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19 December 2006

Dear Ms Eu,

Harbour Area Treatment Scheme (HATS) Stage 2

I refer to your letter of 8 December 2006 addressed to Dr Liao on the captioned subject. Dr Liao has asked me to reply.

My colleagues have gone through the submission by WWF very carefully and compiled a comprehensive response to each point, where necessary drawing on input from consultants who are conducting the on-going EIA of the Advance Disinfection Facility. This is attached hereto. I would however like to stress a few general issues which are relevant to the submission.

The first and most important point is that it is incorrect to say that the Administration plans to postpone secondary (i.e. biological) treatment for HATS Stage 2 indefinitely. To clarify the position I think it important to recap some of the background.

In 2000 an independent panel of local and international experts reviewed the plans for the HATS and recommended that for the next stage we should aim to provide secondary treatment with a discharge through a short outfall into the harbour, rather than a lower level of treatment coupled with a long outfall discharging into the deep fast-flowing currents of the South China Sea (the former Strategic Sewage Disposal Scheme). The experts suggested a number of engineering configurations for doing this, each of which required further detailed investigation so as to clearly define the pros and cons. Between 2001 and 2004 the suggested options were exhaustively investigated with the work being subject to supervision by the HATS Monitoring Group, a group of local experts and community representatives with an interest in the subject. This group included the three local experts who sat on the independent panel mentioned earlier, namely Dr Albert Koenig (a wastewater treatment expert), Prof Rudolf Wu (an expert in marine biology) and Prof Leonard Cheng (an expert in economics).

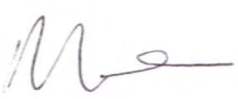
During the course of the studies conducted between 2001 and 2004 it was found that to provide secondary treatment extra land would be required next to the Stonecutters Island Sewage Treatment Works. Furthermore, there were some uncertainties as to the likely rate of population increase in the future and the sewage flow build-up. Consequently, bearing in mind the very significant improvements to overall water quality that had already been brought about by HATS Stage 1, the Government decided that the most pragmatic approach would be to

pursue a phased implementation of the review panel's findings, with the first step being to focus on providing the same highly effective treatment to the remainder of the harbour area sewage as had been applied in HATS Stage 1. This was the recommendation that the Government put forward during the extensive consultation exercise held between 21 June 2004 and 20 November 2004, the outcome of which was presented to LegCo EA Panel on 25 April 2005 and further debated on 5 July 2005. According to the consultation results, 68% of the key stakeholders and 50% of the individuals who expressed a view on the subject supported phased implementation. Certainly there were some in the community who expressed the view that we should proceed to implement biological treatment in one step and such views were canvassed at the discussion with deputations at the EA Panel meeting on 5 July 2005. However we have been proceeding in accordance with what we believe to have been the consensus view, namely that we should extend the highly cost-effective chemical treatment to all the HATS area sewage first, and then provide the biological step subsequently when the projected build up of sewage flows, and water quality trends, indicate that it is necessary to do so. In this way we can avoid saddling users of sewage services (or taxpayers) with the extra $700m per annum recurrent costs of biological treatment before it is absolutely necessary.

Turning to the disinfection proposal, the need to apply chlorination disinfection arises mainly from the community's wish to improve water quality at the Tsuen Wan beaches as soon as possible. You may recall that this view was expressed most forcefully by the Public Accounts Committee in May 2004. The only way we can meet this request in a reasonable time frame is by applying chlorination disinfection (followed by dechlorination to remove any residual trace quantities of toxic chlorine). The alternative would be to pursue UV disinfection. This would take approximately four more years to bring about improvements and at least an extra $400 million in capital investment. Much more time is involved in the UV option because of issues such as land availability, land re-zoning, additional EIA procedures, and possible need for a new power sub-station would have to be addressed. With regard to the environmental impact of the chlorination/dechlorination process, this is currently being assessed through a formal environmental impact assessment being conducted under the EIAO. The report will be subject to public inspection and comment in due course. I feel it would be best to let the EIA take its course so that I have the opportunity to consider all the views that might be expressed on the EIA, and to take them all into account in a balanced fashion. Notwithstanding this, I have included at Annex the findings by the Drainage Services Department's consultants in relation to some of the issues now raised by WWF.

I trust this helps put matters in context, we stand ready to discuss with the EA Panel at any time.

Yours sincerely,



(Anissa Wong)
Permanent Secretary for the Environment,
Transport and Works (Environment)

Encl.
c.c. SETW
DDS

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1	**BACKGROUND**		
1.1	*Secondary (biological) treatment of sewage is the norm in developed countries*	Secondary (or biological) treatment of sewage is now the norm in developed countries and is fast becoming the norm in developing countries, including China (see below).	Secondary treatment is often adopted when there is a need to minimize the impact of a discharge on nearby sensitive waters, or waters with low assimilative capacity. Local sewage is subject to this or higher level of treatment when discharged to sensitive water bodies such as Sai Kung, Tolo Harbour, Mirs Bay, or inland waters. Nevertheless, primary treatment or chemically-enhanced primary treatment (CEPT) is still practised in major cities when their discharges enter into less sensitive waters or waters with good assimilative capacity. Examples include the Bailongguan STW (with a design dry weather flow of 1.2 million m^3/d), and Zhuyuan STW (with a design dry weather flow of 1.7 million m^3/d) in Shanghai, the City of Montreal STW (with an average flow of 2.57 million m^3/d), the Sand Island STW (with an average flow of 0.31 million m^3/d) in Honolulu, and the Bondi STW (which serves a customer base of 500,000) in Sydney, Australia.
1.2	*Experts recommended in 2000 that we should upgrade to secondary treatment*	In 2000, a panel of international experts set up by Government (the International Review Panel) concluded and recommended that the Stonecutter Island Sewage Treatment Works (SCISTW) should be upgraded to secondary treatment.	The Government has accepted the recommendation of the IRP that it would be preferable and feasible to provide the HATS sewage with secondary treatment and discharge it directly in the harbour, rather than pursue the original proposal for a lower level of treatment combined with a long sea outfall discharging in the South China Sea. The present plan to split HATS Stage 2 into two phases does not deviate from the IRP's recommendation.

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1.3	*Secondary treatment was the initial policy direction until ETWB suddenly changed tack, sub-dividing the project into two stages, HATS 2A and 2B*	Secondary treatment of sewage was the initial policy direction of the Government for HATS Stage 2. However, presumably due to precarious government finances and a weak economy at the time, and fearing that there would not be support in Legco or in the community for the cost of secondary treatment, the ETWB under Sarah Liao suddenly changed tack and in 2004 proposed sub-dividing HATS Stage 2 into Stage 2A and Stage 2B.	There has been no change in the policy direction. It remains the Government's intention to pursue secondary treatment under HATS Stage 2. The proposal to pursue a phased approach was made in recognition of uncertainties (caused by slower population growth and sewage flow build-up) over precisely at what point the biological treatment would be needed in order to safeguard water quality objectives, the complexities of tackling various issues concerning the earmarked expansion site for the works, and very significant extra recurrent costs which would have to be recovered from sewage services users through sewage charges. Taking these factors into account the HATS Monitoring Group of local experts and community representatives which was set up to oversee the Government's further development of the IRP proposals agreed that a phased approach would be a pragmatic way forward. During the extensive public consultation carried out between 21 June 2004 and 20 November 2004 we found that 68% of key stakeholders and 50% of individual respondents who commented supported the phased approach. The findings were presented to and debated at the LegCo EA Panel on 25 April 2005 and 5 July 2005. Panel members did not object to the phased approach at that time either.
1.4	*2A would provide "primary" treatment; 2B (secondary treatment) would be postponed*	Stage 2A would provide *primary* treatment of sewage from the harbour area not already treated by Stage 1. Secondary treatment under Stage 2B would be postponed to an indeterminate date.	The Government's plan is to provide chemically enhanced primary treatment (not just primary treatment) to the Stage 2A flows and review the timing for further upgrade of treatment levels to biological treatment at 2010/11. Chemically-enhanced primary treatment is highly cost-effective when compared to primary and secondary treatment and has been used successfully in HATS Stage 1, leading to observable and significant

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			improvements in water quality in the eastern and central part of Victoria Harbour. In terms of treatment efficiency it removes about 70% of the organic pollution (measured as BOD) and 80% of the suspended solids. The phased approach is both environmentally acceptable and cost-effective in handling the uncertainties caused by population changes and other factors mentioned in the response in Item 1.3 above. The Government will upgrade to biological treatment at the appropriate time. We have no plan to postpone Stage 2B indefinitely.
1.5	*The proposal to disinfect the primary effluent by chlorination was driven by political considerations*	In view of the anticipated increase in outflow of primary treated effluent from the SCISTW as result of HATS Stage 2A, and its effect on water quality in the Tsuen Wan area, in particular its seven bathing beaches, it was further proposed that primary treated effluent should be disinfected through chlorination. The chlorine disinfection proposal was primarily driven by the desire to re-open the seven bathing beaches, in order to ensure the support of the local communities for the HATS Stage 2 extension of sewage treatment in the SCISTW.	In relation to the impact on the Tsuen Wan Beaches caused by HATS Stage 1, in 2004 the Public Accounts Committee (PAC) of the Legislative Council expressed concern that the Stonecutters Island Sewage Treatment Works (SCISTW) had not been provided with a permanent disinfection facility, and considered that the Government had the responsibility to improve the water quality in the affected area in order that the beaches could be re-opened for public use. Thus, the proposal to install a permanent disinfection facility at SCISTW, and to advance part of the facility is primarily to address the requests of LegCo and the public. In programming terms, the chlorination proposal enables the project to be delivered within a relatively short time compared with other disinfection options, thus meeting the request of the PAC for early action.

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1.6	*The chlorination proposal and delay of secondary treatment have caused dismay in many circles*	These proposals – to postpone secondary treatment indefinitely, and to chlorinate the primary treated effluent – have caused consternation among sewage treatment experts as well as those sections of the community who had been led to expect that sewage treatment in Hong Kong would finally and belatedly catch up with standards in the developed world.	As stated above, we do not propose to postpone secondary treatment indefinitely but rather to split the project into two phases. Further, as stated in the response for Item 1.1, large scale application of CEPT has been proven to be highly cost-effective in Hong Kong and is also adopted in other big cities. With regard to chlorination, the proposal for the advance disinfection facility is currently the subject of an EIA. As part of the process there have been a number of consultation sessions with the academic and engineering community so far and the Drainage Services Department's consultants have not detected significant signs of the "consternation" referred to here. At a public seminar held on 7 December which included a substantive presentation on the proposed use for chlorination for HATS, attended by over 100 local practitioners in the environmental engineering and scientific community there was not a single question on the suitability of the proposed disinfection technique.
2	**CHINA VERSUS HONG KONG**		
2.1	*PRC standards for sewage treatment have been established and are higher than Hong Kong's*	China has now adopted consistent effluent discharge standards nationally, whereas Hong Kong has yet to do so. Furthermore, under recent regulations, every new sewage plant in China has to offer secondary treatment; additional disinfection is required if discharging into Grade II	The PRC discharge standards tend to be prescriptive in nature irrespective of flow quantity. In Hong Kong, for large sewage treatment works (STWs) the discharge standard and treatment levels are set only after detailed assessments of the works' environmental impacts have been conducted. This case-by-case approach for large STWs is adopted in recognition of the

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		waters and even more stringent treatment if discharging in to Grade I receiving waters such as the Pearl River estuary. Existing plants have to be upgraded by 2006. It is anticipated, therefore, that an overwhelming proportion of all sewage in China will be given secondary treatment soon. Hong Kong will be the exception. (Note: all sewage in Macau receives secondary treatment.)	fact that their huge discharge volumes could have significant impacts on the receiving waters, especially those with limited assimilative capacity. The case-by-case approach is the preferred method to determine treatment levels as it is through the detailed impact assessment process that we are able to ensure cost-effective solutions are put in place which do not place an excessive burden on the taxpayer, or the users of sewage services. In cases where sewage flow is anticipated to increase over the long term proposals for expansion will need to be subject to further environmental impact assessment so that the treatment level can be upgraded in a timely fashion. The Government has been adopting this prudent approach in managing the public sewage treatment facilities and together with other pollution abatement measures, has been successful in raising the Water Quality Objectives compliance rate, in spite of increases in population and pollution loads.
2.2	*National standards require tertiary treatment of sewage in Shenzhen and Zhuhai*	The waters around Shenzhen and Zhuhai are Grade I: they are therefore required under law to apply not only secondary treatment to their sewage but also tertiary treatment (removal of Nitrogen and Phosphorus) followed by disinfection. Most rivers and seas	We understand that different grades of waters surrounding cities in China are specified depending on the different designated functional uses of the waters in question. We also understand that the "Discharge Standards of Pollutants for Municipal Wastewater Treatment Plant of the National Standard", which applies to areas of China except HKSAR, stipulates that the level of treatment depends on the designated functional uses and hence the different grades of the receiving water bodies. So, in effect, the level of treatment would depend very much on where the effluent will be

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		in China are graded at least Grade II, requiring secondary treatment and disinfection at a minimum.	discharged and therefore it varies on a case-by-case basis. Nevertheless, since most sewage treatment works in China are at inland locations discharging into waters of limited assimilative capacity it is inevitable that most will need to provide treatment of a relatively high level.
2.3	*Hong Kong is not only failing to meet international and PRC standards, but going backwards*	In contrast, Hong Kong seems to be taking retrograde steps in its sewage treatment. Whereas the sewage plants serving the New Towns offer secondary treatment, those now being planned will offer primary treatment only, e.g. SCISTW and the Pillar Point sewage treatment plant.	The Government believes it is more prudent to adopt a case-by-case approach to evaluate the treatment levels needed for its large sewage treatment works by making sure the environmental impacts are properly assessed and the quality of the treated effluent is acceptable for discharge into specific receiving water bodies with varying assimilative capacities and sensitive uses. This approach ensures close match of the adopted treatment levels with the characteristics and specific uses of the local waters. General improvement in Hong Kong's water quality over the last decade has borne witness to the successful implementation of this approach. It ensures public money is properly spent to achieve the desirable water quality in a cost-effective way.
3	**DISINFECTION BY CHLORINATION: THE PROBLEMS**		
3.1	*Chlorine disinfection is outdated and being phased out around the world*	Very few sewage plants around the world offer chlorine disinfection of primary treated effluent. To the extent that they do exist, they are seen as outdated and are being phased out where possible.	Drainage Services Department's consultants have provided the following information based on their work on the on-going EIA study for the Advance Disinfection Facilities (ADF). The consultants have gathered information on a total of 132 sewage treatment works (STWs), each with a design capacity of not less than 10,000 m^3/d, were surveyed in 24 coastal cities, including eight cities in North America, nine in Asia/Australia/New Zealand and seven in Europe.[Note (a)] 13 of the surveyed sewage treatment works were primary/chemical

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			enhanced primary treatment works with a total flow capacity of 6,762,000 m^3/day. Almost 70% of the total effluent was discharged without disinfection. The remaining 30% of the effluent was disinfected using chlorination/dechlorination, the largest plant being Newton Creek STWs in New York, USA, which has a capacity of 1.2 million m^3/day. Of the disinfection facilities commissioned in the surveyed cities in the last 10 years, some 75% of the installed capacity used chlorination/dechlorination, whilst the remaining 25% used UV radiation for disinfecting mostly secondary or tertiary effluents. For those disinfection facilities planned for commissioning in the coming 5 years, the total design capacities using chlorination and UV radiation are of a similar order. Notable examples for recent large-scale chlorination facilities include the South STWs in Seattle, USA, which was upgraded in 2002 and has a capacity of 435,000 m^3/day; the Orange County STWs in California, USA, which has a capacity of about 900,000 m^3/day, and the two STWs in Guangzhou which were commissioned in 2004 and have a total capacity of 1,020,000m^3/day. It is noted from the survey conducted by the consultants that several new STWs are proposing to adopt UV radiation for disinfecting either primary or secondary effluent. Yet, at the same time, a secondary STWs in Shell Harbour, Australia is intending to replace its current UV disinfection system with a chlorination system. In addition, several overseas primary or secondary STWs are intending to upgrade their current chlorination system from chorine gas to sodium hypochlorite, rather than to switch to

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			UV radiation. Examples include the Annacis Island STWs and the Lion Gates STWs in Vancouver, Canada, which have capacity of 483,000m^3/day and 92,000m^3/day respectively.
3.2	*Chlorine disinfection is more usual for secondary treated effluent, on a much smaller scale*	Chlorine disinfection is still quite common for secondary treated effluent. However, since secondary treated effluent is already much cleaner, the scale of chlorine disinfection required is much smaller.	The survey on disinfection practices in other coastal cities conducted under the ADF EIA study by DSD's consultants showed that 119 plants of the surveyed sewage treatment works were secondary/tertiary sewage treatment works with a total flow capacity of 31,926,000 m^3/day. 29% of the secondary/tertiary effluent was discharged to receiving waters without disinfection. Chlorination was used to disinfect 65% of the secondary/tertiary effluent. The capacity of the largest secondary plant using chlorination was 1,817,000 m^3/d in Deer Island, Boston, USA. UV radiation was used to disinfect 5% of the secondary/tertiary effluent. The capacity of the largest secondary plant using UV radiation was 638,000 m^3/d in Ringsend, Dublin, Ireland. One plant in Tokyo, Japan, uses a combined chlorination and ozonation to disinfect its effluent which is discharged to the upstream of some water gathering catchments. Note (a) For the Deer Island STW in Boston, USA, which has similar scale as SCISTW and uses chlorination/dechlorination for disinfection, the average chlorine dosages during the primary treatment stage and the secondary treatment stage are 16.5 mg/L and 2.2 mg/L respectively. Based on the results of the bench scales tests conducted on the CEPT effluent from SCISTW and those on the secondary treated effluent from Shatin STWs, the ADF EIA Consultants recommend that the required

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			chlorine dosages during the HATS Stage 2A (CEPT effluent) and Stage 2B (secondary effluent) would be about 11-13mg/L and 2-3 mg/L respectively. Note (a)
3.3	*Hong Kong will be one of the largest buyers of chlorine in the world*	The proposed chlorine disinfection facility at the STISTW will be by far the largest such facility in the world. It will be four times larger than the next largest facility in Vancouver. The anticipated requirement for chlorine will make the Drainage Services Department (DSD) one of the largest single buyers of chlorine in the world – about 100,000 tons of industrial bleach per year, costing about HK$100 million and representing 8.9% of the total USA demand for industrial bleach. The fact that Hong Kong is now committing to such outdated technology on such a large scale is very puzzling to local and	DSD's consultants have estimated that the annual consumption of sodium hypochlorite solution for disinfecting the CEPT effluent from SCISTW under the ADF stage and Stage 2A would be about **7,180** and **9,810** metric tons on a chlorine equivalent basis respectively[1] (equivalent to about **49,400** cubic metres and **67,500** cubic metres of 12.5% solution respectively). Note (a) According to information available[2], the annual world consumption of sodium hypochlorite solution in 2005 was approximately **1,319** thousand metric tons on a chlorine equivalent basis. Of which, approximately **893** thousand metric tons were for non-household uses[3]. In comparison, the estimated annual demand of sodium hypochlorite at SCISTW under the ADF Stage and Stage 2A would be about **0.54%** and **0.74%** of the world's total consumption respectively, or about **0.80%** and **1.10%** of the world's consumption for non-household uses. According to information gathered from the States[4], the sodium hypochlorite (at 12.5% strength) consumption in the States in 2006 would

[1] The sodium hypochlorite consumption under the ADF stage and Stage 2A are estimated based on a chlorine dosage of 12mg/l and an average flow of 1.64 million cubic metres and 2.24 million cubic metres per day respectively.
[2] References: "James Glauser, Chemical Economics Handbook -Hypochlorite Bleach (August 2006)", http://www.sriconsulting.com/CEH/Public/Reports/508.2000/
[3] Non-household uses include pool sanitization, wastewater treatment and drinking water disinfection, pulp and paper, and textile bleaching.
[4] Reference: "Chemical Market Report, Schnell Publishing Company", http://www.the-innovation -group.com/ChemProfiles/Sodium% 20Hypochlorite.htm

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		international sewage treatment experts.	be about **282** thousand metric tons on a chlorine equivalent basis. Of which, approximately **161** thousand metric tons would be for industrial use. In comparison, the estimated annual demand of sodium hypochlorite at SCISTW under the ADF Stage and Stage 2A would be about **2.5**% and **3.5**% respectively of the projected total consumption, or **4.5%** and **6.1%** respectively of the projected industrial consumption in the States in 2006. Based on the above information, the estimated annual consumption of hypochlorite solution (@ 12.5% concentration) will be less than 1% of the total consumption world-wide, or less than 4% of the total consumption in the States.
3.4	*Chlorine by-products can be extremely toxic, and harmful to humans and the environment*	Chlorination is out of favour in the world of sewage treatment because the Total Residual Chlorine (TRC) and the creation of by-products (such as THM and HAA) are harmful to human health and detrimental to the environment. TRC is extremely toxic to marine organisms. THM and HAA are less toxic to aquatic life but are mostly of concern for human health: THMs are suspected	DSD's consultants have, under the ADF EIA study, conducted a series of tests and studies[5] on using chlorination/dechlorination for disinfecting HATS effluent to investigate its environmental acceptability. All results indicate that chlorination/dechlorination is an environmentally acceptable disinfection technology for HATS. Note (a) The key concern with chlorination on the environment is the toxicity generated by the total residual chlorine (TRC). This concern can be fully dealt with by applying dechlorination in the disinfection process, which is part and parcel of a chlorination disinfection system nowadays. By the addition of sodium bisulphite, the proposed dechlorination chemical, TRC

[5] Tests and studies include: (i) laboratory tests and studies to understand the chemistry of the chlorination and dechlorination process, the optimal chemical dosages, and the formation of disinfection by-products, (ii) whole effluent toxicity tests to determine the acute and chronic toxicity of chlorinated/dechlorinated effluents on local marine species, (iii) human health and ecological risk assessments to determine the risk of these chemicals to human being, aquatic life and marine mammals

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		carcinogens and are strictly monitored in drinking water.	in the effluent can be completely removed. The consultants' assessment shows that the TRC criteria established by the United States Environmental Protection Agency (USEPA) can well be met at the initial dilution zone of the HATS discharge. Note (a) Another concern with chlorination is the formation of chlorinated by-products, mainly the trihalomethanes (THM) and haloacetic acids (HAA). The consultants' test results indicate that the levels of THM and HAA after chlorination and dechlorination would be well below the USEPA Drinking Water Standard of 0.08 mg/L for THM and 0.06 mg/L for HAA. Moreover, their studies confirm that neither THM nor HAA would result in bioaccumulation through the food chain. Note (a) The tests conducted on local marine species indicate that the chlorination/dechlorination process did not introduce additional toxicity to the effluent. The risk assessments, based on very conservative assumptions, also show that the incremental risks arising from chlorinated effluent from SCISTW on human health and marine ecology are insignificant and are in compliance with the risk criteria established by the USEPA with a large safety margin. Note (a)
3.5	*The harmful effects of chlorination will be mitigated by de-chlorination, but nowhere has this been*	In order to mitigate the creation of harmful by-products, it is proposed that the chlorination process will be followed by de-chlorination. However, the success of this requires	DSD's consultants found that the chlorination/dechlorination technology, with the use of hypochlorite solution, has been widely practised for disinfection in many countries for many years. One of the notable examples is the Deer Island STWs in Boston, USA which has a capacity of 1,817,000 m^3/day and has been using hypochlorite chlorination since 1991 when it

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	attempted on a scale contemplated for Hong Kong: control of risks on this scale is untested	accurate monitoring and delicate control of dosage of the large amounts of chemicals involved. Nowhere has this been attempted on the scale being proposed at the STISTW(sic). An EIA on chlorine disinfection has recently been completed, which tested for by-product formation of chlorination/de-chlorination. However, the bench scale tests conducted in the EIA are not equivalent to the large scale processes of the final facility. Chlorination of primary treated effluent will require high dosages; the chlorination/de-chlorination process will therefore be difficult to control, creating risks of discharge of high levels of residual chlorine.	was a primary treatment plant before upgrading introduction of the secondary process in 1997. Note (a) With reference to the experience gained from the Deer Island case, the consultants have developed a conceptual operation and control plan for our HATS case based on an approach involving slight over-dechlorination to ensure all TRC in the effluent is removed prior to discharge. Under the EIA Study, the potential impacts of chlorination-by-products and the slight overdosing of sodium bisulphite to the receiving water had been assessed and found to be acceptable. Note (a) DSD's consultants have also commissioned Professor Howard Huang of HKUST under the ADF EIA study to conduct a series of tests to examine the effects of dechlorination on the chlorinated CEPT effluent from SCISTW. It was reported that no residual chlorine was found in the effluent after a less than 15-second dechlorination reaction. The test results also showed that no further production of CBPs was found after dechlorination. Note (a)
3.6	*Long-term effects on the marine environment are of grave concern*	The long-term effects on the marine environment and marine organisms of the harmful by-products of chlorination, a fairly well researched area in the scientific community, are	The whole effluent toxicity tests (WETT) for raw and chlorinated/dechlorinated (C/D) effluents from SCISTW and Tolo Harbour Effluent Export Scheme (THEES), i.e. effluents from Sha Tin STWs and Tai Po STWs (to represent the secondary effluent to be generated from HATS Stage 2B), were carried out by DSD's consultants following the

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		of grave concern to WWF. In the EIA, toxicity tests were carried out on five representative local species, but it is questionable whether the limited scope of these tests can gauge the long-term reproductive and multi-generational effects on species or other indirect impacts on complex marine ecosystems. (Organisms were exposed for only 48 hours and the effects multiplied by a factor of 10 to predict prolonged exposure.)	protocol established by the Agriculture, Fisheries and Conservation Department (AFCD) through a study undertaken by the City University in 2001 for the Hong Kong marine environment. Four species, including fish, amphipod, barnacle larvae and shrimp, were chosen for the acute toxicity tests, while diatom was used for the chronic toxicity tests. These five species represent the important species of different communities in the marine environment of Hong Kong and are of great ecological and fisheries significance. Note (a) The WETT results showed no acute toxicity on fish, amphipod and shrimp for the raw and C/D effluents of SCISTW, but the 48-hr LC50[6] for barnacle larvae and the No-Observable-Effect-Concentration (NOEC)[7] for diatom could be determined for both the raw and C/D effluents of SCISTW. Further statistical analysis was conducted on the toxicity test data of barnacle larvae and diatom to determine whether the C/D process has induced additional toxicity in the chemically enhanced primary treated (CEPT) effluent in SCISTW. The analysis showed that the C/D process did not induce any statistically significant differences to the toxicity effect in the CEPT effluent on barnacle larvae and diatom. Note (a) The WETT results for the secondary effluents from THEES showed that the raw and C/D secondary effluents did not exert acute and chronic toxicity effect on the species used in the WETT. No 48-hr LC50 for animal species and no NOEC for diatom could be determined. Note (a)

[6] 48-hr LC_{50} is the lethal concentration of effluent to 50% of test animals after 48 hours of exposure.

[7] NOEC – No-Observable-Effect-Concentration is the highest concentration of effluent producing effects not significantly different from responses to controls.

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			The use of the "acute-to-chronic ratio" (ACR) to assess the chronic toxicity of the chlorinated/dechlorinated effluent, based on the acute toxicity data from the acute WETT conducted for the C/D effluent, is a conservative approach adopted by USEPA as it acknowledges that chronic toxicity data may be sparse. USEPA therefore developed the ACR approach to extrapolate to a chronic toxicity concentration using exposure considerations and available acute toxicity data when chronic toxicity data for the species, chemical or effluent of concern are unavailable. Note (a) According to USEPA (1991), "*the ACR of 10 represents the upper 90th percentile of all the ACR data obtained by USEPA. Given the protective margin of safety inherent with the use of a critical flow for the calculation of a chronic receiving wastewater concentration, an ACR of 10 should provide ample protection against chronic instream impacts*." Based on the literature review[8] conducted by the ADF EIA consultants, no evidence can be found to suggest that the chlorinated effluent would affect the reproductive ability of marine mammals. Note (a) In addition, according to the consultants' ecological risk assessments on

[8] According to Intergraded Risk Information System (IRIS) database of USEPA and WHO's Environmental Health Criteria 216 "Disinfectants and Disinfectant Byproducts", the animal studies conducted so far have demonstrated no reproductive or teratogenic effects of chlorine.

[9] The Hazard Index (HI) for dolphins (due to TRC & chlorinated by-products) estimated for the worst-case scenario is 0.00137 which is far below the acceptable criteria. HI is the measurement of health hazard due to exposure of all identified chemical of concerns (COCs), which is calculated by summing the Hazard Quotients (HQs) of all identified COCs whereas HQ is the measurement of health hazard due to exposure of a COC. The risk of an adverse effect occurring is low if HI<1.

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			aquatic life and marine mammals[9] conducted under the EIA study, the incremental risks arising from chlorinated/dechlorinated HATS effluent are low, and are well within the risk criteria established by the USEPA with a large safety margin. Note (a) A long term marine water quality monitoring programme has been conducted for years for the Deer Island STWs. It is understood from their monitoring results that there were no unacceptable environmental impact arising from the discharge of chlorinated effluent.
4	**A FLAWED AND WASTEFUL SOLUTION**		
4.1	*Chlorine disinfection will not even achieve its primary purpose of re-opening the seven bathing beaches*	Chlorine disinfection was proposed as a solution to re-open seven bathing beaches in the Tsuen Wan area, beaches which were in any case experiencing low and declining public usage because of the growing background pollution of our western waters. At a recent DSD briefing, a chart was shown which indicated that even with HATS 2A fully operational, water quality at the seven beaches would not be good enough for re-opening – this information was not disclosed to the public during the consultation	It should also be noted from the consultant's water quality model results that, if no disinfection is provided, the bacteria levels in the Western Harbour and the Tsuen Wan beaches would further deteriorate as the sewage flow at SCISTW increases due to the projected population growth in the harbour area and the commissioning of Stage 2A. Therefore, disinfection is required not only to reduce the bacterial impact resulting from the commissioning of Stage 1, but also to mitigate any future deterioration so that the water quality of the Western Harbour and Tsuen Wan beaches can be returned to a healthier condition. Water quality modeling results have demonstrated that the provision of disinfection to the SCISTW effluent would improve the water quality in the Western Harbour and the beaches along the Tsuen Wan coast, which together with other local sewerage improvement works, would facilitate the closed Tsuen Wan beaches to be re-opened for public enjoyment. The disinfection of the HATS effluent would also comply with the existing policy of providing

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		process in 2004.	disinfection to all large discharges of sewage effluent. Note (a)
4.2	*The stated objective of the chlorine disinfection facility is fatally flawed*	In other words, the Government is now proposing the world's largest chlorine disinfection facility, costing millions of dollars of public money and with potentially harmful effects on the marine environment, with the objective of re-opening seven little used beaches, an objective that is now not achievable by HATS 2A alone.	A technical review of the effectiveness of the various disinfection technologies was conducted by the consultants under DSD's ADF EIA Study. The study showed that chlorination is an effective disinfectant for inactivating bacteria. The germicidal efficiency of disinfection by chlorination depends primarily on residual chlorine and the contact time. Chlorine is also a highly effective viricide. With average C_RT of 4 to 400 mg·min/L, it is shown to be capable to achieve 99.99% virus inactivation (USEPA, 1999). Although chlorination is found to be less effective in protozoa inactivation, this inactivation is generally not the main concern in the wastewater disinfection especially for discharging of wastewater to ocean. Note (a) On the other hand, the consultants noted the effectiveness of the UV disinfection process depends on a number of variables including the characteristics of the UV disinfection system, the overall system hydraulics, the presence of particles, the characteristics of the microorganisms, and the chemical characteristics of the wastewater. The characteristic of the microorganism is one of the key variables. Bacteria, protozoa and viruses are susceptible to UV-C radiation. Studies have shown that the amount of cell damage and subsequent repair is directly related to the UV dose. Photochemical damage caused by UV may be repaired by some organisms. The amount of repair will also depend on the dose (intensity) of photo-reactivating light. Note (a)

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4.3	*Chlorine disinfection has limited effectiveness. The risk/reward ratio is not optimal*	Chlorine disinfection will **not** remove pathogenic viruses, parasites or heavy metals (substances that are if anything more harmful to the marine environment and bathers), nor does it address the massive nutrient load discharged into the harbour, which disrupts the natural flora and fauna of the harbour and could lead to areas of eutrophication (de-oxygenated dead zones). It could also lead to algal blooms and red tides which pose risks both to bathers and local fisheries (both wild and farmed).	Please see responses above. In addition, disinfection is not intended to address nutrient loads. For algal growth, among other factors, it requires adequate supply of nutrients such as nitrogen and phosphorus, and human sewage is one of the sources for such nutrients. Nitrogen in human sewage may be removed by biological treatment process that we call "denitrification". But, a consultancy study for the way forward for HATS opined that denitrification is not the most economical means for controlling red tides in the receiving water body, due to the water body's specific characteristics. This findings tally with the IRP's original recommendation that denitrification might not be necessary for HATS. The consultancy study further recommended to limit the discharge of phosphorus through the CEPT process in Stage 2A, for controlling red tides. This concept was proposed by the consultant's expert team which composed of local and international academics specialized in red tides, and oceanography, and was agreed by the Monitoring Group for HATS in which the three IRP members (one of which is a renowned marine biologist) are members.
4.4	*The true cost of the project is unclear and likely far higher than disclosed. Redundancy when HATS 2B materialises will be a huge cost to*	When HATS Stage 2B materialises, the huge chlorination facility will become largely redundant. The financial cost of the facility being quoted by Government today is very different (lower) than the cost quoted at the time of the public consultation	A capital cost of $60M (inclusive of site supervision costs) for the ADF was mentioned during the 3rd Consultation Forum conducted by DSD's consultants under the ADF EIA Study on 12 October 2006. As explained at the Forum, the figure represents only the capital cost for the construction of the advance disinfection facilities. The full capital cost of providing chlorination / dechlorination for disinfecting the Stage 2A CEPT effluent would be about $290M. The difference is mainly to provide a

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	the community	in 2004. The latest estimate appears unrealistically low in the view of most professionals in the field. We urge members of the Panel to closely examine the true financial costs of the chlorination facility (both in terms of capital investment and future operation and maintenance), the scale of the redundancy in the event of Stage 2B and therefore the value for money of the chlorination facility.	purpose-built disinfection contact tank under the Stage 2A main works. There would be little redundancy (except perhaps some surplus in storage capacity) when Stage 2B is in place if chlorination remains the disinfection option for HATS. Note (a)
4.5	*Given the risks, better no chlorination at all*	In view of the risks of harmful impacts of chlorine disinfection on the environment and human health, WWF considers it preferable to abandon chlorine disinfection as a part of HATS 2A, irrespective of the arguments over the timing of HATS 2B.	As part of the ADF EIA study, scientific studies have been carried out to evaluate risks as described above. Note (a) WWF's position on abandoning chlorine disinfection is noted.
5	**HONG KONG DESERVES SECONDARY TREATMENT TODAY**		
5.1	*Hong Kong needs and deserves world-class sewage treatment –*	Proceeding straight to secondary treatment under HATS 2B will certainly be more expensive, but the	The Government has already pledged to provide secondary treatment to all the HATS sewage as an ultimate measure to tackle the harbour pollution. The splitting of HATS Stage 2 into two phases is due to the uncertainty in

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	and we can afford it	GDP per capita of Hong Kong is as high as many cities in the developed world – we can certainly afford it. It should be remembered that although Hong Kong has world class infrastructure in many areas (e.g. airport, MTR), it is well behind in the quality of its sewage treatment: in this sense, investment in HATS 2B secondary treatment is simply making up for many years of underinvestment in proper treatment of sewage from the harbour area. Government finances are in good order and the economy is strong: if Hong Kong cannot make these necessary investments in such circumstances, when else is a good time to do so?	population growth and sewage flow build-up, the time needed to resolve land issues related to Stage 2B, and that Stage 2A alone will likely enable water quality in the harbour to meet the water quality objectives for a reasonable amount of time after its commissioning. Since HATS is a mega scale project and requires substantial fiscal commitment by the community, we believe that we have a duty to exercise fiscal prudence in its implementation. We do not believe that Hong Kong is "*well behind in the quality of its sewage treatment*". Rather, over the past two decades, we have implemented a number of facilities with different treatment levels (including CEPT, secondary, and tertiary), in order to protect receiving waters of different sensitivities and assimilative capacities. Our phasing proposal for HATS Stage 2 is in line with this practice.
5.2	*Investing in HATS 2B now solves many problems and delivers a far better and safer solution. It is more expensive, but offers*	In contrast to primary treatment, secondary treatment makes it feasible to remove viruses and most bacteria and reduce the organic load of the discharge. It would ensure better water quality in the Tsuen Wan	Implementing Stage 2 in one phase would delay water quality improvements by some 2 to 3 years when compared with completion of HATS Stage 2A. The two-phase approach represents the most efficient way forward in terms of earlier delivery of improvements.

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	better value-for-money	area far quicker than the current proposal of Stage 2A + disinfection. In other words it can do much more than primary treatment + disinfection, without any of the harmful side effects.	
5.3	*Stage 2B can be made operational within the same timescale as the chlorination facility*	Furthermore, Stage 2B could be built by the time the disinfection facility is planned to be operational. The proposal to build a "temporary facility" of this scale confounds engineering sense.	Taking into account funding procedures, the need to carry out further feasibility studies, investigations, etc., implementing Stage 2 in one phase would delay water quality improvements by some 2-3 years when compared with completion of HATS Stage 2A.
5.4	*It is unacceptable that an advanced city like Hong Kong should move in the opposite direction of China and the developed world*	In spite of the formidable scale and challenges of China's environmental problems, the country is making a determined and impressive effort to improve the situation. It is unacceptable that Hong Kong, arguably China's most advanced city, moves in the opposite direction of China or indeed of every other country in the developed world.	See response to 5.1.
5.5	*We've waited long*	Hong Kong has waited long enough	Noted and agreed that further debate about the project would delay the

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	enough. Let's do the job properly.	for world-class sewage treatment to clean up its world famous but polluted harbour. Let's seize the opportunity to fix the problem once and for all.	cleaning up of the harbour.

Note (a) : Any comments related to the findings of the ADF EIA study at this stage are made without prejudice to the EIA process; and any expressions of impacts, being acceptable or not, must be taken to be the consultants' opinions.

EPD, December 2006