2 PROJECT DESCRIPTION

2.1 BACKGROUND OF THE PROJECT

2.1.1 The title of the Project is “Improvement to So Kwun Po Interchange” (hereafter referred to as the Project).

2.1.2 Traffic congestion has become an increasingly concerning issue at discrete road junctions and intersections in the North District. Among the major transport interchanges in the area, Kai Leng Roundabout is one of the busiest and most important road intersections connecting inter- and intra-district traffic onto the Fanling Highway. In recent years, public complaints have been lodged through members of the North District Council (NDC) on the traffic congestion and recurrent accidents at the Roundabout location.

2.1.3 Media reports had also asserted that the series of traffic incidents occurred in January 2016, which paralysed and stranded the District’s external traffic links, was partly due to the traffic gridlock and overcapacity at this Roundabout and other road junctions in the District. The traffic chaos appeared in these incidents also highlighted the fragility and deficiencies of existing transport infrastructure at some locations in the District where upgrading or improvement works was necessary to rectify the situation.

2.1.4 To address the above congestion problem, the Traffic and Transport Committee (T&TC) of NDC has earlier proposed a new North to South Link in an attempt to mitigate the current traffic situation at So Kwun Po Roundabout and Fanling Highway.

2.1.5 The study area of the proposed new North to South Link is located in the vicinity of the Kai Leng Roundabout in the North District. The study area aligns along the So Kwun Po from the south of Pak Wo Road to the northeast of North District Park, intercepting the Fanling Highway in the middle portion of the area.

2.1.6 The site was located in cultivated lands based on the earliest aerial photograph available in Year 1963. Minor building construction works were gradually carried out between Year 1973 and Year 1982. The site was a construction site for the connection of Fanling Highway and So Kwun Po Road between Years 1982 and 1993. The Fanling Highway was commissioned in Year 1991. Since then, no significant change within the concerned area has been observed.

2.2 NEED OF THE PROJECT

2.2.1 As described in **Sections 1.1 & 1.2**, the project is designed: -

(a) to provide a new direct road link, referred to as So Kwun Po Link (SKPL), comprising an at-grade road, an underpass, a single 2-lane flyover (main ramp) and a single 1-lane flyover (side ramp) connecting San Wan Road on the north side of SKPL and Pak Wo Road on the south side of SKPIC.

(b) to realign So Kwun Po Road between So Kwun Po Interchange (SKPIC) and Pak Wo Road;

(c) to modify junctions at San Wan Road and Pak Wo Road; and

(d) to reprovision the affected footpaths, cycle tracks and staircases.

Traffic Condition

2.2.2 SKPIC is a major interchange connecting Sheung Shui / Fanling area to / from other districts, it is important to ensure smooth traffic operation of SKPIC. With consideration of the future developments in North District, the captioned study was carried out to formulate the improvement scheme – SKPL to ensure the traffic operation of this major junction.

Provision of SKPL

2.2.3 Currently, there is an indirect link connecting San Wan Road and Pak Wo Road via Kai Leng Roundabout. Traffic coming from Fanling Highway westbound (WB), Fanling Highway eastbound (EB) and accessing either San Wan Road or Pak Wo Road shall be via SKPIC. The proposed new direct link provides an alternative route between San Wan Road and Pak Wo Road. Upon commissioning of SKPL under this project, a portion of traffic between San Wan Road and Pak Wo Road via SKPIC would be diverted to the new SKPL, and thereby accessibility between the northern and southern parts of Fanling will be enhanced. In addition, connectivity of Fanling / Sheung Shui via SKPL will also be enhanced with the completion of this new link. With the new road link serving as the bypass of SKPIC for traffic to and from San Wan Road / Pak Wo Road, the traffic flow of SKPIC will also be reduced.

2.3 SCENARIO "WITH" AND "WITHOUT" PROJECT

Scenario "without" Project

2.3.1 As stated above, the SKPIC has been operating to its capacity. With the anticipated population growth in the North District following the completion of the undergoing public and private housing developments, the traffic condition at SKPIC is anticipated to deteriorate further. Moreover, some of the major road links and road junctions in Fanling and Sheung Shui would also experience capacity problems without the Project.

2.3.2 If the Project could be completed and operated by Year 2031, the capacity problem on traffic flow of the major road links and junctions in Fanling and Sheung Shui would be relieved or even resolved.

Scenario "with" Project

2.3.3 As the Project will provide an alternative link for traffic to and from Fanling North and Fanling South, a decrease in traffic volume of SKPIC and adjacent road links is expected. Also, the modification of the SKPR at the downstream of SKPL near the south of Pak Wo Road could enhance its land capacity of the heavily trafficked road between SKPIC and Fanling South and relieve traffic demand, thereby leading to smoother traffic flows and a potential reduction in congestion of SKPIC. As a result, the capacity problem of the critical section of SKPIC would be alleviated and the capacity of some road junctions would also be improved during peak hours.

2.3.4 Nevertheless, the Project will induce short-term environmental impacts during construction such as construction noise, dust, site surface runoff etc.. It is envisaged that with the implementation of low-noise machinery and good site practices, the construction environmental impacts could be limited to acceptable levels. It should also be noted that the works under the Project are designed to avoid impacting the surrounding residents and users as far as possible.

2.3.5 A summary of the environmental benefits and disbenefits with and without the Project is provided in **Table 2.1**.

Table 2.1 Summary of Environmental Benefits and Disbenefits With and Without the Project

Scenarios	Environmental Benefits	Environmental Disbenefits
With Project	• Noise protection due to direct noise mitigation measures along SKPL and SKPR will be increased. Existing traffic noise impacts can be alleviated as much as possible.	• C&D materials will be generated due to the excavation and lateral support works along the boundary of North District Park and SKPR (potential for re-use and at other projects).

Scenarios	Environmental Benefits	Environmental Disbenefits
	• Provide additional traffic capacities to the SKPIC to / from San Wan Road and Pak Wo Road, thereby relieving congestion and decreasing the impacts on air quality and noise along the existing SKPR, San Wan Road and Pak Wo Road.	• There will be environmental impacts from construction noise, dust, site surface runoff etc. (implement good site practices) during construction phase.
Without Project	• No construction-related environmental impacts to the surroundings of SKPR, San Wan Road and Pak Wo Road. • No waste will be generated.	• Many of the existing roads in the vicinity of the Project site are already operating close to or beyond capacity. Traffic congestion in SKPR, San Wan Road, Pak Wo Road and other areas in Fanling will continue to worsen. Environmental impacts, such as air quality and noise will continue to deteriorate as a consequence.

2.4 CONSEQUENCES OF NOT PROCEEDING WITH THE PROJECT

2.4.1 In case the Project could not be proceeded according to the proposed schedule, SKPIC will be operating over its capacity(1) in Year 2030. The situation of traffic congestion will not be improved until SKPL or other traffic measures are completed and commissioned. With SKPIC operating beyond capacities, longer traffic queues at Fanling Highway, San Wan Road and Pak Wo Road will be anticipated, especially during peak hours, resulting in longer travelling time.

2.4.2 In the absence of the Project, the increased traffic through SKPIC would overload its road network and cause heavy congestion. Higher traffic flows through SKPIC will result in greater environmental impacts on air quality and noise.

2.4.3 If the Project could not be completed and operated by Year 2031, the capacity problem on the major roads and junctions in Fanling and Sheung Shui will further worsen.

2.5 IMPLEMENTATION PROGRAMME

2.5.1 Construction of the Project is scheduled to commence in Year 2025 and to be completed before the end of Year 2030. Details of the construction programme and the measures recommended to be taken during the construction phase are presented in **Section 2.12**.

2.6 ENGINEERING CONSIDERATIONS AND DEVELOPMENT OF SCHEME OPTIONS

2.6.1 A scheme, hereinafter referred to as the Base Scheme, was formulated under Agreement No. CE4/2018 – "North-South Link(s) as Alternative to So Kwun Po (Kai Leng) Roundabouts in North District – Feasibility Study". The base scheme has been further refined and developed

(1) Source: https://www.legco.gov.hk/yr18-19/english/fc/pwsc/papers/pwsc20190111pwsc-110-2-e.pdf

under this Consultancy. Description of the base scheme and the developed scheme of the various road links are given as follows.

General

2.6.2 As described in **Section 1.1**, the traffic problems at SKPIC were intended to be resolved by the provision of SKPL elevated above the existing SKPIC and connecting with San Wan Road on the north side and Pak Wo Road on the south side.

2.6.3 Starting from the north side, with a view of achieving the desirable minimum radius of 88m as per the requirement of the *Transport Planning and Design Manual* for roads with a speed limit of 50kph, SKPL will be located on the north side of the existing two ramps connecting San Wan Road, i.e. existing SKPR / San Wan Road up ramp and down ramp, and SKPR (i.e. underpass the existing SKPR which is on an embankment). SKPL will connect with San Wan Road on the west side of the existing SKPR/San Wan Road down ramp in order to facilitate traffic coming from and heading to MTR Sheung Shui Station to use SKPL, minimizing the likelihood of SKPL being affected by the potential tailing back of the SKPIC to San Wan Road. Arrangement of SKPL as described above will affect the existing footpath and cycle track between North District Park and the existing two SKPR / San Wan Road ramps. The affected footpaths and cycle tracks will be reprovisioned by realignment to suit SKPL. The reprovisioned footpaths and cycle tracks will encroach into the North District Park and affect the existing skating rink of North District Park. The affected skating rink will also be reprovisioned.

2.6.4 After the underpass beneath SKPR, SKPL will start to be elevated to overpass San Wan Road, East Rail Line and then further elevate to overpass SKPIC, which is a roundabout elevated above Fanling Highway.

2.6.5 SKPL will reach its highest level at SKPIC. Also, SKPL will be split into two ramps for connecting with Pak Wo Road, i.e. a 2-lane Main Ramp and a 1-lane Side Ramp. The split-ramp arrangement is to facilitate the traffic of SKPL to access both bounds of Pak Wo Road and maintenance of existing traffic movements at the junction of San Wan Road / Pak Wo Road. The Main Ramp will be a single 2-lane carriageway for traffic from either bound of Pak Wo Road to access SKPL and the traffic from SKPL to access Pak Wo Road-WB. The Side Ramp will be a single 1-lane carriageway for traffic from SKPL to access Pak Wo Road-EB.

2.6.6 With a view of incorporating SKPL and maintaining all existing traffic movements at the junction of SKPR/Pak Wo Road, the existing SKPR-NB to SKPIC and SKPR-SB to Pak Wo Road will be split into two carriageways. The Main Ramp will be sandwiched into the split carriageways of SKPR. SKPR-SB will be sandwiched between the Main Ramp and the Side Ramp.

2.6.7 The arrangement as described above will involve multiple phases of traffic movements at the junction of San Wan Road and SKPR. Maintenance of the existing pedestrian crossing across SKPR will not be feasible, as multiple staggered crossings will be involved. As a result, the Scheme involves the provision of a new subway across SKPR to obviate reprovisioning of the affected pedestrian crossings. The new subway will serve both pedestrians and cyclists.

2.6.8 The existing junctions of San Wan Road/SKPR and SKPR/Pak Wo Road will be modified to facilitate the connection of SKPL with San Wan Road and Pak Wo Road respectively, whilst maintaining all existing traffic movements.

2.6.9 Further to the base scheme for the SKPL formulated under Agreement No. CE4/2018 (HY) – "North-South Links as Alternative to So Kwun Po (Kai Leng) Roundabout in North District – Feasibility Study", an alternative road scheme was also developed under this Assignment and this alternative road scheme is named "Developed Scheme". A description of the various scheme options is presented below.

Base Scheme

2.6.10 Basically, the Base Scheme involves the provision of a new road link connecting San Wan Road on the south side and Pak Wo Road on the north side above the existing elevated SKPIC and Fanling Highway. The general layout of Base Scheme is shown in **Figure 2.1**.

2.6.11 The bridge scheme of Base Scheme is required to overpass the following existing road links:

- The existing at-grade Fanling Highways in both bounds;
- The existing elevated SKPIC (i.e. HyD Structure No. N496);
- The live tracks of East Rail Line;
- The existing Dongjiang Watermains (DJWM);
- The existing at-grade slip road from SKPR to Fanling Highway-EB; and,
- The existing at-grade slip road from Fanling Highway-WB to SKPR.

2.6.12 The gradient of Base Scheme will be as high as the proposed SKPL. SKPL will have to climb and overpass the existing Fanling Highway and SKPIC within a short distance. It is envisaged that the road gradient of Base Scheme could be as high as 8.0%, which exceeds the absolute maximum gradient of 8% for "Trunk Roads, Primary Distributors and Bus Routes" as stipulated in Table 3.3.6.1 of Chapter 3.3 in *Transport Planning and Design Manual*, Volume 2. A high gradient of 8.0% will pose constraints to double-decker buses and may even refrain them from using the new slip road. However, further shifting the existing slip road of SKPR/Fanling Highway-EB and/or Fanling Highway-WB/SKPR with a view of reducing the maximum gradient is highly undesirable as the Fanling Highway might be realigned for provision of the piers of the proposed SKPL at the existing central divider of Fanling Highway.

2.6.13 The sharp changes from the horizontal near both upstream and downstream due to the steep gradient might slightly affect the vertical sightline of the proposed road link. Hence, the Base Scheme is less desirable.

Developed Scheme

2.6.14 Owing to the issues of the Base Scheme as described above, the Developed Scheme is formulated and the general layout is presented in **Figure 2.2**. The main objectives of Developed Scheme are to achieve its key benefits by overcoming the following issues / problems of Base Scheme:

- Minimization of the impact on North District Park and Po Wing Road Playground;
- Maintenance of the existing at-grade footpath adjacent to Vienna Garden;
- Maintenance of the existing southern kerbline of Pak Wo Road;
- Interdependence of the structural form, span length, maximum gradient, pier locations and alignment of SKPL, impacting the existing SKPR; and
- Reduction of the maximum gradient of the proposed SKPL with a view of complying with the absolute maximum gradient of 8% as stipulated in Table 3.3.6.1 of Chapter 3.3 in *Transport Planning and Design Manual*, Volume 2.

2.6.15 The at-grade footpath and cycle track adjacent to Vienna Garden under the Base Scheme is proposed to be modified to a subway ramp for connection with the new subway, as the space between the football pitch and Vienna Garden is insufficient for maintaining the existing at-grade footpath and cycle track after the addition of the Main Ramp and the Side Ramp of SKPL. Provided that the existing football pitch and the at-grade footpath shall not be affected, the existing cycle track along San Wan Road between Ching Hiu Road and Kat Cheung Crescent will be permanently abandoned.

2.6.16 As the existing cycle track on the south side of Fanling Highway serves as a parallel and an alternative route for the section of cycle track affected, abandonment of the section of cycle track would be practical. To enhance the connectivity of the existing cycle track along Fanling Highway with the cycle track to be affected, retrofitting of cycle tracks along the section of Pak Wo Road between Wai Wo Street (adjacent to Sheung Shui Police Married Quarters) and Po Wing Road Playground, as well as the eastern section of Kat Cheung Crescent are proposed. As the new subway will be provided only for pedestrians, provision of ramp for cyclists will be obviated.

2.6.17 With the arrangement of the subway as described above, i.e. obviation of subway ramp for cycle track and provision of the staircase and lift at the western end of the subway at the existing landscaping area, the space will be sufficient for addition of the Main Ramp, the Side Ramp, the staircase and lift at the eastern end of the new subway, whilst maintaining the existing football pitch, the pedestrian access (within the current Government Land Allocation (GLA) for Po Wing Road Playground) of 2m between the football pitch and the reprovisioned SKPR-NB carriageway, and the existing footpath of 3m adjacent to Vienna Garden.

2.6.18 As far as the section of the existing cycle track between Ching Hiu Road and Kat Cheung Crescent will be abandoned, the space vacated by its abandonment will be sufficient for the maintenance of Eden Garden with sufficient clear distance, and Pak Wo Road will be maintained. Thus, environmental impacts to Eden Garden due to the junction improvement will be minimized.

2.6.19 As compared to the Base Scheme, SKPL above Fanling Highway and SKPIC is realigned to minimize the bridgeworks above the existing carriageways to enhance constructability, facilitate optimization of the span length, and provision of piers at favourable locations, e.g. avoidance of pier to be located in the central divider of Fanling Highway.

2.6.20 As SPKL will overpass the existing SKPIC which is elevated above the existing Fanling Highway and be connected to San Wan Road and Pak Wo Road at the northern and the southern ends respectively in a short distance, the gradient of the realigned SKPL after the addition of the Main Ramp and Side Ramp in the Developed Scheme will not exceed an absolute maximum gradient of 8% as per the requirement of *Transport Planning and Design Manual*.

2.7 ENVIRONMENTAL CONSIDERATIONS FOR THE SCHEME OPTIONS

2.7.1 The environmental considerations for scheme options for SKPL are identified and presented in **Table 2.2**.

Table 2.2 Summary of Environmental Considerations of the Scheme Options of SKPL

Scheme Options	Environmental Considerations	
	Environmental Benefits	**Environmental Disbenefits**
Base Scheme	**Noise and Air Quality:** • Adoption of quiet piling method would minimize the construction noise impact. **Landscape and Visual:** • The bridge structure is situated away from educational institutions and residential blocks of Vienna Garden and Cheerful Park, hence the visual impact on the residents in the vicinity area is reduced.	**Noise and Air Quality:** • Road sections with steeper gradients would induce higher vehicular emissions. **Landscape and Visual:** • Another layer of bridge construction above the existing elevated SKPR near Fanling Highway with noise barriers creates a wall effect and causes intrusive and adverse visual impacts to the Visual Sensitive Receivers (VSRs) in Sheung Shui / Fanling. • The viaduct across Fanling Highway and elevated SKPR is massive in size and induces significant visual impacts on the surrounding

Scheme Options	Environmental Considerations	
	Environmental Benefits	**Environmental Disbenefits**
		environment during operation phase. **Ecological:** • Potential impact to the ardeid night roosting site at North District Park would occur during the construction and operation phase.
Developed Scheme	**Noise and Air Quality:** • New noise barriers will be installed along SKPL and SKPR. Noise and air quality impacts on the residents of the buildings close to the SKPL will be reduced during operation phase. • Adoption of quiet piling method will minimize the construction noise impact. **Landscape and Visual:** • Slip road connecting SKPL to San Wan Road would induce insignificant visual impacts to the surroundings during operation stage, particularly for the recreational users of North District Park.	**Noise and Air Quality:** • Due to the aforesaid traffic issues, the viaduct alignment is unavoidably shifted towards the educational institutions and residential blocks. Air quality and noise impact on these sensitive receivers during construction of the slip road (including Excavation and Lateral Support (ELS) and piling works) would be affected. • Noise barriers are required to reduce noise levels during operation phase. **Landscape and Visual:** • The bridge structures situated above the existing landscape might block some of the sunlight to the greenery and planting area. • The additional layer of bridge construction above the existing elevated SKPR near Fanling Highway with noise barriers creates a wall effect and causes intrusive and adverse visual impacts to the VSRs in Fanling / Sheung Shui. • The proposed noise barriers along SKPL and SKPR will induce visual impacts on the nearby VSRs during operation phase. **Ecological:** • Potential impact to the ardeid night roosting site at North District Park would occur during the construction and operation phase.

2.8 EVALUATION OF THE SCHEME OPTIONS AND SELECTION OF THE PREFERRED OPTION

General

2.8.1 Throughout the evaluation process of the alignment options for the Project, environmental considerations including air quality, noise, landscape and visual, and ecological during construction and operation phase have been thoroughly reviewed and evaluated. Apart from the environmental considerations, other engineering aspects such as traffic, land requirement, engineering feasibility, as well as public perception, construction time and cost, and maintenance requirements, have also been taken into consideration. The following are the main reasons for selecting the preferred option.

Developed Scheme of SKPL

2.8.2 The proposed viaduct connecting San Wan Road to Pak Wo Road is developed to improve the existing traffic conditions of SKPIC and alleviate the traffic demands at So Kwun Po Roundabout and other road junctions in the North District. Moreover, the impacts that the proposed viaduct running across Fanling Highway brings to the existing and future residential buildings are considered acceptable. The installation of noise barriers along SKPL and SKPR adjacent to the existing educational institutions and residential blocks would make the traffic improvement scheme more robust and therefore not appeal to the public, in particular to the local stakeholders of Fanling / Sheung Shui. The Developed Scheme however may induce medium visual impacts on the surrounding environment, but would harmonize it as much as possible.

2.8.3 To maintain daily traffic between the northern portion and the southern of So Kwun Po, a portion of slip road connecting SKPR to San Wan Road, Fanling Highway-WB to SKPR, SKPR to Fanling Highway-EB, Pak Wo Road and San Wan Road would be temporarily diverted and permanently realigned. Temporary provision of noise screening structures would be required to reduce the noise levels to the residents of Vienna Garden, Eden Garden, Cheerful Park and the users of nearby educational institutions.

2.8.4 Encroachment upon the boundary of North District Park for the construction of the underpass structure and realignment of the road connecting San Wan Road and SKPL is thus required. In the Developed Scheme, the extent of such encroachment is further refined to minimize further adverse landscaping and visual impacts on the recreational users in the greenery area and the urban park.

2.8.5 The existing skating rink within North District Park affected by SKPL will be reprovisioned by setting back from SKPL. The pedestrian access (within the current GLA for North District Park) will reconnect with the realigned public footpath to suit SKPL. Other than landscaping aspects, no other existing facilities in the North District Park adjacent to the existing SKPR/San Wan Road down ramp will be affected.

2.8.6 The proposed viaduct will be above the existing elevated SKPIC and cause a certain degree of visual obstruction and loss of views or visual openness due to the proposed viaduct from key public viewing points.

2.8.7 Although there are some impacts to the residents, recreational and school users nearby during the construction and operation phase of the Project, these impacts are not insurmountable and would further limit to the acceptable levels by means of suitable noise mitigation measures taken in place.

2.8.8 The vertical alignment of the proposed viaduct descends at maximum allowable gradient when crossing Fanling Highway and East Rail Line such that the height of the bridge structures could be reduced as much as possible. The slight reduction in height of the bridge structures across Fanling Highway and East Rail Line would reduce the visual impact on the surrounding environment and the nearby VSRs. The environmental impacts on the nearby residents of the

residential buildings, recreational and school users under the Developed Scheme would be alleviated.

2.8.9 Given the above engineering and environmental considerations, the new SKPL under the Developed Scheme is selected to be the preferred option.

Improvement to SKPIC Traffic Condition

2.8.10 The proposed additional link will provide a new connection between the north and south of Sheung Shui / Fanling to relieve the traffic pressure of SKPIC by diverting the traffic flow. With the provision of SKPL, some traffic in the north-south direction of Sheung Shui (especially traffic to / from MTR Sheung Shui Station and the south of Sheung Shui / Fanling town) can bypass junctions at San Wan Road and SKPIC. As shown in **Figure 2.3**, the future traffic condition of SKPIC will be improved from an overloaded condition to a sufficient capacity, while the junction of So Kwun Po Road will be further enhanced with more capacities from the benefit of the proposed SKPL.

2.9 KEY DESIGN ELEMENTS

2.9.1 At the southern portion of SKPL, a minimum traffic headroom of 5.1m between the existing road level of SKPIC and the soffit of the flyover shall be reserved. Cast-in-situ slab on precast beams is adopted to minimize the required structure depth. Mobile crane would be deployed to erect the precast beams during non-peak traffic hours with appropriate Temporary Traffic Arrangements to maintain the traffic flow. Permanent formworks, e.g. formwork made of fibre-reinforced plastic (FRP) would be used to construct the cast-in-situ slab. Erection of falseworks to support the segment erection will not be required. Construction traffic impact will be minimized.

2.9.2 The bridge deck structures will be supported by intermediate piers located along the new alignment. To minimize the extent of diversion / disruption of a variety of features or utilities both above and below ground, streamlined shape of the bridge piers will be adopted to reduce modification / diversion of underground utilities as much as possible.

2.9.3 For the compliance of noise level requirements to the nearby NSRs in Fanling / Sheung Shui, including Vienna Garden, Eden Garden, Cheerful Park, Glamour Garden and Sheung Shui Disciplined Services Quarters, noise barriers on the bridge structures of the SKPL abutting the adjacent residential blocks would be anticipated. Nevertheless, the assessment findings of the Traffic Noise Impact Assessment (see Section 4 of EIA Report) revealed that the operation traffic noise from existing roads is the dominant source of noise. In order to effectively reduce the overall traffic noise, it is recommended to apply low-noise road surfacing (LNRS) to the carriageways of the at-grade roads so that the extent of noise barriers on the bridge structure would be minimized.

Underpass

2.9.4 The headroom for the underpass at the setting out line, i.e. centreline of the underpass, is 5.5m, which is sufficient for provision of the splay on both sides of the top slab and provision of cross fall of the road surface. The structural depth of the top slab would be 1m approximately. As the minimum clearance between the soffit of the top slab of the underpass and SKPR would be less than 1m, the road level of SKPR above the underpass will be slightly increased to accommodate the top slab of the underpass. Based on the information available during the course of the EIA study, it is anticipated that the maximum increase in road level of SKPR after the completion of the works would be 500mm approximately.

2.9.5 Cut-&-cover method will be adopted for the construction of the underpass. SKPR will be reconstructed based on the designed level in conjunction with the construction of the underpass.

2.9.6 A portion of the existing box culvert will be modified to suit the road realignment of the existing down ramp connecting SKPIC to San Wan Road and to be structurally capable of withstanding the additional traffic load.

2.9.7 As the deck will be supported by foundation, which is independent from the existing box culvert, additional load will not be imposed on the existing box culvert.

2.9.8 Cut-&-cover method will be adopted for the construction of the underpass, SKPR will be reconstructed based on the designed level in conjunction with the construction of the underpass.

2.10 CONSIDERATION OF DIFFERENT CONSTRUCTION METHODS FOR VIADUCT

2.10.1 The SKPL connecting San Wan Road and Pak Wo Road will be in the form of prestressed concrete viaducts. Various methods for construction of the deck structures, including precast method or cast-in-situ method have been considered.

2.10.2 Alignment of SKPL shall be determined to facilitate the adoption of optimized span length and minimize construction traffic impact. The piers shall be located at the appropriate location in order to suit the structural form, construction activities and major site constraints such as major roads and facilities as described above, as well as the temporary traffic arrangement for construction of the foundation and the substructure.

2.10.3 As San Wan Road and the existing down ramp from SKPIC to Fanling Highway-SB are 50m apart, the maximum reach required for the lifting operation will be 25m approximately. Mobile crane of super-capacity shall be deployed to undertake the lifting operation. Availability of such mobile carne is limited in Hong Kong. Time for setting up and removal of such mobile crane would be long. Consequently, the risk of such mobile crane to be not available for this project and failure to complete the lifting operation within the limited non-train hours would be high. In fact, given that the total length of the elevated road section will be less than 500m and various types of bridge girder shall be adopted to cater for the varying geometrical layout, it may not be cost-effective to adopt precast method.

2.10.4 On the other hand, erection of temporary portal frames across East Rail Line will not be feasible taking account of the risks and disturbance to the East Rail Line.

2.10.5 Erection of precast segments by launching girder will not be practical based on the site conditions listed below:

(i) The launching girder would be close to or even encroach into East Rail Line. Progress of the works will be affected as the operation of the launching girder will be restricted to safeguard operational safety of East Rail Line;

(ii) Not the entire underbridge area is accessible for trailers for delivery of the precast segments necessary for the operation of launching girder;

(iii) The precast segment can only be erected one by one. Only one launching girder can be mobilized for construction of SKPL due to site constraints. Progress of works will be affected by the operation sequence of the launching girder; and

(iv) The piers shall be constructed in sequence from one end towards the other end to suit the operation of the launching girder. If completion of any piers is delayed, for example, due to utility diversion, erection of the precast segments for all piers downstream of the piers in concern will also be delayed, even though the piers downstream of the piers in concern have been completed.

2.10.6 As launching girder will not be practical due to site conditions, span by span method will not be feasible either. Balanced cantilever method shall be adopted for staged cast-in-situ construction based on the bridge span configuration, except at the end span. The segments

will be progressively cast from the pier head towards the adjacent piers on both sides in equilibrium.

2.10.7 In case the precast segments will be erected by mobile crane, temporary road closure shall be implemented for setting up of plant & equipment, especially the heavy-duty mobile crane, for erection of the precast segments. The temporary road closure might induce adverse traffic impacts and high traffic disruption. From the environmental perspective, construction noise impact will be induced for erection of the precast segments by mobile crane during the restricted hours.

2.10.8 Taking account of the above, the favourable method for construction of the concrete box girder across East Rail Line is cast-in-situ using cantilevered travelling formworks. By adopting cast-in-situ method using travelling formworks, the segments shall be constructed based on balanced cantilever. The cantilevered formworks will be erected at the piers on both sides of East Rail Line, which are all accessible by mobile crane.

2.10.9 The cantilevered formworks will be launched forward by jacking during non-train hours upon each cantilevered segment is completed. Repositioning of the formworks by mobile crane will not be required. After the last cantilever segment on each side is constructed, the cantilever formworks above East Rail Line will be removed during non-train hours by mobile crane setting up in San Wan Road.

2.10.10 For cast-in-situ method, the deck structure can either be constructed on suspended travelling formworks or on ground-supported falseworks.

2.10.11 For cast-in-situ works on suspended travelling formworks, balanced cantilever method which is similar to the precast method as described above shall be adopted, except that the segments will be cast-in-situ on suspended travelling formworks instead of precast. The cast-in-situ works can be carried out during non-restricted hours, as logistics of the cast-in-situ works can be provided via the working space of the existing roads, and the traffic can be maintained.

2.10.12 Permanent formworks, e.g. formwork made of fibre-reinforced plastic (FRP), would be used to construct the cast-in-situ slab. Erection of falseworks to support the segment erection will not be required. Thus, construction traffic impact will be minimized.

2.10.13 Cast-in-situ on ground-supported falseworks will be favourable in expediting the construction programme, as the scale of works for each concrete pour will be increased. Expediting the works is the most effective means of minimizing the environmental and traffic impacts during the Construction Phase. Cast-in-situ on ground-supported falseworks is more environmentally-friendly compared with other methods listed in **Table 2.3**.

Table 2.3 Environmental Considerations for Various Construction Methods

Construction Methods	Precast Method	Cast-in-situ Method	
		Suspended Travelling Formworks	Ground-supported Falseworks
Night-time construction noise impact	The most serious amongst all methods due to heavy lifting operation during restricted hours.	Night-time construction noise impact due to repositioning the suspended travelling formworks above existing carriageways is not as serious as precast method.	Night-time construction noise impact due to erection of temporary cross beams above existing carriageways, is not as serious as precast method.
Construction site activities and traffic flow	The least amount of construction site activities and traffic flow due to precast	The largest amount of construction site activities and traffic flow due to small scale cast-	Moderate amount of construction site activities and traffic flow due to synergy of larger

Construction Methods	Precast Method	Cast-in-situ Method	
		Suspended Travelling Formworks	Ground-supported Falseworks
	segmental construction.	in-situ works for segmental construction.	scale of cast-in-situ works.
Environmental Impacts	Moderate environmental impact due to moderate duration of works.	The most serious environmental impact due to the longest duration of works.	The least environmental impact due to the shortest duration of works.

2.10.14 Based on the considerations in **Table 2.4**, cast-in-situ construction method is the most favourable method for the construction of the elevated SKPL and is thus considered.

2.11 CONSIDERATION OF DIFFERENT CONSTRUCTION METHODS FOR UNDERPASS

2.11.1 The underpass under SKPR-NB can be constructed using various tunnelling methods such as cut-and-cover construction method and drill-and-break / drill-and-blast method. In view of the extent and geometry of the SKPL alignment, cut-and-cover construction method is considered a more reliable and controllable approach and is recommended to be adopted as mentioned in **Section 2.9**. A comparison of the merits and demerits between these two construction methods is shown in **Table 2.4**.

Table 2.4 Considerations for Various Construction Methods

Construction Methods	Cut-and-Cover	Drill-and-Break / Drill-and-Blast
Merits	• It is a conventional construction method and requires relatively less special skilled labour force and specialists when comparing with other construction methods considered. • It can facilitate construction of complex underpass geometry. • It can control complex geotechnical conditions better. • It is more flexible for dividing works areas within the site, thus it can allow flexibility for the contractor to coordinate with other concurrent projects in the vicinity for arrangement of respective construction programme to avoid cumulative environmental impacts.	• It can be used for different underpass shapes. • It is a fast underpass construction method. • Construction work are mainly carried out underground which can avoid working above ground in some busy urban area. • Existing trees and vegetation could be retained as the construction work will be mainly carried out underground.
Demerits	• Vibration and settlement to adjacent building structures, and ground	• Vibration and settlement to adjacent building structures will be substantial, which is not suitable building

Construction Methods	Cut-and-Cover	Drill-and-Break / Drill-and-Blast
	treatment are required to control adverse effects due to excavation. • Land is required for temporary storage of excavated material to be reused on site. • Construction work would be affected by adverse weather conditions. • Removal of existing trees and vegetation for construction is required, though the affected areas will be reinstated and replanted.	structures with shallow foundations and sites of cultural heritage. • High risk for storage and delivery of explosives to work sites in urban area. • It is not suitable for construction work on soft ground. • Noise impact during construction phase will be substantial.

2.12 CONSTRUCTION PROGRAMME

2.12.1 The construction works of the Project will tentatively commence in Year 2025 and to be completed before the end of Year 2030. A tentative construction programme for the Project is provided in **Appendix 2.1**.

2.12.2 To minimize the adverse impacts on the sensitive receivers during the construction of traffic improvement works to So Kwun Po, the construction programme and sequence of works will be carefully planned such that the environmental impacts would be kept to minimum and within acceptable limits. The following are the measures recommended to be taken during construction phase:

- Control of working hours is recommended to reduce noise impact to the surroundings. No works are to be carried out from 16:30 to 07:30 during dry season (Oct – Mar) and 17:00 to 07:00 during wet season (Apr – Sep) within 100m from the ardeid night roost site; and to avoid construction works between 18:00 and 08:00 on weekdays and all hours on Sunday and Public Holidays within North District Park;
- Avoid noisy construction activities during school examination period and schedule construction works as much as possible during the summer recess for schools and kindergartens in the vicinity of the construction site, if the programme allows; and
- Close liaison with the contractors of other concurrent projects in order to avoid overlapping of construction activities, and allow sufficient buffer for works at project interface due to possibly delayed commencement or expedited completion of certain activities in the programme, so that the cumulative effects of environmental impacts could be minimized.

2.13 CONCURRENT PROJECTS

2.13.1 Concurrent projects in the vicinity of the Project site are identified. The status of these concurrent projects is based on the available information obtained during the course of the EIA Study. It should be noted that the implementation of individual projects would be subject to further development and subsequent actions of the respective project proponent.

2.13.2 The locations of these planned / committed projects, which potential cumulative environmental impacts may arise during the construction and operational phases, are shown in **Figure 2.4**, of which the key details of these projects which may bear cumulative impacts during construction phase in its vicinity are summarized in **Table 2.5**. Cumulative impacts from the concurrent projects have been assessed in the individual sections of this EIA Report.

Table 2.5 Summary of the Other Projects in the Vicinity of the Project Site which may bear Cumulative Impacts during Construction Phase

Project	Project Proponent	Construction Period
Housing Development in Ching Hiu Road	Civil Engineering and Development Department (CEDD) / Housing Department (HD)	2022 to 2030
Housing Development in Fanling Area 17	CEDD / HD	2023 to 2031
Expansion of North District Hospital	Architecture Service Department (ArchSD) / Hospital Authority (HA)	2021 to 2028
Utilities Works and Junction Improvement Works for Partial Development of Fanling Golf Course Site	CEDD	2024 to 2029
Reclaimed Water Supply to Sheung Shui and Fanling	Water Supplies Department (WSD)	2021 to 2026

2.14 PUBLIC CONCERNS

2.14.1 The Project Profile (PP-616/2021) was submitted to the Environmental Protection Department (EPD) on 6 January 2021 and was exhibited for public inspection between 7 January 2021 and 20 January 2021.

2.14.2 During the exhibition period, public comments on the Project Profile were received and mainly focused on observations of the existing traffic conditions, suggestions on additional traffic aids or modifications to alleviate the situation, nuisance of noise, construction impacts to the egretry at a pond in North District Park and surrounding environments, extent of tree felling, and preservation of the habitat. The construction programme has been optimised based on the suggestions received during the public inspection, such as minimisation of heavy construction works near North District Park during ardeids' breeding season, and implementation of practical mitigation measures to reduce the construction impacts and the likelihood of bird collision. The aforementioned potential impacts have been addressed in **Sections 3 to 10**.

2.14.3 After the issue of EIA Study Brief (ESB-338/2021) in February 2021, views for consideration in the design of So Kwun Po Link had been obtained from various consultations with stakeholders and considered. A briefing session with the representative green groups including Kardoorie Farm & Botanic Garden (KFBG) and Hong Kong Bird Watching Society (HKBWS) was made on 16 June 2023 and their suggestions raised in the session were incorporated in **Sections 3 to 10**. The correspondences of green groups are enclosed in **Appendix 2.2**.

2.14.4 The Project was consulted at the T&TC of NDC dated 9 November 2020. A further consultation with NDC T&TC had been held on 8 May 2023. The proposal has obtained preliminary support from members of the NDC.