

PUB(WRN) REQUIREMENTS
SPECIAL REQUIREMENT FROM PUB (WRN)

CONTENTS

Clause No.	Title	Page
1	PUB ADVISORY NOTES (Revised Edition – Feb 2022)	19
1.1	PUBLIC SEWER CORRIDORS, SPECIFIED ACTIVITIES, SEWER SETBACK AND MANDATORY REQUIREMENTS	20
1.2	DOs AND DON'Ts ON THE PREVENTION OF DAMAGE TO THE SEWERAGE SYSTEM	24
1.3	APPLICATION FOR WORKS AFFECTING PUBLIC SEWERAGE SYSTEM (WAPS)	26
1.4	GENERAL REQUIREMENTS FOR PROTECTION OF SEWERS AND PUMPING MAINS	30
1.5	PENALTIES FOR OFFENCES UNDER THE SEWERAGE AND DRAINAGE ACT / REGULATIONS AND THE SEWERAGE AND DRAINAGE (PROTECTION OF PUBLIC SEWERAGE SYSTEM) REGULATIONS 2017	41

1 PUB ADVISORY NOTES (Revised Edition – Feb 2022)

The public sewerage system, including the deep tunnel sewerage system (DTSS), is a national infrastructure that conveys used water for reclamation. The sewerage system thus is an integral part of Singapore's water supply system. Any damage to the sewerage system will not only cause environmental pollution but also disrupt the conveyance of used water to the water reclamation plants for the production of NEWater. We seek your cooperation and diligence in the conduct of your construction activities to ensure that the sewerage system is well protected and prevented from any damage.

This advisory, which can be found in the PUB website at <http://www.pub.gov.sg> (under Used Water-Legislation and Requirements), provides guidance to assist qualified persons (QPs), professional engineers and contractors in protecting the sewerage infrastructure when carrying out any works within the public sewer corridors. The advisory consists of the following clauses:

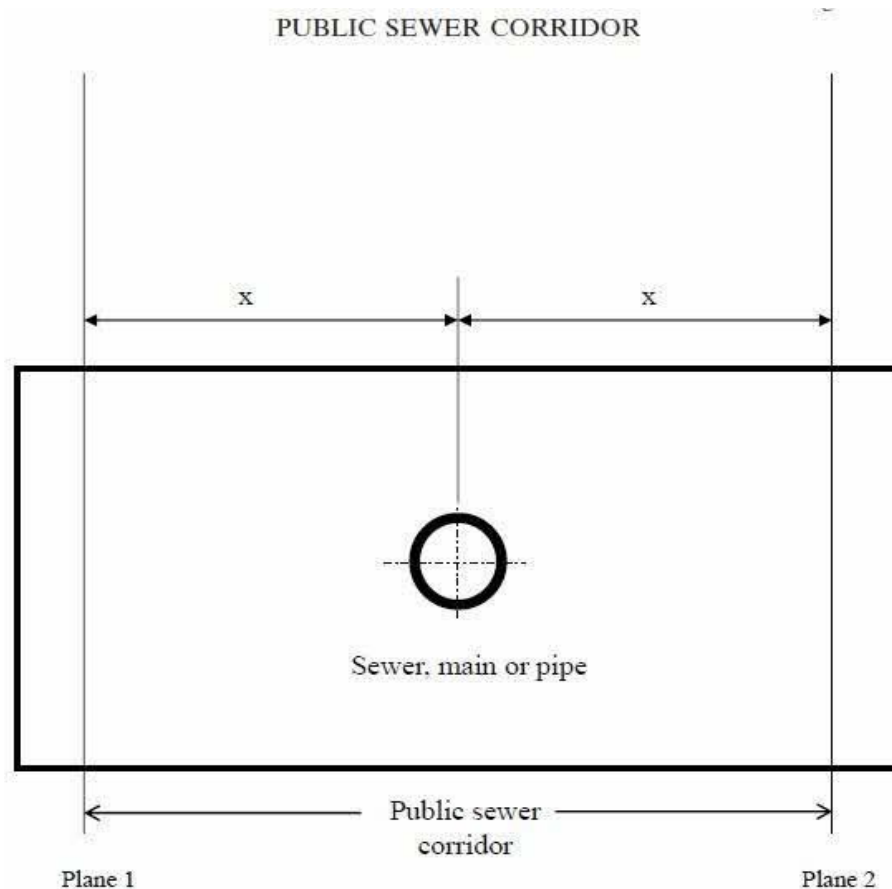
- Clause 1.1: Public sewer corridors, specified activities, sewer setback and mandatory requirements
- Clause 1.2: Dos and Don'ts
- Clause 1.3: Application for Works affecting public sewerage system (WAPS)
- Clause 1.4: Technical requirements for protection of the sewerage system
- Clause 1.5: Penalties for offences under the Sewerage and Drainage Act/Regulations and the Sewerage and Drainage (Protection of Public Sewerage System) Regulations 2017

For clarification:

- a) General requirements for protection and site verification, please contact Ms Hui Shan Khong at Tel: 68056273 or Mr Johnathan JW Lim at Email: Johnathan_JW_Lim@pub.gov.sg of the Network Management Branch;
- b) Consultation and submission of application, please contact Mr Sophian Ismail at 67313656 or Ms Taraney Gunasekaran at Tel: 67313691 of the Planning & Design Division.

1.1 PUBLIC SEWER CORRIDORS, SPECIFIED ACTIVITIES, SEWER SETBACK AND MANDATORY REQUIREMENTS

- 1.1.1 **Public Sewer Corridor**, as stipulated in the Sewerage and Drainage (Protection of Public Sewerage System) Regulations 2017, means the land and space bounded by 2 vertical planes as illustrated below, through which any sewer, main or pipe of a public sewerage system runs (whether under, on or above ground).



Where “X” is the distance of each of Plane 1 and Plane 2 from the centreline of a sewer, main or pipe and is —

- (a) in the case of a sewer which is part of the Deep Tunnel Sewerage System, 40 metres;
- (b) in the case of a sewer, main or pipe with a diameter equal to or larger than 900 millimetres, 20 metres; and
- (c) in the case of a sewer, main or pipe with a diameter less than 900 millimetres, 10 metres.

1.1.2 Specified activity, as stipulated in the Sewerage and Drainage (Protection of Public Sewerage System) Regulations 2017, means one or more of the following activities:

- (a) the carrying out of any earthwork for site formation, whether by excavation, filling or backfilling;
- (b) the excavation of any trench, well, pond or pool, or excavation for any underground structure which is more than 0.5 metre in depth;
- (c) the excavation of earth, rock or other material by means of explosives;
- (d) the carrying out of any ground exploratory or testing work, including through soil boreholes and geological surveys;
- (e) the installation of any foundation, sheet pile, piled foundation, earth retaining or stabilising structure, ground anchor, horizontal tie-back, or any other similar installation;
- (f) the carrying out of any ground stabilising work, including jet grouting, soil compacting and ground freezing;
- (g) the carrying out of any tunnelling, excavation work or jacking work;
- (h) the erection of any temporary or permanent structure, including any site office or show flat;
- (i) the installation of any heavy construction machine or plant, including the stacking and installation of any concrete block for pile testing;
- (j) the installation of any container box.

1.1.3 Sewer setback is the lateral separation distance between the outer edge of any structure to centerline of a sewer pipe. All buildings or structures are required to be setback by a distance as stipulated in the [Code of Practice on Sewerage and Sanitary Works](#) and is appended below:

TABLE A: SEWER SETBACK DISTANCE CLEARANCE REQUIRED

Sewer Pipe Diameter	Net Clearance Required
150 to 600	1.0m from outer edge of any structure to centreline
150 to 600	1.5m from outer edge of any structure to centreline
150 to 600	2.0m from outer edge of any structure to centreline
> 600 to 1500	2.5m from outer edge of any structure to outer
> 1500 to 2500	3.0m from outer edge of any structure to outer
> 2500	4.0m from outer edge of any structure to outer
DTSS Tunnel	6.0m from outer edge of any structure to outer

TABLE B: PUMPING MAIN SETBACK DISTANCE CLEARANCE REQUIRED

Pumping Main	Net Clearance Required
100 to 600	1.0m from outer edge of any structure to
100 to 600	1.5m from outer edge of any structure to
100 to 600	2.0m from outer edge of any structure to centreline of the pipe
> 600 to 1500	2.5m from outer edge of any structure to outer
> 1500	3.0m from outer edge of any structure to outer

1.1.4 Mandatory requirement before commencement of works/specified activity at site

1.1.4.1 No works or specified activities within a public sewer corridor are to commence unless an approval from the Director, PUB (WRN) pursuant to an application [through POWS (<https://bpu.pub.gov.sg/pows/>)] made by the contractor of the activity under regulation 5 of the Sewerage and Drainage (Protection of Public Sewerage system) Regulations 2017 has been obtained.

1.1.4.2 No utilities services (cable, gas pipe, water pipes, etc) either permanent or temporary shall over-cross/under-cross **within one metre (1m)** from the outer edge of sewers or pumping mains. A written clearance from the Director, PUB (WRN) shall be obtained before carrying out any utility service works that over-cross/under-cross any sewer pipes.

1.1.5 QP to obtain PUB's Clearance Certificate or approval under section 14 & 33 of Sewerage and Drainage Act (SDA) for proposed development or building or works likely to affect sewer or sewerage system

1.1.5.1 For any development or building works if the plan requires the approval of the Commissioner of Building Control (BCA), the QP for the development or building works must obtain a Clearance Certificate for the proposal development or building works to be carried out **in or outside** a public sewer corridor from the Building Plan Unit (BPU) of PUB.

1.1.5.2 For any other works, if the plan does not require the approval of the Commissioner of Building Control (BCA), a registered professional engineer (or the contractor if permitted by PUB under certain circumstances) for the proposed works must obtain a clearance from PUB(WRN) for the proposal works to be carried out **in or outside** a public sewer corridor.

1.1.6 Contractor to obtain PUB's approval under regulation 5 of Sewerage and Drainage (Protection of Public Sewerage System) Regulations for carrying out specified activity within a public sewer corridor

1.1.6.1 The contractor of the specified activity must obtain an approval from PUB(WRN) before carrying out the specified activity (eg trial trenching or soil investigation works, site formation works, earth works, piling works, building works, etc) **within** a public sewer corridor.

1.2 DOs AND DON'Ts ON THE PREVENTION OF DAMAGE TO THE SEWERAGE SYSTEM

[Reminder: Under the Sewerage and Drainage Act, the penalty for erecting any building or structure over, across or adjacent to any sewerage system without prior approval from PUB is a fine of up to \$20,000. The penalty for causing any damage to sewer is a fine of up to \$40,000 or to imprisonment for a term up to 3 months or to both.]

1.2.1 DO

- 1.2.1.1 Do purchase a Sewerage Information Plan (SIP) from PUB Building Plan Unit (BPU) and display a copy of the SIP at site.
- 1.2.1.2 Do submit the application n for approval of plan for specified activities within public sewer corridor through POWS system (<http://bpu.pub.gov.sg/pows>) to obtain the written clearance from PUB(WRN) before carrying out any of the specified activities within the public sewer corridor.
- 1.2.1.3 Do consult PUB (WRN), **Network Management Branch (NMB)** at Tel: **67313294** when you are unable to locate existing sewers/pumping mains/manholes/chambers, etc at site.
- 1.2.1.4 Do engage a Registered Surveyor to peg the outer edge of the sewers/pumping mains alignment to forewarn contractors of the presence of sewers/pumping mains, etc.
- 1.2.1.5 Do use only manual excavation near the pipes while carrying out trial trenches to ascertain the exact location of existing sewers/pumping mains/sanitary drain-lines before carrying out any excavation, boring or piling work. Do take photos of the trial holes/pre-probing.
- 1.2.1.6 Do reconfirm the sewers/pumping mains alignment before replacing any missing or faded pegs.
- 1.2.1.7 Do have proper protection for existing sewers/pumping mains during excavation. Prior approval must be obtained from PUB (WRN) for protection/diversion works.
- 1.2.1.8 Do ensure that daily site briefings with all worksite workers are conducted (in languages that are understood by all workers) to remind them about the location of the sewers/pumping mains and the measures to be taken to prevent damage.

- 1.2.1.9 Do ensure that information on the presence of sewers/pumping mains in the vicinity of the worksite and all mitigation measures to be taken to prevent damage have been communicated and adhered to by all personnel of all working levels in the project team, including sub-contractors and any third party who are in any way involved with any part of the intended work.
- 1.2.1.10 Do contact PUB (WRN) immediately if you find any live or abandoned sewers/pumping mains, which are not shown in the SIP, in the course of carrying out any work at the worksite.
- 1.2.1.11 Do report to PUB (WRN), **Network Management Branch (NMB)** at Tel: **67313294** should any of the sewerage system be damaged, exposed or any sealing work is required for immediate attention.
- 1.2.2 DON'T**
 - 1.2.2.1 Don't carry out any specified activity (eg excavate, pile, etc) or construct any structures in the public sewer corridors without prior approval from PUB (WRN).
 - 1.2.2.2 Don't allow heavy machinery to move over any existing sewer/pumping main without adequate protection (e.g steel plate).
 - 1.2.2.3 Don't use excavator to dig trial holes to locate the existing sewers/pumping mains/sanitary drain-lines.
 - 1.2.2.4 Don't lay any services on top of any existing sewer/pumping main.
 - 1.2.2.5 Don't lay any services inside any manhole/chamber.
 - 1.2.2.6 Don't cover any manhole/chamber with earth, concrete, premix, construction debris or any other materials during the construction work.
 - 1.2.2.7 Don't place any surcharge such as excavated earth on top of any sewer/pumping main/manhole/chamber. No overburden load should be imposed on the sewers/pumping mains/manholes/chambers.
 - 1.2.2.8 Don't leave the manhole or inspection chamber cover open. If the cover is damaged in the course of the construction work, replace them immediately or call the PUB(WRN), **Network Management Branch (NMB)** at Tel: **67313294** for assistance.

1.3 APPROVAL OF PLANS FOR PROPOSED DEVELOPMENT OR BUILDING WORKS AND SPECIFIED ACTIVITY WITHIN PUBLIC SEWER CORRIDOR

A. PUB's Clearance Certificate or approval under section 14 & 33 of Sewerage and Drainage Act (SDA) 1999 for proposed development or building or works likely to affect sewer or sewerage system

1. For any development or building works if the plan requires the approval of the Commissioner of Building Control (BCA), the QP for the development or building works must obtain a Clearance Certificate for the proposal development or building works to be carried out in or outside a public sewer corridor from the Building Plan Unit (BPU) of PUB.
2. For any other works, if the plan does not require the approval of the Commissioner of Building Control (BCA), a registered professional engineer (or the contractor if permitted by PUB under certain circumstances) for the proposed works must obtain a clearance from Building Plan Unit (BPU) of PUB for the proposal works to be carried out in or outside a public sewer corridor.

B. PUB's approval under regulation 5 of Sewerage and Drainage (Protection of Public Sewerage System) Regulations for carrying out specified activity within a public sewer corridor

1. The contractor of the specified activity must obtain an approval from PUB(WRN) before carrying out the specified activity (eg trial trenching or soil investigation works, site formation works, earth works, piling works, building works, etc) within a public sewer corridor.

1.3.1 Who to make application?

1.3.1.1 A contractor who is engaged in or is to carry out any specified activity within a part of a public sewer corridor must ensure that the activity is carried out in accordance with an approved plan (including any amendment permitted to the plan) for the activity.

1.3.1.2 An application to PUB(WRN) through POWS (<http://bpu.pub.gov.sg/pows>) for the approval of the plan for any specified activity within public sewer corridor must:

(a) be made by the contractor of the activity;

(b) be prepared and submitted: -

- (i) if the plan requires the Commissioner's approval, by the appointed Qualified Person; or
- (ii) if the plan does not require the Commissioner's approval: -
 - (A) by the appointed registered professional engineer; or
 - (B) if PUB permits in any particular case, by the contractor;

- (c) be accompanied by the plan.

1.3.2 What documents to be submitted?

1.3.2.1 The following documents shall be submitted: -

- (a) if the works/specified activity is **within a 10m public sewer corridor (- affect sewer pipe of less than 900mm diameter)**:
 - (i) SIP showing the existing sewer pipes/manholes within and near the site;
 - (ii) Layout plan endorsed by QP showing the proposed building/structure (including retaining and boundary walls, footings drains, etc) or engineering works.;
 - (iii) Survey plan endorsed by Registered Surveyor (RS) showing the alignment of all the affected public sewers/manholes and marked the public sewer corridors. The plan shall indicate the minimum setback distance for the existing sewer in relation to the works;
 - (iv) Pre-construction CCTV inspection report together with the CCTV video (DVD) for the public sewers;

[Notes:

1. PUB (WRN) only accept CCTV inspection and reports from PUB Registered CCTV contractors. The list of latest PUB registered CCTV contractors is available in our website, [http://www.pub.gov.sg/Documents/List of PUB RegisteredCCTVContractor.pdf](http://www.pub.gov.sg/Documents/List_of_PUB_RegisteredCCTVContractor.pdf)

2. For small redevelopment/A&A works of single landed property (terrace, semi-detached and detached house), the submission of pre-construction CCTV survey report is waived and QP is only required to submit the post-construction CCTV survey report upon completion of the development work.

3. From 1 Oct 2017 onwards, submission of CCTV reports and videos is to be made online by the registered CCTV contractor at www.sewstv.sg. QP/PE is to review the CCTV reports and videos before allowing the CCTV contractor to make the submission.]

- (v) Method statement detailing how the works/activity is proposed to be carried out;
 - (vi) Detailed drawings for the works/activity (eg detailed piling plans), details of the machinery/equipment used;
 - (vii) PE's analysis/assessment that the construction method proposed will not cause any impact or damage to the sewerage system; and
 - (viii) Such other plan, information, technical report, certificate and document as may be required by PUB.
- (b) If the works/specified activity is **within a 20m and/or 40m public sewer corridor (- affect sewer pipe of 900mm diameter or greater or DTSS tunnel)**
- (i) All the documents listed in (a) (i) to (viii) above;
 - (ii) Construction Impact Assessment Report (CIAR) (Refer to **Annex 4 item B9** for details);
 - (iii) Instrumentation and monitoring plan (Refer to **Annex 4 item B11-22** for details); and
 - (iv) Details of installation of web-based IP surveillance cameras.

1.3.2.2 Application can be made via e-corenet using the form Works Affecting Public Sewer.

1.3.3 Approval for the application

- 1.3.3.1 PUB will review the submissions within 14 working days and if all the documents are in order, grant the approval for the specified activity, with or without conditions. No works are to commence until the approval has been granted by PUB(WRN).
- 1.3.3.2 PUB, when reviewing the submission, may direct the responsible person (i.e. QP/PE/contractor) to comply with such requirements as it may specify and re-submit the application within such period as may be specified in the direction.
- 1.3.3.3 The approval for the specified activity will cease:
- (i) if the activity does not start before the end of the commencement window period for that activity;
 - (ii) upon the failure of the contractor to comply with any condition or requirement imposed by PUB;
 - (iii) upon the QP/PE ceases to supervise the specified activity; or
 - (iv) upon the revocation by PUB of the approval.

1.3.4 Commencement window period

- 1.3.4.1 The contractor of the specified activity must ensure that the activity is commenced before the period of 12 months from the date of approval.
- 1.3.4.2 The contractor may apply to PUB for an extension of the commencement window period not later than 14 days before the expiry of the commencement window period. PUB, in granting the application, will also fix the period of the extension.
- 1.3.4.3 The date of commencement must be clearly indicated in the application form.

1.3.5 Amendment to approved plan

- 1.3.5.1 No deviation from the plans approved by PUB shall be made unless with prior written approval from PUB (WRN).
- 1.3.5.2 The contractor of the activity may make application to PUB for permission to amend the approved plan. The Application shall be prepared by the person who prepared the application for approval of the original plan (refer to item 2 above).

1.3.6 Supervision of specified activity

- 1.3.6.1 The specified activity to be carried out in a public sewer corridor must be supervised by the QP (if the plan for the activity requires the Commissioner of Building Control's approval) or the PE (if the plan for the activity does not require the Commissioner of Building Control's approval) who prepared the application for the approval of the plan (refer to item 2 above).
- 1.3.6.2 The supervisor must:
- a) exercise due diligence in supervising and inspecting the carrying out of the activity;
 - b) take all reasonable steps when supervising and inspecting the carrying out of the activity to ensure that the activity is carried out in accordance with the approved plan for the activity and any condition or requirement imposed by PUB.
 - c) notify PUB of any contravention of the Act/Regulations or any condition or requirement imposed by PUB.
 - d) keep and maintain at the premises at which the activity is carried out, such document, book or record;
 - e) carry out the inspection of the activity;
 - f) submit to PUB a declaration and certificate of completion of works relating to the activity; and
 - g) submit such other document at such time as PUB may specify.

1.3.7 Post-construction CCTV inspection

- 1.3.7.1 Upon The post-construction CCTV inspection videos and reports shall be submitted through CCTV online submission system (<http://www.sewerccvt.pub.gov.sg>) to PUB(WRN) when the QP/PE submits the declaration and certificate of completion of works/activity to PUB or at such time as specified by PUB(WRN).

1.3.8 Submission of “as-built” survey plan upon completion of works

1.3.8.1 Upon completion of the development, QP/PE shall submit a certificate of completion and an “as-built” survey plan endorsed by a registered surveyor to show the exact location/clearances (horizontal/vertical) between the existing sewers/manholes and all the existing/new buildings/structures including wall, drains, boundary lines, services laid etc. The top and invert levels of all the sewer manholes shall be indicated in the plan. The QP/PE shall:

- highlight and certify if there are any changes in the condition of the existing sewers/manholes between the post and the pre-construction CCTV inspection.
- confirm that the minimum clearance distance between the building/structure/services and the sewer met the stipulated requirements in the code of practice and is in accordance with the requirements/conditions imposed by PUB (WRN) when the development plans were approved.
- certify with submission of the as-built drawing of the installed piles/drilling boreholes that there are no impacts/damages caused to the sewers, manholes and pumping mains based on the as-constructed works, instrumentation monitoring results, sewer pre/post construction CCTV survey report and pre/post sewer levels as detailed in the construction survey report submitted to PUB (WRN).

1.4 GENERAL REQUIREMENTS FOR PROTECTION OF SEWERS AND PUMPING MAINS

1.4.1 General Requirements for All Diameters of Sewer Pipes and DTSS Tunnels

Duty to investigate to locate sewer pipes and pumping mains

1.4.1.1 The information of the sewers and pumping mains on the SIP is valid as of the date issued and is given without any liability for any error, misalignment or omission therein. Positions of the sewers and pumping mains as shown in the SIP are approximate only. The exact positions, alignments and levels of the sewers, lateral connections and pumping mains must be ascertained by you on site by means of trial holes using manual excavation or pre-probing.

- 1.4.1.2 The alignment of the sewer pipes or pumping mains must be pegged and the zone of the sewer corridor must be marked on site so that they are clearly visible and appropriate precautions and protection measures can be taken to safeguard the sewers or pumping mains during construction works.

Duties of QP/PE/Contractor

- 1.4.1.3 The copies of all SIP, PUB (WRN)'s approvals, including approved plans, shall at all times be kept at the site and made available for audit check by PUB (WRN) when requested.
- 1.4.1.4 PUB (WRN)'s approval for Form B (- Application to work in the public sewerage system) must be obtained before opening any manhole/chamber of the public sewerage system or entering any public sewers or manholes to carry out any works.
- 1.4.1.5 The construction works or activities shall not cover up/bury any sewer manholes or valve chambers and appurtenances for pumping mains. The public sewers and pumping mains must be accessible for maintenance and repair works at all times.
- 1.4.1.6 The public sewers and pumping mains are not to be exposed, suspended, altered, diverted or otherwise interfered with without prior approval from PUB (WRN). The cost of diverting any existing sewers/pumping mains shall be borne by the party necessitating the diversion works.
- 1.4.1.7 If a diversion is proposed for the existing sewer, proposal for the diversion sewer shall have to be approved by PUB (WRN). Then, the diversion sewer shall first be completed and passed for operation by PUB (WRN) before any work that would affect the existing sewer is allowed to start.
- 1.4.1.8 The Developer/Contractor shall be fully liable for any damage caused to any public sewers or pumping mains at the work site. The cost of repairs to any sewers/pumping mains damaged as a result of work carried out shall be borne by the developer or contractor who is responsible for the damage.
- 1.4.1.9 The supervising QP or PE shall ensure any precautionary, protective or recovery measures deemed fit by PUB (WRN) or as conveyed to him during the construction or the defects liability period of the works are fully complied with.

- 1.4.1.10 The contingency plan to ensure that the flow is not disrupted should the existing sewer be damaged during construction works shall be kept at the site. The contingency plan shall be activated and repair works to the damaged sewer must be immediately carried out in the event that any sewer is damaged due to the works.

Before Commencement of Works

- 1.4.1.11 Registered Surveyor to verify, set out and carry out the pegging of the sewer alignment and the edge of the sewer, tunnel/pipe jacking alignment, pile/drilling hole positions, temporary earth retaining system (TERS) alignment on site and endorse on setting out plan.
- 1.4.1.12 The supervising QP or PE shall verify and check that the setting out plan is as per the QP submitted DC/BP/Detailed plans which are registered with PUB (BPU).
- 1.4.1.13 The supervising QP or PE shall check the positions of all heavy construction machinery and lifting equipment and material storage area in the vicinity of the sewer and ascertain that the imposed loads will not cause any damage to the sewer.
- 1.4.1.14 If the proposed work is likely to affect the existing sewers, a level sensor shall be installed at the nearest manhole upstream of the affected sewer section. The level sensor shall be provided with data logger and auto alarm system at preset trigger levels. When the preset level is triggered, the alarm system should be capable of informing PUB (WRN) via SMS. QP/PE/Contractor shall liaise with **PUB (WRN), Network Management Branch (NMB)** on the details of the trigger levels and PUB staff to receive the SMS.

During Implementation of Works (for sewers)

- 1.4.1.15 The supervising QP/PE's competent site representative shall closely monitor the works and provide standing supervision and conduct verticality and penetration depth checks on the piles, TERS and excavation works to ensure that they are installed within the allowable construction tolerance limits in terms of setting out, eccentricity and verticality. Records of the standing supervision, verticality and penetration depth checks, as-built piling and TERS drawings shall be properly maintained on-site and made available for inspection upon request.
- 1.4.1.16 Any work carried out in the vicinity of existing sewers or pumping mains shall not subject the sewers or pumping mains to a vibration of more than 15mm/s peak particle velocity at any frequency.

1.4.2 Additional Requirements to Protect Existing Large Diameter (900mm or greater) Sewers and DTSS Tunnels & Structures

- 1.4.2.1 The responsible QP, PE and Contractor shall comply with the technical requirements stipulated in Part 2 and Annex G of the Code of Practice on Sewerage and sanitary Works (COPSSW 2nd edition Jan 2019) to protect the sewers and DTSS tunnels in the vicinity of the works.
- 1.4.2.2 The responsible QP or PE shall design both the temporary and permanent works in such a way to ensure that ground movements are kept to an absolute minimum. The employment of proven techniques and good workmanship are important to minimize ground loss and in turn ground movements.
- 1.4.2.3 The QP or PE shall select and ensure the operation of construction equipment shall be in a manner such that vibration induced damage to the sewers and DTSS tunnels/structures is prevented.

Construction within Public Sewer Corridor of Large Diameter Sewer and DTSS Tunnel

- 1.4.2.4 The QP or PE shall establish and inform PUB (WRN) of the procedures and methods for all excavation and other construction works within the public sewer corridor of large diameter sewers and DTSS tunnels to prevent damage to the sewers and DTSS structures during the work
- 1.4.2.5 If the proposed works involve the installation of piles, construction of structure or excavation to a level within the sewers or DTSS tunnels setback distance (**all works should be kept out of sewer/DTSS setback. Works proposed within the setback must be absolutely unavoidable and only with PUB's approval after critical and exhaustive examination by PUB**), pre-probing shall be conducted to ascertain if the sewers or DTSS tunnel is in the way of the works. Before commencement of works, the QP or PE shall submit the detailed method statement and drawings for the pre-probing works, details of the machinery/equipment used (especially that for the advancement of the probe) with analyses/assessment to demonstrate that the pre-probing method proposed is non-invasive and will not cause any impact or damage to the sewers or DTSS tunnels.
- 1.4.2.6 **Equipment Vibrations** - Construction activities such as piling, excavation, soil improvement, diaphragm wall and retaining wall construction etc and the use of construction equipment such as piling/boring machine etc shall not subject the sewers and DTSS tunnels & structures to **a peak particle velocity (PPV) exceeding 15 mm/s** at any frequency. The QP or PE shall provide a detailed impact assessment that clearly demonstrates the vibration attenuation for each of the equipment proposed to be used at the development site and in similar ground conditions to show that this vibration limit would not be exceeded on the existing sewers and DTSS tunnels &

PS-S-35

structures. On-site testing and monitoring with a seismometer may be requested by PUB (WRN) to verify the QP's assessment.

- 1.4.2.7 **Ground Displacements** - Ground displacements in the vicinity of the sewers and DTSS tunnels & structures (in either x, y, or z direction) caused by construction or other activities shall be “zero”. If the QP's or PE's analysis shows that the ground displacement in the vicinity of the sewers and DTSS tunnels & structures due to the construction or other activities exceeds “zero”, a further design check shall be undertaken to ensure that the construction or other activities **will not induce a calculated crack width of 0.1mm** in the DTSS concrete structure.
- 1.4.2.8 **Load Transfer from Foundations to sewers and DTSS Tunnel** - Load transfer (if any) from the foundation elements to the sewers and DTSS tunnels (e.g. by skin friction) **shall not exceed an average of 10 kPa (10 kN/m²)**. This requirement may necessitate the “debonding” of the entire foundation elements above the sewers and DTSS tunnel levels.
- 1.4.2.9 **Groundwater Drawdown** - The groundwater drawdown **shall not exceed 10 kPa** in the vicinity of the sewers and DTSS tunnels. If the groundwater drawdown is expected to exceed 10kPa, mitigation measures such as recharge wells shall be incorporated to ensure compliance with this requirement. Otherwise, the QP shall assess and submit analysis to verify that there will be no adverse impact (i.e. expected stress is within structural strength, crack width, etc.) to the structural integrity of the sewers and DTSS tunnels & structures in view of the expected groundwater drawdown.

Assessment of Construction Effects on Existing Structures

- 1.4.2.10 **Construction Impact Assessment Report (CIAR)** - The QP or PE shall carry out a construction impact assessment of the construction effects of the works on the sewers and DTSS structures in the vicinity of the works and submit the report to PUB (WRN) for approval. The report shall include the following details:
- (i) The ground conditions, geotechnical profiles and relevant borehole logs.
 - (ii) The proposed construction equipment and methods, and sequencing of construction.
 - (iii) Assessments on the use of the proposed construction equipment/methodology on the existing sewers/DTSS tunnels, vibrations, ground displacements, load transfer from foundation elements to the sewers and DTSS tunnels and groundwater draw downs and how the impacts would be mitigated to meet requirements.

- (iv) Vibration characteristics and attenuation for major construction equipment/methodology.
 - (v) Instrumentation and monitoring proposals.
 - (vi) The damage potential and risks to the sewers and DTSS structures.
 - (vii) Preventative and precautionary measures to protect the sewers and DTSS structures from damage and remedial measures to be taken in the event of damage/incidents.
- 1.4.2.11 The QP or PE shall advise PUB (WRN) on the assessed probable risk and level of damage to the sewers and DTSS tunnels/structures and his proposed mitigating measures for preventing the sewers and DTSS structures from damage to the satisfaction of PUB (WRN).

Instrumentation and Monitoring Programme

- 1.4.2.12 The QP or PE shall carry out an instrumentation and monitoring programme to monitor the surface and subsurface ground movements, vibrations, the variation of groundwater table and pore pressures, and the displacement and distortion of sewers and DTSS tunnels/structures, and assess the effect of construction works on the sewers and DTSS tunnels/structures in the vicinity.
- 1.4.2.13 The QP or PE shall include in the monitoring plan all sewers and DTSS tunnels/structures that in his view are likely to be affected by the works.
- 1.4.2.14 The QP or PE shall submit full details of the proposed monitoring procedures and instrumentation to PUB (WRN) for concurrence before commencing the works.
- 1.4.2.15 The QP's or PE's method statement shall include the proposed monitoring intervals and all requirements imposed by PUB (WRN).
- 1.4.2.16 The QP or PE shall stop the works immediately if the instrumentation monitoring results exceed the allowable limits and inform PUB (WRN), Network Management Branch (NMB) immediately before investigating whether the works have any impacts on the sewers. The QP or PE shall submit his assessment of the impacts of the works on the sewer, including his proposed mitigating measures to address the excessive ground movement or any other abnormalities, to PUB (WRN) for approval, before resuming the works..

- 1.4.2.17 The QP or PE shall be responsible for ascertaining and setting the safe limits of ground movements, vibration levels or other changes for ensuring the structural integrity and proper functioning of all sewers and DTSS structures. He shall provide comprehensive basis for the proposed safe limits.
- 1.4.2.18 The QP or PE shall verify and certify by monitoring that construction works have not resulted in displacements or vibration levels that have or will cause damage to any sewers or DTSS structures. As a minimum, the following are required to be carried out and the relevant details are to be submitted to PUB (WRN):
- (i) Monitoring of the displacements or vibration levels of sewers and DTSS structures or the adjacent ground from the construction works
 - (ii) Preparation of action plans for remedial action in the event that displacements or vibration levels exceed the design limitations or cause damage.
- 1.4.2.19 It shall be clearly understood that the submissions of the instrumentation monitoring results and reports to PUB (WRN) are only for PUB (WRN)'s information. **The QP or PE shall be fully responsible for the analysis and interpretation of all the readings and measurements and for taking all remedial measures where necessary.** When abnormal readings or measurements are obtained, QP or PE shall immediately investigate the causes of the abnormalities and take all necessary remedial measures. QP or PE shall promptly inform PUB (WRN) should such abnormalities be likely to affect the structural integrity of the sewers, pumping mains or DTSS structures.
- 1.4.2.20 All deformation monitoring instrumentation shall be designed to allow for any ground settlements, heaves or deformations that may occur. A new set of instrumentation shall be provided or resetting of the instrumentation shall be carried out, as recommended by the manufacturer, if the instrumentation reading exceeds 85% of its design value.
- 1.4.2.21 Instrumentation monitoring regime consists of inclinometers, ground settlement markers, vibration meters, piezometers, strain gauges, rod extensometers, etc. shall be carried out by QP or PE to check whether ground movements & vibration impacts are within allowable limits during the construction works. Records of the instrumentation monitoring regime shall be endorsed by the QP and properly maintained at the site, submitted to PUB (WRN) or made available for inspection by PUB (WRN) upon request.
- 1.4.2.22 QP or PE shall monitor and review the instrumentation monitoring results daily, looking out particularly for excessive ground movements that may

cause damage to the sewer. The QP or PE shall submit the instrumentation monitoring records to **PUB (WRN), Network Management Branch (NMB)** at a frequency stipulated by PUB (WRN). QP or PE shall highlight in his submission if there are any excessive ground movements monitored or any other abnormalities.

- 1.4.2.23 **QP or PE shall stop the works immediately if the instrumentation monitoring results exceed the allowable limits and inform PUB (WRN), Network Management Branch (NMB)** immediately before investigating whether the works have any impacts on the sewers. The QP or PE shall submit his assessment of the impacts of the works on the sewer, including his proposed mitigating measures to address the excessive ground movement or any other abnormalities, to PUB (WRN) for approval, before resuming the works.

Surveillance Cameras Above Large Diameter (≥ 900 mm) Sewers and DTSS Tunnel & Structures

- 1.4.2.24 Contractor shall provide web-based IP surveillance cameras to continuously monitor construction activities in the vicinity of the DTSS tunnel/structures and large diameter (> 900 mm) sewers. The number of cameras to be provided shall be approved by PUB (WRN) and shall be sufficient to cover at least the setback distances of the DTSS tunnel/structures (ie. 6m from both edges) and large diameter sewers (ie. 2.5m for 900mm to 1500mm diameter; 3m for >1500 mm to 2500mm diameter and 4m for >2500 mm diameter, from both edges).
- 1.4.2.25 The surveillance cameras must be able to capture still pictures and perform continuous video recording.
- 1.4.2.26 The contractor shall provide PUB (WRN) with the Internet website address for centralized live viewing or viewing of the still picture and video recordings of the construction activities within the setback distances of DTSS tunnel/structures and large diameter sewers captured by the surveillance cameras.

Pre and Post-Construction CCTV, Laser and Sonar Inspection for DTSS Tunnel for Construction Works carried out within DTSS 6m Setback Distance

- 1.4.2.27 Pre and post-construction CCTV, sonar and Laser inspection for the DTSS tunnel, to be carried out by a specialist contractor with proven track records for deep tunnel inspections, are required for construction works within the **DTSS 6m setback distance**.

- 1.4.2.28 The specialist contractor's inspection system for the DTSS tunnel shall comprise CCTV, laser and sonar inspection technologies for a complete assessment of the condition of the DTSS tunnel. The proposed inspection system shall have proven track records for carrying out similar inspections of large diameter deep sewer tunnels.
- 1.4.2.29 The QP or PE shall submit the pre-construction CCTV, Laser and Sonar inspection report (highlight all minor and major geometric defects) and records (in DVD) of the DTSS tunnel prepared by the specialist contractor prior to the commencement of works within the **DTSS 6m setback distance**.
- 1.4.2.30 For every pre- and post-construction CCTV inspection carried out, the QP or PE shall compare the two inspection reports and highlight / certify whether there is any deterioration in the tunnel condition. QP or PE shall promptly inform PUB (WRN) should any abnormalities be found that may have affected the structural integrity of the DTSS. CCTV reports together with the CCTV video shall be in accordance with PUB (WRN)'s CCTV requirements which can be found in PUB website.
- 1.4.2.31 The QP or PE would have to apply to PUB (WRN) for a permit to access the DTSS Shafts to carry out the DTSS tunnel inspection. The application for permit shall include the proposal for the implementation of the DTSS tunnel inspection. The proposal shall include a Risk Assessment Report, deployment procedures & methodology, format/details of analytical reports with details of the inspection system used, the CVs of competent personnel with track record of similar inspections, safety plans and odour control system.
- 1.4.2.32 The QP's or PE's representative (RE/RTO) and safety officer must provide standing supervision while the access shaft is opened and during the DTSS tunnel inspection to ensure that no damage is caused to the DTSS tunnel and safety of the contractors or any personnel and public is not compromised.
- 1.4.2.33 The QP's or PE's representative (RE/RTO) shall ensure that adequate ventilation and lighting are provided to ensure sufficient brightness and clear views for inspection and that details of the tunnel are not obscured by gases in the tunnel. Ventilation should not lead to public health concerns and sufficient odour control systems must be provided.

1.4.2.34 During the inspection, the QP's or PE's representative (RE/RTO), in consultation with the safety officer, shall ensure that all necessary/adequate measures are taken to safeguard the safety of the contractors' personnel and public. The measures shall include risk assessment, confined space entry safety requirements, prevent access by public to the access shaft while the access shaft is opened, securing of contractors' personnel to the secured scaffolding members (metal based) (which can take human weight as a minimum) when near opened shaft and confirmation that access shaft covers opened for inspection are tightly closed and secured with bolts at the end of the inspection. Risk Assessments should include "Hazop" to ensure all measures necessary to prevent damage to the tunnel and shaft are adopted during the inspection.

1.4.2.35 During the inspection process, the QP or PE shall ensure that all precautionary actions are taken to prevent damage to the DTSS tunnel and shafts. The precautionary actions shall include but not limited to the following:

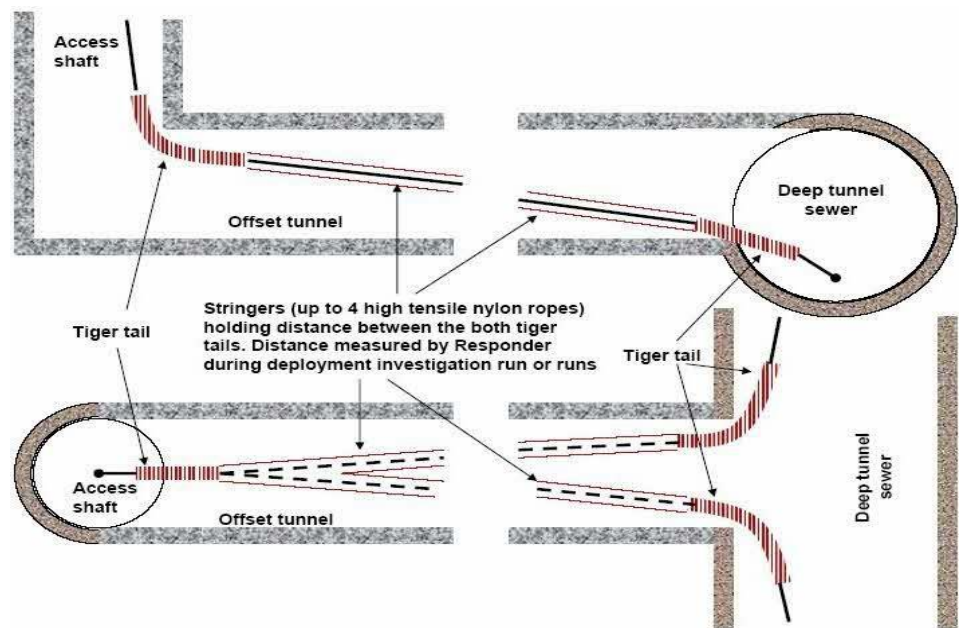
During the deployment and retrieval of the inspection system into and out of the DTSS shaft

- (i) Measures must be in place to prevent excessive swaying during the deployment and retrieval of the inspection system into and out of the DTSS shaft to prevent damage to the shaft. Adequate padding shall also be provided at appropriate locations on the inspection platform to prevent damage to the DTSS shaft's internal lining.
- (ii) Pan-Tilt and Zoom (PTZ) CCTV camera that can rotate 180 degrees shall be mounted on the inspection system and used to view backward and forward during the deployment and retrieval to ensure that the inspection platform maintains a safe distance from the access shaft wall and does not cause any damage to the shaft.

During the inspection of the DTSS tunnel

- (iii) The Contractor shall examine carefully the shaft and tunnel interior for areas that might be susceptible to scratching by the tether or the inspection instrument and take additional measures/care to prevent any potential damage to the protective liner covering the shaft and tunnel interior or structural components of the DTSS. Adequate protection such as the use of "Tiger Tails" shall be provided to prevent damage to the DTSS tunnel/shaft.

- (iv) An example on the deployment of "Tiger Tails" to protect the tether from scrapping against the shaft or tunnel is shown in Figure 1 below.
- (v) Upon the completion of the inspection of the tunnel, QP or PE shall ensure that the inspection platform re-inspect in the reverse direction using the Pan-Tilt and Zoom (PTZ) CCTV camera system to check and ensure that the DTSS tunnel was not damaged in any way due to the inspection.



**FIGURE 1 – PLAN & ELEVATION VIEW SHOWING DEPLOYMENT
OF “TIGER TAILS” TO PROTECT DTSS**

1.5 PENALTIES FOR OFFENCES UNDER THE SEWERAGE AND DRAINAGE ACT / REGULATIONS AND THE SEWERAGE AND DRAINAGE (PROTECTION OF PUBLIC SEWERAGE SYSTEM) REGULATIONS 2017

1.5.1 Sewerage and Drainage Act (chapter 294)

Section	Description of Section/Regulation	Penalty
13A(1)	<p>Duty to enquire before excavation</p> <p>No person shall dig, bore, trench, grade, excavate, tunnel or break any ground with any mechanical equipment, tool or explosive, or allows his employee or agent to do so, without first: -</p> <ul style="list-style-type: none"> a) obtaining from the Board the relevant drainage plan or sewerage plan or other plans or records to ascertain the location of any public sewerage system or part thereof that may be interfered with by such works; b) carrying out trial trenches to physically ascertain the location of any such public sewerage system or part thereof that may be interfered with by such works; and c) complying with such other requirements as the Board may specify to protect any such public sewerage system or part thereof within the vicinity of such works, 	Any person found guilty shall be liable on conviction to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 3 years or to both.
14(1)	<p>Works likely to affect sewer or sewerage system not to be carried out without Board's certificate or approval</p> <p>No person shall –</p> <ul style="list-style-type: none"> a) erect or cause or permit to be erected any object, building or structure over, across or adjacent to any sewer or sewerage system; or b) carry out or cause to be carried out any other works which adversely affect or are likely to adversely affect any sewer or sewerage system, directly or indirectly <p>without obtaining, in respect of those works, a clearance certificate or the approval of the Board</p>	Any person found guilty shall be liable on conviction to a fine not exceeding \$20,000.

Section	Description of Section/Regulation	Penalty
20(1)	<p>Damage caused to public sewer, etc.</p> <p>No person shall –</p> <ul style="list-style-type: none"> a) cause any damage to any public sewer or any drain-line or sewer communicating with a public sewer; or b) renders any public sewer or private sewer a nuisance. 	Any person found guilty shall be liable on conviction to a fine not exceeding \$40,000 or to imprisonment for a term not exceeding 3 months or to both
20(2)	<p>No person shall –</p> <ul style="list-style-type: none"> a) do any act which renders any public sewer or private sewer dangerous or injurious to health; b) cause any damage to a pipe of 0.9 metres or greater in diameter that is part of or connected to the public sewerage system; or c) do any act which disrupts the operation of or causes damage to any sewage treatment plant, sewage treatment works or water reclamation facility. 	Any person found guilty shall be liable on conviction to a fine not exceeding \$200,000 or to imprisonment for a term not exceeding 2 years or to both.
63(b)	<p>General Penalties</p> <p>No person shall fail to comply with any condition subject to which any clearance certificate is issued or approval is granted by the Board under <u>section 33</u>,</p>	Any person found guilty shall be liable on conviction to a fine not exceeding \$15,000 or to imprisonment for a term not exceeding 3 months or to both, and in the case of a continuing offence, to a further fine not exceeding \$500 for every day or part thereof during which the offence continues after conviction.

Section	Description of Section/Regulation	Penalty
Reg4(1)	<p>Sewerage and Drainage (Sanitary Works) Regulations Permission to work in public sewerage system</p> <p>No person shall enter the public sewerage system to carry out any works except with the prior permission of the Board</p>	<p>Any person found guilty of an offence shall be liable on conviction to a fine not exceeding \$15,000 and, in the case of a continuing offence, to a further fine not exceeding \$500 for every day or part thereof during which the offence continues after conviction.</p>
Reg 4A	<p>Sewerage and Drainage (Sanitary Works) Regulations</p> <p>Prohibitions relating to manhole and chamber of public sewerage system</p> <p>No person shall do any of the following except with the prior permission of the Board:</p> <p>(a) cover up or pave over, or cause or permit to be covered up or paved over with bitumen, cement, concrete slab or any hard material any access into any manhole or chamber of the public sewerage system;</p> <p>(b) open, or cause or permit to be opened, any cover of a manhole or chamber of the public sewerage system.</p>	<p>Any person found guilty of an offence shall be liable on conviction to a fine not exceeding \$5,000 and, in the case of a continuing offence, to a further fine not exceeding \$500 for every day or part thereof during which the offence continues after conviction.</p>

**1.5.2 Sewerage and Drainage (Protection of Public Sewerage System)
Regulations 2017**

Reg	Description of Regulation	Penalty
4(1)	<p>Obligation relating to specified activity</p> <p>A contractor who is engaged in or is to carry out any specified activity within a part of a public sewer corridor must ensure that the activity is carried out in accordance with an approved plan (including any amendment permitted to the plan) for the activity.</p>	Any person who is guilty of an offence shall be liable on conviction to a fine not exceeding \$15,000 and, in the case of a continuing offence, to a further fine not exceeding \$500 for every day or part of a day during which the offence continues after conviction.
9 (2)	<p>Supervision of specified activities</p> <p>A contractor of any specified activity to be carried out in a public sewer corridor must —</p> <p>(a) appoint the following person as a supervisor to supervise the carrying out of the activity:</p> <p>(i) if the plan for the activity requires the Commissioner's approval, the qualified person who prepared the application for the approval of the plan; or</p> <p>(ii) if the plan for the activity does not require the Commissioner's approval, the registered professional engineer who prepared the application for the approval of the plan; and</p> <p>(b) ensure at all times when the activity is carried out, that it is supervised by the supervisor appointed under paragraph (a).</p>	A contractor who is guilty of an offence shall be liable on conviction to a fine not exceeding \$15,000.

Reg	Description of Regulation	Penalty
9(4)	<p>The supervisor must —</p> <ul style="list-style-type: none"> (a) exercise due diligence in supervising and inspecting the carrying out of the activity; (b) take all reasonable steps when supervising and inspecting the carrying out of the activity, to ensure that the activity is carried out in accordance with — <ul style="list-style-type: none"> (i) the Act; (ii) these Regulations; (iii) the approved plan for the activity; and (iv) any condition or requirement imposed by the Board under regulation 5(3), 12(1)(a) or 15(2)(a); (c) notify the Board of any contravention of — <ul style="list-style-type: none"> (i) the Act; (ii) these Regulations; or (iii) any condition or requirement imposed by the Board under regulation 5(3), 12(1)(a) or 15(2)(a); (d) keep and maintain at the premises at which the activity is carried out, such document, book or record as the Board may require; (e) carry out the inspection of the activity in such manner as the Board may require; (f) submit to the Board a declaration and certificate of completion of works relating to the activity in such form and at such time as the Board specifies; and (g) submit such other document to the Board at such time as the Board may specify. 	Any supervisor who is guilty of an offence shall be liable on conviction to a fine not exceeding \$15,000.