Manual For the Safe Execution of Earthworks in Singapore Changi Airport and Seletar Airport

Compiled by

Safety and Health Unit
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CONTRACTORS FOR THE MANAGEMENT OF UNDERGROUND INSTALLATIONS WITHIN CHANGI AIRPORT AND SELETAR AIRPORT

GENERAL

1. This document must be disseminated to ALL contractors and personnel who are in any way involved in the proposed earthworks notified to the CAG.

   ALL REQUIREMENTS IN THIS DOCUMENT MUST BE STRICTLY COMPLIED WITH. If a contractor encounters difficulty in complying with any requirement, it must consult CAG on the appropriate action to be taken.

2. Under the requirements stipulated in the Code of Practice for the Management of Underground Installations Within Changi Airport and Seletar Airport ("**COP**"), Section 6.3, contractors who carry out earthworks[1] ("**Earthworks Contractors**") are to comply with all reasonable requirements to adopt proper and disciplined management of underground installations[2]. The requirements of the COP shall apply to all earthworks within the boundaries as shown in Appendix 1.

3. This document sets out the requirements of that must be complied with by Earthworks Contractors for the purpose of complying with the COP.

4. Earthworks Contractor performing earthworks at the airport shall exercise proper and disciplined management of underground installations to avoid damage to underground installations during works, including:

   a) assign a qualified and competent, full-time site supervisor who is well-versed in all the provisions outlined in this document to closely oversee and manage the execution of the earthworks during the entire period of the project. Additionally, maintain open communication with CAG to report any alterations in key personnel, including changes to the site supervisor, LCDW, and other relevant roles;

   b) put in place proper and sufficient protective measures and support methods to safeguard all underground installation, which may include measures and methods

[1] Under the Code of Practice for the Management of Underground Installations Within Changi Airport and Seletar Airport, "earthworks" means —

(a) excavating earth, rock or other material (by whatever means) in connection with —
   (i) any works for or relating to the construction, reconstruction, extension, renovation, alteration, demolition or repair of any building, road, railway, bridge, viaduct, flyover, sewer or sewage works;
   (ii) any works for or relating to the laying, inspecting, repairing or renewing of any mains, pipes, cables, fittings or other apparatus;
   (iii) any soil investigation works; or
   (iv) such other works as are usually undertaken by a person carrying on business as a contractor in the construction industry or as a professional civil or structural engineer;
   (v) any act of boring, dredging, jacking, levelling, piling or tunnelling on or under any premises or street by any mechanical means; and
   (vi) the driving or sinking of any earth rod, casing or tube into the ground.

[2] "underground installation" means any pipe, tunnel, duct, line, wire, cable, fitting, drain, water fitting or other thing used for the supply or transmission of any underground service, or any underground sewer;
"underground service" means the supply or transmission of chemicals, drainage, electricity, electronic signals, fuel, gas, refrigerant, sewerage, telecommunications, water or other similar services through the use of pipes, lines, cables or other associated structures located underground.

stipulated by CAG. Regularly inspect and maintain these measures and methods to ensure their continued reliability and effectiveness during the entire course of the earthworks.

c) The use of service corridors or service ducts for the laying of underground installations, as designated by CAG;

d) The removal of decommissioned underground installations as a result of the works, or abandoned underground installations discovered within the excavated zone, as designated by CAG;

e) Obtaining all necessary information on underground installations prior to commencing earthworks from CAG and other relevant agencies and the owner of the underground installations, and procuring the relevant services drawings;

f) Carry out cable detection on site by Licensed Cable Detection Worker (LCDW);

g) Carry out trial holes to ascertain the location of underground installations;

h) Locate and trace all underground services, both charted ones shown in as-built services layout drawings and uncharted ones as per guidance listed in Part A of this document, within the work boundaries set out by the work party and approved by project sponsor, before commencement of any earthworks including underground installation diversion work in the airport premises; and

i) Comply with any other measures that CAG may deem necessary, ensuring the safe execution of earthworks within the airport boundaries.

5. This document comprises four sections –

a) **Section A** sets out the procedures for earthworks contractors before commencing earthworks

b) **Section B** sets out the measures to be taken where the underground installations need to be diverted.

c) **Section C** sets out the requirements in the event of damage to underground installation.

d) **Section D** sets out the general guidelines on the do's and don'ts.

6. **The Earthworks Contractor responsible for executing the actual earthworks must ensure compliance with the CAG's Earthworks Requirements. They cannot claim delegation of this responsibility to another party or reliance on another party to ensure compliance, whether through a contract, agreement, arrangement, understanding, or any other means**.

7. **In cases where multiple Earthworks Contractors are conducting earthworks at the same work site, each party is individually obligated to adhere to the CAG's Earthworks Requirements for their respective earthworks.**

8. Prior to commencing any earthworks, all proposed earthworks must obtain an Earthwork Permit through CAG's OneCalendar System (https://onecalendar.changiairport.com/). Sufficient lead time of approximately 2 weeks, shall be catered for when applying for the permit for all planned earthworks. Earthworks Contractor can refer to the user guide under the "EarthWorks" section at https://cag-one-calendar.s3.amazonaws.com/user-guide/contractor.html#submit. For Earthworks in Seletar Airport, the application of the "Earth Works Permit" and all relevant forms and checklists shall be done via hardcopy or email where the forms and checklists can be found in the Airport Operational and Safety (AOS) requirements manual.

9. Earthworks Contractors commencing or carrying out earthworks in emergency situations and having a valid reason to believe that quick action is necessary in the interest of public or private safety, are exempt from completing Section A of the Earthworks Requirements. Such earthworks requests, initiated by CAG or relevant third parties (e.g., government agencies, etc.), must be accompanied by the following information before commencement: (a) Earthworks Contractor's name, (b) name of the party requesting the earthworks, (c) contact information for the works coordinator, (d) photos of the earthworks/excavation location, and (e) date and time of the earthworks. These earthworks contractors can proceed with the earthworks and provide CAG with a notice in writing (e.g. via email, text message, etc.) stating the nature and extent of those earthworks and explaining how these earthworks were in the interest of public or private safety not more than 7 days after the commencement of such earthworks.

   If the work is under the sponsor of CAG project officer, then the Earthworks Contractor shall provide the written notice to the CAG project officer who will then communicate with the affected stakeholders and system owners. However, if the work is under the sponsor of external party such as CAFHI / CAAS, then the written notice shall be attention to Airside Management Centre (AMC).

   If the emergency work is to be performed in Seletar Airport, notices shall be submitted to the CAG Seletar Engineering team.

10. IMPORTANT: Earthworks Contractors are required to maintain necessary safety precautions, which may include conducting cable detection on-site and manually digging trial holes to ascertain the location of underground installations.

11. The requirements stated in this document are not exhaustive. Additional requirements may be issued from time to time by CAG or the affected service owner. These additional requirements, together with the requirements in this document, shall constitute the full set of requirements that must always be complied with by the Earthworks Contractor to prevent damage to airport underground services.

12. The Earthworks Contractor shall not take any short cuts or omit any of the steps and actions required to be taken before commencing with the earthworks. In case the Earthworks Contractor encounters challenges while attempting to adhere to any of the stipulations within this document, be it due to site conditions or any other reasons, it is

imperative to consult CAG and request their assistance. There should be no instance where the Earthworks Contractor disregards or attempts to circumvent any of the requirements or takes independent actions.

13. The Earthworks Contractor shall not tamper with, remove, modify, dismantle or in any way interfere with CAG's installation and plant, including –

    a) any underground services;
    b) the ducts/pipes housing the underground services;
    c) any concrete encasing the underground services or the ducts/pipes housing the underground services; and
    d) any warning slab installed at the underground services or the ducts/pipes housing such underground services.

14. The Earthworks Contractor shall not open, remove or cover up any of the manholes, equipment boxes or pedestal boxes with earth or any construction/building materials, equipment, or machinery without obtaining CAG's prior written approval.

15. Where requested to do so by CAG or any relevant authority, furnish all documents and information required to be prepared, submitted, or maintained by the Earthworks Contractor as referred to in this document.

SECTION A: PROCEDURES FOR EARTHWORKS CONTRACTORS BEFORE COMMENCING EARTHWORKS

STEP 1: OBTAIN AIRPORT STAKEHOLDER SERVICE LAYOUT PLAN

A1 The Earthworks Contractor is responsible for initiating the earthwork permit in the OneCalendar system using Form A – Request for Information on Underground Services for Trial Hole / Excavation / Piling Works to contact all stakeholders, as identified in the e-permit system. This is to obtain the relevant underground installation layout plans within the vicinity of the proposed earthworks.

A2 In preparation for the application of Form A, the Earthworks Contractor shall:

a) Prepare layout plan showing the locations of proposed earthwork; and
b) Scope of the earthwork.

A3 IMPORTANT: It is important to note that the stakeholder's service layout plan provides only approximate locations of their underground installations and is not definitive. The exact positions and depths of these installations MUST be determined through the manual excavation of trial holes by the Earthworks Contractor, in accordance with Steps 6 and 7 below.

A4 The stakeholder's service layout plan shall only be valid for a period of six months. In this regard –

(a) If the Earthworks Contractor will only commence the proposed earthworks more than six months from the date that it obtained the stakeholders' service layout plan, the Earthworks Contractor shall obtain a fresh set of the stakeholders' service layout plan. This is important as updates and revisions may have been made to the stakeholders' service layout plan since the time it was issued to the Earthworks Contractor.

(b) The Earthworks Contractor shall ensure that its copy of the stakeholders' service layout plan is obtained no more than six months prior to the date of commencement of the earthworks.

(c) The Earthworks Contractor shall ensure that it refers to and always uses the most updated version of the stakeholders' service layout plan in its possession.

(d) The stakeholders shall issue its service layout plan to the Earthworks Contractor in physical or digital format.

STEP 2: CARRY OUT UNDERGROUND INSTALLATION DETECTION WORK

A5 The Earthworks Contractor shall ensure:

(a) Licensed Cable Detection Worker ("LCDW") to carry out underground services detection work within 6 months upon receiving the stakeholders' services layout plan and prepare a cable detection report to indicate the (a) detection method used; (b) locations and services routing of all underground cables identified throughout the entire vicinity of the proposed earthworks.

(b) LCDW to determine the positions and number of proposed trial holes that are required to ascertain the location of the underground cables throughout the entire vicinity of the proposed earthworks;

(c) physically mark out the locations and routes of all the stakeholders' underground installation throughout the entire vicinity of the proposed earthworks with using suitable methods such as surface markers, pegs, barricades, spray paint and signposts, or any method approved by CAG, to alert all contractors and personnel at the work site to the presence of the cables. (Samples of such markers are shown in Figure 1 below);

(d) the markings of the detected underground installation are durable, prominent, visible, and shall not be removed or tampered with at any time by any person, plant, equipment, material, or object; and

(e) the site staff are fully briefed on the markings so that they are clear about the locations and routes of the underground installation.

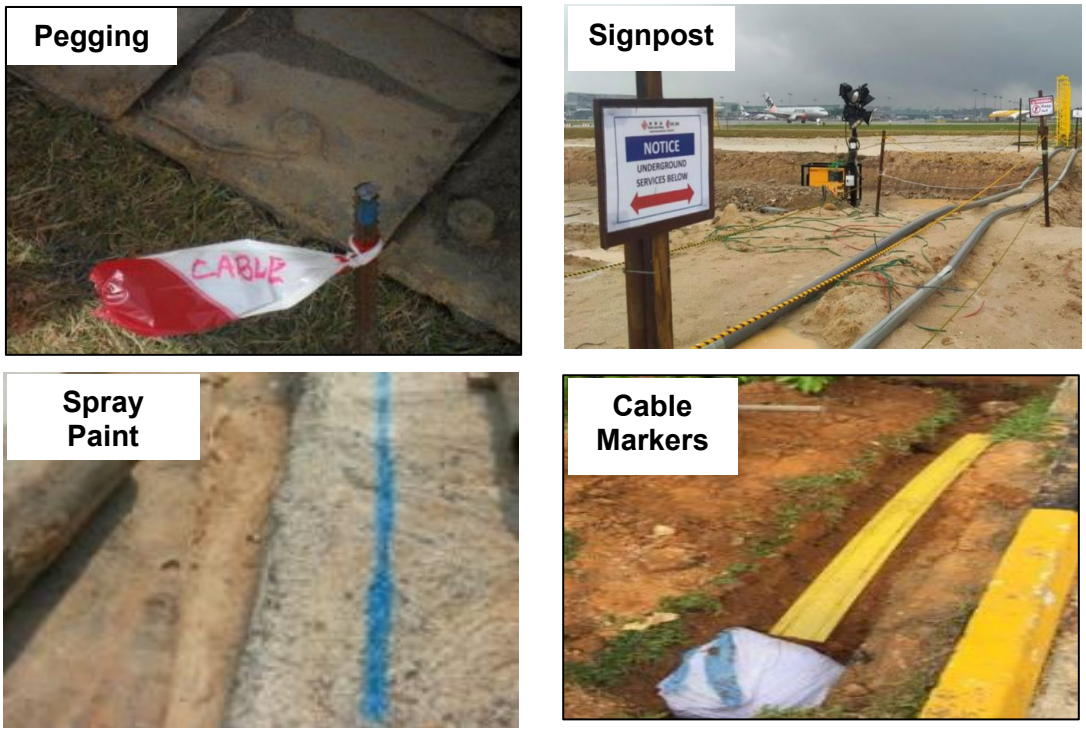

Figure 1: Samples of underground service markings

A6 **IMPORTANT: The cable detection report from the LCDW provides only approximate detected locations of the stakeholders' underground installations and is not definitive. The LCDW may not be capable of detecting all cables, such as optical fiber cables without copper components or metallic tracer wire inserts, and cables running on Direct Current. Consequently, it is imperative that the precise positions and depths of the stakeholders' underground installations be determined through the manual excavation of trial holes.**

A7 Due to the uniqueness of some systems that exist only in the airport environment, the recommended detection mode as shown below is provided for reference. CAG shall not be responsible if the Earthworks Contractor misjudged the detection mode. The Earthworks Contractor shall exercise their professional knowledge and judgement to ensure that the right services detection method is employed. The Earthworks Contractor shall be clearly marked out in the service detection report and included in the legend the location of the services detected / not detected within the worksite.

Type of underground services	Recommended Detection Mode
CAFHI e-stop Cable (110V DC signal)	Power Mode with direct cramping detection. Active and Passive detection. Work party to exercise caution as cable runs on DC signal and may not be clearly identified. When in doubt, CAFHI shall be consulted, and a site meeting should be arranged to locate such cables.
Fuel Hydrant / Fire Hydrant / Drainage Sub-soil, Potable and NEWater Pipes	Radio Mode (Metal detection)
Airfield Lighting (AFL) Cable	Power Mode or Power and Radio Mode. Active and Passive detection (*required to Master ON – energize the AFL circuit)
Structured Cabling / IT services, E&D & ATE Fibre Optics	Ground Probing Radar (GPR) *Note: Only able to detect up to depth of 2 - 3m. Work party to exercise caution as fibre optic cables may not be clearly indicated during the scan.
High Tension (HT) Cable	Power Mode. Passive and/or active detection (when necessary, such as cable on soak cannot be passively detected and cable known to be passing through the area cannot be detected in passive mode) Injection of signal to the cable at CAG substation.
Low Tension (LT) Cable	Power Mode. Active and Passive detection

A8 When performing electrical cable detection, the Earthworks Contractor shall request “Master on” circuits within the vicinity of the area where earthworks is to be conducted. Where “Master On” is not possible, the LCDW will have to perform cable detection once in the day and once after sunset. This is to ensure that services which are not turned on during the daytime can be detected.

“Master On” all related AFL circuits including those blocked circuits leading into the closure areas, taxiway edge light circuits and taxiway stop bar light circuits when carrying out underground services detection, verification, and confirmation of the AFL primary cables.

STEP 3: OBTAIN CONDITIONAL APPROVAL FOR DIGGING OF TRIAL HOLES

A9 After the necessary services detection are carried out, the Earthwork Contractor shall be issued with Form B – Permit to Carry Out Trial Hole Works in the OneCalendar system.

A10 The "Form B - Permit to Carry Out Trial Hole Works" serves the purpose of authorising the Earthworks Contractor to proceed with the manual excavation of trial holes for the precise determination of underground service locations.

The Earthworks Contractor shall arrange for a Joint Site Meeting with CAG project sponsor and the LCDW to verify the signages to denote live cables on-site are present and to propose the location and numbers of the trial holes to be carried out.

A11 **The "Form B - Permit to Carry Out Trial Holes" is valid for six month from its issuance date.** It is incumbent upon the Earthworks Contractor to execute and conclude the digging of trial holes within this one-month validity period. Failure to do so will necessitate the submission of a new "Permit to Carry Out Trial Holes." Throughout the process, the Earthworks Contractor must ensure the timely completion of trial hole excavation within the stipulated validity period.

A12 The proposed trial holes –

(a) shall be positioned on and along the routes proposed for works to be conducted by the work party in order to positively confirm that the cables are in fact running along the said routes;

(b) shall, where the service layout plan and the LCDW’s cable detection report indicate the route of the services, be spaced at intervals of no more than 10m apart for such segments of the services;

(c) shall be spaced at appropriate intervals of no more than 10m apart along the route of the underground services throughout the entire vicinity of the proposed earthworks. Any suspected crossing of existing service with the proposed new services routing must be identified by further trial holes.

STEP 4: DIG TRIAL HOLES TO ASCERTAIN EXACT LOCATION OF UNDERGROUND INSTALLATION

A13 The Earthworks Contractor shall dig the trial holes manually until it positively locates (i.e. visually confirms) and physically exposes all underground installation throughout the entire vicinity of the proposed earthworks. The Earthworks Contractor shall not assume that:

a) underground services are only located at any particular maximum depth (e.g. 1.5m) as the underground services may be located at different depths;

b) underground services run at a uniform depth across the entire area of the earthworks, as the depth of these services may vary. For instance, they may be situated at significant depths where they cross beneath a drainage or canal, while remaining shallower in other sections;

c) underground services follow a direct, linear path from one manhole to another, as the route of these services may take detours or deviate. For example, the underground services might be routed around an existing underground feature, resulting in a non-linear pathway; and

d) all underground services are contained within a single pipe or duct, as it is possible for underground services to be distributed across different sets of pipes or ducts within the same area. Consequently, it is essential to comprehensively account for and validate all underground services within the earthworks' vicinity.

A14 IMPORTANT: The Earthworks Contractor <u>shall only use manual digging</u> and exercise due care when digging the trial holes to avoid damaging the underground services. The Earthworks Contractor MUST NOT use any mechanical equipment (e.g. excavator) except for the removal of top asphalt or concrete layer. Only Registered Excavator (REO) or Probational Registered Excavator Operators (PREO) will be allowed to operate the excavators.

A15 The Earthworks Contractor should not assume the absence of underground installation if they are not discovered during the excavation of trial holes. Several factors might account for this, such as the services being situated at a greater depth than the trial holes or following a non-linear path. Consequently, the Earthworks Contractor must continue to manually dig additional and/or deeper trial holes without the use of machinery or equipment with sharp pointed edges to actively pinpoint and physically expose the underground services.

A16 **IMPORTANT: If, even after digging trial holes, the Earthworks Contractor is unable to positively identify and expose all underground installation, it is imperative that they seek the assistance of the CAG Project Sponsor to ascertain the precise location of underground installation throughout the entire area designated for the proposed earthworks. UNDER NO CIRCUMSTANCES should the Earthworks Contractor proceed with the proposed earthworks without consulting CAG.**

A17 The Earthworks Contractor shall stop all work and inform CAG officer should they come across any suspected abandoned / unknown underground installation. In the absence of any information, underground installation discovered shall be deemed to be live and shall not be removed without prior approval of the service owner.

A18 The Earthworks Contractor is required to maintain photographic documentation of all trial holes they have excavated, and the underground installation exposed within these holes. These photographic records must also be submitted to CAG upon request.

A19 For trial holes, the Earthworks Contractor shall to the best of his ability, obtain information on the depth of the underground services so as not to damage them during the course of work. When digging a trial hole, there must be 100% standing supervision for each excavation, with the presence of LCDW and Registered Earthwork Supervisor (RES) accredited under the Registered Earthwork Supervisor Scheme administered by EMA and SPPG.

A20 There may be instances where different entities may engage the same term contractors to help service their systems, (e.g. Contractor A serving System 1 and System 2) as such, it is the duty of the work party to ensure that the correct stakeholders are consulted during the request for information stage to confirm the presence of underground services.

STEP 5: CONDUCT JOINT TRIAL HOLES INSPECTION (TO BE ATTENDED BY EARTHWORKS CONTRACTOR, LCDW, PARTY WHO IS SUPERVISING OR INSTRUCTING THE EARTHWORKS CONTRACTOR AND CAG)

A21 The Earthworks Contractor shall arrange a joint inspection at the work site, known as the "**Joint Trial Holes Inspection**," which includes the CAG project sponsor, the Earthworks Contractor, the LCDW after the completion of trial holes.

A22 The purpose of the Joint Trial Holes Inspection is for all parties to –

a) to collectively confirm that the Earthworks Contractor has accurately identified the precise locations of all underground installation within the entire area designated for the proposed earthworks;
b) verify the exact positions and quantity of proposed trial holes and actual trial holes conducted;
c) determine if it is a necessity for diversion work concerning either a portion or the entirety of the underground installation;

d) verify the physical markings had marked out the locations and routes of the underground installation; and

e) verify if there is any discrepancy between the stakeholder's service layout plan and underground installation detected on site.

In cases where inaccuracies exist in the physical markings applied, the Earthworks Contractor shall update these markings on-site. Additionally, the Earthworks Contractor shall ensure the complete removal of any inaccurate markings and provide comprehensive briefings to all contractors and personnel at the work site regarding the revised markings.

Should there is discrepancy between the stakeholder's service layout plan and underground installation detected on site, the Earthworks Contractor shall highlight such discrepancy to the services owners concerned.

A23 It is the responsibility of the earthworks contractor to ensure that all relevant stakeholders are consulted, and information gathered are as comprehensive as possible.

A24 Where necessary, additional trial holes shall be conducted along the route of cables to confirm the absence of services. CAG may request the Earthworks Contractor to excavate additional trial holes if further confirmation of the exact locations and/or routes of the underground services is deemed necessary.

a) After the location of all the underground installation within the vicinity of the proposed earthworks location have been ascertained pursuant to the Joint Trial Holes Inspection, the Earthworks Contractor shall: ensure that all relevant drawings and plans utilised by personnel at the work site are updated to accurately reflect the locations and routes of all the underground installation throughout the entire vicinity of the proposed earthworks, and

b) provide a copy of the updated underground installation layout plan to personnel (e.g., registered earthworks supervisor, earthworks machine operator, etc.) that are involved in the proposed earthworks.

STEP 6: SUBMIT APPLICATION FOR FINAL APPROVAL FOR COMMENCEMENT OF EARTHWORKS

A25 After CAG Project Sponsor is satisfied with the Earthworks Contractor underground installation detection and completion of the Joint Trial Holes Inspection, the Earthworks Contractor shall submit the "**Application for Permit to Carry Out Earthwork**" to CAG through OneCalendar system, Form C – Application for Permit to Carry Out Earthworks for earthwork process.

A26 The purpose of the "Application for Permit to Carry Out Earthworks" is for the Earthworks Contractor to –

(a) declare and confirm that the Earthworks Contractor has read, understood and will

comply with CAG's Earthworks Requirements;

(b) declare and confirm that the Earthworks Contractor has duly completed the required steps to apply for the permit; and

(c) provide full details of the protection measures and methods of support that the Earthworks Contractor will implement to prevent damage to any underground services throughout the entire course of the proposed earthworks.

A27 IMPORTANT: The "Form C - Application for Permit to Carry Out Earthworks" is to be submitted by the Earthworks Contractor responsible for executing the earthworks. This requirement ensures that the party directly engaged in the earthworks is fully informed about CAG's Earthworks Requirements and holds direct responsibility for furnishing the necessary declarations, confirmations, and information as mandated by "Form C - Application for Permit to Carry Out Earthworks."

STEP 7: OBTAIN FINAL APPROVAL FOR COMMENCEMENT OF EARTHWORKS

A28 The Earthworks Contractor shall submit the request to commence earthworks, Form C – Application for Permit to Carry Out Earthworks to the CAG via the online e-permit platform, OneCalendar System (https://onecalendar.changiairport.com/) **not less than seven days** prior to the commencement of the proposed earthworks.

A29 The Earthworks Contractor shall complete all the required steps under Section A and obtain the Final Approval for Commencement of Earthworks, Form C – Application for Permit to Carry Out Earthworks from CAG before proceeding with the proposed earthworks.

A30 Upon the Earthworks Contractor's submission of the duly completed "Form C - Application for Permit to Carry Out Earthworks" and CAG's satisfaction with the adequacy of the protective measures and support methods outlined in the application, CAG will issue the "Permit to Carry Out Earthworks" to the Earthworks Contractor via OneCalendar. The Earthworks Contractor is responsible for requesting an extension of the Permit to Carry Out Earthworks when it expires.

A31 **Each Earthwork Permit shall only be valid for a period of 12 months**. Where the earthworks are to be carried out and completed more than 12 months after the date that Form C – Application for Permit to Carry Out Earthworks was approved (the "**expiry date**"), the Earthworks Contractor shall comply with the following procedure –

a) The Earthworks Contractor shall obtain a fresh set of the service layout plan from the respective stakeholders to confirm whether there have been any revisions or updates to the plan since the previous set obtained by the Earthworks Contractor (which shall be within the validity period not more than 6 months).

b) If there have been changes such as updates or revisions to the stakeholder's service layout plan, the Earthworks Contractor shall be required to repeat Form B – Application for Permit to Carry Out Trial Hole Works and Form C – Application for Permit to Carry Out Earthworks applications.

c) If there have been no changes to the stakeholder's service layout plan, the Earthworks Contractor may apply to CAG to extend the earthwork permit for a further period of 12 months, which shall be accompanied by the updated works schedule for the proposed earthworks.

A32 If the extension request is granted, the Earthworks Contractor must conduct and finish the earthworks within the extended 12-month validity period. Failure to do so will necessitate the Earthworks Contractor to initiate the entire earthwork permit application process anew, starting from Form A – Request for Information on Underground Services for Trial Hole / Excavation / Piling Works in order to proceed with the earthworks.

A33 IMPORTANT: The "Earthwork Permit (Form C – Application for Permit to Carry Out Earthworks)" MUST be endorsed electronically and submitted by the Earthworks Contractor who will be carrying out the actual earthworks. Earthworks Contractors who are carrying out separate earthworks at the work site are required to submit individual permit applications on their respective earthworks. This is to ensure that the *actual party* carrying out the earthworks is fully aware of CAG's Earthworks Requirements and is directly responsible for providing the declarations, confirmations and information required in the application.

A34 IMPORTANT: The Earthworks Contractor MUST NOT proceed with the proposed earthworks until it receives the "Permit to Carry Out Earthworks" from CAG.

A35 In carrying out the earthworks, the Earthworks Contractor shall –

a) thoroughly implement the protective measures and support methods they have committed to, as detailed in their "Permit to Carry Out Earthworks";

b) make readily available or display the latest version of the underground installation layout plan, and relevant approved permits for trial hole / earthworks submitted by the Earthworks Contractor through OneCalendar system;

c) ensure that all personnel at the work site receive comprehensive briefings regarding the locations and paths of underground services, including those of any redirected cables, within the entire area designated for the proposed earthworks. Keep records of all these briefings, including the date, time, location, the person conducting the briefing, the content covered, and the names of attendees;

d) regularly assess the soil conditions at the work site, conducting checks at intervals of six weeks to identify any soil movement that could potentially harm the underground services or result in shifts or alterations in their locations or routes. Implement effective soil control measures, such as shoring and

shuttering, to mitigate soil movement that could lead to damage to the underground services;

e) not park or place heavy vehicles, equipment or machinery across, over or along the location and routes of the underground services;

f) provide full time standing supervision of excavation works by a competent supervisor;

g) establish a underground installation corridor by using barricades and appropriate signage as needed. Ensure that earthworks within the barricaded corridor are supervised and controlled by the Registered Earthwork Supervisor (RES);

h) only Registered Excavator Operators (REO), Probational Registered Excavator Operators (PREO) and certified piling operator will be allowed to operate excavator / piling machines within the underground installation corridor; and

i) allow CAG with access to the work site, allowing relevant personnel to assess the sufficiency of the protective measures and support methods put in place by the Earthworks Contractor and to take any required actions to safeguard the underground services from potential damage.

j) Provide update once every 6 months to CAG appointed supervision (e.g., RTO) or CAG Project Sponsor to confirm the information in the working drawings (e.g. combined services drawings) is accurate and incompliance with the services drawing annotations requirements.

Should there be overlaid cables, the cables shall be protected, firmly secured to the ground and make visible by securing them at about 300 mm above ground or placed under marker boards (i.e. at taxiways, apron access areas, etc.). Measures shall be taken to:

a) transferred to permanent installation whenever possible.
b) remove unused cables from the airfield immediately.
c) remove unwanted or unused cables promptly.

A36 Any markings and/or signages used to denote presence of underground services shall only be removed upon the completion of earthworks and after obtaining the acknowledgement and approval of the site occupier project manager and CAG Project Sponsor. Should earthworks is required to be carried out after the removal of markings and/or signages, the Earthworks Contractor shall ensure the reinstatement of markings and/or signages before commencement of earthworks.

A37 It shall be the responsibility of the work party who applied for the permit to carry out earthworks to conduct regular checks on signages and/or markings during trial hole and at least once before commencement of earthworks to verify that signages and/or markings to denote live underground services are present and not displaced.

A38 In cases where suspected abandoned / unknown underground installations are discovered within the proposed earthworks area, the Earthworks Contractor shall stop all work and inform CAG officer. The Earthworks Contractor shall **NOT** without obtaining CAG's prior written approval cut or remove or divert the suspected abandoned / unknown underground installation.

A39 Unknown underground installations and/or confirmed abandoned/decommissioned underground services found during works within the approved work area shall be clearly tagged on site and marked out in contractor's working drawings with a red cross. Contractors shall ensure that such markings do not overlap with other live services. Information gathered of abandoned/decommissioned or unknown services discovered during cable detection, trial trenching and actual earthwork shall be submitted together with the as-built submission for consolidation by CAG Drawing Management Office (DMO).

A40 The Earthworks Contractor shall notify and obtain CAG's written approval before removing or dismantling of any protection measures or methods used to support the underground services and/or before backfilling the underground installation after the completion of the earthworks. Earthworks Contractors shall maintain photographic records of the entire dismantling and backfilling process.

SECTION B: MEASURES TO BE COMPLIED WITH BY EARTHWORKS CONTRACTORS IN THE EVENT THAT UNDERGROUND INSTALLATION DIVERSION IS REQUIRED

B1 In the event that the Earthworks Contractor determines at the Joint Trial Holes Inspection that it is necessary to divert any of the underground services which may be affected by the proposed earthworks ("**Affected Services**"), the following procedures and requirements shall apply –

(a) The Earthworks Contractor must ensure that adequate protection and support measures are in place for the Affected Services, and written approval from CAG is required before any diversion work can commence.

(b) After completion of the relevant diversion works, the Earthworks Contractor shall inform CAG project sponsor and arrange for a joint site inspection with relevant stakeholders of the Affected Services and submit the as-built drawing, testing & commissioning report as required by the system owner.

(c) The purpose of the joint site inspection is for the Earthworks Contractor and CAG project sponsor and relevant stakeholder to carry out the following –

(i) to verify that all of the Affected installation have been successfully diverted;

(ii) to confirm the exact locations and routes of the newly diverted underground installation;

(iii) to ensure that the service layout plan is updated to accurately reflect the diversion of the Affected Services.

B2 Prior to removal of diverted underground installations, the Earthworks Contractor shall verify the installations to confirmed they are no longer “live” and is the correct ones to be removed (e.g. check nearby manhole for existing services).

B3 If the diverted underground services are relocated to a different area within the Earthworks Contractor's proposed earthworks site, it is the responsibility of the Earthworks Contractor to ensure that the diverted underground installation is physically marked.

B4 In cases where the diverted underground installation is relocated to areas where other Earthworks Contractors are conducting earthworks, the CAG project sponsor will inform these other Earthworks Contractors about the locations and routes of the diverted underground installation in the vicinity of their earthworks and provide them with the updated service layout plan.

B5 For works where it involved the AFL primary cables in Changi Airport, “Master On” ALL the AFL circuits again after any works to ensure and confirm that there are no circuit faults (i.e., opened circuits, earth fault, etc) received by FMC via Honeywell ALCS system or operational airfield lighting circuits failure on site before night falls.

B6 For works where it involved the AFL primary cables in Seletar Airport, “Master On” ALL the AFL circuits again after any works to ensure and confirm that there are no circuit faults (i.e., opened circuits, earth fault, etc) received by IEPL via ALCMS system or operational airfield lighting circuits failure on site before night falls.

B7 The following checklists shall serve as a guide for the proper and complete execution of the underground M&E services diversion works to be carried out by the appointed contractor(s)

(a) Sewerage & Sanitary Service Diversion Works

Checklist for Underground Sewerage & Sanitary Service Diversion Works (Appendix 1)

(b) Water Supply Service Diversion Works

Checklist for Underground Water Service Diversion Works (Appendix 2)

(c) Gas Supply Service Diversion Works

Checklist for Underground Gas Supply Service Diversion Works (Appendix 3)

SECTION C: REQUIREMENTS IN THE EVENT OF DAMAGE TO UNDERGROUND INSTALLATION

C1 Stop the earthwork and immediately report to CAG Project Sponsor and Changi Fault Management Centre (FMC) at 6451 2424, CAAS Fault Reporting Centre (FRC) at 6454 6909/6910 and Changi Airside Management Centre (AMC) at 6541-2275 (Changi) or Seletar Airside Operations (SAO) at 6481-5077 (Seletar) of the damage or suspected damage caused at any point in time to the underground installation to enable CAG to take early action to address and minimise any possible disruption in airport operations and services resulting from such damage. The Earthworks Contractor shall not Ignore and/or conceal any damage, or endeavor to rectify any harm or suspected damage.

C2 The Earthworks Contractor shall appoint a licensed cable jointer for all earthworks in the airport to ensure any underground service damage incident is rectified in an expeditious manner as far as reasonably practicable.

C3 The Earthworks Contractor shall respond within 30 minutes and take actions as soon as reasonably practicable in the event of any damage or suspected damaged caused to any underground services to recover the affected services by:

a) informing the owner of the underground installation, supplier of the affected underground service and any person responsible for the maintenance of the underground installation, if service is known, so as to enable them to manage and rectify the damage and any disruption to the affected underground service;

b) engage the help of incumbent airfield maintenance contractors to trace and identify the service if damaged service is unknown; and

c) carrying out rectification works for its underground installation upon consultation and obtaining approval from the system owner of the damaged service.

C4 The Earthworks Contractor shall investigate any incident of underground installation damage or disruption and submit an investigation report to CAG no later than 14 calendar days from the date of occurrence. The Earthworks Contractor shall provide full cooperation to CAG for any subsequent clarification or follow-up actions that need to be taken after the submission of the investigation report.

C5 The earthworks permit will be suspended and will only be allowed to resume after the investigation report and mitigating measures are accepted by CAG.

SECTION D: DO'S AND DON'TS

Do's

D1	**Do**	make readily available or display the following in a prominent place at the work site for all contractors and personnel at the work site to refer to – • the latest version of the service layout plan issued to the Earthworks Contractor; • the latest version of the LCDW's cable detection report showing the locations and routes of the underground services; and • relevant approved permits for trial hole / earthworks submitted by the Earthworks Contractor through OneCalendar system.
D2	**Do**	assign a qualified and competent, full-time site supervisor to closely oversee and manage the execution of the earthworks during the entire period of the project. Ensure that the site supervisor is well-versed in all the provisions outlined in this document. Additionally, maintain open communication with CAG to report any alterations in key personnel, including changes to the site supervisor, LCDW, and other relevant roles.
D3	**Do**	ensure that proper and sufficient protective measures and support methods are put in place to safeguard all underground services, which may include measures and methods stipulated by CAG. Regularly inspect and maintain these measures and methods to ensure their continued reliability and effectiveness during the entire course of the earthworks.
D4	**Do**	establish a designated cable corridor using barricades and appropriate signage as needed. Ensure that activities and the movement of personnel within the barricaded cable corridor are supervised and controlled by the site supervisor.
D5	**Do**	provide protective plates over trenches containing underground services to prevent heavy vehicles or machinery from exerting pressure on the cables as they pass over them.
D6	**Do**	ensure that all contractors and personnel at the work site receive comprehensive briefings regarding the locations and paths of underground services, including those of any redirected cables, within the entire area designated for the proposed earthworks. This ensures their awareness of these details. Keep records of all these briefings, including the date, time, location, the person conducting the briefing, the content covered, and the names of attendees. These records should be accessible for review by CAG when requested.

D7	**Do**	allow CAG with access to the work site, allowing relevant personnel to assess the sufficiency of the protective measures and support methods put in place by the Earthworks Contractor and to take any required actions to safeguard the underground services from potential damage.
D8	**Do**	notify and obtain the CAG's prior written approval before any removing or dismantling of any protection measures and methods of support for the underground services and/or before backfilling the underground services after the completion of the earthworks. Earthworks Contractors shall maintain photographic records of the entire dismantling and backfilling process.
D10	**Do**	immediately stop all works and report to CAG any damage or suspected damage caused at any point in time to – a) any underground services; and/or b) the ducts, pipes, manhole or other infrastructure housing or encasing the underground services, so as to enable CAG to take early action to address and minimize any possible disruption in airport operations and services resulting from such damage.
D11	**Do**	take immediate action in the event of any damage or suspected damaged caused to any underground services, including but not limited to: a) informing CAAS FRC (6545 6909 / 6910) and CAG FMC (6541 2424) of the damage; b) Informing CAG AMC (6541 2273 / 2275) if damage or suspected damage to underground services happens in Changi airside or CAG Seletar Airside Operations (6481 5077) if the damage happens in Seletar Airport; c) informing the owner of the underground installation, supplier of the affected underground service and any person responsible for the maintenance of the underground installation, if service is known, so as to enable them to manage and rectify the damage and any disruption to the affected underground service; d) engage the help of incumbent airfield maintenance contractors to trace and identify the service if damaged service is unknown; and e) carrying out rectification works for its underground installation upon consultation and obtaining approval from the system owner of the damaged service.
D12	**Do**	investigate any incident of underground service damage or disruption and submit the investigation report to CAG no later than 14 calendar days from the date of occurrence.
D13	**Do**	regularly assess the soil conditions at the work site, conducting checks at intervals of six weeks to identify any soil movement that could potentially harm the underground services or result in shifts or alterations in their locations or routes. Implement effective soil control measures, such as shoring and shuttering, to mitigate soil movement

		that could lead to damage to the underground services.
D14	**Do**	where requested to do so by CAG or any relevant authority, furnish all documents and information required to be prepared, submitted or maintained by the Earthworks Contractor as referred to in this document.
D15	**Do**	in case the Earthworks Contractor encounters challenges while attempting to adhere to any of the stipulations within this document, be it due to site conditions or any other reasons, it is imperative to consult CAG and request their assistance. There should be no instance where the Earthworks Contractor disregards or attempts to circumvent any of the requirements or takes independent actions.
D16	**Do**	"Master On" all related AFL circuits including those blocked circuits leading into the closure areas, taxiway edge light circuits and taxiway stop bar light circuits when carrying out underground services detection, verification and confirmation of the AFL primary cables.
D17	**Do**	In Changi Airport, "Master On" ALL the AFL circuits again after any works involved with the AFL primary cables which might be affected during the work to ensure and confirm that there are no circuit faults (i.e., opened circuits, earth fault, etc) received by FMC via Honeywell ALCS system or operational airfield lighting circuits failure on site before night falls. In Seletar Airport, "Master On" ALL the AFL circuits again after any works involved with the AFL primary cables which might be affected during the work to ensure and confirm that there are no circuit faults (i.e., opened circuits, earth fault, etc) received by IEPL on the ALCMS system or operational airfield lighting circuits failure on site before night falls.
D18	**Do**	Submit as-built drawings in accordance to requirements as stipulated in CAG's As-Built Drawing Submission Requirements issued by Engineering & Development cluster.
Don'ts		
D18	**Do not**	take any short cuts or omit any of the steps and actions required to be taken before commencing with the earthworks. In the event of cable diversion, do not take any action that may damage the Affected Services.
D19	**Do not**	assume that the underground services are only located at any particular maximum depth (e.g. 1.5m) as the underground services may be located at different depths.
D20	**Do not**	assume that the underground services run at a uniform depth across

the entire area of the earthworks, as the depth of these services may vary. For instance, they may be situated at significant depths where they cross beneath a drainage or canal, while remaining shallower in other sections.

D21 **Do not** assume that underground services follow a direct, linear path from one manhole to another, as the route of these services may take detours or deviate. For example, the underground services might be routed around an existing underground feature, resulting in a non-linear pathway.

D22 **Do not** assume that all underground services are contained within a single pipe or duct, as it is possible for underground services to be distributed across different sets of pipes or ducts within the same area. Consequently, it is essential to comprehensively account for and validate all underground services within the earthworks' vicinity.

D23 **Do not** park or place heavy vehicles, equipment or machinery across, over or along the location and routes of the underground services.

D24 **Do not** dig trial holes using machinery or manual equipment with sharp pointed edges.

D25 **Do not** open, remove or cover up any of the manholes, equipment boxes or pedestal boxes with earth or any construction/building materials, equipment or machinery without obtaining CAG's prior written approval.

D26 **Do not** Ignore and/or conceal any damage, or endeavor to rectify any harm or suspected damage to:

- The underground services; and/or
- The ducts, pipes, manholes, or other structures containing or encompassing the underground services.

The Earthworks Contractor should promptly report any such damage or suspected damage to CAG.

D27 **Do not** tamper with, remove, modify, dismantle or in any way interfere with the CAG's installation and plant, including –

- any underground services;
- the ducts/pipes housing the underground services;
- any concrete encasing the underground services or the ducts/pipes housing the underground services; and
- any warning slab installed at the underground services or the ducts/pipes housing such underground services.

without obtaining CAG's prior written approval.

D28 **Do not** cut any unknown cables without LCDW confirmation that they are "dead" or "abandon" cables.

Appendix 1

CHECKLIST FOR UNDERGROUND SEWERAGE & SANITARY SERVICE DIVERSION WORKS IN CHANGI/SELETAR AIRPORT

No	Check Item	**Check box when completed** (Or indicate as "Nil" if not applicable or required)
1.	Engage qualified registered & competent contractor of the relevant trade & work head.	☐
2.	Engage Registered Plumber (LP) registered under Singapore Plumbing Society (SPS), who holds a valid water service plumber licence.	☐
3.	Consult CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WRN)/NEA to obtain approval or written clearance on proposed works in vicinity of existing sewerage system (within influence zone or 25m corridor for sewers & 36m for DTSS)	☐
4.	Have a copy and follow latest Guideline & comply with PUB's Advisory Notes on: - "General Requirements for the Protection of Sewers" - "Prevention of Damage to the Sewerage System"	☐
5.	Engage PUB registered CCTV contractor to carry out and submit pre & post construction CCTV inspections & reports (with CCTV video (DVD)) for any existing/new sewer within or adjacent to development lot to PUB(WRN)	☐
6.	Engage Registered Surveyor to verify/set out/peg & prepare endorsed setting out plan for sewer alignment, pile positions, TERS alignment etc on site.	☐
7.	Ensure no utilities services (cable, gas pipe, water pipe etc) shall over-cross/undercross within 1m from outer edge of sewers unless written clearance from CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WRN) is obtained before any works at site.	☐
8.	If reuse of existing sanitary/sewerage system is required – a thorough investigation by qualified person to ensure adequate capacity & good condition and an endorsed inspection report is to be submitted to CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WRN)	☐
9.	Coordinate with CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WRN) for sewerage diversion services to be carried out by PUB(WRN)	☐
10.	To notify or report to FMC, CAG E&D Utilities Team, CAG Project Officer and/or PUB-24 Hour Call Centre hotline at **1800-2846600** immediately should any sewerage service be damaged, exposed or any sealing work is required. If damage happens in Seletar, to notify or report to SAO (6481 5077) and/or PUB-24 Hour Call Centre hotline.	☐

Applicant

Name of PD/Mgr: _____

Signature/Date: _____

Approval by CAG

Name of Project Officer: _____

Signature/Date: _____

Supported by Consultant:

Name of QP: _____

Signature/Date: _____

Appendix 2

CHECKLIST FOR UNDERGROUND WATER SERVICE DIVERSION WORKS IN CHANGI/SELETAR AIRPORT

No	Check Item	**Check box when completed** (Or indicate as "Nil" if not applicable or required)
1.	Engage qualified registered & competent contractor of the relevant trade & work head.	☐
2.	Engage Registered Plumber (LP) registered under Singapore Plumbing Society (SPS), who holds a valid water service plumber licence.	☐
3.	Consult CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WSN) on proposed works & detected existing water mains for advice on whether diversion is required.	☐
4.	Coordinate with PUB(WSN) for water mains diversion services to be carried out by PUB(WSN).	☐
5.	Coordinate with CAG E&D Utilities Team (Changi) or E&M team (Seletar) and/or PUB(WSN) to obtain clearance/advice prior to commencement of diversion or connection works to existing water mains.	☐
6.	Engage Registered Surveyor to verify/set out/peg & prepare endorsed setting out plan for water mains alignment, pile positions, Earth Retaining and Stabilizing Structure (ERSS) alignment etc on site.	☐
7.	Ensure no utilities services (cable, gas pipe, sewerage pipe etc) shall over-cross/be erected over any or a drain undercross a water main within a clearance of 0.5m(dia<300mm) & 1m(dia>500mm).	☐
9.	Ensure no manhole is allowed on top of any water main and there is a horizontal clearance of 1m between the manhole and water main.	☐
10.	To notify or report to FMC, CAG E&D Utilities Team, CAG Project Officer and/or PUB's 24- hour Call Centre at Tel No. **1800-2846600(24 Hrs)** immediately in the event of damage to any existing water main or water quality & supply pressure issues or possible contamination of the water supply downstream. If damage happens in Seletar, to notify or report to SAO (6481 5077) and/or PUB-24 Hour Call Centre hotline.	☐
11.	To notify FMC and Terminal Mechanical Team (Changi) or Engineering & Maintenance Team (Seletar) before shutting and reopening valve.	☐
12.	To request for CCTV inspection.	☐
13.	To request for water quality test.	☐
14.	To coordinate with respective Terminal Mechanical Team (Changi) or Engineering & Maintenance Team (Seletar) to check the condition of water before discharging into tank.	☐

Applicant

Name of PD/Mgr: _____

Signature/Date: _____

Approval by CAG

Name of Project Officer: _____

Signature/Date: _____

Supported by Consultant:

Name of QP: _____

Signature/Date: _____

Appendix 3

CHECKLIST FOR UNDERGROUND GAS SUPPLY SERVICE DIVERSION WORKS IN CHANGI/SELETAR AIRPORT

No	Check Item	**Check box when completed** (Or indicate as "Nil" if not applicable or required)
1.	Engage qualified registered & competent contractor of the relevant trade & work head.	☐
2.	Engage EMA Licensed Gas Service Worker (LGSW) who holds a valid gas service worker licence.	☐
3.	Consult CAG Project Officer and/or PowerGas or CityGas on proposed works & detected existing gas mains for advice on whether diversion is required.	☐
4.	Coordinate with PowerGas or CityGas through email at gasenquiry@singaporepower.com.sg for gas diversion services to be carried out by PowerGas or CityGas.	☐
5.	Engage Registered Surveyor to verify/set out/peg & prepare endorsed setting out plan for gas mains alignment, pile positions, TERS alignment etc on site.	☐
6.	Contractor(s) to attend safety briefings by PowerGas or CityGas on precautions & mitigation measures to prevent damage to existing gas lines during excavation & earthworks.	☐
7.	All excavation works in the vicinity of identified gas transmission lines to notify and be supervised by PowerGas or CityGas.	☐
8.	To notify or report to CAG Project Officer and/or PowerGas or CityGas Customer Service Centre at Tel No. **1800-7521800** promptly if any existing gas pipe is damaged or gas leak pipe is detected.	☐

Applicant

Name of PD/Mgr: _____

Signature/Date: _____

Approval by CAG

Name of Project officer: _____

Signature/Date: _____

Supported by Consultant:

Name of QP: _____

Signature/Date: _____