

Environmental Protection Department
Agreement No. CE16/2004(DS)
Demonstration Scheme on Reclaimed Water Uses
in the North District – Investigation

Project Profile
Demonstration Scheme on Reclaimed Water Uses
in the North District

July 2005

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1. BASIC INFORMATION

1.1 Project Title

Demonstration Scheme on Reclaimed Water Uses in the North District

1.2 Purpose and Nature of the Project

Being one of the new initiatives in the 2003 Policy Agenda, the Government undertakes to implement the Total Water Management programme in which water conservation and water resource protection are enhanced through education and promotion, while technologies for recycling and desalination are examined in parallel through pilot schemes. The 2005 Policy Agenda reiterated the need to roll out the programme and the proposed Reclaimed Water Demonstration Scheme at SWHSTW in the North District (the Scheme) is one of the two pilot schemes identified for exploring the alternative uses of reclaimed water in the territory.

The Scheme involves the reuse of tertiary treated effluent from Shek Wu Hui Sewage Treatment Works (SWHSTW) for household toilet flushing, unrestricted irrigation and water features (e.g. decorative streams and fountains). Treated effluent from the SWHSTW will further undergo pre-treatment process (micro-straining), membrane filtration (ultrafiltration) and disinfection (chlorination) by a pilot demonstration advanced treatment plant. The reclaimed water will be conveyed to some selected users such as schools, old folks home and village houses by means of temporary pipeline, and water tankers as provisional need. Figure 1 shows the general layout of the project. There will be sampling and laboratory testing to monitor the quality of reclaimed water and the performance of the demonstration advanced treatment plant and feedback from the users will be collected for review. It is hoped that the pilot Scheme can demonstrate the economic, environmental and technical feasibility as well as the system reliability of such processes before full-scale implementation of reclaimed water uses.

1.3 Name of Project Proponent

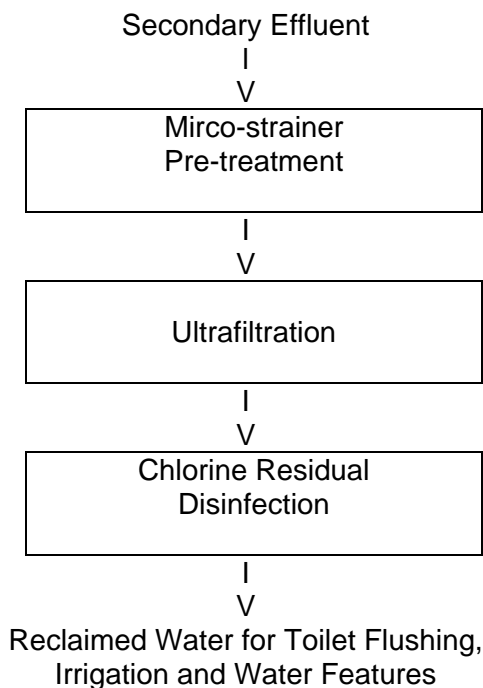
Environmental Infrastructure Division of Environmental Protection Department.

1.4 Location and Scale of Project

1.4.1 The pilot demonstration advanced treatment plant is the main works under this project. The plant will be located at an open space at the North-western corner of the SWHSTW. Apart from the core unit, it will include also a chlorination chamber and the associated pumping facilities. As this is a pilot scheme, the plant is designed for a very small treatment capacity of about 150 m³/day only. The plant occupies a footprint of about 200 m², including a 50 sq. meter tanker loading area. It has a maximum height of 4 to 6 meters and all associated tanks will be covered for safety purpose and to minimize odour emission.

1.4.2 Figure 1 shows the schematic layout of the temporary pipeline connecting the pilot plant to the selected users. The size of the temporary pipeline will be less than 150 mm in diameter and the alignment of the associated piping will be laid, where possible, above ground and along existing foot path/roads. The total length of the pipeline will be about 2 km.

1.4.3 The following shows the process train of the advanced treatment:



1.4.4 The following shows the a list of the selected users. Their locations are showed in Figure 1.

- 3 domestic dwellings (village houses) at Sheung Shui Heung
- Fung Kai No 1 Secondary School
- Fung Kai Primary School
- CITA Sheung Shui Training Centre
- Fung Kai Man Shek Tong Secondary school
- Fung Kai Elderly Home

1.4.5 The Scheme is scheduled to operate in July 2006 and to complete in October 2008 when all the fixtures built under the scheme will be dismantled and disposed of as necessary, including the removal of the pilot plant and associated facilities, all sections of temporary reclaimed water distribution pipelines above ground. The piping connections at selected users' premises will be reverted back to the original arrangement.

1.5 **Number and Type of Designated Project to be Covered**

The reuse of treated effluent from SWHSTW for toilet flushing and other non-potable uses is identified as a Designated Project under Schedule 2, Part I, Item F4 of the Environmental Impact Assessment Ordinance.

1.6 **Name and Telephone Number of Contact Person(s)**

Mr. Daniel S C YANG, Senior Environmental Protection Officer, Infrastructure Planning Group, Environmental Protection Department (Tel. 2872 1806).

2. OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

The consultancy of Agreement No. CE16/2004 Demonstration Scheme on Reclaimed Water Uses in the North District will started in mid-June 2005. The appointed consultants will carry out the design of the proposed reclaimed water facilities. They will also supervise the construction, operation of the whole scheme.

It is anticipated that the tender and construction of the works will commence in September 2005 and December 2005 respectively for completion of all the construction works by June 2007. Operation of the Scheme will take place after the installation of the pilot demonstration advanced treatment plant in July 2006 and the whole Scheme will be concluded by October 2008.

3. MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

The purpose of this section is to outline the existing and planned sensitive receivers (which might be affected by the Project) and the major elements of the surrounding environment (which may affect the Project).

3.1 Existing Sensitive Receivers and Sensitive Parts of Natural Environment

The study area (where the advanced treatment plant is located) is defined by a distance of 500m from the boundary of the project. Within the study area, representative sensitive receivers have been identified in accordance with the criteria set out in the EIAO TM. The representative sensitive receivers are listed in **Table 1** below and their location is shown in Figure 2.

Table 1: Existing Sensitive Receivers (SR) in Vicinity of the Demonstration Advanced Treatment Plant

SR No.	Description	Type of Use	No. of Storeys	Type of SR (ASR/NSR)	Distance between SR and the plant boundary (m)
SR1	Ancestor of Liu Temple (Tak Yeung Tong)	Worship	1	ASR & NSR	580
SR2	Fu Tei Au Tsuen	Residential	3	ASR & NSR	480
SR3	Fu Tei Au Tsuen	Residential	3	ASR & NSR	530
SR4	Warehouse/Trading area (with Ka Lei Warehouse, Sheung Shui Trading and Cambridge Plaza)	Industrial	5	ASR only	540
SR5	Sheung Shui Heung Sitting Out Area and Basketball Court	Open Space	-	ASR only	400
SR6	Wai Loi Tsuen	Residential	3	ASR & NSR	480
SR7	Temporary Structure	Domestic Residential	2	ASR & NSR	410

3.1.1 Residential Developments

The nearest residential areas are the Fu Tei Au Tsuen, the Wai Loi Tsuen and a temporary domestic structure, which are about 480m, 480m and 410 from the study area boundary respectively.

3.1.2 Place of Worship

There is a place of worship named Ancestor of Liu Temple (Tak Yeung Tong), which is about 580m north of the proposed area.

3.1.3 Recreational Facilities

There is a recreational open space called Sheung Shui Heung Sitting-out Area and Basketball Court, which is about 400m north-east of the proposed area.

3.1.4 Industries

There is a warehouse/trading area, which is about 540m north-east of the proposed area boundary.

3.2 Planned Sensitive Receivers and Sensitive Parts of Natural Environment

Within the study area, representative sensitive receivers have been identified in accordance with the criteria set out in the EIAO TM. There are no planned sensitive receivers in the vicinity of the SWHSTW which will be affected by the Project.

3.3. Major Elements of the Surrounding Environment Affecting the Project

There are no major elements of the surrounding environment affecting the Project.

4. POSSIBLE IMPACT ON THE ENVIRONMENT

4.1 Possible Environmental Impacts During Construction

4.1.1 Dust

The proposed Project comprises the installation of the demonstration advanced treatment module and the associated facilities at the SWHSTW, laying of the temporary reclaimed water distribution pipelines from SWHSTW to the users' premises and the necessary modification of piping connections at users' premises. We envisage that the major potential air quality impact during construction of this Project will only be dust arising from general construction activities.

4.1.2 Noise

The construction activities involved in this Project will include excavation and general E & M installation works. Sources of noise during the construction phase would be associated with the use of conventional construction plants and equipment.

4.1.3 Water Quality

Water quality impacts of the Project would be associated with site runoff and wastewater generated from construction activities. In view of the small scale of the Project, adverse water quality impact during the construction phase is not anticipated.

Water Supplies Department's requirements for working within the users' premises will be observed during the construction phase of the Project.

4.1.4 Waste Management Implications

The demonstration advanced treatment plant and the associated facilities will be installed above ground. Some excavation is expected for the installation of the temporary reclaimed water distribution pipelines. However, as most of the pipeline is expected to be constructed above ground, the volume of excavated material generated would be minimal.

4.1.5 Ecology

The demonstration advanced treatment plant and the associated facilities will all be located within the boundary of the SWHSTW. The alignment of the temporary reclaimed water distribution piping would be along existing foot path/roads. No habitat with ecological values was identified either within the site for the pilot plant or the boundary of the associated distribution network. No adverse ecological impact is therefore anticipated for the proposed Scheme.

4.1.6 Landscape and Visual

The pilot demonstration advanced treatment plant and the associated facilities would all be located within the boundary of the SWHSTW at an open space in the North-western corner with a footprint of about 150 m². The alignment of the distribution piping would be along existing footpath/roads. In view of the small scale and the temporary nature of the works, landscape and visual impacts will be small, localised and short-term. No tree felling is expected for this project.

4.2 Possible Environmental Impacts During Operation

4.2.1 Natural Resources

Currently, the existing toilets in the users' premises utilise potable water for flushing activities. The use of reclaimed water for flushing under the Scheme will reduce the fresh water demand at the existing toilets of the selected users premises. The remaining portion of the generated reclaimed water will also be used for landscape irrigation or water features at the selected users premises. It is anticipated that approximately 150 m³ of fresh water in total would be saved each day due to the proposed Scheme.

4.2.2 Air Quality

Secondary treated effluent from the SWHSTW will further undergo pre-treatment process (micro-straining), membrane filtration (ultrafiltration) and disinfection (chlorination) by the advanced treatment plant at the proposed site. The treatment system are electrically operated and unlikely to cause emission of airborne pollutants from the tertiary treated reclaimed water. Odour from the chlorination process may be of slight concern.

4.2.2.1 Cumulative Odour Impact from the Existing Sheung Shui Slaughter House and Shek Wu Hui Sewage Treatment Plant

Odour from the existing Sheung Shui Slaughter House would also affect the vicinity. A supplementary EIA (SEIA) Study of Sheung Shui Slaughter House has been conducted by ECEL in 1995. The report indicated that by-products from slaughtering process, particularly rendering and blood handling, animals and their waste, wastewater treatment processes and easily putrefying organic matter (manure) in areas such as lairages, transit pens, unloading area, are the potential odour sources. With the adoption of the of the mitigation measures recommended such as water spray and odour scrubbing, the odour concentration predicted in the SEIA was in the range of 0.609 – 2.46 OU at the identified ASRs.

Odour from the existing SWHSTW would also affect the vicinity. The Project Profile for Expansion of SWHSTW in 2005 revealed that with the adoption of mitigation measures (i.e. covering the inlet screw pumping station, grit channels, flume channels, effluent launder channels of primary sedimentation tanks and sludge holding tanks; and provision of de-odourizers for inlet pumping station and sludge holding tanks), the odour impact is predicted to be in compliance with the EIAO TM.

Since the odour characteristic of the Sheung Shui Slaughter House and the SWHSTW are very different from the Advanced Treatment Plant under this project, it is not appropriate to directly consider the cumulative odour impact. Notwithstanding, with the adoption of the mitigation measures at the slaughter house and the STSTW, significant odour impact would not be expected.

4.2.3 Noise

The pumps of the reclaimed water facilities would be the main potential noise source during the operational phase of the Project.

4.2.4 Water Quality

Reclaimed Water from the pilot demonstration advanced treatment plant

The reclaimed water scheme will utilize the treated effluent from the SWHSTW. The advanced treatment plant will comprise core process units including micro-straining, ultrafiltration and chlorination disinfection. The reclaimed water will be treated to meet the requirement (developed by making reference to the USEPA Guideline for Urban Reuse) as shown in Table 2 below.

Table 2
Proposed Reclaimed Water Criteria for Domestic Toilet Flushing, Unrestricted Irrigation and Water Features

Water Quality Parameters	Proposed Criteria
pH	6.0 – 8.0
BOD ₅ (mg/l)	< 10
Turbidity (NTU)	< 2 ¹
Fecal Coliform per 100 ml	Non-Detectable ^{2,3}
Residual Chlorine (mg/l)	> 1 ⁴

Footnotes (with reference to USEPA)

- 1 The recommended turbidity limit should be met prior to disinfection. The average turbidity should be based on a 24-hour time period. The turbidity should not exceed 5 NTU at any time
- 2 The recommend coliform limits are median values determined from the bacteriological results of the last 7 days for which analyses have been completed. Either the membrane filter or fermentation tube technique may be used.
- 3 The number of faecal coliform organisms should not exceed 14/100ml in any sample.
- 4 Total chlorine residual after a minimum contact time of 30 minutes.

Impact of Reclaimed Water as Flushing Water

Reclaimed water will be used for household toilet flushing, As shown in the table below, the reclaimed water output of this project will have a better water quality than the sea water currently in use for flushing as recommended by WSD.

Water Quality Parameters	HK Seawater Flushing	Proposed Criteria
pH	N/A	6.0 – 8.0
BOD ₅ (mg/l)	< 10	< 10
Turbidity (NTU)	< 2	< 2
Fecal Coliform per 100 ml	< 1,000	Non-Detectable
Residual Chlorine (mg/l)	N/A	> 1

Impact of Reclaimed Water as Irrigation Water

Apart from flushing, reclaimed water may also be used for irrigation and water features at some of the selected users premises and discharged into inland water. Despite the high quality of the reclaimed water (note that even the secondary treated effluent from SWHSTW can comply with WPCO for discharge into inland water), a Effluent Discharge Licence will be applied for from the Authority to ensure the reclaimed water are safe to be discharged.

In view of the above, there shall not be any major water quality impact during the operation of the Scheme.

4.2.5 Waste

It is not expected that there would be any additional waste generated due to the operation of the Scheme.

4.2.6 Ecology

No ecological impact is expected during the operation of the Scheme.

4.2.7 Health and Hygiene

Toilet flushing is a typical non-potable reclaimed water usage in which water will not have direct human contact. Thus, the impact on human health and hygiene is minimal.

For the uses of reclaimed water for unrestricted irrigation or water features, there are chances of direct human contact leading to impacts on human health and hygiene.

4.2.8 Hazard

Sodium hypochlorite required for the chlorination process. It is anticipated that sodium hypochlorite solution of concentration of 11%-15% will be used to provide the chlorine residual of 1.0 mg/L to the effluent.

4.2.9 Landscape and Visual

The pilot demonstration advanced treatment plant and the associated facilities would all be located within the boundary of the SWHSTW at an open space in the North-western corner. The alignment of the associated distribution piping would be along existing footpath/roads. In view of the small scale and the temporary nature of the works, landscape and visual impacts will be small, localised and short-term.

5. ENVIRONMENTAL PROTECTION MEASURES TO BE INCORPORATED IN THE DESIGN AND ANY FURTHER ENVIRONMENTAL IMPLICATIONS

5.1 Environmental Protection Measures During Construction Stage

5.1.1 Dust

The effect of dust generation from the construction works is expected to be insignificant with the implementation of proper mitigation measures. The impact will be minimized by the adoption of proper working methods such as regular water spraying and providing wheel-washing facilities. Relevant clauses will be incorporated into the contract documents in this regard.

5.1.2 Noise

The construction activities involved in this Project will include excavation and general E & M installation works. Sources of noise during the construction phase would be associated with the use of conventional construction plants and equipment. It is anticipated that only minor noise impacts will be generated. Notwithstanding this, clauses will be incorporated into the construction contract requiring the contractor to comply with the Noise Control Ordinance, Technical Memorandum of the Environmental Impact Assessment Ordinance (EIAO) and other relevant regulations so as to control the noise level within acceptable limit during the construction stage.

5.1.3 Water Quality

It is anticipated that very minor water quality impact will be generated during the excavation works. The contractor shall be required to provide, where necessary, a silt

removal facility on site so as to remove the silt before discharging into the nearby storm water drains. Such a silt removal facility shall be provided by the contractor on site before commencement of the excavation. The assessment shall be carried out in accordance with ProPECC PN 1/94 "Construction Site Drainage".

5.1.4 Waste Management Implications

Excavation will be required for the construction of the temporary reclaimed water distribution pipelines. However, as most of the pipeline is expected to be constructed above ground, the volume of excavated material generated would be minimal. Notwithstanding, Relevant clauses will be incorporated into the contract documents requiring the contractor to comply with the Waste Control Ordinance and its subsidiary regulations.

5.1.5 Landscape and Visual

In view of the small scale of this project, no significant adverse landscape and visual impacts are anticipated during the construction phase.

5.2 Environmental Protection Measures During Operation Stage

5.2.1 Air Quality

Chlorination tank will be enclosed to contain any potential odour emission. Since the facilities are located some 400 to 600m away from the ASR (see table 3), adverse odour impact on air sensitive receivers during the operational phase of the Project is not expected.

5.2.2 Noise

The pumps of the reclaimed water system will be enclosed to contain the noise emissions from the reclaimed water system. Silenced ventilation system incorporating silencers at the air intakes and discharge openings of the effluent reuse facilities would also be employed to further reduce the noise impact. Since the facilities are located some 400 to 600m away from the NSR (see table 3), with these mitigation measures in place, adverse noise impact is not anticipated during the operational phase of the Project.

5.2.3 Health and Hygiene

For the purpose of addressing possible concerns over public health risk, strict control measures will be introduced to minimize public health risk from reclaimed water uses. The measures include the following:

- a) The reclaimed water will be further processed with chlorination prior to reuse to ensure no bacteria contamination during the transmission of effluent to the selected users. A chlorine dosing system in the form of sodium hypochlorite with contact time of about 30 minutes will form part of the effluent reuse system. With the proposed chlorination system, the total residual chlorine will be greater than or equal to 1.0 mg/l, which is a level recommended by the United States Environmental Protection Agency (USEPA) for reducing odours, slime, and bacterial growth in distribution system for effluent reuse.
- b) To avoid cross-connection of the reclaimed water supply to the potable supply, the flushing water source shall be ascertained by dye testing. Furthermore, the reclaimed water pipeline shall be painted in colour different from the portal water mains, say, purple, for distinguishing between the two supplies. Dye testing shall be repeated periodically to ensure no cross-connection at all time.

- c) To gauge the performance of the demonstration advanced treatment plant and ensuring continuous high quality of the reclaimed water, a comprehensive monitoring programme will be implemented throughout the operation phase. Sampling and subsequent laboratory analyses will be carried out for the reclaimed water before and after it receives appropriate polishing by the advanced treatment processes. Water quality will be monitored at the inlet to the advanced water treatment unit, immediately downstream of each and every core treatment process steps (i.e. micro-straining, ultra-filtration and chlorination) as well as down at the users' end. To acquire a comprehensive understanding of the quality of the reclaimed water, apart from the routine monitoring of the key parameters as referred to in **Table 1**, additional parameters such as Colour, Odour, Ammoniacal Nitrogen, Total Suspended Solids, Total Organic Carbon, Dissolved Oxygen, Synthetic Detergent, Cryptosporidia, Giardia and bacteriophage/virus will also be examined in different detail as appropriate. An overall sampling and analysis schedule shall be worked out subsequent to the appointment of the project consultant.
- d) To minimize human contact, signage of "Reclaimed Water – Do Not Drink" shall be provided and generation of aerosols of reclaimed water would be minimized. If spray irrigation were employed, suitable precautionary measures would be taken to prevent the public from making direct contact with the spray. This can be achieved either by spraying at odd hours, say, night time only and/or fencing off/excluding the public from entering the irrigation spot during the spraying operation. Spray irrigation would also be located to avoid getting contact with air conditioners, fan intake points and area where food or drink is processed for consumption. Detailed guidelines will be developed in due course in consultation with all relevant parties.
- e) To provide a back-up fresh water supply to cater for occasion of the break down of the advanced treatment plant or any possible shortage of the reclaimed water supply.

5.2.4 Hazard

Sodium hypochlorite solution is a poisonous substance classified as Category 4 dangerous goods item. The solution can be transported to SWHSTW in liquid form for storage in tanks fabricated from fibreglass or rubber lined steel. Fire Services Department's requirements for bulk storage would be properly observed. Under this Scheme, the sodium hypochlorite solution will be kept below 250L in storage at designated areas not exceeding the exempted quantity under the Dangerous Goods Ordinance (Cap. 295) and its subsidiary Regulations. In light of the small quantities of chemicals stored, no significant hazard impact is anticipated from the Scheme.

5.2.5 Landscape and Visual

The landscape and visual impact arising from the pilot project is negligible due to the considerable distance between the nearest sensitive receivers and the pilot advanced treatment plant and the small scale of the project.

6. SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The potential environmental impacts and the proposed environmental mitigation measures to be incorporated into the design and construction contract of the proposed effluent reuse scheme are summarised in the following table.

Project Stage	Potential Environmental Impact	Mitigation Measures	Relevant Section in this Project Profile
Construction	Minor dust nuisance	Control by contract specifications.	4.1.1 & 5.1.1
	Minor noise impact	Control by contract specifications.	4.1.2 & 5.1.2
	Minor water quality impact	Control by contract specifications.	4.1.3 & 5.1.3
	Minor waste impact	Control by contract specifications.	4.1.4 & 5.1.4
	Ecology	No adverse impact is identified; no mitigation measure is required.	4.1.5
	Landscape and Visual	Only small adverse impact is identified, no mitigation measure is required.	4.1.6 & 5.1.5
Operation	Impact on natural resources	No adverse impact is identified; no mitigation measure is required.	4.2.1
	Air Quality	Chlorination tank will be enclosed to contain any potential odour emission	4.2.2 & 5.2.1
	Minor noise impact	Pumps enclosed, use silenced ventilation system.	4.2.3 & 5.2.2
	Impact on inland water quality	No mitigation measure is required.	4.2.4
	Waste impact	No adverse impact is identified; no mitigation measure is required.	4.2.5
	Ecological impact	No adverse impact is identified; no mitigation measure is required.	4.2.6

Project Stage	Potential Environmental Impact	Mitigation Measures	Relevant Section in this Project Profile
Operation	Impact on health and hygiene	<p>Provide chlorination to ensure no bacteria growth along the effluent reuse distribution system.</p> <p>Dye testing and colour coding of treated effluent pipes to avoid incorrect connection with potable water fittings.</p> <p>Sampling and subsequent laboratory analyses to ensure water quality meets requirement.</p> <p>Provision of back-up fresh water supply to augment the break down of the advanced treatment plant or any possible shortage of the reclaimed water supply.</p> <p>spraying at odd hours, fencing off/excluding the public from entering the irrigation spot during the spraying operation.</p>	4.2.7 & 5.2.3(a), (b) (c),(d) and (e)
	Hazard impact	Chemicals will be stored at designated areas complying with Dangerous Goods Ordinance (Cap. 295) and its subsidiary Regulations	4.2.8 & 5.2.4
	Landscape and Visual	Only small adverse impact is identified, no mitigation measure is required.	4.2.9 & 5.1.5

With proper implementation of the above environmental mitigation measures that will be incorporated into the design and construction contracts of the proposed demonstration scheme, insurmountable environmental impact during the construction and operational stages of the proposed scheme is not expected.

To conclude, reclaimed water has the advantage of decreasing wastewater discharges thereby reducing pollution loading to the environment and reducing the demand on raw water, which is a scarce natural resource deserved for preservation to the maximum extent practicable.

- END -

Figure 1

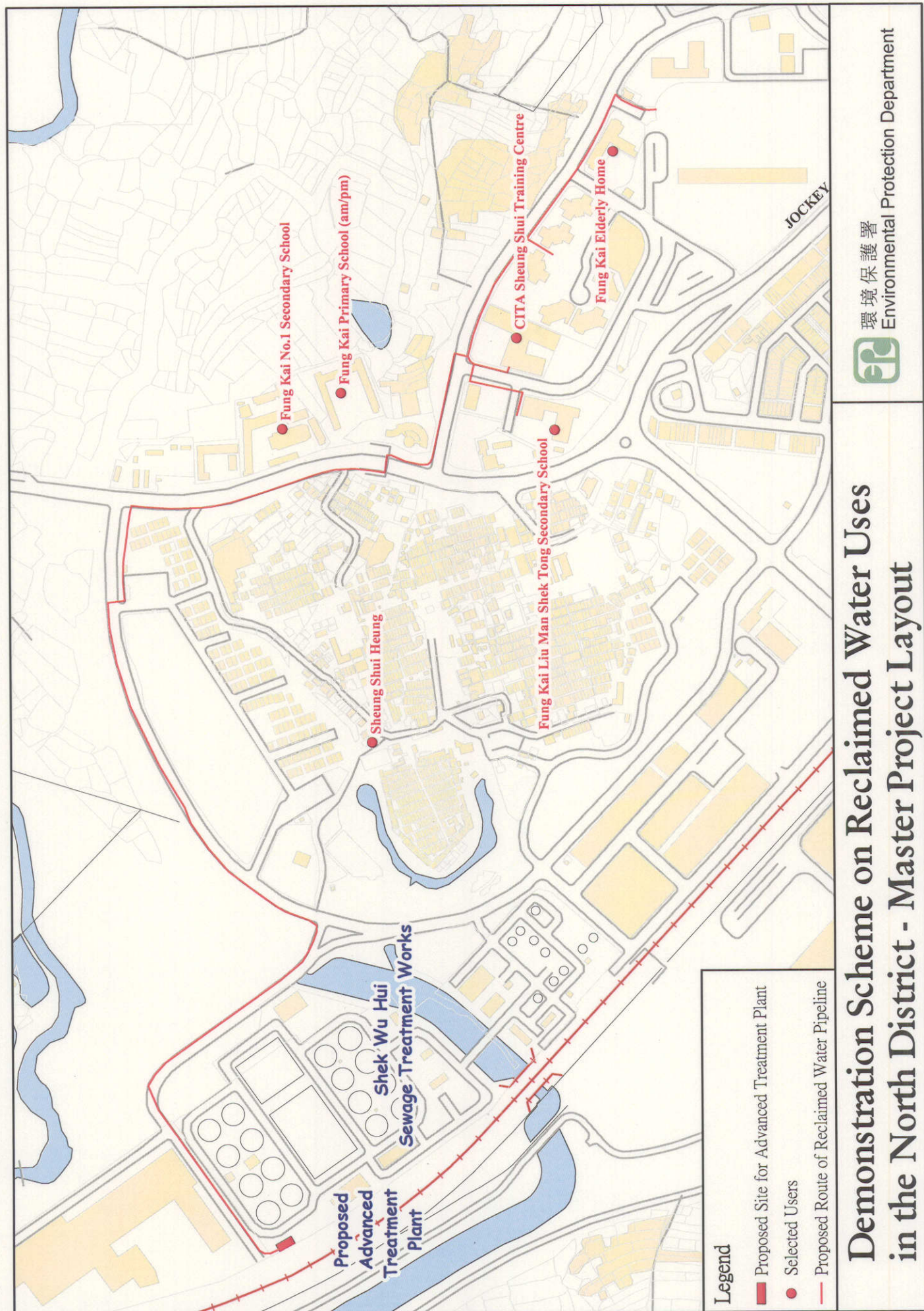


Figure 2



Legend

- Proposed Site for Advanced Treatment Plant
- ⊕ Sensitive Receivers (SR)

Existing Sensitive Receivers		Type of Use
SR1	Ancestor of Liu Temple (Tak Yeung Tong)	Worship
SR2	Fu Tei Au Tsuen	Residential
SR3	Fu Tei Au Tsuen	Residential
SR4	Warehouse / Trading Area	Industrial
SR5	Sheung Shui Heung Sitting-out Area and Basketball Court	Recreational Open Space
SR6	Wai Loi Tsuen	Residential
SR7	Temporary Domestic Structure	Residential

Figure Title
Demonstration Scheme on Reclaimed Water Uses in the North District
Location Plan of Sensitive Receivers

 環境保護署
 Environmental Protection Department