APPENDIX 2D: FURTHER EVALUATION OF TREATMENT SYSTEM

Based on the latest findings of the flows and loads estimation, the future sewage flow from Peng Chau will reach an Average Dry Weather Flow (ADWF) of 1,580 m^3/day. As the existing sewerage system is largely combined with the storm drains and will not be separated in short term, the future Peng Chau Sewage Treatment Works (STW) will need to cater for an additional stormwater inflow of 5,616 m^3/day (or 65 l/s) before the system is completely separated (see **Annex 1**). Therefore, the design peak flow of 10,360 m^3/day (= 3x1,580 + 5,616) for the plant was concluded in our previous Working Paper No. 3.

Because of the significant quantity of stormwater inflow, a "dual streams" system for the plant was proposed to save the cost on biological treatment. The system consists: a biological treatment, which is the "main stream" with a treatment capacity of 3,160 m^3/day (i.e. 2xADWF); the other, so-called "side stream", being a primary treatment process with a treatment capacity of 7,200 m^3/day to the flow exceeding the main stream capacity. The combined capacity of the two streams is 10,360 m^3/day.

However, with the lower treatment ability of the side stream, the effluent quality during extreme storm events may not meet the effluent requirement. DSD and EPD have expressed their concern on the uncertainty of the frequency of such exceedance. It is difficult at the development stage to predict the sewage characteristics and the flow patterns. Therefore, after further studying on the latest wet weather flows and loads data, another alternative which provides more consistent effluent quality is proposed as follows:

The biological treatment unit is designed for a capacity of 4,740 m^3/day (i.e. 3xADWF). The flow exceeding the biological treatment unit capacity will be temporarily stored by an equalization tank. It is anticipated that the sewage flow to the plant will increase with time due to the commissioning of the sewerage projects, while the stormwater inflow will have a reverse pattern with time due to the separation of the combined sewerage system. In order not to waste extra resources, the storage capacity of the equalization tank is designed for the most critical time period instead of adding up the largest estimated sewage and stormwater inflow. Following the recommendations in the OISMP2 (see **Annex 2**), a 2-hour rainfall storm event with intensity of 216 mm/hr at 1 in 2 year return period is adopted. With the incorporation of the equalization tank, both the hydraulic and treatment capacity of the plant will be sufficient even in heavy storm events to provide consistent effluent quality. Based on the calculation presented in **Table 1**, we recommend the capacity of the equalization tank to be 996 m^3 (say 1,000 m^3) with the base biological treatment unit capacity of 4,740 m^3/day.

Table 1 Flow and equalization tank capacity estimation (planned scenario)

	Sewage average flow (m^3/day)	Sewage peak flow (m^3/day)	Total runoff volume (m^3)*	Required plant Capacity (m^3/day)	Design capacity of biological unit(m^3)	Required capacity of equalization tank(m^3)
2004	450	1,350	1,524	2,874	4,740	0
2006	1,000	3,000	1,524	4,524		0
2010	1,580	4,740	996	5,736		996
2016	1,580	4,740	801	5,541		801

* as recommended in OISMP2 (see Annex 2)

In case there is any change of population forecast in the future, the ultimate scenario is also considered. The estimated required storage capacity for the equalization tank is 801 m^3 (**Table 2**) which is smaller than 1,000 m^3. Therefore, the equalization tank will still be sufficient to handle the storm inflow, even if the next phase of the STW proceeds. While, more modules of other facilities will be required in the next phase to handle the peak flow of 8,125 m^3/day (2.5xADWF).

Table 2 Flow and equalization tank capacity estimation (ultimate scenario)

	Sewage average flow (m^3/day) *	Sewage peak flow (m^3/day)	Total runoff volume (m^3) *	Required plant Capacity (m^3/day)	Design capacity of biological unit(m^3)	Required capacity of equalization tank(m^3)
2010	2,136	5,340	996	6,336	8,125	0
2016	2,312	5,780	801	6,581		0
Ultimate	3,250	8,125	801	8,926		801

* as recommended in OISMP2 (see Annex 2)

Annex 1

(Comment from Sewerage Projects Division of Drainage Services Department
on Working Paper No. 3 (Revision of Population, Flows & Loads)
regarding the additional stormwater inflow)

Drainage Services Department
Sewerage Projects Division
44th floor, Revenue Tower, 5 Gloucester Road,
Wan Chai, Hong Kong.

ISO 9001 : 2000
Certificate No. : CC2088

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By Fax (2424 - 9114) & Post

28 April 2003

CDM
4305-12 Metroplaza Tower 1,
223 Hing Fong Road, Kwai Fong,
Hong Kong.
(Attn.: Mr. Chris Chen)

Dear Sir,

Agreement No. CE 83/2001 (DS)
Peng Chau Sewage Treatment Works Upgrade
- Investigation, Design and Construction

Draft Working Paper No. 3 – Revisions of Population, Flows & Loads

Referring to the above Draft Working Paper circulated under CE/CM, DSD's memo ref. (63) in CM8/CE8301/26 (II) dated 15 April 2003 for comments, I attach a copy of my comments on the above Paper for your necessary action please.

Yours faithfully,

(Ir. Kent K Y Ma)
for Chief Engineer/Sewerage Projects
Drainage Services Department

c.c.

CE/CM, DSD	(Attn.: Ir. K C KWOK & Ir. C K LAM)
CE/E&MP, DSD	(Attn.: Ir. Peter WONG)
CE/ST2, DSD	(Attn.: Ir. C W TSE)

Section No. in Draft Working Paper No. 3 – Revisions of Population, Flows & loads	SP/DSD's Comments
2.4 Design Population	
Para. 1	Please advise the strategy to be adopted in making provision for further extension for Ultimate Population at the Peng Chau STW site. The change in Design Population (from 11,000 to 6,200) in term of percentage is substantial but in absolute term the population involved is not so large (about 11,000 ultimately). As the population forecast is a very uncertain design parameter, please consider the option of constructing the design for Ultimate Population instead of for Planned Population for some buildings (e.g. building for housing E&M control equipments) as this may help releasing the constraints of the relative small footprint of the site for further extension.
2.5 Population Distribution, Employment and Student Places	
Table 2 –4	Please advise the classification (i.e. Public Housing/R3/R4/Village?) adopted for the existing two housing estates (Kam Peng Estate and Peng Lai Court) mentioned in Section. 5.2.1.
3.2 Flows Estimation	
Table 3 – 1	Flow Factor for Ave Day Visitors is missing. Please add.
3.4 Summary	
Para. 2	Please note that OISMP Stage 2 Review recommended the Peak Flow adopted for the design of the Peng Chau Sewage Pumping Station (PCSPS) under Package H is 150 l/s to account for the Additional Stormwater Allowance due the inherent characteristics of the existing combined drainage system and internal house drainage system in Peng Chau central area. It is anticipated that complete separation of the existing internal house drainage system will not be feasible in short to medium terms. Among the Peak Flow of 150l/s adopted in the design of the PCSPS, about 65l/s is the Additional Stormwater Allowance (= 150 l/s - Peaking Factor Excluding Stormwater Allowance * ADWF in unit of l/s). Please discuss and confirm with EPD and CE/CM of DSD whether the same Additional Stormwater Allowance shall be allowed for the STW upgrade.
4.2 Load Estimation	
Table 4 – 1	Please also revise the load estimation if there is revision to the classification for the two existing housing estates as commented on Table 2-4 above.

5.4.2 Issues Arise	
Proposed New Peng Chau Sewage Pumping Station	The sewage pumping station shall be designed to handle the peak flow anticipated during it design life to prevent unnecessary sewage bypass. To include more useful information in the report, please also add the Peak Flow of the planned average flow (1,570m^3/day) which is 73l/s (i.e. with Peaking Factor of 4 recommended in Section 3.4) to this paragraph. Please also include in this paragraph the operation mechanism of the pumping system under Package H: - The pumping system of Package H consists of 3 pumps (2 duty plus one standby each with capacity of 75 l/s) and twin 250mm diameter rising mains. The design capacity of 150 l/s can be achieved when both rising mains are in operation and each is being fed by one duty pump. When either one of the twin rising mains is out of service, two pumps will then feed the single rising main remained in operation if inflow exceeds the capacity of one pump. From above, it can be seen that the peak flow of 73 l/s can be handled by operating one rising main and one duty pump. Nevertheless, please confirm the peak flow to be adopted for design of STW upgrade as mentioned in Section 3.4 above.
5.4.4 Environmental Impact Assessment (EIA)	
	For outfall operation, the critical condition for dilution occurs at the Planned Flow instead of Ultimate Flow as presumably the outfall will be sized for the Planned Flow. The jet velocity (or dilution) at Planned Flow will be lower than that at Ultimate Flow for a given outfall diameter as the former is smaller than the latter and therefore more critical in term of dilution. So please check if any other worst-case-analysis should be conducted for Planned Flow (smaller flow) rather than Ultimate Flow (larger flow).

Annex 2

(Excerpt from Outlying Island Sewerage Master Plan Stage 2 Review
on stormwater projection on Peng Chau)

14.1 Introduction

As noted in Sections 6 and 7, the existing situation at Peng Chau exhibits the following characteristics and problems:

Sewerage:

- large portions of the existing sewerage in Peng Chau are combined systems. A current project will provide a separate system for storm flows where it is practical to do so. However, the foul sewerage system will still receive substantial stormwater flows before complete separation of the combined system is achieved;
- most existing discharges are at present direct to sea, causing some odour problem in the vicinity of the ferry pier;
- significant structural condition problems were identified (13 lengths of Grade 4 sewer with a total length of over 230 m);
- debris, silt and grease were particularly evident in Peng Chau, with a resulting loss in cross-sectional area of up to 50% in some areas.

Treatment and Disposal:

- a low proportion of the population of Peng Chau is currently connected to sewage treatment;
- the existing treatment works, which was designed to serve the new housing estates, has a ADWF capacity of 450 m3/day. The capacity of the existing STW is far short of the requirement for the projected future flows and loads from Peng Chau.

14.2 Constraints and Requirements

14.2.1 Projected Flows and Loads

Flow and load projections are described in Section 5 and summarised in Table 14.2.1.

Table 14.2.1

Total Flow and Load Projections for Peng Chau

Future	2006	2011	2016	Ultimate (Note 1)
Flow, m3/day	1,938	2,163	2,312	3,250
BOD, kg/day	384	452	469	618
Amm-N, kg/day	42	50	52	69

Note 1: Ultimate development relates to revised population capacity of 11,000

It should be noted that the flows and loads in Table 14.2.1 represent the whole of Peng Chau. The amount of sewage actually captured will depend on the progress of the sewerage works and the percentage of successful connections in each drainage area. The quantities actually received at the main pumping station in the year 2006 will therefore be significantly less than the values in the Table. From the 1999 flows (about 240 m3/day) received at the existing STW there will be a sudden increase once the Peng Chau Phase 1 sewerage works being undertaken by DSD are completed to around 1,070 m3/day by 2004/05 (DSD estimate). Thereafter, a more gradual increase in flows is projected as the Stage 2 branch sewer extensions are constructed and connections are progressively made to this network, as shown in Figure 14.2.1 and Table 14.2.2. The following levels of connection have been assumed in preparing the graph and Table:

- 60%, 95% and 100% by 2006, 2011 and 2016 for Stage 1 sewerage;
- 60%, 90% and 100% by 2008, 2011 and 2016 for Stage 2 sewerage.

The flow projections assume that the existing seawall discharge points will not cause tidal inflows to the reconstructed sewerage system. The flow projections in m^3/day are also of annual average dry weather flows unless otherwise stated.

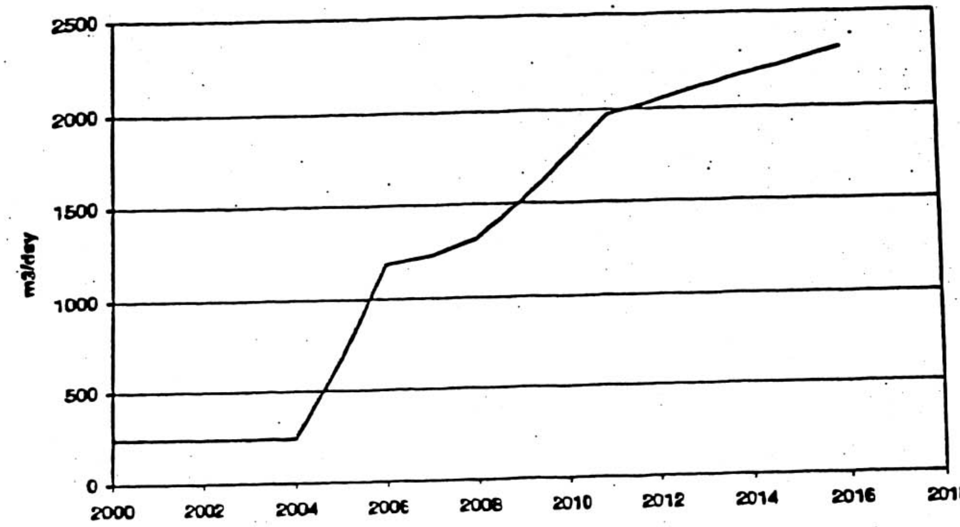

Figure 14.2.1: Projected flow build-up to Peng Chau STW or Export Scheme

Table 14.2.2

Projected Flow Generated and Collected with and without Outlying Island SMP Stage 2

Flow (m^3/day)	Year						Area connected/to be connected
	1996	2006	2008	2011	2016	Ultimate	
Total Generated	1,548	1,938	2,028	2,163	2,312	3,250	
Collected to main PS without PC Sewerage Stages 1 & 2	196	240	240	240	240	240	Existing
Collected to main PS with PC Sewerage Stage 1 but without Stage 2	196	1,084	1,708	1,890	2,112	2,997	Existing + Stage 1 catchment
Collected to main PS with OI SMP Stage 2 Review Proposals	196	1,110	1,900	2,136	2,312	3,250	Whole Catchment

14.7 Sewerage Extensions and Improvements

14.7.1 Recommended Option from SMP

The SMP for Peng Chau comprised two phases. Phase 1 comprised partial reconstruction of the existing sewerage network and new extensions in the central area. Phase 2 would comprise extensions of the system to villages in the fringe areas. These villages included Wai Tsai Tsuen, Tai Lung Tsuen, Yuen Ling Tsai, Nam Wan San Tsuen, Tai Yat San Tsuen and Nam Wan Shan Ting San Tsuen. The Phase 1 village sewerage and the scheme to export the flow to Lantau via the Discovery Bay export scheme were grouped under SMP Stage 1 Implementation, and Phase 2 village sewerage under Stage 2 Implementation.

14.7.2 Improvements to Existing Network under Stage 1

14.7.2.1 Introduction

An initial performance assessment undertaken under this study on the basis of continued utilisation of the combined sewerage system at Peng Chau showed high levels of storm inflow into the Peng Chau sewerage system. These have been confirmed from the flow survey results where peaks of between 10 and 20 DWF were observed.

However, since the original SMP DSD have progressed the detailed design of a separate foul and stormwater system for Peng Chau. A trunk and branch sewer system has been designed to take separate foul flows to a network pumping station at the downstream end of the trunk sewer and discharge to the STW. The design of this sewerage has been undertaken by DSD under the Outlying Islands Sewerage Stage 1 Phase 1 works. The intention is for the existing combined sewers to be retained and converted to storm drains, and for there to be no connection between the foul and storm systems. The details of this system were supplied by DSD in March 2001.

It is noted that the installation of a separate foul sewer system in Peng Chau will be particularly difficult because of space constraints in the narrow congested alleyways and the need for the existing system to be maintained in operational condition throughout the construction process. There is therefore a risk of disruption to the public over an extended period. The constructability of the Stage 1 proposed system needs to be reviewed and public consultation undertaken at the appropriate time.

As well as checking for long-term conditions, the interim hydraulic conditions were reviewed where total separation of flows has not been achieved and the Stage 1 Phase 1 catchment still contributes a substantial storm component of flows into the foul system. This section of the report presents the flow build-up under interim conditions (2006,2011,2016 and ultimate) and the peak flow rate to the pumping station under these conditions to check the pumping station capacity.

14.7.2.2 Stage 1 Details Adopted in Hydraulic Assessment

The existing trunk sewer will be incorporated into the new foul sewer system. Figure 14.7.1 depicts the extent of the Stage 1 Phase 1 catchment.

The three existing overflows are all located below the 1 in 1 year tide level of 2.5mPD. However, these will no longer exert an influence on the foul system in the medium to long-term.

The design of the pumping station by DSD assumed a capacity of 114 L/s based on total separation of the foul system. This was derived from a peaking factor of 3.5 applied to the average DWF of 33 L/s for the Phase 1 and Phase 2 catchments. This peaking factor i Table 3 of the DSD Sewerage Manual. 3.5 is the value from the lower part of the including for some stormwater and is valid for the population range 10,000 – 25,000 following aspects should be noted:

1. the equivalent population by the year 2016 is likely to be less than 10,000, and the peaking factor from Table 3 for flows arriving at the pumping station for popu < 10,000 would be 5;
2. the ultimate equivalent population is > 10,000, for which the sewer peaking factor for arriving at the pumping station would be 4.

The initial pumping station layout adopted in the model consisted of 2 duty pumps of ca 57 L/s each with 1 standby pump of 57 L/s capacity. The layout was adopted from the dra DDN/211DS/1810B and 1811B supplied by DSD. The start and stop levels of the p obtained from DSD/SP are tabulated in Table 14.7.1.

Table 14.7.1
Pumping Station Start/stop Levels for Initial Model Configuration

Pump no.	Start level	Stop level
1st duty pump	-2.75	-3.05
2nd duty pump	-2.65	-2.95
3rd standby pump	-2.45	-2.85

DSD confirmed that the normal mode of operation of the pumps would be two pum duty/standby arrangement. During storms it is possible that all three pumps could op together once the water level in the sump rises above the standby pump cut-in level of - mPD. It is normally intended that the standby pump would only be operated as a backup t of the duty pumps. DSD advised that there will be space in the pumping station to add a f pump if necessary.

Twin 250 mm dia. rising mains have been proposed between the pumping station and the S

The level of the emergency overflow is currently designed at 2.9 mPD.

14.7.2.3 *Other Parameters Adopted in Hydraulic Assessment*

The proposed network was assessed to evaluate the impacts of all the future extensions future populations, and therefore parameters were assigned to the future Stage 2 extension well as to the Stage 1 sewerage catchment.

1. Extent of separation achieved in interim and ultimate conditions

   This depends on the % of proper connections under Stage 1. This depends on the action various Government departments. The modelled parameters were agreed with EPD DSD and are presented in Table 14.7.2.

Table 14.7.2

Area contributing storm component of flows in interim and future catchments

Catchment	2006	2011	2016 and ultimate
Stage 1 Phase 1	75% of roof area	50% of roof area	25%
Stage 1 Phase 2 and Stage 2	Not connected	5%	5%

These assumptions, which cannot be confirmed at present, are fundamental to the outcome of the modelling. These values and the flows to the new pumping station in wet-weather conditions should be reviewed once the works have been commissioned.

2. **Rainfall conditions**

The rainfall conditions adopted were a 1 in 2 year 2 hour storm with 2 x ADWF as adopted for other system performance assessments. The maximum rainfall intensity was 216 mm/h and the duration was 120 minutes.

14.7.2.4 ***Total Wet Weather Flows***

As expected, the revised separate system shows marked drops in the level of storm response compared to the original model runs with a combined system. The results for the various development years are summarised below in Table 14.7.3.

Table 14.7.3
Wet Weather Predicted Flows
Runoff and peak flow assessment for design storms

Year	Total runoff volume (m^3)	Maximum flow rate (L/s)
2006	1524	232
2011	996	213
2016	801	216
Ultimate	801	226

It can be seen from the assessment that the maximum flow is predicted to occur in the 2006 network when 75% of the Phase 1 Stage 1 catchment roof area is assumed to contribute wet weather flows to the network.

14.7.3 **Performance Assessment**

14.7.3.1 ***Performance assessment – Proposed pumping station***

It is evident from the above results that the flow into the system under storm conditions could exceed the maximum capacity of the pumping station. With 2 duty + 1 standby pumps of 57 L/sec each, both duty pumps would operate for most of the storm, with surcharging along the network for most of the storm duration. There would be no overflow at the pumping station but there would be resultant surcharging in the upstream system.

With the addition of a third duty pump the capacity of the pumping station under storm conditions would be approximately 150 L/s through the twin rising mains. This would reduce

the duration of surcharging of the trunk sewer to just over an hour for the two hour d
design storm event.

It is concluded that it is not necessary for the pumping station to be designed to pump the
year storm peak flow but to pump a flow which would alleviate surcharging in the up
trunk sewer system under the interim (2006) conditions. The pumps would have capac
5ADWF based on the 2016 ADWF of 27 L/sec calculated in this Review study, and 4
based on the projected ultimate flows. These values conform to the sewer peaking factors
Sewerage Manual.

To illustrate this Figure 14.7.2 shows the incoming flows under worst case conditi
Scenario 1 with the design storm. It can be seen that the addition of a third duty pump g
reduces the potential period of surcharging.

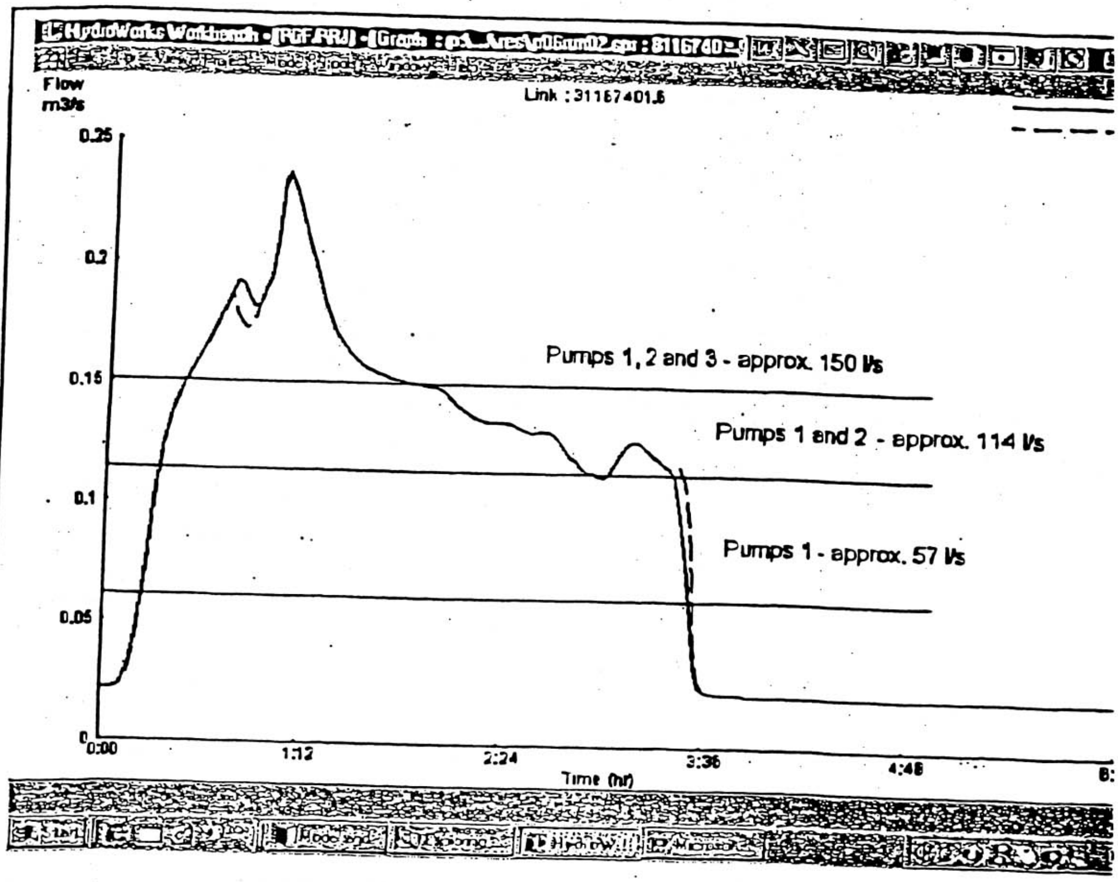

Figure 14.7.2: Predicted flow hydrograph to pumping station under 1 in 2 year storm conditio

14.7.3.2 *Performance assessment – Proposed network*

The model results were analysed for each year and are presented on the system performa
plans provided in Appendix F.

The 2006 network shows some surcharging due to minor undercapacity in the proposed netwo
in the centre of Peng Chau. This is in one of the proposed new lengths of sewer to take t
assumed runoff entering the new system from the roofs of the connected houses (which a
assumed to remain internally combined). This reduces in time and there is no flooding predict
in the 2011, 2016 and ultimate events. See Figure 14.7.3 for the location of the length
undercapacity sewer. The design could be further upgraded to remove this surcharging.

In the case of breakdown of power supply to the pumping station flow would continue to arrive at the pumping station. DSD have advised that the wet well has a capacity to store 2 hours flow at future average dry weather flow. Once this is exceeded the trunk sewer would start to surcharge and this would continue until the water level in the pumping station wet well reached the level of the emergency overflow which is currently designed at 2.9 mPD. In this case during dry weather flow conditions there would be no flooding caused in the upstream network.

14.7.3.3 *Rising mains*

The proposed twin 250DN rising mains have been checked for the higher storm flowrate of approx. 150 L/s. The velocity in these rising mains will increase to 1.53 m/s under these conditions, which is an acceptable velocity.

For single pump and single rising main operation under DWF conditions the flow would be 57 L/s which would correspond to a velocity of 1.16 m/s, again an acceptable velocity for sediment transport. It is also greater than the critical velocity for slime stripping for this size of pipe, which should help to limit septicity generation in the rising mains.

14.7.3.4 *Dry weather flow assessment*

The dry weather flow assessment was undertaken to represent peak dry weather flow conditions. A 2 x ADWF profile was used to test the 2016 system. This showed that low velocities would prevail over most of the new system during DWF conditions. This is due mainly to the low flows from the small contributing populations connected to the system, combined with shallow sewers and poor gradients in some locations. A planned maintenance regime to monitor the condition of the sewers will be required to minimise siltation during the dry season.

14.7.3.5 *Effect on Sewage Treatment Works*

It is estimated that the existing two secondary clarifiers have a total capacity of 250 m^3. Reference to Figure 14.7.2 shows that with a total pumping capacity of 150 L/sec the third duty pump could be in operation for about 2½ hours during the design storm. However, if the biological treatment stage is designed to receive peak flows of 3.5 times average (132 L/sec), the two existing clarifiers as storm tanks could cope with the excess flows. This suggests that there would be no overflow of screened wastewater that has not received biological treatment.

In order to avoid overflow under more extreme conditions, a third storm tank could be added as shown in Figure 14.3.3.

14.7.4 Recommendations for Stage 1 Catchment

No change is proposed to the structure of the pumping station as designed by DSD. In view of the potential wet weather flows in the early years of operation, it is recommended that a fourth pump should be installed so that three duty pumps are available during storms. All of the flows from the pumping station will receive preliminary treatment at Tai Lei, once the new sewage treatment works is commissioned. During storms when the third duty pump is operating for long periods, some of the flow will be diverted to storm tanks at the treatment works, downstream of preliminary treatment.

It is not known exactly what level of storm response will result in the new system, because this will be highly dependent on the level of separation achieved. Thus it is recommended that the flows to the new sewage pumping station be monitored in the years immediately after the new network and pumping station are commissioned to allow confirmation of the flows re from this assessment.

As described in Section 6.2.5, two cases of sewers passing beneath buildings were identi Peng Chau. The sewer at Peng Chau Wing On Street, downstream of manhole HK211 which flows seaward beneath flat no. 56-58, is not a critical sewer as the flow can pass alternative route to the Po Peng Street sewer. The other example was the sewer near th pier (upstream of manhole no. HK22160201), which flowed from Peng Chau Wing O Street beneath the Water Supplies Department depot. DSD HK&I Division has recently di this sewer.

The CCTV survey identified numerous lengths of Grade 4 sewer. It is recommended that be rehabilitated/replaced before they deteriorate further.

An assessment of surcharging was undertaken. This assessment revealed that surcharging network is not a major issue, however a large portion of the new network design is shallow than 1m depth to invert - more details are provided on this in Appendix F) and therefore th freeboard criterion is impossible to achieve in these areas.

14.7.5 Updated Scope of SMP Stage 2

New sewers will be constructed under TDD project Contract No. IS 10/98. The sewer ext will cover Yuen Ling Tsai, Nam Wan San Tsuen, Tai Yat San Tsuen and Shing Ting 1 The planned sewer alignment overlaps with the proposed trunk sewer alignment in the or SMP to a large extent, therefore, the SMP proposed option needs to be updated. The rem works include the trunk sewer route to Tai Lung Tsuen and village sewerage connections.

Detailed surveys have been completed in Peng Chau to provide further information fc preliminary design of the Stage 2 sewerage extensions as part of this SMP Review.

A drawing of the future sewerage system is included in Figure 14.7.4. This identifie existing, committed and future proposed sewerage, along with the contributing are identified and included in the updated hydraulic modelling. The original SMP alignments been reviewed and revised. Apart from the main pumping station described in Section 14 no pumping stations are required.

14.8 Summary of Recommended Sewerage Master Plan for Peng Chau

As noted in Section 9.4.2, the existing sewerage system is largely combined. In many case existing house drainage is combined internally, i.e. grey water drainage is often combined roof drainage.

The Peng Chau Village Sewerage Phase 1 project (part of Outlying Islands Sewerage Stag will provide a separate foul sewerage system in the central areas of Peng Chau. However, separation of storm runoff flows will be difficult to achieve within a short time period. In meantime, the upgrades to existing facilities should be designed on the basis that large flow storm water to the foul sewerage system are likely in the medium term. The installation fourth pump at the proposed pumping station is suggested for this reason. It is recommen that the flows to the new sewage pumping station be monitored in the years immediately a the new network and pumping station are commissioned to allow confirmation of the st flows received.

It is recommended that Peng Chau STW should be reconstructed with provision for nitrogen removal as soon as possible. The new treatment works can be substantially completed alongside the existing works so that operation of the existing treatment works can be maintained. A nitrifying denitrifying activated sludge plant (Figures 14.3.2 and 14.3.3) can be provided on the existing site to treat the anticipated ultimate loads (11,000 population). The new treatment works should be designed to produce the ultimate design objectives listed in Table 14.3.3.

In view of the difficulty of separating the storm flows and foul flows fully in the medium term, storm flow retention tanks are recommended at the treatment works to protect effluent quality in storm conditions.

New sewers will be constructed under a TDD project to Yuen Ling Tsai, Nam Wan San Tsuen and Tai Yat San Tsuen. The remaining works under Outlying Islands Sewerage Stage 2 include the trunk sewer route to Tai Lung Tsuen and village sewerage connections.

Given that the Phase 1 sewerage design has been in progress but the EIA and design work for the outfall and the treatment works upgrade have yet to commence, there is likely to be a mismatch between the potential completion dates of these two projects. Options that were considered in this study included conveying the collected Phase 1 sewage flows to the existing Peng Chau STW during the interim period. This would eliminate dry weather flow discharges from the Phase 1 catchment to the inshore waters near the ferry pier. However, such options were considered not promising because of unresolved environmental and regulatory concerns.

If such an interim scheme is not possible, it will be necessary to either defer the commissioning of the Stage 1 pumping station or accelerate the implementation of the recommended treatment works (possibly by obtaining special approval to fast-track the administrative procedures), or a combination of these.