Drainage Services Department
Technical Circular No. 4/99

DRY WEATHER FLOW INTERCEPTORS

INTRODUCTION

In a review of the existing types of Dry Weather Flow Interceptors (DWFI) throughout the territory, a number of major O&M problems and hydraulic design deficiencies have been identified. To ensure that these problems will not be repeated in the future, it is essential to have a unified set of design criteria for DWFI. This Circular announces the details of the design criteria and the procedures for dealing with new DWFI proposals and handling of existing DWFI.

PROBLEMS IN EXISTING DWFI

2. The problems identified in the review are summarized as follows:-

i. weirs and other similar structures constructed within stormwater drains (SWD) may increase the risk of flooding. High level weirs in tidal zones are a significant problem;

ii. few DWFI have sufficient measures to properly control the amount of DWF diverted to the foul sewerage system. Overloading of the sewerage system by stormwater or seawater intrusion results in treating large quantities of flow unnecessarily. Also it has the potential to overload pumping stations and treatment plants perhaps leading to high risks of pollution from seawall bypasses, activated sludge washout, etc;

iii. many DWFI designs have the potential to allow the build-up of excessive quantities of silt behind weirs in the SWD or to allow excessive quantities of silt and rubbish to be transferred to the foul sewers (FS);

iv. some DWFI include equipment such as flap valves, float controlled penstocks etc which have the potential to cause serious problems in the SWD and/or the FS if the equipment failed or jammed or if rubbish collects on the equipment during high flows; and

v. many DWFI are in manholes, sometimes in busy roads. Proper and safe inspection and maintenance is not possible in many cases.

DESIGN CRITERIA FOR NEW DWFI

3. A point which is often forgotten is that DWFI is a very inefficient method of controlling pollution however good the design might be. Every time it rains, the pollution continues past the DWFI down to the sea. In a high rainfall climate such as Hong Kong, DWFI is obviously ineffective during a substantial part of the year and is particularly ineffective, for example, in controlling pollution of beaches where the bathing season is the rainy season. DWF interception is therefore only acceptable if it can be demonstrated that a reasonable degree of effectiveness can be achieved.

4. In the apparent absence, however, of effective means to control pollution at source, it appears inevitable that DWFI will be a feature of Hong Kong's drainage systems for a considerable period of time. It is therefore very important to ensure that the sort of problems experienced with existing DWFI are not repeated.

5. The over-riding principle in considering the installation of a DWFI is to emphasize that the function of a SWD is to prevent flooding. **Interception and removal of polluted flows should not compromise this primary function.**

6. To reflect current circumstances, it is recommended that DWFI be considered as either temporary (where there are definite plans to remove the DWFI within 3 years) or as long-term (where there are no definite plans for removal). The difference is that, for temporary DWFI, a lower standard of O&M facilities may be tolerated; **however there should be no compromises on the essential hydraulic and risk considerations.**

7. The recommended basic design principles and criteria are as in the following tables.

Table 1- Essential Criteria for Both Temporary and Long-term DWFI

ESSENTIAL CRITERIA FOR BOTH TEMPORARY AND LONG-TERM DWFI	REMARKS
1. There shall be no adverse effect on the hydraulics of SWD.	i.e. no increase in risk of flooding – this usually precludes the use of high level weirs in culverts and limits the use of screens that will inevitably become blocked with rubbish every time it rains.
2. There shall be no potential for blockage of the SWD during heavy rain.	i.e. no likelihood of rubbish collecting on hand-raked screens, flap valve frames etc that may increase the risk of flooding.
3. There shall be no adverse effect on the hydraulics and capacity of FS receiving the DWF. The volume of DWF to be intercepted shall either be determined by flow measurement or by calculation and the flow to the FS shall be strictly limited to this amount.	i.e. FS capacity must be checked and appropriate flow limiting devices shall be used to strictly limit the DWF to the designed volume, e.g. hydrobrakes or limited flow pumps. It is unacceptable and uneconomical to divert rainwater into the FS for treatment at sewage treatment plants. The uncontrolled orifice method of limiting flows therefore is usually precluded.

ESSENTIAL CRITERIA FOR BOTH TEMPORARY AND LONG-TERM DWFI	REMARKS
4. All DWFI devices shall be fail-safe so as not to adversely affect either the SWD or FS in the event of failure or malfunctioning of the device.	i.e. if the devices fail then the SWD and FS shall not be subject to risk of flooding, overflow, etc and the intercepted DWF shall not exceed the designed volume. This requirement usually precludes the use of flap valves that might jam, float controlled devices that might remain open, electrically operated penstocks that might fail, etc.
5. DWF Interception should not lead to an excessive increase in silt deposition in the SWD or lead to transfer of excessive amounts of silt and rubbish to the FS.	i.e. very careful design is required to avoid these consequences. Difficult to achieve and is a major factor controlling the effectiveness and reliability of DWFI. Sumps on SWD as silt traps are unlikely to be effective as the sumps will be filled up with silt every time it rains and the DWFI will consequently be very unreliable and expensive to maintain. Similarly, vertical walls as weirs also have the potential to lead to unacceptable levels of silt deposition. The recommended arrangement is a low crump weir with sloping upstream and downstream faces which is likely to be self-cleansing. If a crump weir is hydraulically unacceptable, then a shallow sump with sloping upstream and downstream faces may be an acceptable self-cleansing alternative. Any silt collecting behind the weir or within the sump will be washed away during heavy rain.
6. At the planning stage the project proponent shall prepare a design memorandum including the degree of effectiveness in controlling pollution expected from each DWFI. The quantity of sewage to be intercepted should also be stated. At the design stage, an O&M manual shall be prepared in order to demonstrate that the target effectiveness can be achieved.	i.e. DWFI are very inefficient as a pollution control device. If, in a particular case, a reasonable degree of effectiveness cannot be achieved, then a DWFI proposal should not be accepted having regard to the inherent O&M disadvantages.
7. At the planning stage the project proponent shall prepare a decommissioning programme, setting targets and criteria for dealing with the pollution by other methods.	i.e. present policy is to have separate drainage and sewerage systems. Therefore, even for long-term DWFI, there should be targets set for eventual decommissioning.

Table 2 - Criteria Essential for Long-term DWFI and Preferable for Temporary DWFI

CRITERIA ESSENTIAL FOR LONG-TERM DWFI AND PREFERABLE FOR TEMPORARY DWFI	REMARKS
1. Interceptors should be effective and reliable in removing the DWF from the SWD.	i.e. the interception devices and pipework leading to the foul sewer shall not easily become choked with rubbish or silt every time it rains. Difficult to achieve at many locations due to lack of space, etc. It is recommended that the take-off pipe for the intercepted DWF shall do a U-turn back against the direction of flow in the SWD. Silt and rubbish will not then get washed into the pipe during heavy rain.
2. DWFI should be located so that frequent access is easily available for inspection, operation and maintenance.	i.e. generally, long term DWFI should be in an open chamber in its own compound with vehicular access. Any compromise on these requirements will obviously adversely affect ease of inspection, operation and maintenance and consequently the effectiveness and reliability of DWFI will be reduced. DWFI in manholes under roads, carparks etc will be very unreliable and are unacceptable as a long term measure unless the project proponent can conclusively demonstrate that unrestricted access is easily available for the proper inspection and maintenance of the DWFI.
3. DWFI should require minimum resources to operate and maintain.	i.e. items 1 and 2 above have a very great influence on the efficiency and economics of operation and maintenance of DWFI.

8. Calculations must be carried out for both temporary and long-term DWFI proposals to conclusively demonstrate that there will be no adverse effects on the hydraulics and capacity of both the stormwater and foul sewerage systems.

HANDLING OF EXISTING DWFI

9. O&M Divisions should review the existing DWFI in their areas against the above recommended basic design criteria. Following on from the review, it is suggested that for existing DWFI:-

i. difficult or inefficient operations and maintenance will have to be tolerated unless there is a potential for excessive silting of a SWD leading to flooding;

ii. uncontrolled discharge of flow to a foul sewer will have to be tolerated unless it leads to overflow of sewage from the sewerage system or an unacceptable increase

in risk of overloading of downstream sewage pumping station or treatment works. EPD, as the sewerage authority, should monitor sewerage systems to check whether capacities as a whole are being exceeded; and

iii. action must be taken to rectify any problem that has the potential to result in an unacceptable increase in risk of flooding in the SWD system e.g. adverse effect on hydraulics due to weirs, potential for blockage of screens, interception devices not fail-safe.

An example of action that might be taken to overcome an unacceptable increase in risk of flooding is to replace a weir by stop-logs that would only be installed during the dry season.

CONCLUSIONS

10. All future DWFI proposals must comply with the basic design principles and criteria set out in paras 3 to 8 above which may be summarized as:-

i. DWFI shall not adversely affect the hydraulics or increase the risk of flooding in the stormwater drainage system at any time or under any circumstance;

ii. a DWF interception device shall strictly limit the flow diverted to the foul sewer to a carefully designed DWF volume, which shall not be exceeded at any time or under any circumstance;

iii. a DWFI shall not have the potential to lead to excessive deposition of silt or rubbish in either the SWD or foul sewer; and

iv. all DWFI facilities and devices shall be fail-safe such that criteria (i), (ii) and (iii) will not be compromised at any time or under any circumstance.

If a DWFI proposal cannot comply with the design principles and criteria then DWF interception shall be considered to be unacceptable for that particular location or circumstance. An alternative method of pollution control will have to be implemented by the project proponent.

11. O&M Divisions should check the existing DWFI against the basic design principles and criteria. Certain deficiencies may have to be tolerated but action must be taken to rectify any problems that have the potential to cause an unacceptable increase in risk of flooding of the SWD system or overloading of downstream sewage pumping station or treatment works.

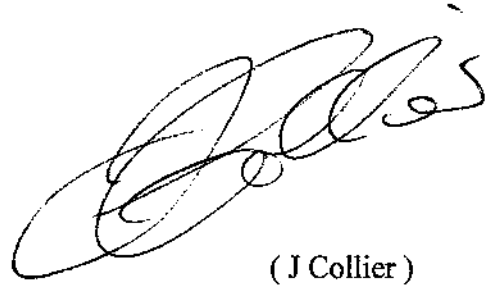
12. The importance of the following two points regarding DWFI should be emphasized in the future:-

i. DWFI is a very inefficient method of controlling pollution however good the design might be. Every time it rains, the pollution continues past the DWFI down to the sea. In a high rainfall climate such as Hong Kong, DWFI is obviously ineffective during a substantial part of the year; and

ii. The over-riding principle governing the installation of a DWFI is to recognize that the function of a SWD is to prevent flooding. Interception and removal of polluted flows should not compromise this primary function.

ENQUIRIES

13. Enquiries on this Circular should be directed to the Senior Engineer/Research & Development.



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