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2. PROJECT DESCRIPTION AND PROJECT CONSIDERATION

2.1 Project Objective

2.1.1 The objectives of the Project are to upgrade the drainage provisions at Tai Tei Tong, Luk Tei Tong, Nam Bin Wai, Ma Po Tsuen, Ling Tsui Tau and Chung Hau to the latest flood protection standard and relieve the flood risks in the low-lying areas of Mui Wo.

2.2 Project Location

2.2.1 The Project areas are mainly consisting with river channels and roads, residential/village type development and agricultural.

2.2.2 There are five (5) major river channels in Mui Wo, namely Pak Ngan Heung River, Tai Tei Tong River, Luk Tei Tong River (West), Luk Tei Tong Bypass Channel and Luk Tei Tong River (South) for collecting runoff of the rural catchment on the west of Mui Wo. These five (5) major river channels in Mui Wo converge at River Silver, with urban developments on both sides, flowing towards the outfall on the east to the sea.

2.2.3 Most of the watercourses in Mui Wo remain untouched at their upper reaches and are partially channelised at their midstream and downstream.

2.2.4 The current land uses within the Project area are generally rural village with farmland and orchard at the upstream location (i.e. Tai Tei Tong, Ma Po Tsuen and Luk Tei Tong) and suburban development with residential, government, institution or community use at the downstream location (Ling Tsui Tau, Chung Hau).

2.2.5 Majority residential area in west of Mui Wo is located at Ling Tsui Tau, Chung Hau. An existing bathing beach (i.e., Silver Mine Bay Beach), is located within 500m site boundary at the downstream location.

2.2.6 Lantau North Country Park and Sunset Peak Site of Special Scientific Interest (SSSI) area located at the west of Project area while Lantau South Country Park is located at the south of Project area. Fung Shui Woods at Pak Ngan Heung and Luk Tei Tong are located at the north and south of Project area. The Country Park, SSSI area and Fung Shui Woods mentioned above are outside the works area of the Project.

2.2.7 Six (6) Grade 2 historic sites/buildings/structures and one (1) Grade 3 historic sites/buildings/structures are located within Yuen's Mansion outside the works area of the Project.

2.3 Site History

2.3.1 Drainage improvement works in Southern Lantau, which involved widening three existing bottlenecks at Tai Tei Tong River; construction of about 80 metres long river channel, about 180 metres of diversion box culvert and about 100 metres of channel at the upstream, midstream and downstream of the Pak Ngan Heung River respectively; and construction of about 350 metres and 240 metres long of river channels at Luk Tei Tong Bypass Channel and Luk Tei Tong River respectively, was completed in 2010 under DC/2006/11.

- 2.3.2 Although drainage improvement works completed at some sections of Tai Tei Tong River in 2010, it was confined at three bottlenecks of the river and the drainage capacity of Tai Tei Tong River is remains inadequate.
- 2.3.3 The DMP Review Study completed in 2018 revealed that the drainage provisions at the Tai Tei Tong, Luk Tei Tong, Nam Bin Wai, Ma Po Tsuen, Ling Tsui Tau and Chung Hau could not meet the latest flood protection standard, taking cognisance of the topography, existing drainage capacity and updated hydrological statistics.
- 2.3.4 The flooding incident recorded in Mui Wo during the red rainstorm warning in May 2015, typhoon *Hato* in August 2017 and typhoon *Mangkhut* in September 2018 corroborated the above findings in DMP Review Study.

2.4 Project Interface and Stakeholders

- 2.4.1 The major potential project interfaces are listed in **Table 2.1** and presented in **Figure 2.5**. Detailed discussion on the cumulative impacts from the concurrent projects is presented in **Section 2.16**.

Table 2.1 - Potential Project Interface

| Department | Project | Programme |
|---|--|---|
| Drainage Services Department (DSD) | PWP No. 4353DS – Outlying Islands Sewerage Stage 2 – Extension of Sewerage System to Other Unsewered Villages in Mui Wo Village Sewerage Works at Luk Tei Tong and Ma Po Tsuen | November 2021 – June 2025 |
| | Desilting Works at River Silver Mui Wo | 1 st desilting works conducted in Q1 2021. Subsequent desilting works will be reviewed annually and carried out if necessary |
| CLP | LV cable laying at Nam Bin Wai near Tai Tei Tong, Mui Wo | No information available |
| | LV cable laying & meter box erection at Ling Tsui Tau Lot. 41, 42, 43, Mui Wo, Lantau | No information available |
| Civil Engineering and Development Department (CEDD) | 7414 RO “Improvement Works at Mui Wo – Remaining Phase” | Programme to be confirmed |

2.5 Environmental Benefits of the Project

- 2.5.1 Upon completion of the drainage improvement measures, the flood protection standard at Tai Tei Tong, Luk Tei Tong, Nam Bin Wai, Ma Po Tsuen, Ling Tsui Tau and Chung Hau will be upgraded to meet the requirements in the latest DSD’s Stormwater Drainage Manual. The flood risks of the low-lying areas in Mui Wo thereon can be significantly relieved and help safeguard the livelihood of existing and future development along the river.

- 2.5.2 Tidal gate and mechanical penstock will be operated according to the tidal and weather condition. The tidal gate and mechanical penstock will be opened in general circumstance. Under high tidal and / or adverse weather condition such as typhoon and storm surge events, tidal gate will be closed in advance to prevent seawater intrusion to the low-lying areas while mechanical penstock will be closed appropriately to divert the stormwater to stormwater pumping station to prevent flooding.
- 2.5.3 Enhancement measures such as river revitalisation works will also be introduced along Luk Tei Tong Bypass Channel which could improve and enhance the appearance of the rivers and surroundings. Blue-green infrastructure concepts will be adopted in this Project, such as planting and landscaping work along riverbanks to promote greening, enhance biodiversity and beautify the surrounding environment. Leisure facilities will also be provided appropriately along Luk Tei Tong Bypass Channel to improve the amenity value.
- 2.5.4 Enhancement measures include provision of fish ladders at mid-stream of Tai Tei Tong River and up-stream of Tai Tei Tong River to relieve the level difference which hinders fish movement along the river. Upon completion, fish movement along the river can be enhanced. The fish ladder will be designed using natural bedding material with small ponds and waterfalls to mimic the natural stream course and provide habitats for aquatic life.
- 2.5.5 The proposed stormwater pumping station will integrate the concept of sustainability and green building design including green roof and vertical greening such as planting of climbers to enhance the greenery of proposed structure. Measures to safeguard environmental quality and reduce the carbon footprint include retaining natural vegetation, phasing of construction to minimise noise and dust emissions, stormwater reuse by means of rain harvesting for irrigation purpose will be adopted.
- 2.5.6 In addition, the applicability of usage of renewable energy (i.e. Solar Panel) for leisure facilities, street lighting, flood control system and electrical and mechanical (E&M) system within the stormwater pumping station will be adopted as far as practicable in order to reduce the energy consumption and carbon emission during the operation phase of the Project.

2.6 Without Project Scenario

- 2.6.1 Without the Project, the flood risk would persist, and extent of flooding would continue to increase in the Mui Wo area under extreme weather events and increasing sea-level due to climate change.
- 2.6.2 Livelihood of existing and future development along the Pak Ngan Heung River, Tai Tei Tong River, Luk Tei Tong River (West), Luk Tei Tong Bypass Channel and Luk Tei Tong River (South) will be at risk without the Project.
- 2.6.3 In addition, flooding and seawater intrusion due to adverse weather and high tide condition could cause potential damage to existing graded historic sites/buildings/structures and living habitats of wildlife.

2.6.4 Under existing condition, the residual flooding resulted in approximately 1,000mm at the major flooding locations, which are located along Tai Tei Tong River, at the Ma Po Tsuen, Nam Bin Wai & Yuen's mansion, and the Mui Wo Rural Committee Road at Chung Hau respectively.

2.7 With Project Scenario

2.7.1 In comparison with the previous drainage improvement works completed in 2010 under DC/2006/11, the proposed design scheme could effectively mitigate the flood risk while land requirement for project implementation is kept minimal in line with minimum land requirement.

2.7.2 Upon completion of the drainage improvement measures, the flood protection standard at the concerned areas will be upgraded to meet the requirements in the latest DSD's Stormwater Drainage Manual and the flood risks of the low-lying areas in Mui Wo thereon can be significantly relieved.

2.8 Relevant Technical Circulars / Guidelines

2.8.1 Reference has been made to the following Government Technical Circulars / Guidelines in designing the Project:

- Development Bureau Technical Circular No. 2/2015 and Environmental Bureau Circular Memorandum No. 3/2015 – Green Government Buildings;
- Environment, Transportation and Works Bureau Technical Circular (Works) No. 5/2005 – Protection of Natural Streams / Rivers from Adverse Impacts Arising from Construction Works;
- DSD Technical Circular No. 2/2004 – Protection of Natural Rivers and Streams from Adverse Impact Arising from Construction Works; and
- DSD Practice Note No. 3/2021 – Guideline on Design for Revitalisation of River Channel

2.8.2 The first Technical Circular set out the best practicable targets to be achieved for green government buildings, including the requirement that renewable energy technologies should be incorporated in all new government buildings and all capital works projects as far as practicable.

2.8.3 The second and third Technical Circulars provide an administrative framework to better protect all natural streams / rivers from the impacts of construction works, to provide guidelines for the planning and execution of construction works and for the vetting of development proposals that affect natural rivers and streams.

2.8.4 The last DSD Practice Note presents the essential environmental and ecological considerations that should be taken into account and incorporated wherever practicable, in the design of river channels. The Practice Note addresses the eco-hydraulics design in implementing flood mitigation works and it would help mainstream biodiversity and sustainable use of biological resources.

2.9 Essential Design Consideration / Principal Adopted

2.9.1 In addition to the Government guidelines, the following essential design considerations / principles were considered in formulating the preferred options:

- Flood protection capability – The proposed drainage improvement works should have adequate capability to achieve DSD’s flood protection standard taken into account the probability of flooding and climate changes factors;
- Environmental impacts – Environmental impacts shall be taken into account the consideration for preferred design option. Alternative construction method and environmentally friendly design should also be considered to reduce the environmental impacts during the construction and operation phase of the project;
- Public safety – Flood wall and gabion wall along the riverbank will be key elements to protect potential flooding during high tide and adverse weather. The protection should be stable for long-term usage while minimising the disturbance to nearby resident and road user during construction;
- Existing site condition – The downstream and upstream areas are connected by narrow passage. Disturbance to the public shall be considered in formulation the preferred alignment and construction methods;
- Land resumption - Resumption of private domestic houses / any commercial use lands / factories needs to be minimized as much as possible; and
- Blue Green Infrastructure design – The design of the Project shall also aim to improve the sustainability and resilience of Hong Kong’s drainage system to meet the contemporary public aspirations in respect of the natural environment and protection of the local culture and rural lifestyle.

2.10 Design Options

2.10.1 In general, the proposed design options follow the alignment of existing watercourses in order to minimize land resumption and nuisance to public wherever possible.

2.10.2 River reprofiling at upstream of Tai Tei Tong River will be essential element of this Project as the drainage capacity of river section is under perform and could cause potential flooding during adverse weather. Construction of flood wall / reconstruction of gabion wall at the upstream of Tai Tei Tong River, downstream of Tai Tei Tong River and western bank of Luk Tei Tong River (South) are also required to prevent flooding.

Conforming Scheme

2.10.3 Conforming Scheme is the drainage improvement works proposed in the DMP Review Study.

2.10.4 Two (2) mechanical penstocks are proposed in Conforming Scheme. One (1) is located at the upstream of Tai Tei Tong River and another one (1) is located at the upstream of

Luk Tei Tong River (West) to control the stormwater flow.

- 2.10.5 Two (2) tidal gates are proposed at the downstream of Tai Tei Tong River and Luk Tei Tong River (West) to prevent flooding cause by high tide condition and seawater intrusion.
- 2.10.6 Under adverse weather condition, the stormwater at upstream of Tai Tei Tong River will be diverted to Pak Ngan Heung River and Luk Tei Tong Bypass Channel via proposed diversion box culvert respectively. Hence, construction of flood wall / Reconstruction of gabion wall will be required along the riverbanks of Luk Tei Tong Bypass Channel.
- 2.10.7 Stormwater pumping station with area of 750m² and pump rate of 10m³/s is proposed at Nam Bin Wai to collect the stormwater during adverse weather and discharge at downstream of Pak Ngan Heung River.
- 2.10.8 The design of Conforming Scheme is shown in **Figure 2.1**.

Design Option 1

- 2.10.9 Design Option 1 is modified based on Conforming Scheme and diversion box culvert from upstream of Tai Tei Tong River to Pak Ngan Heung River will be omitted. Stormwater during adverse weather condition at upstream of Tai Tei Tong River will be diverted to Luk Tei Tong Bypass Channel via diversion box culvert.
- 2.10.10 Tidal gate at Luk Tei Tong River (West) in Conforming Scheme will be replaced by mechanical penstock and will be closed to prevent stormwater from Luk Tei Tong River (South) entering Luk Tei Tong River (West) during adverse weather. Tidal gate at downstream of Tai Tei Tong River in Conforming Scheme will be relocated to River Silver to act as first layer of protection to low-lying area in west of Mui Wo. Reconstruction of gabion wall at the downstream of Luk Tei Tong Bypass Channel will be then omitted.
- 2.10.11 Alignment of stormwater drainage at Ma Po Tsuen will be modified and located along existing public road to avoid land resumption of private lots as far as practicable.
- 2.10.12 Same as Conforming Scheme, the stormwater pumping station in Design Option 1 will be located at Nam Bin Wai, but the area and pump rate is required to increase to 1600m² and 12m³/s respectively. Stormwater collected will be discharged outside the tidal gate at River Silver.
- 2.10.13 Design Option 1 is shown in **Figure 2.2**. After enhancing the drainage system, the residual flooding resulted in under 600mm at the Luk Tei Tong River upstream, which is considered as relatively rural and floodable area.

Design Option 2

- 2.10.14 The mechanical penstock at downstream of Luk Tei Tong River (West) will be omitted. Gabion wall will be then required to reconstruct at Luk Tei Tong River (West) to prevent flooding during adverse weather.

- 2.10.15 Stormwater will be diverted to stormwater pumping station at Chung Hau with area of 3650m² and pump rate 120m³/s respectively. Stormwater collected will be discharged outside the tidal gate at River Silver.
- 2.10.16 Design Option 2 is shown in **Figure 2.3**. After enhancing the drainage system, the residual flooding resulted in under 600mm at the Luk Tei Tong River upstream, which is considered as relatively rural and floodable area.

Design Option 3

- 2.10.17 Tidal gate will be proposed at downstream of Luk Tei Tong River (South) to focus the protection of low-lying area at Ma Po Tsuen and Luk Tei Tong River (South). In this case, gabion wall along Luk Tei Tong River (West) will only be required to construct at downstream.
- 2.10.18 Stormwater will be diverted to stormwater pumping station at Ma Po Tsuen. The area and pump rate of the stormwater pumping station will be 1404m² and 80m³/s respectively. The stormwater collected will be then discharge outside the tidal gate at Luk Tei Tong River (South).
- 2.10.19 Design Option 3 is shown in **Figure 2.4**. After enhancing the drainage system, the residual flooding resulted in under 600mm at the Luk Tei Tong River upstream, which is considered as relatively rural and floodable area.

Evaluation of Different Design Options

- 2.10.20 The evaluation of environmental factors, land resumptions practicability, effectiveness of different design options are summarized in **Table 2.2**. Comparison of environmental benefits and disbenefits are summarized in **Table 2.3**.

Table 2.2 - Evaluation of Different Design Options

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|---------------------------------------|--|---|---|---|
| Land Matters | Affected land lots area about ~44,900m ² | Affected land lots area about ~37,700m ² | Affected land lots area about ~45,950m ² | Affected land lots area about ~38,200m ² |
| Feasibility and Practicability | <p>The footprint of proposed stormwater pumping station may require further expansion to cater the required pumping efficiency due to updated design standard.</p> <p>Additional land required extent for box culvert from Tai Tei Tong to Pak Ngan Heung. A flood wall at the Luk Tei Tong Bypass channel is required in the scheme and result in higher potential public nuisance</p> <p>Proposed tidal gate located at Tai Tei Tong River will protect the houses adjacent to Tai Tei Tong River only, but excluding Yuen's Mansion from tidal effect.</p> <p>Construction cost as well as the power consumption for this pumping station can be optimized to relief the existing flood risk.</p> | <p>The proposed location of the proposed station at Nam Bin Wai. A proposed cross bridge as an access will be provided for connecting to Ngan Shu Street.</p> <p>The proposed stormwater pumping station utilise the government land and few private lots nearby rural area. As the pump rate of the pumping station is 12m³/s only, the proposed size and height of the structure is relatively smaller compared with Option 2 and 3 so that the level of construction difficulty can be restrained</p> <p>Proposed tidal gate located at River Silver will protect all low-lying area including Yuen's Mansion from tidal effect.</p> <p>Construction cost as well as the power consumption for this pumping station can be optimized to relief the existing flood risk.</p> | <p>The proposed location of the proposed pumping station is at Chung Hau Car Park and Mui Wo River Silver Garden, which is close to major residential area in Mui Wo.</p> <p>The proposed stormwater pumping station utilise the government land nearby for its large scale of size and will affect the existing high usage Chung Hau Car Park and Mui Wo River Sliver Garden. Re-provision of car park and rest garden is required during construction. In addition, car park lots are currently insufficient in Mui Wo, more public nuisance will be imposed</p> <p>Proposed tidal gate located at River Silver will protect all low-lying area including Yuen's Mansion from tidal effect.</p> <p>Construction cost as well as the power consumption for this pumping station will be the highest among all options.</p> | <p>The proposed location of the stormwater pumping station is fairly remote area at Ma Po Tsuen, which is away from major residential area.</p> <p>To minimize the land resumption extent, the pumping station required deep excavation and higher height to cater for the large pump rate at 80m³/s. The construction of pumping station may require longer period and highly concern on the worker safety due to deep excavation.</p> <p>Proposed tidal gate located at Luk Tei Tong River will mainly project Yuen's Mansion from tidal effect.</p> <p>Construction cost as well as the power consumption for this pumping station will be higher due to higher pump rate compared with</p> |

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|-----------------------------|---|---|--|---|
| | | | | Conforming Scheme and Option 1. |
| Air Quality Impact | <p>Potential air quality impact due to construction of diversion box culvert at Nam Bin Wai will be required.</p> <p>Stormwater Pumping Station located away from major residential area in Chung Hau and hence less air quality impact on the major residential area in Chung Hau due to construction of the station</p> | <p>Less air quality impact during construction as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Stormwater Pumping Station located away from major residential area in Chung Hau and hence less air quality impact on the major residential area in Chung Hau due to construction of the station</p> | <p>Less air quality impact during construction as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Potential air quality impact during construction as the Stormwater Pumping Station located close to major residential area in Mui Wo.</p> | <p>Less air quality impact during construction as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Stormwater Pumping Station located away from major residential area in Chung Hau and hence less air quality impact on the major residential area in Chung Hau due to construction of the station</p> |
| Noise Impact | <p>Potential noise impact due to the construction of diversion box culvert at Nam Bin Wai will be required.</p> <p>Stormwater Pumping Station located away from major residential area and less noise impact due to construction and operation of the station.</p> | <p>Less construction noise impact as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Stormwater Pumping Station located away from major residential area and less noise impact due to construction and operation of the station.</p> | <p>Less construction noise impact as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Potential construction and operation noise impact as the Stormwater Pumping Station located close to major residential area in Mui Wo.</p> | <p>Less construction noise impact as diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Stormwater Pumping Station located away from major residential area and less noise impact due to construction and operation of the station.</p> |
| Water Quality Impact | <p>Potential water quality impact from construction of flood wall / gabion wall at Luk Tei Tong Bypass Channel.</p> <p>Water quality impact could be minimized as construction of flood wall / gabion wall at Luk Tei Tong River (West) will be omitted.</p> | <p>Less water quality impact during construction as the extension of gabion wall at Luk Tei Tong Bypass Channel will be shortened.</p> <p>Water quality impact could be minimized as construction of flood wall / gabion wall at Luk Tei Tong River (West) will be omitted.</p> | <p>Water quality impact could be minimized as construction of flood wall / gabion wall at Luk Tei Tong Bypass Channel will be omitted.</p> <p>Potential water quality impact from construction of flood wall / gabion wall at Luk Tei Tong River (West).</p> | <p>Water quality impact could be minimized as construction of flood wall / gabion wall at Luk Tei Tong Bypass Channel will be omitted.</p> <p>Less water quality impact during construction as the extension of gabion wall at Luk Tei Tong River (West) will be shortened.</p> |
| Waste Management | More C&D material generated from | C&D material could be minimized as | C&D material could be minimized as | C&D material could be minimized as |

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|------------------------------------|--|---|--|--|
| | <p>construction of diversion box culvert at Nam Bin Wai.</p> <p>Less C&D material generated as shortened alignment of stormwater drain at Ma Po Tsuen.</p> | <p>construction of diversion box culvert at Nam Bin Wai will be omitted.</p> <p>More C&D material generated from extended alignment of stormwater drain at Ma Po Tsuen.</p> | <p>construction of diversion box culvert at Nam Bin Wai will be omitted.</p> <p>More C&D material generated from extended alignment of stormwater drain at Ma Po Tsuen</p> | <p>construction of diversion box culvert at Nam Bin Wai will be omitted.</p> <p>Less C&D material as the shortened alignment of stormwater drain at Ma Po Tsuen.</p> |
| Ecological Impact | Disturbance to semi-natural Luk Tei Tong River (West) could be minimized as the construction of gabion wall will be omitted. | Disturbance to semi-natural Luk Tei Tong River (West) could be minimized as the reconstruction of gabion wall will be omitted. | Disturbance to semi-natural Luk Tei Tong River (West) as the extension of gabion wall will be required. | Less disturbance to semi natural Luk Tei Tong River (West) as the extension of gabion wall will be shortened. |
| Landscape and Visual Impact | Less landscape and visual impact as smaller stormwater pumping station with area of ~711.8m ² proposed with multiple storey structure design. | Landscape and visual impact will be slightly higher as larger stormwater pumping station with area of ~1593.1m ² proposed with two storey structure design. | Landscape and visual impact will be slightly higher as larger stormwater pumping station with area of ~3642.1m ² proposed with multiple storey structure design. | Landscape and visual impact will be slightly higher as larger stormwater pumping station with area of ~1404m ² proposed with multiple storey structure design. |
| Cultural Heritage | Less cultural heritage impact as major works are located away from Graded Historic Sites / Buildings / Structures. | Less cultural heritage impact as major works are located away from Graded Historic Sites / Buildings / Structures. | Less cultural heritage impact as major works are located away from Graded Historic Sites / Buildings / Structures. | Potential cultural heritage impact as major works are located close to Graded Historic Sites / Buildings / Structures. |
| Construction Programme | More exposure to potential environmental impact during ~5 years construction period. | Less exposure to potential environmental impact may be minimized during ~4.25 years construction period. | More exposure to potential environmental impact during ~5 years construction period. | Less exposure to potential environmental impact during ~4.5 years construction period. |
| Effectiveness | The proposed pumping station with pump rate at 10m ³ /s is able to minimize the flood extent during rainstorm event but with an extensive construction working area of associate drains (2 nos. of tidal gate and additional box culvert from Tai | The proposed pumping station with pump rate at 12m ³ /s is able to minimize the flood extent during rainstorm event with a relatively small construction extent with 1 no. of tidal gate, both the box culvert from Tai Tei Tong to Pak Ngan | The proposed pumping station with relatively large footprint (pump rate at 120m ³ /s) is able to minimize the flood extent during rainstorm event, with 1 no. of tidal gate, both the box culvert from Tai Tei Tong to Pak Ngan Heung and the flood | The proposed pumping station at 80m ³ /s pump rate is able to minimize the flood extent during rainstorm event, with 1 no. of tidal gate, both the box culvert from Tai Tei Tong to Pak Ngan Heung and the flood wall along Luk Tei Tong Bypass |

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|--|------------------------------|---|---|--------------------------|
| | Tei Tong to Pak Ngan Heung). | Heung and the flood wall along Luk Tei Tong Bypass channel is not required. | wall along Luk Tei Tong Bypass channel is not required. | channel is not required. |
| All options could achieve similar hydraulic performance. | | | | |

Table 2.3 - Comparison of Environmental Benefits and Disbenefits for Different Design Options

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|-------------------------------|---|--|--|---|
| Environmental Benefits | <ul style="list-style-type: none"> • less air quality impact to the major residential area in Chung Hau. • Less noise impact from construction works at proposed stormwater pumping station. • Water quality impact from construction works at Luk Tei Tong River (West) could be minimized. • Less C&D material generated from construction works at Ma Po Tsuen. • Disturbance to semi-natural Luk Tei Tong River (West) could be minimized. • Less landscape and visual impact from proposed stormwater pumping station. • Less cultural heritage impact to Graded Historic Sites / Buildings / Structures. | <ul style="list-style-type: none"> • Less air quality impact from construction works at Nam Bin Wai. • less air quality impact to the major residential area in Chung Hau. • Less noise impact from construction works at Nam Bin Wai. • Less noise impact from construction works at proposed stormwater pumping station. • Water quality impact at Luk Tei Tong River (West) could be minimized. • Water quality impact from construction works at Luk Tei Tong Bypass Channel could be reduced. • Less C&D material generated from construction works at Nam Bin Wai. • Disturbance to semi-natural Luk Tei Tong River (West) could be minimized. • Less cultural heritage impact to Graded Historic | <ul style="list-style-type: none"> • Less air quality impact from construction works at Nam Bin Wai. • Less noise impact from construction works at Nam Bin Wai. • Water quality impact at Luk Tei Tong Bypass Channel could be minimized. • Less C&D material generated from construction works at Nam Bin Wai. • Less cultural heritage impact to Graded Historic Sites / Buildings / Structures. | <ul style="list-style-type: none"> • Less air quality impact from construction works at Nam Bin Wai. • Less air quality impact to the major residential area in Chung Hau. • Less noise impact from construction works at Nam Bin Wai. • Less noise impact from construction works at proposed stormwater pumping station. • Water quality impact at Luk Tei Tong Bypass Channel could be minimized. • Less C&D material generated from construction works at Nam Bin Wai and Ma Po Tsuen. • Disturbance to semi-natural Luk Tei Tong River (West) could be reduced. |

| | Conforming Scheme | Design Option 1 | Design Option 2 | Design Option 3 |
|----------------------------------|---|--|--|---|
| | | <p>Sites / Buildings / Structures.</p> <ul style="list-style-type: none"> Exposure of environmental impact may be minimized during ~4.25 years construction programme. | | |
| Environmental Disbenefits | <ul style="list-style-type: none"> Potential air quality impact from construction works at Nam Bin Wai Potential water quality impact from construction works at Luk Tei Tong Bypass Channel. More C&D material generated from construction works at Nam Bin Wai. More exposure to environmental impact during ~5 years construction programme. | <ul style="list-style-type: none"> Slightly higher landscape and visual impact from proposed stormwater pumping station. More C&D material generated from construction works at Ma Po Tsuen. | <ul style="list-style-type: none"> Higher noise impact from construction works at proposed stormwater pumping station. Higher water quality impact from construction works at Luk Tei Tong River (West). More C&D material generated from construction works at Ma Po Tsuen. Disturbance to semi-natural Luk Tei Tong River (West). Higher landscape and visual impact from proposed stormwater pumping station. More exposure to environmental impact during ~5 years | <ul style="list-style-type: none"> Higher water quality impact from construction works at Luk Tei Tong River (West). Potential cultural heritage impact to Graded Historic Sites / Buildings / Structures. Slightly higher landscape and visual impact from proposed stormwater pumping station. |

2.11 Recommended Design Option

2.11.1 Based on the evaluation and comparison of design options in **Table 2.2** and **Table 2.3**, Conforming Scheme will introduce more environmental impacts to air quality, noise impact and C&D material at Nam Bin Wai due to the construction of diversion box culvert. Design Option 2 will introduce more environmental impacts to air quality and noise impact to major residential area at Mui Wo while Design Option 3 will introduce more impact close to Graded Historic Sites / Buildings / Structures which is not preferred. Hence, the above-mentioned design options will not be recommended to pursue.

2.11.2 In general, the alignment of diversion box culvert is shorter, location of stormwater

pumping station is located away from major residential area and disturbance to Luk Tei Tong River can be avoided while the construction period will be the shortest. Hence, the duration and magnitude of environmental impacts for Design Option 1 will be minimized compared with other design options. Despite the proposed stormwater pumping station and alignment of stormwater drain at Ma Po Tsuen will introduce potential landscape and visual impact and C&D material respectively, the environmental impacts and waste introduced can be mitigated by implementation of proper mitigation measures. In view of the above, Design Option 1 is more preferable and recommended to pursue.

2.12 Considerations of Enhancement Works

- 2.12.1 As mentioned in **Section 2.5**, apart from drainage improvement works for the proposed design options, this Project also adopted the concept of “Blue-green drainage infrastructure” and implement river revitalization works as to providing the public with quality river facilities and enhancing the environmental and social values of river.
- 2.12.2 For proposed river revitalization works along Luk Tei Tong Bypass Channel, planting and leisure facilities will be provided to enhance the ecological and amenity value of the surrounding. Native species will be selected for planting and landscape works as far as possible. Environmentally friendly material and nature colour will be selected for leisure and other associated facilities.
- 2.12.3 By adopting the concept of “Blue-green drainage infrastructure”, green roof and vertical planting will be provided to the proposed stormwater pumping station. Screening plant around the proposed stormwater pumping station will also be provided as far as possible to screen the hard structure. The applicability of renewable energy (i.e. Solar Panel) will be evaluated in detailed design stage as to reduce the energy consumption and carbon emission during the operation phase of the Project.
- 2.12.4 As mentioned in **Section 2.5.4**, fish ladders is proposed at Tai Tei Tong River to enhance the fish movement. Design using natural bedding material with small ponds and waterfalls will be adopted to mimics the natural stream course and provides habitats for aquatic life.

2.13 Overall Scope for the Project

- 2.13.1 The scope of works for Design Option 1 is summarised as follow:

Tai Tei Tong River

- (a) Construction of flood walls (about 580m);
- (b) Reconstruction of gabion walls (about 280m);
- (c) River reprofiling (about 1000m²);
- (d) Modification of agricultural weirs; and
- (e) Construction of fish ladders and associated works (about 510m²).

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- (a) Construction of access across Pak Ngan Heung River (about 15m);
- (b) Construction of stormwater pumping station and the associated drainage works (about 1150m);
- (c) Construction of diversion box culvert from Tai Tei Tong River to Luk Tei Tong Bypass Channel (about 180m); and
- (d) Construction of tidal gate at River Silver and other associated works.

Luk Tei Tong River (South) and Luk Tei Tong Bypass Channel

- (a) Reconstruction of gabion walls (about 290m);
- (b) Construction of box culvert (about 10m);
- (c) Construction of mechanical penstock; and
- (d) River revitalisation and associated works.

2.14 Construction Method

2.14.1 Construction of the proposed Project comprises the following key activities:

- Excavation within river channel;
- River Reprofilng Works;
- Construction of flood wall / Reconstruction of gabion wall;
- Drainage works;
- Construction of stormwater pumping station;
- Construction of access across Pak Ngan Heung River; and
- Construction of tidal gate and mechanical penstock.

Excavation within river channel

2.14.2 Excavation within river channel will be required for river reprofiling, modification of agricultural weirs, construction of fish ladders, construction of mechanical penstock and construction of tidal gate.

2.14.3 To minimise the water quality impact, river flow will be diverted to the far side of the works area. Cofferdam and /or other means of temporary flow diversion will be undertaken before any excavation / major works within the existing watercourses to ensure the flow is not affected and to provide a dry working environment. In addition, excavation of river sediment will be scheduled to carry out in dry seasons (typically from November to March) as far as practicable. All excavated river sediment will be reused on-site as backfill material.

- 2.14.4 As the excavation works will be undertaken under dry condition, the works will not cause release of riverbed sediment into the water column nor increased turbidity in the river. Hence, no open dredging will be required to conduct and water quality impact during the excavation within river channel will be minimized. In addition, all excavated river sediment will be reusing on-site which disposal of river sediment can be avoided.

River Reprofiling Works

- 2.14.5 River reprofiling works at Tai Tei Tong River comprised with reprofiling of riverbed gradient and modification of agricultural weirs at upstream of Tai Tei Tong River. Section drawing of river reprofiling works is shown in **Appendix 2.1**.
- 2.14.6 River sediment and/or boulders excavated during river reprofiling works will be reused at Tai Tei Tong River as natural bedding substrate and/or as backfilling material at other works area. Such construction method could avoid the disposal of sediment. Also, the semi-natural habitat at upstream of Tai Tei Tong River could be maintained. Concreting at the riverbed will not be required for the river reprofiling works at Tai Tei Tong River.
- 2.14.7 The design of existing agricultural weirs at mid-stream and up-stream of Tai Tei Tong River are not favour for fish movement as there is significant gradient different. The agricultural weir at upstream of Tai Tei Tong River will be modified after river reprofiling works based on the reprofiled level. Conceptual design of modified agricultural weir is shown in **Appendix 2.1**. Fish ladders will be constructed at the mid-stream and up-stream of Tai Tei Tong River to enhance the fish movement from downstream to upstream. The fish ladder will be designed using natural bedding material with small ponds and waterfalls to mimics the natural stream course and provides habitats for aquatic life.

Construction of flood wall / Reconstruction of gabion wall

- 2.14.8 Construction of flood wall / Reconstruction of gabion wall will be required at Tai Tei Tong River, Luk Tei Tong Bypass Channel and Luk Tei Tong River (South) in preferred design option. The flood wall / gabion wall will be constructed section by section at the proposed alignment based on current construction design. Section drawing of construction of flood wall / Reconstruction of gabion wall are shown in **Appendix 2.1** and **2.2**.
- 2.14.9 Precast flood wall / pre-filled gabion wall could minimize the environmental impact to air quality, construction noise and water quality on-site. However, since the works area are located close to public access which lifting and unloading of precast flood wall / gabion wall could pose significant safety concern and nuisance to pedestrian nearby as well as extended construction period due to temporary traffic arrangement. As such, on-site construction method for flood wall / gabion wall will still be preferred to shorten the construction period, hence minimise the potential environmental impacts to the nearby sensitive receivers.

Drainage works

- 2.14.10 In general, the proposed drainage works comprised with diversion box culvert, and stormwater drainage and majority of those drainage works are located along existing pedestrian and vehicles access roads. Trenchless excavation method required wider pit

area compared to open-cut excavation method which is not preferred at area close vicinity to pedestrian and road users. Therefore, open-cut excavation method will be adopted for the construction of diversion box culvert and stormwater drainage. Despite open-cut excavation method could pose environmental impacts to air quality, construction noise and water quality, open-cut excavation method is considered to be faster which the duration of environmental impact can be generally reduced. To further minimize the environmental impacts to air quality and construction noise, as well as nuisance to public, drainage works will be carried out on a section-by-section basis.

- 2.14.11 For drainage works at river crossing, open-cut excavation method could pose significant environmental impact to water quality. Hence, trenchless excavation method will be adopted. In general, trenchless excavation method only require excavation at launching and receiving pit locations which excavation at riverbed can be avoided and environmental impact to water quality can be minimized. In addition, inert C&D material generated from trenchless excavation method can be reduced compared with open-cut excavation method. Pipe jacking would be employed as a trenchless method at two proposed sections along the stormwater drain and outlet pipe. The sections are located under the river such that the trenchless method can reduce interruption caused to Pak Ngan Heung and Tai Tei Tong River. A micro-tunnel boring machine (tunnelling machine) would be used to construct the trenchless tunnel sections.

Construction of stormwater pumping station

- 2.14.12 Construction method includes offsite precast structures or Modular Integrated Construction (MiC) method could minimize the environmental impact to air quality, construction noise and water quality. However, offsite precast structures and MiC method generally implement for project with standardized design while the proposed stormwater pumping station is project specific design to suit the site condition. In addition, transportation of large size precast structures or MiC unit on-site could pose significant traffic impact to the nearby area. Hence, on-site construction will be preferred for construction of the proposed stormwater pumping station as it could allow more flexibility for on-site alteration of E&M equipment and pumping system installation, and would avoid prolonged construction time, hence reduce potential disturbance to environment and nearby sensitive receivers. Indicative section drawing of stormwater pumping station is shown in **Appendix 2.3**.

Construction of access across Pak Ngan Heung River

- 2.14.13 A cross bridge will be constructed across Pak Ngan Heung River to the works area of stormwater pumping station as an access during construction and maintenance access during operation. The cross bridge will be constructed by prefabricated steel structure off-site which environmental impact to air quality and construction noise can be minimized. Bridge column will not be required to construct at the Pak Ngan Heung River which water quality impact can be avoided.

Construction of tidal gate and mechanical penstock

- 2.14.14 As mentioned in **Section 2.5.2**, tidal gate and mechanical penstock will be constructed and aim to operate according to the tidal and weather condition to prevent seawater intrusion

and divert the stormwater to stormwater pumping station to prevent flooding. During the construction of tidal gate and mechanical penstock, the same construction principal for excavation within river channel as mentioned in **Section 2.14.3** will be adopted to minimize the water quality impact during construction. Since the main components of proposed tidal gate and mechanical penstock will be made of steel and / or other non-concrete material with project specific design to suit the site condition, precast structures or MiC unit for supporting structure will not be feasible and on-site construction for supporting structure will be preferred to allow more flexibility for on-site alteration and installation of E&M equipment.

2.15 Construction Programme

2.15.1 The construction works are expected to last for around 51 months. Subject to completion of statutory procedures, the preliminary construction programme for the project is anticipated to commence in 3rd quarter of 2025 and completed in 4th quarter of 2029. To minimise the extent of active works areas at any given time, the construction works will be carried out by phases to avoid excessive concurrent construction works. Besides, the construction works along the rivers and for the proposed drainage pipe will be carried out section by section to avoid/minimise the potential adverse cumulative impact to the environment and the public. As mentioned in **Section 2.14.3**, excavation of river sediment will be scheduled to carry out in dry seasons (typically from November to March) as far as practicable. Detail construction sequence will be reviewed and confirmed based on the site condition. The preliminary construction programme for the Project is enclosed in **Appendix 2.4**.

2.16 Cumulative Environmental Impact

2.16.1 Based on available information as presented in **Table 2.1**, the potential interfacing project will only be the Desilting Works at River Silver, Mui Wo.

2.16.2 Desilting Works at River Silver, Mui Wo has been started in Q.1 2021 and subsequent desilting works will only be carried out if necessary based on annual review results. The desilting works is classified as a designated project and governed by Environmental Permit No. EP-589/2021. Under the Environmental Permit Specific Conditions 2.2 to 2.6, the desilting works will only be allowed to carry out during non-bathing season from December to February or closing date of Silvermine Bay Beach, with specific environmental mitigation measures to control the environmental impacts to dust emission, odour generation, gaseous emission, noise and water quality (for example, only allow either manually or by non-diesel operated powered mechanical equipment, use of container with watertight bottom during storage and transportation of desilted materials and installation of silting curtain to enclose the 2 openings of the berthing bay, etc.). In view of the relatively small scale of desilting works, relatively short duration of works and with implementation of appropriate environmental mitigation measures, no cumulative environmental impact during construction and operation phase are expected to be anticipated.

2.16.3 Based on the latest information provided by DSD, the construction works for PWP No. 4353DS – Outlying Islands Sewerage Stage 2 – Extension of Sewerage System to Other Unsewered Villages in Mui Wo Village Sewerage Works at Luk Tei Tong and Ma Po Tsuen

has started in November 2021 and expected to complete in June 2025. No significant environmental impact is expected from the operation sewerage system. In view of the above, no cumulative environmental impact during construction and operation phase are anticipated.

2.16.4 Despite no detail construction programme is available for 7414 RO “Improvement Works at Mui Wo – Remaining Phase” at this stage, the works area is located at Mui Wo East near the Mui Wo Ferry Pier which is over 300m away from the work area. As such, no cumulative environmental impact during construction and operation phase are anticipated.

2.16.5 Despite no information is available for the remaining potential interface projects (i.e., LV cable laying at Nam Bin Wai near Tai Tei Tong, Mui Wo and LV cable laying & meter box erection at Ling Tsui Tau Lo. 41, 42, 43, Mu Wo, Lantau), the nature of those interface projects are utility installation and leisure facilities only which large scale of construction are not expected. In view of the above, no cumulative environmental impact during construction and operation phase are anticipated.

2.17 Sustainability Consideration

2.17.1 The proposed stormwater pumping station will integrate the concept of sustainability and green building design including green roof and vertical greening such as plating of climbers to enhance the greenery of proposed structure. Measures to safeguard environmental quality and reduce the carbon footprint include retaining natural vegetation, phasing of construction to minimise noise and dust emissions, stormwater reuse by means of rain harvesting for irrigation purpose and investigating potential green infrastructure such as green roofs and vertical planting for climate resilience with an objective to build a sustainable drainage system.

2.17.2 Blue-green infrastructure concepts will be adopted in this Project, such as planting and landscaping work along riverbanks, to promote greening, enhance biodiversity and beautify the surrounding environment. Leisure facilities will also be provided along Luk Tei Tong Bypass Channel to improve the amenity value.

2.17.3 Various ecological features would be adopted in the proposed revitalisation works such as, planting and landscaping work along riverbanks, to promote greening, enhance biodiversity and beautify the surrounding environment. Blue-green components, embracing Sustainable Drainage Systems (SuDS) such as green roofs, solar panels, porous pavements and rainwater harvesting facilities, would be subjected to further feasibility study in detailed design stage. While exterior elements such as vertical greening, porous pavements & green roofs are incorporated as far as practicable within the project site, internal elements such as the use of harvested rainwater for irrigation purposes would also be explored in detailed design stage. Hence, achieving a value-adding design to the proposed works and Mui Wo.

2.18 Continuous Public Involvement

Public Activities to Date

2.18.1 The process of continuous public involvement for the proposed Project through meetings and public consultation are summarized in **Table 2.4** below.

Table 2.4 - Summary of Continuous Public Involvement

| Period | Activities | Concerned Parties |
|----------------------|--------------------------------------|---|
| Dec 2021 to Mar 2022 | Expert Interview | Green Groups (i.e., Representatives of Asia Ecological Consultant Ltd., Green Power, Kadoorie Farm and Botanic Garden), Engineering Professionals (i.e., Representatives of Sustainable Lantau Office), Government Officials (i.e., Representatives of DSD) |
| Mar 2022 to Jun 2022 | Stakeholder Interviews | Community Representative (e.g., Islands District Council members, Mui Wo Rural Committee members, Village representatives), Local Groups / Organizations (e.g., OIWA Mui Wo Sunny Centre, Land Education Foundation, Chan Shi Memorial Social Service Centre, Living Islands Movement, Save Lantau Alliance), Residents (e.g., residents who live nearby the project works with different background) and Community Users (e.g., Mui Wo School, Lick Hang Kindergarten, boat owners, and farmers) |
| Jul 2022 | Street Station and School Activity | Residents and Students |
| Jul 2022 | 1 st Co-creation Workshop | Residents, Community Activists, Rural Committee Members |
| Oct 2022 | Public Survey | Residents, Local Farmers, Village representatives, Community Activists |
| Dec 2022 | 2 nd Co-creation Workshop | Residents, Community Activists, Rural Committee Members |
| 20 February 2023 | Site Visit with Green Groups | Green Groups (i.e., Kadoorie Farm and Botanic Garden, Green Power, The Hong Kong Bird Watching Society, The World Wide Fund for Nature in Hong Kong, Designing Hong Kong, Civic Exchange and Green Sense) |
| 3 March 2023 | Site Visit with Green Groups | Green Groups (i.e., Living Islands Movement and Save Lantau Alliance) |

Public Comments in Continuous Public Involvement

2.18.2 The public comments collected from the continuous public involvement activities are categorized and the analysis are summarized in **Table 2.5** below.

Table 2.5 - Summary of Public Concerns and Analysis

| Major Comment / Concern | Design Consideration |
|--|--|
| Alleviate flooding issue/ Effectiveness of flood prevention | The preferred design option will be able to meet DSD's latest DSD standard and relieve the flood risks of the low-lying areas in Mui Wo. |
| Ecological impact to the natural environment in Mui Wo | The preferred design option avoided the disturbance to semi-natural Luk Tei Tong River (West). With the implementation of mitigation measures during the construction of project, the ecological impact to the existing environment will be minimized. In addition, fish ladder is proposed at the section with significant elevation difference at Tai Tei Tong River to enhance the fish movement from upstream to downstream. |
| Impact on water source for irrigation/ sustainable water supply for farming activities | Excavation of river sediment will be conducted in a confined and dry condition to minimize the environmental impact to water quality. Agricultural weir will be modified after the river reprofiling works at upstream of Tai Tei Tong River. |
| Accessibility of riverside and public space | Enhancement measures including river revitalisation works have been proposed under this Project with planting and leisure facilities including footpath to be provided along Luk Tei Tong Bypass Channel to allow easy access. |
| Impact on water source for irrigation | The agricultural weir at upstream of Tai Tei Tong River will be modified after river reprofiling works based on the reprofiled level such that the water source for irrigation will not be affected after the drainage improvement works. |