation/removal of the existing mains due to the proposed site formation and infrastructure works under the project will be needed. Details of the diversion or relocation scheme will be proposed in the later stage of the project.

8.1.7 The proposed pumping station is branched off from the existing DN1000 FWM and connect to the proposed DN600 FWM. Fresh water will be pumped to the proposed fresh water service reservoir and connect to proposed DN450 FWM to provide fresh water supplies for the Development. Also, distribution mains of size DN300 supplying fresh water is proposed to be laid with fire hydrants staggered every 300m along alternate sides of the proposed access road to be connected to Tin Shui Wai West Interchange (TSWWI) slip road and Shun Tat Road, as well as the access road between housing platforms. Hydraulic analysis has been carried out and the proposal is found to be technically feasible.

8.1.8 The proposed pumping station is branched off from the existing DN1000 flushing water main and connect to the proposed DN200 flushing water main. Flushing water will be pumped to the proposed flushing water service reservoir and connect to proposed DN200 flushing water main to provide flushing water supplies for the

Development. Hydraulic analysis has been carried out and the proposal is found to be technically feasible.

8.1.9 The Site is not within the existing WSD's water gathering ground. Hence, no impact is anticipated to the water gathering ground.

8.1.10 It is concluded that there will be no adverse impact on the existing water supply networks due to the proposed site formation and infrastructure works with the implementation of the proposed mitigation measures. Last but not least, with the proposed waterworks, it is anticipated that sufficient and reliable fresh and flushing water supplies could be achieved for the Development.

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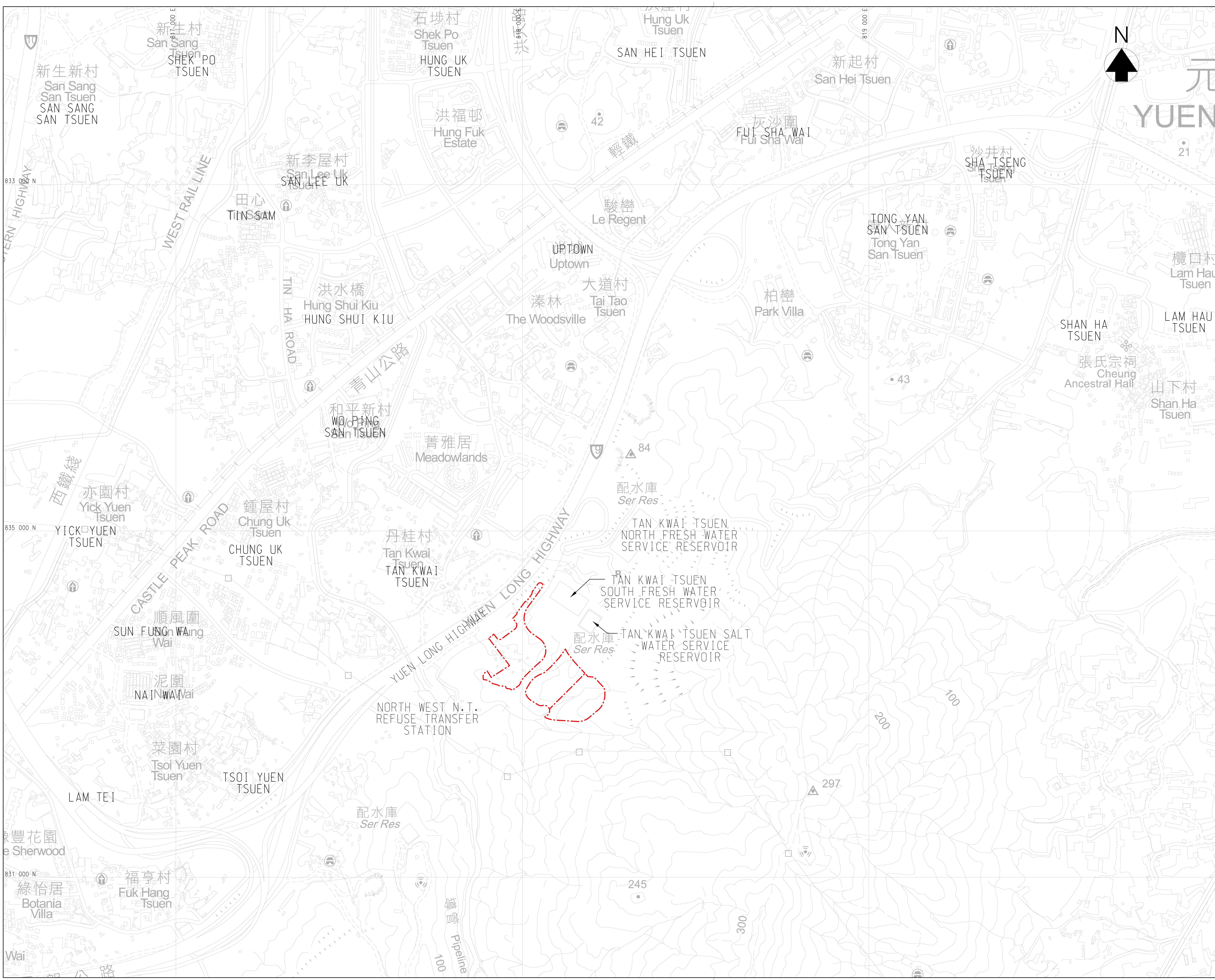
FIGURES



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LEGEND:

PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED G/IC FACILITIES

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROJECT LAYOUT PLAN

Drawing No.
199086/BIN/GEN/001

Scale
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1 : 10000 (A3)

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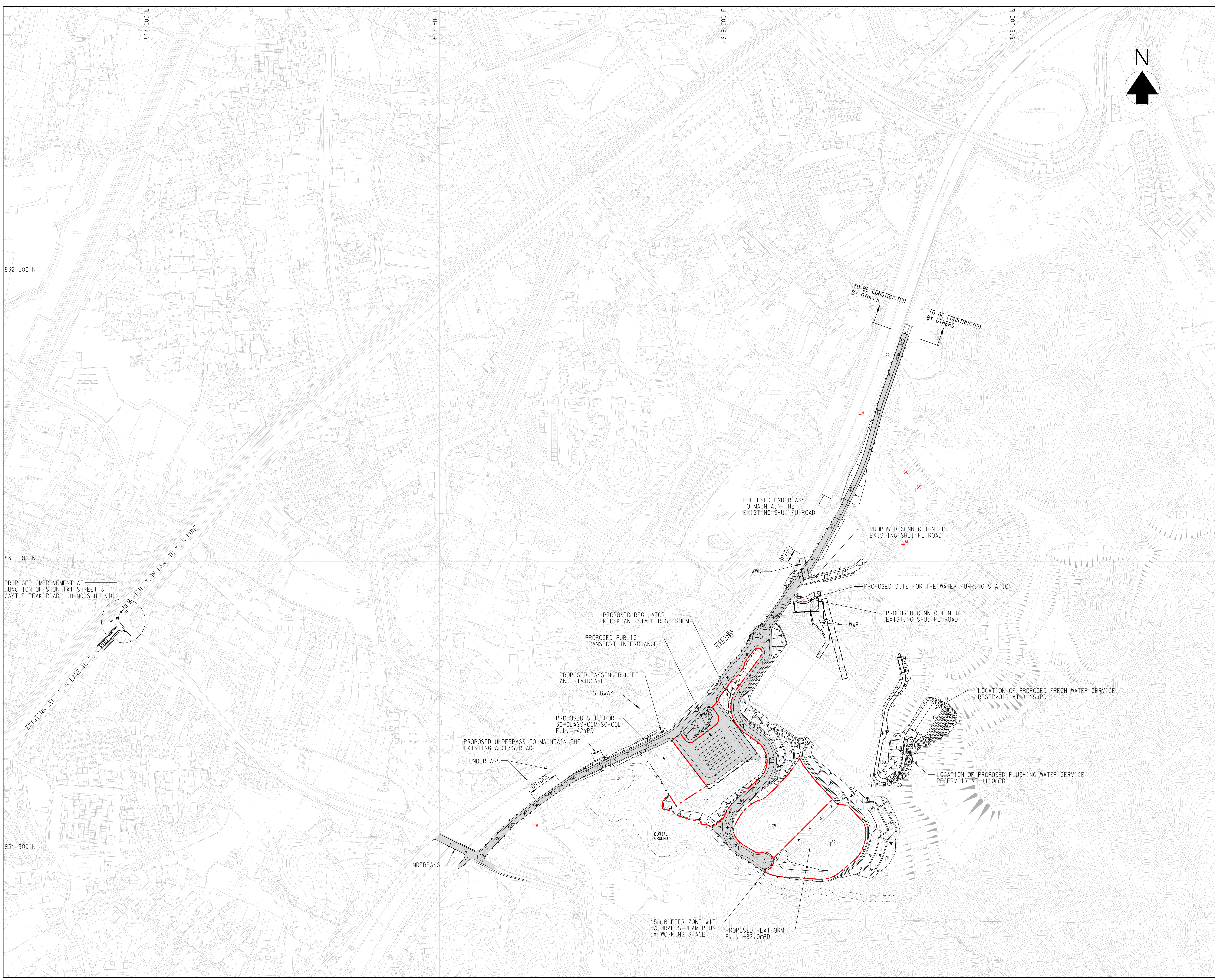

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED G/IC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

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Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
SITE FORMATION LAYOUT PLAN

Drawing No.	Scale
199086/BIN/SFAI/001	1 : 3000 (A1) 1 : 6000 (A3)

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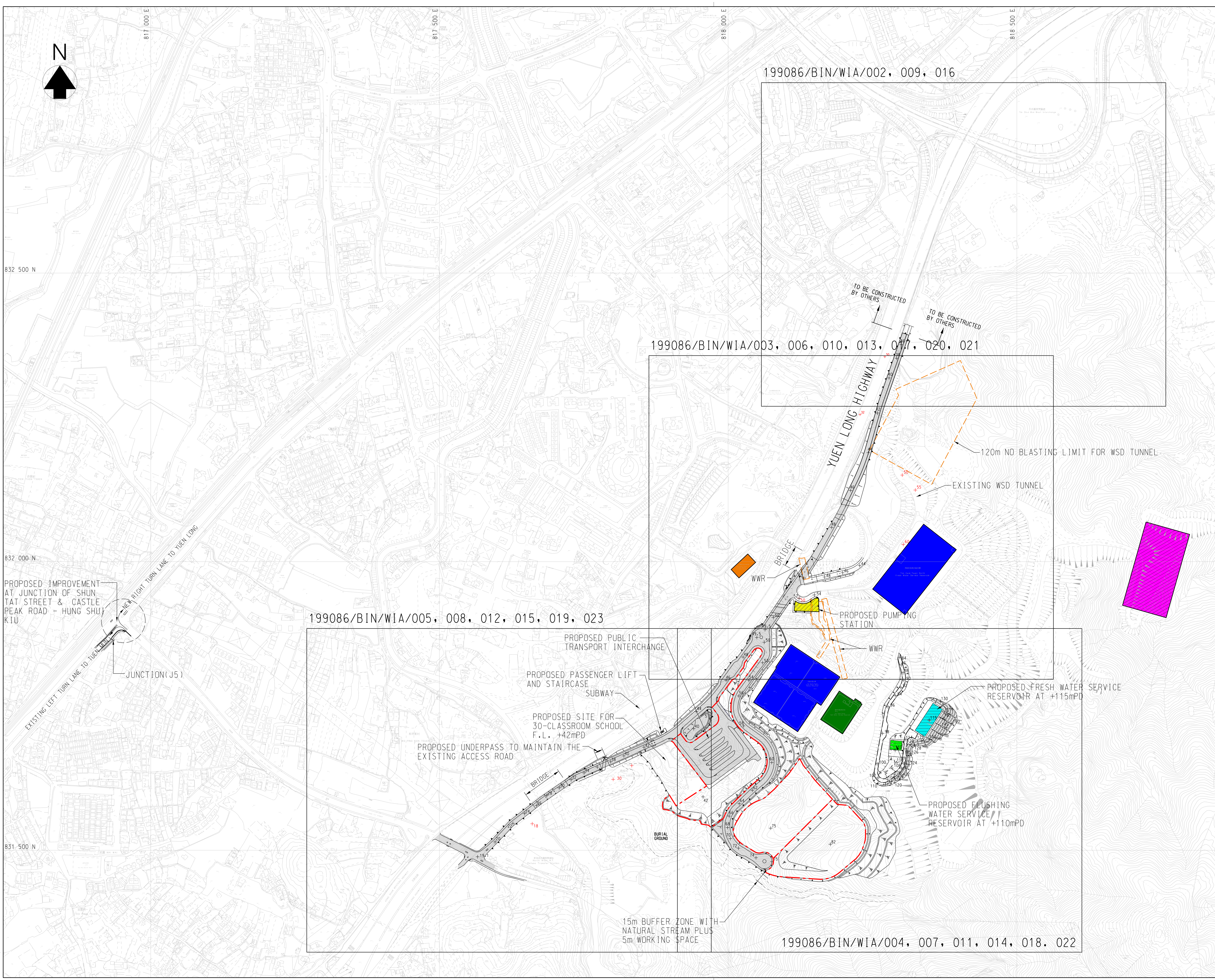

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING FLUSHING WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR
- PROPOSED PUMPING STATION
- INDICATIVE LOCATION OF THE PLANNED TAN KWAI TSUEN RECLAIMED WATER SERVICE RESERVOIR UNDER HSK NDA DEVELOPMENT

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	TCL	WLC	SZ	LCH	
Date	04/22	04/22	04/22	04/22	

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Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
WATERWORKS INSTALLATION (KEY PLAN)

Drawing No.
199086/BIN/WIA/001

Scale
1 : 3000 (A1)
1 : 6000 (A3)

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賓尼斯工程顧問有限公司

Plot File by = qlu15947 2022/11/15

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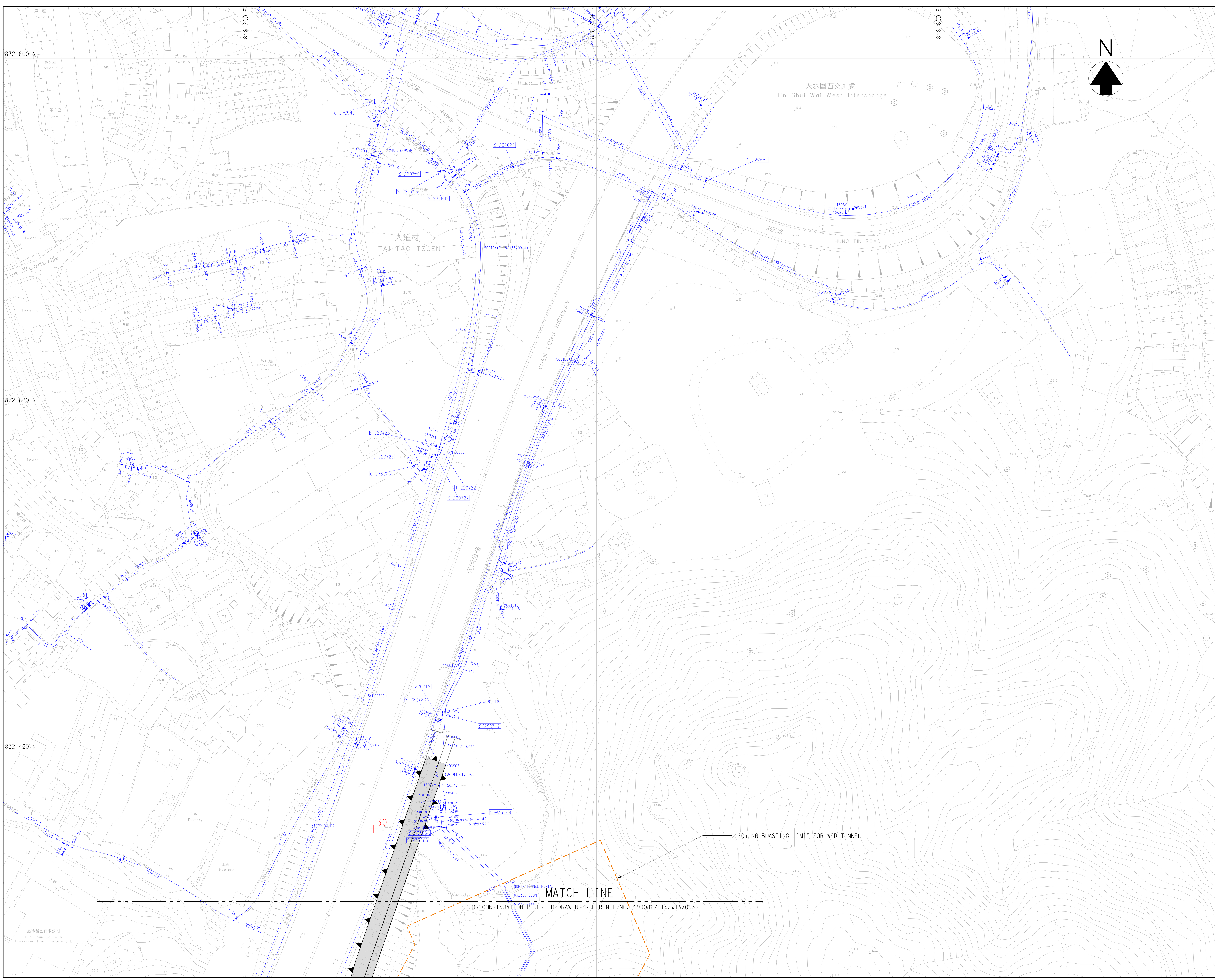


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER MAINS

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	TCL	WLC	SZ	LCH	
Date	04/22	04/22	04/22	04/22	

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING FRESH WATER MAINS RECORD PLAN

(SHEET 1 OF 4)

Drawing No.
199086/BIN/WIA/002

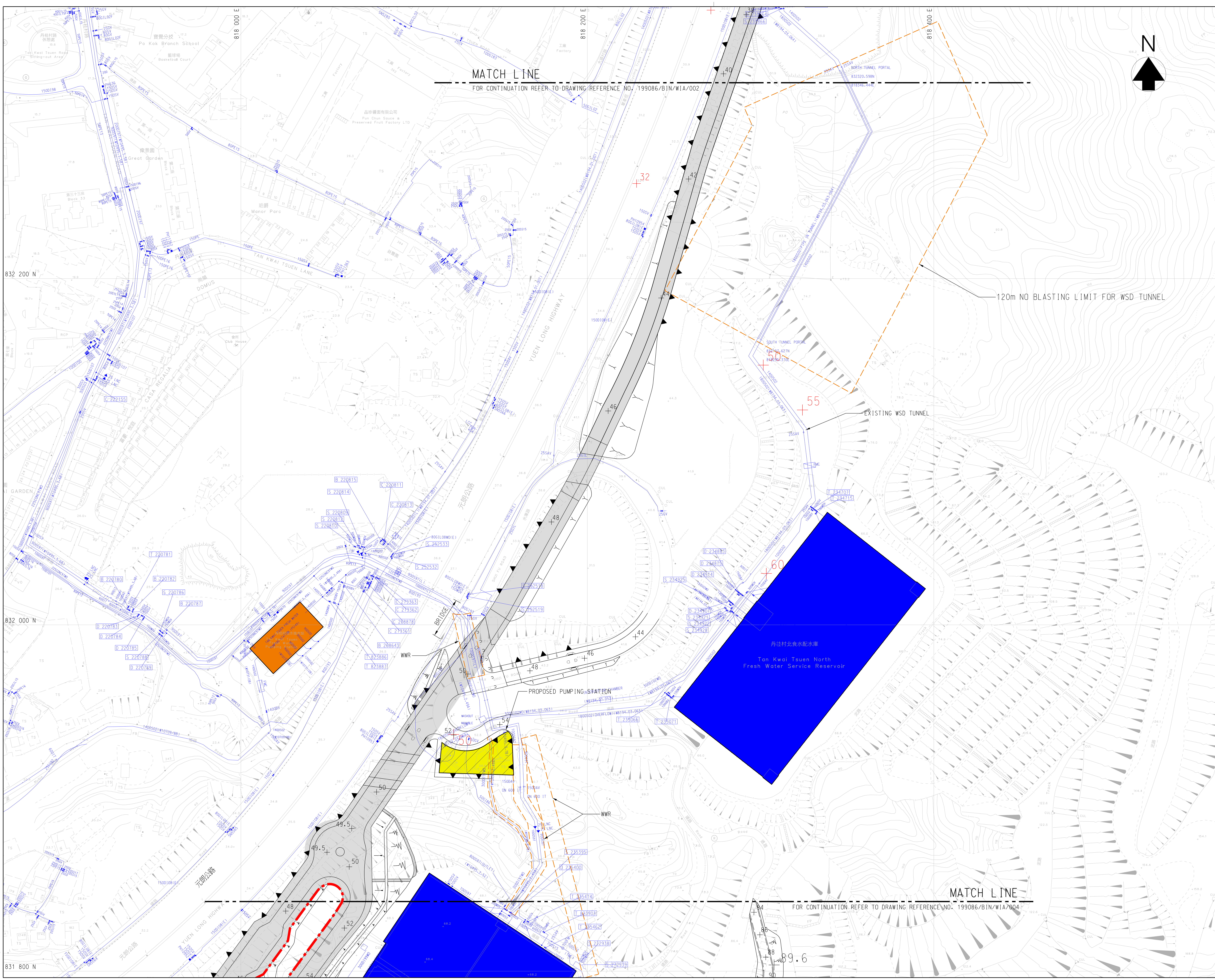
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2022/10/24

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-002.dgn



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- EXISTING FRESH WATER MAINS
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- PROPOSED PUMPING STATION

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING FRESH WATER MAINS RECORD PLAN
(SHEET 2 OF 4)

Drawing No.
199086/BIN/WIA/003

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2022/10/24

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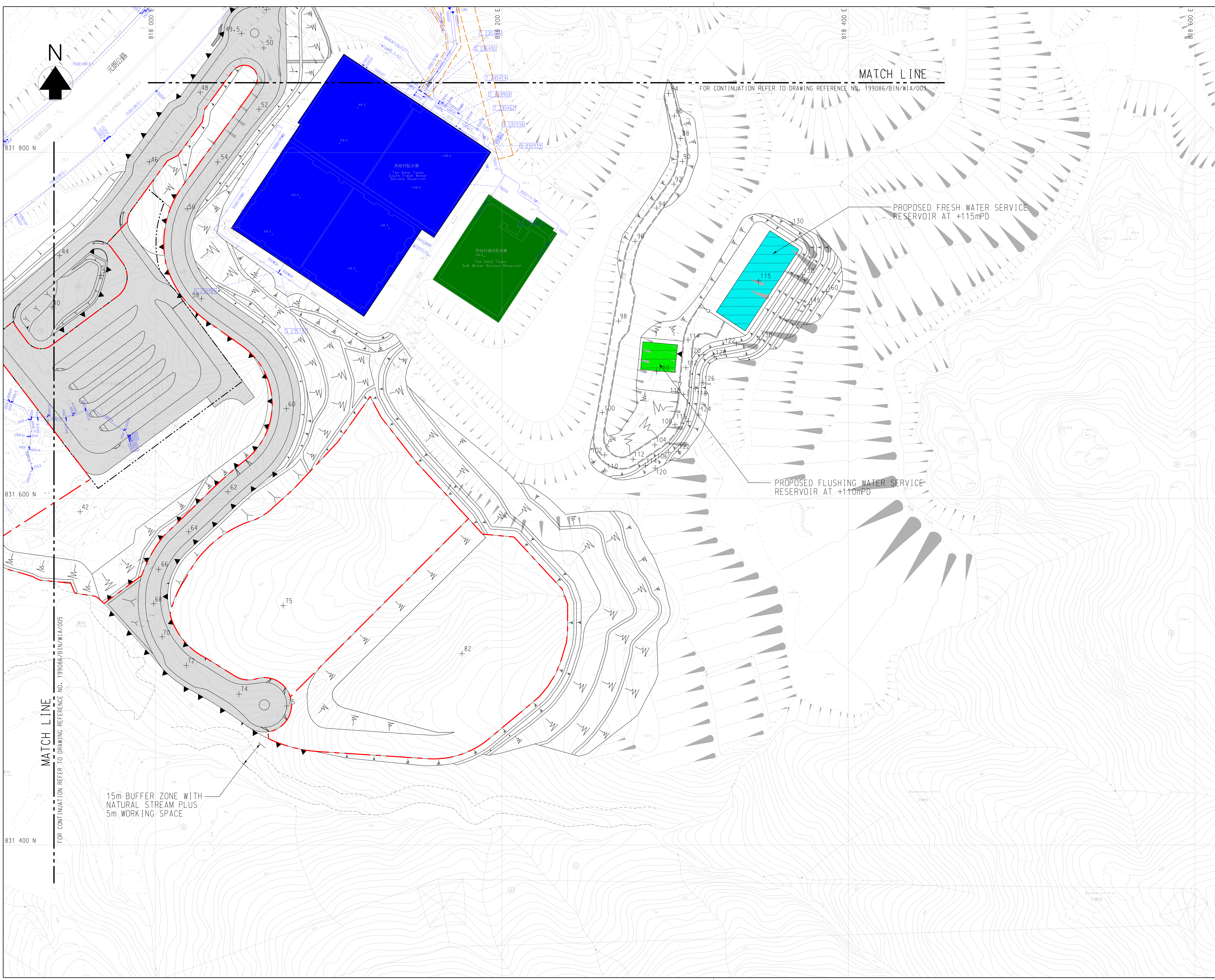

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING FLUSHING WATER SERVICE RESERVOIR
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	TCL	WLC	SZ	LCH	
Date	04/22	04/22	04/22	04/22	

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING FRESH WATER MAINS RECORD PLAN

(SHEET 3 OF 4)

Drawing No.
199086/BIN/WIA/004

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qlu15947 2022/11/15

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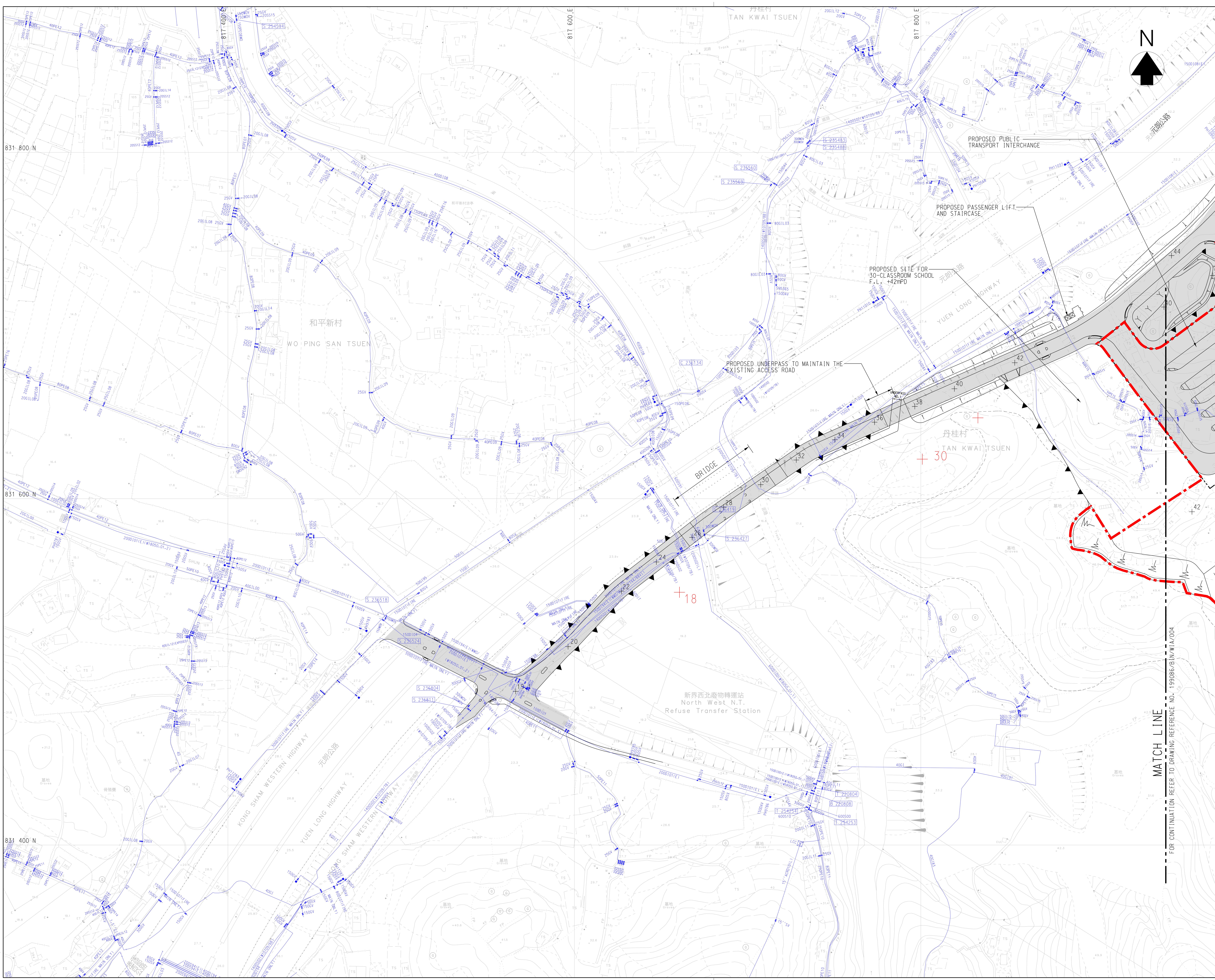


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- 65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER MAINS

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING FRESH WATER MAINS RECORD PLAN

(SHEET 4 OF 4)

Drawing No.
199086/BIN/WIA/005

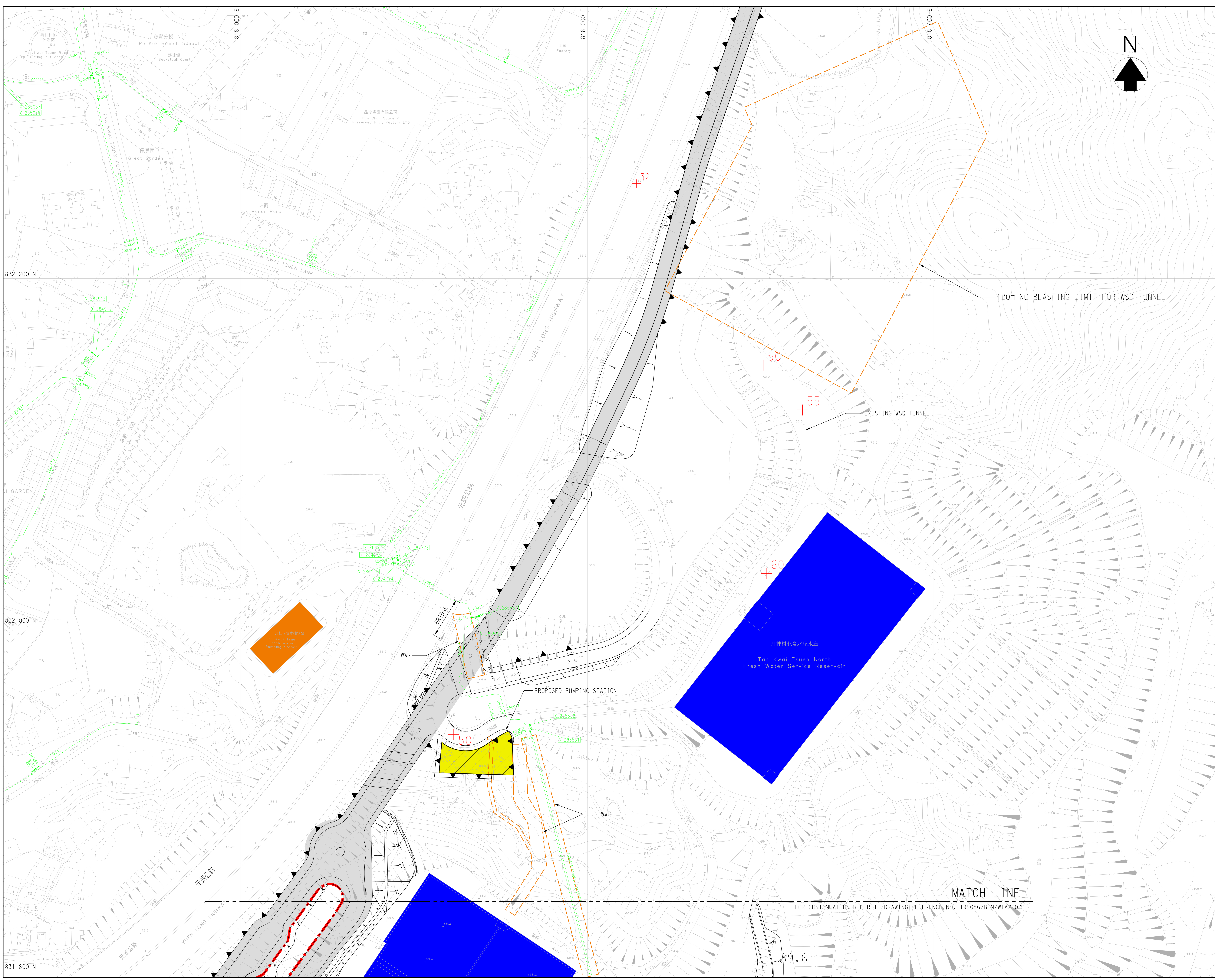
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by : sjlu15947 2022/10/24

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-005.dgn



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- EXISTING SALT WATER MAINS
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- PROPOSED PUMPING STATION

Revision	Date	Description			Initial
	Designed	Checked	Drawn		Checked
Initial	TCL	WLC	SZ		LCH
Date	04/22	04/22	04/22		04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING SALT WATER MAINS RECORD PLAN

(SHEET 1 OF 3)

Drawing No.
199086/BIN/WIA/006

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2022/10/24

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-006.dgn

Revision	Date	Description	Initial

	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG – INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

EXISTING SALT WATER MAINS RECORD PLAN

(SHEET 2 OF 3)

Drawing No.

199086/BIN/WIA/007

Scale

1 : 1000 (A1)
1 : 2000 (A3)

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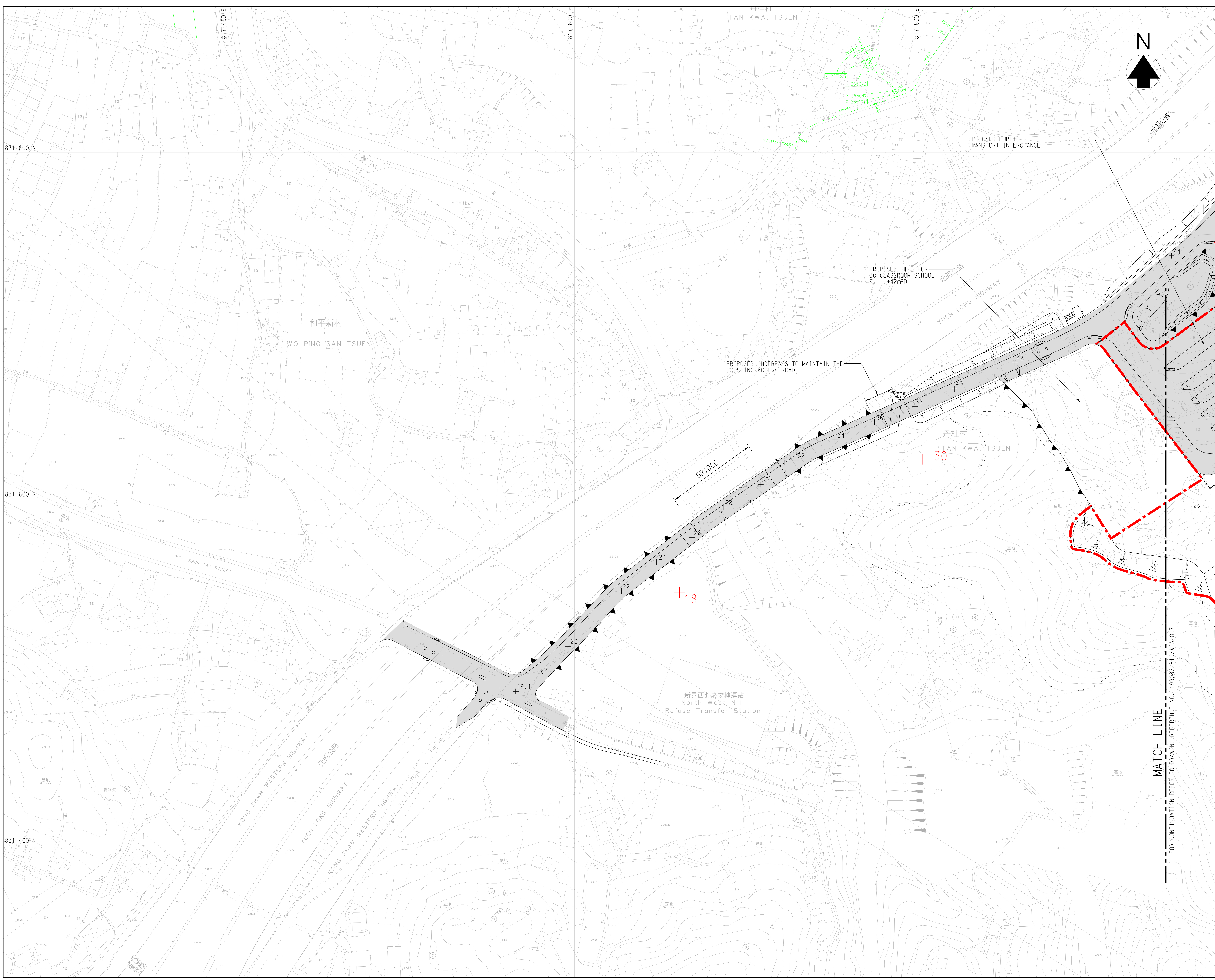
Plot File by = qlu15947 2022/11/15

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-007.dgn



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LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- EXISTING SALT WATER MAINS

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	TCL	WLC	SZ	LCH	
Date	04/22	04/22	04/22	04/22	

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

EXISTING SALT WATER MAINS RECORD PLAN

(SHEET 3 OF 3)

Drawing No. 199086/BIN/WIA/008

Scale 1 : 1000 (A1) 1 : 2000 (A3)

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賓尼斯工程顧問有限公司

Plot File by = qiu15947 2022/10/24

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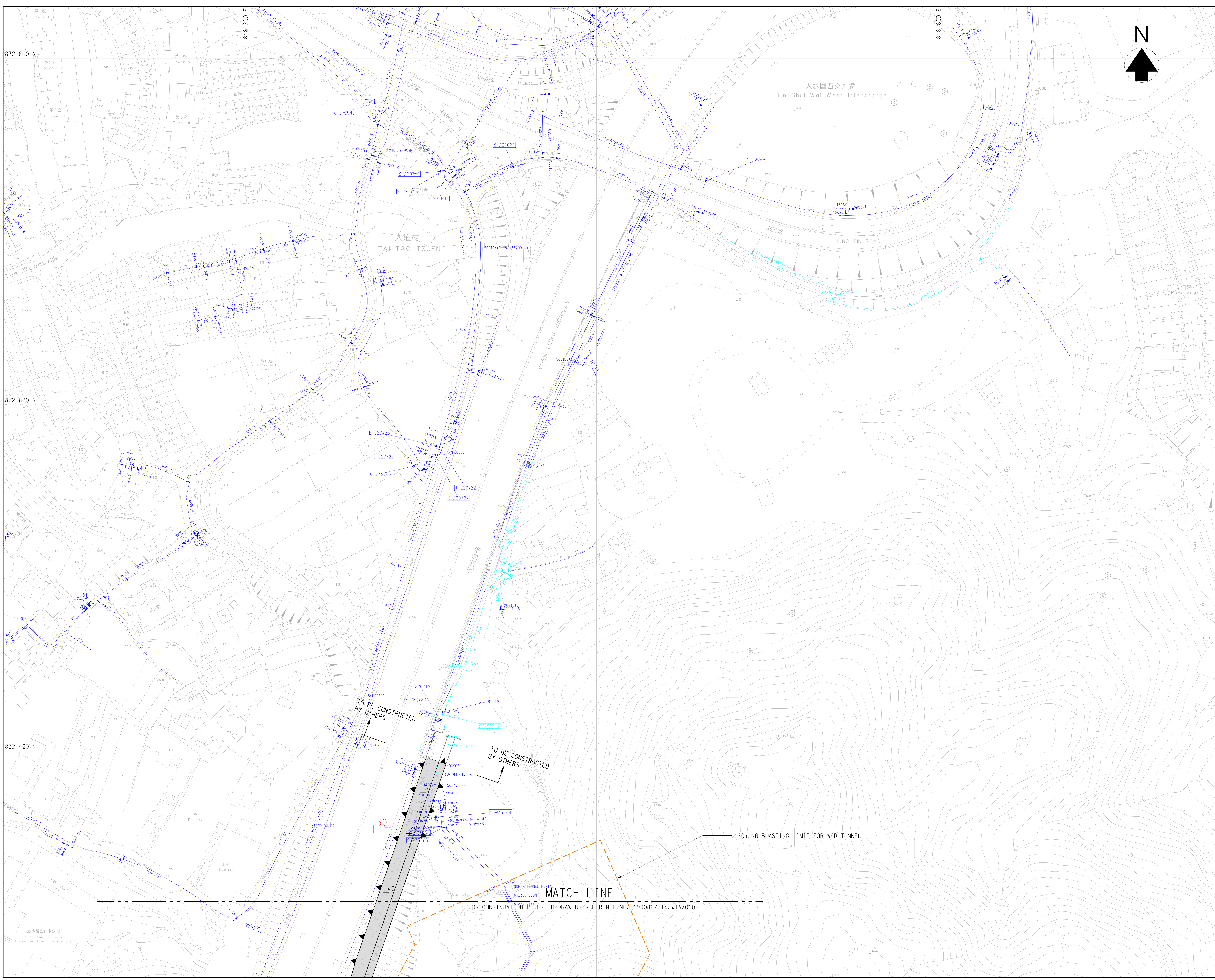


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- EXISTING FRESH WATER MAINS TO BE DIVERTED

Revision	Date	Description	Initial

	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
POTENTIAL IMPACT TO THE EXISTING FRESH WATER MAINS

(SHEET 1 OF 4)

Drawing No.
199086/BIN/WIA/009

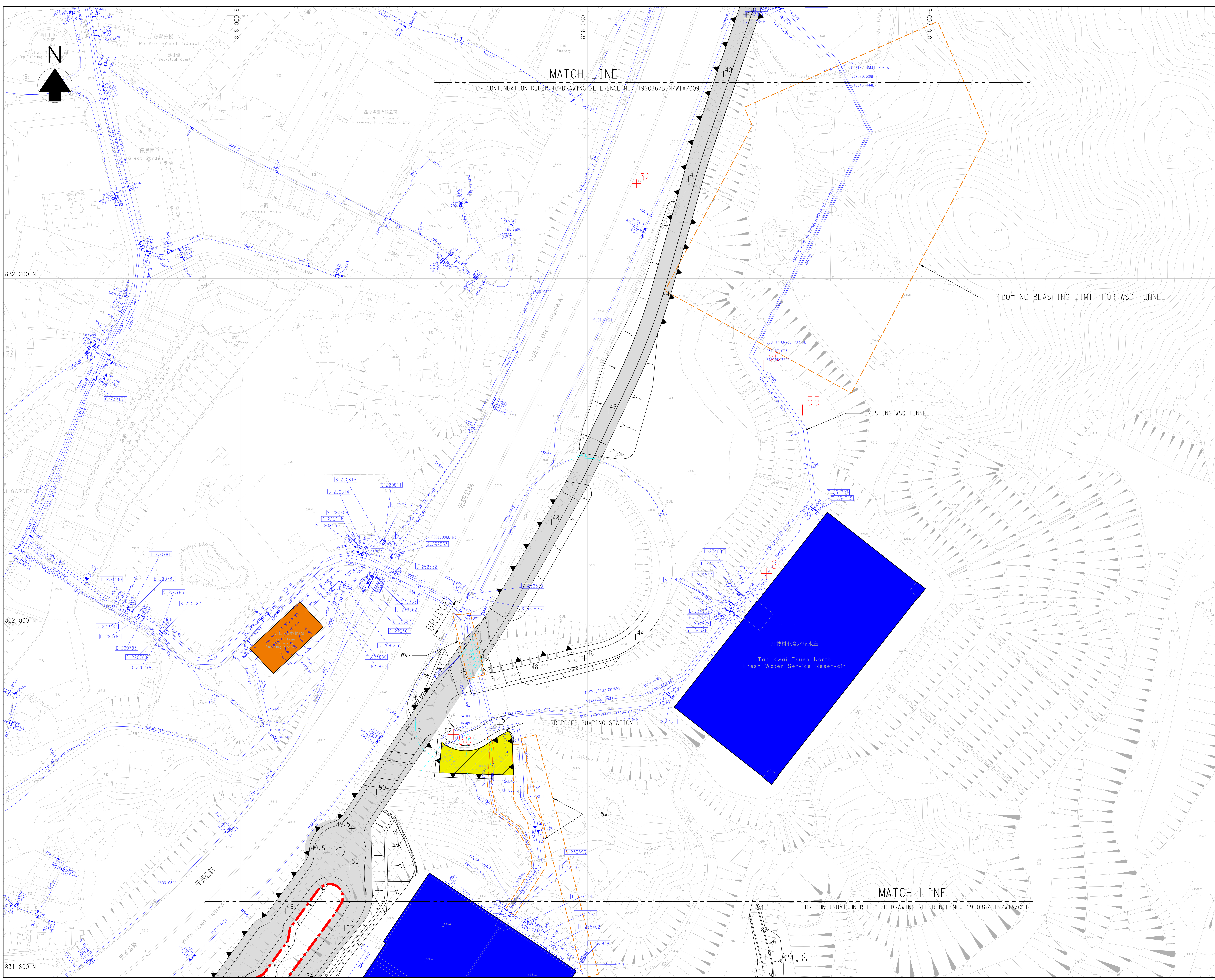
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qlu15947 2022/10/24

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-009.dgn



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LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
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- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- EXISTING FRESH WATER MAINS TO BE DIVERTED

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
POTENTIAL IMPACT TO THE EXISTING FRESH WATER MAINS

(SHEET 2 OF 4)

Drawing No.
199086/BIN/WIA/010

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2022/10/24

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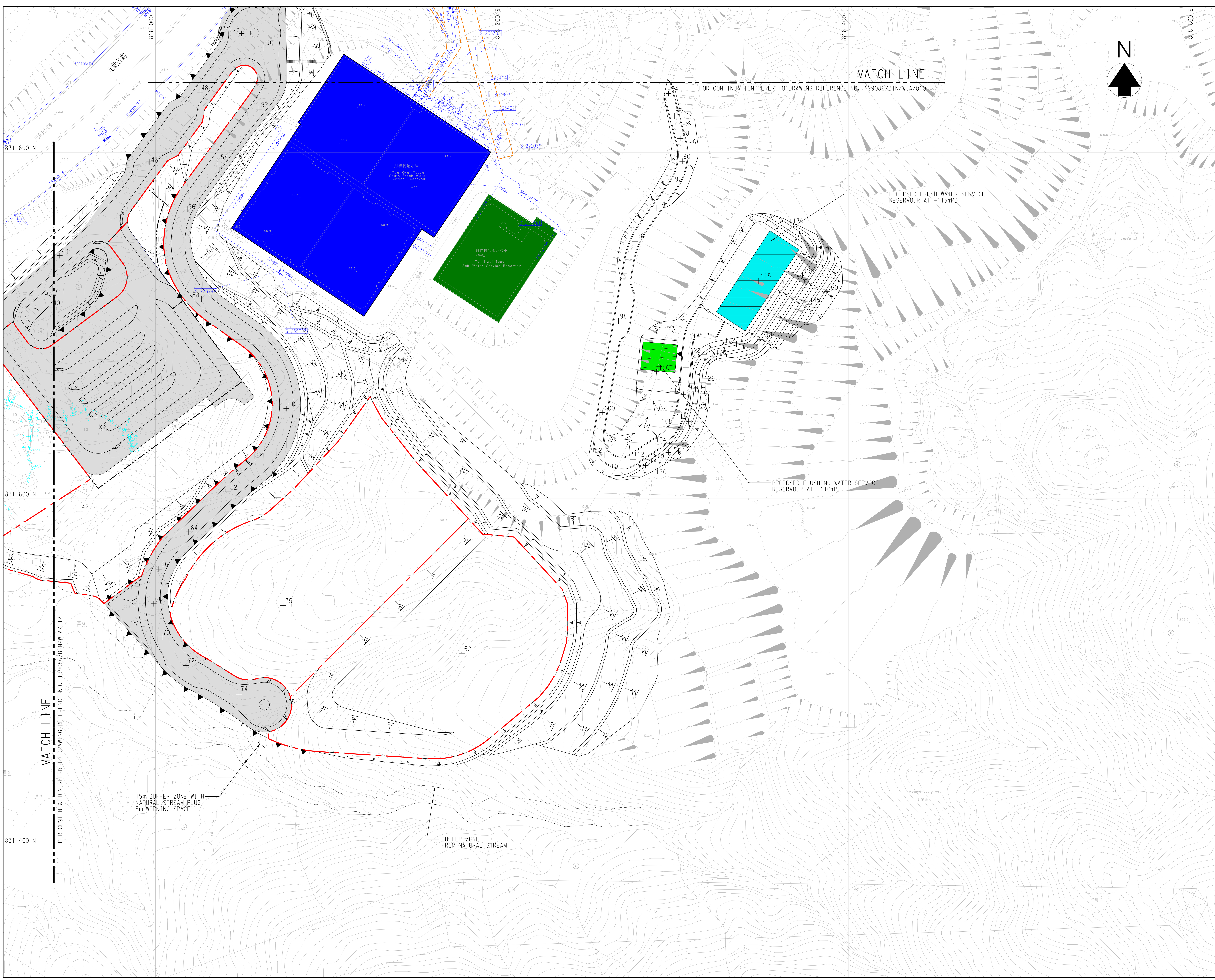

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- EXISTING FRESH WATER MAINS TO BE DIVERTED

Revision	Date	Description		Initial
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Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
POTENTIAL IMPACT TO THE EXISTING FRESH WATER MAINS

(SHEET 3 OF 4)

Drawing No.
199086/BIN/WIA/011

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = ojo15947 2022/11/15
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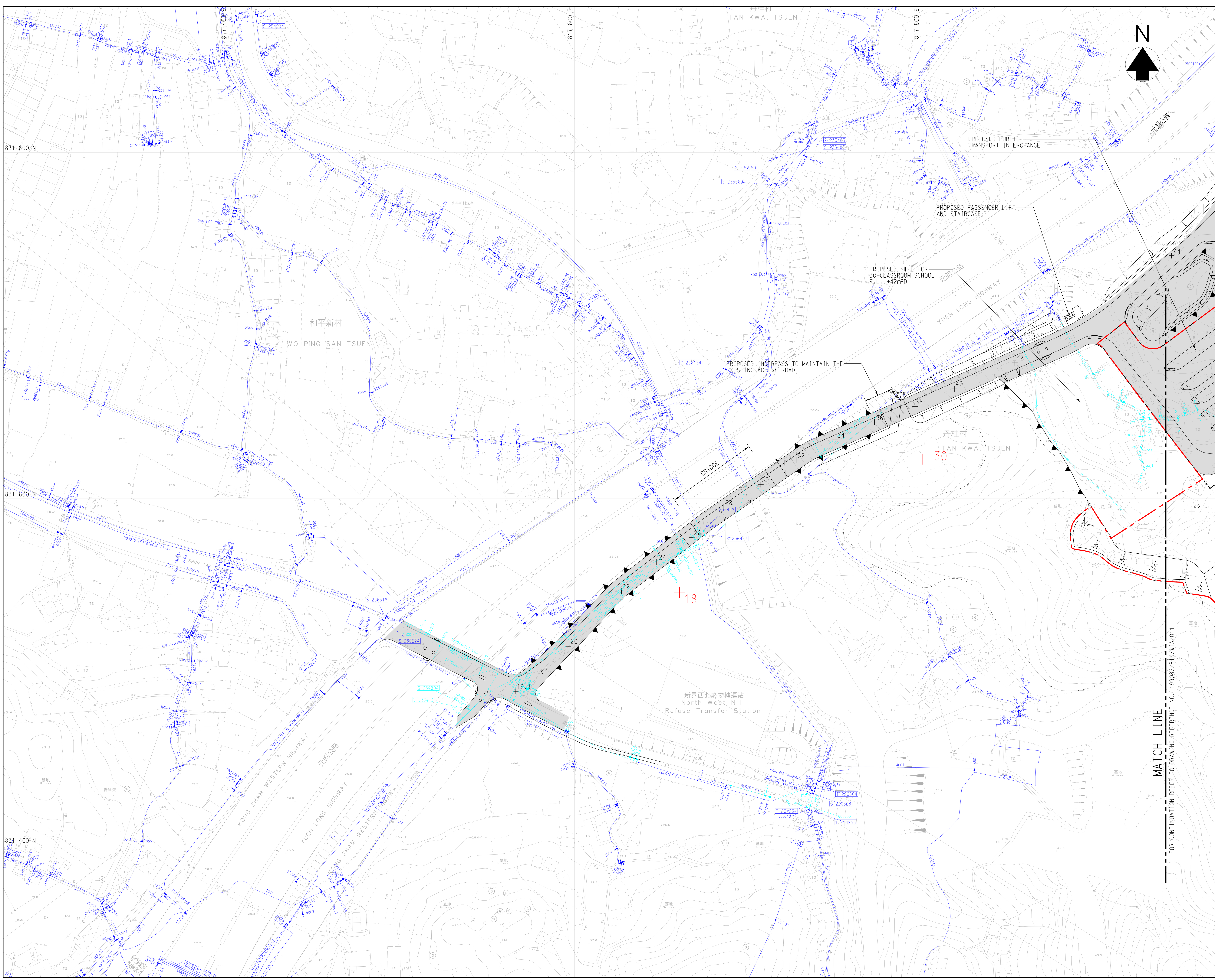

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- 65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- EXISTING FRESH WATER MAINS TO BE DIVERTED

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

POTENTIAL IMPACT TO THE EXISTING FRESH WATER MAINS

(SHEET 4 OF 4)

Drawing No.	Scale
199086/BIN/WIA/012	1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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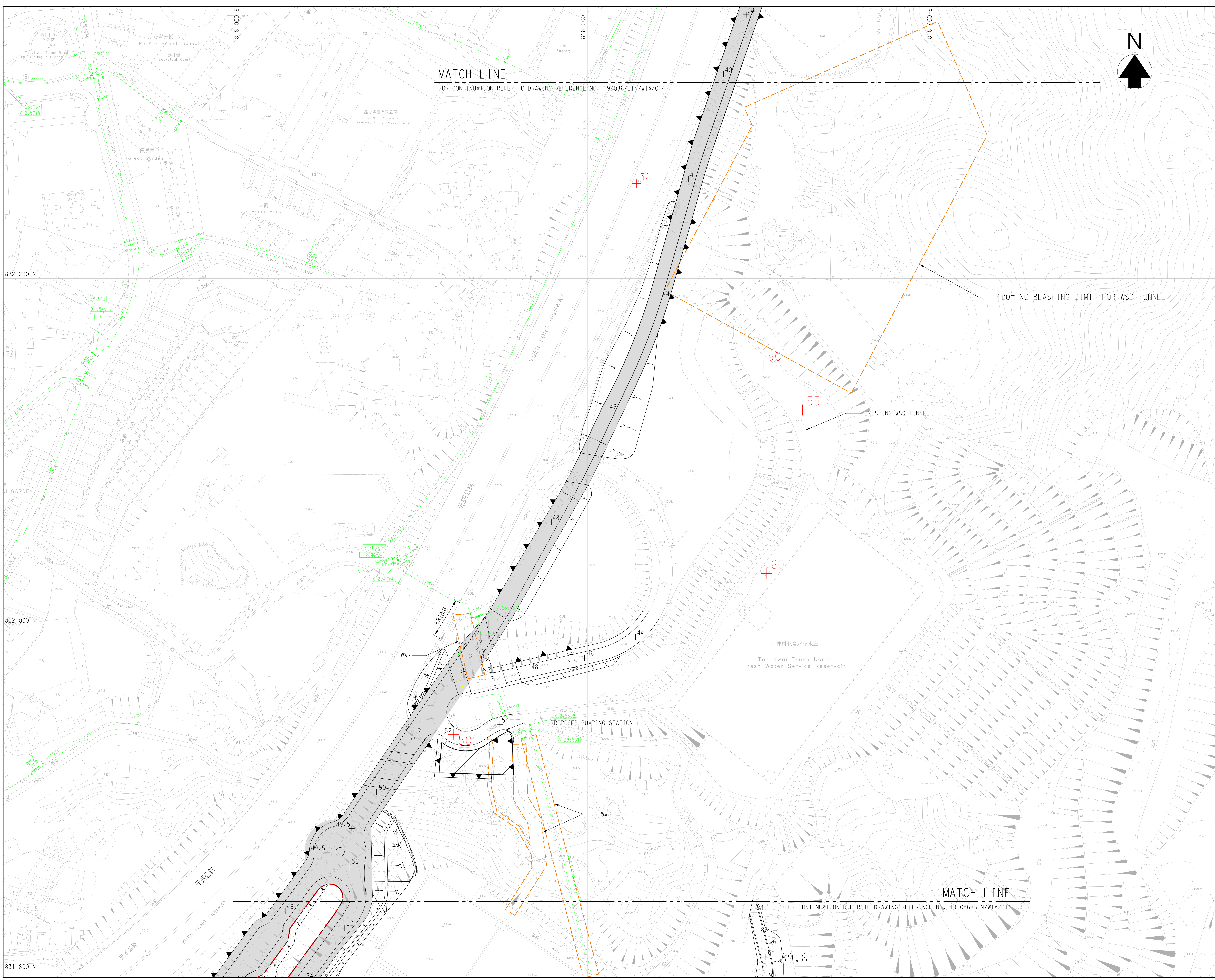
Plot File by = qiu15947 2022/10/25

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-012.dgn



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- 65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING SALT WATER MAINS
- EXISTING SALT WATER MAINS TO BE RETAINED

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
POTENTIAL IMPACT TO THE EXISTING SALT WATER MAINS

Drawing No.
199086/BIN/WIA/013

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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賓尼斯工程顧問有限公司

Plot File by : ojk15947 2022/10/25

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LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER MAINS
- PROPOSED FIRE HYDRANT
- 300 DIAMETER (mm) PROPOSED FIRE WATER MAINS

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED FRESH WATER SYSTEM

(SHEET 1 OF 4)

Drawing No.
199086/BIN/WIA/014

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = Chn15988 2023/5/22

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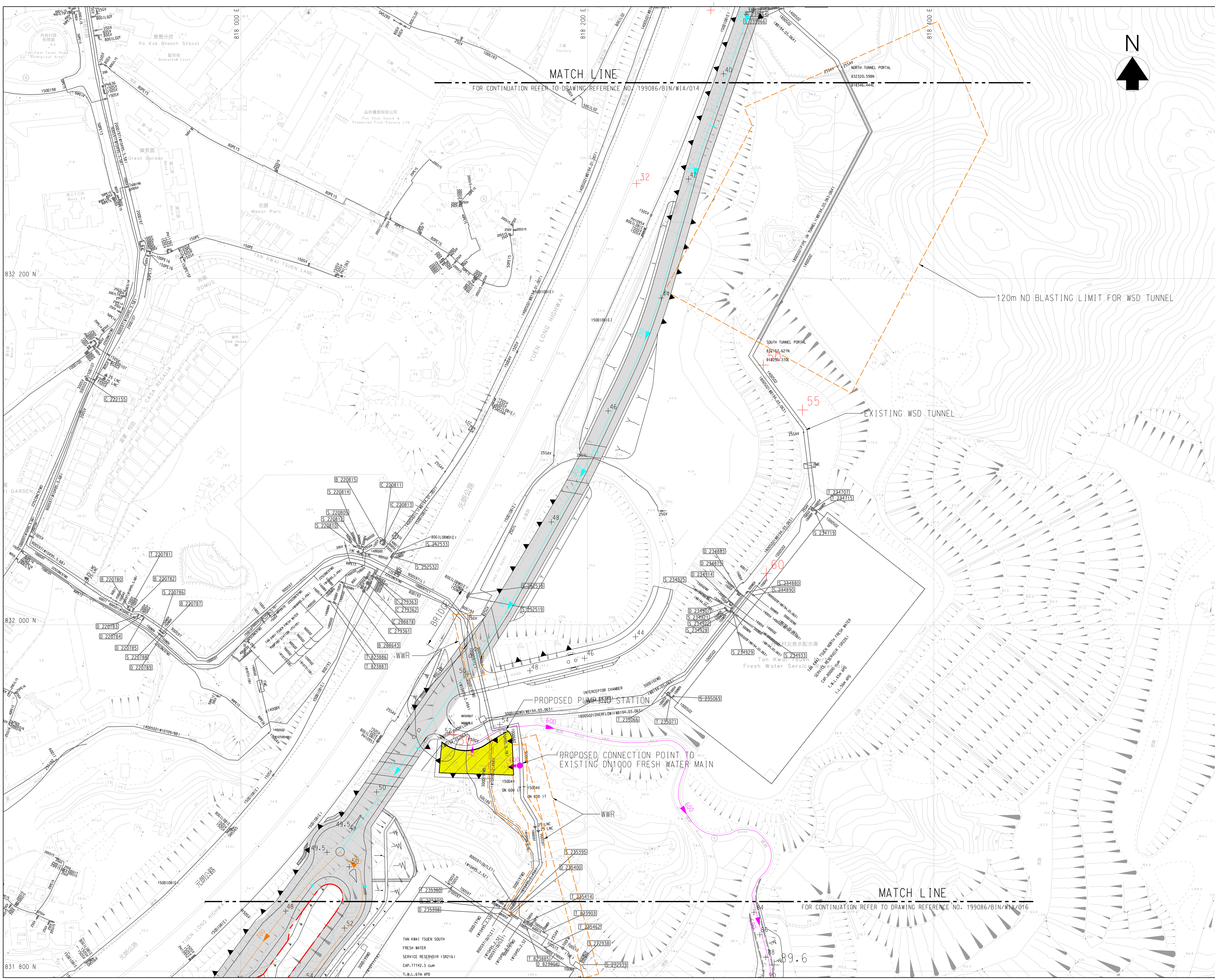

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- PROPOSED PUMPING STATION
- EXISTING FRESH WATER MAINS
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - INLET
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - OUTLET
- PROPOSED FIRE HYDRANT
- 300 DIAMETER (mm) PROPOSED FIRE WATER MAINS

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED FRESH WATER SYSTEM

(SHEET 2 OF 4)

Drawing No.	Scale
199086/BIN/WIA/015	1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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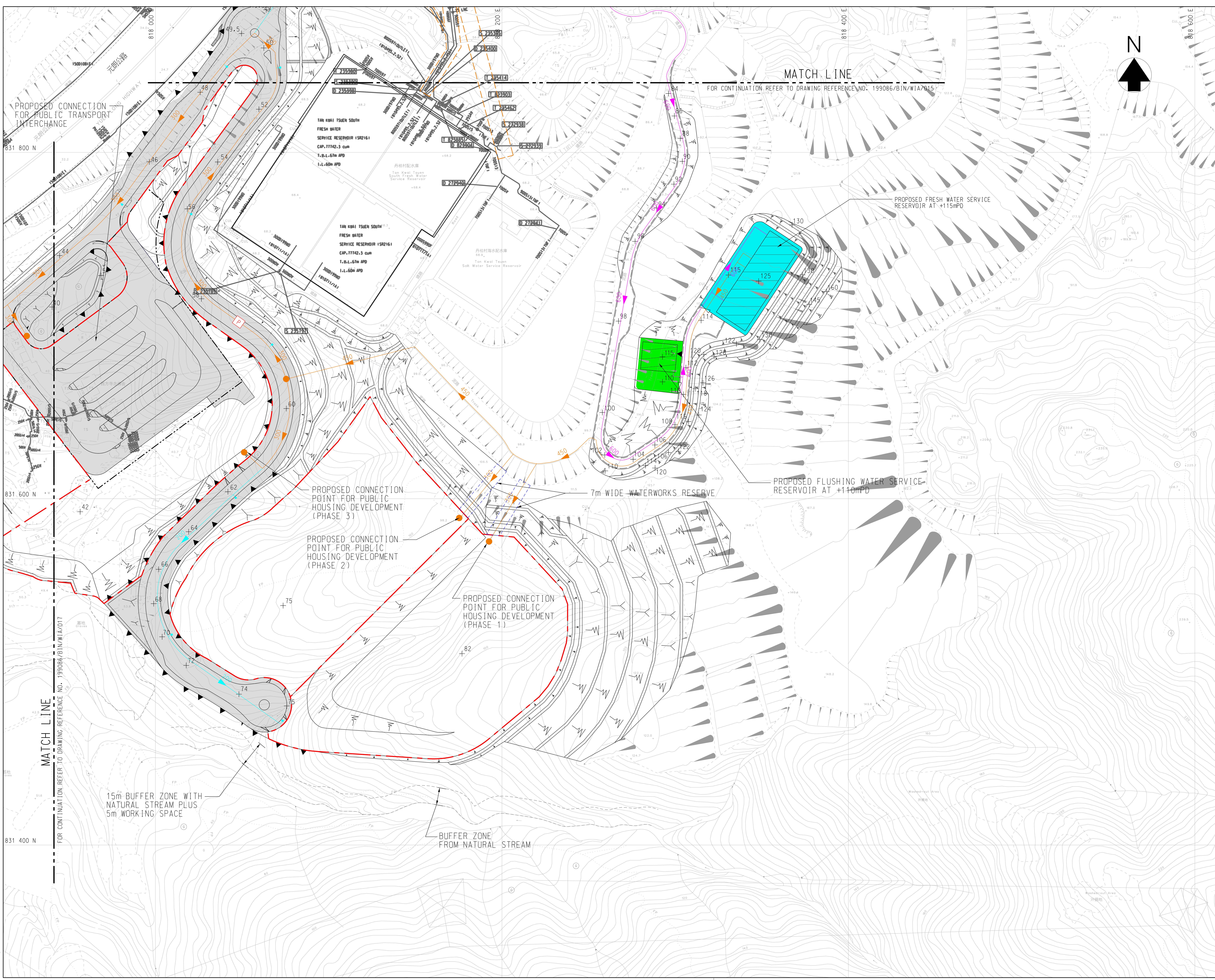
BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELEMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR
- EXISTING FRESH WATER MAINS
- 600 DIAMETER (mm) PROPOSED FRESH WATER MAINS - INLET
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - OUTLET
- 200 DIAMETER (mm) PROPOSED FRESH WATER AUGMENTATION MAIN
- PROPOSED FIRE HYDRANT
- 250 DIAMETER (mm) PROPOSED FIRE WATER MAINS
- PROPOSED WATERWORKS RESERVE
- P PRESSURE REDUCING VALVE

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED FRESH WATER SYSTEM

(SHEET 3 OF 4)

Drawing No.
199086/BIN/WIA/016

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = cjs15947 2023/5/29

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-016.dgn

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- EXISTING FRESH WATER MAINS
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - OUTLET
- PROPOSED FIRE HYDRANT
- 300 DIAMETER (mm) PROPOSED FIRE WATER MAINS

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED FRESH WATER SYSTEM

(SHEET 4 OF 4)

Drawing No.
199086/BIN/WIA/017

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

binnies
BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = cjs15947 2023/5/29
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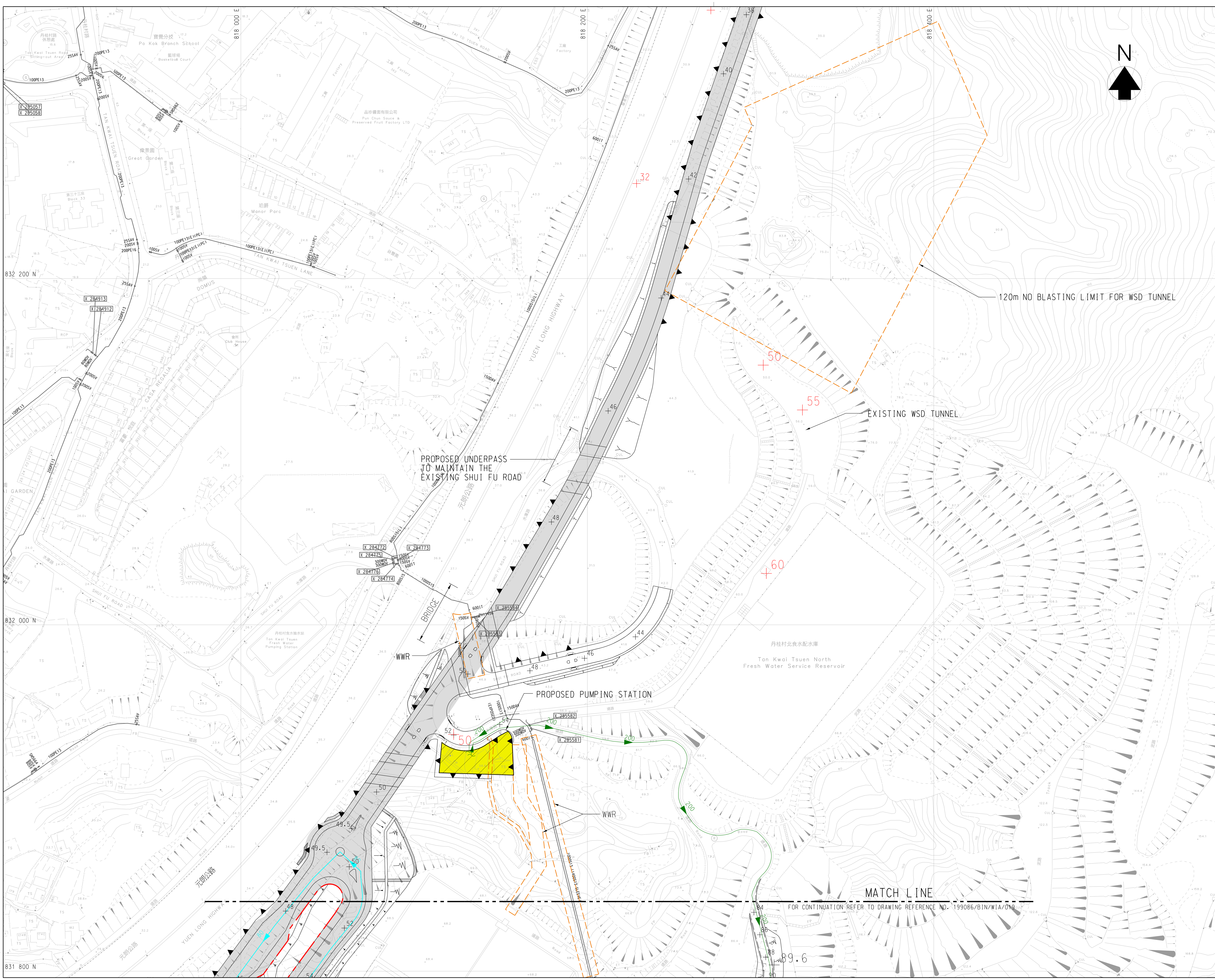

LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- PROPOSED PUMPING STATION
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED SALT WATER MAINS - INLET
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED INTERIM FLUSHING WATER SYSTEM

(SHEET 1 OF 3)

Drawing No.
199086/BIN/WIA/018

Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2023/5/29

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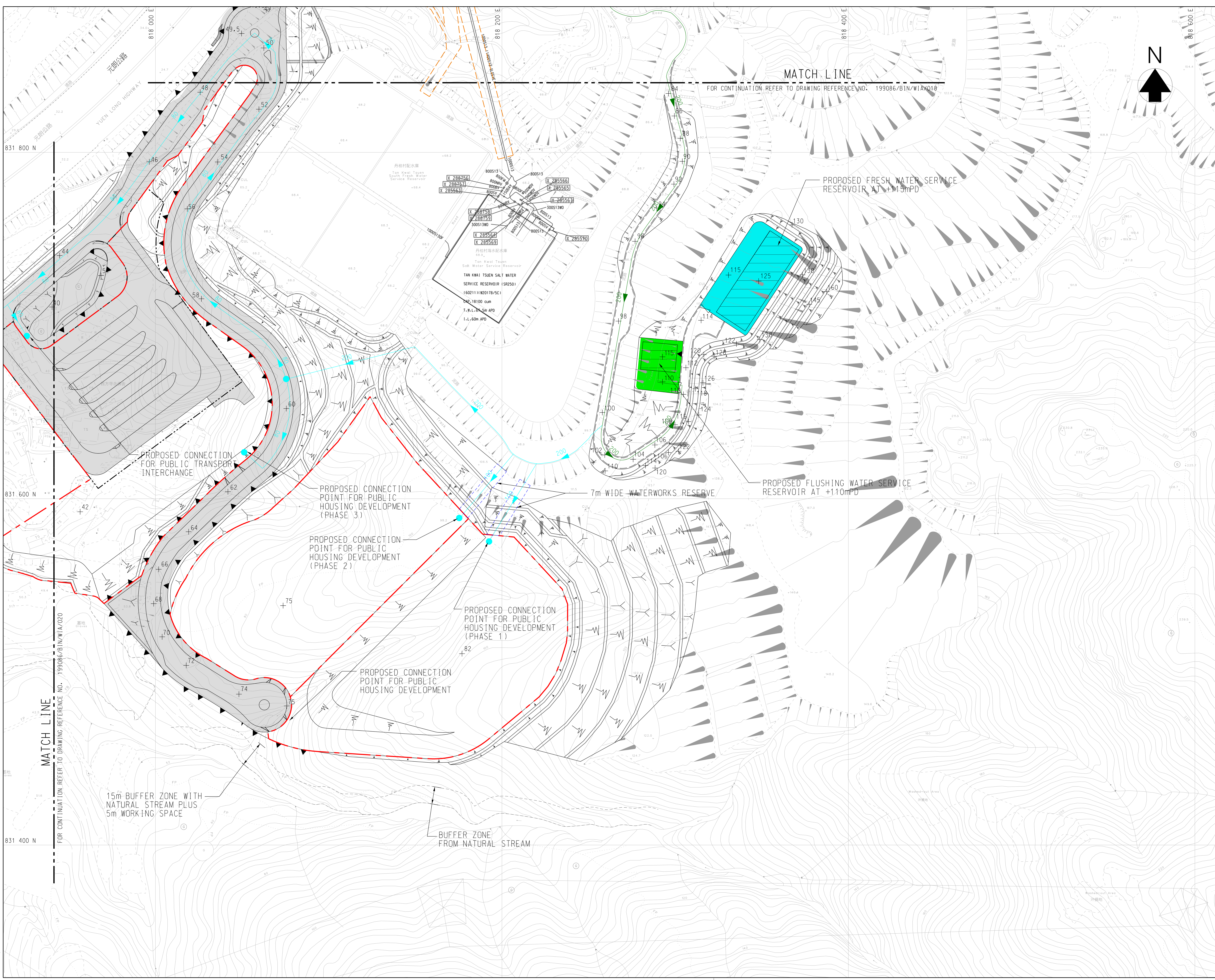


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED SALT WATER MAINS - INLET
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET
- PROPOSED WATERWORKS RESERVE

Revision	Date	Description	Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED INTERIM FLUSHING WATER SYSTEM

(SHEET 2 OF 3)

Drawing No.
199086/BIN/WIA/019

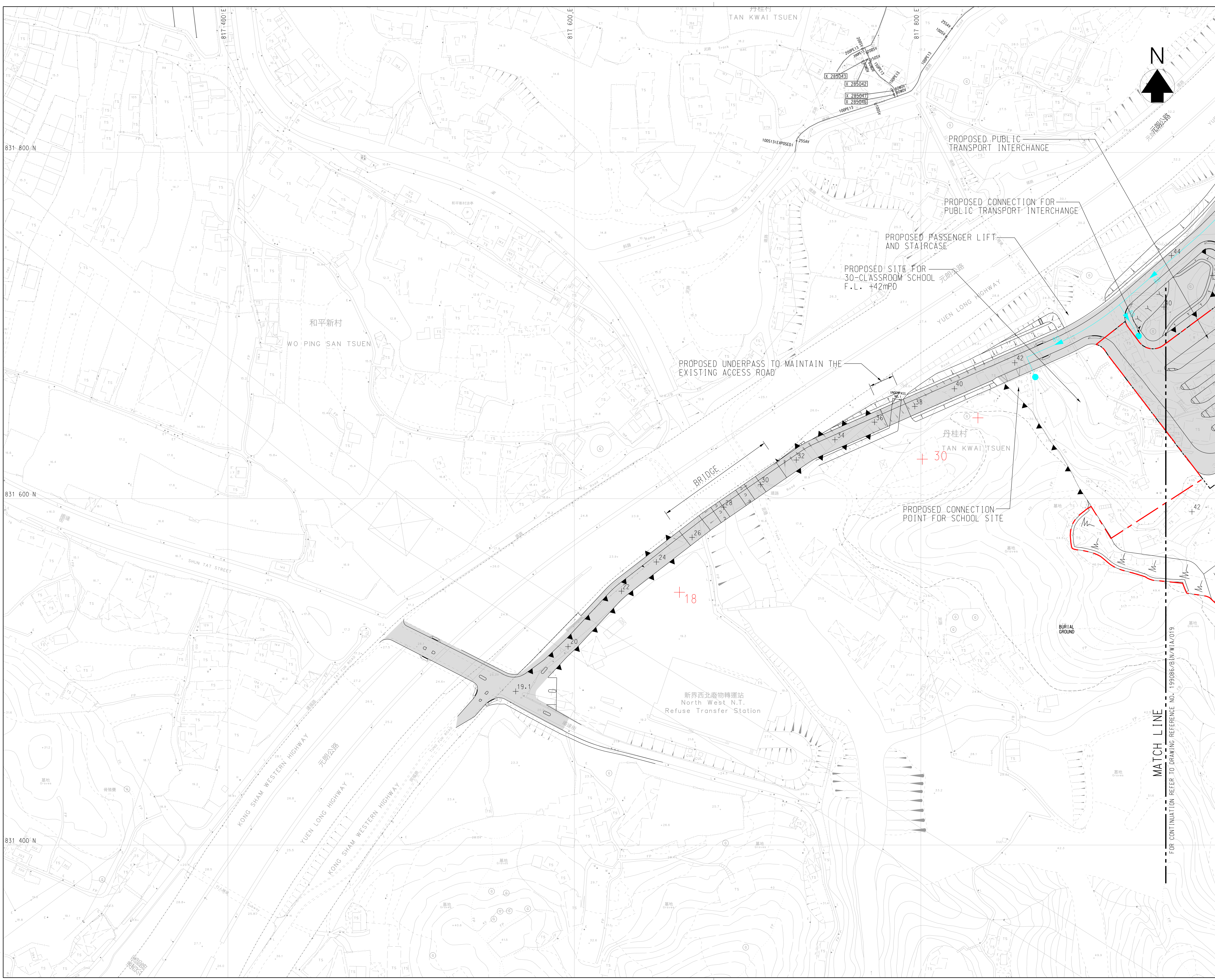
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = gju15947 2023/5/29

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-019.dgn



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET

Revision	Date	Description			Initial
		Designed	Checked	Drawn	Checked
Initial		TCL	WLC	SZ	LCH
Date		04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED INTERIM FLUSHING WATER SYSTEM

(SHEET 3 OF 3)

Drawing No.	Scale
199086/BIN/WIA/020	1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = gla15947 2023/5/29

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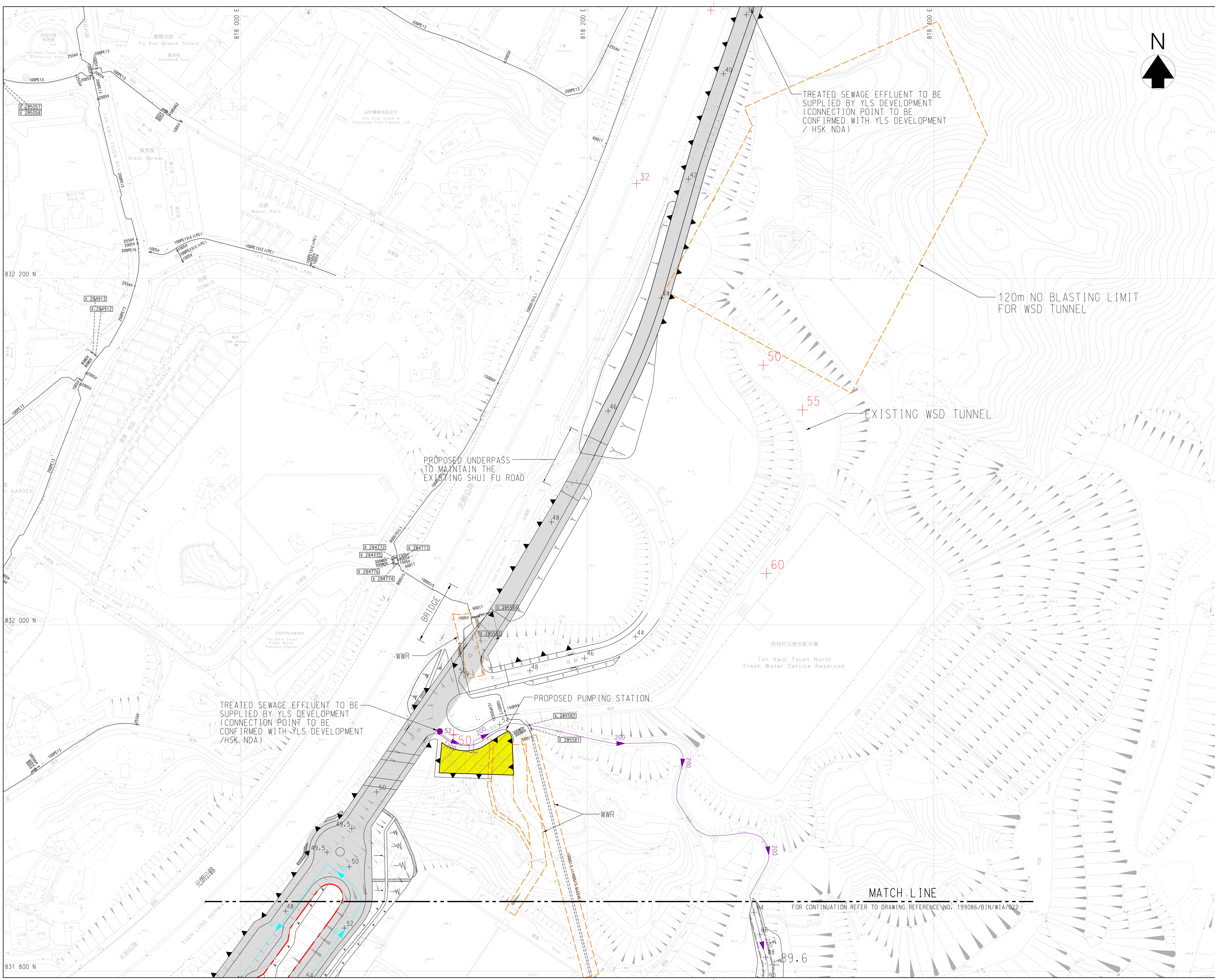

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- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- PROPOSED PUMPING STATION
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS – INLET
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS – OUTLET

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG – INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED ULTIMATE FLUSHING WATER SYSTEM

(SHEET 1 OF 3)

Drawing No.	Scale
199086/BIN/WIA/021	1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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Plot File by = qiu15947 2022/11/15

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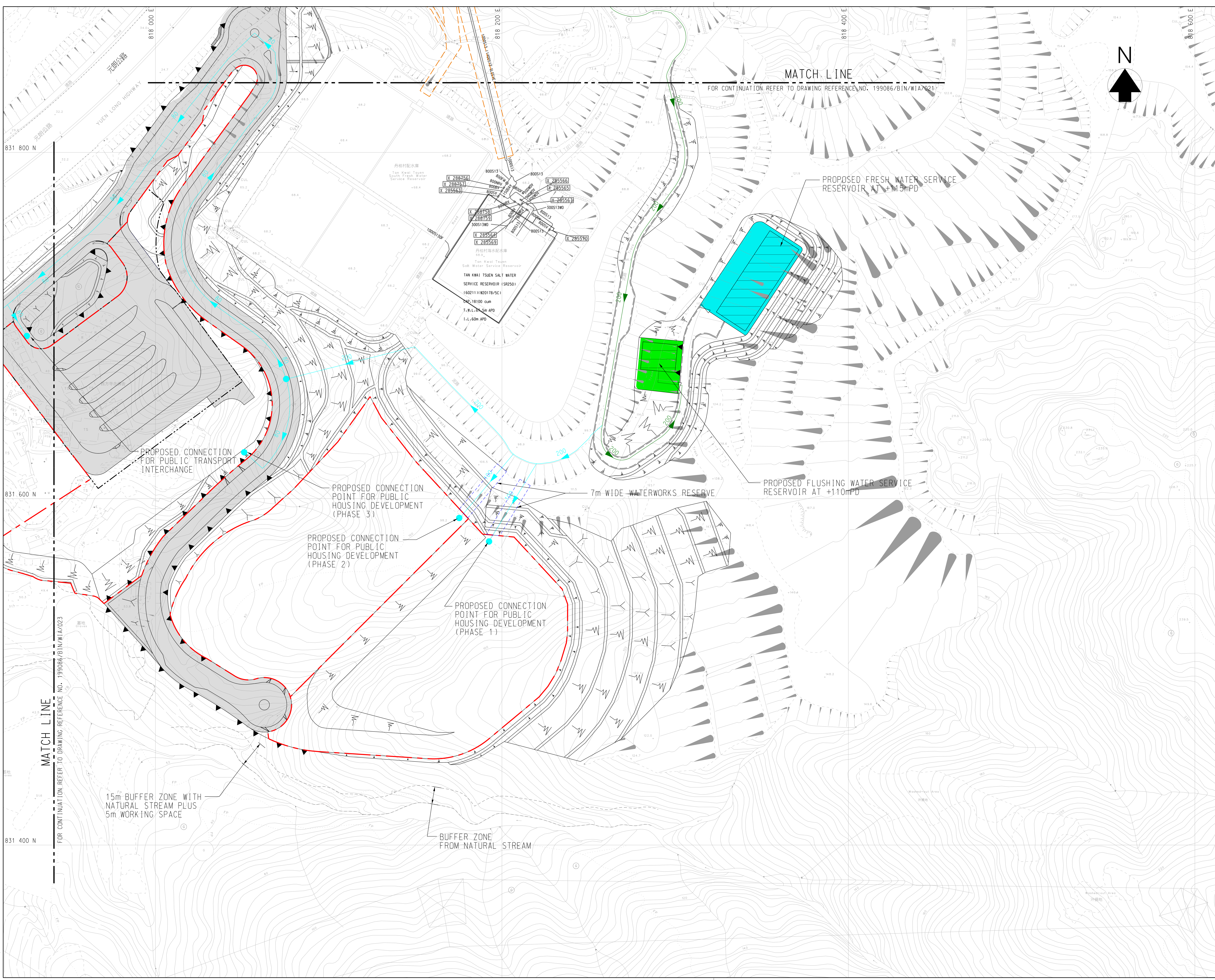


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - INLET
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET
- PROPOSED WATERWORKS RESERVE

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED ULTIMATE FLUSHING WATER SYSTEM

(SHEET 2 OF 3)

Drawing No.
199086/BIN/WIA/022

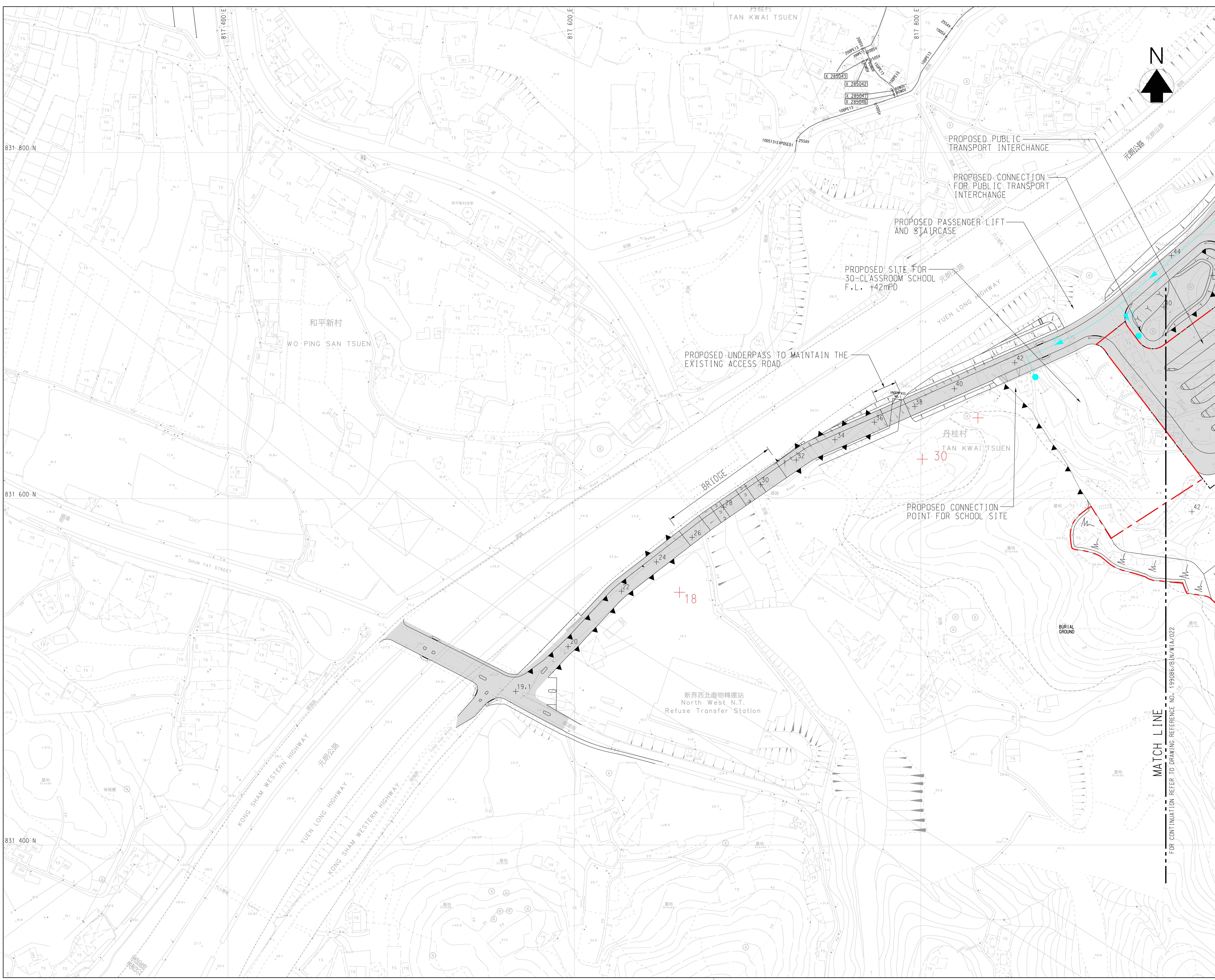
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = qiu15947 2023/5/29

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-022.dgn



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED ULTIMATE FLUSHING WATER SYSTEM

(SHEET 3 OF 3)

Drawing No.
199086/BIN/WIA/023

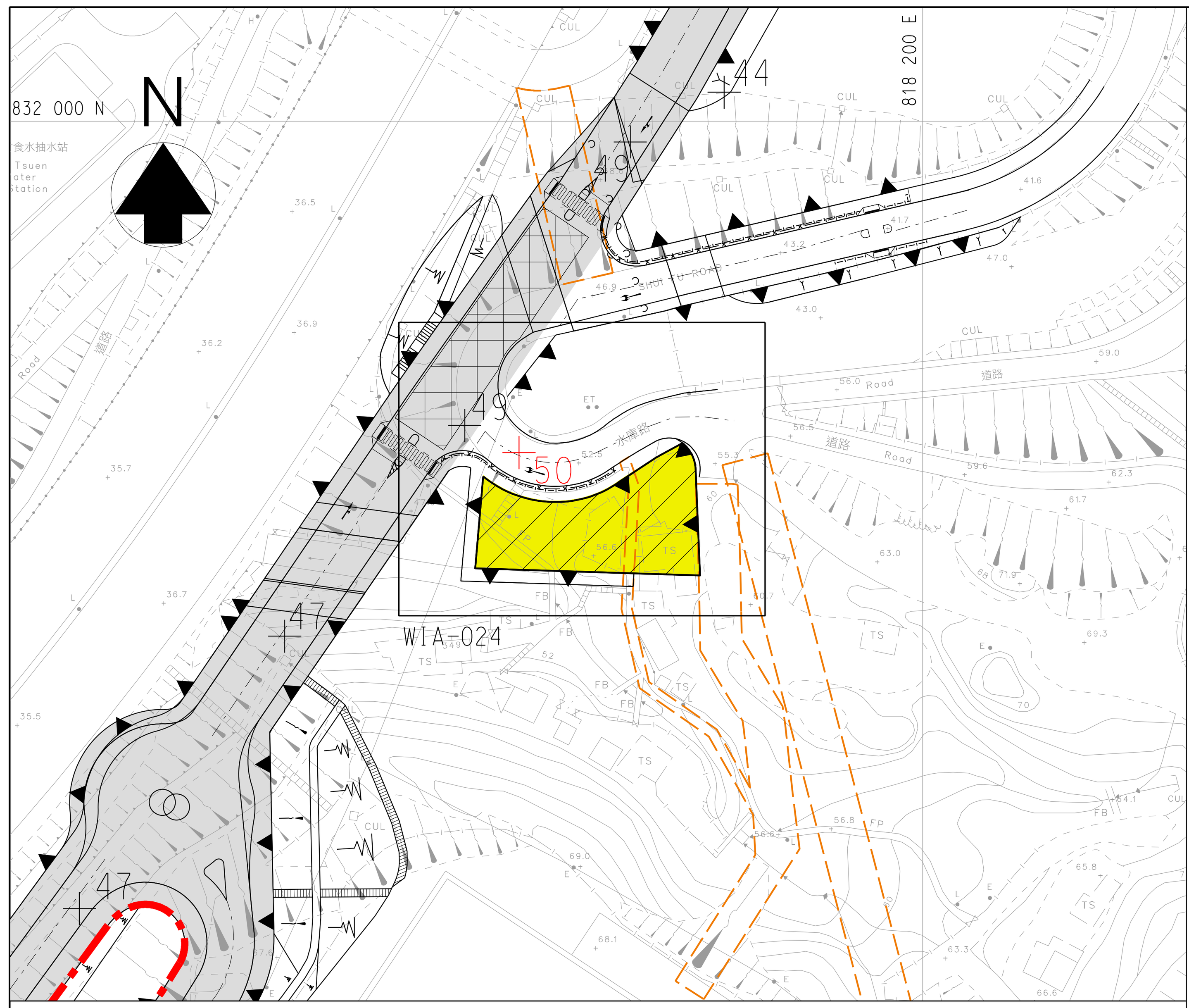
Scale
1 : 1000 (A1)
1 : 2000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

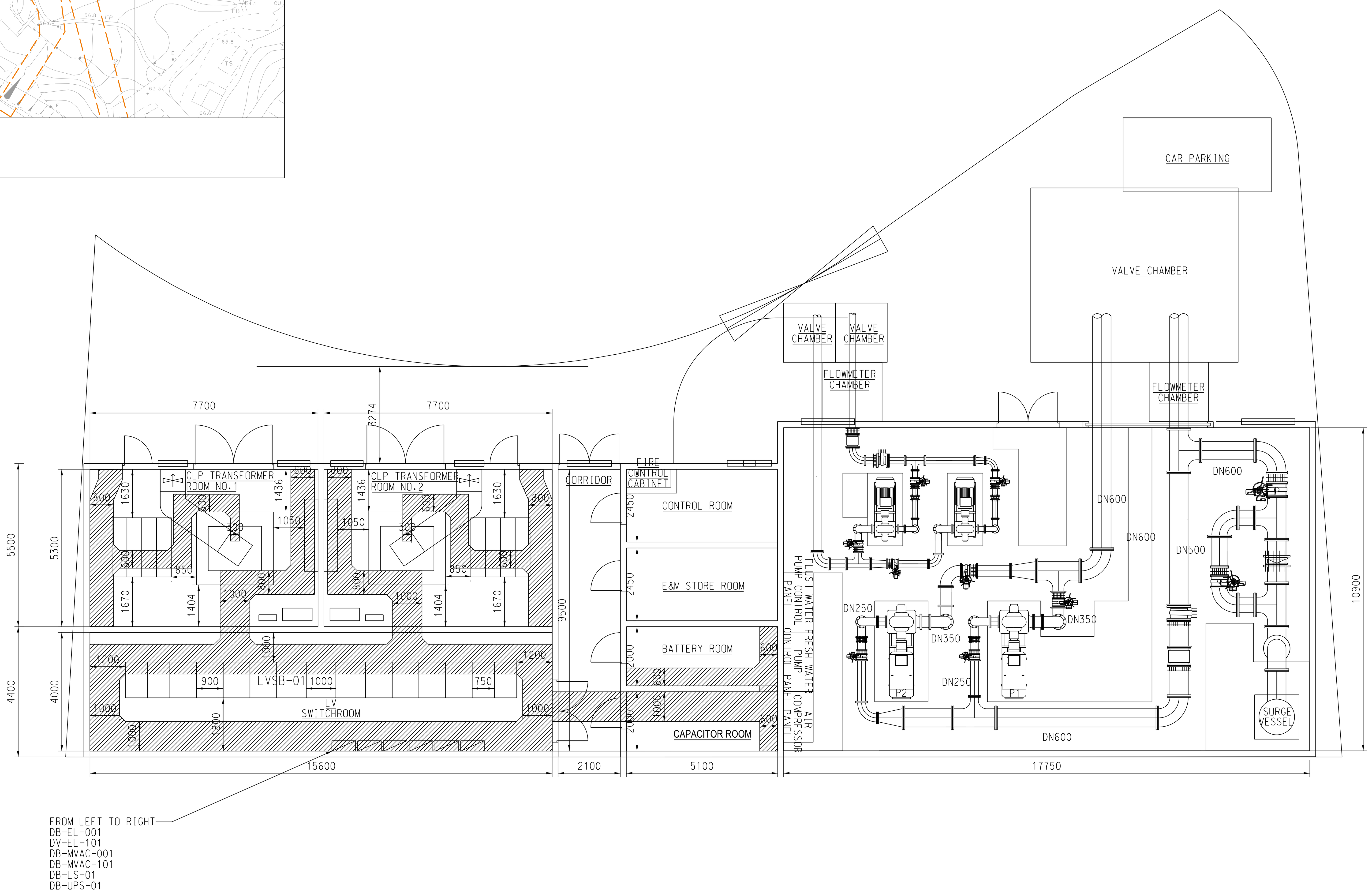
Plot File by = gju15947 2023/5/29

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-023.dgn



KEY PLAN

N.T.S.



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.

LEGEND:

DOUBLE-LEAF DOOR

CABLE / PIPE TRENCH WITH CHEQUER PLATE OR GOATING COVER

Revision	Date	Description			Initial
		Designed	Checked	Drawn	Checked
Initial		TCL	WLC	SZ	LCH
Date		04/22	04/22	04/22	04/22

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

GENERAL ARRANGEMENT OF THE PROPOSED PUMPING STATION

Drawing No.

199086/BIN/WIA/024

Scale

1 : 100 (A1)
1 : 200 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Plot File by = Che15988 2022/10/25

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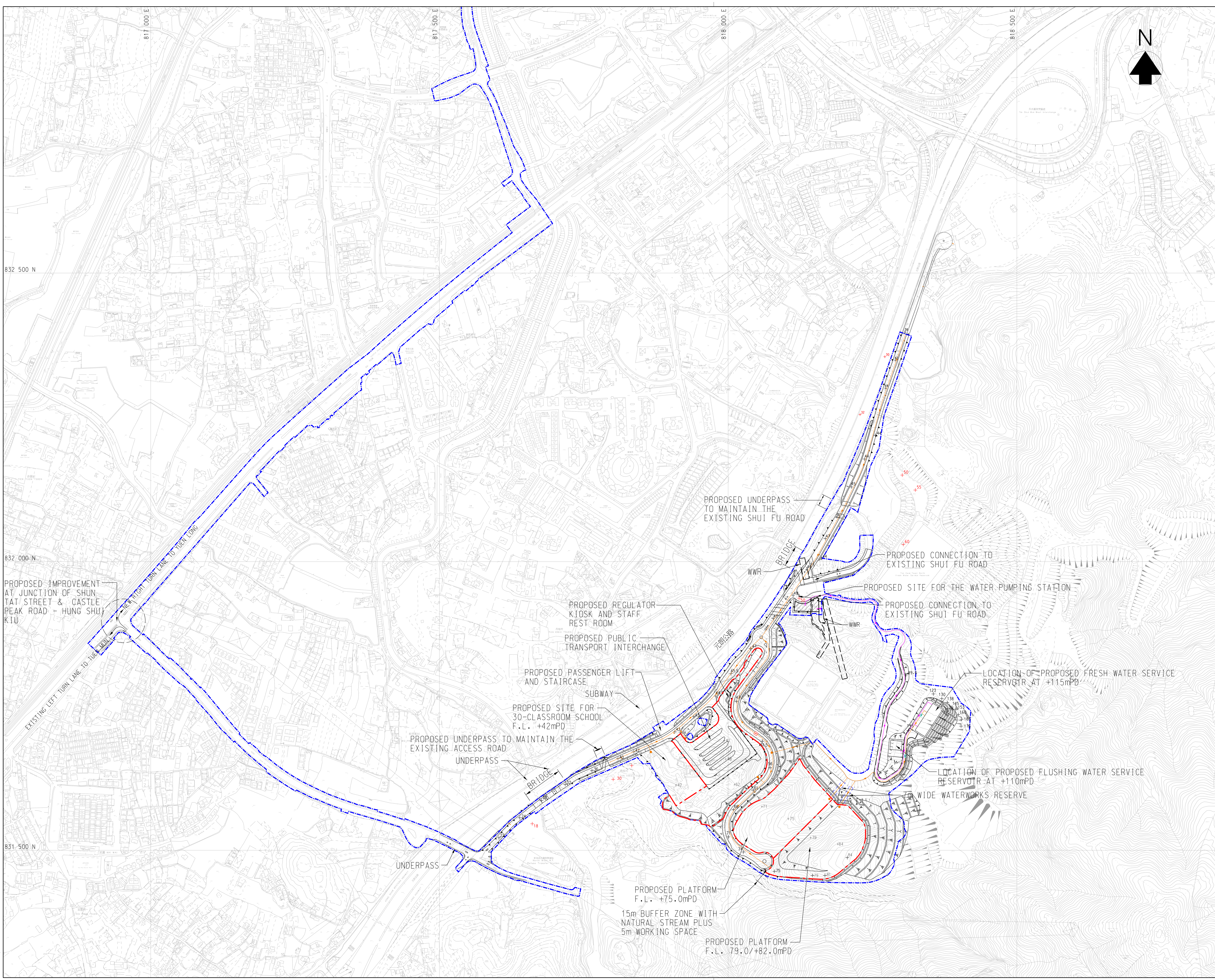


LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED G/IC FACILITIES
- PROPOSED DISTRICT METERING AREA (DMA) AND PRESSURE METERING AREA (PMA) BOUNDARY
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- PROPOSED FRESH WATER MAINS
- PROPOSED FIRE WATER MAINS
- PROPOSED FIRE HYDRANT
- PROPOSED PRESSURE REDUCING VALVE (PRV)
- M PROPOSED ELECTROMAGNETIC FLOWMETER (EMFM)
- PROPOSED WATERWORKS RESERVE
- P PRESSURE REDUCING VALVE

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED DISTRICT METERING AREA AND PRESSURE MANAGEMENT AREA FOR FRESH WATER SERVICE RESERVOIR

Drawing No.
199086/BIN/WIA/025

Scale
1 : 3000 (A1)
1 : 6000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

binnies
BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

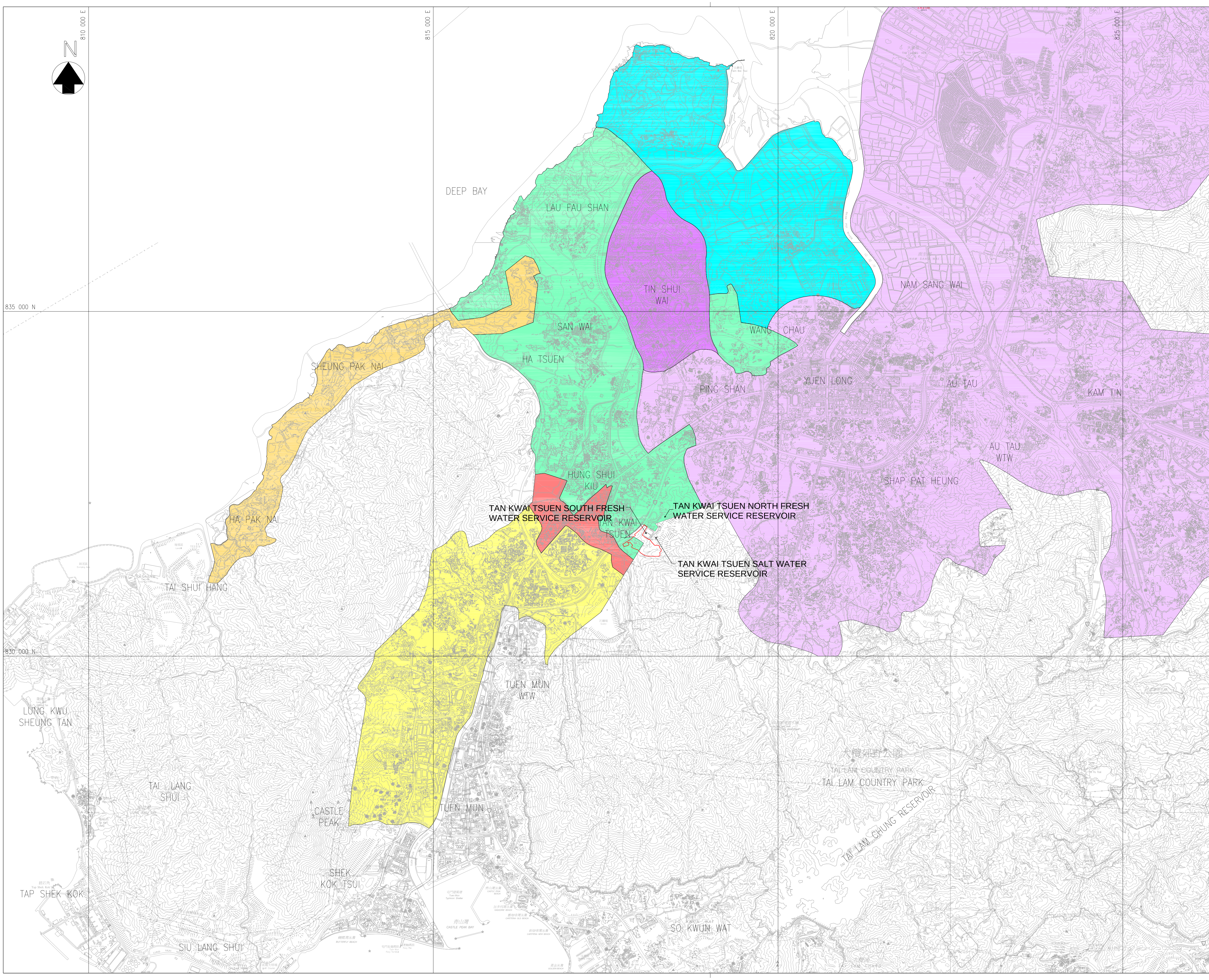
Plot File by = ghl5947 2023/5/29

CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-025.dgn

APPENDICES

Appendix A

FRESH WATER SUPPLY ZONE



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. THE BASE PLAN IS EXTRACTED FROM SURVEY SHEET NOS. T2, T5, T6.

LEGEND:

- AU TAU & NGAU TAM MEI F.W. PRIMARY S/R COMMON SUPPLY ZONE
- WANG CHAU F.W. S/R SUPPLY ZONE
- TAN KWAI TSUEN SOUTH AND TAN KWAI TSUEN NORTH F.W. S/R COMMON SUPPLY ZONE
- TAN KWAI TSUEN NORTH F.W. S/R SUPPLY ZONE (TMF SUPPLIED BY WANG CHAU F.W. S/R)
- YUEN LONG F.W. S/R SUPPLY ZONE
- TUEN MUN NORTH F.W. S/R SUPPLY ZONE
- FUNG KONG TSUEN AND FUNG KONG TSUEN NO.2 F.W. TANKS SUPPLY ZONE
- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED G/IC FACILITIES

Revision	Date	Description			Initial
		Designed	Checked	Drawn	Checked
Initial		EM	LCH	SZ	LCH
Date		02/19	02/19	02/19	02/19

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING FRESH WATER SUPPLY ZONES

Drawing No.
APPENDIX A

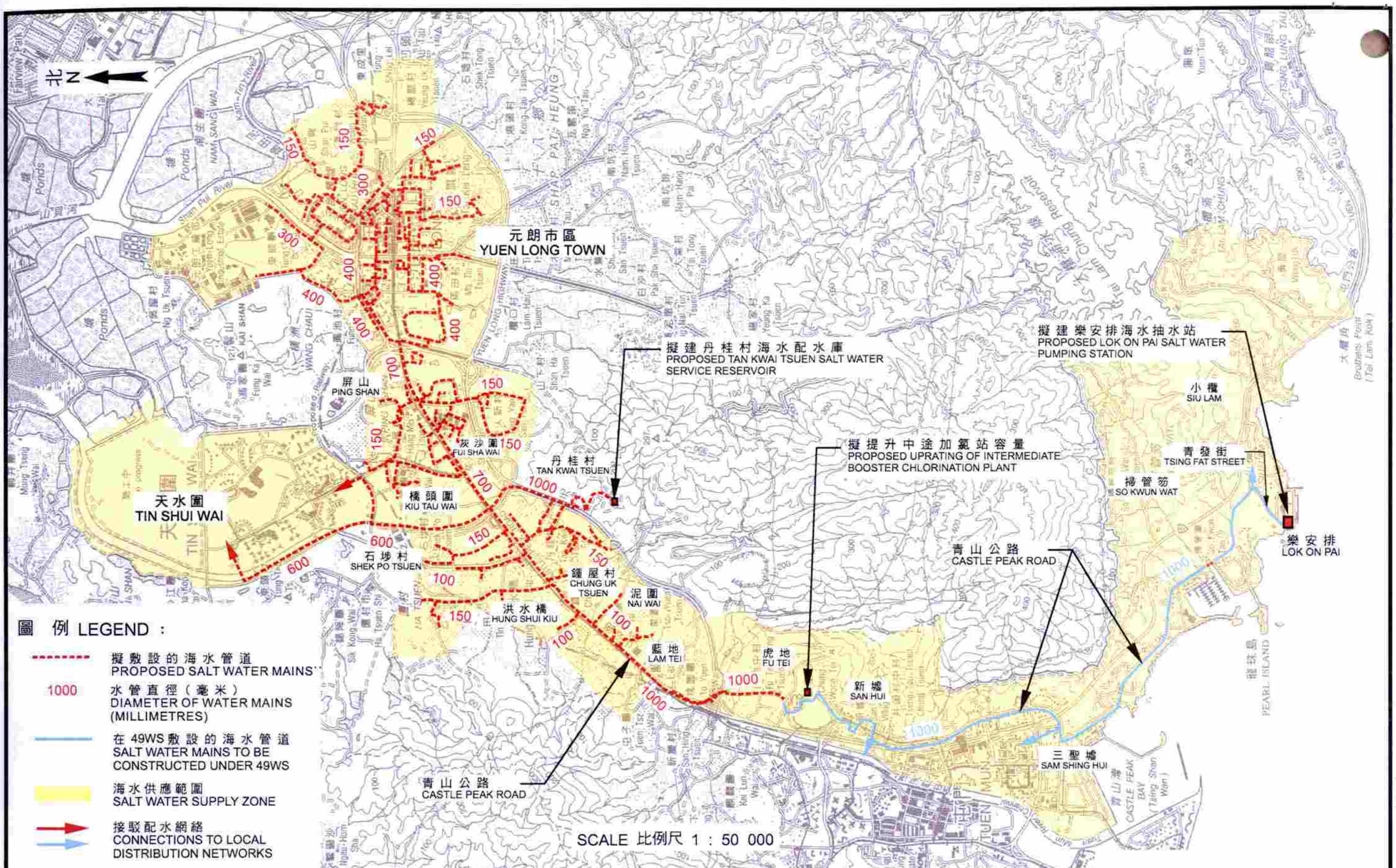
Scale
A1 1 : 25000
A3 1 : 50000

土木工程拓展署
CEDD Civil Engineering and Development Department

binnies
BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

Appendix B

SALT WATER SUPPLY ZONE



核准 APPROVED

總工程師/設計 CE / DES

13 / 11 / 2008

工務計劃項目45WS號 - 新界西北區海水供水計劃 - 餘下工程

P.W.P. Item No. 45WS - Salt water supply for Northwest New Territories - remaining works

（甲級工程）
(CAT 'A' Submission)

水務署
WATER SUPPLIES DEPT.

草圖編號 SKETCH NO. SK 62008 / 086 / 001

REF. 62008-086.CDR

附件一 ENCLOSURE 1

Appendix C

WATER DEMANDS, SERVICE RESERVOIR VOLUME AND RESIDUAL HEADS CHECK

CE 92/2017 (CE) Public Housing Development near Tan Kwai Tsuen, Yuen Long – Investigation, Design and Construction
Appendix C - Water Demands, Service Reservoir Volume and Residual Heads Check

(1) Development Breakdown- Estimate of Water Demand

Phase 1 (SSF)

Land Use	Domestic Population [1]	Non-domestic population [2][3]	No. of teaching staffs and students [4][5][6]	Fresh Water Unit Demand (m^3/h/d) [6]			Fresh Water Mean Daily Demand (MDD) (m^3/d)	Flushing Water Unit Demand (m^3/h/d) [6]			Flushing Water Mean Daily Demand (MDD) (m^3/d)
				Residential	Service Trade	School		Residential	Service Trade	School	
Domestic	**5,319**	-	-	0.23	0.04	-	1436.1	0.07	-	-	372.3
Non-Domestic	-	**168**	-	-	-	-	-	-	-	-	-
Retail [7]	-	0	-	-	-	-	-	-	0.07	-	0.0
Welfare Facilities [8]	-	152	-	-	0.2	-	30.4	-	0.07	-	10.6
Ancillary Facilities [9]	-	11	-	-	0.04	-	0.4	-	0.07	-	0.8
Others [9]	-	5	-	-	0.04	-	0.2	-	0.07	-	0.4
Kindergarten	-	-	**201**	-	-	0.025	5.0	-	-	0.03	6.0
Total FWMDD (m^3/day)							**1,472**				**390**

Phase 2 (PRH)

Land Use	Domestic Population [1]	Non-domestic population [2][3]	No. of teaching staffs and students [4][5][6]	Fresh Water Unit Demand (m^3/h/d) [6]			Fresh Water Mean Daily Demand (MDD) (m^3/d)	Flushing Water Unit Demand (m^3/h/d) [6]			Flushing Water Mean Daily Demand (MDD) (m^3/d)
				Residential	Service Trade	School		Residential	Service Trade	School	
Domestic	**6,480**	-	-	0.23	0.04	-	1749.6	0.07	-	-	453.6
Non-Domestic	-	**286**	-	-	-	-	-	-	-	-	-
Retail [7]	-	110	-	-	-	-	-	-	0.07	-	7.7
Welfare Facilities [8]	-	152	-	-	0.2	-	30.4	-	0.07	-	10.6
Ancillary Facilities [9]	-	24	-	-	0.04	-	1.0	-	0.07	-	1.7
Others [9]	-	0	-	-	0.04	-	0.0	-	0.07	-	0.0
Kindergarten	-	-	**201**	-	-	0.025	5.0	-	-	0.03	6.0
Total FWMDD (m^3/day)							**1,786**				**479**

Phase 3 (PRH)

Land Use	Domestic Population (1)	Non-domestic population (2) (3)	No. of teaching staffs and students (4) (5) (6)	Fresh Water Unit Demand (m^3/h/d) (6)			Fresh Water Mean Daily Demand (MDD) (m^3/d)	Flushing Water Unit Demand (m^3/h/d) (6)			Flushing Water Mean Daily Demand (MDD) (m^3/d)
				Residential	Service Trade	School		Residential	Service Trade	School	
Domestic	**8,235**	-	-	0.23	0.04	-	2223.5	0.07	-	-	576.5
Non-Domestic	-	**543**	-	-	-	-	-	-	-	-	-
Retail (7)	-	98	-	-	-	-	-	-	0.07	-	6.9
Welfare Facilities (8)	-	220	-	-	0.2	-	44.0	-	0.07	-	15.4
Ancillary Facilities (9)	-	3	-	-	0.04	-	0.1	-	0.07	-	0.2
Others (9)	-	222	-	-	0.04	-	8.9	-	0.07	-	15.5
Kindergarten	-	-	**0**	-	-	0.025	0.0	-	-	0.03	0.0
Total FWMDD (m^3/day)							**2,276**				**614**

Primary School

Land Use	Domestic Population (1)	Non-domestic population (2) (3)	No. of teaching staffs and students (4) (5) (6)	Fresh Water Unit Demand (m^3/h/d) (6)			Fresh Water Mean Daily Demand (MDD) (m^3/d)	Flushing Water Unit Demand (m^3/h/d) (6)			Flushing Water Mean Daily Demand (MDD) (m^3/d)
				Residential	Service Trade	School		Residential	Service Trade	School	
Primary School	-	-	**821**	-	-	0.025	**20**	-	-	0.03	**25**

Remarks: (1) Assumed 2.7 persons per flat;

(2) No water demand is assumed for car parking area;

(3) Worker densities of 3.5 employees (Retail Trade) and 3.3 employees (Community, Social & Personal Services) per 100 m^2 GFA is adopted in accordance with "Commercial and Industrial Floor Space Utilization Survey" issued by the PlanD in 2004/2005;

(4) Asusming 180 students per kindergarden (with 2 kindergartens planned) and 25.5 students per class for the planned primary school (30-classrooom) with reference to Chapter 3 of the HKPSG;

(5) Pupil-teacher ratios of 8.6:1 (kindergarden) and 13.8:1 (primary school) are assumed based on Education Bureau's 2017/18 Figures and Statistics;

(6) Refereces have been taken from the mean unit daily demands recommeneded in Table 1 and 2 in the WSD DI 1309 and derived from GESF published by EPD;

(7) The fresh water unit demand of retail is included in domestic service trade;

(8) The fresh water unit demand of welfare facilities is adopted in accordance with Section 4.4(d) of GESF published by EPD;

(9) Ancillary facilities and others include office, workshop, PTI and covered walkway etc.

CE 92/2017 (CE) Public Housing Development near Tan Kwai Tsuen, Yuen Long – Investigation, Design and Construction
Appendix C - Water Demands, Service Reservoir Volume and Residual Heads Check

(2) Summary for Estimate of Water Demand

Land Use	Domestic Population [1]	Non-domestic population [2] [3]	No. of teaching staffs and students [4] [5] [6]	Fresh Water Unit Demand (m^3/h/d) [6]			Fresh Water Mean Daily Demand (MDD) (m^3/d)	Flushing Water Unit Demand (m^3/h/d) [6]			Flushing Water Mean Daily Demand (MDD) (m^3/d)
				Residential	Service Trade	School		Residential	Service Trade	School	
Domestic	**20,034**	-	-	0.23	0.04	-	5409.2	0.07	-	-	1402.4
Non-Domestic	-	**1,059**	-	-	-	-	-	-	-	-	-
Retail [7]	-	207	-	-	-	-	-	-	0.07	-	14.5
Welfare Facilities [8]	-	524	-	-	0.2	-	104.8	-	0.07	-	36.7
Ancillary Facilities [9]	-	37	-	-	0.04	-	1.5	-	0.07	-	2.6
Others [9]	-	291	-	-	0.04	-	11.6	-	0.07	-	20.4
School	-	-	**1,223**	-	-	0.025	30.6	-	-	0.03	36.7
Total FWMDD (m^3/day)							**5,558**				**1,513**

Remarks: (1) Assumed 2.7 persons per flat;
(2) No water demand is assumed for car parking area;
(3) Worker densities of 3.5 employees (Retail Trade) and 3.3 employees (Community, Social & Personal Services) per 100 m^2 GFA is adopted in accordance with "Commercial and Industrial Floor Space Utilization Survey" issued by the PlanD in 2004/2005;
(4) Asusming 180 students per kindergarten (with 2 kindergartens planned) and 25.5 students per class for the planned primary school (30-classrooom) with reference to Chapter 3 of the HKPSG;
(5) Pupil-teacher ratios of 8.6:1 (kindergarden) and 13.8:1 (primary school) are assumed based on Education Bureau's 2017/18 Figures and Statistics;
(6) Refereces have been taken from the mean unit daily demands recommeneded in Table 1 and 2 in the WSD DI 1309 and derived from GESF published by EPD;
(7) The fresh water unit demand of retail is included in domestic service trade;
(8) The fresh water unit demand of welfare facilities is adopted in accordance with Section 4.4(d) of GESF published by EPD;
(9) Ancillary facilities and others include office, workshop, PTI and covered walkway etc.

(3) Capacity of Service Reservoir

Required Volume of Fresh Water Reservoir required (m^3)

Scenario 1: Isolated Supply Zone (Note: no critical consumer is assumed)

(a) Isolated Supply Zone = 85% of MDD
4724 m^3

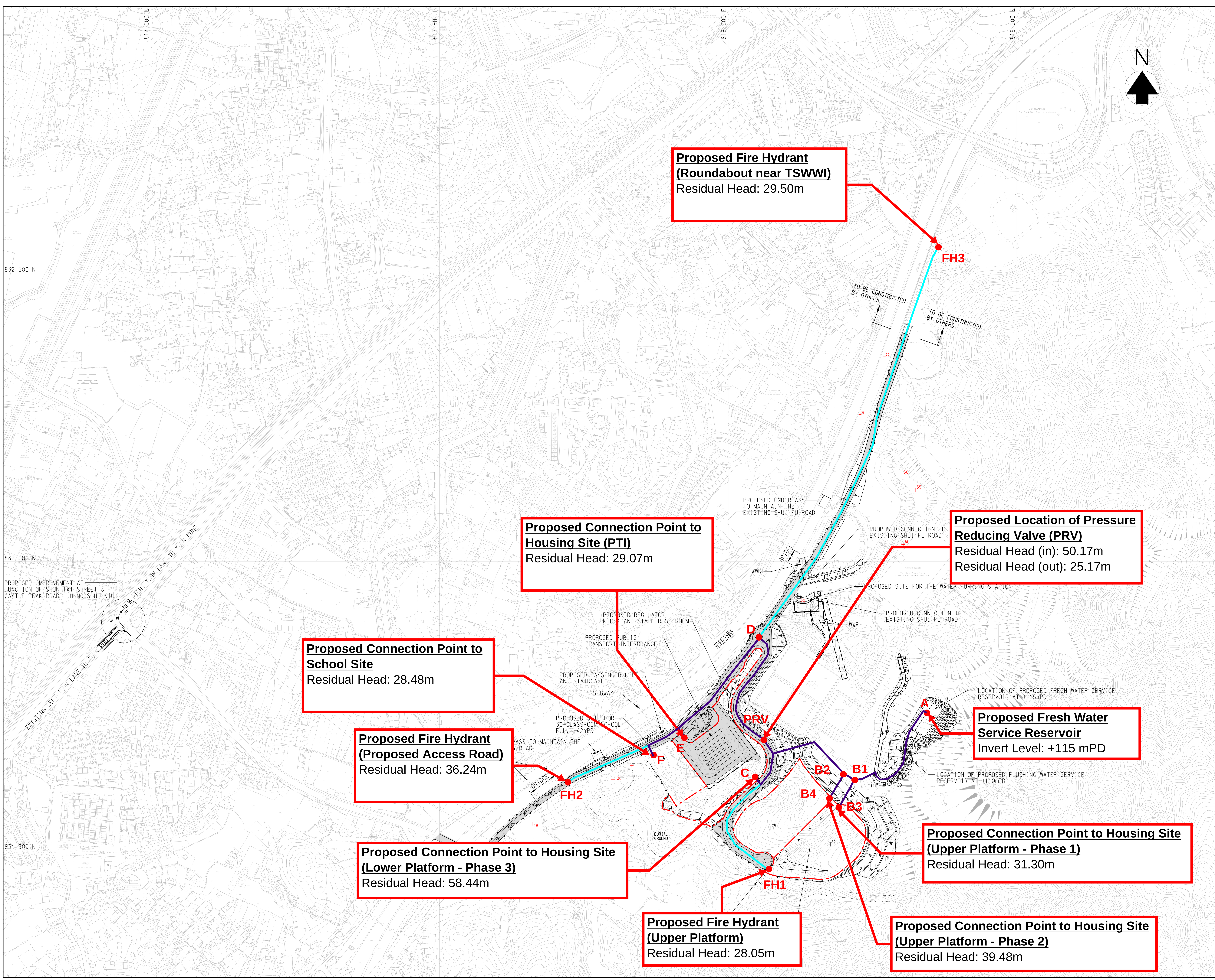
Scenario 2: Fire-fighting requirement (For R1)

(a) For R1: = [0.4MMD +9900/2]/0.9 (According to AD/Dev's memo of ref. (8) in WSD 3608/50/3/02 Pt.2 dated 11 May 2006)
7970 m^3 (Governs)

Therefore, the **Required Capacity** of the Fresh Water Reservoir is = **7970** m^3

Required Volume of Flushing Water Reservoir (m^3)

= Flushing Water Demand x 0.64 (for flushing water)
= 1561 x 0.64
Therefore, the **Required Capacity** of Flushing Water Reservoir is **969** m^3



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED G/IC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- +66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
FRESH WATER SUPPLY PLAN

Drawing No.
199086/BIN/SFAI/001

Scale
1 : 3000 (A1)
1 : 6000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

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Agreement No. CE 92/2017 (CE)
CE 92/2017 (CE) Public Housing Development near Tan Kwai Tsuen, Yuen Long – Investigation, Design and Construction
Water Supply Impact Assessment
(4) Residual Head Adequacy - Fresh Water Supply

Summary of Fresh Water Demand

			Daily Operation		Fire Fighting Scenario	
Supply Zone	**Type**	**MDD (m^3/day)**	**Demand Multiplier**	**Peak Demand (m^3/day)**	**Demand Multiplier**	**Peak Demand (m^3/day)**
Proposed Housing Development (Phase 1)	FW	1,472	3	4,416	1	7,472
Proposed Housing Development (Phase 2)	FW	1,786	3	5,358	1	1,786
Proposed Housing Development (Phase 3)	FW	2,276	3	6,828	1	2,276
Primary School	FW	20	3	60	1	20
Fire Fighting Flow	FW	6,000	-	-	1	6,000

Hydraulic Assessment of Fresh Water Mains (Daily Operation)

Invert level of the proposed FWSR **115** mPD
Head Reduction of PRV **25** m

Start	End	Nominal Pipe Diameter (mm)	Internal Pipe Diameter (mm)	Available Peak Flow Capacity (m^3/day)	Pipe Length (m)	Say Pipe Length (m)	Hazen-Williams Coefficient	Peak Demand (m^3/day)	Peak Velocity (m/s)	Friction Loss(1)	Minor Loss(2)	Total Head Loss	Culmulative Head Loss	Elevation (m)	Residual Head (m)	Residual Head Check (>20m)	Remarks
E	F	250	250	6362	92	120	110	60	0.01	0.00	0.00	0.00	1.56	42.00	46.44	OK	
D	E	250	250	6362	235	290	110	60	0.01	0.00	0.00	0.00	1.56	43.00	45.44	OK	
PRV	D	300	300	9161	220	270	110	60	0.01	0.00	0.00	0.00	1.56	49.50	38.94	OK	
C	PRV	300	300	9161	100	120	110	60	0.01	0.00	0.00	0.00	1.56	55.00	33.44	OK	After PRV
															58.44	OK	
B2	C	450	450	20612	225	270	110	6888	0.50	0.22	0.04	0.26	1.56	61.00	52.44	OK	
B2	B4	300	300	9161	48	60	110	5358	0.88	0.22	0.04	0.26	0.26	75.00	39.74	OK	
B1	B2	450	450	27483	22	30	110	12246	0.89	0.07	0.01	0.08	1.38	88.00	25.62	OK	
B1	B3	300	300	12215	55	70	110	4416	0.72	0.18	0.04	0.22	1.51	82.00	31.49	OK	
A	B1	450	450	27483	215	260	110	16662	1.21	1.08	0.22	1.29	1.29	90.00	23.71	OK	Before PRV

Hydraulic Assessment of Fresh Water Mains (Fire Fighting)

Invert level of the proposed FWSR **115** mPD
Head Reduction of PRV **25** m

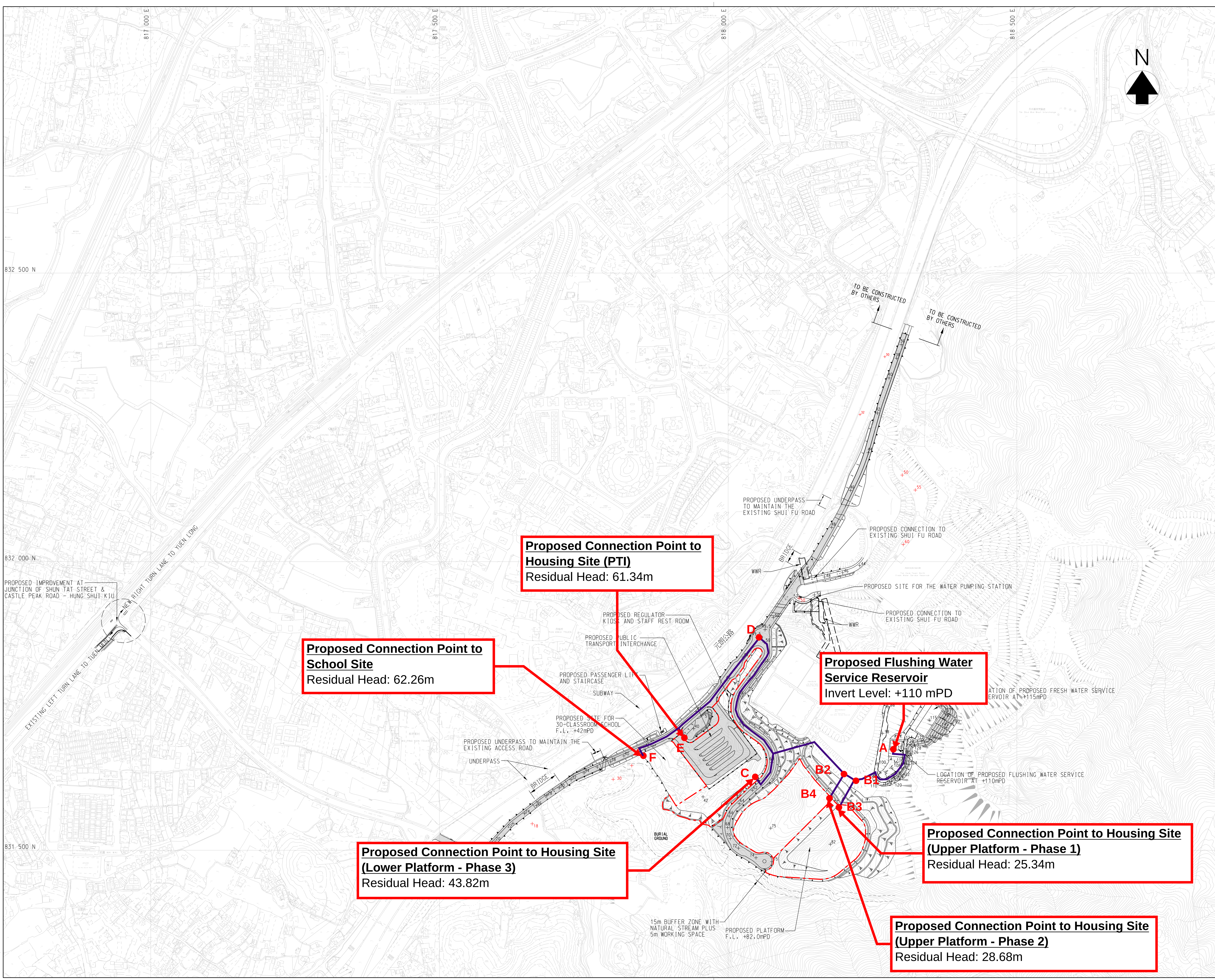
Start	End	Nominal Pipe Diameter (mm)	Internal Pipe Diameter (mm)	Available Peak Flow Capacity (m^3/day)	Pipe Length (m)	Say Pipe Length (m)	Hazen-Williams Coefficient	Peak Demand (m3/day)(3)	Peak Velocity (m/s)	Friction Loss(1)	Minor Loss(2)	Total Head Loss	Culmulative Head Loss	Elevation (m)	Residual Head (m)	Residual Head Check (>17m for draw off note and >20m for others)	Remarks
D	FH3	250	250	6362	942	1140	110	6000	1.41	12.52	2.50	15.02	29.10	25.00	35.90	OK	
F	FH2	250	250	6362	136	170	110	6000	1.41	1.87	0.37	2.24	21.76	32.00	36.24	OK	
E	F	250	250	6362	92	120	110	6020	1.42	1.33	0.27	1.59	19.52	42.00	28.48	OK	
D	E	250	250	6362	235	290	110	6020	1.42	3.20	0.64	3.85	17.93	43.00	29.07	OK	After PRV
PRV	D	300	300	9161	220	270	110	6020	0.99	1.23	0.25	1.47	14.08	49.50	26.42	OK	
C	PRV	300	300	9161	100	120	110	6020	0.99	0.55	0.11	0.65	12.61	55.00	22.39	OK	
															47.39	OK	
C	FH1	200	200	4072	210	260	110	6000	2.21	8.46	1.69	10.16	11.95	75.00	28.05	OK	
B2	C	450	450	20612	225	270	110	8296	0.60	0.31	0.06	0.37	1.80	61.00	52.20	OK	
B2	B4	300	300	9161	48	60	111	7786	1.27	0.43	0.09	0.52	0.52	75.00	39.48	OK	Before PRV
B1	B2	450	450	20612	22	30	110	10082	0.73	0.05	0.01	0.06	1.49	88.00	25.51	OK	
B1	B3	300	300	9161	55	70	110	13472	2.21	1.41	0.28	1.70	1.70	82.00	31.30	OK	
A	B1	450	450	27483	215	260	110	17554	1.28	1.19	0.24	1.43	1.43	90.00	23.57	OK	

Note:

(1) By Hazen Williams Equation, Friction Loss = $\frac{10.67L(Q^{1.85})}{C^{1.852}d^{4.82}}$ where L is length of pipeline (m), C is Hazen-Williams Coefficient, d is internal diameter of pipe (m) and Q is design flow of pipe (m^3/s)

(2) Assume minor loss (i.e. due to bends and tees) is 20% of the friction loss.

(3) Assume Pressure Reducing Valve (PRV) has lowered the Residual Head by 30m.



LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED G/IC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
FLUSHING WATER SUPPLY PLAN

Drawing No.
199086/BIN/SFAI/001

Scale
1 : 3000 (A1)
1 : 6000 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

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Agreement No. CE 92/2017 (CE)
CE 92/2017 (CE) Public Housing Development near Tan Kwai Tsuen, Yuen Long – Investigation, Design and Construction
Water Supply Impact Assessment
(5) Residual Head Adequacy - Flushing Water Supply

Summary of Flushing Water Demand

			Daily Operation	
Supply Zone	**Type**	**MDD (m^3/day)**	**Demand Multiplier**	**Peak Demand (m^3/day)**
Proposed Housing Development (Phase 1)	FLW	390	2	780
Proposed Housing Development (Phase 2)	FLW	479	2	958
Proposed Housing Development (Phase 3)	FLW	614	2	1,228
Primary School	FLW	25	2	50

Hydraulic Assessment of Flushing Water Mains

Invert level of the proposed FLWSR **110** mPD

Start	End	Nominal Pipe Diameter (mm)	Internal Pipe Diameter (mm)	Available Peak Flow Capacity (m^3/day)	Pipe Length (m)	Say Pipe Length (m)	Hazen-Williams Coefficient	Peak Demand (m^3/day)	Peak Velocity (m/s)	Friction Loss(1)	Minor Loss(2)	Total Head Loss	Culmulative Head Loss	Elevation (m)	Residual Head (m)	Residual Head Check (>15m)
E	F	80	80	651	92	120	90	50	0.12	0.07	0.01	0.08	5.74	42.00	62.26	OK
D	E	80	80	651	235	290	90	50	0.12	0.17	0.03	0.20	5.66	43.00	61.34	OK
C	D	80	80	651	320	390	90	50	0.12	0.23	0.05	0.27	5.45	49.50	55.05	OK
B2	C	200	200	4072	225	270	90	1278	0.47	0.73	0.15	0.87	5.18	61.00	43.82	OK
B2	B4	100	100	1018	48	60	90	1008	1.49	3.05	0.61	3.66	6.32	75.00	28.68	OK
B1	B2	200	200	4072	22	30	90	1788	0.66	0.15	0.03	0.18	4.31	88.00	17.69	OK
B1	B3	100	100	1018	55	70	90	780	1.15	2.22	0.44	2.66	2.66	82.00	25.34	OK
A	B1	200	200	4072	215	260	90	3016	1.11	3.44	0.69	4.12	4.12	90.00	15.88	OK

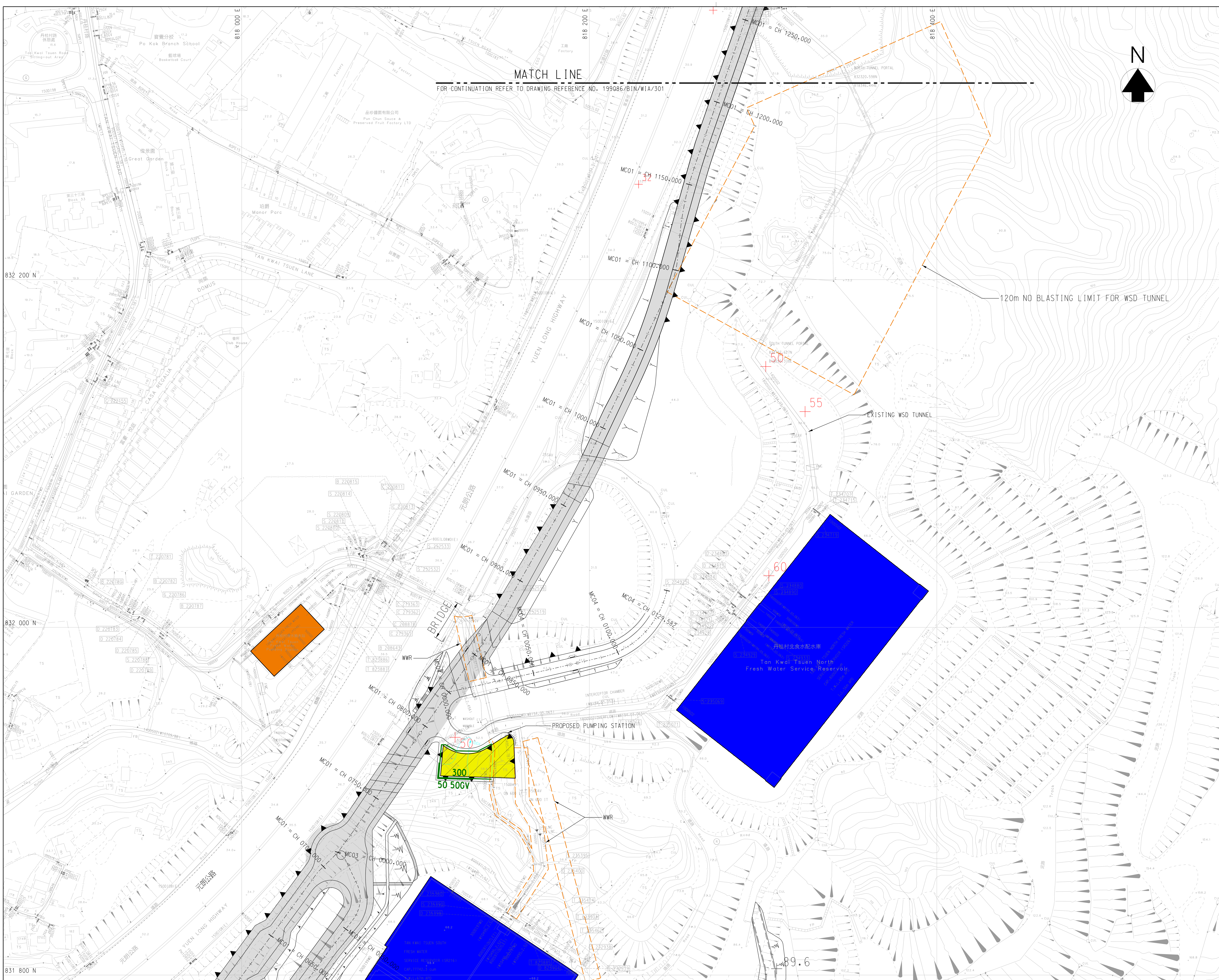
Note:

(1) By Hazen Williams Equation, Friction Loss = $\frac{10.67L(Q^{1.85})}{C^{1.852}d^{4.82}}$ where L is length of pipeline (m), C is Hazen-Williams Coefficient, d is internal diameter of pipe (m) and Q is design flow of pipe (m^3/s)

(2) Assume minor loss (i.e. due to bends and tees) is 20% of the friction loss.

Appendix D

PROPOSED DIVERSION PLAN FOR EXISTING WATER MAINS



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NOTES:

1. ALL CORRDINATES REFER TO HONG KONG GEODETIC DATUM (1980) AND ARE IN METRES.
2. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS OTHERWISE STATED.
3. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.

LEGEND:

- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- 22.0 ROAD LEVEL (mPD)
- REFERENCE LINE MC01
- 1400 DIAMETER (mm) PROPOSED FRESH WATER MAIN DIVERSION

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	TCL	WLC	SZ	LCH	
Date	04/22	04/22	04/22	04/22	

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PRELIMINARY DIVERSION PLAN FOR FRESH WATER MAIN

(SHEET 2 OF 2)

Drawing No. 199086/BIN/WIA/302

Scale 1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署 CEDD Civil Engineering and Development Department

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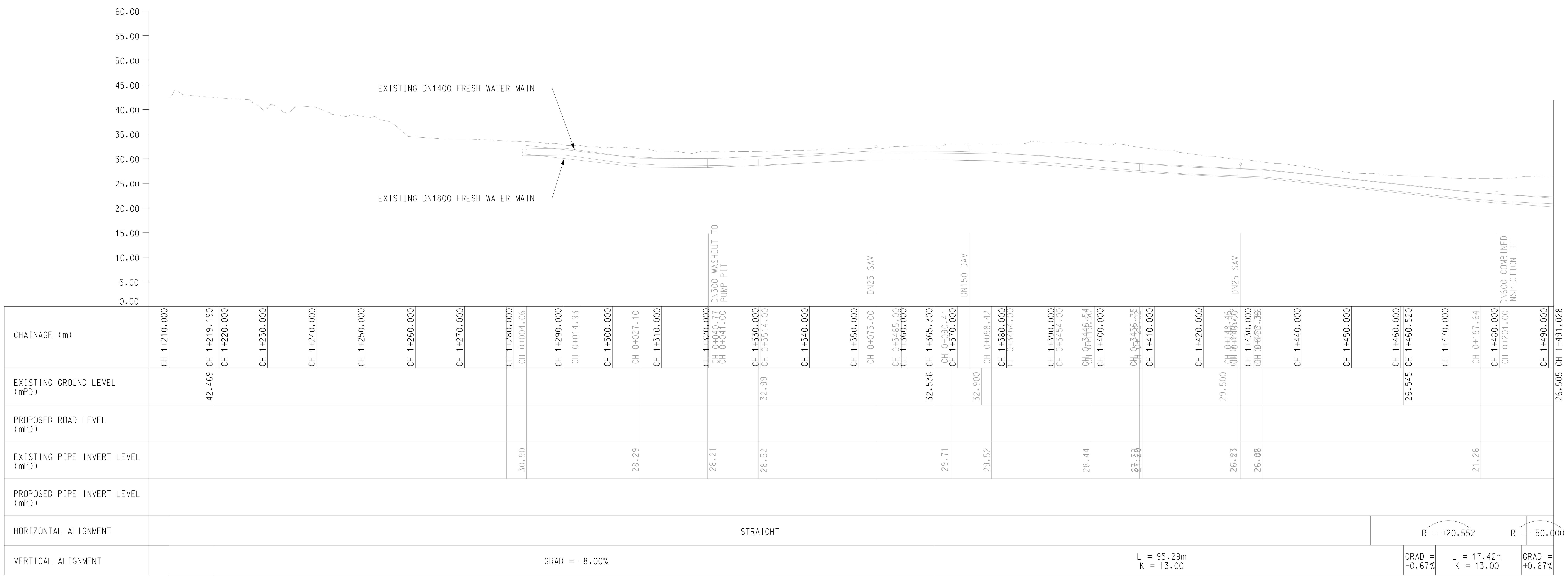

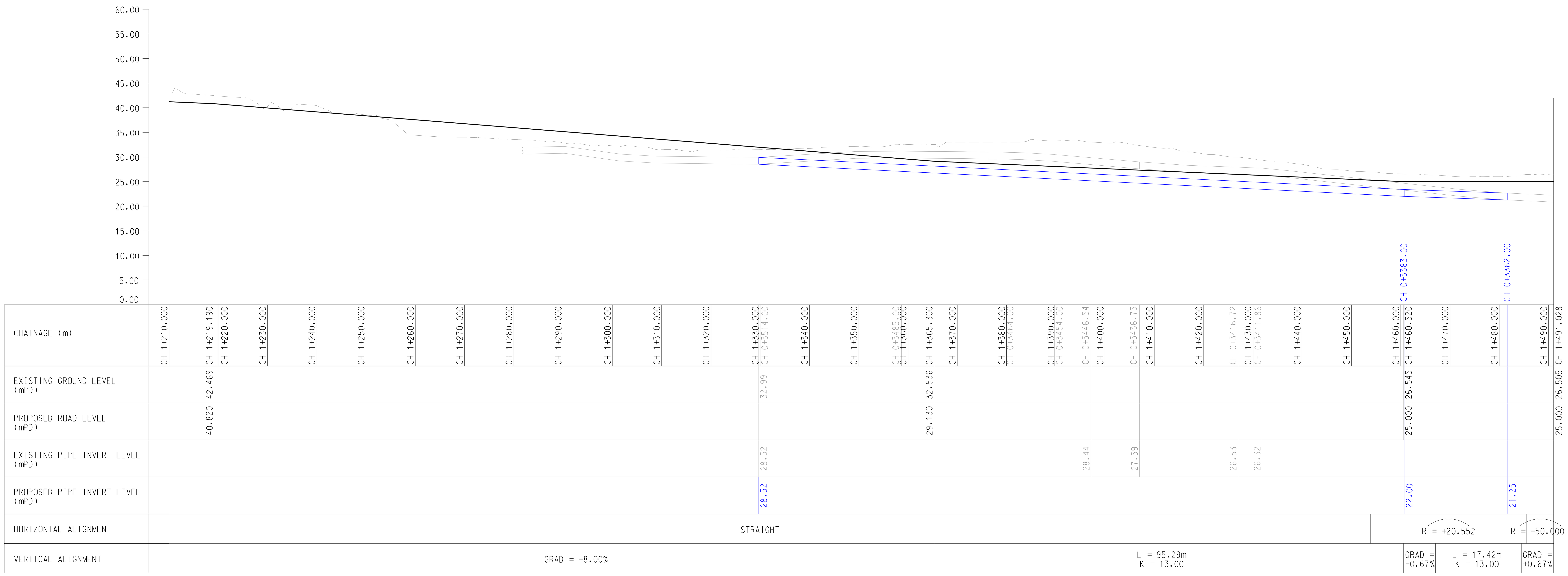

PROPOSED ROAD LONGITUDINAL PROFILE (MC01)

SCALE A1 1 : 500
A3 1 : 1000

NOTES:

1. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.
3. ALL VERTICAL CURVES ARE PARABOLIC. ALL HORIZONTAL TRANSITIONS ARE CLOTHOIDAL.
4. CHAINAGES AND LEVELS SHOWN ARE ALONG THE SETTING OUT LINES.
5. EXISTING GROUND LEVELS SHOWN ARE APPROXMATE ONLY.

LEGEND:

- EXISTING PROFILE
- PROPOSED PROFILE
- EXISTING FRESH WATER MAIN
- PROPOSED FRESH WATER MAIN DIVERSION

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	KWM	LCH	SZ	LCH
Date	03/21	03/21	03/21	03/21

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PRELIMINARY DIVERSION PLAN FOR FRESH WATER MAIN- LONGITUDINAL SECTION

Drawing No.
199086/BIN/WIA/304

Scale
AS SHOWN

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
賓尼斯工程顧問有限公司

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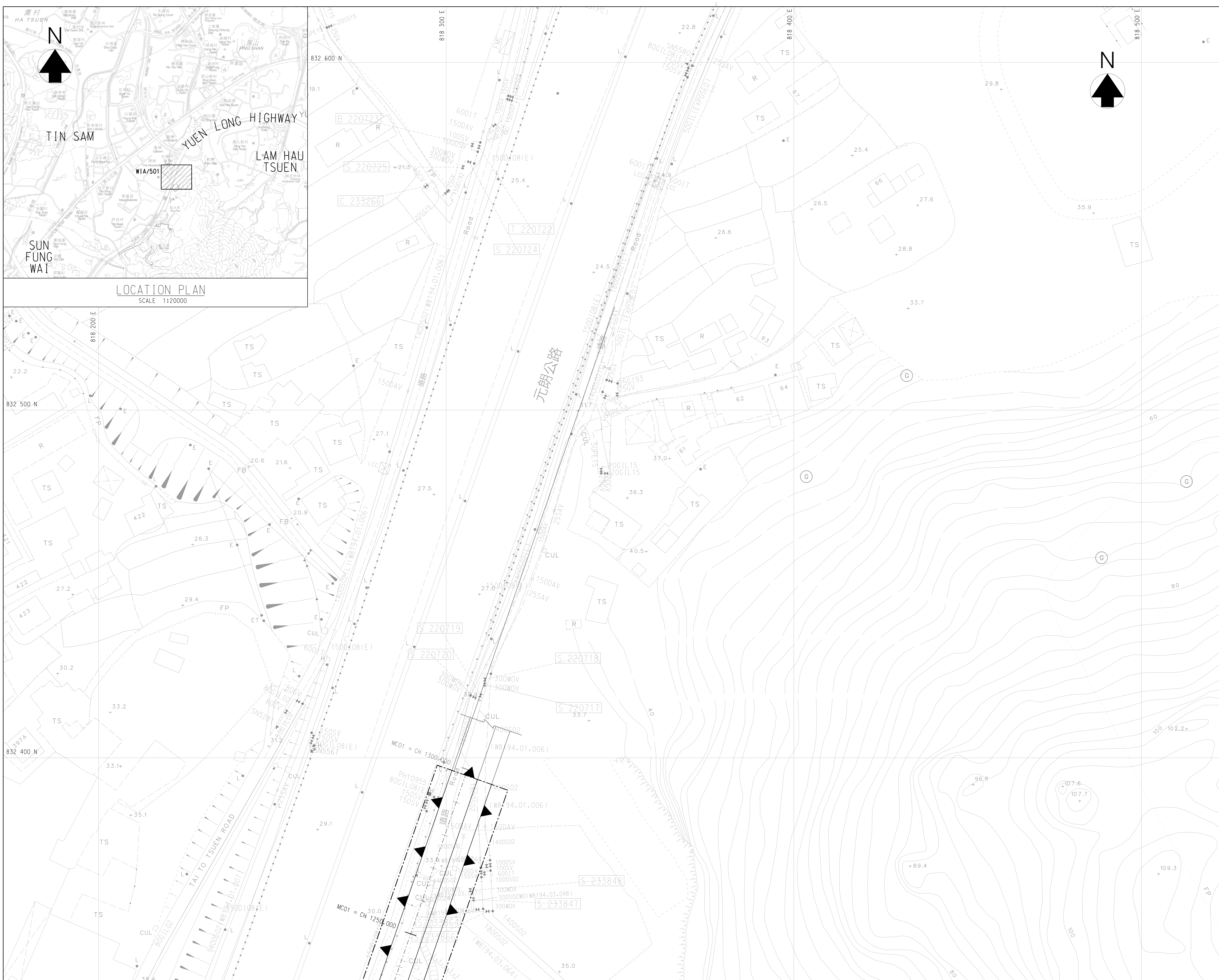

NOTES:

1. ALL CORRDINATES REFER TO HONG KONG GEODETIC DATUM (1980) AND ARE IN METRES.
2. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS OTHERWISE STATED.
3. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.

LEGEND:

- LIMIT OF WORKS AREA
- PROPOSED PUBLIC TRANSPORT INTERCHANGE TO BE CONSTRUCTED BY HD
- +22.0 ROAD LEVEL (mPD)
- REFERENCE LINE MC01

Revision	Date	Description			Initial
		Designed	Checked	Drawn	Checked
Initial		TCL	WLC	SZ	LCH
Date		04/22	04/22	04/22	04/22

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

PRELIMINARY DIVERSION PLAN FOR FRESH WATER MAIN (INTERFACE A)

Drawing No.: 199086/BIN/WIA/501

Scale: 1 : 500 (A1) 1 : 1000 (A3)

土木工程拓展署
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Plot File by = Chel5988 2022/10/25

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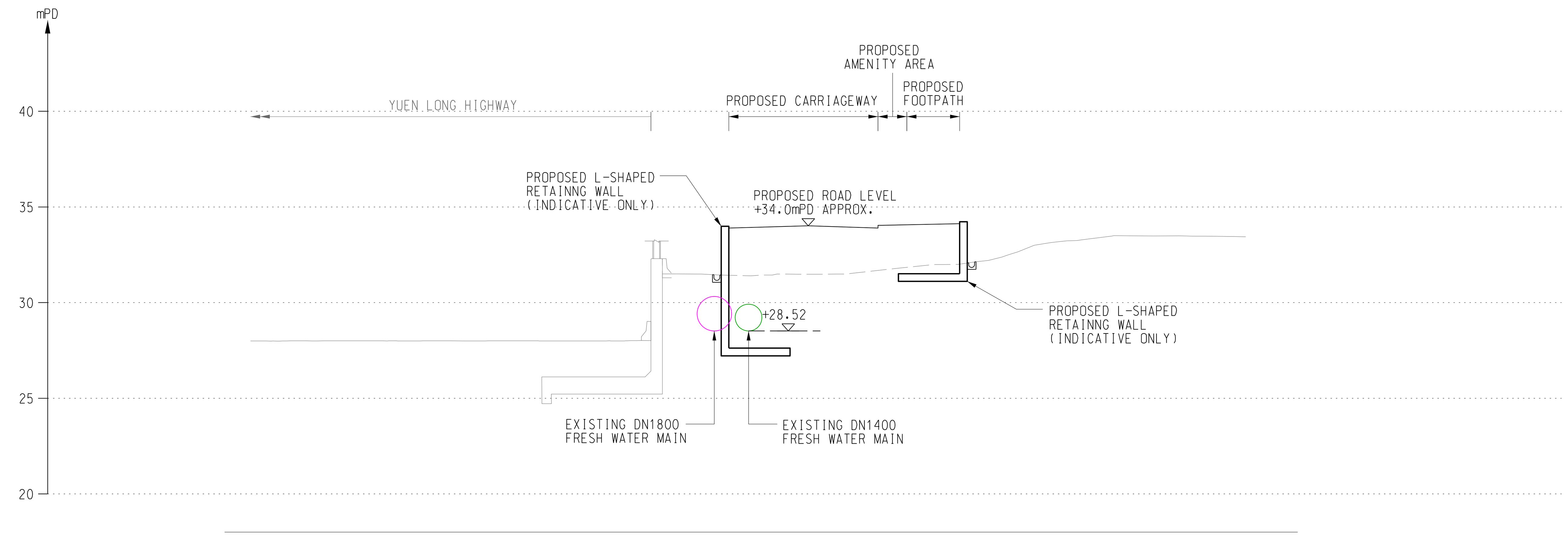
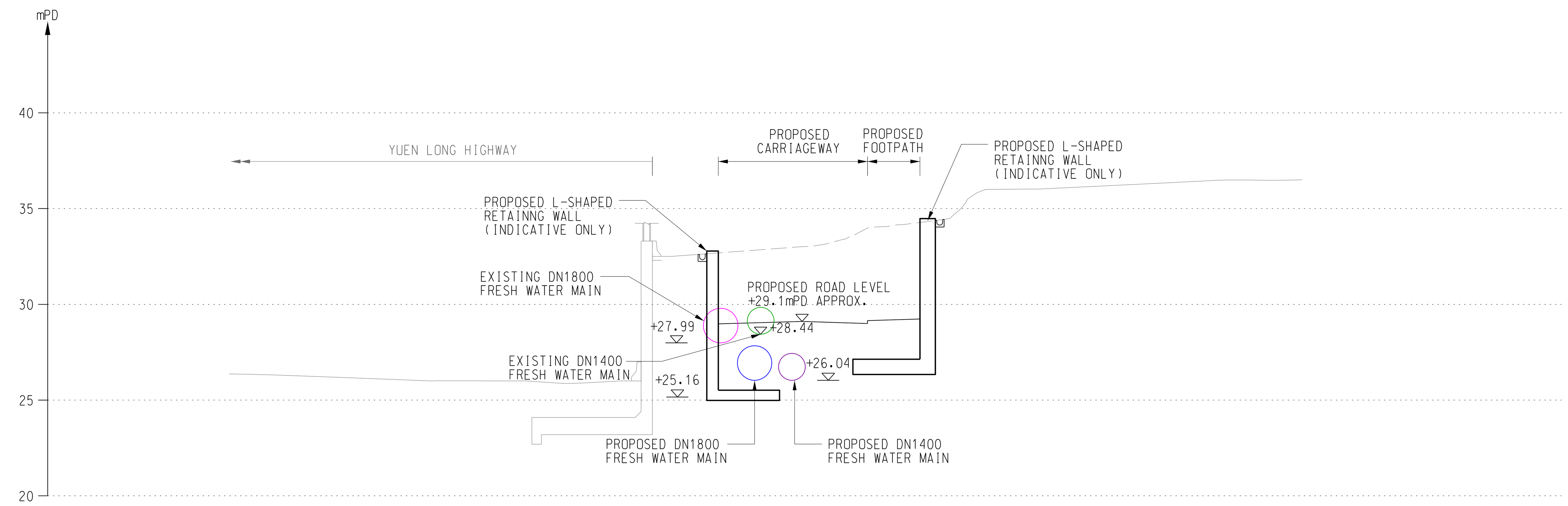
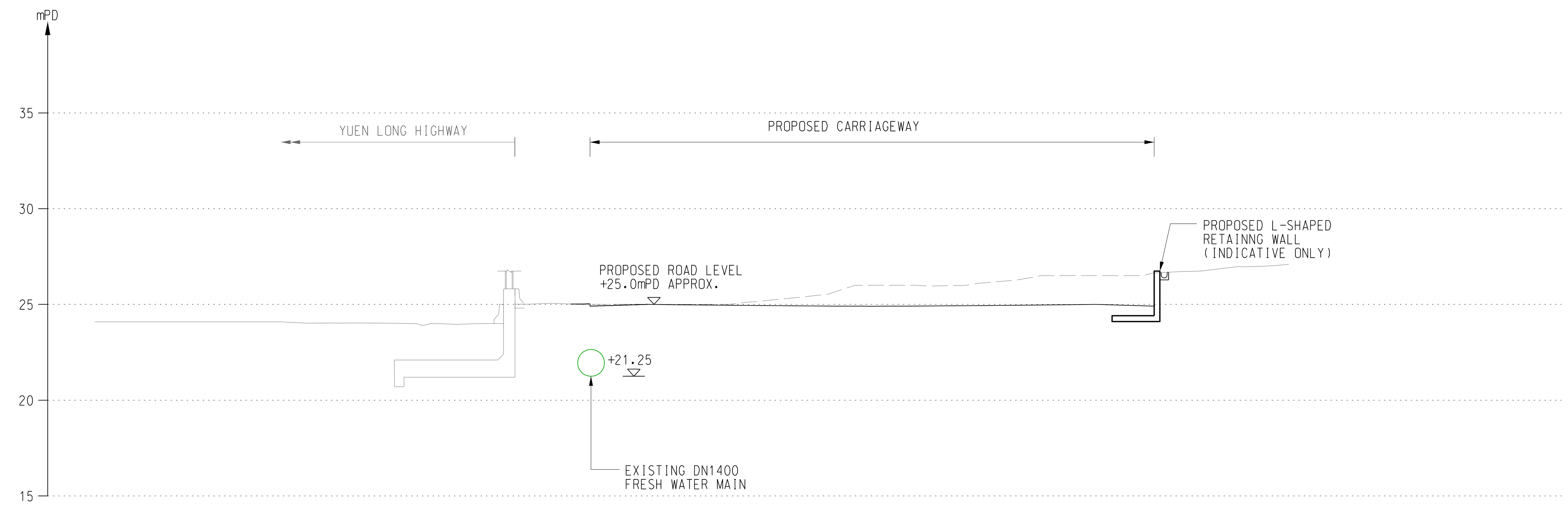


SECTION A-A



SECTION B-B



SECTION C-C

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHER WISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM (P.D.).
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER RELEVANT DRAWINGS, SPECIFICATIONS AND INSTRUCTIONS ISSUED BY THE ENGINEER.

Revision	Date	Description	Initial

	Designed	Checked	Drawn	Checked
Initial	KWM	LCH	SZ	LCH
Date	11/21	11/21	11/21	11/21

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
SITE FORMATION PLAN (SECTION A, B & C)

Drawing No. 199086/BIN/WIA/502

Scale 1 : 200 (A1) 1 : 400 (A3)

土木工程拓展署
CEDD Civil Engineering and Development Department

BINNIES HONG KONG LIMITED
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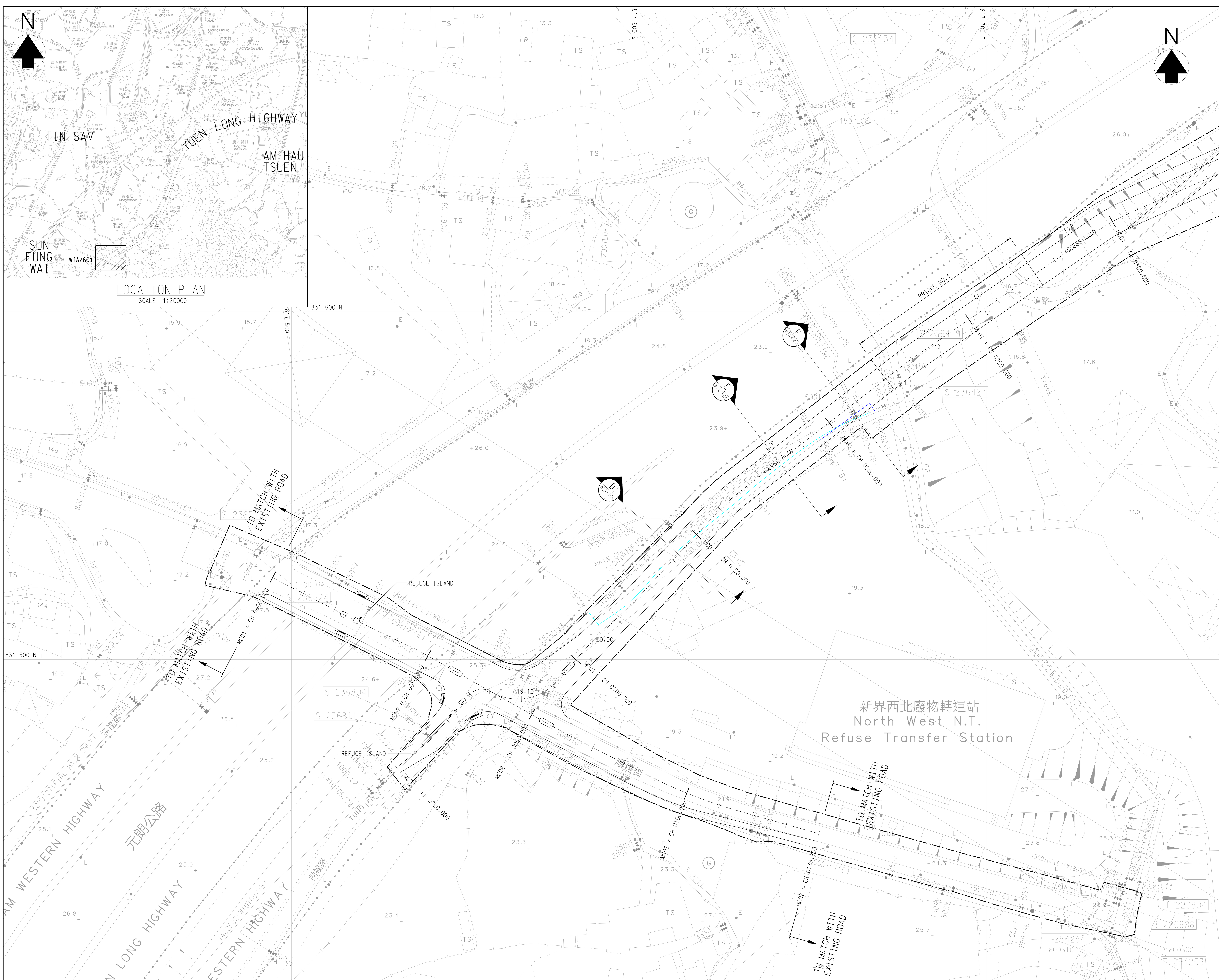

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NOTES:

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2. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS OTHERWISE STATED.
3. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.

LEGEND:

- LIMIT OF WORKS AREA
- PROPOSED PUBLIC TRANSPORT INTERCHANGE TO BE CONSTRUCTED BY HD
- +22.0 ROAD LEVEL (mPD)
- REFERENCE LINE MC01
- EXISTING DN1400 FRESH WATER MAIN
- PROPOSED DIVERTED DN1400 FRESH WATER MAIN

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	KWM	LCH	SZ	LCH
Date	02/21	02/21	02/21	02/21

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PRELIMINARY DIVERSION PLAN FOR FRESH WATER MAIN

Drawing No.
199086/BIN/WIA/601

Scale
1 : 500 (A1)
1 : 1000 (A3)

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Plot File by = Chel5988 2022/10/25

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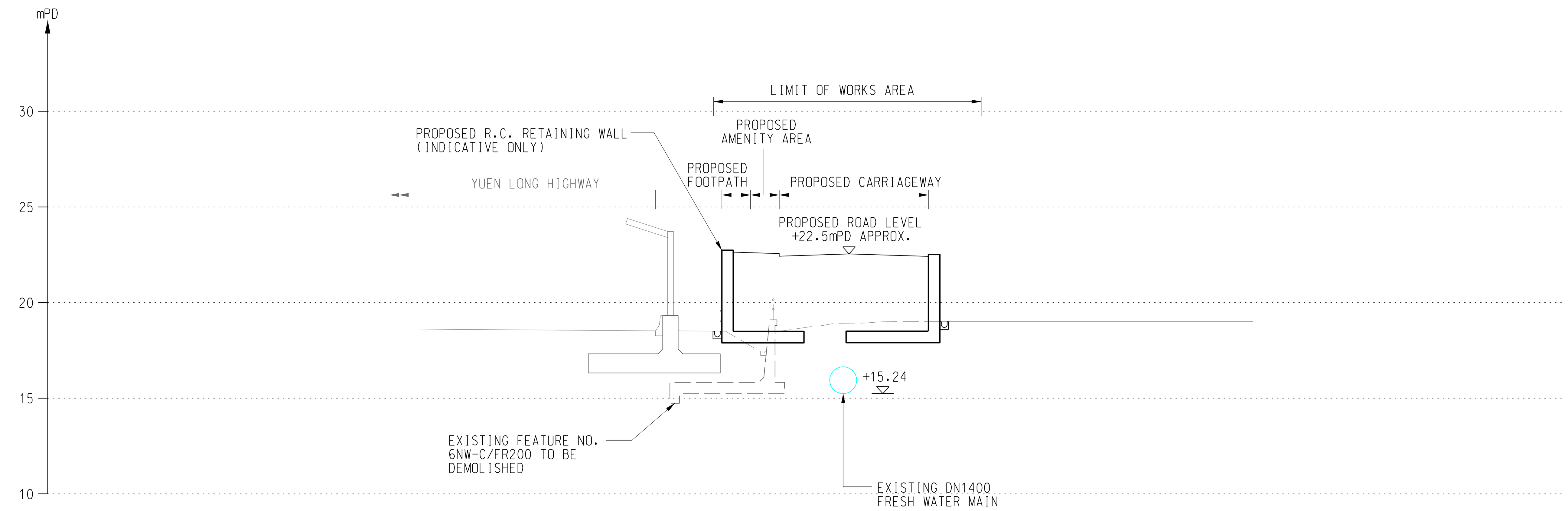
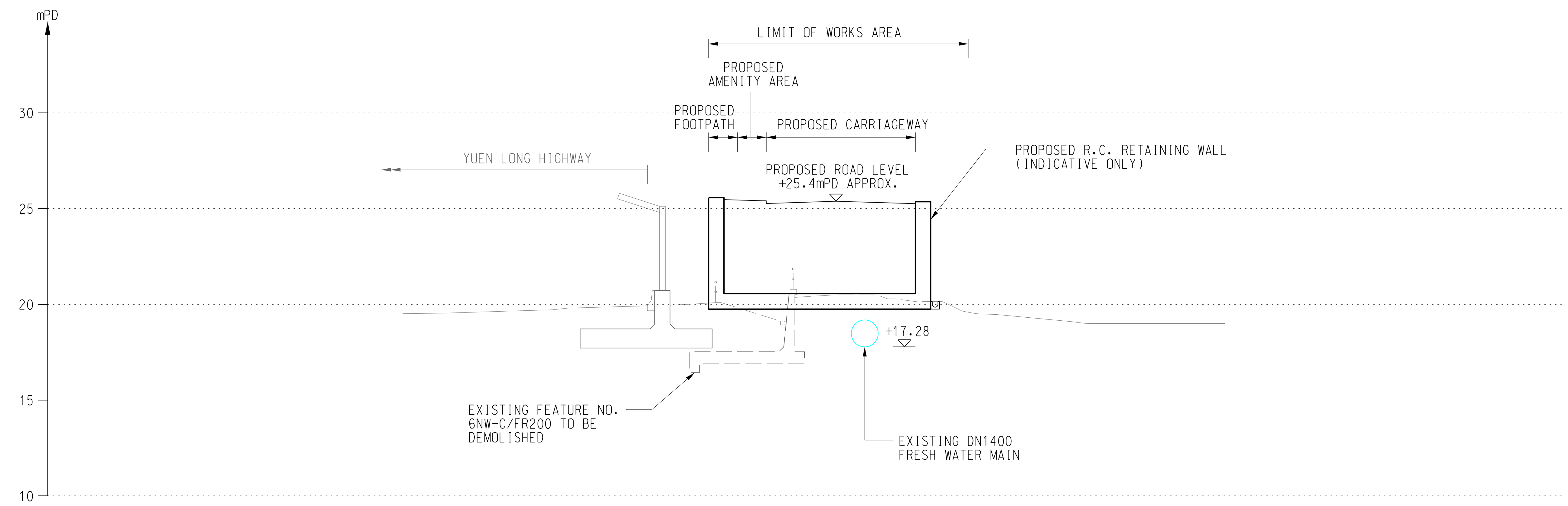


SECTION D-D



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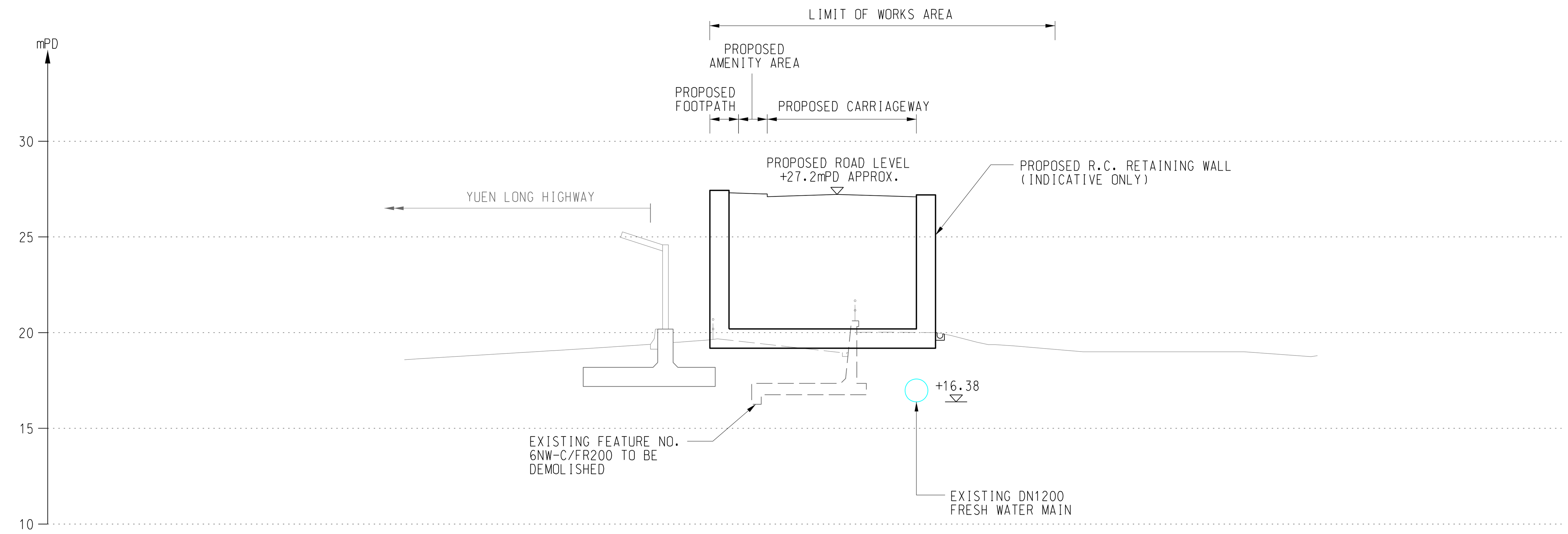

SECTION F-F

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHER WISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM (P.D.).
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER RELEVANT DRAWINGS, SPECIFICATIONS AND INSTRUCTIONS ISSUED BY THE ENGINEER.

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Initial	KWM	LCH	SZ	LCH
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Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
SITE FORMATION PLAN
(SECTION D, E & F)

Drawing No.
199086/BIN/WIA/602

Scale
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1 : 400 (A3)

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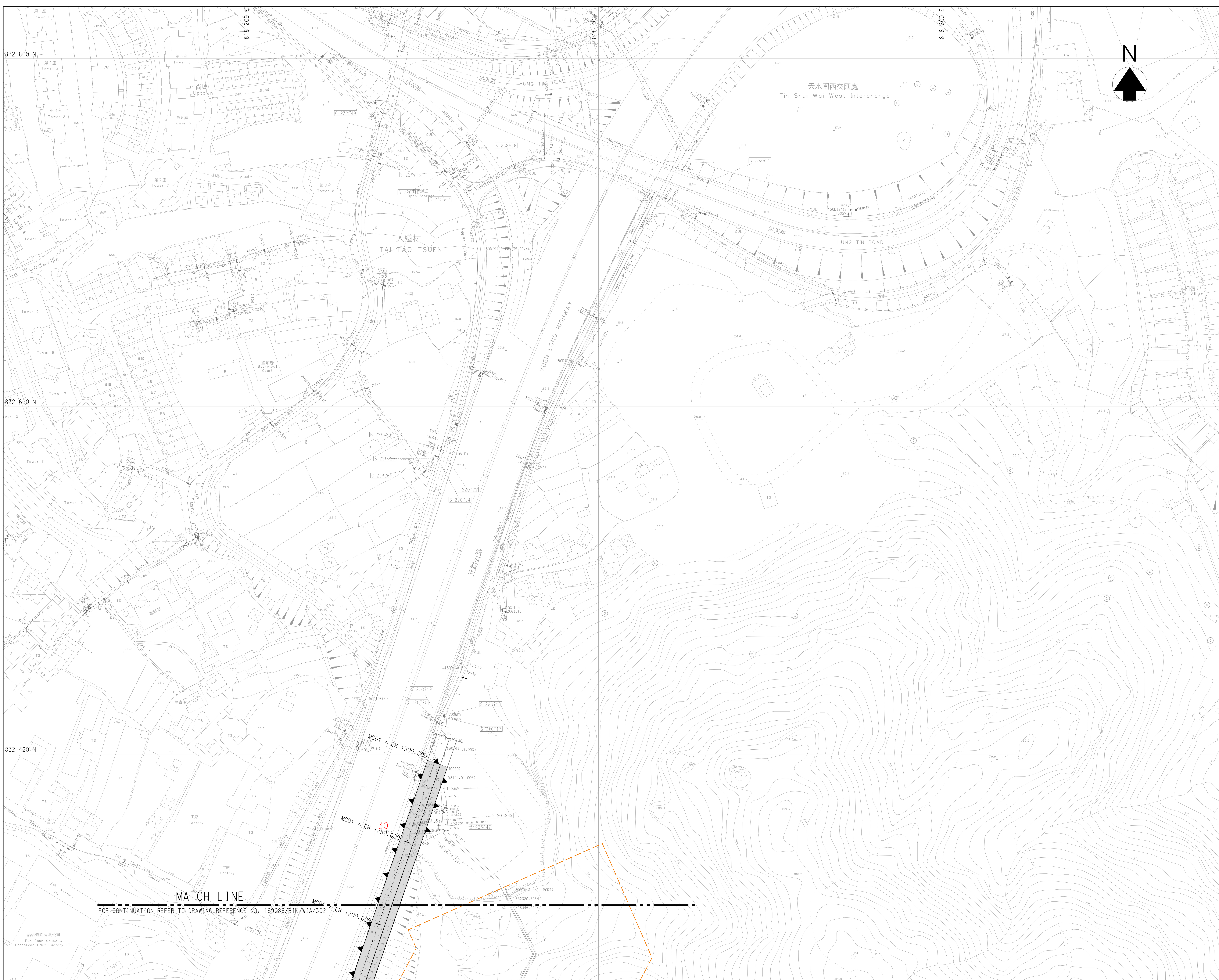

NOTES:

1. ALL CORRDINATES REFER TO HONG KONG GEODETIC DATUM (1980) AND ARE IN METRES.
2. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS OTHERWISE STATED.
3. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.

LEGEND:

- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- EXISTING FRESH WATER SERVICE RESERVOIR
- EXISTING PUMPING STATION
- EXISTING FRESH WATER MAINS
- EXISTING FRESH WATER MAINS TO BE RETAINED
- EXISTING FRESH WATER MAINS TO BE ABANDONED
- +22.0 ROAD LEVEL (mPD)
- REFERENCE LINE MC01

Revision	Date	Description	Initial

	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.

CE 92/2017 (CE)

Title

SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title

PRELIMINARY DIVERSION PLAN FOR FRESH WATER MAIN

(SHEET 1 OF 2)

Drawing No.	Scale
199086/BIN/WIA/301	1 : 1000 (A1) 1 : 2000 (A3)

土木工程拓展署
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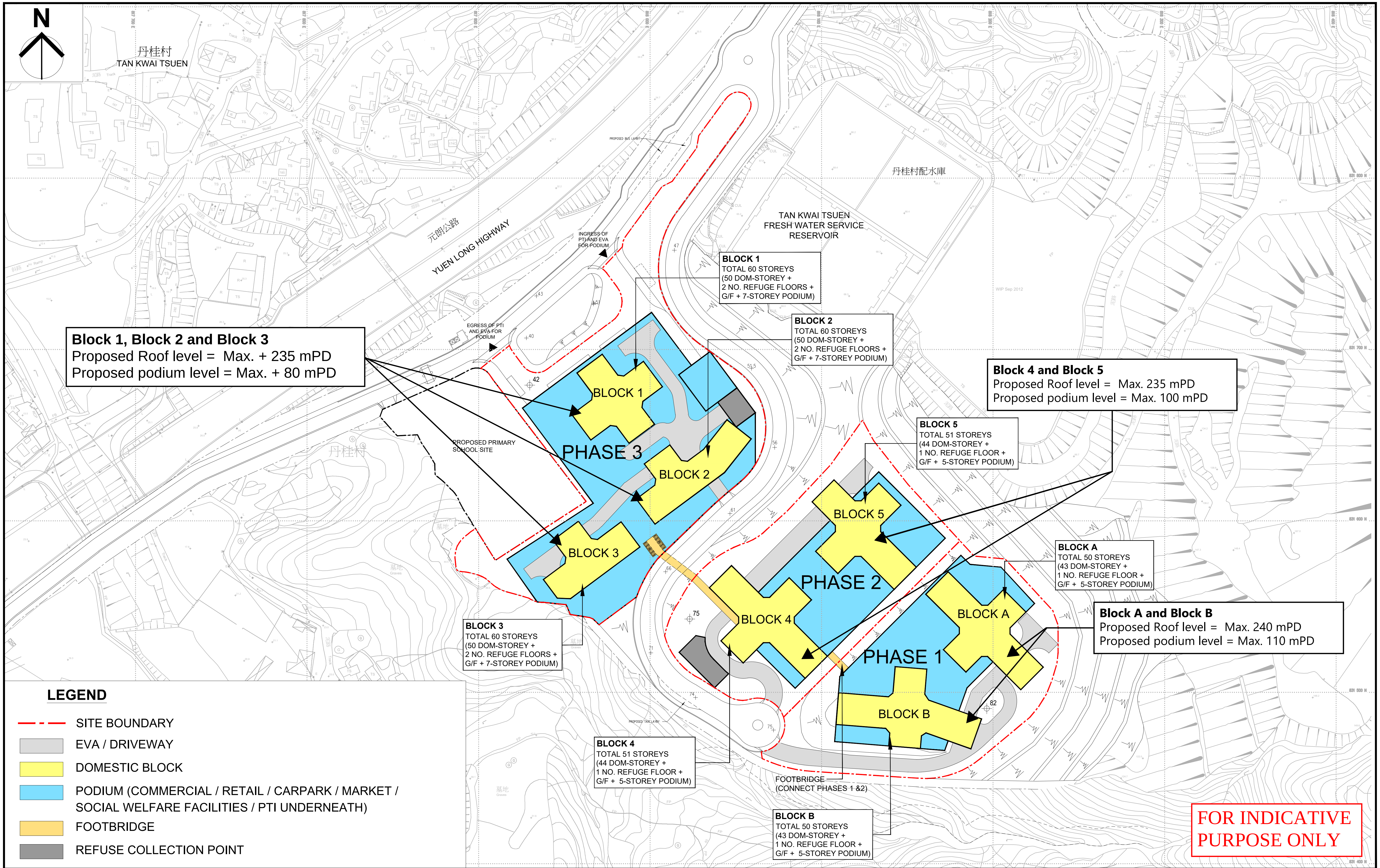
CAD Filename = Y:\Daily Work\02 From other HK Projects\199086 -TKT_Design\dgn\199086-BIN-WIA-301.dgn

Appendix E

PROPOSED HOUSING SITE LAYOUT PLAN



PROJECT TITLE

PUBLIC HOUSING DEVELOPMENT AT NEAR TAN KWAI TSUEN PHASES 1, 2 & 3

DRAWING TITLE

PROPOSED SITE LAYOUT PLAN

SCALE 1:1000 (A1) , 1:2000 (A3)

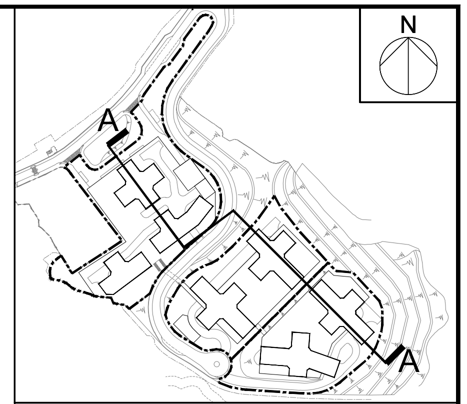
房 屋 署
HOUSING DEPARTMENT

DRAWING NO. YL52/S16/A/LO-01

DATE: 13/6/2022

LEGEND

- SITE BOUNDARY
- DOMESTIC BLOCK
- COMMERCIAL / RETAIL / CARPARK / SOCIAL WELFARE FACILITIES
- PUBLIC TRANSPORT INTERCHANGE
- FOOTBRIDGE



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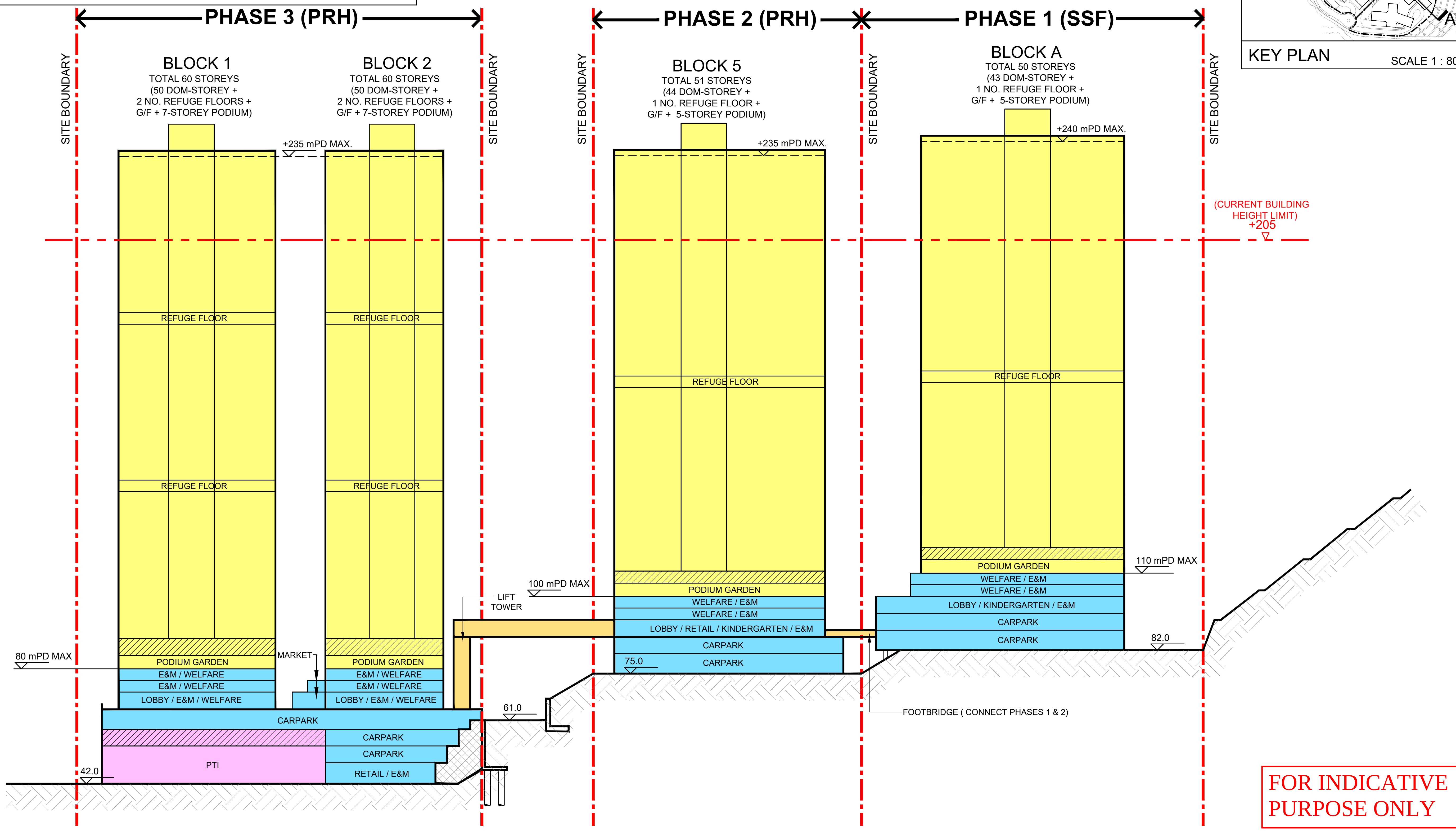


FOR INDICATIVE PURPOSE ONLY

PROJECT TITLE

PUBLIC HOUSING DEVELOPMENT AT NEAR TAN KWAI TSUEN PHASES 1, 2 & 3

DRAWING TITLE

SITE SECTION A - A

SCALE 1:600 (A1) , 1:1200 (A3)

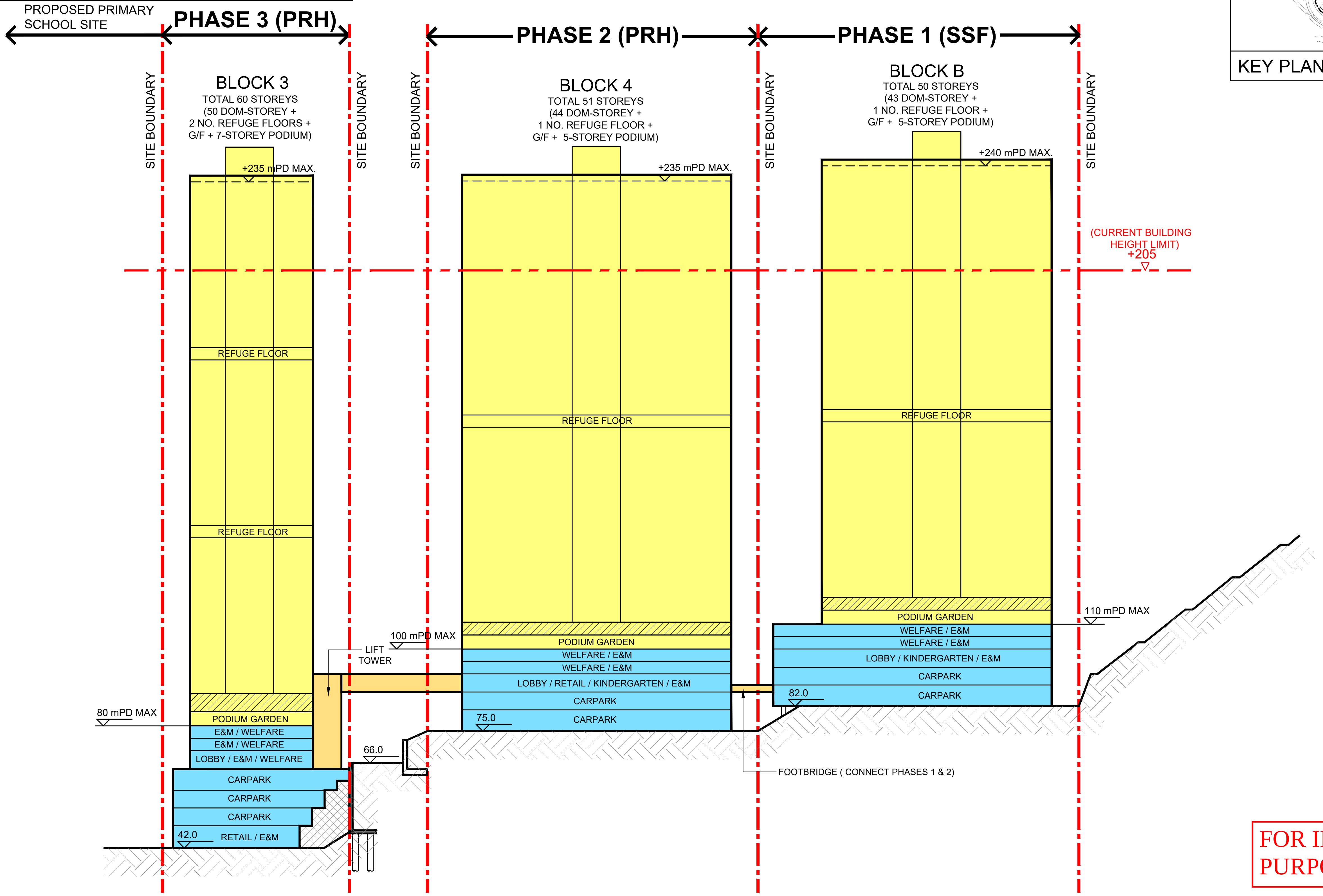
房 屋 署
HOUSING DEPARTMENT

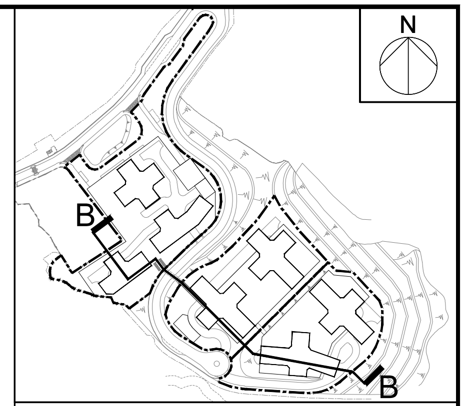
DRAWING NO. YL52/S16/A/LO-02

DATE: 13/6/2022

LEGEND

- SITE BOUNDARY
- DOMESTIC BLOCK
- COMMERCIAL / RETAIL / CARPARK / SOCIAL WELFARE FACILITIES
- FOOTBRIDGE





KEY PLAN SCALE 1 : 8000

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PROJECT TITLE

PUBLIC HOUSING DEVELOPMENT AT NEAR TAN KWAI TSUEN PHASES 1, 2 & 3

DRAWING TITLE

SITE SECTION B - B

SCALE 1:600 (A1) , 1:1200 (A3)

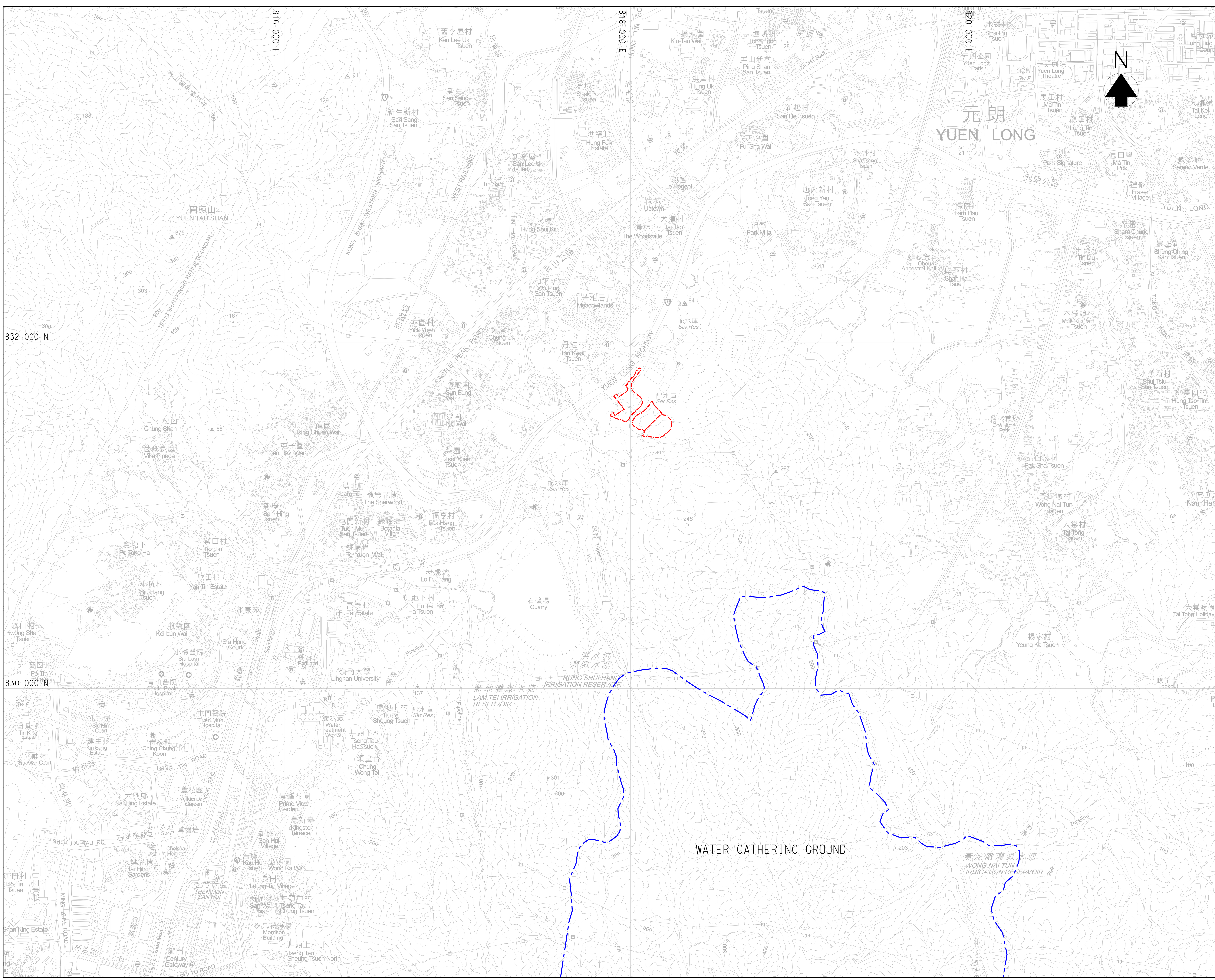
房 屋 署
HOUSING DEPARTMENT

DRAWING NO. YL52/S16/A/LO-03

DATE: 13/6/2022

Appendix F

WATER GATHERING GROUND



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LEGEND:

- POTENTIAL PUBLIC HOUSING SITE
- WATER GATHERING GROUND BOUNDARY

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
WATER GATHERING GROUND BOUNDARY

Drawing No.
APPENDIX D

Scale
1 : 10000 (A1)
1 : 20000 (A3)

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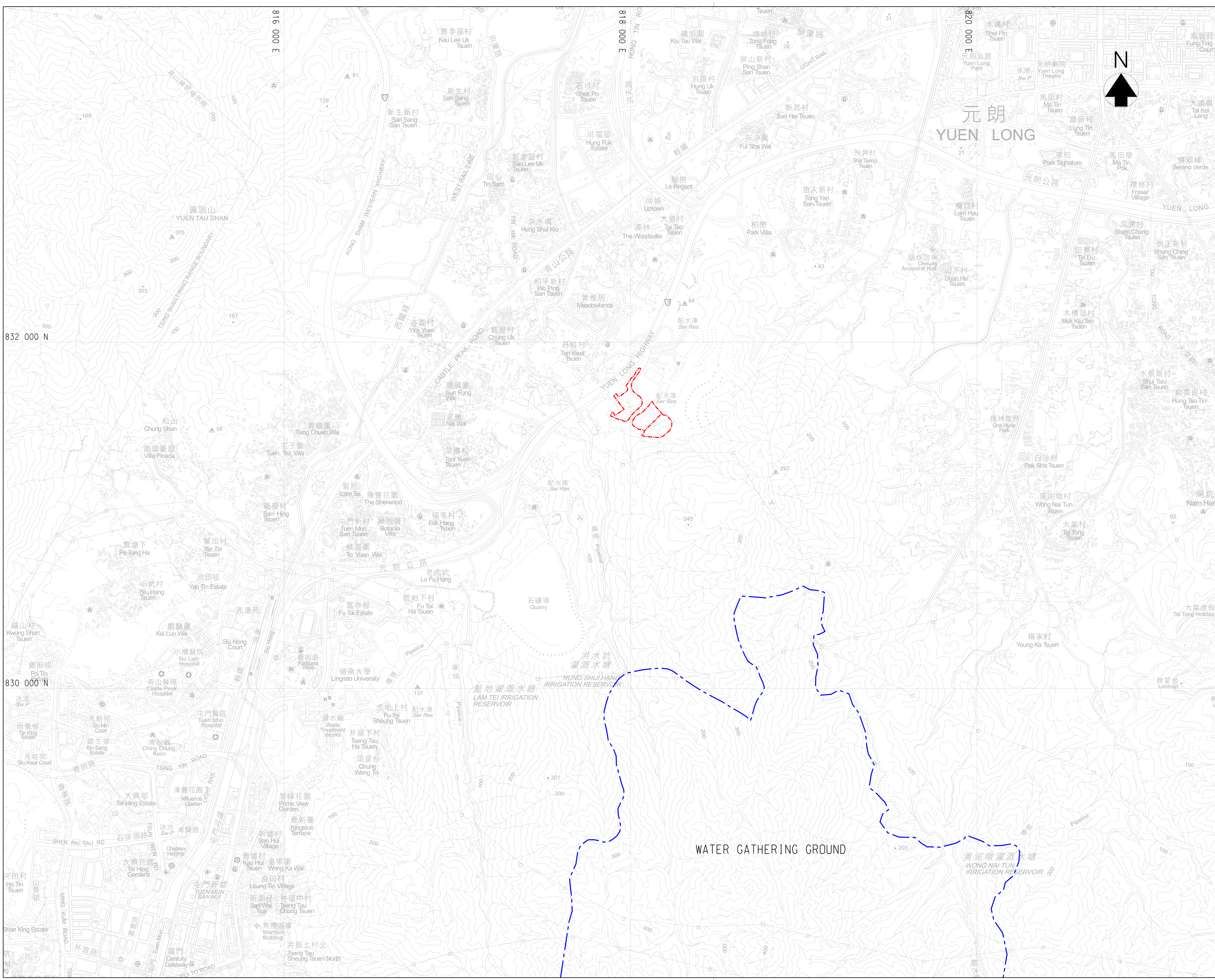

LEGEND:

- POTENTIAL PUBLIC HOUSING SITE
- WATER GATHERING GROUND BOUNDARY

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	TCL	WLC	SZ	LCH
Date	04/22	04/22	04/22	04/22

Approved

Agreement no.
CE 92/2017 (CE)

Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
WATER GATHERING GROUND BOUNDARY

Drawing No.
APPENDIX D

Scale
1 : 10000 (A1)
1 : 20000 (A3)

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Plot File by = ojo15947 2022/11/15

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Appendix G

Surge Analysis Report for Water Supply Systems

AGREEMENT NO. 92/2017 (CE)
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG – INVESTIGATION, DESIGN AND CONSTRUCTION

REPORT
FOR
SURGE ANALYSIS
FOR
TAN KWAI TSUEN PUMPING STATION (FRESH WATER AND FLUSHING WATER SUPPLY SYSTEM

(VERSION 1)

CONTENT

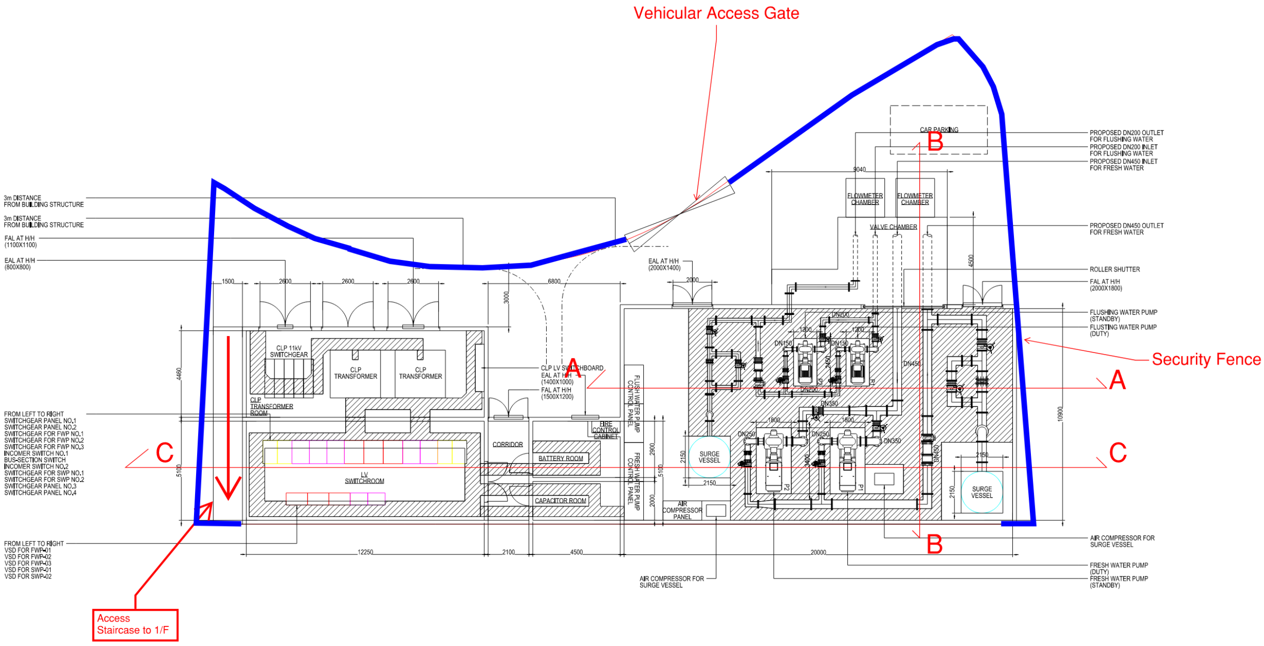
ITEM NO.	DESCRITPION	PAGE
1.	DESCRIPTION OF SYSTEM	3
2.	INVESTIGATION SCENARIOS AND MODELLING OF SYSTEM	7
3.	ASSUMPTIONS OF ANALYSIS	9
4.	MODEL SETUP	9
5	SURGE ANALYSIS	13
6.	DISCUSSION OF SURGE ANALYSIS RESULTS	14
7.	CONCLUSIONS AND RECOMMENDATIONS	19

1. DESCRIPTION OF SYSTEM

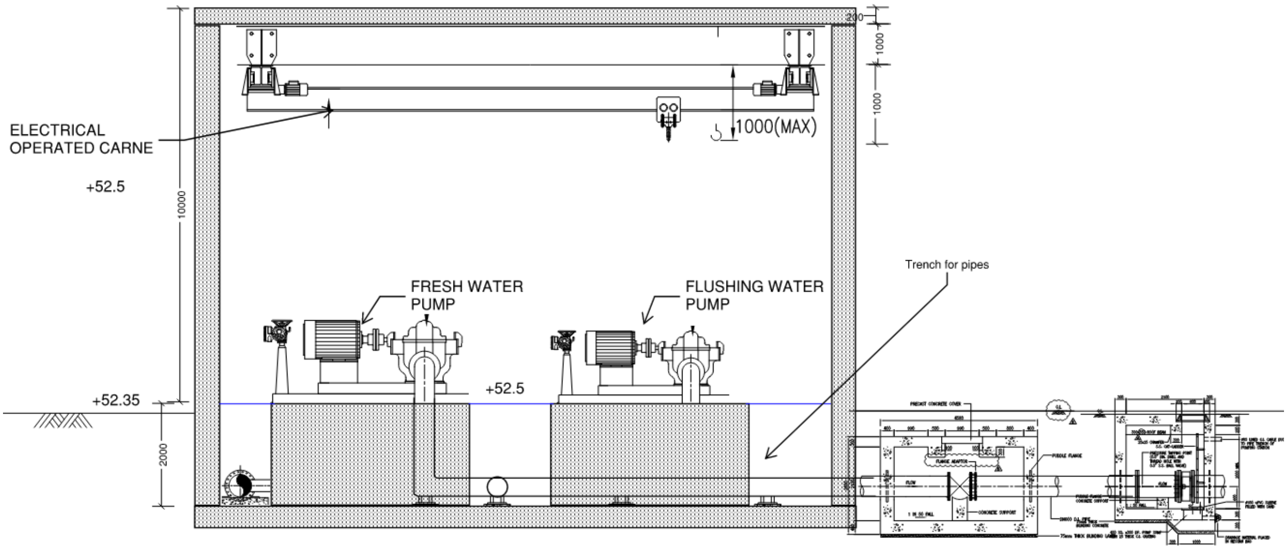
1.1 System Arrangement

A new pumping system will be installed to supply the fresh and flushing water to the nearby new development. It consists of a pumping station, namely Tan Kwai Tsuen Pumping Station (TKTPS) and associated fresh water and flushing water rising mains. For the fresh water pumping system, the pumping station would be equipped with two (2) fresh water booster pumps, with one (1) duty and one (1) standby. For flushing water pumping system, two (2) flush water booster pumps arranged in one (1) duty and one (1) standby would be installed. The original size of fresh water rising main DN450mm whilst that of flushing water rising main is DN200mm. In addition, each pumping system has its own surge vessel as the method of surge suppression device. The minimum sizes of the surge vessels would be found out in the analysis.

The configuration of the pumping station was shown in **Figure 1.1**:-



(a) Plan view at ground floor



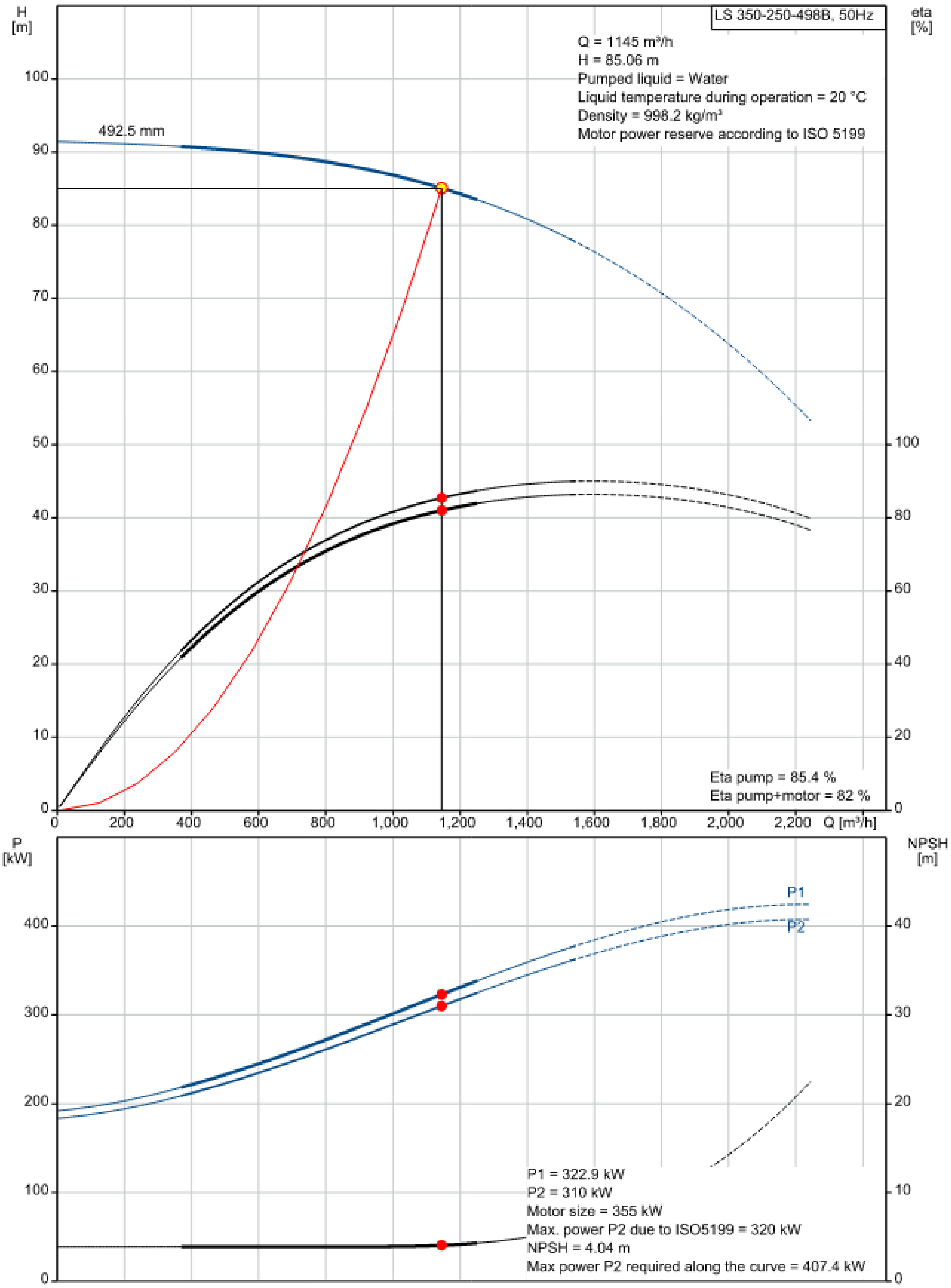
(b) Sectional view

Figure 1.1 Configuration of TKTPS

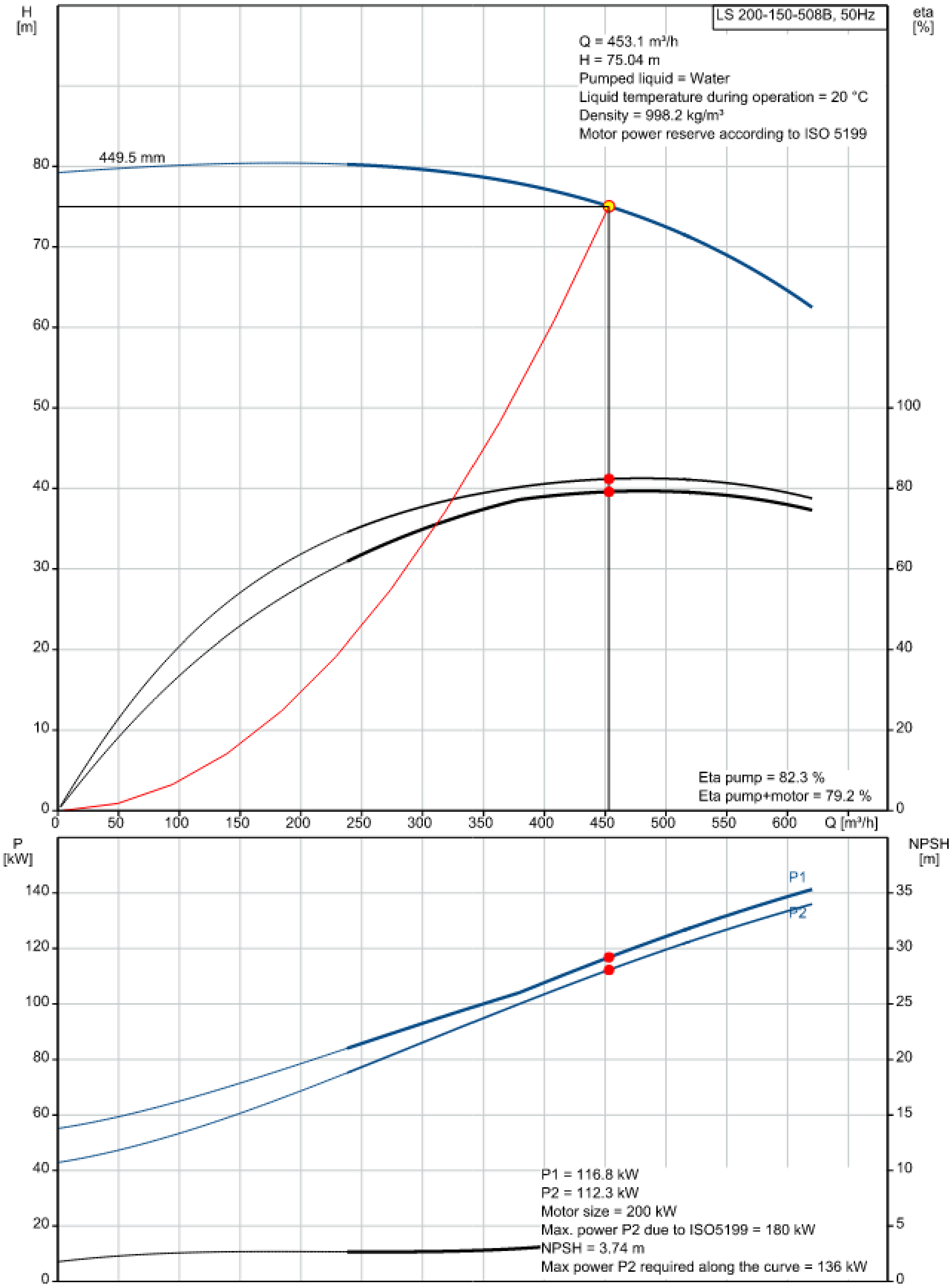
This analysis would investigate the surge effect on the original system and the modified system, if any.

1.2 Pump information

The following **Figure 1.2** shows the pump curve of the selected fresh water pumps and flushing water pumps respectively.



(a) Fresh water pumps



(b) Flushing Water Pumps

Figure 1.2 Pump curve of selected pumps

Fresh Water Pump Model: GRUNDFOS LS 350-250-498B
Salt Water Pump Model: 99596044 TP 150-700/4-F-A-BAQE-WX4
The moment of inertia of the fresh water pump is 18kgm^2.
The moment of inertia of the flushing water pump is 4kgm^2.

1.3 Pipe information

DI pipe would be used as the pipework.

2. INVESTIGATION SCENARIOS AND MODELLING OF SYSTEM

2.1 Formulation of Investigation Scenarios

The surge analysis involved the simulation of the fresh water pumping system operation with ten (10) nos. of operating scenarios. For flushing water pumping system, eleven (11) operating scenarios were investigated. These simulated scenarios were considered to be sufficient to visualize the system capability to withstand the surge impact due to different operating conditions.

2.1.1 Fresh Water Pumping System

Based scenarios for testing the pumping system configuration and formulation of the additional surge suppression measure(s)

Scenario 1 –Original rising main with size DN450mm; 1 pump start in 5s at intake Pressure +60mPD.
Scenario 2 –Suction pipe enlarge to DN600 and remaining pipeline with original size DN450mm (Semi-modified pipework); 1 pump start in 5s at intake Pressure +60mPD.
Scenario 3 – The entire pipework enlarged to DN600 (final modified pipework); 1 pump start in 5s at intake pressure +60mPD.

Further testing scenarios

Scenario 4 – The entire pipework enlarged to DN600 (final modified pipework); one (1) pump start in 5s at intake pressure +65mPD.
Scenario 5 – The entire pipework enlarged to DN600 (final modified pipework); initial one (1) operating pump and the operating pump trip at intake pressure +60mPD.
Scenario 6 – The entire pipework enlarged to DN600 (final modified pipework); initial one (1) operating pump and the operating pump trip at intake pressure +65mPD.
Scenario 7 – The entire pipework enlarged to DN600 (final modified pipework); one (1) pump start to 100% speed in 10s; run for 10s and then stop in 10s at intake pressure +60mPD.

Scenario 8 – The entire pipework enlarged to DN600 (final modified pipework); one (1) pump start to 100% speed in 10s; run for 10s and then stop in 10s at intake pressure +60mPD.
Scenario 9 – The entire pipework enlarged to DN600 (final modified pipework); initial one (1) pump in operation; the operating pump stop in 10s and in stop stage for 10s and then start again to 100% speed in 10s at intake pressure +60mPD.
Scenario 10 – The entire pipework enlarged to DN600 (final modified pipework); initial one (1) pump in operation; the operating pump stop in 10s and in stop stage for 10s and then start again to 100% speed in 10s at intake pressure +65mPD.

2.1.2 Flushing Water Pumping System

Based scenarios for testing the pumping system configuration and formulation of the additional surge suppression measure(s)

Scenario 1 – Original rising main with size DN200mm; one (1) pump start in 10s at intake Pressure +60mPD.
Scenario 2 –Modified pipeline with original size DN200mm; one (1) pump start in 10s at intake pressure +60mPD.

Further testing scenarios

Scenario 3 –Modified pipeline with original size DN200mm; one (1) pump start in 10s at intake pressure +65mPD.
Scenario 4 –Modified pipeline with original size DN200mm; one (1) pump trip at intake pressure +60mPD.
Scenario 5 –Modified pipeline with original size DN200mm; one (1) pump trip at intake pressure +65mPD.
Scenario 6 –Modified pipeline with original size DN200mm; one (1) pump start to 100% speed in 10s, run for 10s and then stop in 10s at intake pressure +60mPD.
Scenario 7 –Modified pipeline with original size DN200mm; one (1) pump start to 100% speed in 10s, run for 10s and then stop in 10s at intake pressure +65mPD.
Scenario 8 –Modified pipeline with original size DN200mm; one (1) operating pump stop in 10s, rest for 10s and then start again to 100% speed in 10s at intake pressure +60mPD.
Scenario 9 –Modified pipeline with original size DN200mm; one (1) operating pump stop in 10s, rest for 10s and then start again to 100% speed in 10s at intake pressure +65mPD.

2.3 Pipeline Profiles

Details of pipe profile for the rising mains were indicated in **Appendix 1**. Whilst the modelling of the pipe profile was shown in Section 4 below.

3. ASSUMPTIONS OF ANALYSIS

a. For both pumping systems, since the pipe sizes of the upstream the connection points is large in comparison with the downstream connection pipe, the downstream piping network is assumed to be a reservoir in constant water levels. In the model, the water level of the reservoir is either +60mPD and +65mPD.
b. Pump operation are the only sources for causing transient flow in the system.
c. Check valve closed to prevent backflow.

4. MODEL SETUP

4.1 Overall model setup for various scenarios

Both pumping systems have the same number of duty and standby pumps, the system configurations of the pumping systems are similar. The details of the original configuration and modified configurations as follows:-

4.1.1 Fresh water pumping system

The configuration of the fresh water pumping system configuration is shown in **Figure 4.1** below. The configuration is the same whether it is the originally proposed system or the modified system. They are different in the pipe size. The originally proposed system has the pipe size of DN450mm whilst the modified system has the pipe size of DN600mm.

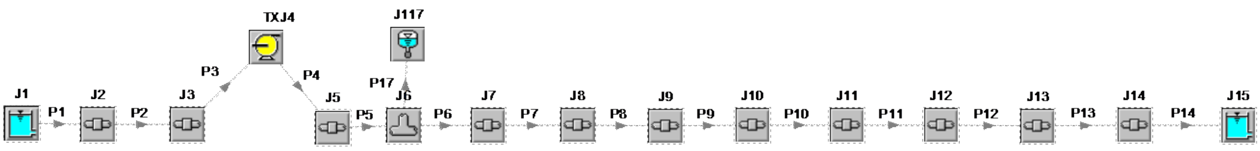


Figure 4.1 Modelling configuration of fresh water pumping system

whereas

P - pipework

J1 – network upstream of the of the connection point is modelled as water reservoir

J15 – water reservoir as the water level just cover the soffit level of the discharge point.

J4 - pumps with inlet level +51.0mPD and J15 (Discharge Chamber) are modelled as reservoir the water level just cover the soffit level of the discharge point; prefix TX (pump start) or T (pump trip) are transient sources.

J117 – Surge Vessel with initial assumed the volume of the vessel to be $1m^3$ and initially charged with gas of volume $0.5m^3$.

J6 - tee

All other junctions - General junction components

The pipeline information was indicated in the below table:-

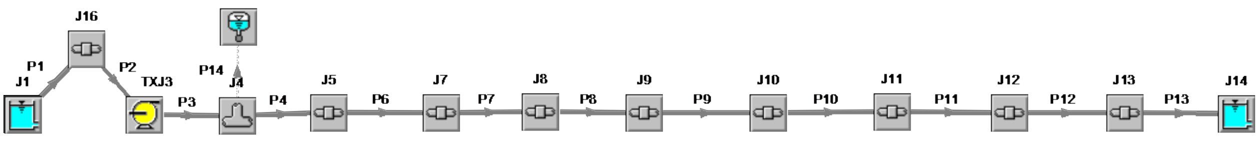
Pipe Section	Start Node Level	End Node Level	Pipe Length, m	Pipe diameter, m	Pipe material	Remark
Station Pipework						
P1	50	51	6.4	Original: 0.45 Modified: 0.6	DI	
P2	50	51	15			
P3	51	51	7.34			
P4	51	51	6.4			
P5	51	51	17.23			
P17	51	52	12.1			Surge vessel at the end node
P6	51	51	17			
P7	51	54.5	23.6			
Rising Main						
P8	54.5	55	19.1	Original: 0.45 Modified: 0.6	DI	
P9	54.5	58.1	46.3			
P10	58.1	65	44.6			
P11	65	68.7	28.7			
P12	68.7	84.9	79.7			
P13	84.9	113.5	424.4			
P14	113.5	123.5	10			
End						

Remark: Minor fittings losses to be distributed along the rising main in accordance with the configuration of the station pipework and mains.

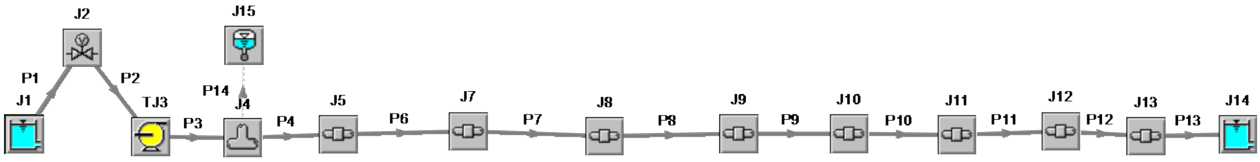
Based on the results, the original system configuration is insufficient and various sections experienced nearly vacuum condition. Various surge suppression measures were considered including the addition of air valve (SAV or DAV) and increase of the pipe size. After the assessment, the addition of air valves was ineffective to solve the issue and finally the pipe size of the final modified system required to be increased from DN450mm to DN600mm.

4.1.2 Flushing water pumping system

The configuration of the flushing water pumping system configuration is shown in **Figure 4.2** below. The different in the originally



(a) Originally proposed configuration



(b) Modified Configuration

Figure 4.2 Modelling configuration of flushing water pumping system

whereas

P - pipework

J1 – network upstream of the of the connection point is modelled as water reservoir

J2 – Single air valve with inflow orifice area of $100mm^2$ (in modified configuration).

J14 – water reservoir as the water level just cover the soffit level of the discharge point.

J3 - pumps with inlet level +51.0mPD and J15 (Discharge Chamber) are modelled as reservoir the water level just cover the soffit level of the discharge point; prefix TX (pump start) or T (pump trip) are transient sources.

J15 – Surge vessel with initial assumed the volume of the vessel to be $1m^3$ and initially charged with gas of volume $0.5m^3$.

J4 - tee

All other junctions - General junction components

The pipeline information was indicated in the below table:-

Pipe Section	Start Node Level, mPD	End Node Level, mPD	Pipe Length, m	Pipe Diameter, m	Pipe Material	Remark
Station Pipework						
P1	50	51	55.8	0.2	DI	Air valve with orifice area $100mm^2$ at the end node
P2	51	51	15			
P3	51	51	11.5			
P4	51	51	17			
P14	51	52	10			Surge vessel at the end node
P6	51	54.5	23.6			
Rising Main						
P7	54.5	55	19.1	0.2	DI	
P8	54.5	58.1	46.3			
P9	58.1	65	44.6			
P10	65	68.7	28.7			
P11	68.7	84.9	79.7			
P12	84.9	108.5	351			
P13	108.5	114	5.5			

End						

4.2 Estimation of wave speed

Ductile Iron Pipe

The wave speed with which pressure waves were propagated through a large unconfined body of water at 20°C and at atmospheric pressure was of the order of 1480m/s. Within a pipe, the wave speed was reduced as it is influenced by the elasticity of the pipe walls. The elasticity of the pipe walls depends upon the material(s) from which they were made, a size ratio (e.g. diameter/wall thickness for cylindrical pipes) and the cross-sectional shape. The nature of pipeline supports also affected the wave speed, but when the wall material had a high elastic modulus, such effects were usually small.

The wave speeds could be calculated from

$$c = \sqrt{\frac{1}{\rho(\frac{1}{K} + \frac{D}{eE}\varphi)}}$$

where φ = (1-μ^2) for pipe completely restrained against axial motion and μ to be poisson ratio of 0.28.

ρ= fluid mass density (1,000kg/m^3)

K= Bulk modulus of liquid (2.2x10^9Pa)

D=diameter of pipe (From DN200 to DN600)

e=pipe wall thickness

E=Young's modulus of elasticity of pipe (172GPa)

From the above equation, the estimated wave speed is in the range of 1100m/s to 1300m/s.
Adopt 1,300m/s as the wave speed for DI pipe which is a typical value.

4.4 Check valves

Check valves were incorporated in the discharge pipework and the model took this component into account for incorporating no back flow to the pipework during surge condition.

4.5 Summary of Parameters

a) Surge vessel – The initial surge volume is set to be 1m^3 with 0.5m^3 initial gas volume
b) Air valve – Single air valve is adopted with orifice area of 100mm^2
c) DI pipe for the pumping system

d) Check valve was installed in each discharge pipe as fast responding and assumed to close instantaneously after pump trip to prevent back flow

e) Wave speed of DI pipe was 1,300m/s

5. SURGE ANALYSIS

The surge analysis would be conducted using commercially available package namely AFT Impulse. The surge models to be built were based on the parameters indicated in Section 4.

The results were presented in the following graphs:-

- Pump speed against time after pump trip;
- Pump discharge static pressure variations after pump trip, stop or start;
- Operation of air valves (inflow and outflow air mass through the valve orifices) after pump trip; and
- Hydraulic gradient line (maximum and minimum static gauge pressure) along the pipeline and rising main.

The analysis results were presented in Section 6 below.

6. DISCUSSION OF SURGE ANALYSIS RESULTS

6.1 Results of Surge analysis

For surge analysis, the following scenarios were executed and detailed results were also presented in **Appendices 2** and **3** and summarized in the following table.

Fresh water supply system

Scenario	Pressure (m gauge) along pipe profile (m)		Rising Main Configuration	Transient Sources
	Max.	Min.		
1	119.43	-9.34	Originally Proposed, 1 duty	Start of one (1) pumps at inlet water level +60.00mPD
2	120.61	-10.00	Suction pipe enlarged to DN600 and discharge pipe and rising main size remain at DN450	Start of one (1) pumps at inlet water level +60.00mPD
3	118.54	-4.49	Size of entire pipework enlarged to DN600	Start of one (1) pumps at inlet water level +60.00mPD
4	124.69	-6.75		Start of one (1) pumps at inlet water level +65.00mPD
5	159.41	-1.70		Trip of one (1) operating pump at inlet water level +60.00mPD
6	150.67	-1.10		Trip of one (1) operating pump at inlet water level +65.00mPD
7	132.40	-4.07		Start one (1) pump to 100% speed in 10s; stay in operation for 10s; and stop the operating pump in 10s at inlet water level +60.00mPD
8	129.72	-4.94		Start one (1) pump to 100% speed in 10s; stay in operation for 10s; and stop the operating pump in 10s at inlet water level +65.00mPD
9	131.31	-5.88		Stop one (1) operating pump in 10s; stay in rest for 10s; and start again the pump to 100% speed in 10s at inlet water level +60.00mPD
10	128.70	-5.43		Stop one (1) operating pump in 10s; stay in rest for 10s; and start again the pump to 100% speed in 10s at inlet water level +65.00mPD

From the above, it was noted that the max. and min. transient pressure to the final modified fresh water supply system were 159.41m and -6.75m respectively which needs to be considered in the design and construction of the system.

Flushing water supply system

Scenario	Pressure (m gauge) along pipe profile (m)		Rising Main Configuration	Transient Sources
	Max.	**Min.**		
1	120.94	-10.00	Originally Proposed, 1 duty	Start of one (1) pumps at inlet water level +60.00mPD
2	99.93	-7.20	Modified pipeline with single air valve (SAV) in the suction pipe	Start of one (1) pumps at inlet water level +60.00mPD
3	102.50	-8.75		Start of one (1) pumps at inlet water level +65.00mPD
4	181.93	-0.70		One (1) operating pump trip at inlet water level +60mPD
5	144.85	0.098		One (1) operating pump trip at inlet water level +65mPD
6	156.02	-8.56		One (1) pump start to 100% speed in 10s, run for 10s and stop in 10s at intake water level of +60mPD
7	156.29	-9.09		One (1) pump start to 100% speed in 10s, run for 10s and stop in 10s at intake water level of +65mPD
8	149.49	-7.08		One (1) operating pump stop in 10s, stay in stop condition for 10s and then start again to 100% speed in 10s at intake water level of +60mPD
9	142.58	-7.24		One (1) operating pump stop in 10s, stay in stop condition for 10s and then start again to 100% speed in 10s at intake water level of +65mPD

From the above, it was noted that the max. and min. transient pressure to the final modified fresh water supply system were 181.93m and -8.75m respectively. However, from the hydraulic gradient line graphs, the min. transient pressure only occurred at the suction pipe which need the system to be catered for. Whilst for the discharge pipe and rising main, the min. transient pressures were almost 0m or slightly negative pressure which should not cause any problem. Thus the selection of discharge pipe and rising main needed to cater for the max. transient pressure only.

6.2 Discussion of Fresh Water Supply System

6.2.1 Formulation of Surge Mitigation Measure(s)

To this, **Scenarios 1** to **3** were used to formulate the required surge mitigation measures. The following were the points shown by the results:-

- ***Scenario 1*** – Based on the configuration of the originally designed pumping system, w/o additional surge mitigation measure which showed inadequate protection in transient condition as the minimum pressure in the pump suction pipe and downstream sections of rising mains became nearly vacuum condition, i.e. -9.34m as shown in **Figure A2.4** in **Appendix 2**. This condition was unacceptable as it may cause rupture of the rising main during operation.

- ***Scenario 2*** – This scenario tried to enlarge the intake pipe, from connection point to the pump suction, to DN600. The results showed that no significant improvement was anticipated as shown in **Figure A2.8** in **Appendix 2**. This modified configuration is considered to be semi-modified configuration and further polishing of the configuration should be required.

  Remark: Various surge mitigation methods were considered including increase of pump moment of inertia (MOI), addition of air valve. For increasing MOI, due to the long pipeline, the increase of MOI should be significant which limit the selection of commercially available pumps. For air valve, addition of the air valve could not mitigate the transient pressure in the pump intake pipe and the rising main is strictly sloped upward make the application of air valve not suitable.

- ***Scenario 3*** – This scenario was based on the enlargement of the entire pipeline, including intake and rising main, to DN600. The results, in **Figure A2.12** in **Appendix 2**, showed that the max. and min. pressures were 118.54m and -4.49m respectively. This transient pressure range showed a significant improvement to the previous scenarios and considered to be acceptable.

  In addition, the volume change of the surge vessel is within 0.1m^3. Thus the proposed 0.5m^3 air volume in the surge vessel (1m^3) should be sufficient.

6.2.2 Analysis based on the Normal Operating Condition and Sensitivity Analysis

With the enhanced surge suppression measures, the modified rising mains were further tested under different conditions. The following **Scenarios 4** to **10** tested the transient responses of the modified rising mains under normal operating conditions.

- **Scenario 4** – This scenario had the same configuration as Scenario 3 except the intake water level increased from +60mPD to +65mPD. With the increased suction pressure, it was expected that the pumping flowrate should increase which increase the transient pressure as shown in **Figure A2.16** in **Appendix 2**. For max. pressure, the increase of max. transient pressure is from 118.54m (**Scenario**

3) to 126.69m (**Scenario 4**) whilst the min. transient pressure further decreased from -4.49m (**Scenario 3**) to -6.75m (**Scenario 4**). Nevertheless, the results in this scenario is still acceptable.

- **Scenarios 5 & 6 –** These scenarios tested the system responses to the pump tripping action at two different water levels. The max. transient pressure is from 150.67m (at inlet water level of +65mPD) to 159.41m (at inlet water level of +60mPD) whilst the min. transient pressure is in the range of -1.10m (at inlet water level of +65mPD) to -1.70m (at inlet water level of +60mPD). It was noted that the increase of water level would decrease the transient pressure magnitude which is favorable to the system. Based on the results of these two scenarios, the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

- **Scenarios 7 & 8** – These scenarios tested the system responses to a series of pump operations (start, remain in operation and then stop). The max. transient pressure is from 129.7m (at inlet water level of +65mPD) to 132.40m (at inlet water level of +60mPD) whilst the min. transient pressure is in the range of -4.07m (at inlet water level of +60mPD) to -4.94m (at inlet water level of +65mPD). These transient pressure need the system to cater for. Similarly the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

- **Scenario 9 & 10** – These scenarios tested the system responses to a series of pump operations (stop of operating pump, remain in rest for a while and then start again). The max. transient pressure is from 128.70m (at inlet water level of +65mPD) to 131.31m (at inlet water level of +60mPD) whilst the min. transient pressure is in the range of -5.43m (at inlet water level of +65mPD) to -5.88m (at inlet water level of +60mPD). These transient pressure need the system to cater for. Similarly, the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

6.3 Discussion of Flushing Water Supply System

6.3.1 Formulation of Surge Mitigation Measure(s)

To this**, Scenarios 1** and **2** were used to formulate the required surge mitigation measures. The following were the points shown by the results:-

- ***Scenario 1*** – Based on the configuration of the originally designed pumping system, w/o additional surge mitigation measure which showed inadequate protection in transient condition as the minimum pressure in the pump suction pipe and downstream sections of rising mains became nearly vacuum condition, i.e. -10.0m as shown in **Figure A3.4** in **Appendix 3**. This condition was unacceptable as it may cause rupture of the rising main during operation.

- ***Scenario 2*** – This scenario incorporated a single air valve (SAV) near the pump suction as the additional surge suppression measure. The results showed a significant improvement as shown in **Figure A3.9** in **Appendix 2**. This modified configuration is considered to be the modified configuration. It is noted that the short section near the pump suction was also subject to the significant negative transient pressure which needed to be taken care. For the remaining pipeline sections, the min. transient pressure should not cause damage.

6.3.2 Analysis based on the Normal Operating Condition and Sensitivity Analysis

With the enhanced surge suppression measures, the modified rising mains were further tested under different conditions. The following **Scenarios 3** to **9** tested the transient responses of the modified system under normal operating condition.

- **Scenarios 3** – Same configuration and condition as **Scenario 2** except the inlet water level to be +65mPD. The max. and min. transient pressure were 102.50m and -8.75m respectively. However, the minimum transient pressure occurred at location close to the pump suction whilst discharge pipe and rising main would be better. In addition, based on the results, the originally proposed surge vessel volume should be sufficient to cater for the gas volume change during transient condition.

- **Scenarios 4 & 5** – These scenarios tested the system responses to the pump tripping action at two different water levels. The max. transient pressure is from 181.93m (at inlet water level of +65mPD) to 144.85m (at inlet water level of +60mPD) whilst the min. transient pressure is in the range of 0.098m (at inlet water level of +65mPD) to -0.70m (at inlet water level of +60mPD). It was noted that the increase of water level would decrease the transient pressure magnitude which is favorable to the system. Based on the results of these two scenarios, the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

- **Scenarios 6 & 7** – These scenarios tested the system responses to a series of pump operations (start, remain in operation and then stop). The max. transient pressure is from 156.02m (at inlet water level of +60mPD) to 156.29m (at inlet water level of +65mPD) whilst the min. transient pressure is in the range of -8.56m (at inlet water level of +60mPD) to -9.09m (at inlet water level of +65mPD). These transient pressure need the system to cater for. However, for the min. transient pressure, it occurred at the very short pipe section closed to the pump suction. Thus it is not necessary for the rising main to cater for this min. pressure. Similarly the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

- **Scenarios 8 & 9** – These scenarios tested the system responses to a series of pump operations (stop of operating pump, remain in rest for a while and then start again). The max. transient pressure is from 142.58m (at inlet water level of +65mPD) to 149.49m (at inlet water level of +60mPD) whilst the min. transient pressure is in the range of -7.08m (at inlet water level of +60mPD) to -7.24m (at inlet water level of +65mPD). These transient pressures needed the system to cater for. Similarly, the initially proposed surge vessel volume was sufficient to handle the gas volume change in transient situation.

7. CONCLUSIONS AND RECOMMENDATIONS

In this report, the transient responses of the fresh water supply system and flushing water supply system were investigated against various operating scenarios. The following were the findings and recommendations of this analysis:-

- For fresh water supply system, the pipework, suction, discharge and rising main, would be enlarged from the originally proposed DN450 to DN600. With the modified system, the max. and min. transient pressure to the final modified fresh water supply system were 159.41m and -6.75m respectively which needs to be considered in the future design of the system.

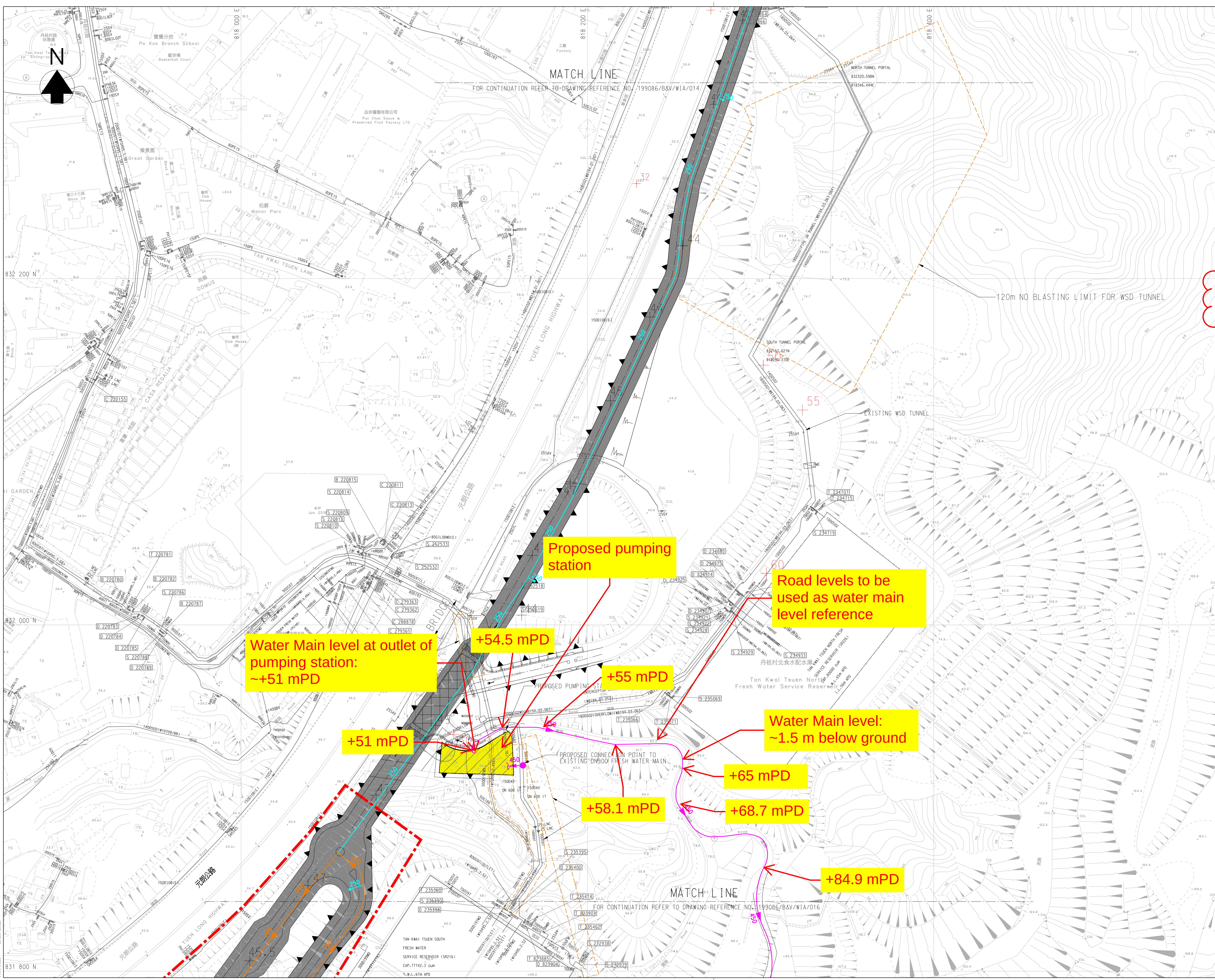
- For flushing water supply system, a single air valve (SAV) with orifice area of $100mm^2$ were recommended at the suction of pumps. With this additional surge suppression measures, the min. transient pressure along the pipeline would be raised to an acceptable value for the typical pipe. Nevertheless, for a short section of pipe close to the pump suction, it may need to cater for a more negative transient pressure of about -9m.

- The surge vessel for both systems are the same which has the vessel volume of $1m^3$ with initial charged gas volume of $0.5m^3$.

- The analysis was considered as preliminary which can provide the skeleton of the required surge suppression provisions to both water supply systems. However, as the design proceed, more details would be generated. Thus it is further recommended to carry out further surge analysis during the construction stage in order to confirm the more details of surge suppression measure(s).

---END--

Appendix 1



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LEGEND:

- PROPOSED SITE FOR PUBLIC HOUSING DEVELOPMENT AND ASSOCIATED GIC FACILITIES
- PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS
- PROPOSED SLOPE
- 66.12 EXISTING LEVEL
- +65 PROPOSED LEVEL
- PROPOSED RETAINING WALL
- EXISTING WSD NO BLASTING LIMIT / WWR
- PROPOSED PUBLIC ROAD
- PROPOSED PUMPING STATION
- EXISTING FRESH WATER MAINS
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - INLET
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - OUTLET
- PROPOSED FIRE HYDRANT
- 300 DIAMETER (mm) PROPOSED FIRE WATER MAINS

Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	EM	LCH	SZ	LCH
Date	02/19	02/19	02/19	02/19

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Title
SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED FRESH WATER SYSTEM

(SHEET 2 OF 4)

Drawing No. 199086/BIN/WIA/015

Scale 1 : 1000 (A1) 1 : 2000 (A3)

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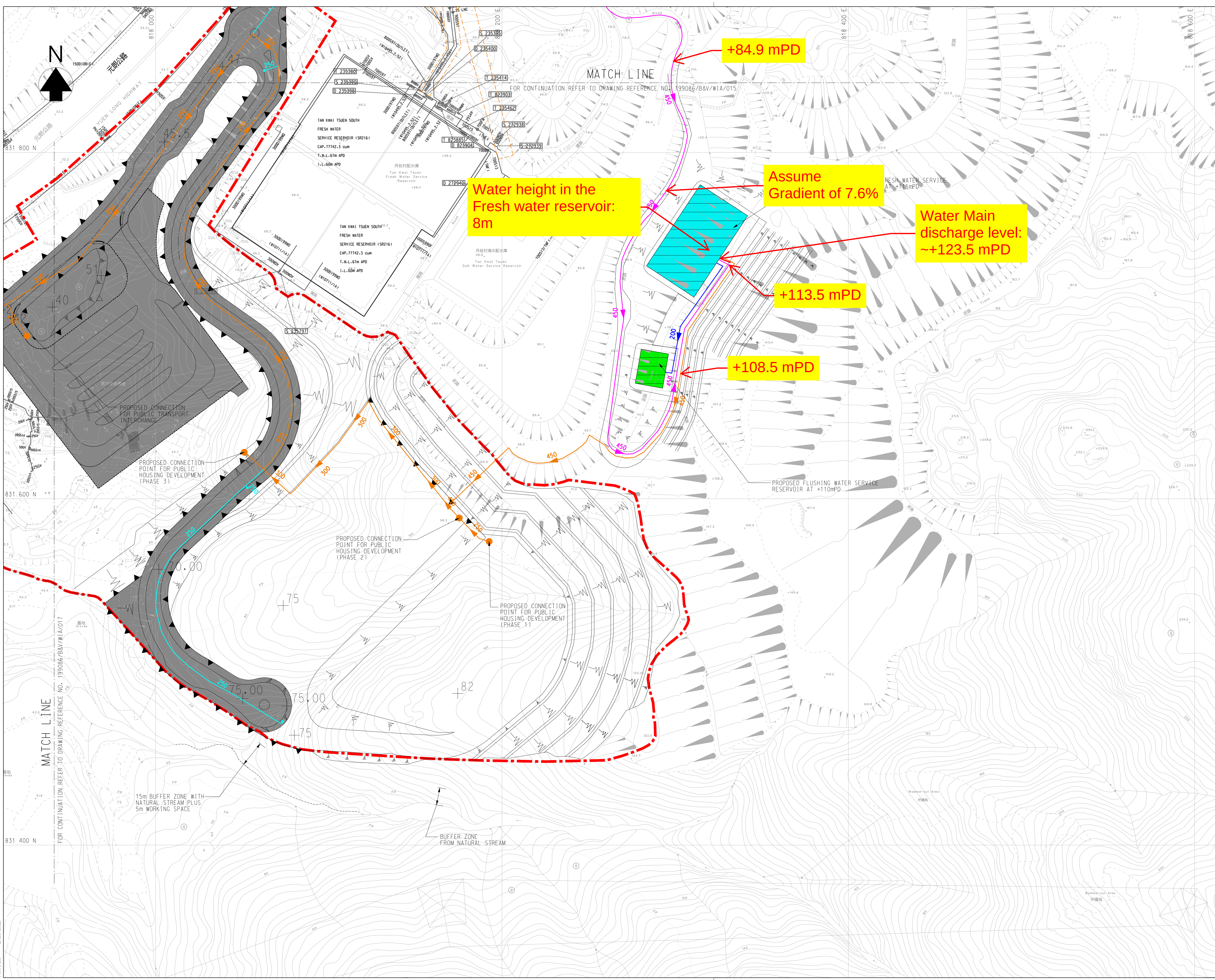

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- PROPOSED PUBLIC ROAD
- POTENTIAL INTERNAL ROAD
- PROPOSED FRESH WATER SERVICE RESERVOIR
- PROPOSED FLUSHING WATER SERVICE RESERVOIR
- EXISTING FRESH WATER MAINS
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - INLET
- 450 DIAMETER (mm) PROPOSED FRESH WATER MAINS - OUTLET
- 200 DIAMETER (mm) PROPOSED FRESH WATER AUGMENTATION MAIN
- PROPOSED FIRE HYDRANT
- 300 DIAMETER (mm) PROPOSED FIRE WATER MAINS

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PROPOSED FRESH WATER SYSTEM

(SHEET 3 OF 4)

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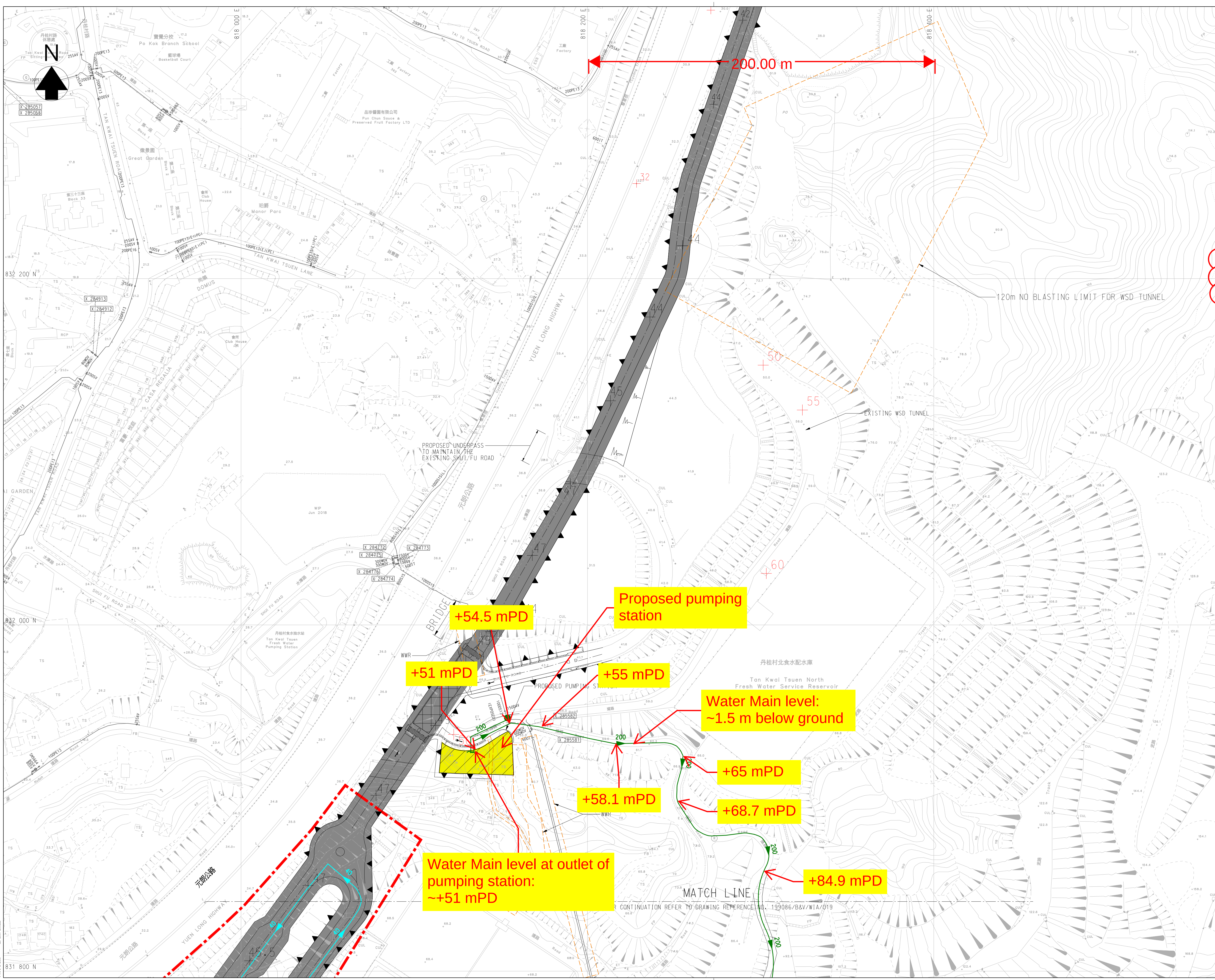

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- PROPOSED PUBLIC ROAD
- PROPOSED PUMPING STATION
- EXISTING SALT WATER MAINS
- 200 DIAMETER (mm) PROPOSED SALT WATER MAINS - INLET
- 200 DIAMETER (mm) PROPOSED FLUSHING WATER MAINS - OUTLET

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Drawing Title

PROPOSED INTERIM FLUSHING WATER SYSTEM

(SHEET 1 OF 3)

Drawing No. 199086/BIN/WIA/018

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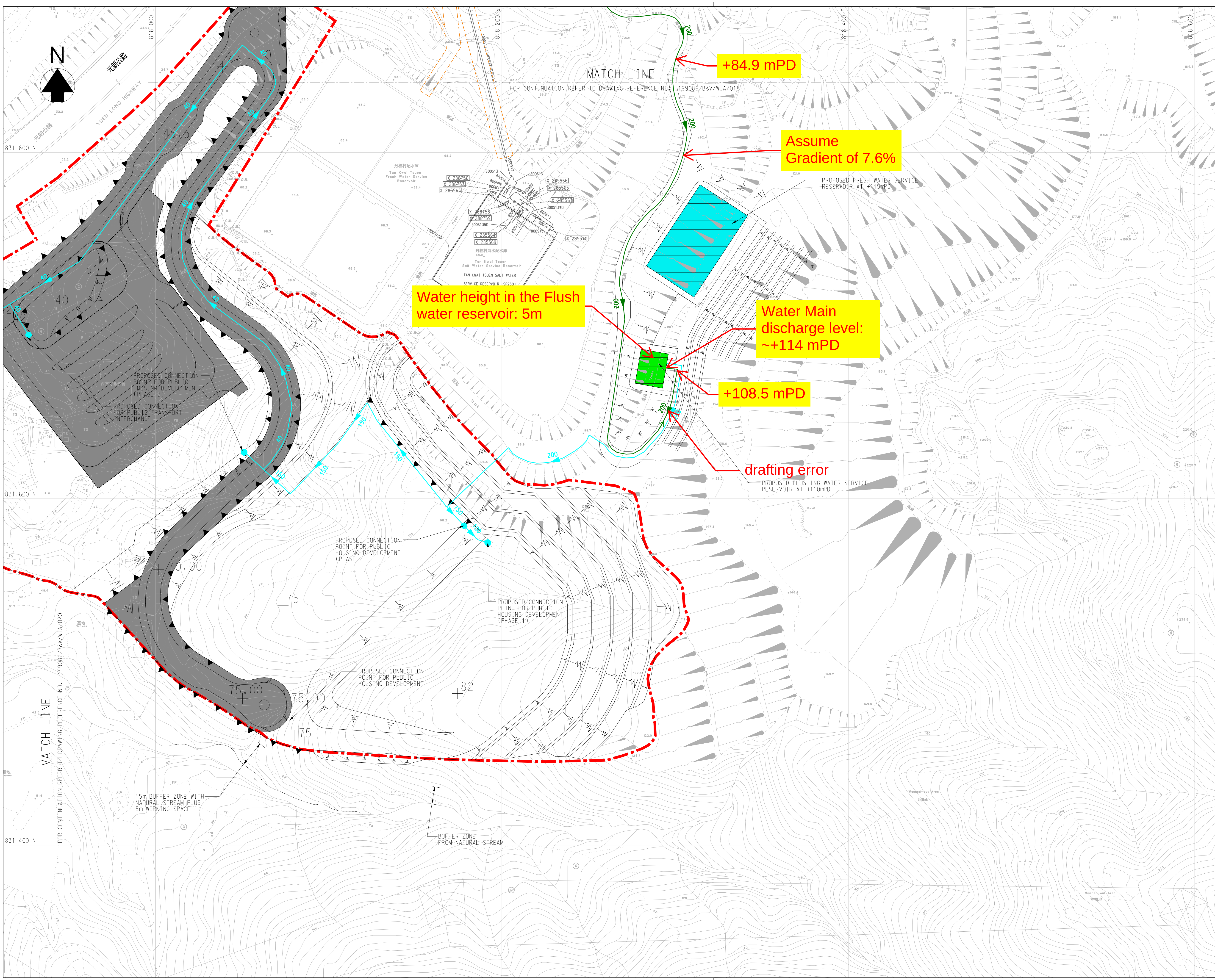

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Revision	Date	Description		Initial
	Designed	Checked	Drawn	Checked
Initial	EM	LCH	SZ	LCH
Date	06/21	06/21	06/21	06/21

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SITE FORMATION AND INFRASTRUCTURE WORKS FOR PUBLIC HOUSING DEVELOPMENT NEAR TAN KWAI TSUEN, YUEN LONG - INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
PROPOSED INTERIM FLUSHING WATER SYSTEM
(SHEET 2 OF 3)

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Appendix 2

A1. Surge Analysis Results for Fresh Water Pumping System

In accordance with Section 1.2 of the report, the surge results for the fresh water pumping system were presented as follows:-

i. **Scenario 1** –Original rising main with size DN450mm; 1 pump start in 5s at intake Pressure +60mPD.

Pump Speed After Pump Start

Figure A2.1 showed the pump speed after starting of the pump.

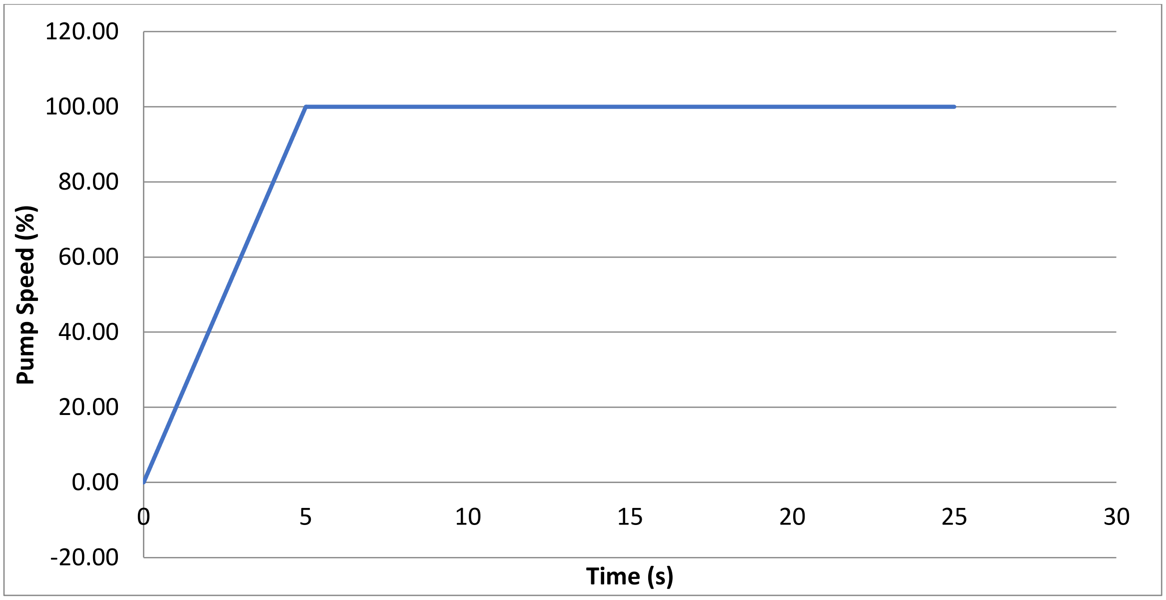


Figure A2.1 Pump speed after starting action (Scenario 1)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[a]	Static Pressure at Pump Discharge (m)[a]
Maximum	20.97	113.64
Minimum	9.05	69.54

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A2.2 showed the pressure response to the pump start at pump suction and discharge locations.

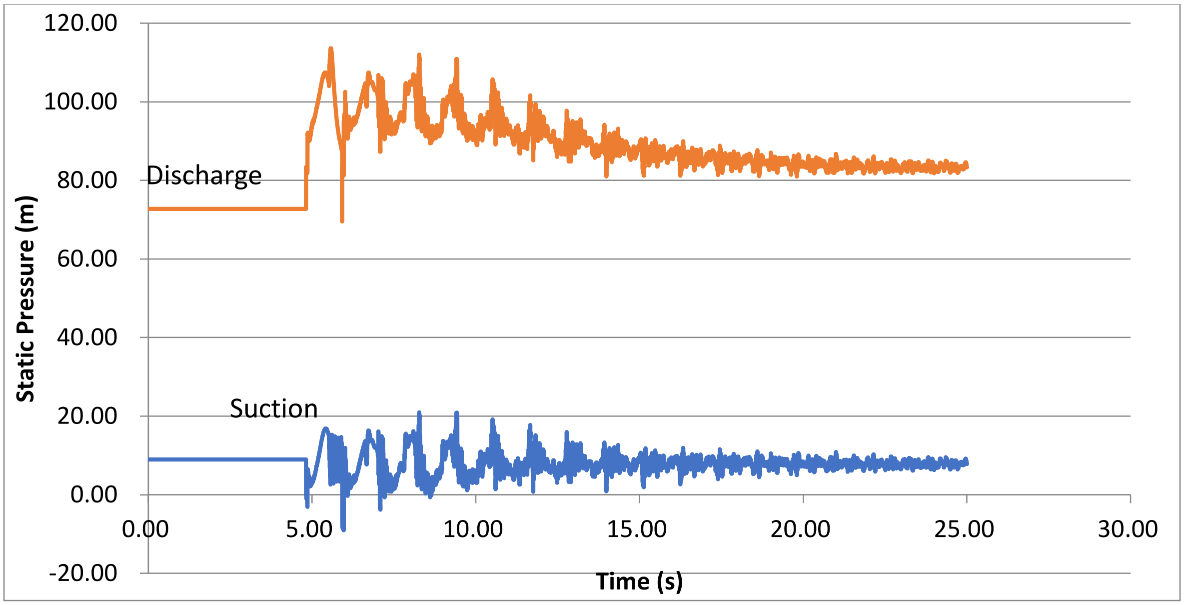


Figure A2.2 Pump suction and discharge pressure responses to pump start (Scenario 1)

Surge Vessel Operation

Figure A2.3 showed the air volume changes of surge vessel after the pump start.

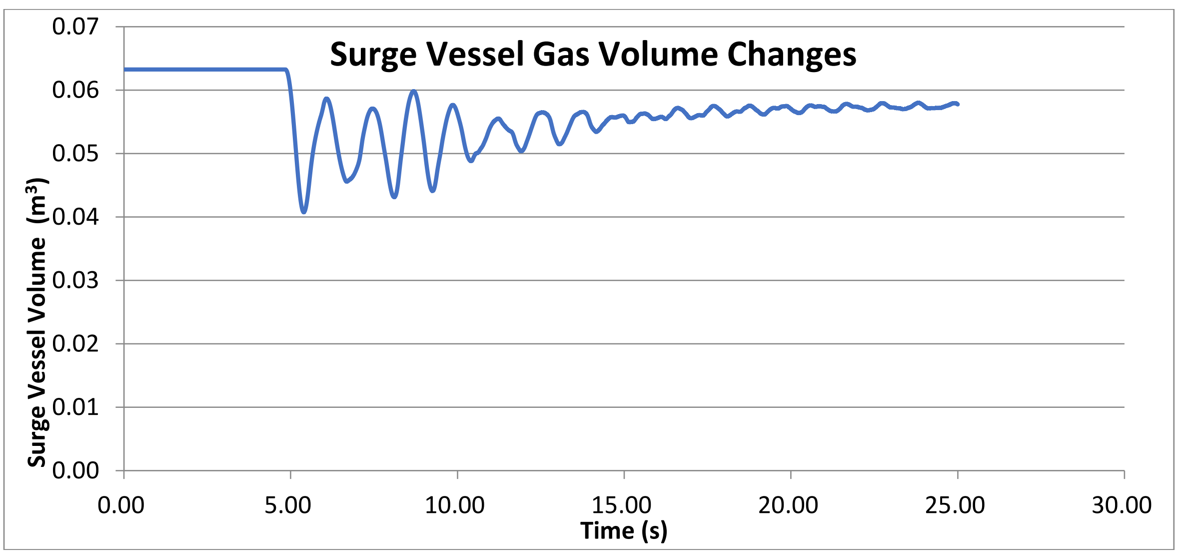
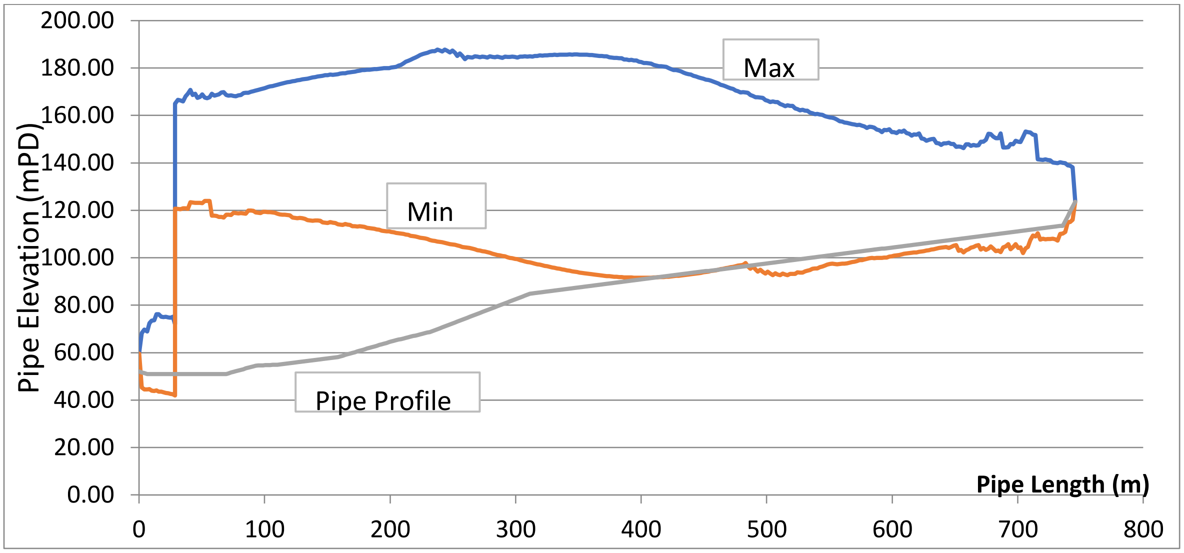


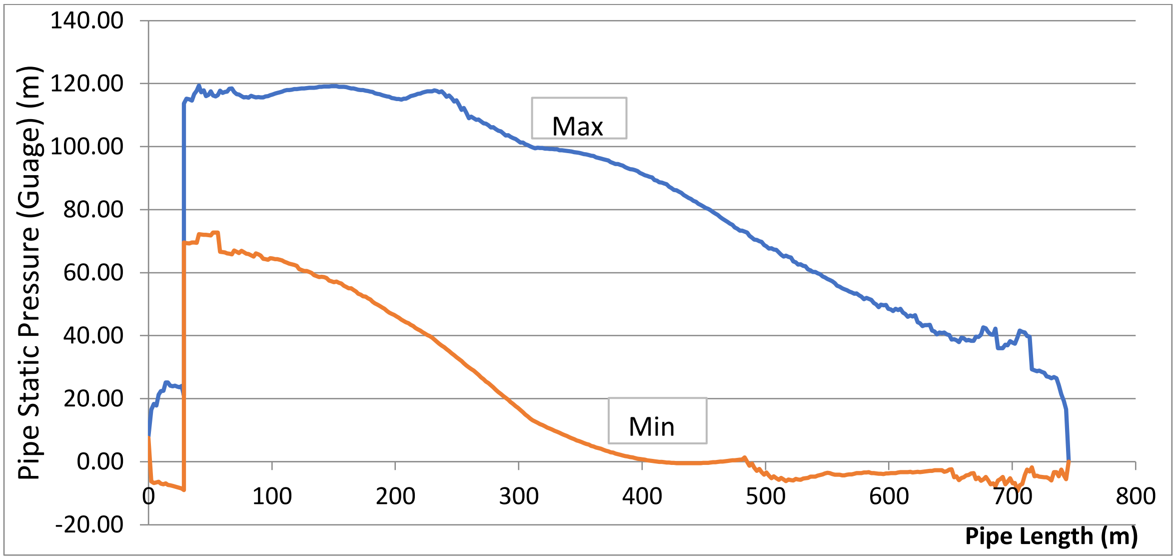
Figure A2.3 Air volume changes of surge vessel (Scenario 1)

Hydraulic Gradient Lines

Figure A2.4 showed hydraulic gradient lines along the pipeline. For the hydraulic gradient line, they could be represented in two ways. One was the elevation as shown in **Figure A2.4(a)** whilst the other was the pipe static pressure as shown in **Figure A2.4(b)**. The pipe static pressure was better to understand the actual pressure inside the pipe and easier to visualize the associated pipe stress. Thus in the following scenarios, the presentation of the pressure along the pipeline should be the static gauge pressure.



(a) Elevation of hydraulic gradient line



(b) Static pressure along the rising main

Figure A2.4 Hydraulic gradient lines along the rising main (Scenario 1)

Maximum and minimum pressures along the rising main were 119.43m and -9.34m respectively.

ii. **Scenario 2** –Suction pipe enlarge to DN600 and remaining pipeline with original size DN450mm (Semi-modified pipework); 1 pump start in 5s at intake Pressure +60mPD.

<u>**Pump Speed After Pump Start**</u>

Figure A2.5 showed the pump speed after starting of the pump.

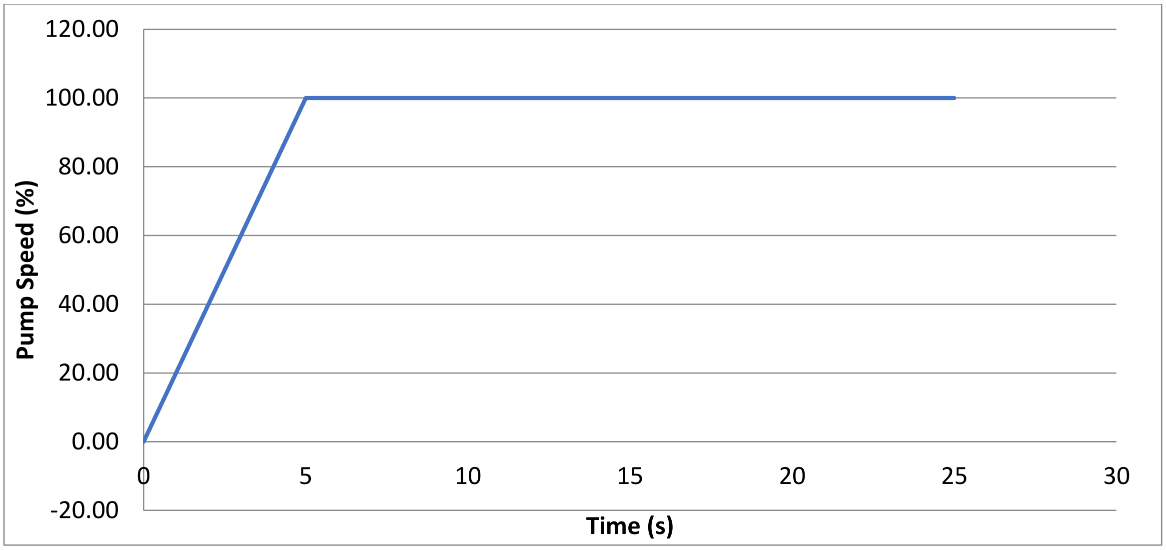


Figure A2.5 Pump speed after starting action (Scenario 2)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[(a)]	Static Pressure at Pump Discharge (m)[(a)]
Maximum	19.42	116.65
Minimum	-8.98	63.30

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.6 showed the pressure response to the pump start at pump suction and discharge locations.

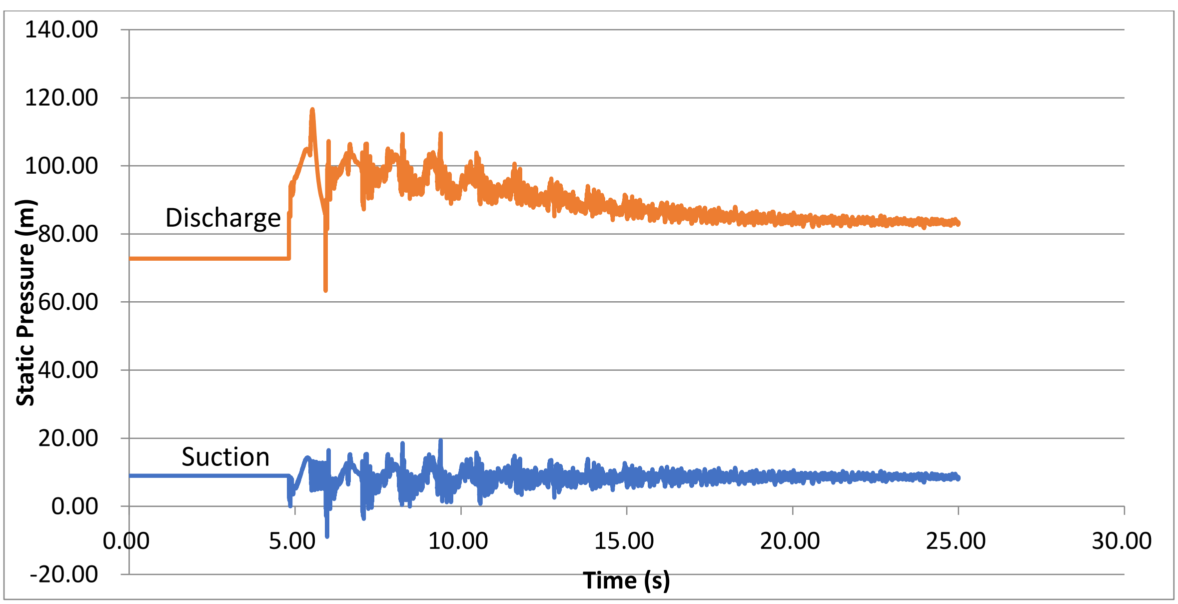


Figure A2.6 Pump suction and discharge pressure responses to pump start (Scenario 2)

Surge Vessel Operation

Figure A2.7 showed the air volume changes of surge vessel after the pump start.

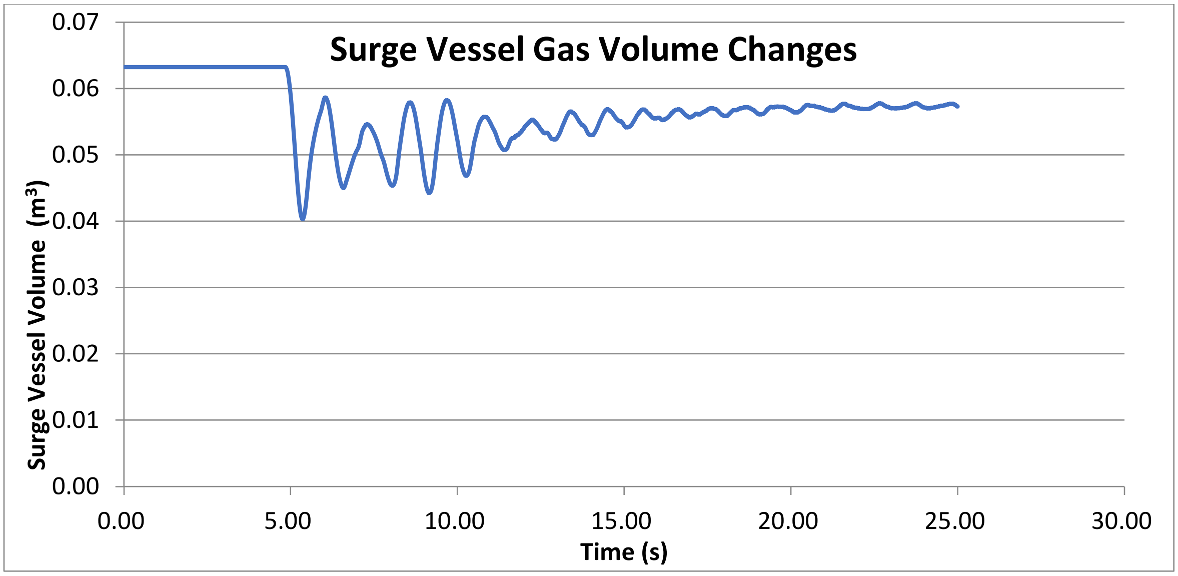


Figure A2.7 Air volume changes of surge vessel (Scenario 2)

Hydraulic Gradient Lines

Figure A2.8 showed the hydraulic gradient lines along the pipeline.

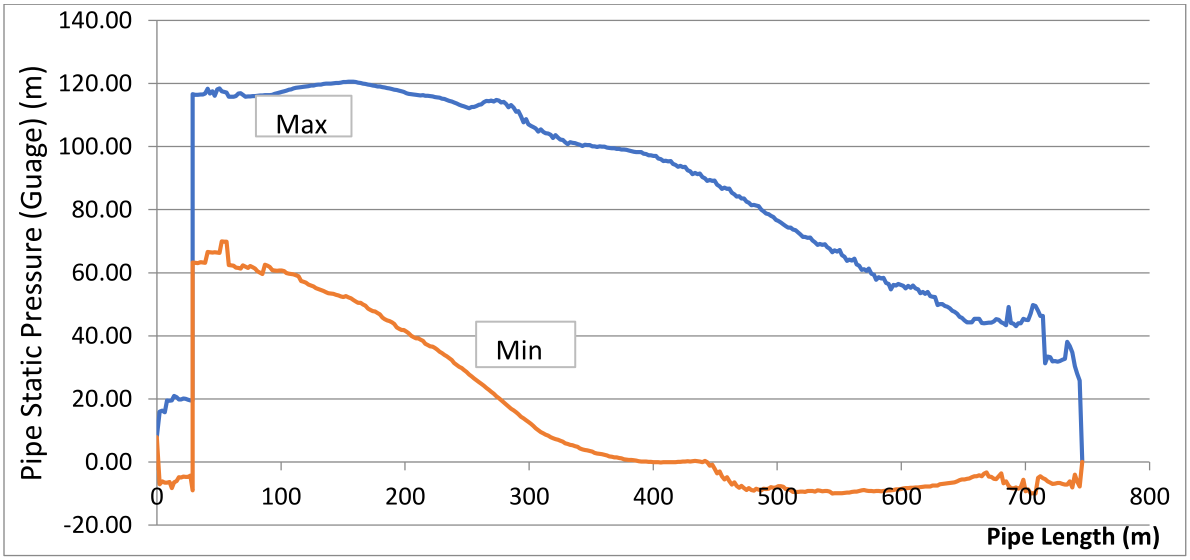


Figure A2.8 Hydraulic gradient lines along the rising main (Scenario 2)

Maximum and minimum pressures along the rising main were 120.61m and -10.00m respectively.

iii. **Scenario 3** – The entire pipework enlarged to DN600 (final modified pipework); 1 pump start in 5s at intake pressure +60mPD.

Pump Speed After Pump Start

Figure A2.9 showed the pump speed after starting of the pump.

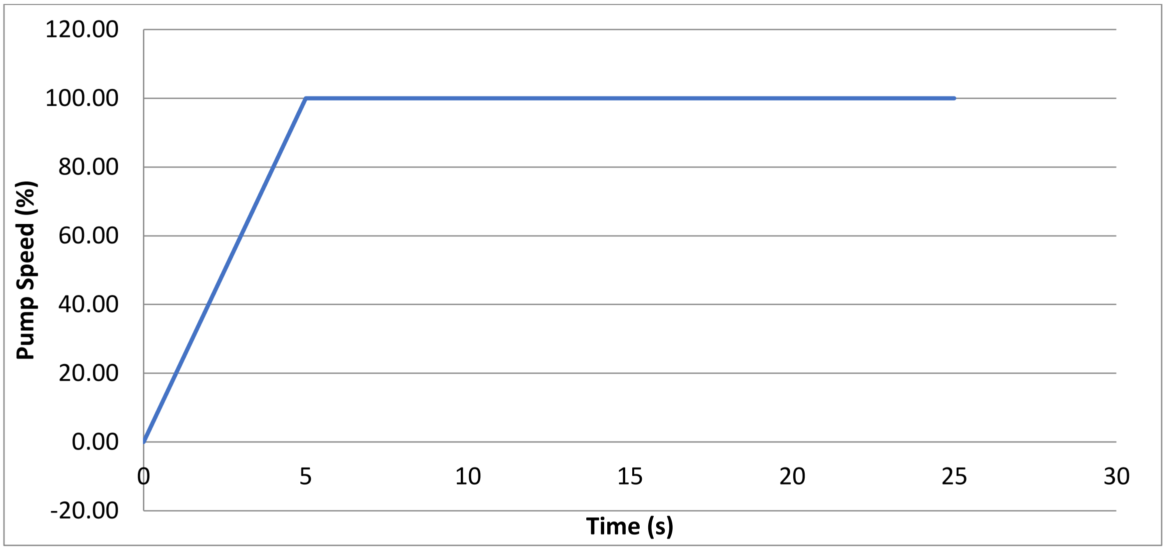


Figure A2.9 Pump speed after starting action (Scenario 3)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	17.81	108.02
Minimum	4.07	72.90

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.10 showed the pressure response to the pump start at pump suction and discharge locations.

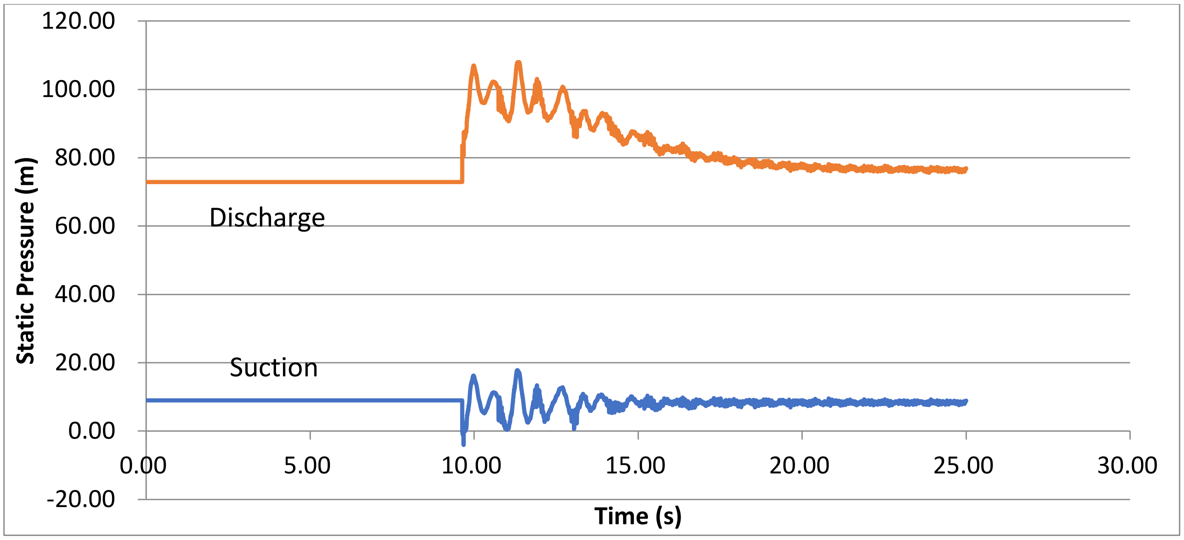


Figure A2.10 Pump suction and discharge pressure responses to pump start (Scenario 3)

Surge Vessel Operation

Figure A2.11 showed the air volume changes of surge vessel after the pump start.

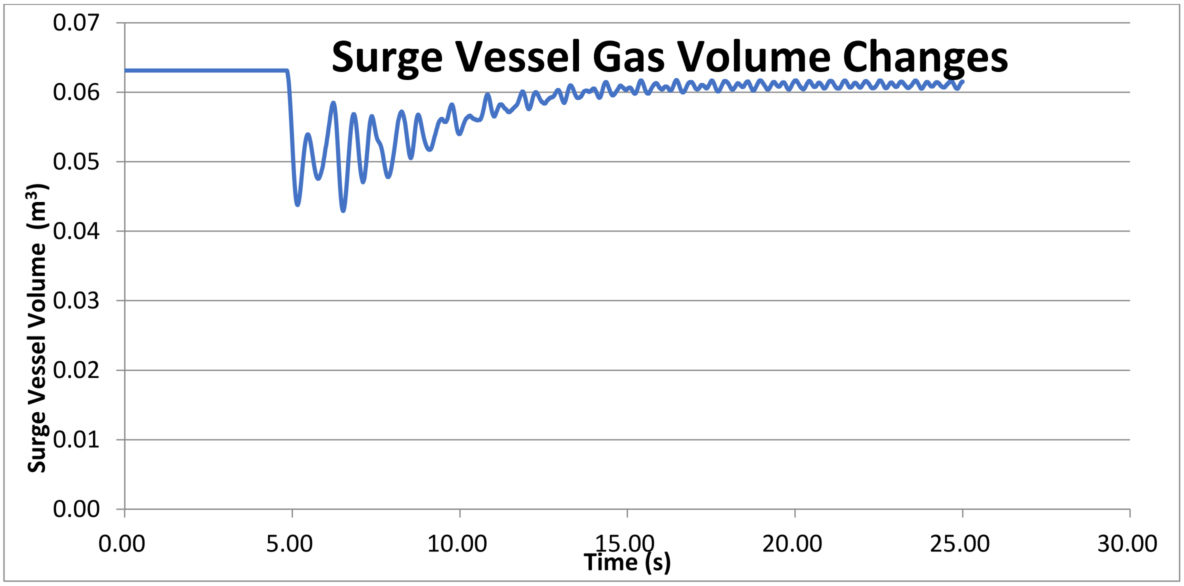


Figure A2.11 Air volume changes of surge vessel (Scenario 3)

Hydraulic Gradient Lines

Figure A2.12 showed the hydraulic gradient lines along the pipeline.

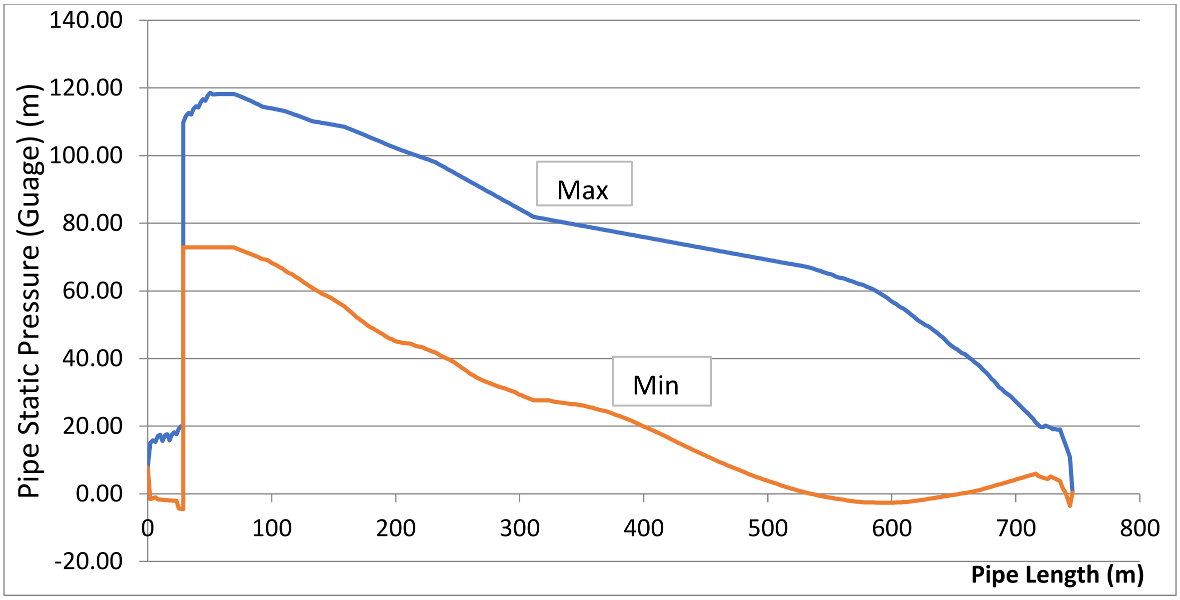


Figure A2.12 Hydraulic gradient lines along the rising main (Scenario 3)

Maximum and minimum pressures along the rising main were 118.54m and -4.49m respectively.

iv. **Scenario 4** – The entire pipework enlarged to DN600 (final modified pipework); 1 pump start in 5s at intake pressure +65mPD.

<u>Pump Speed After Pump Start</u>

Figure A2.13 showed the pump speed after starting of the pump.

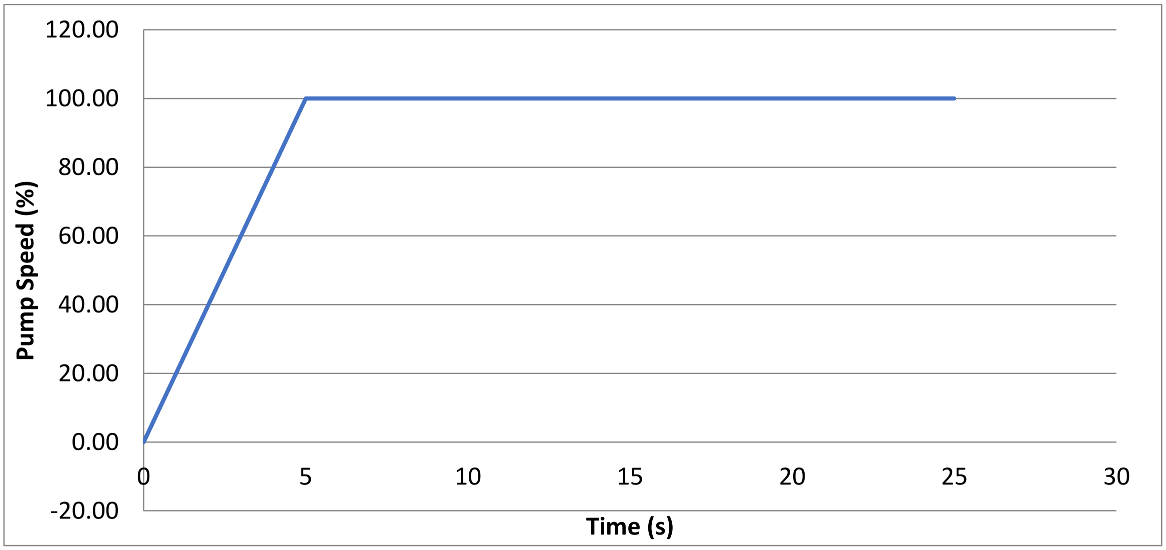


Figure A2.13 Pump speed after starting action (Scenario 4)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[a]	Static Pressure at Pump Discharge (m)[a]
Maximum	26.05	115.74
Minimum	2.74	72.90

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A2.14 showed the pressure response to the pump start at pump suction and discharge locations.

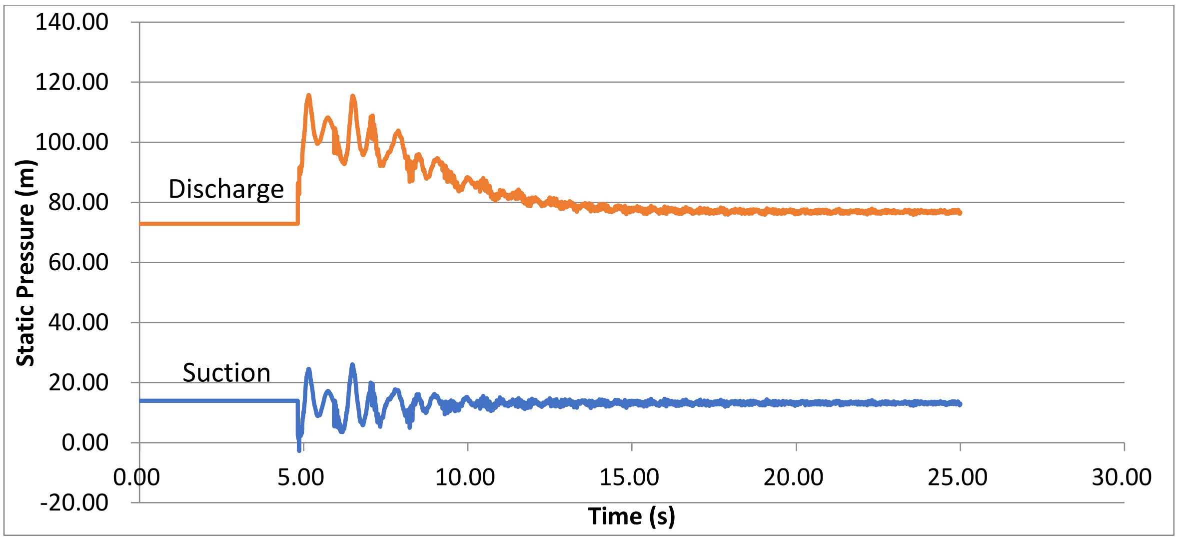


Figure A2.14 Pump suction and discharge pressure responses to pump start (Scenario 4)

Surge Vessel Operation

Figure A2.15 showed the air volume changes of surge vessel after the pump start.

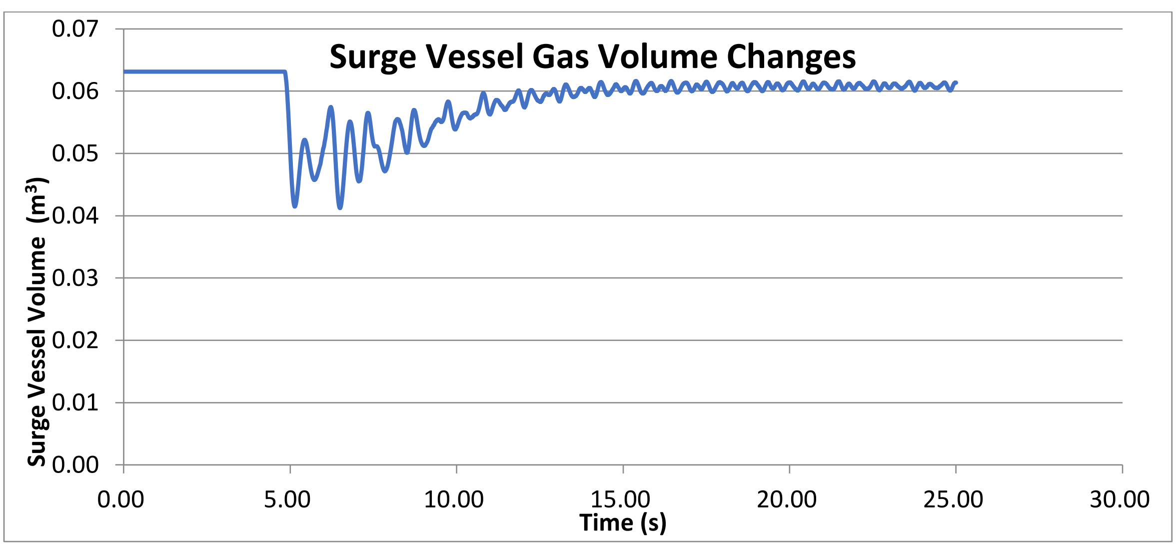


Figure A2.15 Air volume changes of surge vessel (Scenario 4)

Hydraulic Gradient Lines

Figure A2.16 showed the hydraulic gradient lines along the pipeline.

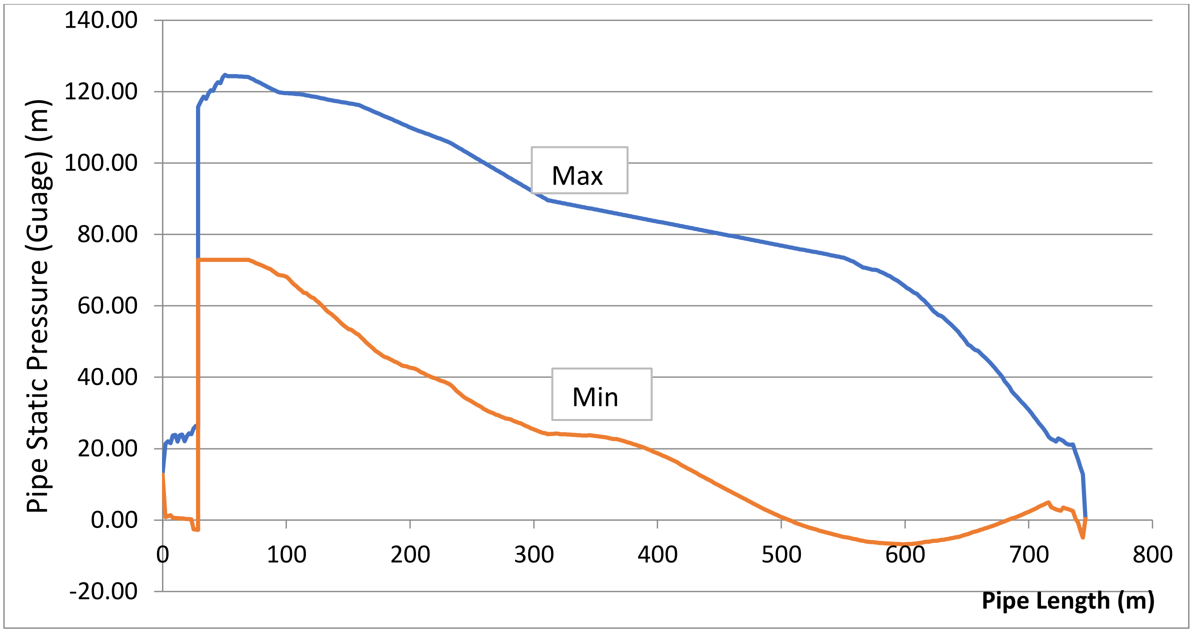


Figure A2.16 Hydraulic gradient lines along the rising main (Scenario 4)

Maximum and minimum pressures along the rising main were 124.69m and -6.75m respectively.

v. **Scenario 5** – The entire pipework enlarged to DN600 (final modified pipework); initial 1 operating pump and the operating pump trip at intake pressure +60mPD.

Pump Speed After Pump Trip

Figure A2.17 showed the pump speed after tripping of the pump.

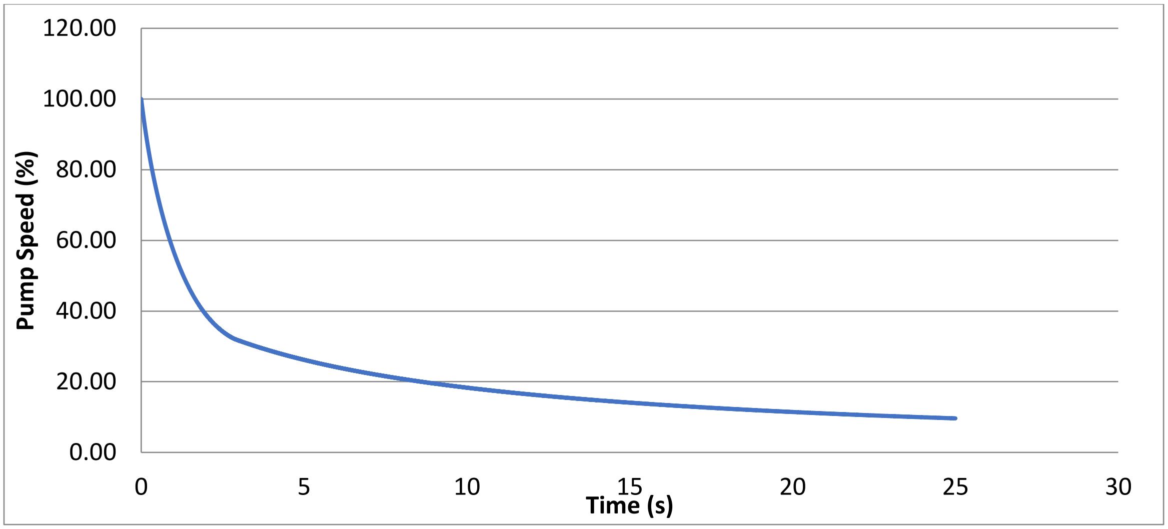


Figure A2.17 Pump speed after tripping action (Scenario 5)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	13.36	159.41
Minimum	5.99	20.67

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.18 showed the pressure response to the pump trip at pump suction and discharge locations.

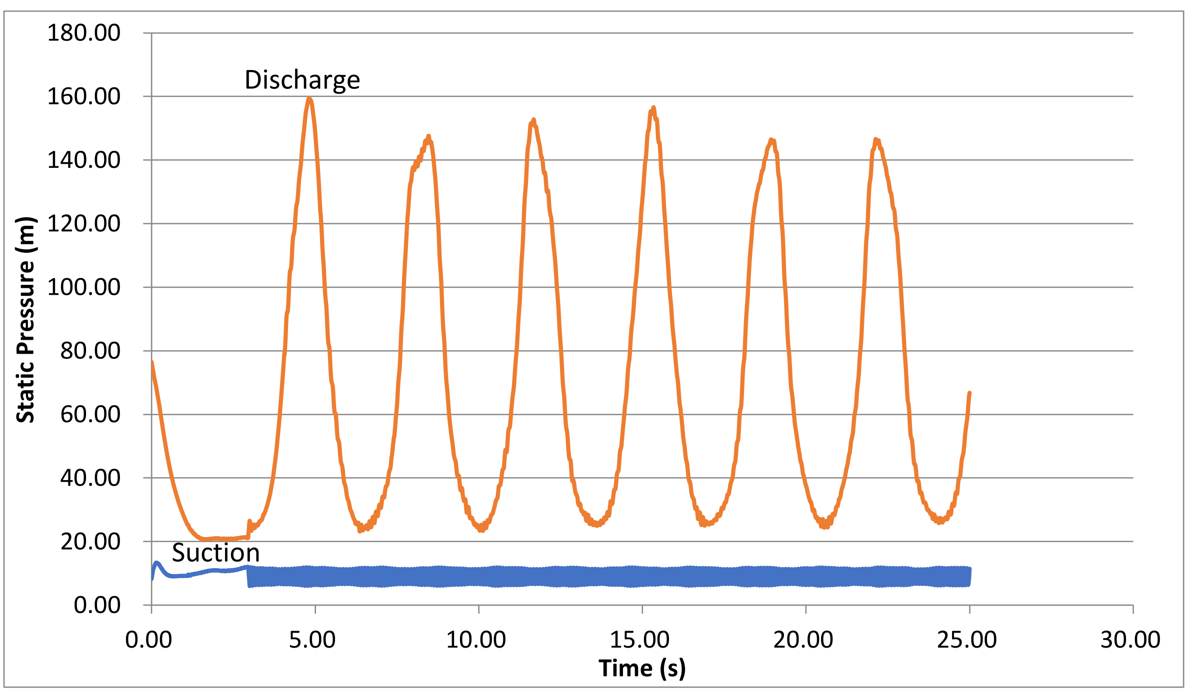


Figure A2.18 Pump suction and discharge pressure responses to pump trip (Scenario 5)

Surge Vessel Operation

Figure A2.19 showed the air volume changes of surge vessel after the pump trip.

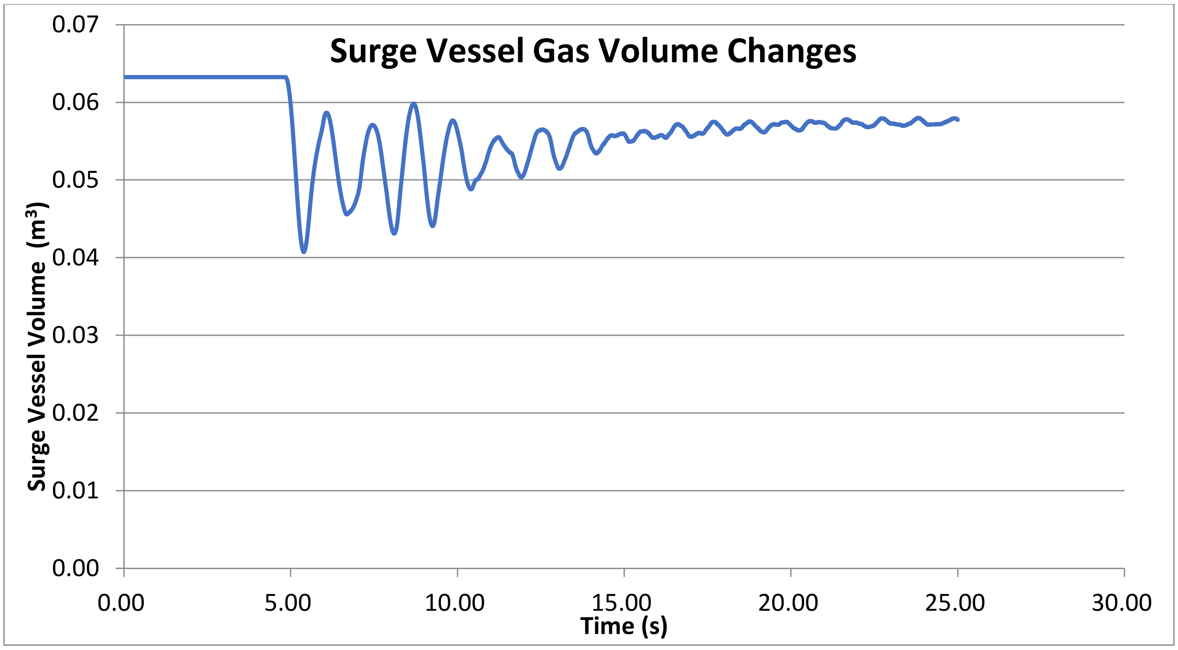


Figure A2.19 Air volume changes of surge vessel (Scenario 5)

Hydraulic Gradient Lines

Figure A2.20 showed the hydraulic gradient lines along the pipeline.

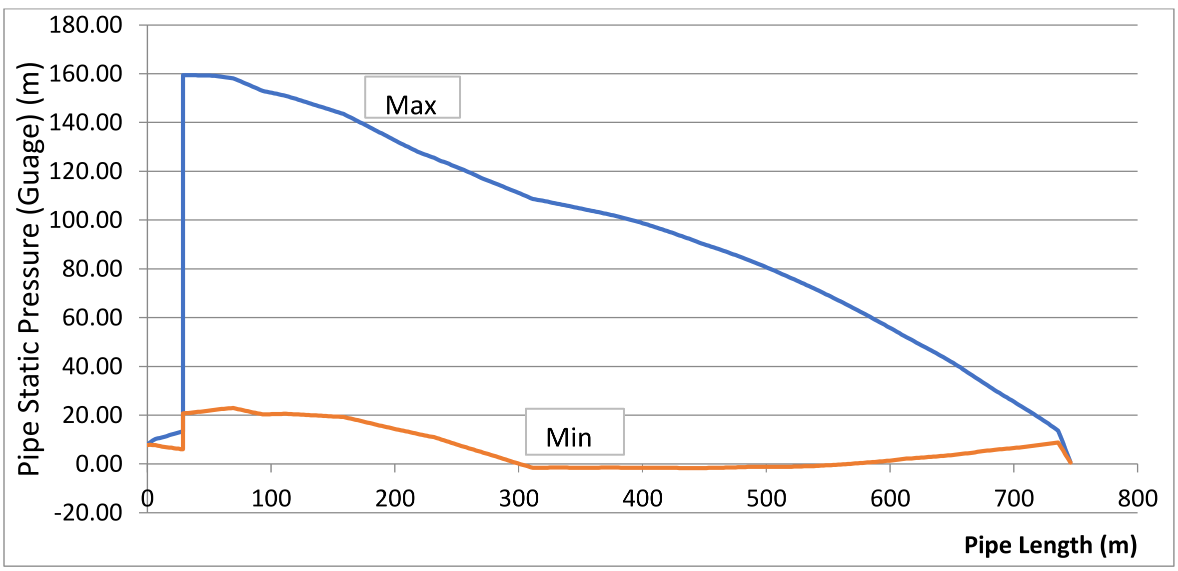


Figure A2.20 Hydraulic gradient lines along the rising main (Scenario 5)

Maximum and minimum pressures along the rising main were 159.41m and -1.70m respectively.

vi. **Scenario 6** – The entire pipework enlarged to DN600 (final modified pipework); initial 1 operating pump and the operating pump trip at intake pressure +65mPD.

Pump Speed After Pump Trip

Figure A2.21 showed the pump speed after tripping of the pump.

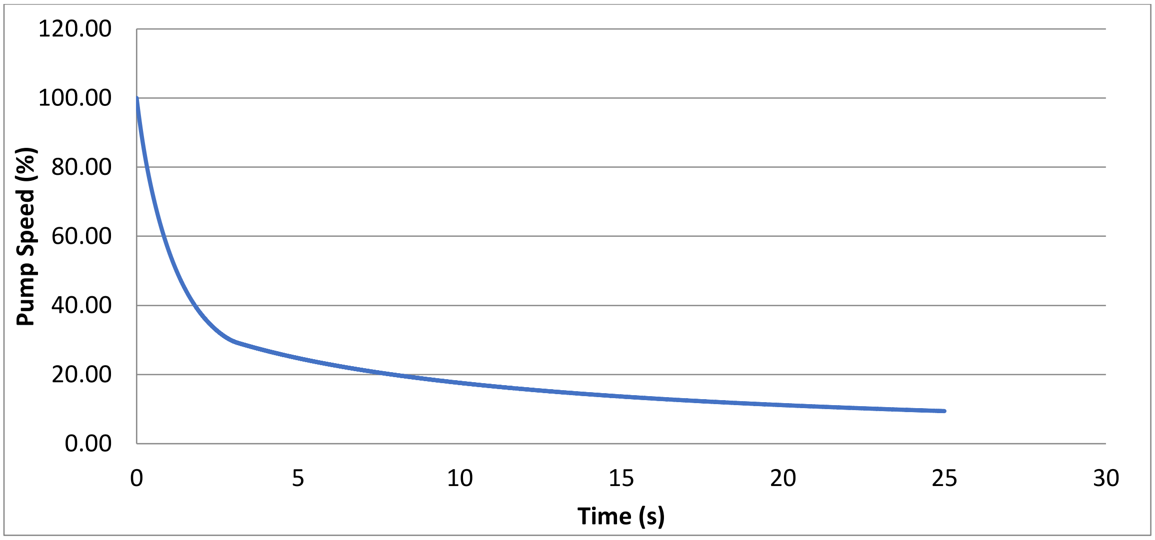


Figure A2.21 Pump speed after tripping action (Scenario 6)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[a]	**Static Pressure at Pump Discharge (m)[a]**
Maximum	18.25	150.67
Minimum	7.82	21.48

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A2.22 showed the pressure response to the pump trip at pump suction and discharge locations.

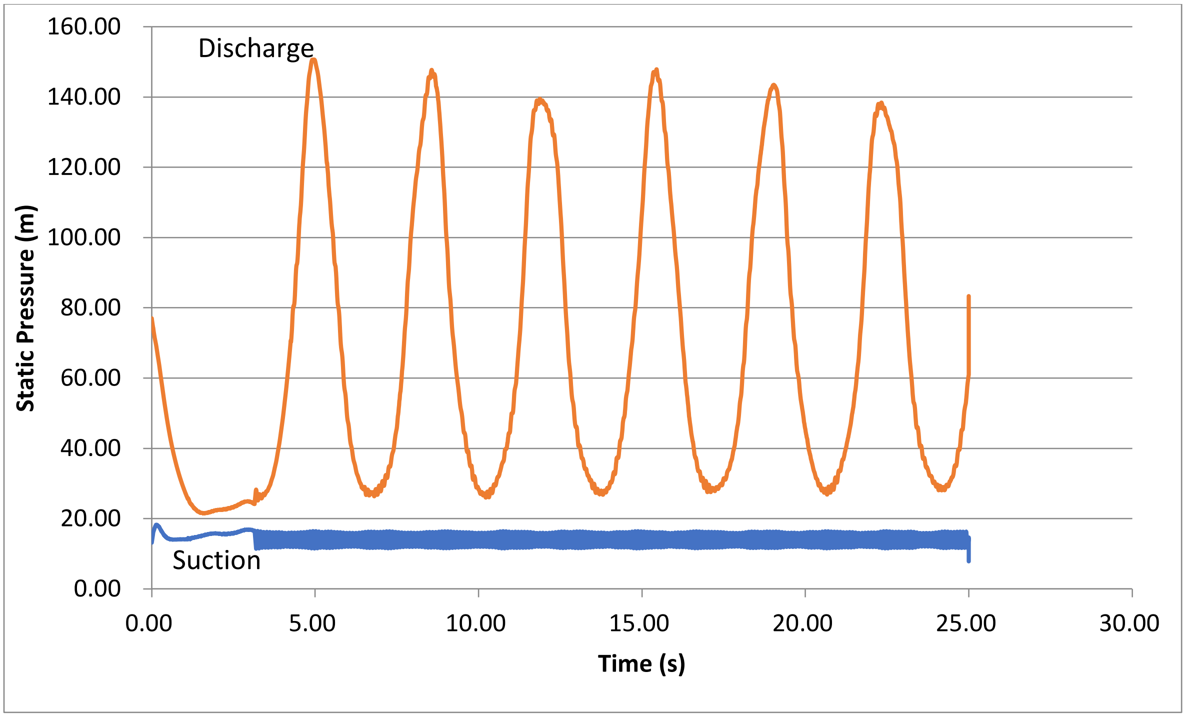


Figure A2.22 Pump suction and discharge pressure responses to pump trip (Scenario 6)

Surge Vessel Operation

Figure A2.23 showed the air volume changes of surge vessel after the pump trip.

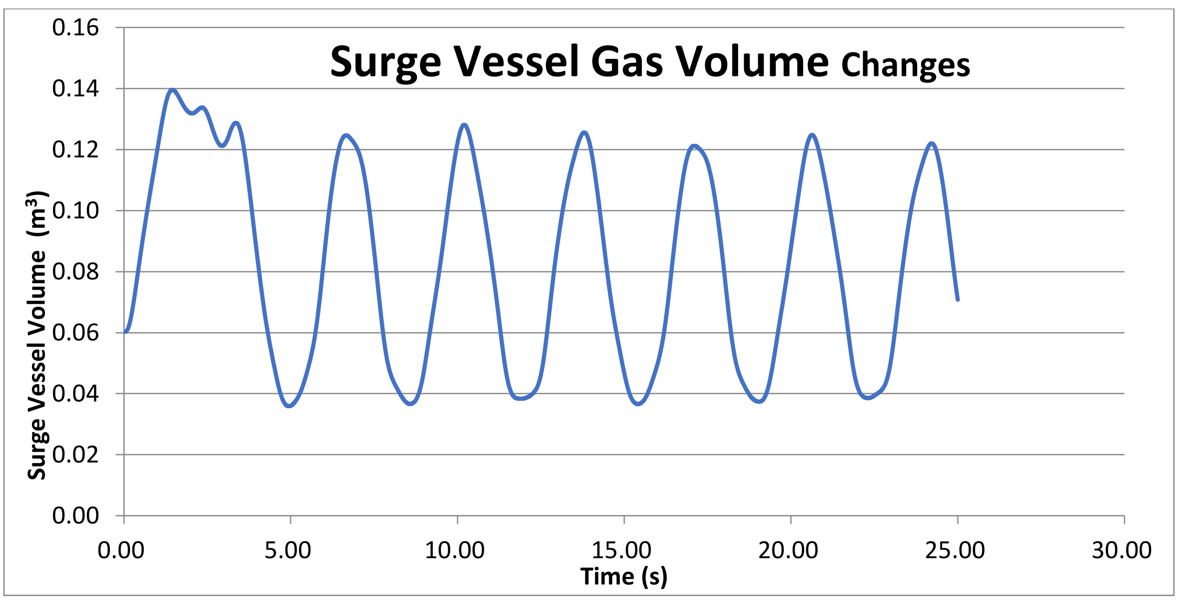


Figure A2.23 Air volume changes of surge vessel (Scenario 6)

Hydraulic Gradient Lines

Figure A2.24 showed the hydraulic gradient lines along the pipeline.

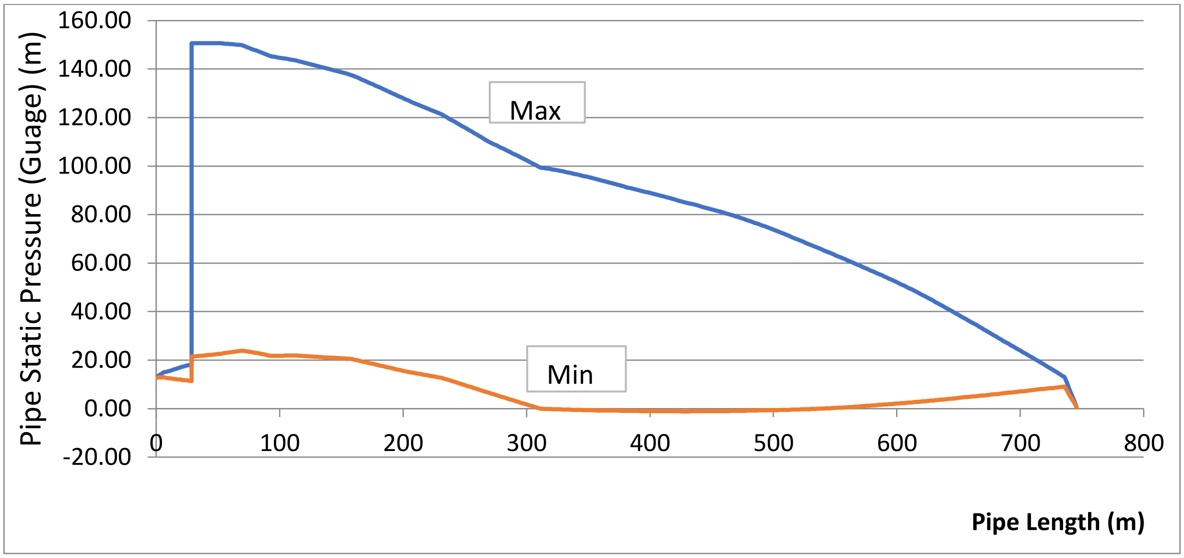


Figure A2.24 Hydraulic gradient lines along the rising main (Scenario 6)

Maximum and minimum pressures along the rising main were 150.67m and -1.10m respectively.

vii. **Scenario 7** – The entire pipework enlarged to DN600 (final modified pipework); one (1) pump start to 100% speed in 10s, stay in operation stage for 10s and then stop in 10s at intake pressure +60mPD.

<u>Pump Speed After Pump Start and Stop</u>

Figure A2.25 showed the pump speed after starting and stopping of the pump.

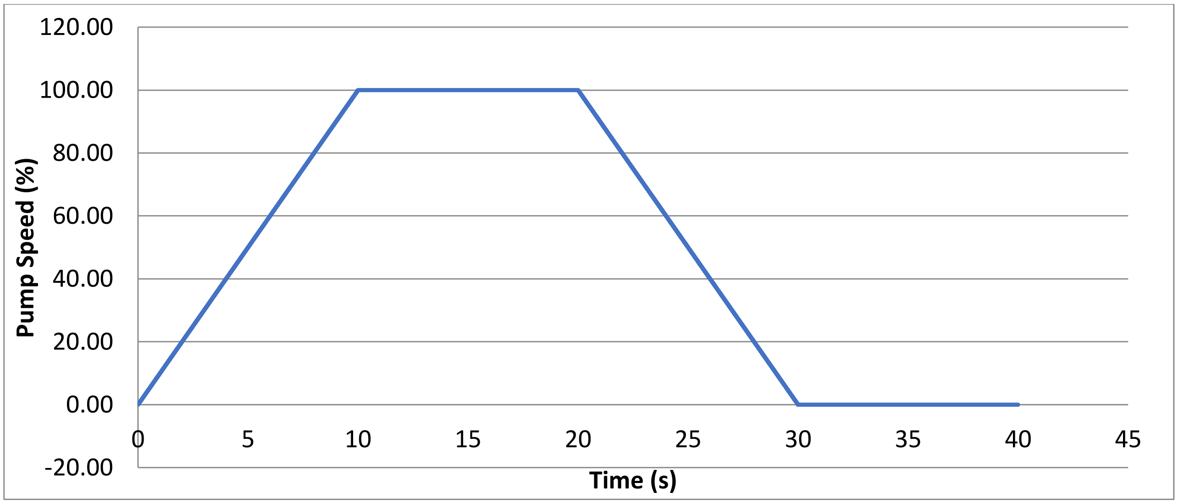


Figure A2.25 Pump speed after starting and stopping action (Scenario 7)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	17.81	132.40
Minimum	-4.07	30.95

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.26 showed the pressure response to the pump start and stop at pump suction and discharge locations.

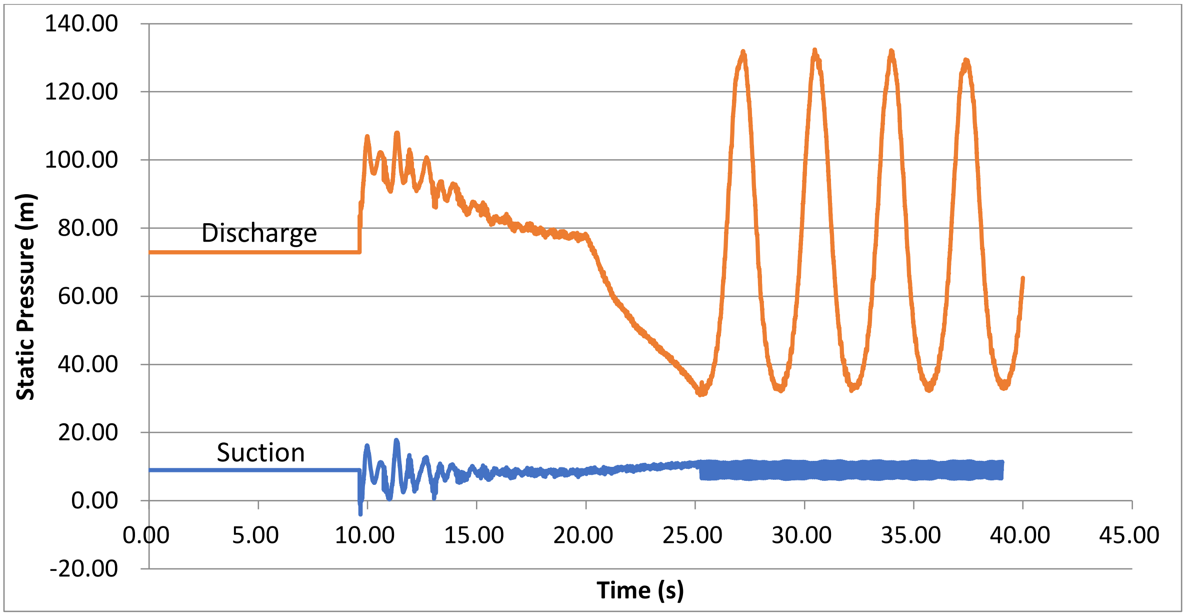


Figure A2.26 Pump suction and discharge pressure responses to pump start and stop (Scenario 7)

Surge Vessel Operation

Figure A2.27 showed the air volume changes of surge vessel after the pump start and stop.

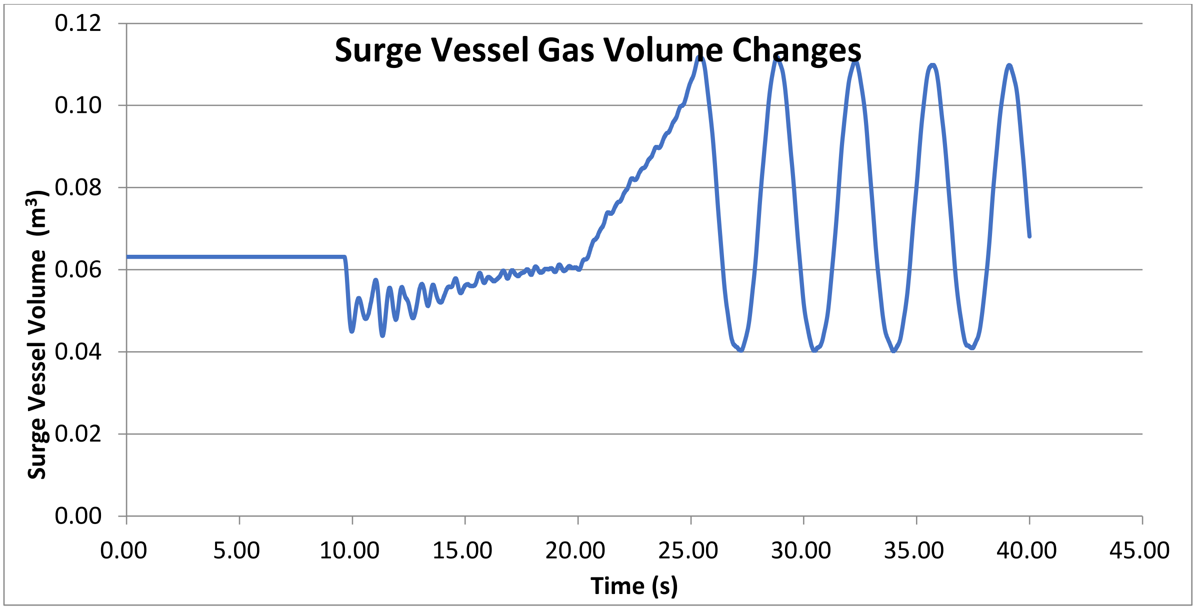


Figure A2.27 Air volume changes of surge vessel (Scenario 7)

<u>Hydraulic Gradient Lines</u>

Figure A2.28 showed the hydraulic gradient lines along the pipeline.

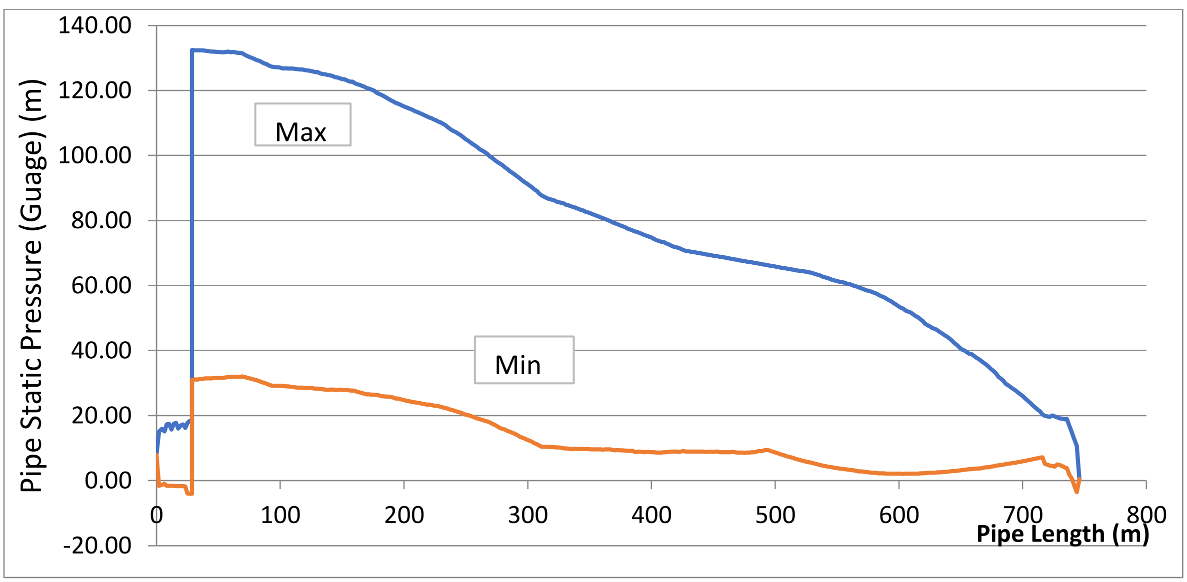


Figure A2.28 Hydraulic gradient lines along the rising main (Scenario 7)

Maximum and minimum pressures along the rising main were 132.40m and -4.07m respectively.

viii. **Scenario 8** – The entire pipework enlarged to DN600 (final modified pipework); one (1) pump start to 100% speed in 10s, stay in operation stage for 10s and then stop in 10s at intake pressure +65mPD.

Pump Speed After Pump Start and Stop

Figure A2.29 showed the pump speed after starting and stopping of the pump.

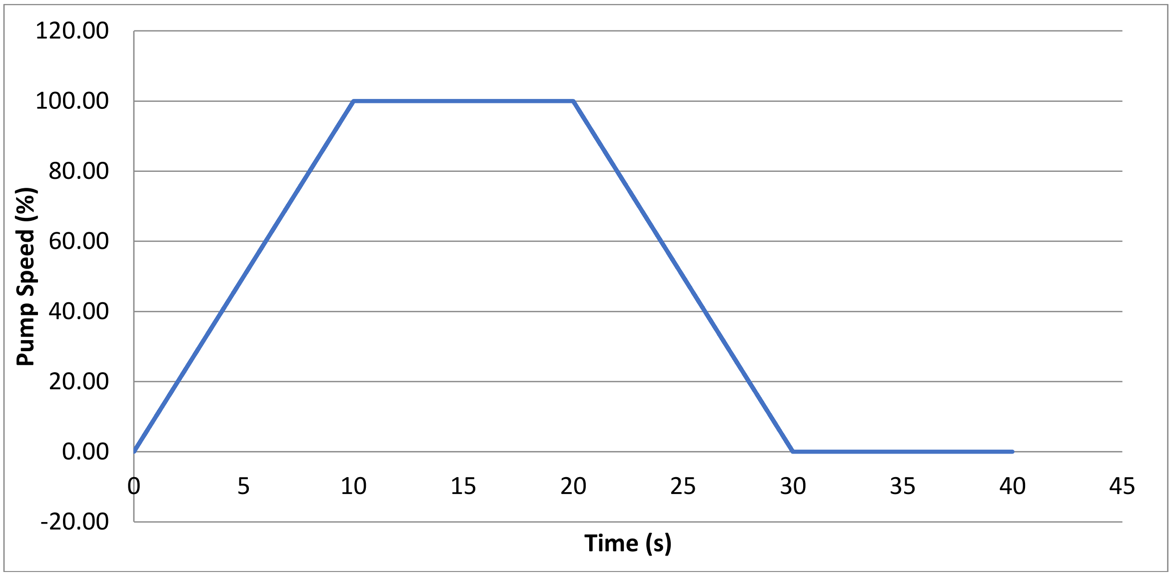


Figure A2.29 Pump speed after starting and stopping action (Scenario 8)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	24.46	129.72
Minimum	-2.32	31.76

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.30 showed the pressure response to the pump start and stop at pump suction and discharge locations.

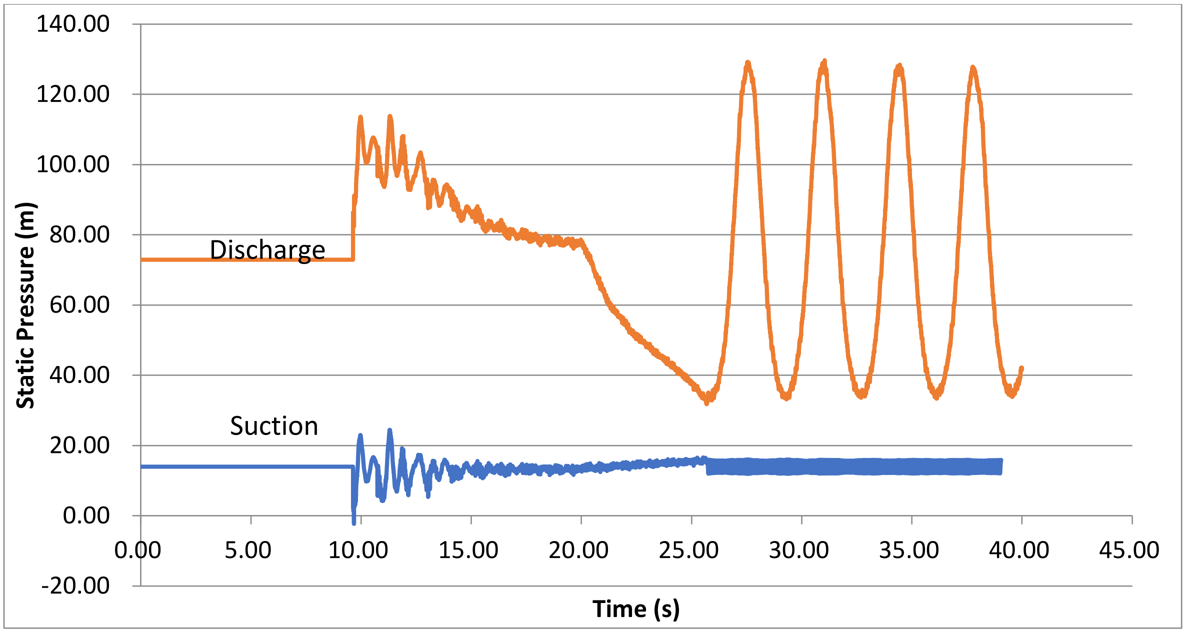


Figure A2.30 Pump suction and discharge pressure responses to pump start and stop (Scenario 8)

<u>Surge Vessel Operation</u>

Figure A2.31 showed the air volume changes of surge vessel after the pump start and stop.

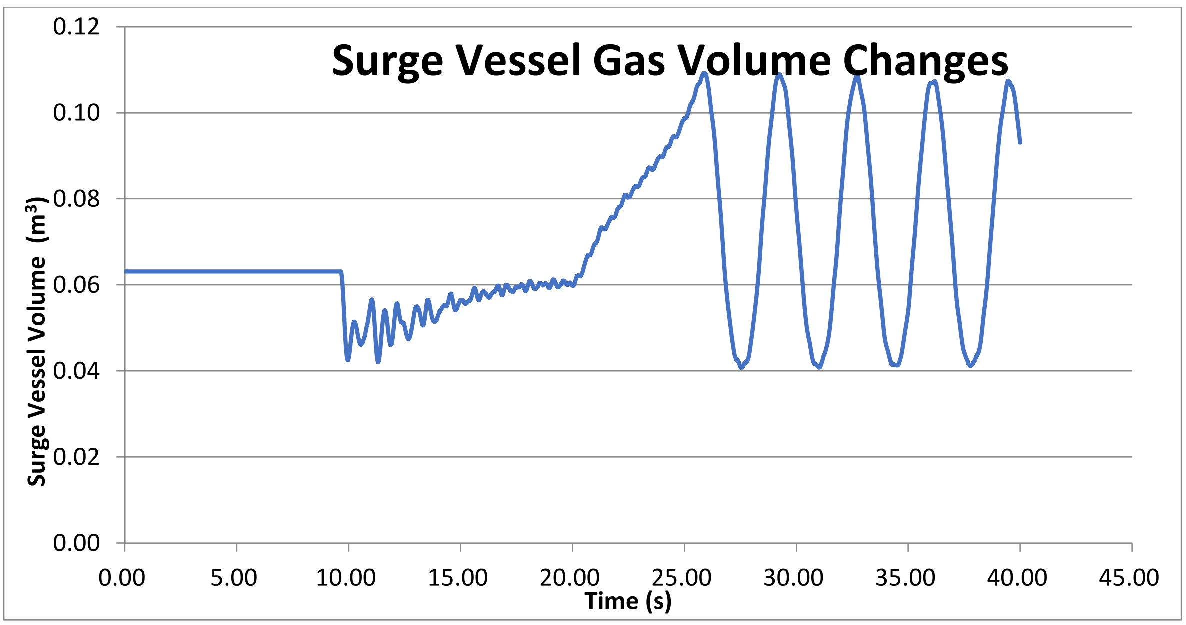


Figure A2.31 Air volume changes of surge vessel (Scenario 8)

<u>Hydraulic Gradient Lines</u>

Figure A2.32 showed the hydraulic gradient lines along the pipeline.

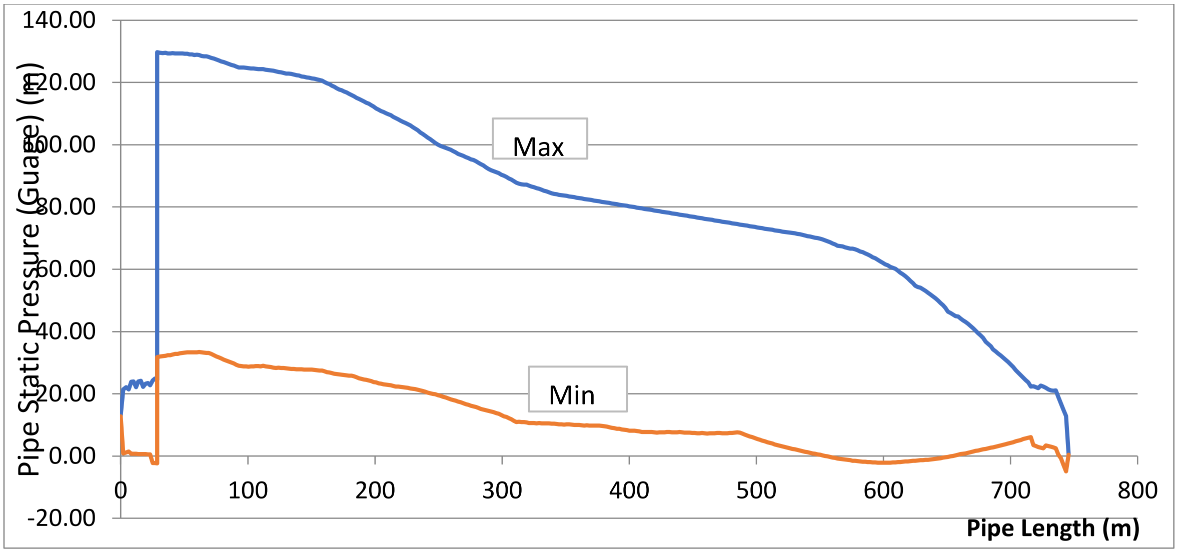


Figure A2.32 Hydraulic gradient lines along the rising main (Scenario 8)

Maximum and minimum pressures along the rising main were 129.72m and -4.94m respectively.

ix. **Scenario 9** – The entire pipework enlarged to DN600 (final modified pipework); initial 1 pump in operation; the other pump start to 100% speed in 10s; run for 10s and then stop in 10s at intake pressure +60mPD.

<u>Pump Speed After Pump Stop and Start</u>

Figure A2.33 showed the pump speed after stopping and starting of the pump.

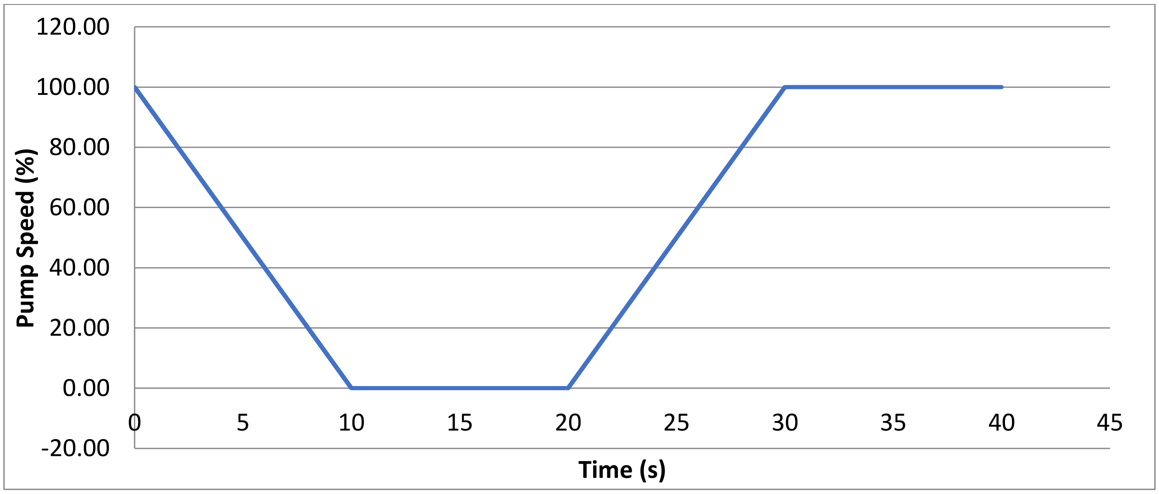


Figure A2.33 Pump speed after stopping and starting action (Scenario 9)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	18.14	131.31
Minimum	-5.88	31.09

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A2.34 showed the pressure response to the pump stop and start at pump suction and discharge locations.

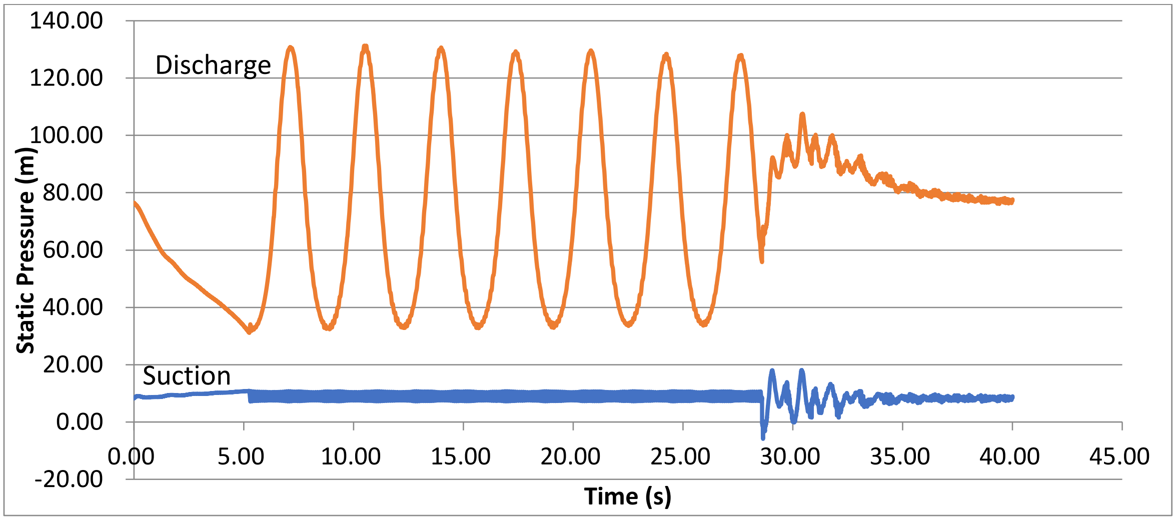


Figure A2.34 Pump suction and discharge pressure responses to pump stop and start (Scenario 9)

<u>Surge Vessel Operation</u>

Figure A2.35 showed the air volume changes of surge vessel after the pump stop and start.

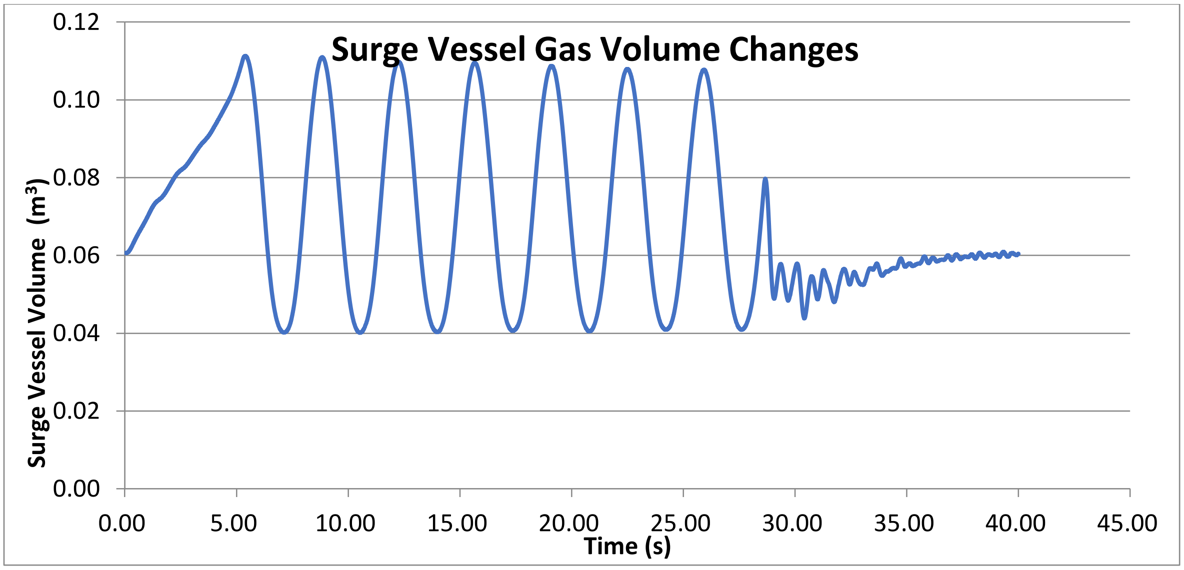


Figure A2.35 Air volume changes of surge vessel (Scenario 9)

Hydraulic Gradient Lines

Figure A2.36 showed the hydraulic gradient lines along the pipeline.

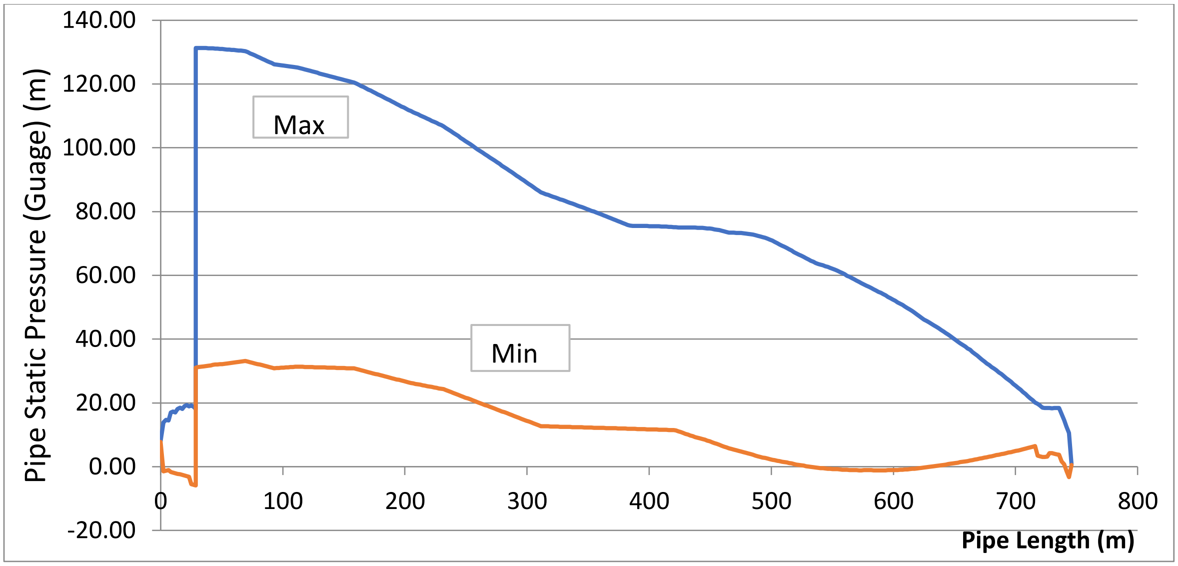


Figure A2.36 Hydraulic gradient lines along the rising main (Scenario 9)

Maximum and minimum pressures along the rising main were 131.31m and -5.88m respectively.

x. **Scenario 10** – The entire pipework enlarged to DN600 (final modified pipework); initial 1 pump in operation; the operating pump stop in 10s; rest for 10s and then start again in 10s at intake pressure +65.00mPD.

Pump Speed After Pump Start and Stop

Figure A2.37 showed the pump speed after stopping and starting of the pump.

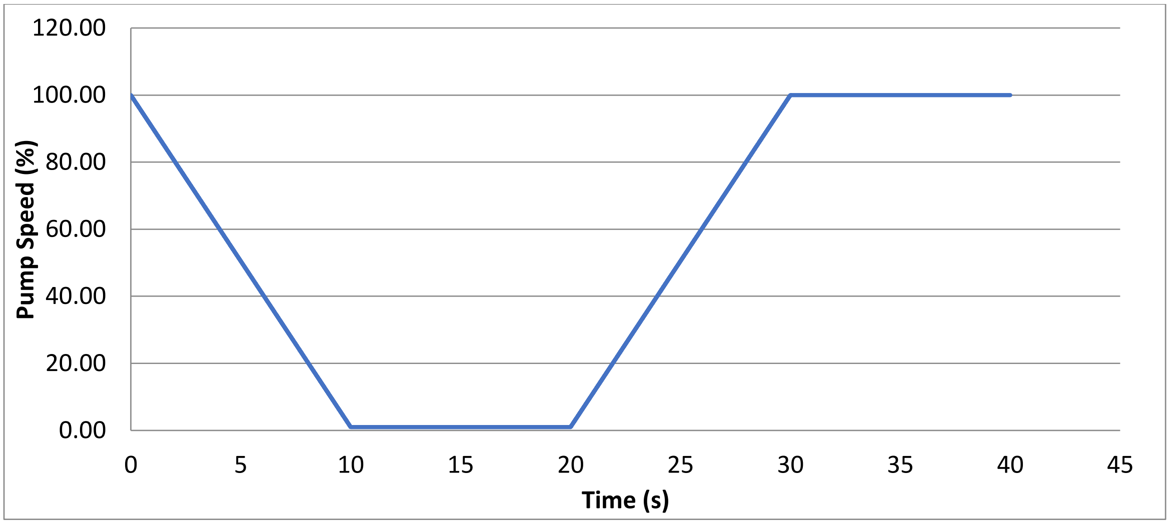


Figure A2.37 Pump speed after stopping and starting action (Scenario 10)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[a]	Static Pressure at Pump Discharge (m)[a]
Maximum	23.36	128.70
Minimum	-5.02	32.31

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A2.38 showed the pressure response to the pump stop and start at pump suction and discharge locations.

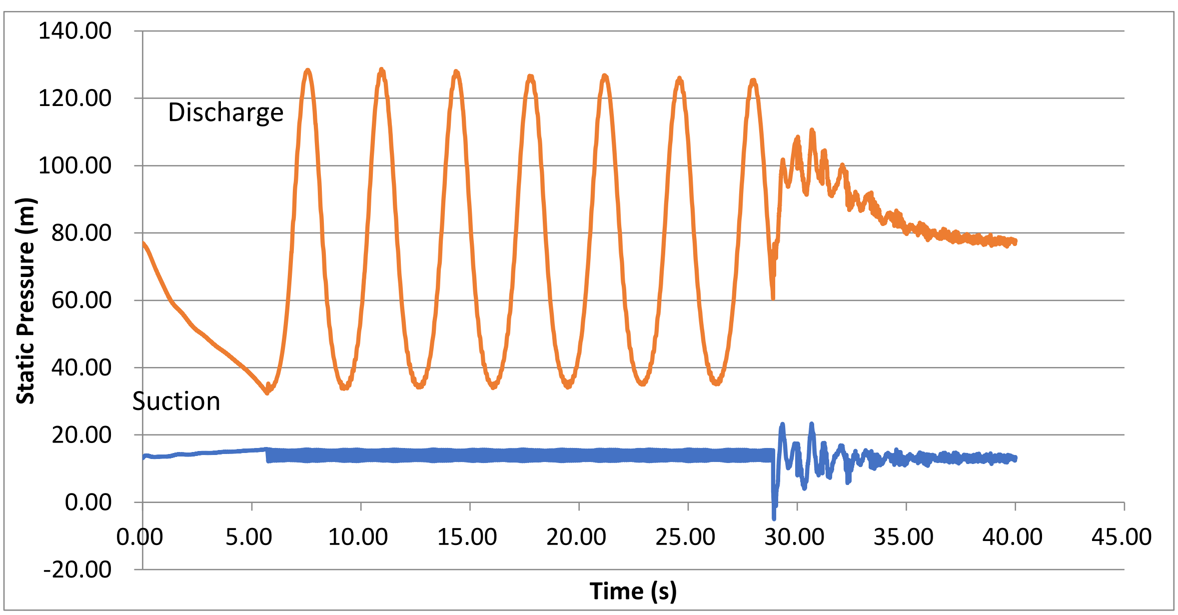


Figure A2.38 Pump suction and discharge pressure responses to pump stop and start (Scenario 10)

Surge Vessel Operation

Figure A2.39 showed the air volume changes of surge vessel after the pump stop and start.

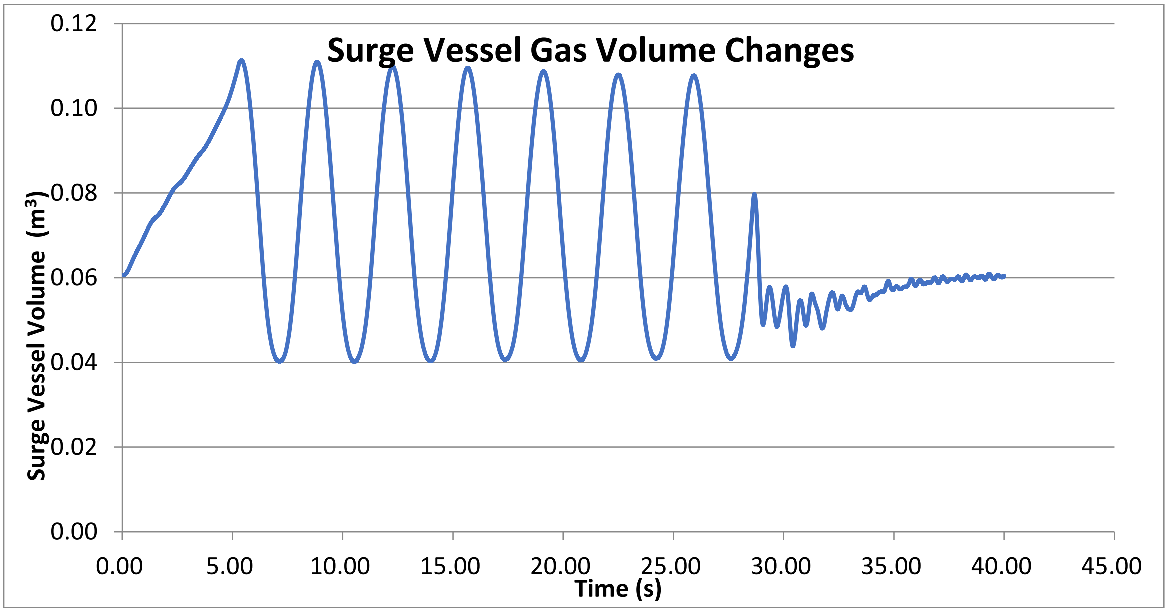


Figure A2.39 Air volume changes of surge vessel (Scenario 10)

<u>Hydraulic Gradient Lines</u>

Figure A2.40 showed the hydraulic gradient lines along the pipeline.

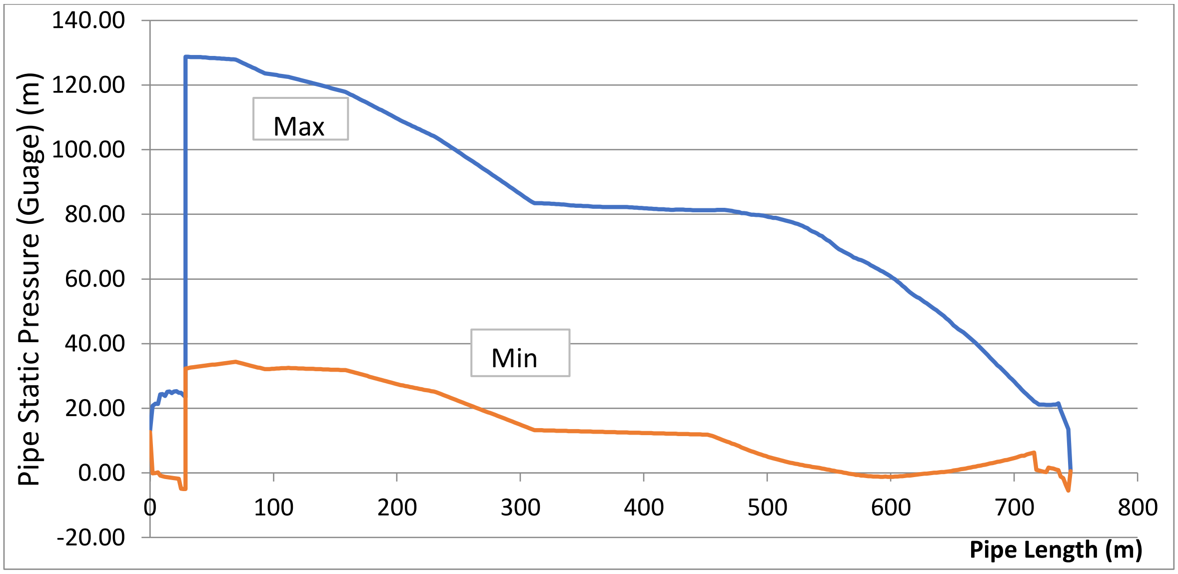


Figure A2.40 Hydraulic gradient lines along the rising main (Scenario 10)

Maximum and minimum pressures along the rising main were 128.70m and -5.43m respectively.

Appendix 2

Appendix 3

A1. Surge Analysis Results for Salt Water Pumping System

In accordance with Section 1.2 of the report, the surge results for the salt water pumping system were presented as follows:-

i. **Scenario 1** – Original rising main with size DN200mm; 1 pump start in 10s at intake Pressure +60mPD.

Pump Speed After Pump Start

Figure A3.1 showed the pump speed after starting of the pump.

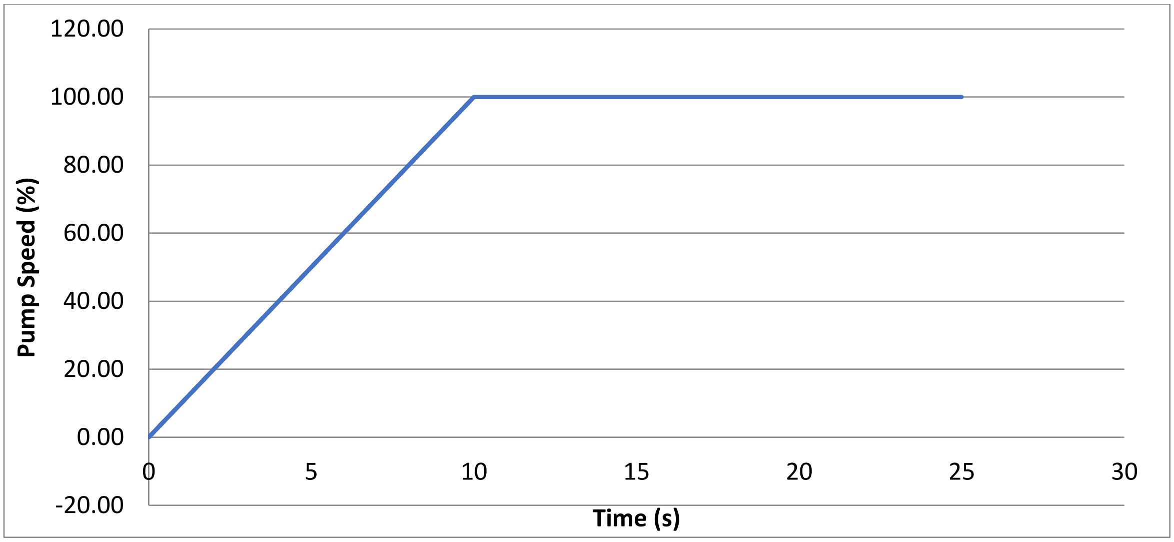


Figure A3.1 Pump speed after starting action (Scenario 1)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	Static Pressure at Pump Discharge (m)[(a)]
Maximum	37.01	118.19
Minimum	-10.00	61.61

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.2 showed the pressure response to the pump start at pump suction and discharge locations.

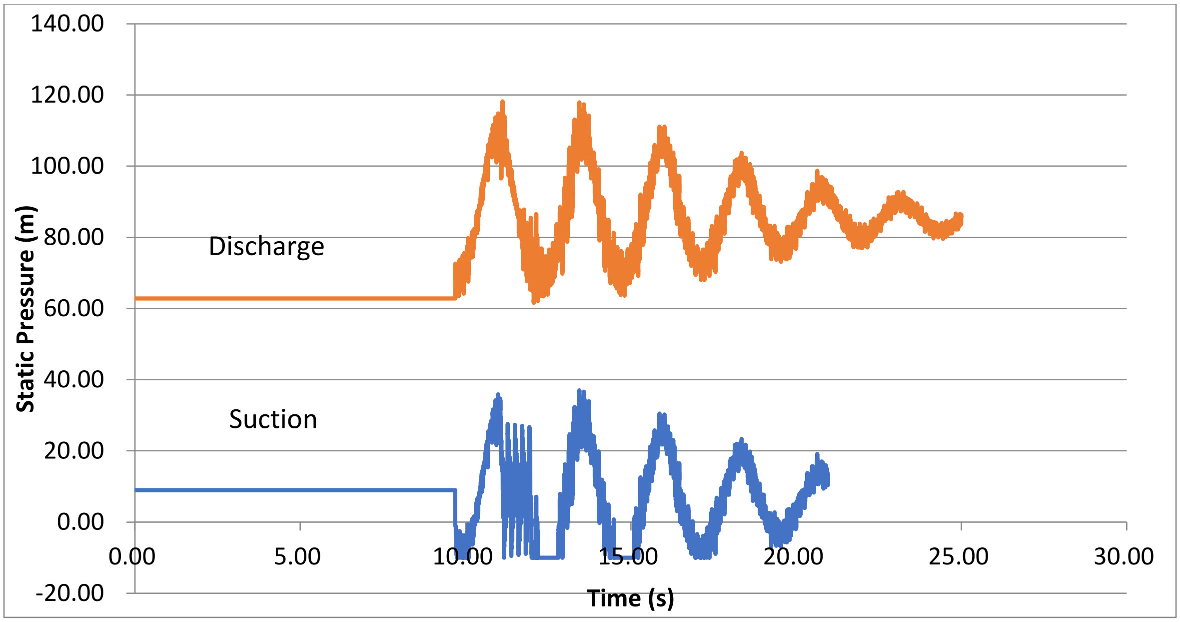


Figure A3.2 Pump suction and discharge pressure responses to pump start (Scenario 1)

Surge Vessel Operation

Figure A3.3 showed the air volume changes of surge vessel after the pump start.

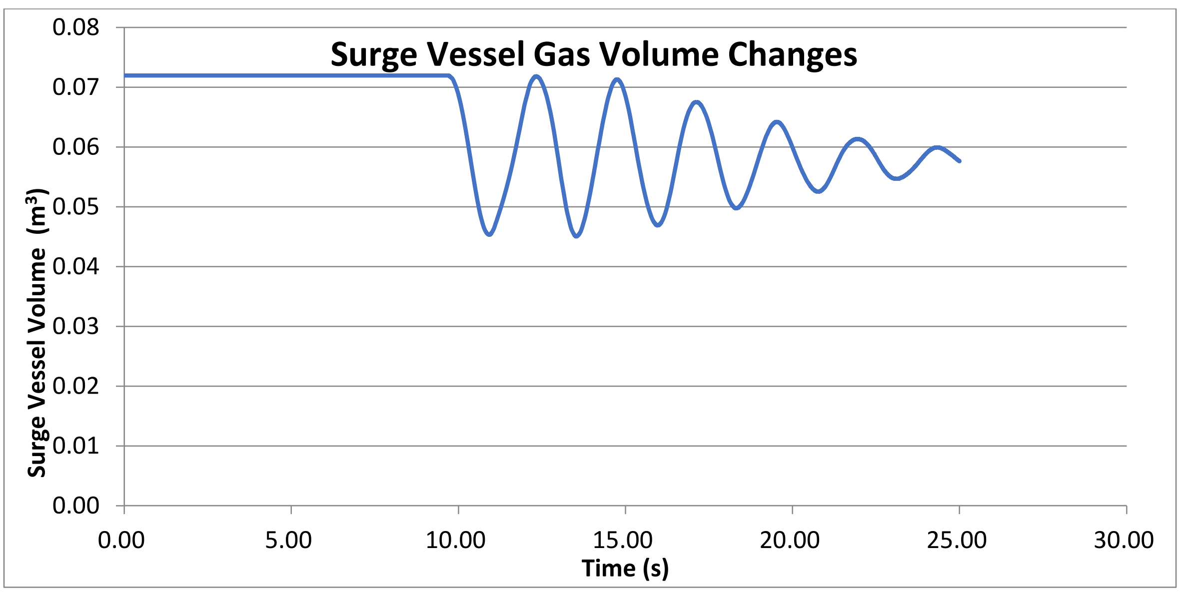
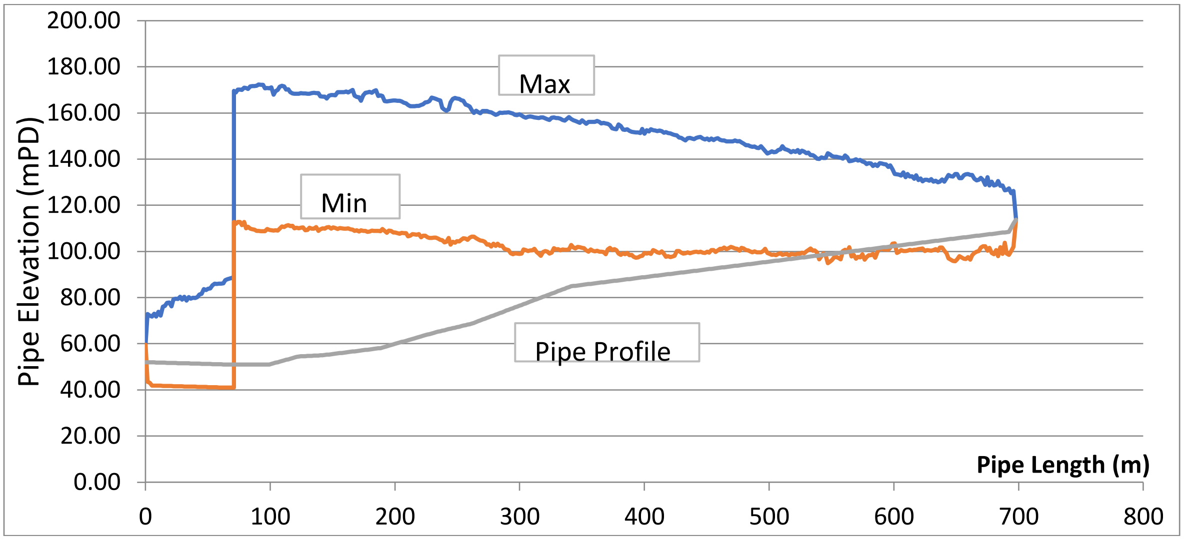


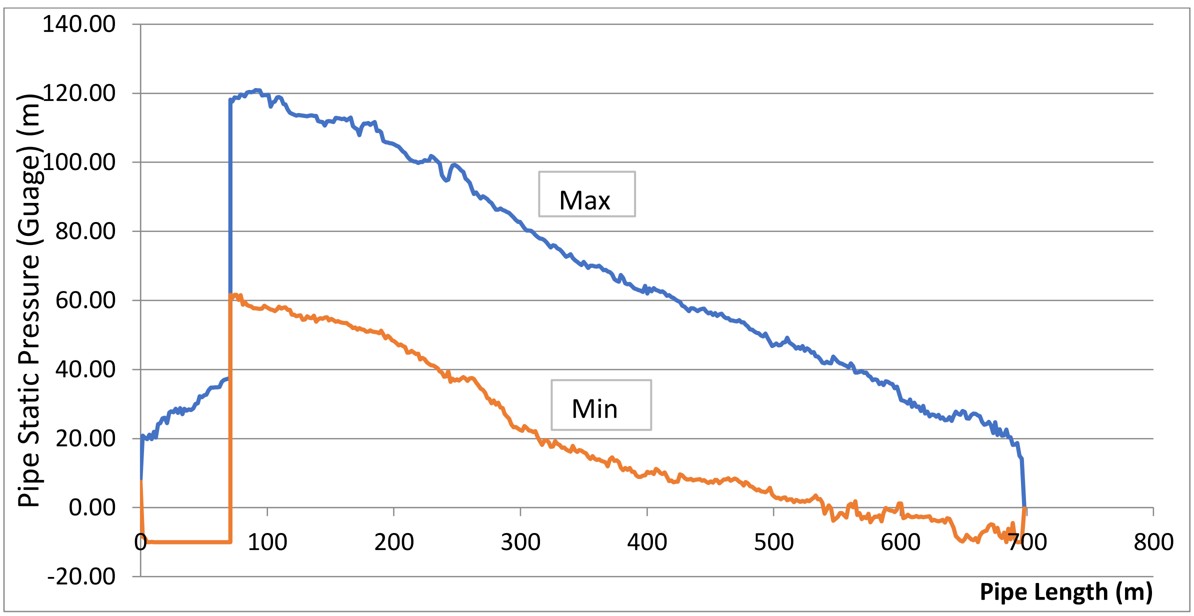
Figure A3.3 Air volume changes of surge vessel (Scenario 1)

Hydraulic Gradient Lines

Figure A3.4 showed hydraulic gradient lines along the pipeline. For the hydraulic gradient line, they could be represented in two ways. One was the elevation as shown in **Figure A3.4(a)** whilst the other was the pipe static pressure as shown in **Figure A3.4(b)**. The pipe static pressure was better to understand the actual pressure inside the pipe and easier to visualize the associated pipe stress. Thus in the following scenarios, the presentation of the pressure along the pipeline should be the static gauge pressure.



(a) Elevation of hydraulic gradient line



(b) Static pressure along the rising main

Figure A3.4 Hydraulic gradient lines along the rising main (Scenario 1)

Maximum and minimum pressures along the rising main were 120.94m and -10.00m respectively.

ii. **Scenario 2** –Modified pipeline with original size DN200mm; 1 pump start in 10s at intake pressure +60mPD.

Pump Speed After Pump Start

Figure A3.5 showed the pump speed after starting of the pump.

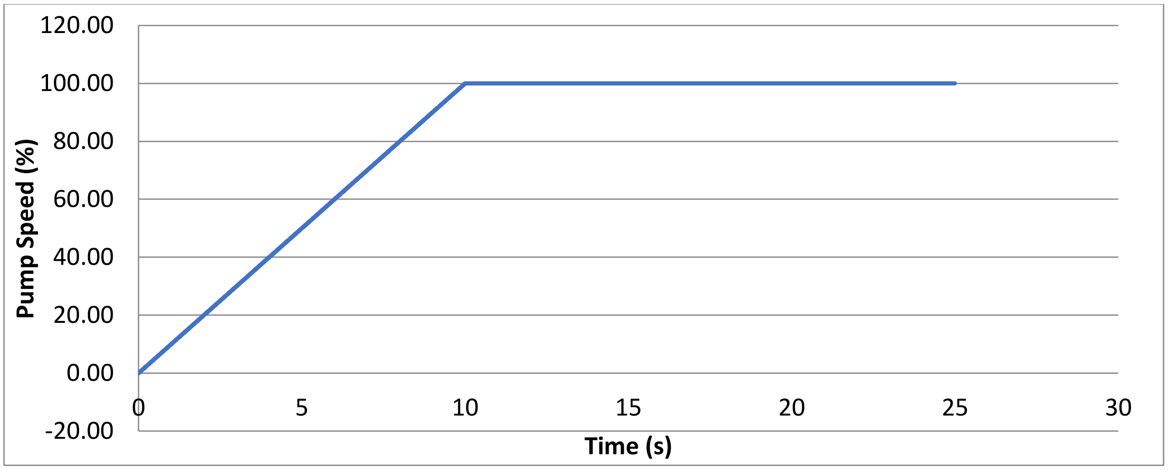


Figure A3.5 Pump speed after starting action (Scenario 2)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	8.97	99.93
Minimum	-8.34	62.8

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.6 showed the pressure response to the pump start at pump suction and discharge locations.

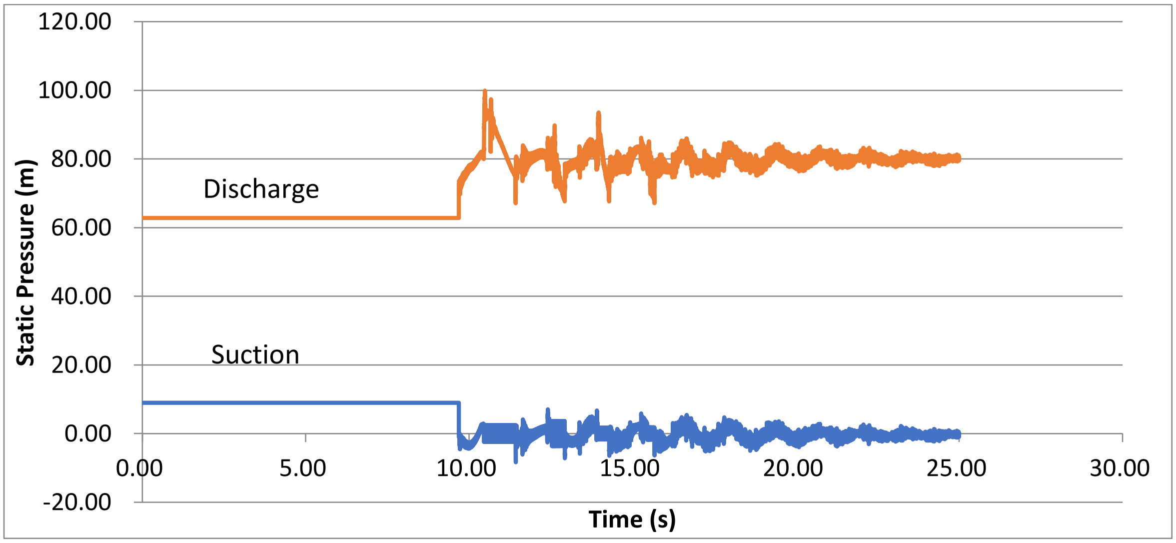


Figure A3.6 Pump suction and discharge pressure responses to pump start (Scenario 2)

Surge Vessel Operation

Figure A3.7 showed the air volume changes of surge vessel after the pump start.

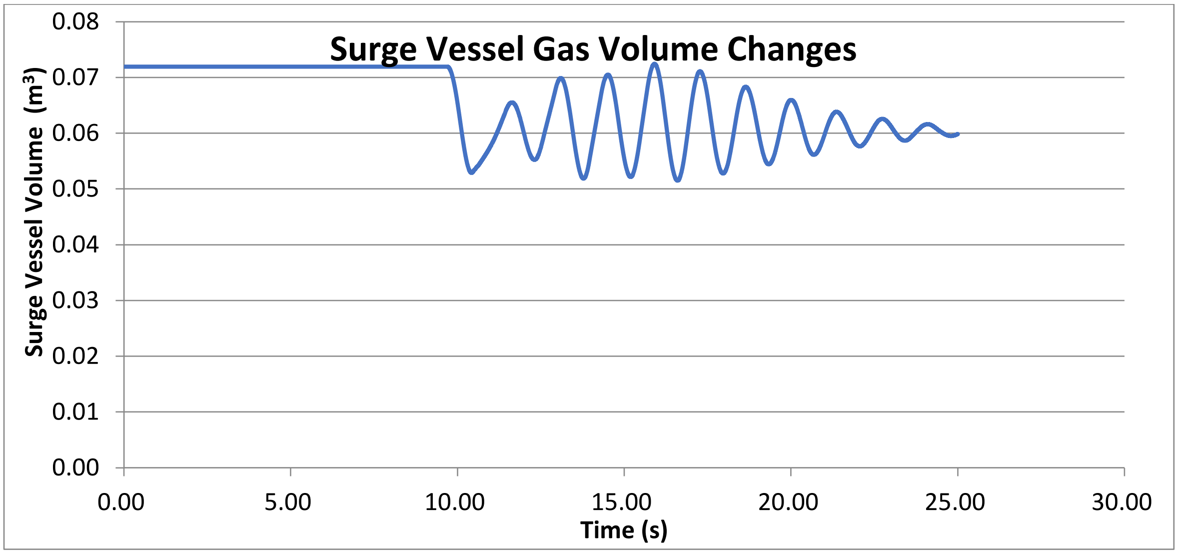


Figure A3.7 Air volume changes of surge vessel (Scenario 2)

Air Valve Operation

Figure A3.8 showed the mass flow through the air valve after the pump start.

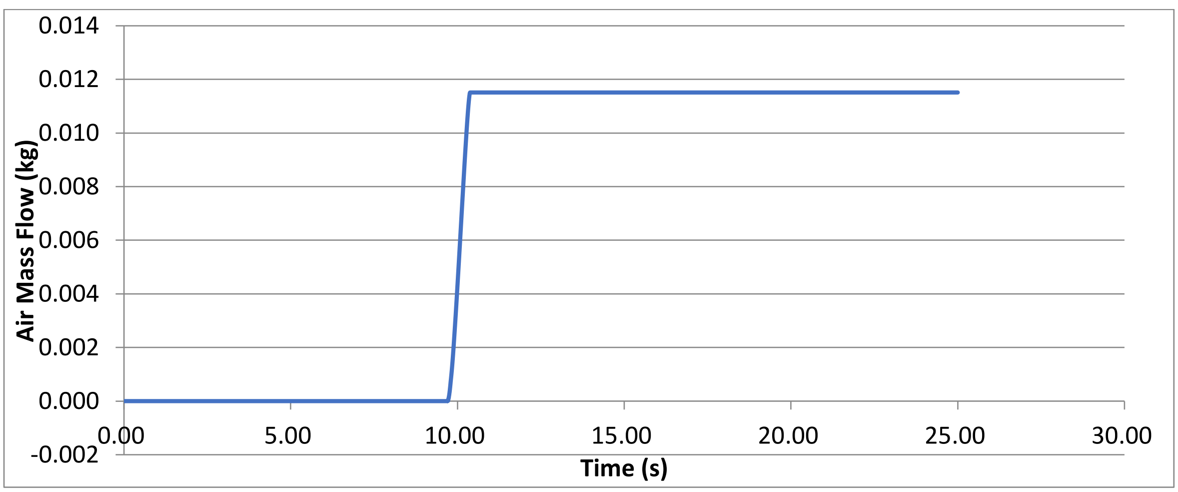


Figure A3.8 Mass flow through air valve (Scenario 2)

Hydraulic Gradient Lines

Figure A3.9 showed the hydraulic gradient lines along the pipeline.

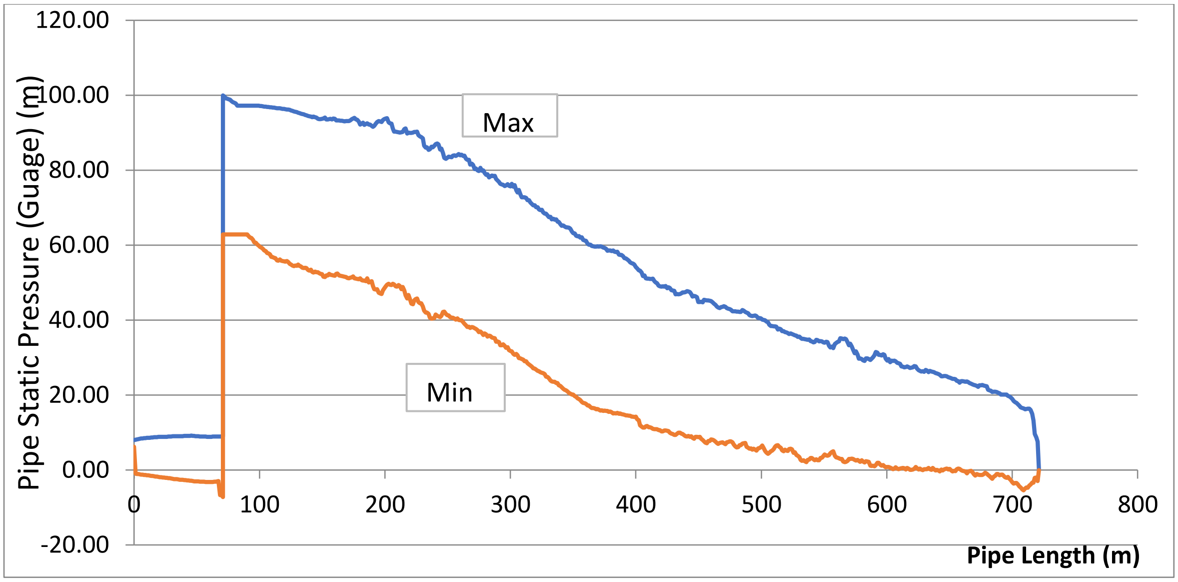


Figure A3.9 Hydraulic gradient lines along the rising main (Scenario 2)

Maximum and minimum pressures along the rising main were 99.93m and -7.20m respectively.

iii. **Scenario 3** –Modified pipeline with original size DN200mm; 1 pump start in 10s at intake pressure +65mPD.

<u>Pump Speed After Pump Start</u>

Figure A3.10 showed the pump speed after starting of the pump.

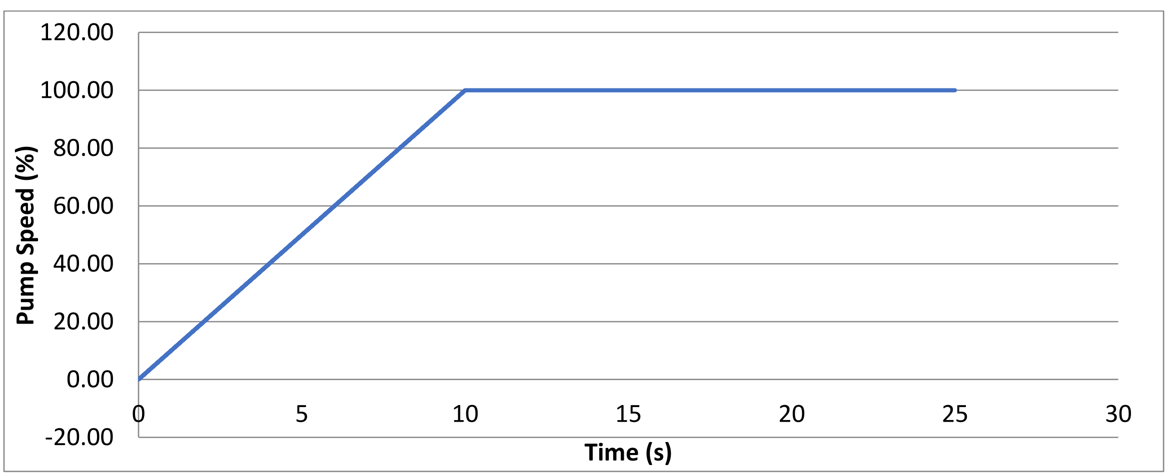


Figure A3.10 Pump speed after starting action (Scenario 3)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[a]	Static Pressure at Pump Discharge (m)[a]
Maximum	13.96	102.50
Minimum	-8.75	62.82

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A3.11 showed the pressure response to the pump start at pump suction and discharge locations.

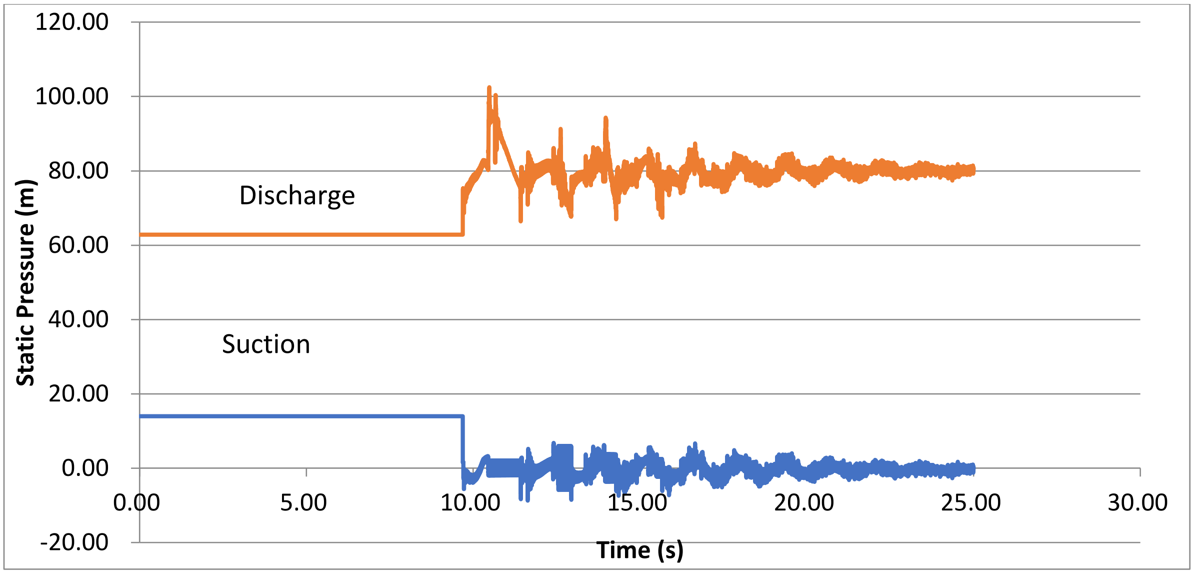


Figure A3.11 Pump suction and discharge pressure responses to pump start (Scenario 3)

<u>Surge Vessel Operation</u>

Figure A3.12 showed the air volume changes of surge vessel after the pump start.

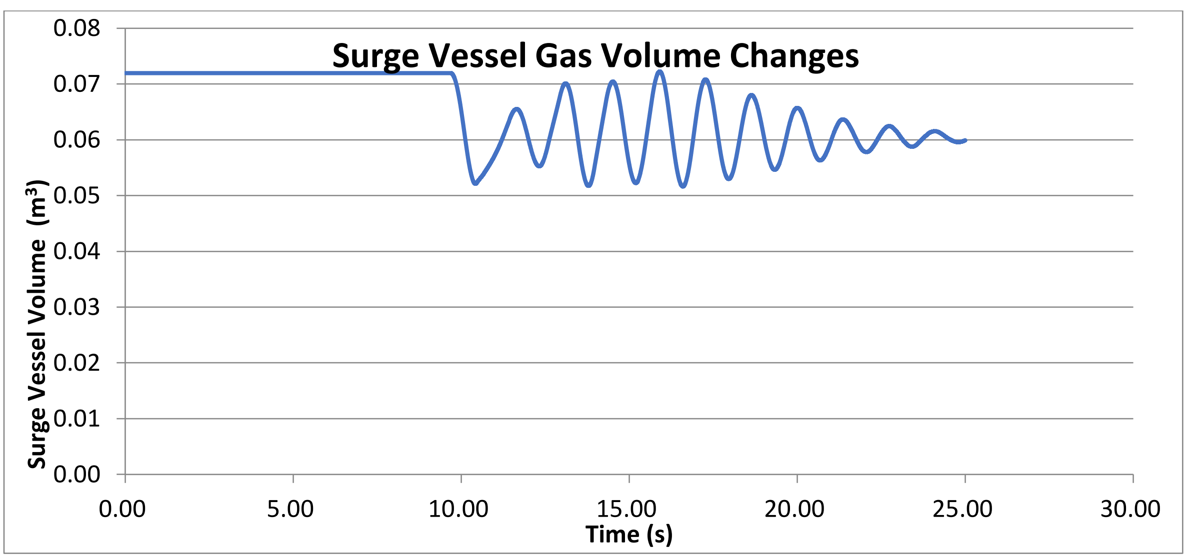


Figure A3.12 Air volume changes of surge vessel (Scenario 3)

Air Valve Operation

Figure A3.13 showed the mass flow through the air valve after the pump start.

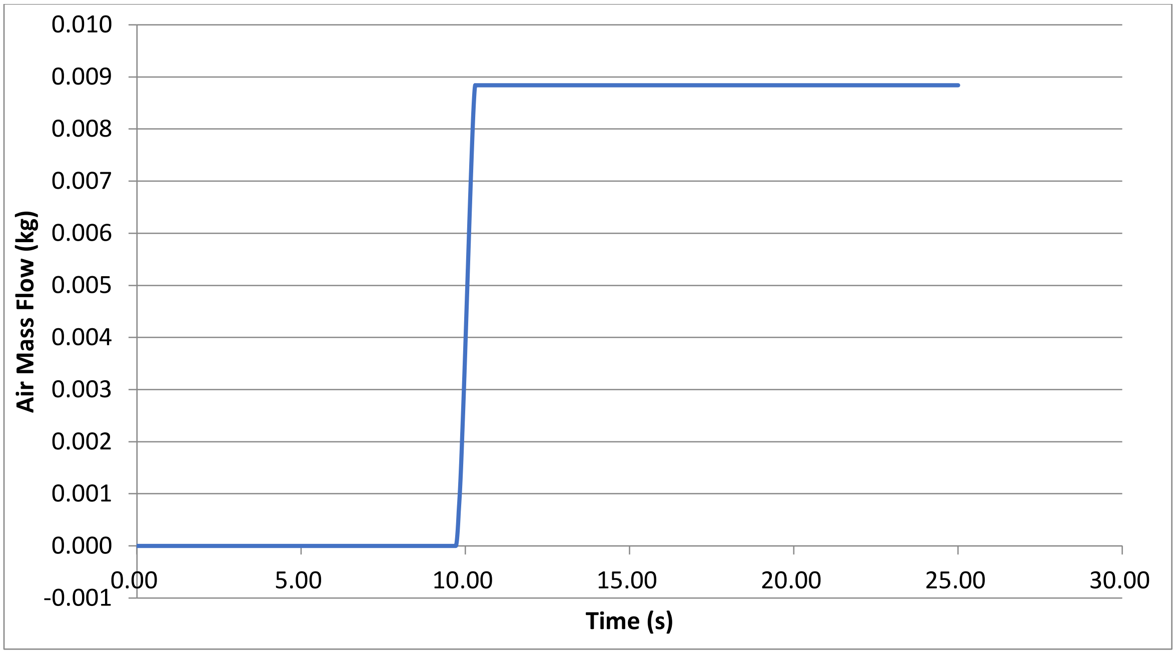


Figure A3.13 Mass flow through air valve (Scenario 3)

Hydraulic Gradient Lines

Figure A3.14 showed the hydraulic gradient lines along the pipeline.

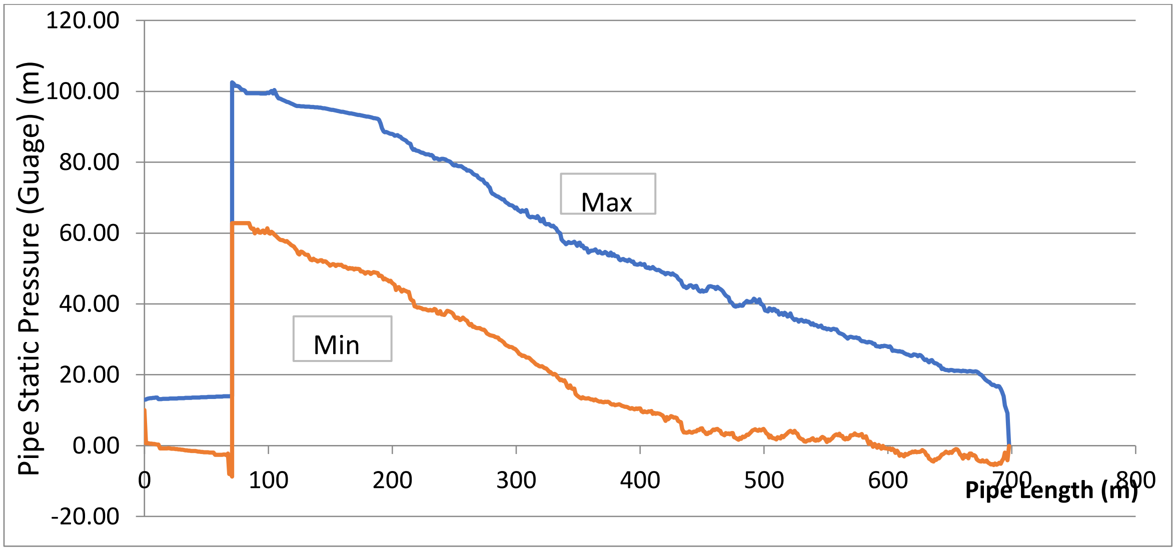


Figure A3.14 Hydraulic gradient lines along the rising main (Scenario 3)

Maximum and minimum pressures along the rising main were 102.50m and -8.75m respectively.

iv. **Scenario 4** –Modified pipeline with original size DN200mm; 1 pump trip at intake pressure +60mPD.

Pump Speed After Pump Trip

Figure A3.15 showed the pump speed after tripping of the pump.

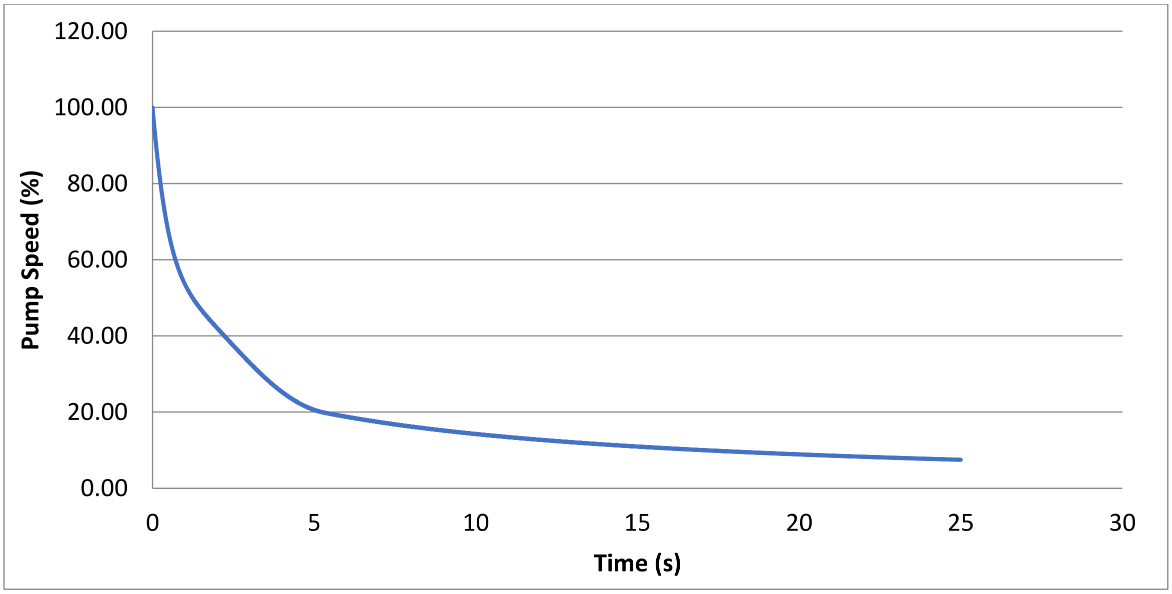


Figure A3.15 Pump speed after tripping action (Scenario 4)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	30.96	181.93
Minimum	-1.14	13.81

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.16 showed the pressure response to the pump trip at pump suction and discharge locations.

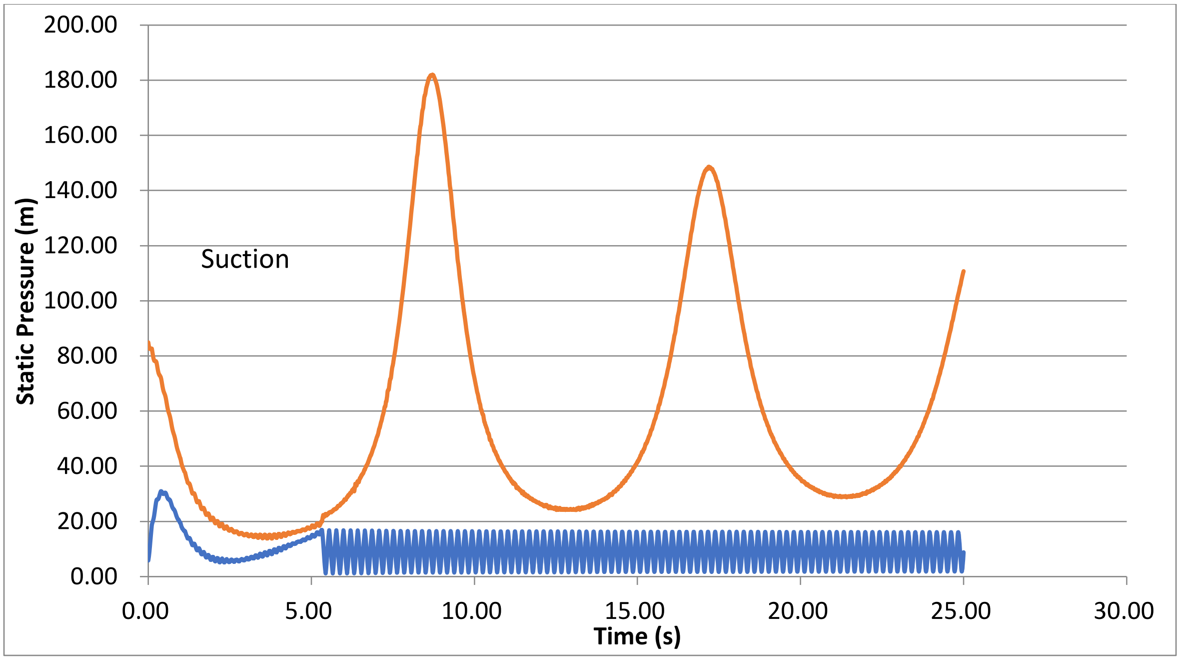


Figure A3.16 Pump suction and discharge pressure responses to pump trip (Scenario 4)

<u>Surge Vessel Operation</u>

Figure A3.17 showed the air volume changes of surge vessel after the pump trip.

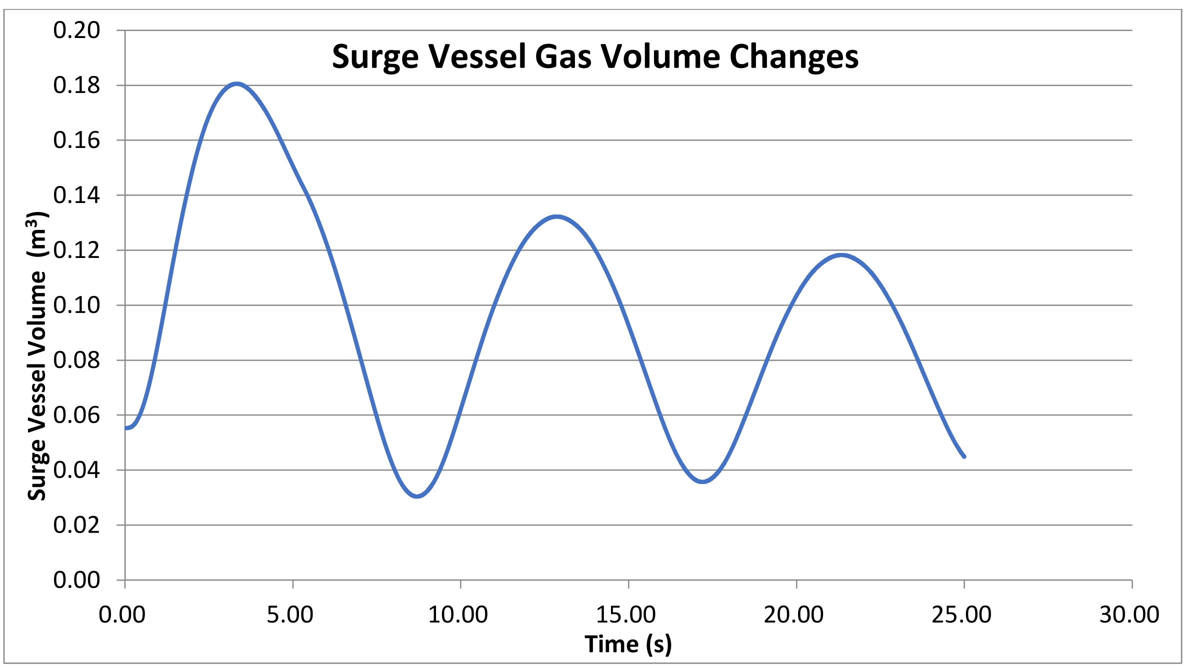


Figure A3.17 Air volume changes of surge vessel (Scenario 4)

<u>Air Valve Operation</u>

Figure A3.18 showed the mass flow through the air valve after the pump trip.

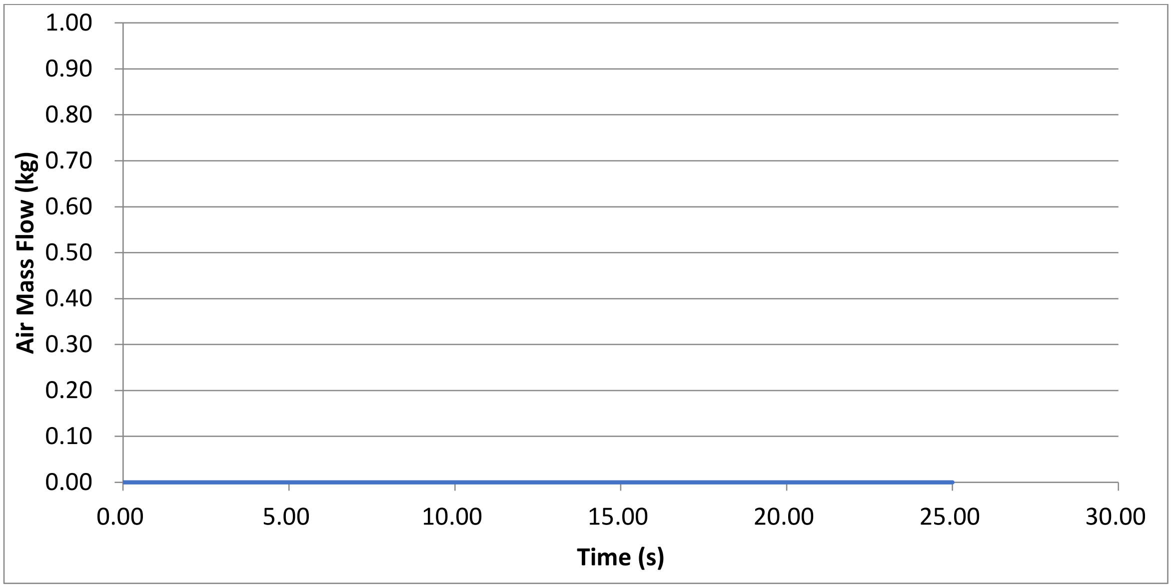


Figure A3.18 Mass flow through air valve (Scenario 4)

Hydraulic Gradient Lines

Figure A3.19 showed the hydraulic gradient lines along the pipeline.

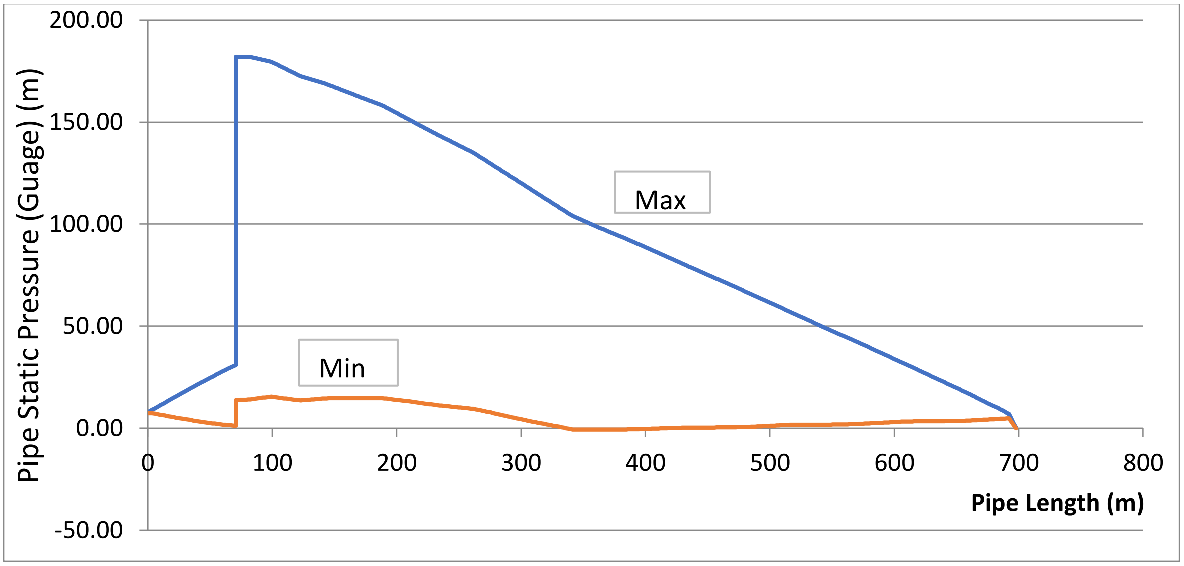


Figure A3.19 Hydraulic gradient lines along the rising main (Scenario 4)

Maximum and minimum pressures along the rising main were 181.93m and -0.70m respectively.

v. **Scenario 5** –Modified pipeline with original size DN200mm; 1 pump trip at intake pressure +65mPD.

Pump Speed After Pump Trip

Figure A3.20 showed the pump speed after tripping of the pump.

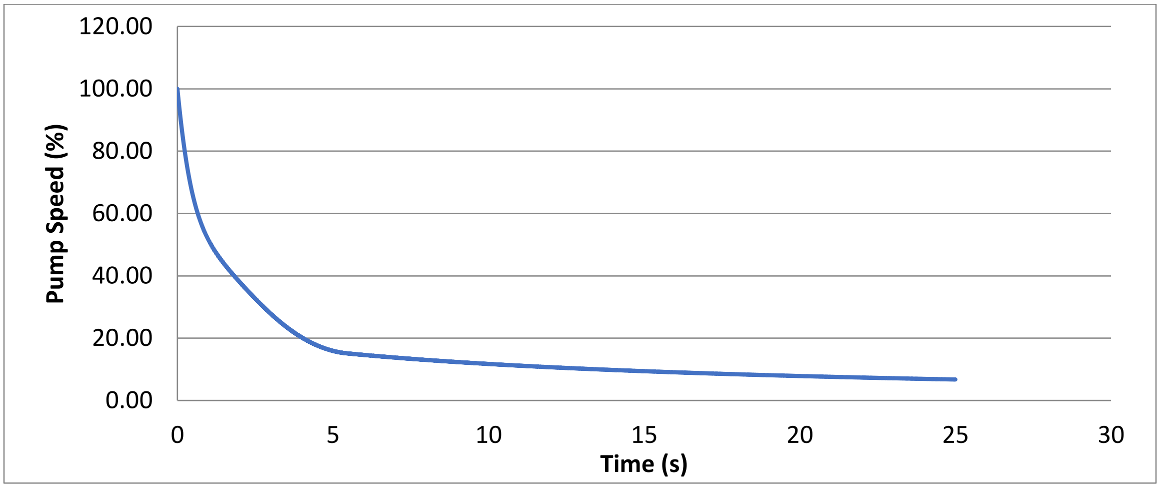


Figure A3.20 Pump speed after tripping action (Scenario 5)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	Static Pressure at Pump Discharge (m)[(a)]
Maximum	35.78	145.08
Minimum	4.65	16.58

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.21 showed the pressure response to the pump trip at pump suction and discharge locations.

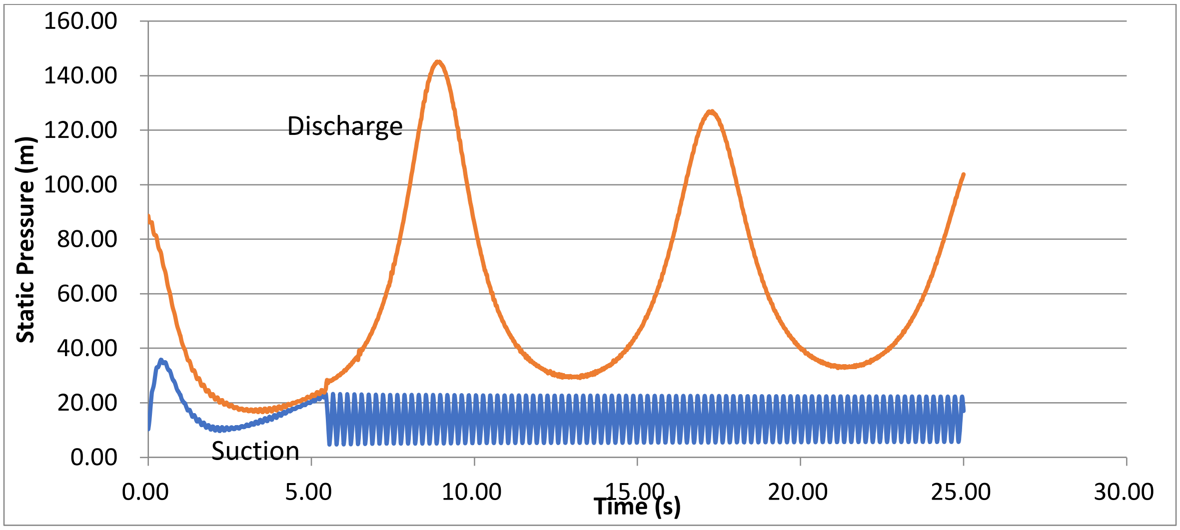


Figure A3.21 Pump suction and discharge pressure responses to pump trip (Scenario 5)

Surge Vessel Operation

Figure A3.22 showed the air volume changes of surge vessel after the pump trip.

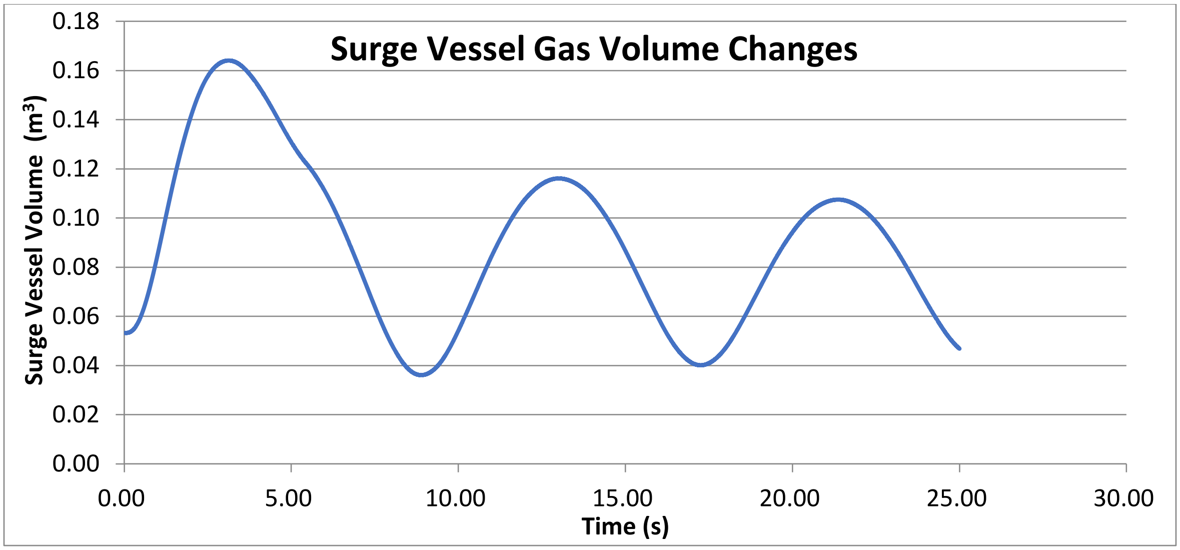


Figure A3.22 Air volume changes of surge vessel (Scenario 5)

Air Valve Operation

Figure A3.23 showed the mass flow through the air valve after the pump trip.

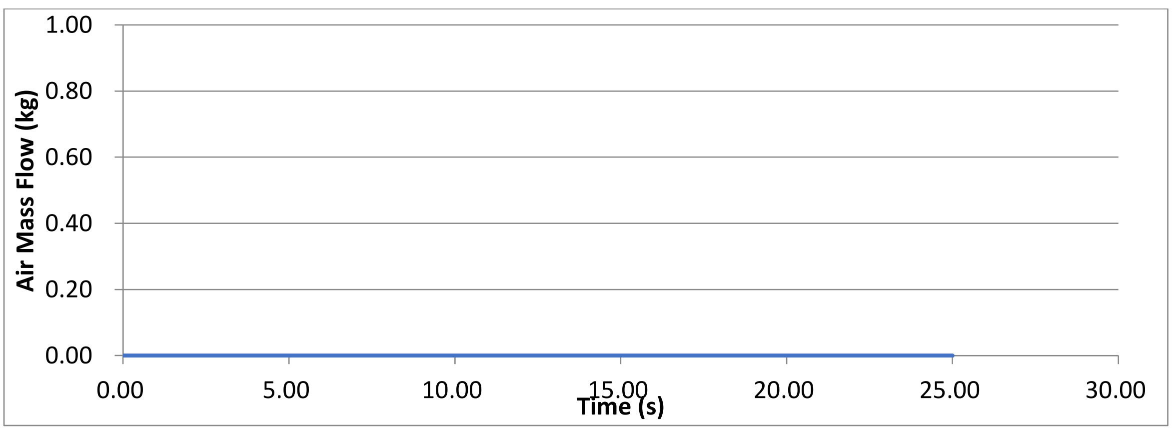


Figure A3.23 Mass flow through air valve (Scenario 5)

Hydraulic Gradient Lines

Figure A3.24 showed the hydraulic gradient lines along the pipeline.

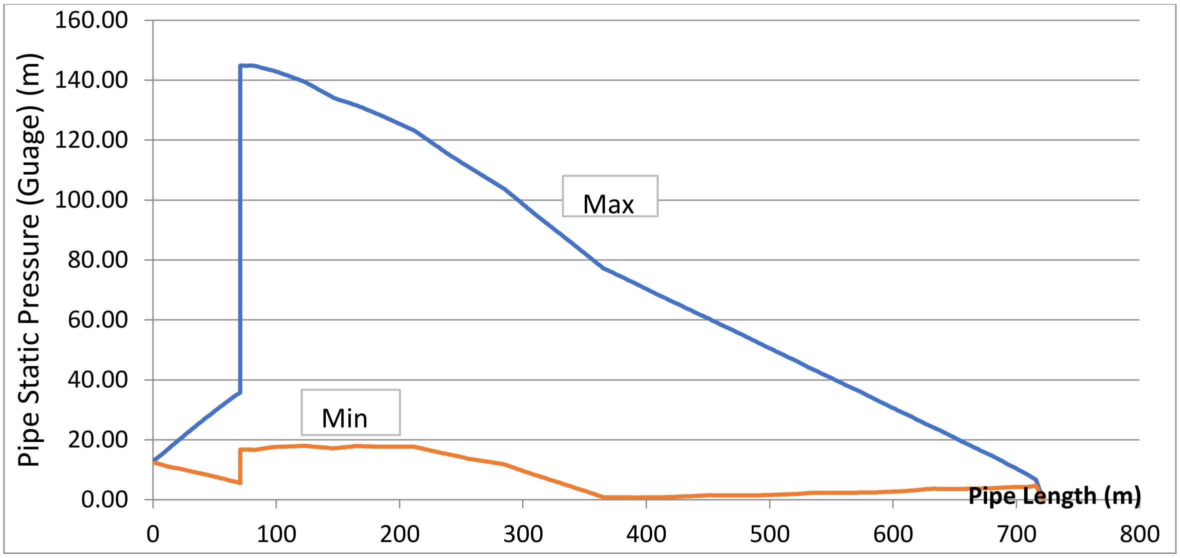


Figure A3.24 Hydraulic gradient lines along the rising main (Scenario 5)

Maximum and minimum pressures along the rising main were 144.85m and 0.098m respectively.

vi. **Scenario 6** –Modified pipeline with original size DN200mm; 1 pump start to 100% speed in 10s, run for 10s and then stop in 10s at intake pressure +60mPD.

<u>Pump Speed After Pump Start and Stop</u>

Figure A3.25 showed the pump speed after starting and stopping of the pump.

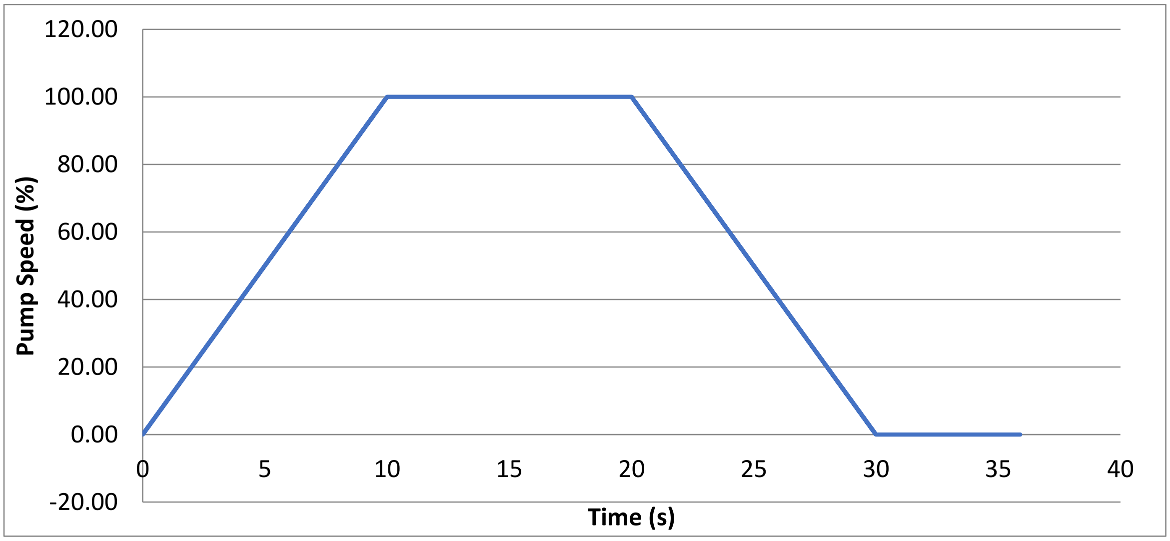


Figure A3.25 Pump speed after starting and stopping action (Scenario 6)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[a]	**Static Pressure at Pump Discharge (m)[a]**
Maximum	8.97	156.02
Minimum	-8.56	18.49

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A3.26 showed the pressure response to the pump start and stop at pump suction and discharge locations.

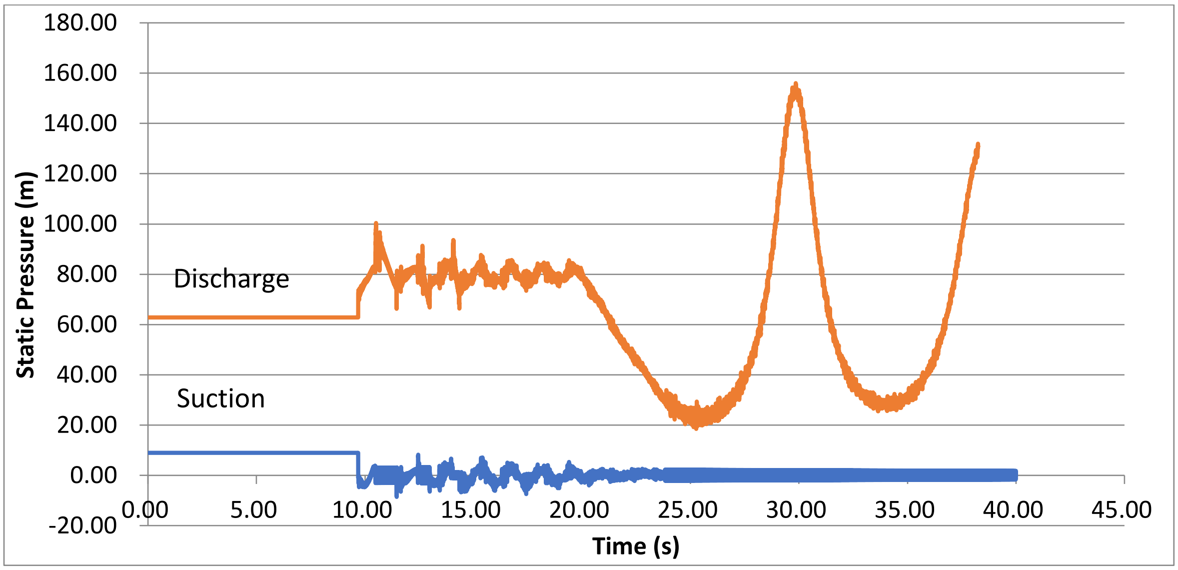


Figure A3.26 Pump suction and discharge pressure responses to pump start and stop (Scenario 6)

<u>Surge Vessel Operation</u>

Figure A3.27 showed the air volume changes of surge vessel after the pump start and stop.

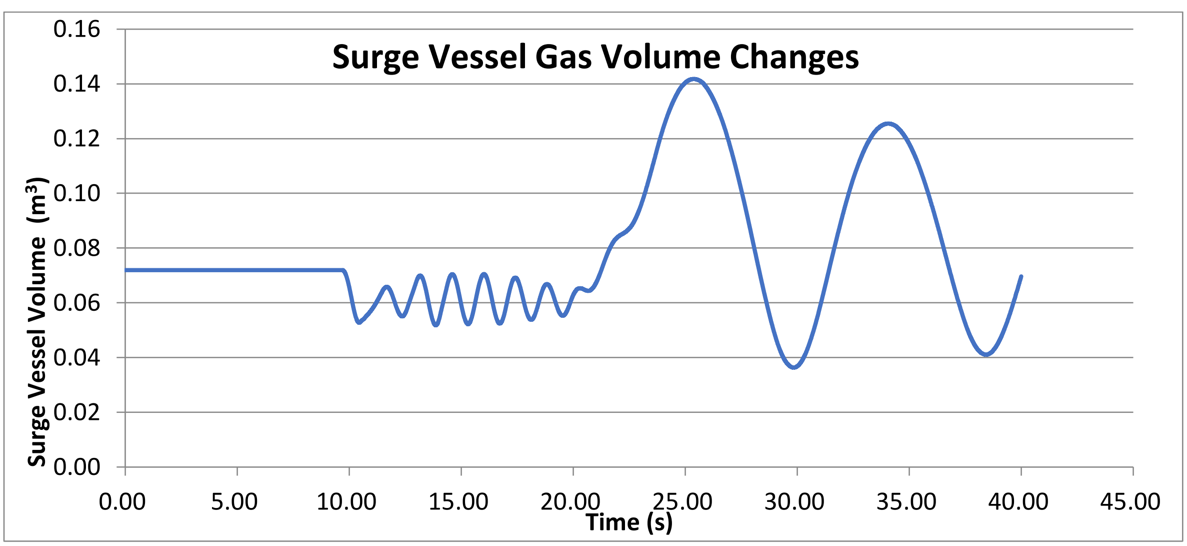


Figure A3.27 Air volume changes of surge vessel (Scenario 6)

Air Valve Operation

Figure A3.28 showed the mass flow through the air valve after the pump start and stop.

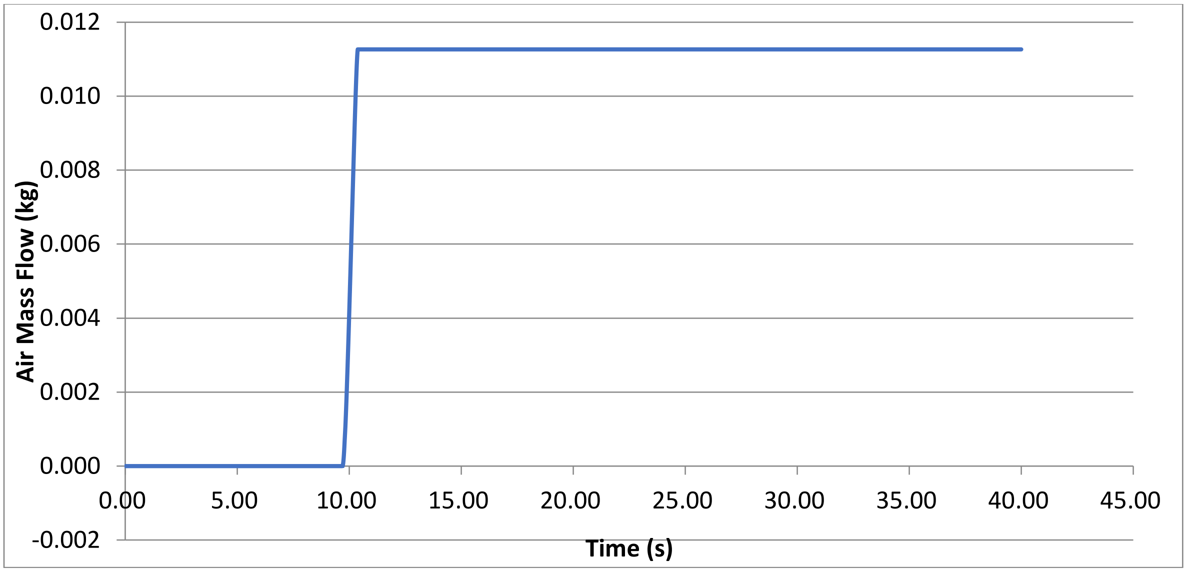


Figure A3.28 Mass flow through air valve (Scenario 6)

Hydraulic Gradient Lines

Figure A3.29 showed the hydraulic gradient lines along the pipeline.

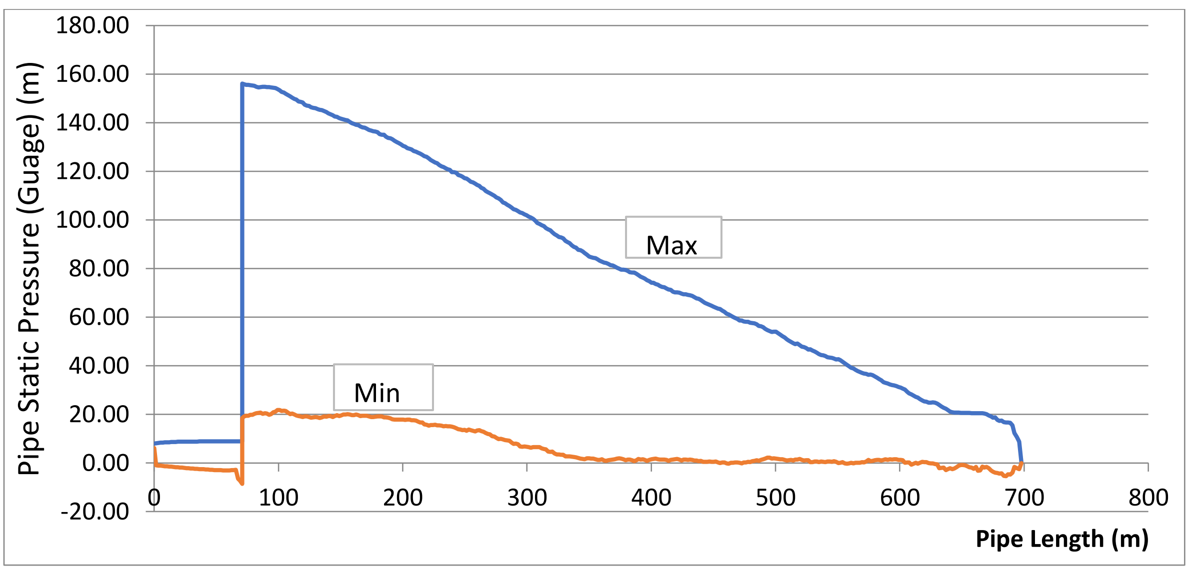


Figure A3.29 Hydraulic gradient lines along the rising main (Scenario 6)

Maximum and minimum pressures along the rising main were 156.02m and -8.56m respectively.

vii. **Scenario 7** –Modified pipeline with original size DN200mm; 1 pump start to 100% speed in 10s, run for 10s and then stop in 10s at intake pressure +65mPD.

Pump Speed After Pump Start and Stop

Figure A3.30 showed the pump speed after starting and stopping of the pump.

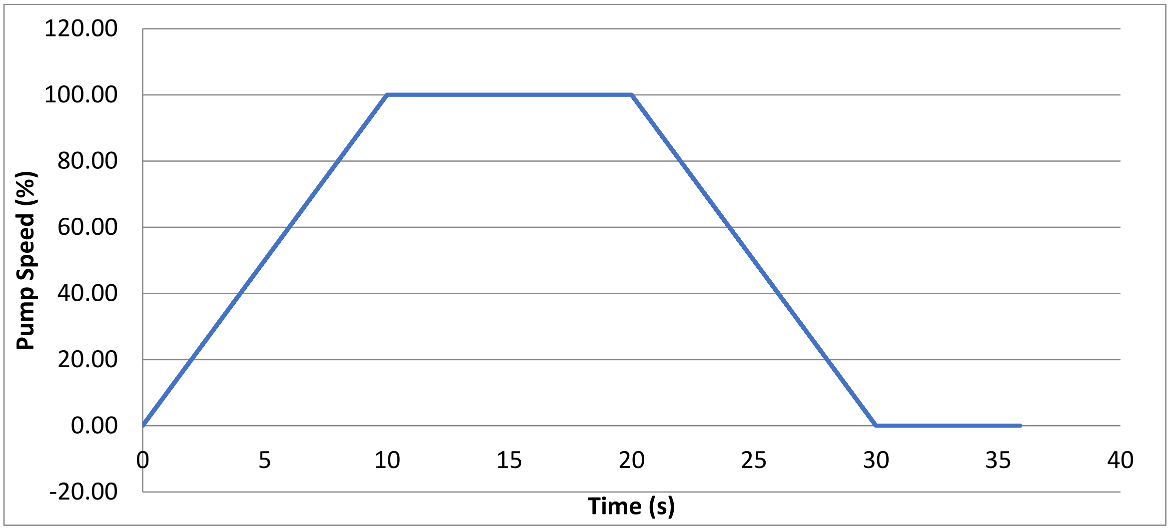


Figure A3.30 Pump speed after starting and stopping action (Scenario 7)

Pressure Variation Range at Pump Discharge

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	13.96	155.85
Minimum	-9.09	19.04

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.31 showed the pressure response to the pump start and stop at pump suction and discharge locations.

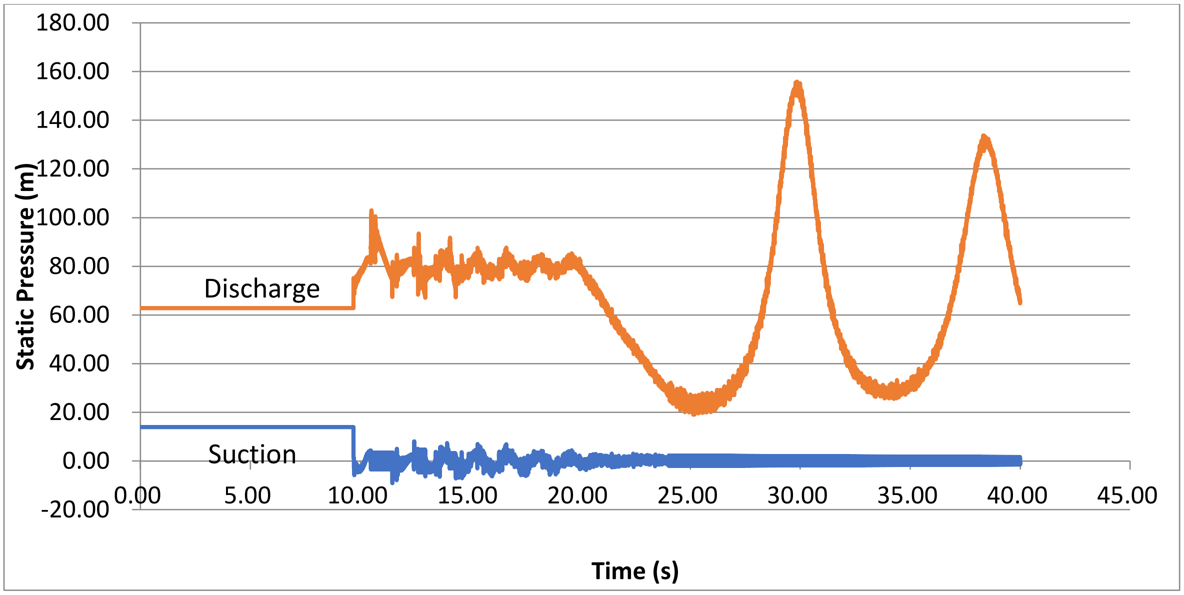


Figure A3.31 Pump suction and discharge pressure responses to pump start and stop (Scenario 7)

<u>Surge Vessel Operation</u>

Figure A3.32 showed the air volume changes of surge vessel after the pump start and stop.

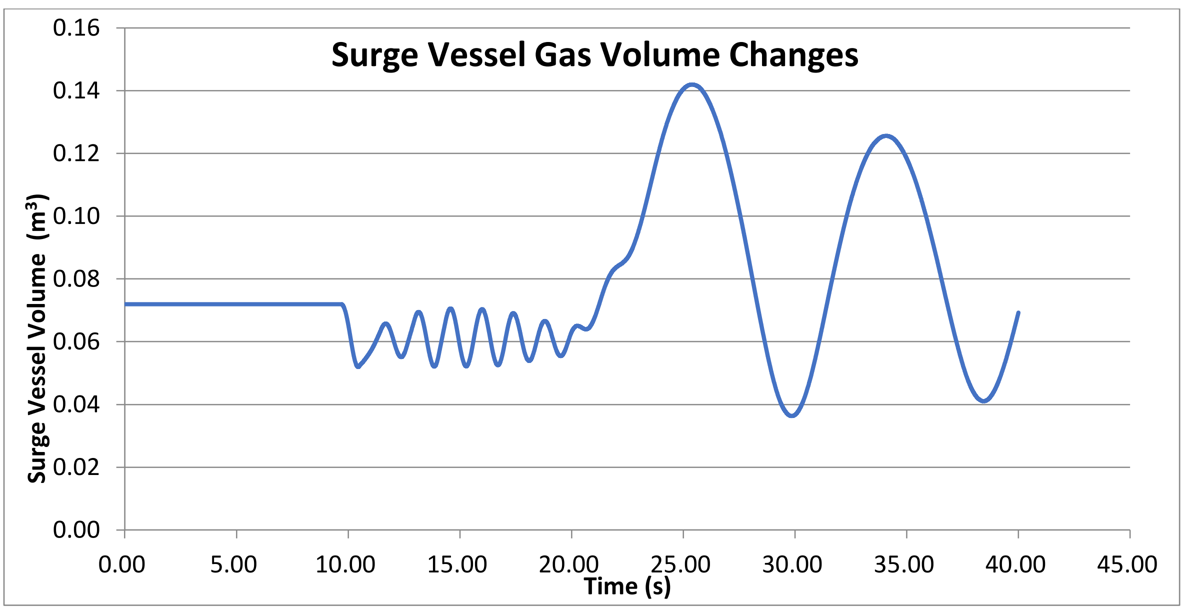


Figure A3.32 Air volume changes of surge vessel (Scenario 7)

<u>Air Valve Operation</u>

Figure A3.33 showed the mass flow through the air valve after the pump start and stop.

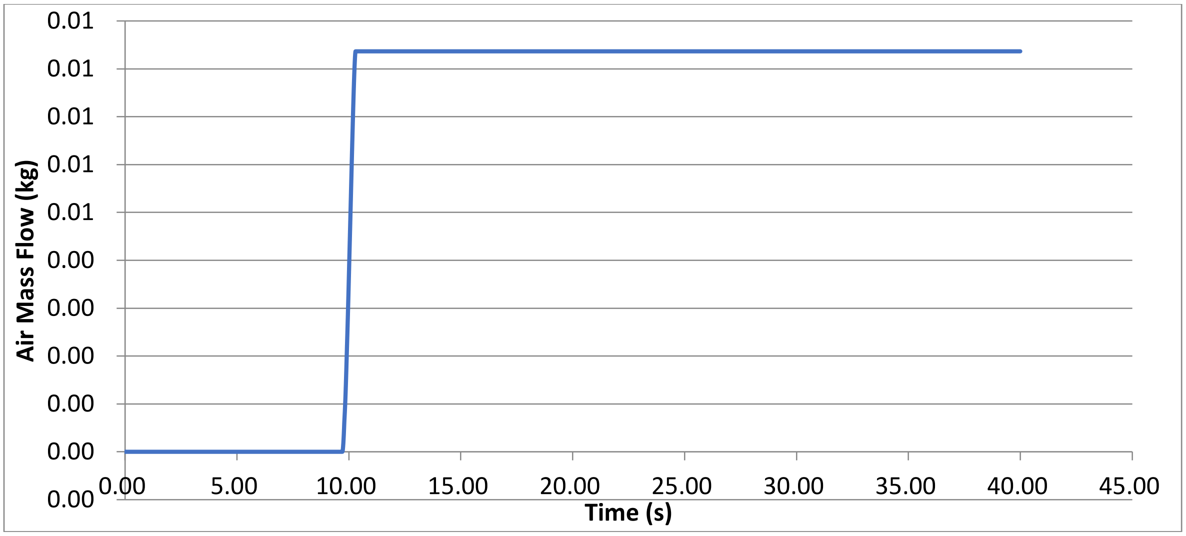


Figure A3.33 Mass flow through air valve (Scenario 7)

Hydraulic Gradient Lines

Figure A3.34 showed the hydraulic gradient lines along the pipeline.

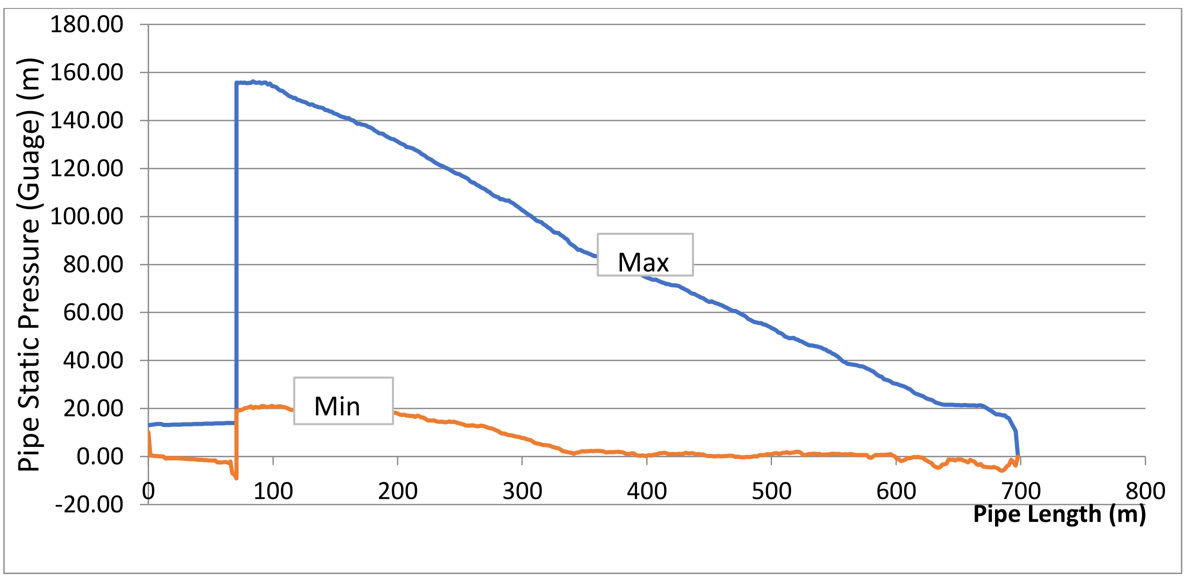


Figure A3.34 Hydraulic gradient lines along the rising main (Scenario 7)

Maximum and minimum pressures along the rising main were 156.29m and -9.09m respectively.

viii. **Scenario 8** –Modified pipeline with original size DN200mm; 1 operating pump stop in 10s, rest for 10s and then start again to 100% speed in 10s at intake pressure +60mPD.

Pump Speed After Pump Start and Stop

Figure A3.35 showed the pump speed after stopping and starting of the pump.

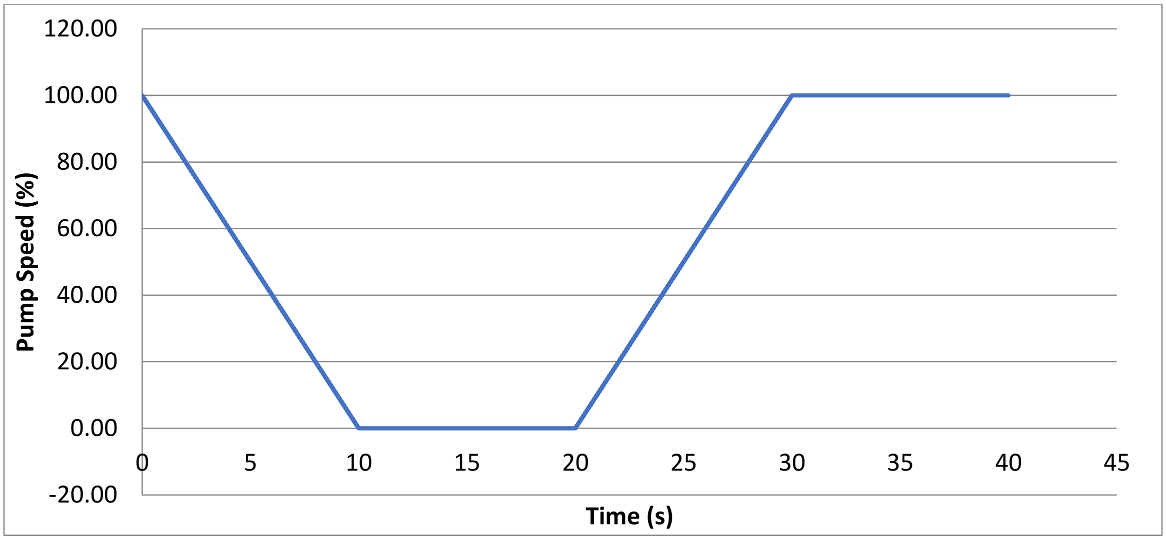


Figure A3.35 Pump speed after stopping and starting action (Scenario 8)

<u>Pressure Variation Range at Pump Discharge</u>

	Static Pressure at Pump Suction (m)[(a)]	**Static Pressure at Pump Discharge (m)[(a)]**
Maximum	13.54	149.49
Minimum	-7.01	22.99

Remark[(a)]: it indicated the pressure range of the pump required to be experienced.

Figure A3.36 showed the pressure response to the pump start and stop at pump suction and discharge locations.

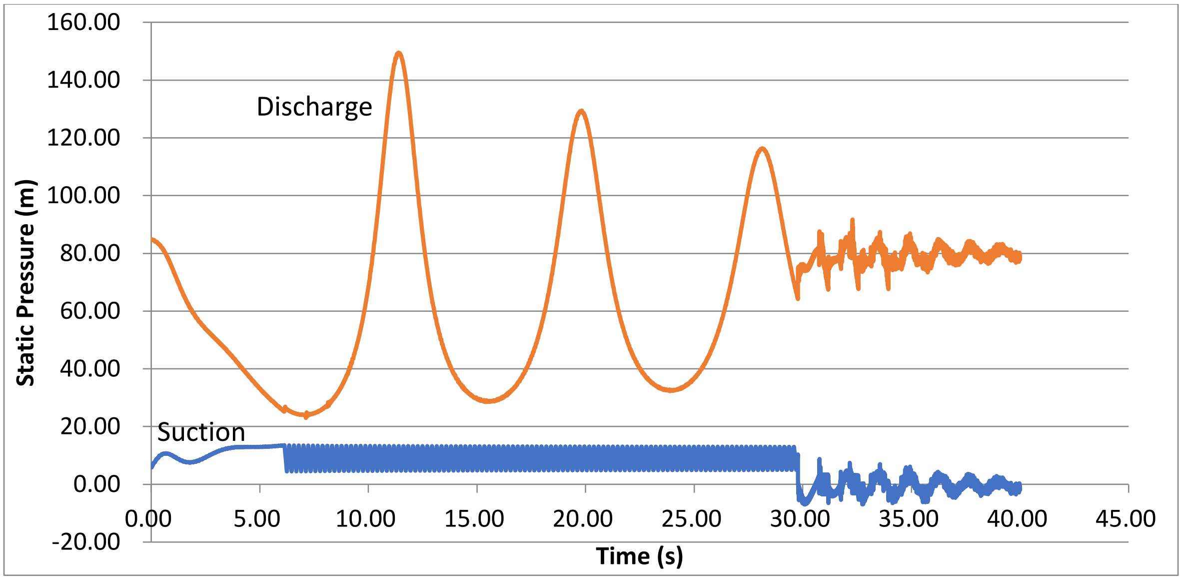


Figure A3.36 Pump suction and discharge pressure responses to pump stop and start (Scenario 8)

<u>Surge Vessel Operation</u>

Figure A3.37 showed the air volume changes of surge vessel after the pump stop and start.

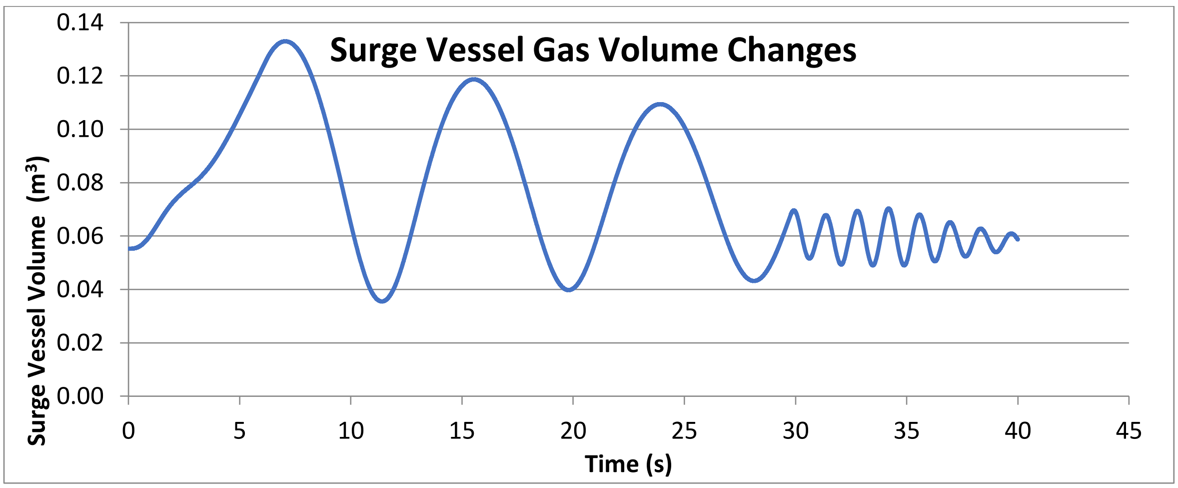


Figure A3.37 Air volume changes of surge vessel (Scenario 8)

<u>Air Valve Operation</u>

Figure A3.38 showed the mass flow through the air valve after the pump start and stop.

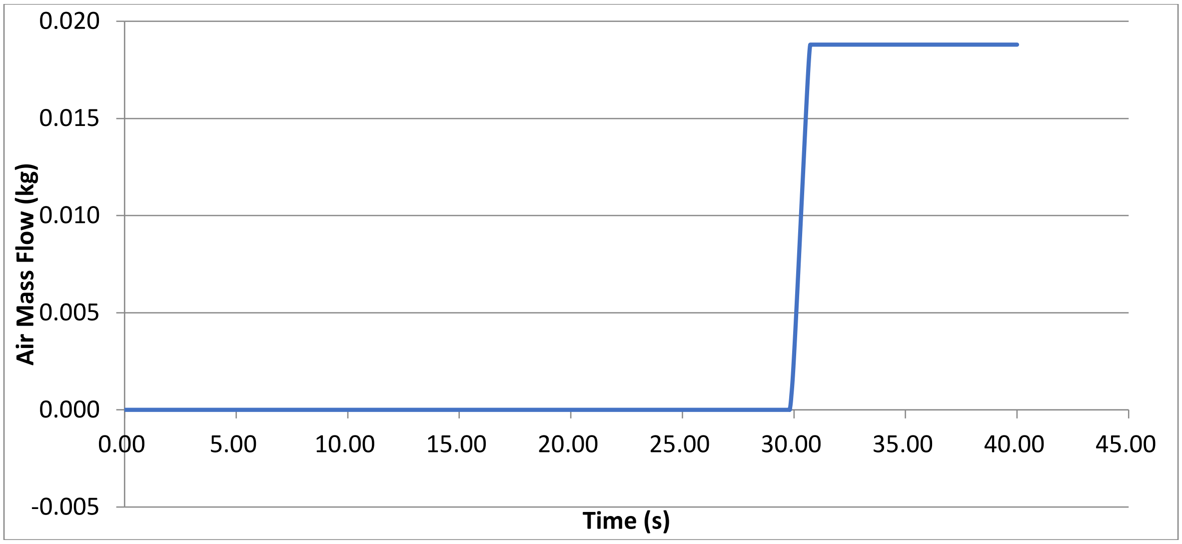


Figure A3.38 Mass flow through air valve (Scenario 8)

Hydraulic Gradient Lines

Figure A3.39 showed the hydraulic gradient lines along the pipeline.

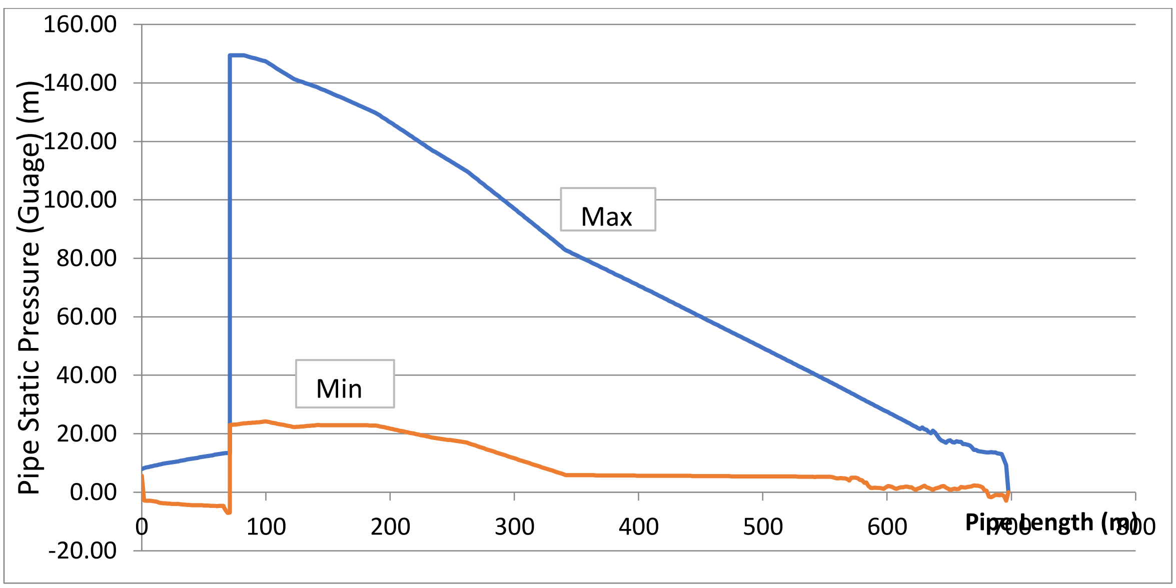


Figure A3.39 Hydraulic gradient lines along the rising main (Scenario 8)

Maximum and minimum pressures along the rising main were 149.49m and -7.08m respectively.

ix. **Scenario 9** –Modified pipeline with original size DN200mm; 1 operating pump stop in 10s, rest for 10s and then start again to 100% speed in 10s at intake pressure +65mPD.

Pump Speed After Pump Start and Stop

Figure A3.40 showed the pump speed after stopping and starting of the pump.

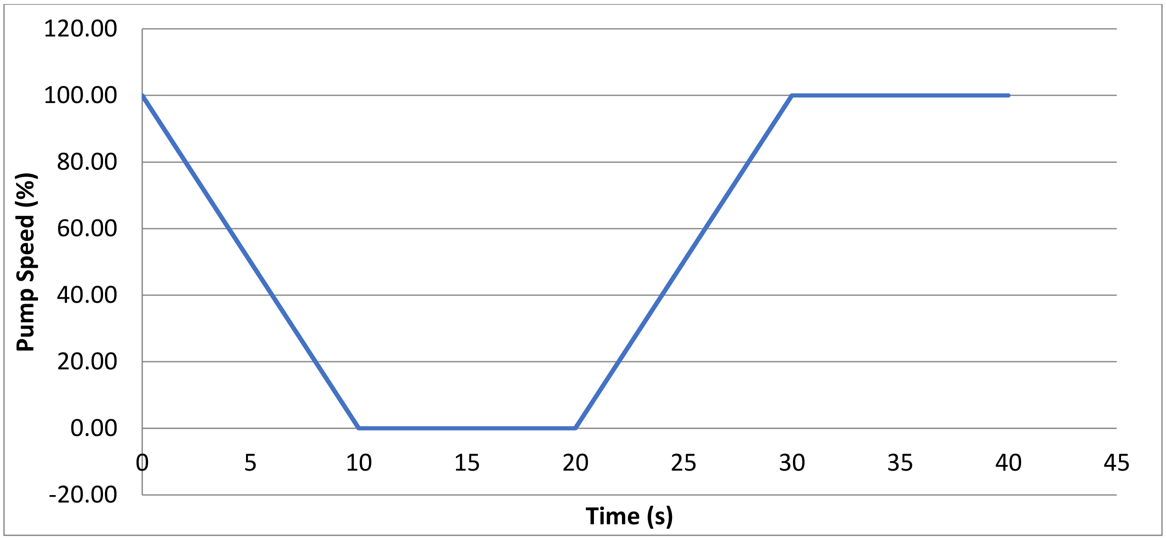


Figure A3.40 Pump speed after stopping and starting action (Scenario 9)

<u>**Pressure Variation Range at Pump Discharge**</u>

	Static Pressure at Pump Suction (m)[a]	**Static Pressure at Pump Discharge (m)[a]**
Maximum	18.51	142.58
Minimum	-7.24	24.70

Remark[a]: it indicated the pressure range of the pump required to be experienced.

Figure A3.41 showed the pressure response to the pump stop and start at pump suction and discharge locations.

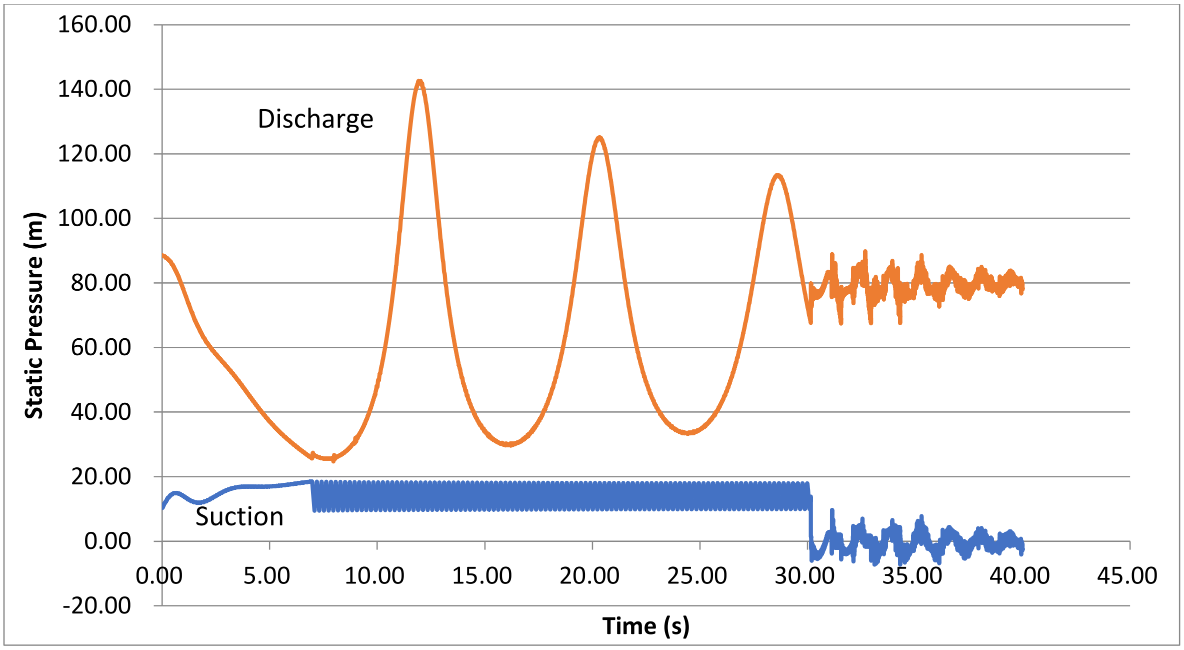


Figure A3.41 Pump suction and discharge pressure responses to pump stop and start (Scenario 9)

Surge Vessel Operation

Figure A3.42 showed the air volume changes of surge vessel after the pump stop and start.

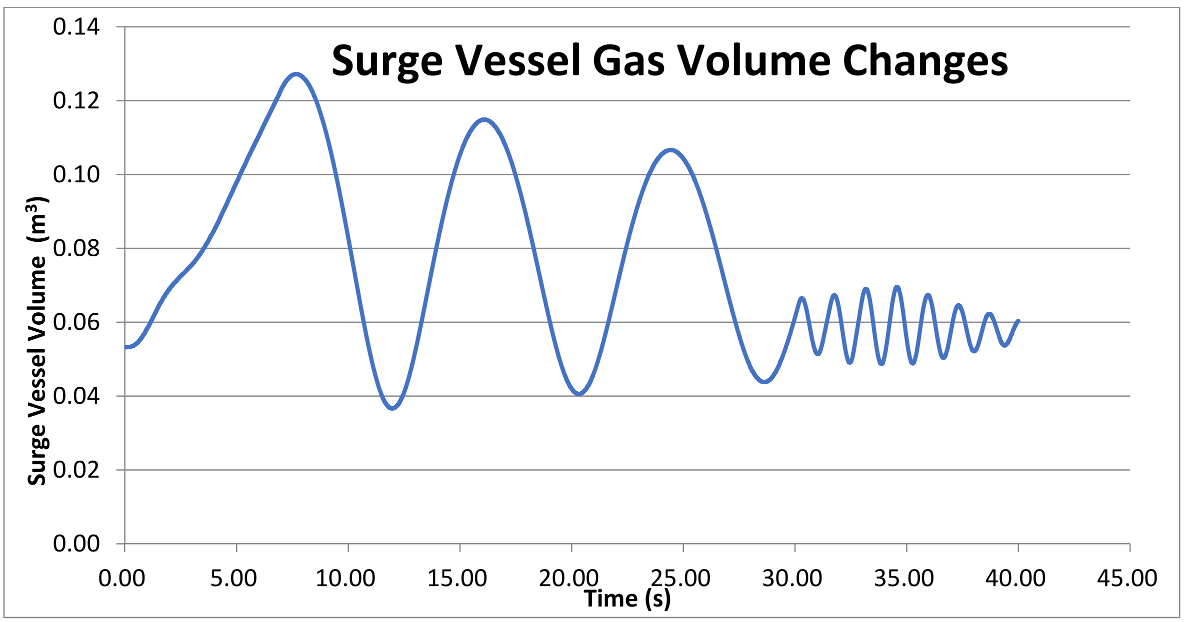


Figure A3.42 Air volume changes of surge vessel (Scenario 9)

Air Valve Operation

Figure A3.43 showed the mass flow through the air valve after the pump stop and start.

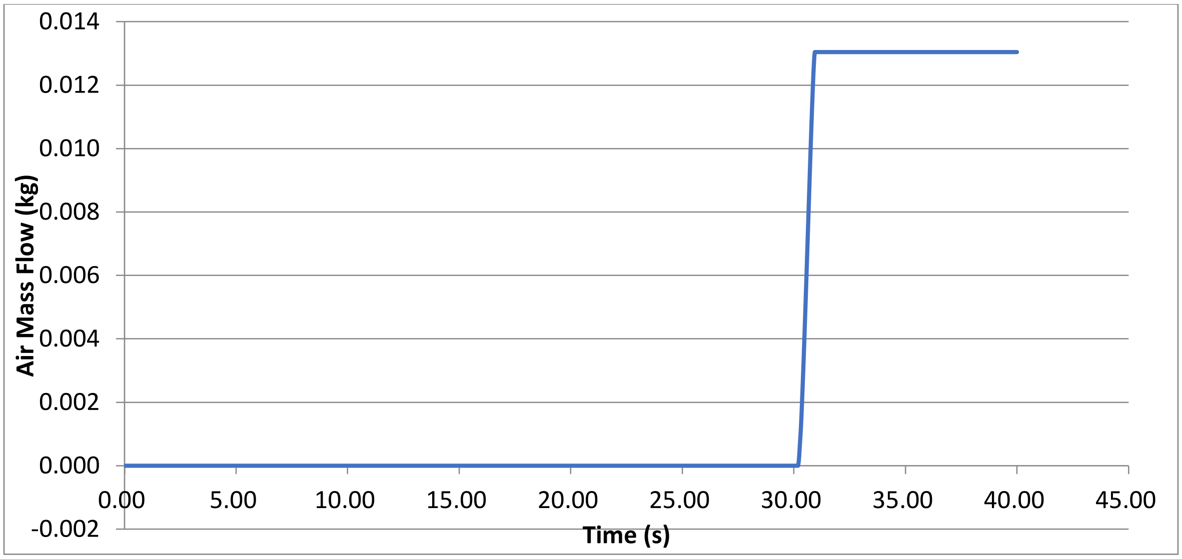


Figure A3.43 Mass flow through air valve (Scenario 9)

Hydraulic Gradient Lines

Figure A3.44 showed the hydraulic gradient lines along the pipeline.

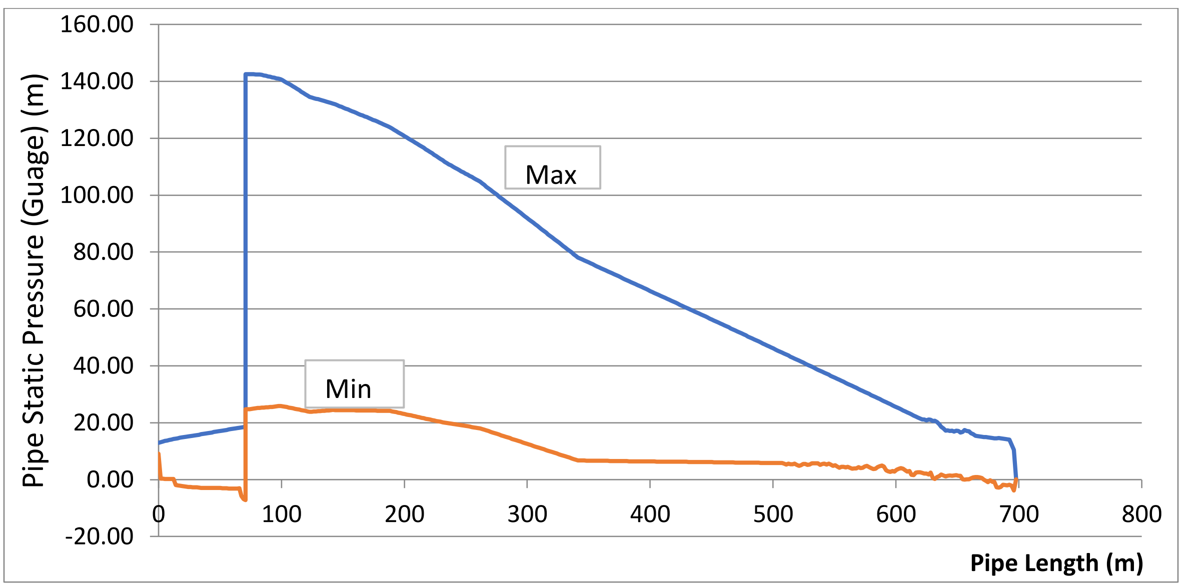


Figure A3.44 Hydraulic gradient lines along the rising main (Scenario 9)

Maximum and minimum pressures along the rising main were 142.58m and -7.24m respectively.