

SEKSYEN I : BAHAGIAN D

Terms of Reference – TOR Lead Consultant

1.0 DEFINITIONS

In this term of Reference unless the context otherwise requires, the following expression shall have the meanings hereby assigned to them:

“Lead Consultant” or “LC” means “CA” as described in **Form CSA2014-Engineering (Amendment 2026)**;

“**Sub-Consultants**”, “**Project**” and “**Works**” are as described in **Form CSA2014-Engineering (Amendment 2026)**;

“**MBSJ**” means Majlis Bandaraya Subang Jaya;

“**Client**” means
Majlis Bandaraya Subang Jaya

“**Government**” means the Sebuah Pertubuhan Perbandanan yang ditubuhkan dibawah Akta Kerajaan Tempatan 1976 (Akta 171) (Selepas ini dirujuk sebagai “Majlis”).

2.0 INTRODUCTION

2.1 It has been decided by the Government to appoint a Lead Consultant to undertake the overall planning, designing, tendering, coordination, supervision and management of The Project. In order for the physical implementation to be on schedule, the completed set of drawings, specifications together with all other drawings (duly signed by the respective registered professional) and the Government must be ready for tender by the date specified by the Government

2.2 The role of MBSJ in this Project shall be:

- (i) as the executing agency overseeing the physical implementation of the Project; and
- (ii) as the monitoring agency overseeing throughout the overall Project progress including the pre-contract and post-contract stages.

2.3 The LC shall provide all reasonable cooperation and access to MBSJ officers throughout the Project implementation stages.

2.4 While every cooperation is given to the LC, it is the responsibility of the LC to collect all the information that is needed in the execution of this Project. The LC shall undertake to inspect the site and its surroundings to ascertain for itself the specific requirements of the Project.

- 2.5 It will be necessary for the LC to meet and consult with the client department and MBSJ in order to obtain detailed requirements necessary for the preparation of the design and plans.

3.0 **OBJECTIVES**

The main objective of employing LC services is to assist the Government to implement the project within reasonable cost, within the time scheduled and compliance with the latest of government procedure, practice and regulations.

4.0 **PROJECT INFORMATION AND SCOPE OF WORKS**

- (a) General information of the project is as below;

Project Name	CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN
Project Cost	RM 29,850,000.00 juta
Project Duration	Construction: 24 months Defect Liability Period: 24 months + 3 months + 14 days Overall Duration : 51 months + 14 days
Client Department	Jabatan Kejuruteraan, Majlis Bandaraya Subang Jaya

The descriptions of the project, the scope of work and tentative overall project implementation schedule are as per **Appendix 1.1** and **Appendix 1.2**.

- (b) The scope of work for the LC shall include all professional services in accordance with the procedure and requirements of Government project throughout the pre-contract to the post contract stages.

5.0 **TERMS OF APPOINTMENT**

The appointment shall be based on conditions of engagement and terms as stipulated in **Form CSA2014-Engineering (Amendment 2026)** and in all other documents contained or mentioned or referred to in the Consultancy Services Agreement between the Government and the LC.

6.0 **DURATION OF SERVICES**

The LC shall commence the services from **the Service Commencement Date** as stated in the Letter of Acceptance and shall complete the services until the submission of accepted 'As Completed Detailed Abstract' (ACDA)

7.0 CONSULTANCY SERVICES

7.1 SCOPE OF SERVICES

- a) The LC shall be responsible for the overall planning, designing, tendering, coordination, supervision and management of The Project according to MBSJ and shall be directly responsible to Pengarah Kejuruteraan of Majlis Bandaraya Subang Jaya or his appointed representative for all aspects which fall within the scope of the project.
- b) The scope of LC services shall include but shall not be limited to the following:
 - (i) Appointing all Sub-Consultants.
 - (ii) Coordinating, monitoring and reviewing the works of the consultant team.
 - (ii) Arranging consultant team meeting and planning work stages.
 - (iii) Preparing overall program and progress report.
 - (iv) Obtaining decision and approval from the Government.
 - (v) Coordinating the evaluation of quotation/tenders* (if applicable).
- c) The LC shall provide the SERVICES as listed below:
 - ~~(i) Architectural – the scope of services is specified in **Appendix 2.1.**~~
 - (ii) Civil and Structural – the scope of services is specified in **Appendix 2.2.**
 - (iii) Mechanical – the scope of services is specified in **Appendix 2.3.**
 - (iv) Electrical – the scope of services is specified in **Appendix 2.4.**
 - (v) Quantity Surveying – the scope of services is specified in **Appendix 2.5.**
 - (vi) Land Survey - the scope of services is specified in **Appendix 2.6.**
 - ~~(vii) Town Planning Services – the scope of services is specified in **Appendix 2.7.**~~
 - ~~(viii) Landscape Architecture Services – the scope of services is specified in **Appendix 2.8.**~~
- d) The LC may also carry out the services as mentioned in paragraph 7.0(c) if the LC are registered in more than one field code (*Kod Bidang*) In this circumstance, the LC is required to submit the technical proposal for each field code separately for the purpose of tender evaluation.

- e) To interpret THE PROJECT briefs and prepare agreed preliminary design of the Project and services based on requirements.
- f) To manage, administer and supervise the physical, financial and contractual aspects of The Project, including recommendation for payments, finalising accounts etc. all MUST be in accordance with the latest Government procedures, practices and regulations.
- g) To obtain various approvals or permits for occupation from various Authorities, to supervise Testing and Commissioning works, defect inspection prior to the acceptance of the buildings by the Government.
- h) Diversion of Existing Services

The LC shall ensure all Sub-Consultants expeditiously investigate on site and identify all existing services e.g pipelines, telephone, ELV that have to be diverted. The LC shall then advise the Government the necessary action to be taken.

7.2 SITE SUPERVISION

- (a) To provide full-time supervision on site and the number of staff to be employed, including the LC's own staff to be seconded to site subjected to the Government's approval. The number of site supervision staff shall be referred to **APPENDIX 3**.
- (b) The L C shall be responsible for the supervision of the Works including certifications of all works.
- (c) The L C shall follow strictly the instructions issued by the Government Representative (GR) of the Project in carrying out the supervision of the works.

8.0 CONSULTING FEES

8.1 The consulting fee is based on "*Fixed Consulting Fees*" according to the Ministry of Finance **Pekeliling Perbendaharaan Malaysia PK3.2 - Kos Perkhidmatan Perunding**. The method of "*Fixed Consulting Fees*" as below:

- (i) The cost of consultancy services as agreed in the **Letter of Acceptance** which consists of consulting fee, supervision fee and out-of-pocket expenses **shall be fixed**.

Nonetheless, the Government shall have the absolute discretion whether or not to consider application of additional consulting fees if there are works variation and/or extension of time in the construction contract.

- (ii) Any additional consulting fees due to the increased in construction contract price and calculated according to Scale of Minimum Fee is not applicable for Government projects since 15 September 2016.
 - (iii) If the accepted construction contract price is lower than the estimated project cost, the Government reserves the right to reduce the consulting fee proportionally in relation to the accepted construction contract price.
 - (iv) In tender submission to the Government, the consultant's consulting fees proposal shall include any reasonable and competitive calculation methods together with costs breakdown.
- 8.2 All out of-pocket-expenses or reimbursable expenses shall be billed in accordance with the allowed items by MBSJ and shall not exceed the cost capping as prescribed in The Ministry of Finance circular.
- 8.3 All out of-pocket-expenses or reimbursable expenses shall be claimed on a monthly basis submitted together with proper receipts and invoices where applicable. All claims must be submitted to the Government as soon as practicable but not later than three (3) months from the occurrence of the event or at the discretion of the Government.
- 8.4 The LC and Sub-Consultants shall pay and maintain at its own cost any insurance policy as required by the Government and the cost shall not be included in out of- pocket-expenses.

9.0 DELIVERABLES

The LC shall submit the deliverables of all stages for overall scope of services which generally comprise the Preliminary Detailed Abstract, reports, specification, drawing, tender documents, As Tendered Detailed Abstract, contract documents, Certificate of Completion and Compliance, Fire Certificate and As Completed Detailed Abstract. Further reference can be made to the scope of services as specified in **APPENDIX 2.1 – 2.7.**

10.0 SUBMISSION OF REPORTS, SCHEDULE AND OTHER DOCUMENTS

- 2.1 Within fourteen (14) days after the appointment of the LC, the LC shall submit the proposed implementation schedule for the design of The Project for Government's approval. The LC must ensure that all the consulting services can be completed within the stipulated time. The LC shall submit a progress report of the services every month in a format acceptable by the Government.
- 2.2 Within fourteen (14) days after the appointment of the LC, the LC shall furnish a list of personnel involved in the consulting services indicating their inputs corresponding to each component of work and the implementation schedule. This should include submission of curriculum vitae of all professional and non-professional personnel's which must be provided at all times. The LC's and Sub- Consultant's representative shall be competent, experienced and registered with the respective Professional Boards duly authorised to act on their behalf.
- 3.4 The LC shall provide three (3) sets of printed drawings and documents at each stage of all scope for Professional Services. A soft copy of each submission must be submitted together on the appropriate storage drive and properly labelled.
- 3.5 All submission must be properly endorsed by the Professional Consultant.

11.0 DISCREPANCIES

11.1 Discrepancies Between Drawings and Documents

It is the responsibility of the LC to ensure that no discrepancy occurs between drawings and documents. If discrepancies due to negligence of the LC or any of his Sub-Consultant(s) are discovered at any stage, then the LC is liable for the cost of rectification. The LC is also required to come up with a working proposal for rectification at his own cost.

12.0 TECHNOLOGY AND KNOWLEDGE TRANSFER

The LC shall endeavour to ensure that the employees of the Government are trained or exposed to the expertise of such professionals pursuant to a programme for technology and knowledge transfer, when necessary.

13.0 CONSULTANCY SERVICE AGREEMENT

- 13.1 This Agreement shall be signed not later than four (4) months after the date of the signing of the Letter of Acceptance by the LC.
- 13.2 This Agreement is prepared in both original (1) and certified duplicate copy (1) and copies (13) sets.
- 13.3 The signing of the Agreement is a condition precedent to payment being made to the LC and Sub-Consultants(s).

Appendix 1.1 – Project Brief

i) Nama Projek ;

CADANGAN PEMBINAAN JALAN SAMBUNG YANG MENGHUBUNGKAN PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, MUKIM PETALING, DAERAH PETALING, SELANGOR DARUL EHSAN

Latar Belakang Projek

- a. Kawasan yang terlibat bagi projek pembinaan jalan sambung ini adalah melibatkan tiga (3) taman perumahan yang sedia ada iaitu di Taman Lestari Putra (LEP), Taman Desaminium dan Taman Lestari Perdana (LP).
- b. Cadangan bagi penyambungan jalan telah dibangkitkan oleh Y.B Tuan Abbas Salimmi Bin Che Adzmin@Azmi di dalam Mesyuarat Jawatankuasa Perancangan Bandar, MBSJ Bil. 11/2025 pada 13.11.2025 dipengerusikan oleh Dato' Bandar, MBSJ yang menekankan pentingnya pembinaan penyambungan jalan tersebut. Ini memberi kemudahan kepada penduduk setempat dan pengguna jalanraya kawasan sekitarnya.
- c. Satu lawatan tapak bersama telah diadakan pada 07/10/2025 yang dihadiri oleh Y.B Tuan Abbas Salimmi Bin Che Adzmin@Azmi (ADN Seri Serdang), Encik Fauzi Bin Jaafar selaku Pengerusi Pusat Khidmat Masyarakat DUN Seri Serdang, Pengarah Jabatan Kejuruteraan dan wakil Jabatan Perancangan Bandar untuk mengenalpasti jajaran dan rekabentuk pembinaan yang terbaik bagi pembinaan jalan sambung ini.

ii) Objektif Projek ;

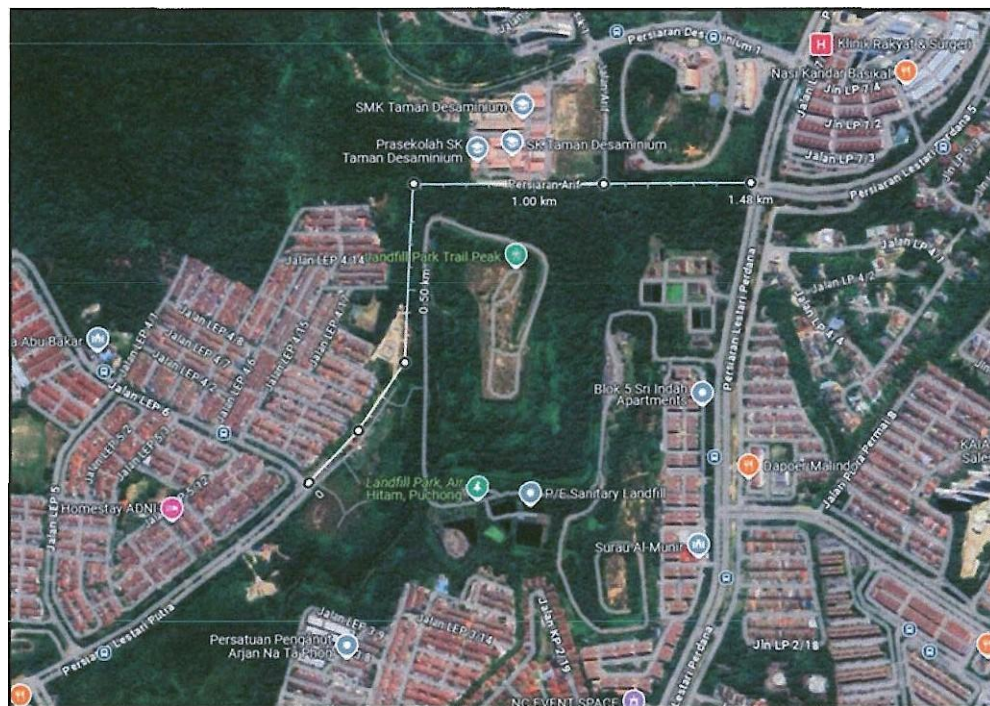
- a. Pembinaan jalan sambung ini adalah jalan atau jajaran utama aliran lalulintas yang menghubungkan taman-taman perumahan yang bersebelahan dan berdekatan seperti Taman Kota Perdana (KP), Taman Lestari Putra (LEP), Taman Lestari Puchong (LP) dan Taman Desaminium.
- b. Cadangan pembinaan jalan sambung ini boleh mengurangkan beban atau kapasiti jumlah kenderaan di jalan-jalan utama yang berhampiran terutamanya di Persiaran Kota Perdana dan Persiaran Lestari Perdana iaitu jalan utama milik Majlis.
- c. Memberi pilihan kepada pengguna jalanraya terutamanya penduduk di Taman Kota Perdana dan Taman Lestari Putra untuk menggunakan jalan sambung ini daripada menggunakan Jalan Putra Permai (milik Jabatan Kerja Raya) dan seterusnya dapat mengurangkan beban dan kapasiti jumlah kenderaan di Jalan Putra Permai.
- d. Menjimatkan masa perjalanan bagi pengguna jalanraya yang hendak menuju ke Puncak Jalil (PUJ) dan Bandar Kinrara (BK).

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

- e. Menggalakkan pembangunan di sepanjang koridor jajaran jalan.
- f. Menerajui pembangunan infrastruktur asas dan sosioekonomi luar bandar menjelang tahun 2030
- g. Melengkapkan infrastruktur asas yang berkualiti dan mempertingkatkan kemampan sosioekonomi masyarakat berteraskan pembangunan yang inklusif dan holistik.

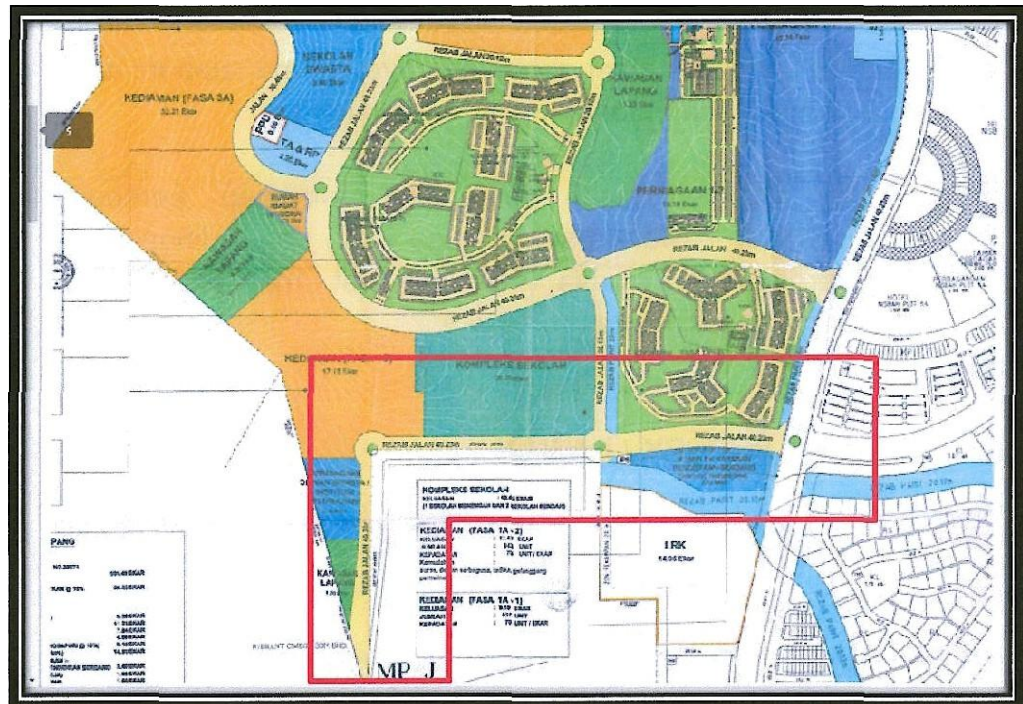
iii) Lokasi Projek ;

Di atas rezab jalan sediada di Persiaran Lestari Perdana 5 yang melalui Persiaran Arif di Taman Desaminium sehingga ke Persiaran Lestari Putra, Bandar Putra Permai, Mukim Petaling, Daerah Petaling, Selangor Darul Ehsan.



Rajah 1

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



Rajah 2

iv) **Kos Siling Projek ;**

RM 29,850,000.00

v) **Justifikasi Projek ;**

Justifikasi bagi pembinaan jalan sambung yang menghubungkan Persiaran Lestari Perdana 5 melalui Persiaran Arif di Taman Desaminium sehingga ke Persiaran Lestari Putra, Bandar Putra Permai adalah amat jelas iaitu menyediakan kemudahan Infrastruktur dari segi pembinaan jalan raya, jambatan dan sebagainya terutama di kawasan yang mengalami kesesakan lalu lintas. Keperluan pelaksanaan projek ini merangkumi perkara berikut :-

- Menyediakan laluan yang selamat serta dapat mengatasi masalah terputus hubungan di kawasan penempatan berhampiran.
- Menyusun semula keutamaan jalan dengan menentukan '*primary road*' dan '*secondary road*' bagi kesinambungan pembinaan jalan.
- Menggalakkan pertumbuhan kegiatan ekonomi dan sosial dengan adanya rangkaian jalan yang sempurna dan dapat meningkatkan taraf hidup masyarakat setempat.
- Memudahkan pengguna jalanraya kerana jalan ini dapat menjadi perhubungan utama kegiatan harian.

- e) Ia akan menjadi pemangkin terhadap pembangunan di kawasan-kawasan sekitar juga akan dapat dibangunkan melalui perancangan masa serta dapat memaksimumkan potensi pembangunannya.
- f) Cadangan projek pembangunan ini juga adalah bagi memenuhi keperluan untuk matlamat pembangunan lestari (SDG) bil 11 dengan matlamat untuk menyediakan kemudahan kepada sistem pengangkutan yang selamat, berpatutan, untuk kegunaan awam dan untuk meningkatkan keselamatan jalan raya.
- g) Pertambahan penduduk dan pembangunan pesat di kawasan sekitar yang memerlukan sistem rangkaian jalanraya yang lebih efisien.

vi) Sejarah Projek yang berkaitan dan maklumat asas ;

Kawasan perumahan berkepadatan tinggi seperti Lestari Permai, Lestari Putra, dan Taman Desaminium selama ini menghadapi masalah **hanya mempunyai satu jalan keluar utama**. Ini menyebabkan ribuan kenderaan bertumpu ke laluan sama pada waktu puncak, mengakibatkan kesesakan luar biasa di Jalan Putra Permai (FT3215). Keadaan ini mendesak wakil rakyat dan pihak berkuasa tempatan mencari alternatif jalan pintas (*bypass*).

vii) Tempoh Perkhidmatan Perunding;

61 bulan

Tempoh Reka Bentuk dan Pelaksanaan Projek :

Peringkat / Skop Kerja	Tempoh (Bulan)
Peringkat Awalan	2 bulan
Pengukuran Tapak	2 bulan
Peringkat Rekabentuk (i) (konsep)	2 bulan
Peringkat Rekabentuk (ii) (terperinci)	3 bulan
Peringkat Tender dan Perlantikan	4 bulan
Peringkat Pembinaan	24 bulan
Peringkat Tempoh Tanggungan Kecacatan (DLP) dan Penyediaan Penyata Akaun dan Bayaran Muktamad	24 bulan
Tempoh Keseluruhan Perkhidmatan Perunding	61 bulan

viii) **Sumber Pembiayaan;**

Peruntukan Majlis (Vot 39554) Kumpulan Wang Perkhidmatan Kemajuan (ISF) untuk pembiayaan perunding dan lain-lain yang berkaitan.

vx) **Kriteria Reka Bentuk**

Jalan sambung Persiaran Lestari Perdana 5 – Persiaran Arif – Persiaran Lestari Putra ini direka bentuk sebagai sebahagian daripada Jalan Arteri Sekunder Bandar (*Urban Secondary Arterial*) berkapasiti tinggi. Cadangan spesifikasi jalan yang akan dibina adalah sekurang-kurangnya sama dengan jalan sediaada iaitu jalan bandaran 4 lorong dua hala dengan pembahagi jalan dan lampu jalan.

a. Lebar Lorong (3.5 meter): Ini merupakan lebar maksimum standard JKR untuk satu lorong kenderaan bagi klasifikasi jalan. Kelebaran ini memberikan keselesaan dan tahap keselamatan yang tinggi bagi semua jenis kenderaan menggunakan laluan Bandar Putra Permai.

b. Lebar Bahu Jalan Berturap (2.0 meter): Menyediakan ruang hentian kecemasan yang selamat tanpa mengganggu aliran trafik utama serta berfungsi memperkukuhkan struktur turapan asphalt tepi.

c. Lebar Laluan Pejalan Kaki (1.5 meter): Piawaian asas keperluan mesra pejalan kaki di kawasan perumahan sekitar Taman Desaminium. Lebar 1.5 meter membolehkan dua pejalan kaki berselisih dengan selesa, selaras dengan garis panduan kemudahan sejagat.

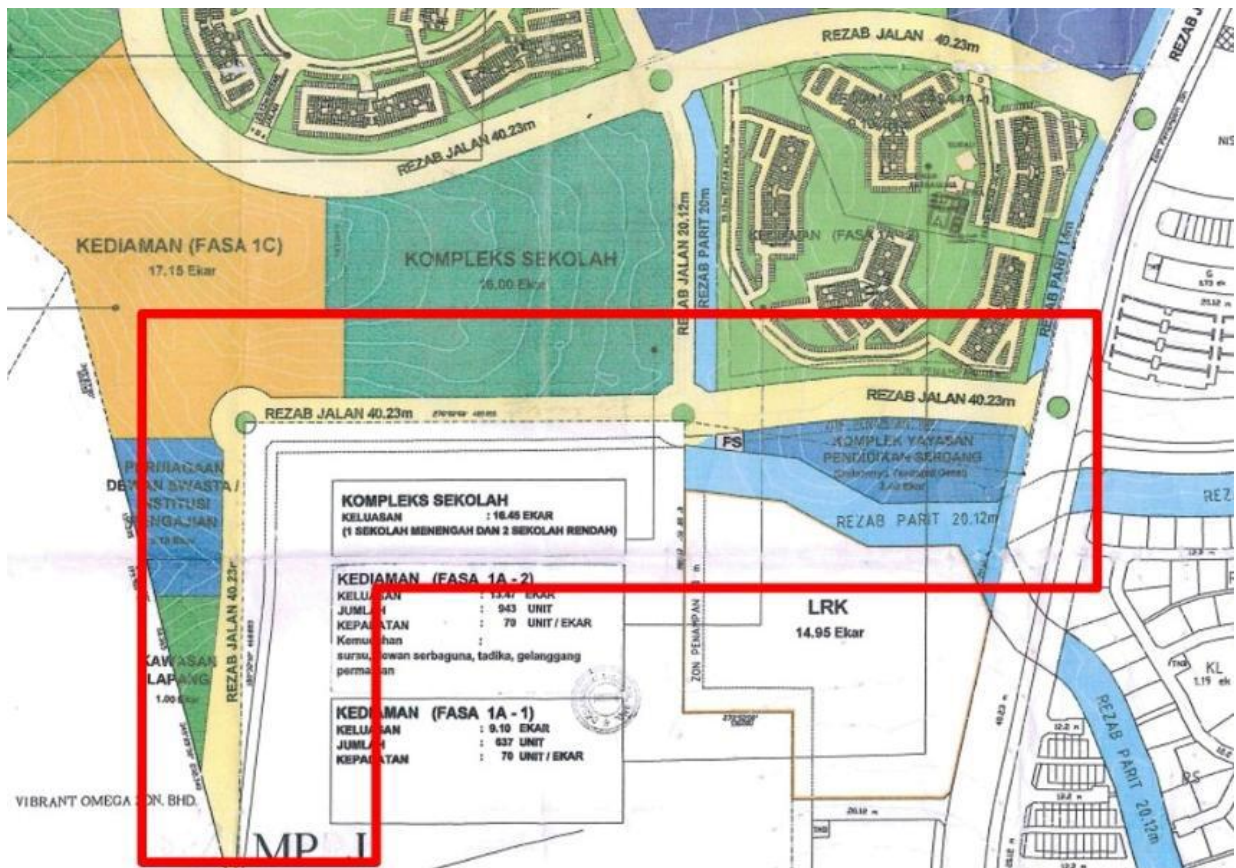
d. Lebar Pembahagi Jalan / *Median* (3.0 meter): Kelebaran 3.0 meter adalah bagi pembahagi jalan fizikal bertujuan memisahkan aliran trafik bertentangan secara selamat untuk mengelakkan pertembungan bertentangan, malah menyediakan ruang yang cukup kawasan landskap/pencahayaan jalan.

e. Had Laju Reka Bentuk (Mengikut ATJ JKR): Mengikut dokumen ATJ JKR, had laju reka bentuk yang dipadankan kerana melalui zon sekolah dan perumahan Desaminium.

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

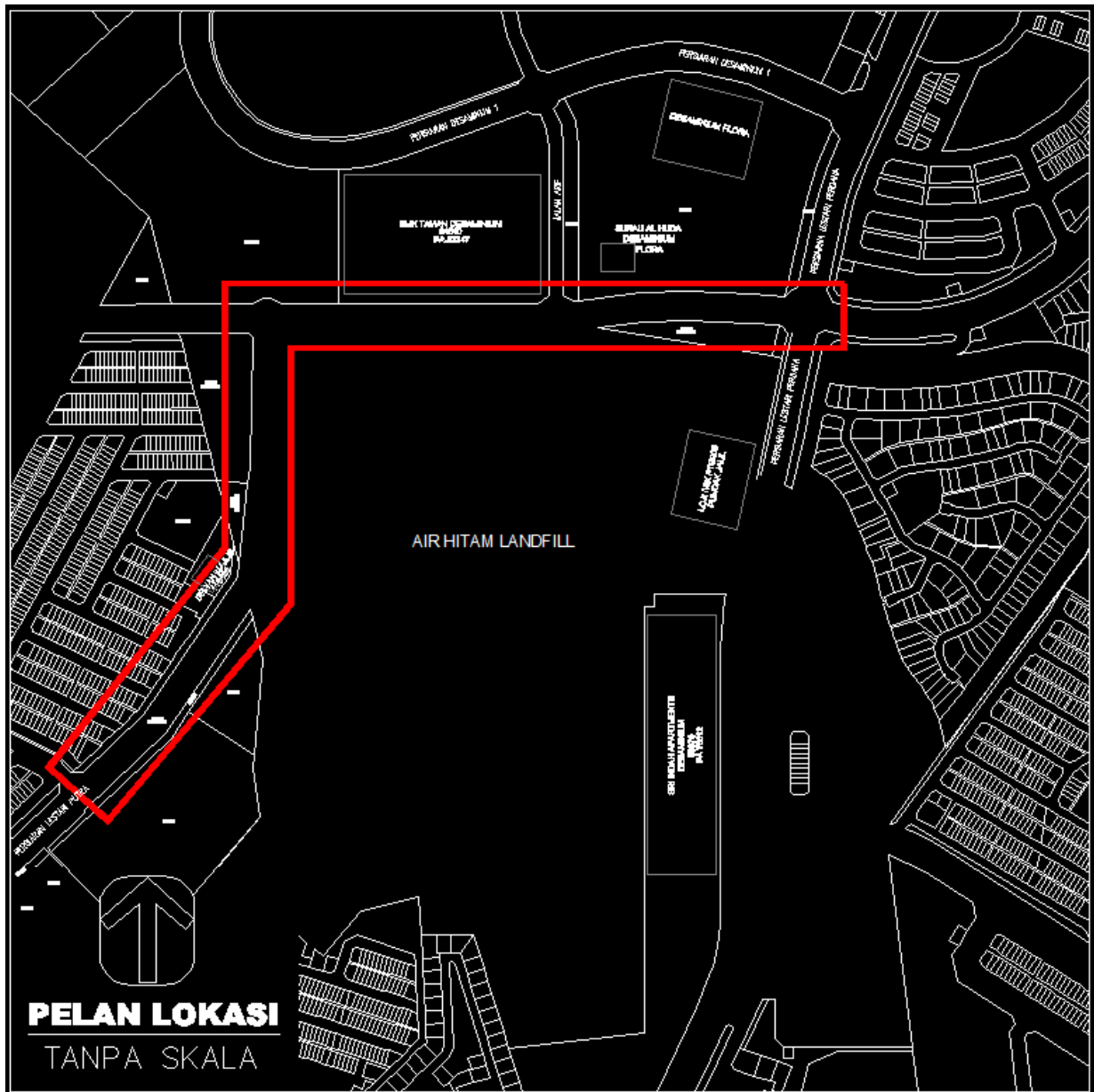
PELANLOKASI

CADANGAN PEMBINAAN JALAN SAMBUNG YANG MENGHUBUNGKAN PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, MUKIM PETALING, DAERAH PETALING, SELANGOR DARUL EHSAN



Rajah 3

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



Rajah 4

GAMBAR TAPAK

SK Taman Desaminium



Lokasi Cadangan Persimpangan Lampu Isyarat Di Antara Persimpangan Lestari Perdana



Simpang tiga Persiaran Lestari Putra



Tapak Pelupusan Sampah Air Hitam



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Dewan Orang Ramai MBSJ



Jalan sedia ada di Persiaran Lestari Putra



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Jalan sedia ada di Persiaran Lestari Perdana



Jalan sedia ada di Persiaran Lestari Perdana



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Cerun di persimpangan Persiaran Arif



Struktur sedia ada yang perlu dirobohkan



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Belukar yang perlu dibersihkan



Peta Lokasi Cadangan Jajaran Jalan Sambung

Appendix 1.2 – Government Project Implementation Schedule

Tempoh Reka Bentuk dan Pelaksanaan Projek :

Peringkat / Skop Kerja	Tempoh (Bulan)
Peringkat Awalan	2 bulan
Pengukuran Tapak	2 bulan
Peringkat Rekabentuk (i) (konsep)	2 bulan
Peringkat Rekabentuk (ii) (terperinci)	3 bulan
Peringkat Tender dan Perlantikan	4 bulan
Peringkat Pembinaan	24 bulan
Peringkat Tempoh Tannggunan Kecacatan (DLP) dan Penyediaan Penyata Akaun dan Bayaran Muktamad	24 bulan
Tempoh Keseluruhan Perkhidmatan Perunding	61 bulan

Appendix 2.1 – Scope of Architectural Services

14.0 SCOPE OF ARCHITECTURAL CONSULTANCY SERVICES

~~14.1 The Scope of Architectural Consultancy Services as specified in Section Architectural, PART A..... under Basic Professional Services are as follows:-~~

- ~~(a) Schematic Design Phase~~
- ~~(b) Design Development Phase~~
- ~~(c) Contract Documentation Phase~~
- ~~(d) Contract Implementation and Management Phase~~
- ~~(e) Final Completion Phase~~

~~14.2 The Scope of Architectural Consultancy services shall include but shall not be limited to the followings:-~~

- ~~(a) To advise Government on the best and most economical design with regards to the site constraints, layout planning, environmental conditions, energy efficiency and Industrialised Building System (IBS).~~
- ~~(b) The CA shall prepare the design and plans of the Project to meet the requirements of sustainable development practices and IBS construction methods to achieve the following:~~
 - ~~(i) MyCREST certification with overall rating or score as specified by the Government, calculated using MyCREST green rating tool by Construction Industry Development Board (CIDB) (for project cost more than RM50 million).~~

~~‘Penarafan Hijau JKR’ (pH JKR) certification with overall rating or score as specified by the Government, calculated using pH JKR green rating tool by JKR (for project cost RM50 million and below);~~
 - ~~(ii) Overall IBS Score of **not less than 70**, calculated using the Manual For IBS Content System (IBS Score) by CIDB.~~

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

- (c) ~~To carry out preliminary site investigation, topography study, boundary demarcation where required, data collection inclusive of field reconnaissance and to determine the existing and proposed availability of facilities, services and hindrances.~~

14.3 ~~The CA is **not required** to carry out Basic Professional Services under Contract Documentation Phase as items listed below:~~

- (a) ~~inviting, on behalf of the Government, tenders for the work~~
(b) ~~evaluating the results of the tenders and submitting a report and recommendation to the Government;~~
(c) ~~awarding the contract on behalf of the Government;~~

14.4 ~~The CA shall be the Principal Submitting Person to the authorities, and shall be responsible for the overall planning & designing, coordination and management of The Project.~~

15.0 ~~DELIVERABLES~~

~~The CA shall submit the deliverables within the time and stage as specified in approved implementation schedule. The deliverables to be provided by CA are as follows:~~

15.1 ~~Schematic Design Phase~~

- ~~* Site analysis & site report~~
- ~~* Approved Schedule of Accommodations by client~~
- ~~* Approved Concept Plan by client~~
- ~~* Approved Schematic Drawings (100 scale) by client~~
- ~~* Submission drawings to Local Authorities for planning permission / Development Order (D.O) / Development Plan (D.P)~~
- ~~* Planning Permission / Development Order (D.O) / Development Plan (D.P) approval~~

15.2 ~~Design Development Phase~~

- ~~* Coordinated drawings with specifications~~
- ~~* Submission drawings for Building Plan (BP) approval~~
- ~~* Submission drawings for Bomba approval~~
- ~~* Bomba & Building Plan (BP) approval~~

15.3 ~~Contract Documentation Phase~~

- ~~* Tender drawings and detail drawings including the list of drawings~~

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

~~15.4 Contract Implementation & Management Phase~~

- ~~* Construction drawings~~
- ~~* Letter on approval of Bomba inspection~~

~~15.5 Final Completion Phase~~

- ~~* Certificate of Completion & Compliance (CCC) / Occupation Permit (O.P) / Occupation Certificate (O.C)~~
- ~~* Certified 'as-built' drawings prepared by the Contractor~~
- ~~* Fire certification~~

Appendix 2.2 – Scope of Civil & Structural Engineering Services

1. SCOPE OF PROFESSIONAL SERVICES

1.1 Types of Services

In general, the CA or the Sub- Consultant on its behalf shall provide Basic Professional Services as specified in Engineering Services, Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026) under the following engineering areas:-

1.1.1 Civil and Structural Engineering Services

The services required include the analysis, design, preparing of specification and all other technical services necessary to produce comprehensive civil and structural engineering drawings and other documents ready to be used for tender and construction purposes. The services shall be rendered for the following part of the project scope of works:-

- ~~(a) substructure (i.e building components located between and including the foundation system and the ground beams)~~
- ~~(b) superstructure* (i.e building components located between and including the ground floor column and the roof beam)~~
(* delete if not required)
- ~~(c) roof structure/ roof truss*~~
(* delete if not required)
- (d) earthworks, internal road, drainage, external water reticulation, sewerage, and other external works required for the project site.

1.1.2 Geotechnical Engineering Services

The services required include site investigation, analysis, design, preparation of specification and all other technical services necessary to produce comprehensive geotechnical engineering recommendations, drawings and other documents ready to be used for tender and construction purposes with compliance to the Geotechnical Design Requirement in Sub Appendix 'A'. The services shall be rendered for the following part of the project scope of works:-

- (a) Site Investigation Works
- (b) Site Investigation Interpretative Report
- (c) Foundation for structures
- (d) Slopes, embankments and retaining structures
- (e) Ground improvements
- (f) Other related geotechnical works

1.1.2.1 Material Survey and Subsurface Investigation

(a) With Site Investigation Data*

The Government may provide the preliminary subsurface investigation results to the CA or the Sub-Consultant on its behalf

The preliminary subsurface investigation locations are indicative only and to be used as a preliminary/general guide only, the Government is not obliged to guarantee the completeness of the soil investigation locations.

The preliminary subsurface investigation results are to be used as a preliminary/general guide only for geotechnical preliminary design purposes. The Government will not be responsible for any inaccuracies and the completeness of the subsurface data presented.

If the data or the report provided by the Government is insufficient, the CA or the Sub-Consultant on its behalf shall provide additional information required/ additional subsurface investigation for the required data to complete the detailed design where deemed necessary for the proper and satisfactory design of the geotechnical works, in accordance with the best engineering practice.

The CA or the Sub-Consultant on its behalf shall propose, coordinate and supervise sufficient subsurface investigation, sampling and testing to gather enough data. A detail material and subsurface investigation are required to permit final detailed design of all structures, slopes, foundations, ground treatments, road pavements, etc.

The CA or the Sub-Consultant on its behalf shall determine the required scope of subsurface investigation and submit his proposals to the Government for concurrence.

(b) Without Site Investigation Data*

The CA or the Sub-Consultant on its behalf shall propose, coordinate and supervise sufficient subsurface investigation, sampling and testing to gather enough data. A detailed material and subsurface investigation are required to permit final detailed design of all structures, slopes, foundations, ground treatments, road pavements, etc.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

The CA or the Sub- Consultant on its behalf shall determine the required scope of subsurface investigation and submit his proposals to the Government for concurrence.

(*delete if not required)

The Government who shall enter into an agreement with the soil investigation contractor shall do the appointment of the soil investigation contractor.

The CA or the Sub- Consultant on its behalf shall consider proposing additional subsurface investigation and tests in the Tender Document for confirmatory purpose for the detailed design during construction stage.

The CA or the Sub- Consultant on its behalf shall administer the contract and shall be responsible to provide full supervision to ensure that the works are carried out properly.

The Final Soil Investigation Report shall be endorsed and certified by a Professional Engineer (i.e. The CA or the Sub- Consultant on its behalf).

All subsurface investigation/ additional subsurface investigation works shall be carried out in accordance with the following: -

- (i) JKR Standard Specification for Site Investigation: JKR/SPJ/2013-S17
- (ii) Malaysian Standard MS 2038: 2006: Code of Practice for Site Investigation
- (iii) Malaysian Standard MS 1056: 2005: Soils for Civil Engineering Purposes (Test Method)
- (iv) Relevant Standard Engineering Practice

In conjunction with the subsurface investigation, the CA or the Sub- Consultant on its behalf shall also carry out a material survey in the location of the proposed new route or improvement and its vicinity to identify the sources of suitable borrow and construction material. He shall also provide verification as to their quality, quantity and suitability.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

The CA or the Sub- Consultant on its behalf is required to submit a Material Survey and Subsurface Investigation Report as soon as the subsurface investigation works are completed.

The report shall give a general description of the geology of the area, results of the material survey and details of the sources, quantity and quality of the available materials as well as their relevance to the project.

The report should also highlight the results of the subsurface investigation giving details of the CA or the Sub- Consultant on its behalf interpretation of those results as well as its implications on geotechnical aspects of the design.

1.1.3 Other Associated Services

In addition to the above, the CA or the Sub- Consultant on its behalf is also required to provide the following associated services:-

- ~~(a) acting as Submitting Person (SP) on behalf of the Government in submitting related Form Gs (as listed below) and other documents for approval from relevant Local Authority for issuance of Certificate of Completion and Compliance (CCC).~~
 - ~~(i) G1 - Kerja Tanah~~
 - ~~(ii) G3 - Asas Tapak~~
 - ~~(iii) G4 - Struktur~~
 - ~~(iv) G13 - Sistem Bekalan Air Luaran~~
 - ~~(v) G14 - Retikulasi Pembetungan~~
 - ~~(vi) G15 - Loji Rawatan Pembetungan~~
 - ~~(vii) G17 - Jalan dan Parit~~
 - ~~(viii) G19 - Parit Luaran Utama~~
- ~~(b) acting as submitting person on behalf of the Government in submitting related documents for approval from relevant Local Authority in Sabah and Sarawak for issuance of Occupation Certificate (OC) or Occupation Permit (OP) respectively.~~
- (c) preparation of tender document*
- (d) supervision on site, including auditing designs submitted by Contractors*
(* delete if not required)

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

1.1.4 Additional Services*

The additional services that shall be provided by the CA or the Sub-Consultant on its behalf are the following:

- (a) Road Safety Audit – the scope of services is as specified in Sub Appendix 'D'.

~~Other consultants may be appointed with the consent of the Government to carry out and commencing the above services.~~
(*delete if not required)

1.1.5 Design Checking

The design shall be checked and approved by Profesional Engineer and shall be submitted with the full report.

1.2 Stages of Services

The required services to be provided by the CA or the Sub- Consultant on its behalf shall be divided into five (5) stages:

1.2.1 Preliminary Stage

The required services to be provided by the CA or the Sub-Consultant on its behalf are described in Part A: Schedule of Services Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026).

1.2.2 Design Stage

The required services to be provided by the CA or the Sub-Consultant on its behalf are described in Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026)

Upon receiving the architectural drawings from the Government, the CA or the Sub- Consultant on its behalf shall evaluate the completeness of the drawings for the purpose of, civil & structural engineering, and geotechnical analysis and design.

The CA or the Sub- Consultant on its behalf shall obtain any additional relevant or important information deemed essential for the completion of the design works on their own accord from various authorities.

The CA or the Sub- Consultant on its behalf shall propose Civil & Structural, and Geotechnical Design Concept for agreement. A review of the Design Concept shall be carried out by the CE as and when requested by Government.

The CA or the Sub- Consultant on its behalf shall be expected to supply the following information to the Government:

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

- ~~(a) roof support reactions~~
- (b) structural key plans
- (c) foundation plans
- (d) earthwork layout plan
- (e) internal road layout plans
- (f) drainage layout plans
- ~~(g) external water reticulation layout plans~~
- ~~(h) sewerage layout plans~~
- (i) design progress report at every stages of service
- (j) other drawings or documents as required by Government

As soon as the agreement is reached with regard to the design concept of the civil and structural works the CA or the Sub-Consultant on its behalf shall proceed by executing the detail analysis, design, and preparing of specifications relevant to the respective parts of the project.

The design shall comply to the technical data as stated in Sub Appendix 'B' and Sub Appendix 'C'.

The CE shall be required to satisfy the following requirements for new design or/ and Pre-Approved Plans:-

~~i. New Design**~~

~~a) Substructure of buildings~~

~~The CA or the Sub-Consultant on its behalf shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the substructure to be constructed on site.~~

~~The CA or the Sub-Consultant on its behalf shall also be required to inform the Government on the design standard, structural assumptions, analytical model and loading values to be used (unless specified by the Government), sizes of members, types of materials and strength selection to enable the appointed Contractor to propose appropriate IBS components for the superstructure.~~

~~b) Superstructure of buildings~~

~~The CA or the Sub-Consultant on its behalf shall apply Industrialized Building System (IBS) requirements when executing the detail analysis, design and specification preparation relevant to this part of work. All designs shall comply the minimum total score of 70 in accordance with latest Pekeliling Perbendaharaan.~~

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

~~The CA or the Sub-Consultant on its behalf shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the component to be manufactured by competent manufacturers.~~

~~Notwithstanding the above, should the Government decided to exempt the CA or the Sub-Consultant on its behalf partly or fully from having to comply with the requirements stated above, the Government shall communicate such exemption to the CA or the Sub-Consultant on its behalf in writing.~~

~~c) Roof structures~~

~~(i) Designed by Prefabricated Roof Truss Provider*~~

~~The CA or the Sub-Consultant on its behalf is not required to provide any professional services for this part of the building.~~

~~(ii) Designed by CA or the Sub-Consultant on its behalf *~~

~~The CE shall utilize either local timber of appropriate strength group or Hot Rolled Structural Steel of appropriate grade as the material for roof structures.~~

~~The CA or the Sub-Consultant on its behalf shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, joint details, bracing details and other relevant information to allow for the roof structure to be prefabricated.~~

~~(* delete if not required)~~

~~ii. Pre-Approved Plans (PAP) Design**~~

~~a) Substructure of buildings~~

~~The CA or the Sub-Consultant on its behalf shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the substructure to be constructed on-site.~~

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

~~The CA or the Sub- Consultant on its behalf shall also be required to inform the Government on the design standard, structural assumptions, analytical model and loading values to be used (unless specified by the Government), sizes of members, types of materials and strength selection to enable the appointed Contractor to propose appropriate IBS components for the superstructure.~~

~~b) Superstructure of buildings / roof structures~~

~~The CA or the Sub- Consultant on its behalf shall evaluate, analyse and review the original design and details in the drawings and perform calculations with a view to determine the adequacy of the key elements.~~

~~The CA or the Sub- Consultant on its behalf, if required to make ammendment to the original design and details in the drawings, shall ensure that such design is suitable, functional, safe, compatible with the requirements of the Government and integrates with the original design and specifications~~

~~The CA or the Sub- Consultant on its behalf shall endorse the design and be fully liable for any design defects, damage, inadequacies or insufficiency of such design regardless wether ammendments were made or not to the original design.~~

~~(** delete if not required)~~

The CA or the Sub- Consultant on its behalf is expected to carry out Civil & Structural, and Geotechnical Design Review at the completion of the services at the end of this stage;

- (a) Concept/ Preliminary design review
- (b) Detailed design review

All civil and structural drawings and specifications shall be compiled in a well documented form suited for submission to the Government.

1.2.3 Tender Stage

The required services to be provided by the CA or the Sub- Consultant on its behalf are described in Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026).

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

1.2.4 Construction Stage

The required services to be provided by the CA or the Sub-Consultant on its behalf are described in Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026).

1.2.5 Defects Liability Period Stage

The required services to be provided by the CA or the Sub-Consultant on its behalf are described in Part A: Schedule of Services Form CSA2014-Engineering (Amendment 2026).

1.2.6 Any Other Duties

The CA or the Sub-Consultant on its behalf will be required to carry out such duties as described elsewhere in this Terms of Reference and in the Agreement.

2. DELIVERABLES

2.1 Submission of Tender Drawing

The CA or the Sub-Consultant on its behalf shall submit minimum 30 sets of copy prints of the Tender and Contract Drawing to the Government as scheduled in Q Plan.

2.2 Final Design Report/ Calculation

Two (2) copies each of hardcopy and softcopy of the final design report and design calculations shall be submitted on completion of the final design.

The design report shall be an overall picture of the Project and scope of works involved, the criteria or rationale used for each of the design components and the events and decisions that were made as regards to design changes along the way. The design report shall be in a format as given in Sub Appendix 'E'.

The design calculations shall be properly bound and set out in the order of design. The design calculations must be complete, legible to be read and must clearly refer to the relevant clauses of the design codes used.

2.3 Other Documents

Other documents as scheduled to be submitted shall include:

- (a) Complete set of final Drawings for review;
- (b) Final submissions of five (5) sets of well documented Construction Drawings and specification;
- (c) Complete set of duly signed and endorsed original transparency (tracing) and one (1) set of endorsed drawing (softcopy) in external hard drive and
- (d) Other documents deemed necessary.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

3. OTHER TERMS AND REQUIREMENTS

3.1 Design Code

The services of the CA or the Sub- Consultant on its behalf shall comply with the latest relevant Malaysian Standards or Eurocode or any other International Standard if such codes are not available.

3.2 Seismic Design Requirements

For projects with seismic requirement as determined in MS EN 1998-1 and Malaysia National Annex to MS EN 1998-1, the design shall comply with the code's design requirement.

~~3.3 Calculations for Industrial Building System (IBS) Content~~

~~Calculations to determine the IBS content is based on the latest Manual IBS Content Scoring System (IBS Score) by CIDB. The CA or the Sub- Consultant on its behalf must submit calculations for IBS Score points obtained when submitting structural drawing for verification. The CA or the Sub- Consultant on its behalf shall also follow all the guideline published by CIDB.~~

~~3.4 Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) / Penarafan Hijau JKR*~~

- ~~(a) MyCREST certification with overall rating or score as specified by the Government, calculated using MyCREST green rating tool by Construction Industry Development Board (CIDB) (for project cost more than RM50 million).~~
- ~~(b) 'Penarafan Hijau JKR' (pH JKR) certification with overall rating or score as specified by the Government, calculated using pH JKR green rating tool by JKR (for project cost RM50 million and below);
(*delete if not applicable)~~

GEOTECHNICAL DESIGN REQUIREMENT

1.0 General

The CA or the Sub- Consultant on its behalf shall study and search all report on geotechnical conditions and engineering works that have been carried out. The CA or the Sub- Consultant on its behalf shall undertake further details of site investigation for the purpose of geotechnical engineering design and construction works.

1.1 The following main Codes of Practice and Standards (Latest Edition) shall be applicable for geotechnical engineering works but not limited to:

- (i) BS 1377 : Methods of Test for Soil for Civil Engineering
- (ii) MS 1056 : Methods of Test for Soil for Civil Engineering
- (iii) MS 2038 : Code of Practice for Site Investigation
- (iv) BS 5930 : Code of Practice for Site Investigation
- (v) MS 1756 : Foundations – Code of Practice
- (vi) BS 8004 : Foundations – Code of Practice
- (vii) MS 1754 : Code of Practice for Earthwork
- (viii) MS 1314 : Precast Concrete Piles
- (ix) MS EN 1997-1 : Geotechnical Design
- (x) MS EN 1998-1 : Design of Structure for Earthquake Resistance
- (xii) JKR Standard Specification for Building Works
- (xiii) JKR Arahan Teknik

Including any relevant amendment thereof, shall be adopted by the CA or the Sub- Consultant on its behalf.

1.2 For works which are not covered by the Standard Specifications and for any details where the CA or the Sub- Consultant on its behalf deems necessary to make modifications. The CA or the Sub- Consultant on its behalf shall submit addendum to the Standard Specifications in his proposal, giving complete details of the proposed specification or modification.

2.0 Excavation

2.1 Adequate design for temporary works on deep excavation (depth > 2.0m) and protection to adjacent structures and employees working in an excavation shall be provided.

2.2 Minimum factor of safety of not less than 1.5 is required in the design of excavation protection system such as strut, brace, sheet pile etc.

2.3 In pumping out water / dewatering, the CA or the Sub- Consultant on its behalf shall take into consideration with regard to stability and settlement of all adjacent structures due to the lowering of the water table.

2.4 Adequate safety measures shall be provided and to comply the requirement of relevant local authority's e.g. signage, hoarding, barriers etc.

3.0 Filling and Embankment

Materials used in the construction of fills and embankments shall, as far as possible be those excavated from adjacent cuts. Rock excavated from the cuts may be used as material for fills if they are crushed to acceptable grading envelopes, with maximum size of individual pieces not greater than 100mm. A drying out of the fill material during hauling and handling from cut to position of placing shall have to be allowed for.

4.0 Ground Treatment

Ground improvement methods shall enable the works to be carried out in the time frame provided and cost effective. If the ground needs to be improved, environmental friendly ground improvement methods should be adopted. Where surcharge is adopted to improve the ground, no other construction activity shall be allowed until the surcharge is removed.

5.0 Retaining Structures

Any proposed system of retaining structures shall be technically appropriate, cost-effective and aesthetically pleasing. The system shall have been successfully implemented in similar accepted conditions with proven case history.

The design shall be in accordance to BS 8006:1994. The types of foundation for the reinforced structures shall be designed based on the subsoil profile and geotechnical properties of the subsoil at each location. Typical design criteria to be complied with are shown in **Appendix A1**.

Load or bearing tests can also be carried out to assess the foundation capacity.

6.0 Slope Drainage System

6.1 Berm Drain

Berm drain shall be designed to have sufficient capacity to undertake the surface runoff based upon 10 years return period rainfall. Function of berm drain is to minimize water infiltration, surface erosion and design to provide self-cleansing velocity (eg. V-shape cast in-situ concrete drain).

6.2 Cascading Drains

Cascading drains in slope faces shall be provided in addition to normal cut off drains at the top of slope and berm drains. Cascading drains shall be provided for all 1:1.5 cut slope surface and all fill slope surfaces which have 1:2 or steeper gradient.

6.3 Subsurface Drains

Subsurface drains such as horizontal drains or drainage blankets shall be provided for cut and fill slopes and for areas where the groundwater/perched water table is found to be high.

7.0 Foundation

- 7.1 The selection of suitable foundation types shall be so chosen to suit the actual soil conditions with regard to the type of structures to be constructed. All timber piles and bakau piles shall not be used in any foundation works in line with Government's environmental policy.
- 7.2 Pile with size less than 200mm shall not be used for building foundation.
- 7.3 The foundations of the buildings shall be designed to safely sustain and transmit design loads to the ground, in such a manner as not to cause any settlement beyond tolerable limits that which would impair the stability of, or cause damage to, the whole or any part of the buildings or of any adjoining structures.
- 7.4 Foundation design shall ensure that foundation movements are within limits that can be tolerated by the proposed structure without impairing its function.
- 7.5 All foundations shall be designed to provide sufficient factor of safety to support the design loads as per the typical geotechnical design criteria shown in **Appendix A1**.
- 7.6 A bearing capacity factor of safety of not less than 3.0 shall be applied in the design of shallow foundation including strip, pad or raft foundation. In the design of deep foundation including pile foundation, a factor of safety of not less than 2.0 for skin friction and 3.0 for end bearing shall be applied.
- 7.7 A tensile capacity factor of safety of not less than 2.0 shall be applied in the design of shallow or deep foundation.
- 7.8 Pile position deviation and verticality tolerances shall be allowed in the design of the foundation works to cover for reasonable inaccuracies in setting out and positioning during construction.
- 7.9 The effect of negative skin friction on piles such as surcharge over soft and compressible soils, effect of groundwater draw-down and decomposition of organic layer shall be incorporated in the design of deep foundation.

- 7.10 Pile selection and installation method shall take into consideration the environmental constraints such as effecting to adjacent structures, build-up areas, heritage buildings, hospitals, schools etc.
- 7.11 RC pile used must be in accordance to JKR Standard Specifications or equivalents, commercial grade pile i.e. MS1314: 2004 Class S shall not be used.
- 7.12 Block bearing capacity for pile groups shall be checked to have a minimum factor of safety of 2.0.
- 7.13 Maximum design structural capacity shall also be discounted for joints (5n%) and slenderness ratio ($l/d = 100$) where n = number of joints, l = length of pile, d = diameter of pile. Maximum number of joints for piles in marine environment is two (2).
- 7.14 Static Load Tests shall be in accordance to JKR Standard Specifications and 1% of piles points for each pile size installed or two (2) tests per pile size per site whichever is higher.
- 7.15 Other relevant tests such as High Strain Dynamic Test (PDA) shall be carry out minimum 3% of total pile points for a consistent ground profile and minimum 7% of total pile points for inconsistent or erratic ground condition.
- 7.16 Plate bearing test shall be carry out for a minimum two (2) numbers per building for pad/shallow foundation founding on the allowable soil bearing pressure $\geq 150\text{kN/m}^2$.
- 7.17 For shallow foundation system, confirmatory test such as JKR Probe or Mackintosh Probe shall be carry out at each column position.
- 7.18 The CA or the Sub- Consultant on its behalf shall propose adequate foundation design for services (drainage sump, manhole, sewerage and others) to suit the ground condition.

8.0 Geotechnical Design Criteria

Typical geotechnical design criteria to be complied with are shown in **Appendix A1**.

8.1 Stability Design for Slopes

8.1.1 Factor of Safety

The short term and long term stability of the fill and cut slope have to be checked. During construction, the short term stability shall be analysed using the Total Stress Strength Parameters like Undrained Shear Strength (S_u) for cohesive materials. Stability analysis using the Effective Stress Strength Parameters like c' and ϕ' shall only be carried out to check for the factor of safety against failure in long term and for granular cohesionless materials.

The stability of the fill and cut slope is to be assessed using established limit equilibrium analysis for both circular and non-circular failure surfaces. The following methods can be used such as but not limited to:

- a) Simplified Bishop's Method (Bishop, 1955 and Janbu et.al., 1956) - For Circular Failure Surface
- b) Janbu's Method (1972) - For Non-Circular Failure Surface
- c) Morgenstern & Price (1965) - For Non-Circular Failure Surface
- d) Sarma (1979) - For Non-Circular Failure Surface

Both circular and non-circular failure surface shall be checked. The shear strength of soils shall be based on the in-situ and laboratory testing carried out. However, the CA or the Sub- Consultant on its behalf * choice of the parameters does not absolve him of his responsibilities under the Contract.

Factor of safety for slope shall be not less than the value given in **Appendix A1: Typical Geotechnical Design Criteria.**

8.1.2 Fill Slopes and Embankments

All fill slope and embankment shall be analysed and designed. Preliminary consideration can be used using gradient of 1V:2H with 2m berm width and maximum height of 6m. For steeper slopes, stabilization measures shall be provided such as but not limited to the followings:

- a) Geogrid/ geotextile reinforcement
- b) Reinforced concrete retaining structure
- c) Reinforced fill structure
- d) Replacing the fills with elevated structures, etc.

8.1.3 Cut Slopes

All cut slope shall be analysed and designed. This includes cut slopes in residual soils and in completely decomposed rock. For preliminary consideration all untreated slopes shall be designed to 1V:1.5H to 1V:2H with 2m berm width and maximum height of 6m.

For steeper slopes, stabilization measures are to be provided such as but not limited to the followings:

- a) Soil nailing with slope surface protection/ guniting
- b) Permanent ground anchors
- c) Retaining walls, etc.

Generally, the maximum number of berms in a cut slope is restricted to six (6) berms unless there is construction difficulty due to the terrain encountered.

8.1.4 Rock Slopes

All rock slopes shall be analyzed and designed. Preliminary consideration can be used using 4V:1H for weathering grade I and 3V:1H for weathering grade II. If analysis indicates that it is unstable, it shall be designed to a better gradient and/or requiring extensive stabilization measures. The type of stabilization measures to be used but not limited to the followings:

- a) Permanent rock anchors
- b) Rock dowels
- c) Rock bolting
- d) Buttress walls
- e) Counter forts
- f) Relief drains / horizontal drains
- g) Gunit protective surface seal
- h) Wire netting

8.1.5 Pore water Pressure Control

Relief drains in the form of horizontal drains and crushed rock drainage blankets shall be provided for cut and fill slopes and for areas where existing water courses have been filled over.

8.1.6 Typical Slope Construction

Some typical slope construction criteria adopted and to comply with **Table 1**.

Table 1: Typical Slope Construction Criteria

Slope Description	No. of berms	Existing Slope Angle	Typical Construction
SIDE-LONG FILL SLOPE	< 3	$\leq 35^\circ$	Normal Slopes 1V:2H
	> 3	$\leq 35^\circ$	Reinforced Slopes 4V:1H
	> 6	$\geq 35^\circ$	Replace with Retaining Structure
EMBANKMENTS	< 6	$\leq 35^\circ$	Normal Slope 1V:2H
	> 6	$\geq 35^\circ$	Reinforced Slope 4V:1H
REINFORCED EMBANKMENT	> 6	$\geq 35^\circ$	Replace with Elevated Structure
CUT SLOPES	< 6	-	Normal Slopes 1V:1.5H to 1V:2H with surface drains and 2.0m berms

8.2 Settlement Consideration

The design of the fill slopes and embankment shall consider both structural and geotechnical solutions to minimize construction cost and considering the time frame available. Alternative designs for ground treatment and fill stabilization are to be prepared following the criteria stated below:

a) Total Settlement

- i) The degree of primary consolidation must achieve 90% during construction.
- ii) For post construction settlement, the primary settlement within the first five (5) years of service shall not exceed 10% of the sum of the total theoretical primary consolidation settlement. In addition, total post construction settlement shall not exceed 250mm.

b) Differential Settlement

- i) In areas of transition between piled approach embankments and generally low embankments, differential settlement within the first five (5) years of service shall not exceed 100mm within a length of 50m.
- ii) In areas remote from structures and transition zones differential settlement shall not exceed 100mm within a length of 100m.

- iii) Notwithstanding the allowable settlement of embankment, the Contractor shall ensure that services particularly water and sewer mains will not be adversely affected by post construction settlement.

During construction, the degree of consolidation and rate of settlement shall be verified on site using field measurement of pore water pressure and settlement. Asoaka's Method (1978), Hyperbolic Methods or etc. is used to measure settlement and evaluate the settlement rates.

8.3 Effect of Earthquake (if applicable)

- 8.3.1 The CA or the Sub- Consultant on its behalf shall carry out sufficient ground investigations and/or geological studies to determine the seismic action in areas that are prone to earthquakes in order to incorporate the seismic factor into design.
- 8.3.2 The CA or the Sub- Consultant on its behalf shall carry out assessment of potential liquefaction or densification hazard of the site and take into consideration in their design, the effect of liquefaction or densification that may lead to risk of ground rupture, slope instability and permanent settlement in the event of an earthquake.
- 8.3.3 The CA or the Sub- Consultant on its behalf shall ensure that the foundation elements and any earth retaining structure elements provided have sufficient stiffness, stability and strength to resist the effects resulting from the response of the superstructure or any related structure in the event of an earthquake.

8.4 Design Considerations in Aggressive Subsurface Environments

- 8.4.1 Consideration shall be given to the possible deterioration of all geotechnical elements including pile over its design life due to the surrounding environment where corrosion, chemical attack, abrasion, and other factors can adversely affect the durability after installation. An assessment of the in-situ soil conditions, fill materials, and groundwater properties is necessary to completely categorize an aggressive subsurface condition.
- 8.4.2 Whenever the pH value of the soil or water is less than 4.5, chloride ion content greater than 100 parts per million (ppm) or sulfate ion content greater than 200 ppm, the foundation design shall be based on an aggressive subsurface environment.

- 8.4.3 If industrial contamination is found, the maximum likely concentrations should be determined as well as an estimate of the lateral and vertical extent of the contamination.

8.5 Corrosion Control

- 8.5.1 Piles especially steel piles driven through contaminated soil and groundwater conditions may be subjected to high corrosion rates and shall be designed appropriately. Corrosion of steel or steel reinforced piles may also occur if piles are driven into disturbed ground, landfills or cinder fills, or low pH soils. Corrosion shall also be evaluated for piles located in a marine environment, or if piles are subjected to alternate wetting and drying from tidal action. Corrosion rates are a function of the ambient temperature, pH, access to oxygen, and chemistry of the aqueous environment surrounding the steel member.
- 8.5.2 For piles in marine environments (salt water), separate zones, each with a different corrosion rate present along the length of the pile, shall be taken into account during design. Zones identified are as below:-
- i. Atmospheric zone: exposed to the damp atmospheric conditions above the highest water level or subject to airborne spray.
 - ii. Splash zone: above the mean high tide, but exposed to waves, spray, and wash from passing ships.
 - iii. Intertidal zone: between mean high and low tides.
 - iv. Continuous immersion zone: below lowest low tide.
 - v. Underground zone: below the mudline.

9.0 Instrumentation

The CA or the Sub- Consultant on its behalf shall also be responsible to provide ground monitoring instrumentations during construction such as piezometer, settlement markers and plates and inclinometer etc, in order to facilitate the monitoring and reporting phase of any ground improvement methods/slope stabilization method:

- (i) To provide sufficient quantities of instrumentations and equipments required.
- (ii) To provide planning and monitoring instrumentation schedule.
- (iii) To analysis and interpret instrument data
- (iv) To review the design in case monitoring result show noncompliance to assumptions made during design stage.

SEKSYEN I : BAHAGIAN D

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI BERDANJAN 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Dokumen Meja Terkawal

APPENDIX A1: SOME TYPICAL DESIGN CRITERIA FOR GEOTECHNICAL WORKS

DESIGN COMPONENT			MODE OF FAILURE		MINIMUM FACTOR OF SAFETY	DESIGN LIFE (durability of materials)	REMARK		
1.	Slope / Embankment (not on soft ground)	Unreinforced	1.1 Local & Global Stability	1.3 Bearing (fill)	2.0	75 yrs	Analysis should be according to GEOTECHNICAL MANUAL FOR SLOPES (1984), GEO Hong Kong		
		Reinforced or Treated	1.3 Local & Global Stability						
2. Embankment on Soft Ground			2.1 Bearing (short term)	1.4	75 yrs	5 years post construction settlement : (i) within 50m from structures approach < 100mm } Differential Settlement (ii) within 100m remote from structures < 100mm Total Settlement <250mm			
			2.2 Local & global slope stability (short term)						1.3
			2.3 Local & global slope stability (long term)						1.2
3. Permanent Anchors			3.1 Tensile Resistance	2.0	75 yrs	Geo Spec 1 (1989), GEO Hong Kong BS 8081			
			3.2 Resistance at Soil Grout Interface	3.0					
			3.3 Creep/corrosion	3.0					
4. Rigid Retaining Structures			4.1 Overturning	1.8	75 yrs	Max. permissible vertical movement : 15mm along face of wall - Geoguide 1 (1983), GEO Hong Kong	Max. permissible lateral movement : 15mm along face of wall	Max. permissible differential movement : 1 : 150 along face of wall	
			4.2 Sliding	1.6					
			4.3 Overall Stability	1.5					
			4.4 Bearing	2.0					
5. Reinforced fill walls/structures			External Stability		BS 8006	120 yrs	Verticality: ± 5mm per metre height	Alignment along top (horizontal) : ± 15mm from reference alignment	Max. permissible differential movement : 1 : 100 along face of wall
			Internal Stability						
6. Individual Foundation Piles (mainly under axial loads)			6.1 Shaft Resistance	2.0	75 yrs	Allowable settlement: 12.5mm along axis of pile at pile head at design load. 38mm or 10% pile size at pile head at twice design load. Residual settlement not exceed ((diam. of pile or diagonal width for non-circular pile /120) + 4) mm OR 12.5 mm whichever is the lower value. BS 8004 & JKR Standard Specification for Building Works 2014			
			6.2 Base Resistance	3.0					
7. Individual Foundation Piles (mainly under lateral & bending loads perpendicular to axis of pile)			Ultimate Lateral Resistance		2.5	75 yrs	Allowable settlement: 12.5mm along axis of pile at pile head at design load BS 8004		Max. permissible lateral movement : 12.5mm perpendicular to axis of pile at design load
8. Pile Group			Block Bearing Capacity		2.0	75 yrs	Allowable settlement: 12.5mm at Working Load BS 8004		
9. Piles as Retaining Structures			As for 4, 6 & 7 above		As for individual foundation piles	75 yrs	As 4 above for rigid retaining structures BS 8004		

STRUCTURAL WORKS DESIGN REQUIREMENTS

1.0 General

- 1.1 The design and construction of all Structural and related services shall follow good engineering practice and shall comply with the requirements of the relevant Authority in terms of design standards and parameters. The CA or the Sub-Consultant on its behalf shall comply with the latest By-Laws and latest Rules and Regulations of all Approving Authorities. A copy of all correspondence with Approving Authorities shall be submitted to the S.O.
- 1.2 All design and build Works shall accommodate and satisfy the Civil & Structural, Mechanical and Electrical (M&E) requirements and drawings.

2.0 Design Consideration

- 2.1 All buildings shall be designed and constructed to ensure structural strength, integrity, stability, serviceability, to satisfy the requirements of durability, cost effectiveness and aesthetics. All structural Works are to be designed and constructed in accordance with the relevant Malaysian/European/British Standards and Codes of Practice.
- 2.2 Design for all concrete structures shall take account of the conditions of exposure, the quality of cement, compatibility of admixtures, concrete compressive strength class, minimum cement content of concrete mix, maximum water/cement ratio, concrete cover to reinforcement, the shape and bulk of the structure, ground water quality, curing, workmanship and other factors which influence the durability of reinforced concrete.
- 2.3 The actual concrete cover shall be determined by the CA or the Sub-Consultant on its behalf based on bond, durability and fire resistance requirements as specified in the Uniform Building By-Laws 1984 and in compliance with MS EN 1992.
- 2.4 All structural steel members shall be given protective treatment against corrosion and minimum 2 hours fire protection and shall comply with the JKR Standard Specification for Structural Steel Works.
- ~~2.5 For Industrialised Building System (IBS) projects, the design must be based on IBS unless otherwise exempted by the Government. The structural component design shall adopt the Modular Co-ordination approach using preferred dimensions to produce repetitiveness and regularity in the structural components. The minimum total IBS Score fixed at 70 points and the calculation shall be carry out based on CIS 18 Manual IBS Content Scoring System (IBS Score) by CIDB. The CA or the Sub-Consultant on its behalf must ensure that all architectural and M&E Works are well coordinated with the structural components.~~

- ~~2.6 All structural solid timber Works shall be of the strength group SG 1, SG 2, SG 3 and SG 4 in accordance to MS 544 and JKR Standard Specifications for Building Works and made up of heavy hardwood and duly treated where applicable. The strength group for Engineered Timber Product (ETP) shall be a minimum of SG5 or equivalent, in accordance with MS 544: Part 2. Engineered Timber Product (ETP) and solid timber structures shall be designed and constructed in accordance with relevant standards. Solid timber properties and other parameters related to Malaysian tropical timbers shall be referred to MS 544.~~
- 2.7 Proper attention shall be given to the stability of non-loadbearing brickwork or blockwork. Wall stiffeners shall be provided at every minimum of 3m vertically and horizontally to strengthen the brickwork and blockwork. Stiffeners, lintels, ties reinforcements, sleeper beam and connections shall be used judiciously.
- 2.8 Concrete slab for all wet areas shall be at least 150mm thickness. This type of floor shall be designed with sloping gradient or small upstand.
- ~~2.9 The design of concrete flat roof and fully cantilevered concrete gutter is not recommended. However, if there is a requirement, the design shall have a minimum cambering of 1:60 or as specified by the Architect towards the water outlet and shall be waterproofed. The same design shall be applied for concrete trenches and other concrete wet areas.~~
- 2.10 All parapet walls located in car parks shall be designed to withstand impact from accidental actions from vehicles. Reference shall be made to the latest IstructE (The Institution of Structural Engineers) guideline entitled Design Recommendations for Multistorey and Underground Car Parks.
- 2.11 All precast elements shall be designed to include safety during transportation, erection and launching. The design of these elements shall take into account the requirements for fail safe mechanisms to prevent accidental collapse during launching and erection. A minimum Factor of Safety of 1.5 shall be used for the design of these elements.
- ~~2.12 All structural attachments for claddings/curtains walls, fascia boards and other architectural fittings shall be properly designed to the relevant limit state requirements and shall be designed for a minimum design life of 50 years and must be checked and approved by the PE.~~
- ~~2.13 Coordination for all mechanical and electrical components such as sanitary fittings, internal plumbing and water reticulation pipes shall be designed and~~

~~installed properly into concrete components. No hacking/break-up is allowed on hardened concrete components.~~

2.14 Detailing of all structural concrete components shall be in accordance to relevant Codes of Practice. The minimum size of main reinforcement for columns and beams is 12mm while for other structures is 10mm. For stirrup or link, the reinforcement shall not be less than 8mm.

2.15 Design for maintenance shall take into consideration the following;

- a) All structural elements shall be designed for enhanced durability. Materials shall be durable and adequate protection shall be provided against environmental deterioration.
- b) All structural elements shall be designed for ease of inspection, maintenance and replacement of the various parts such as expansion joints.
- c) Suitable access facilities shall be provided and incorporated in the building structure where access is not possible by normal means.

2.16 Movement joints, expansion joints, construction joints or other permanent structure joints shall comply with Section D, JKR Standard Specifications for Building Works.

3.0 Structural Action (Loading)

3.1 All structures shall be designed for the worst combination of action (loading) and additional loads and comply with MS EN 1991: Action of Structure. All loads mentioned shall be combined in the most unfavorable way for design of structural member and for stability of the whole structure. Actual action (loading) shall also be obtained from catalogues/mechanical and electrical engineer/architect and special requirements by the client.

3.2 Design of building for earthquake resistance shall be in accordance with MS EN 1998. Check for design ground acceleration for determination of seismic zone and ground types based on soil parameters shall be carried out in early state of design for all projects. For projects under low to moderate seismicity and high intensity seismicity, mitigation approach with level of performance requirement and appropriate structural system shall be adopted. Structural simplicity, uniformity, regularity, symmetry and redundancy shall be as basic principle in conceptual design.

~~3.3 The minimum design variable action (loading) to be used for the roof truss design shall be 0.25kN/m^2 . In the design of roof trusses, provision for inspection for the purpose of maintenance such as platform with railings shall be included to consider M&E services.~~

- 3.4 The minimum density of materials for non-loadbearing brickwork or blockwork considered in the structural design shall be 19kN/m^3 . All slab designs shall be able to transfer action (loading) of non-loadbearing brickwork or blockwork of unknown location.
- 3.5 For load bearing blockwork designs, the mean compressive strength of block units shall not be less than 7N/mm^2 and the minimum net dry density shall not be less than 1500kg/m^3 . The minimum strength of normal mortar shall be 6N/mm^2 and for thin layer mortar shall be 12N/mm^2 . The concrete infill for reinforced block shall be of minimum C25/30 with 10mm nominal size aggregates. All designs and construction shall comply with the JKR Standard Specification for Load Bearing Blockwork System.
- ~~3.6 Wind actions mean all actions (loading) due to the effect of wind pressure or suction. Wind actions (loading) shall be calculated in accordance with MS 1553 or MS EN 1991 with modification on the wind speed to suit the actual local condition.~~
- 3.7 Execution action (loading) affects partially completed structures during the execution stage and is characteristically temporary. The magnitude and direction of such forces acting on any part of the structure depends on the type of execution plant or equipment employed and its placement with respect to the affected structural member concerned and shall be taken into consideration in the design of the structural elements. The minimum execution action (loadings) is 1.5kN/m^2

4.0 Structural Material

- 4.1 All structural concrete shall be of minimum strength class C30/37 (cylinder strength/cube strength) with minimum cement content not less than 300kg/m^3 and maximum free water/ cement ratio 0.55.
- 4.2 Steel reinforcement yield strength shall be 500N/mm^2 and shall be noted as 'H' in the structural drawings. Steel reinforcement yield strength for wire mesh fabric shall not be less than 500N/mm^2 .
- 4.3 All structural steel otherwise specified shall be in Hot Rolled Sections, Structural Hollow Sections, Plates and Bars and shall comply with the appropriate standards mentioned in the JKR Standard Specification for Structural Steel Work, MS EN 1993 and relevant code of practice. The structural steel material shall be at least Grade S275 (yield strength = 275N/mm^2).
- 4.4 Proprietary prefabricated timber/ cold formed roof trusses shall be manufactured only by reputable licensed truss suppliers listed in J-TRUSS

online system and approved by the S.O. The full requirements are outlined in the following documents:

- i. JKR Standard Specification for Prefabricated Timber Roof Trusses ; or
- ii. JKR Standard Specification for Prefabricated Cold Formed Steel Roof Trusses

5.0 Standard and Code of Practice

5.1 The Standards and Codes of Practice shall be applicable for all structural engineering Works but not limited to the following:

Malaysian Uniform Building By-Laws (UBBL).

MS 1553	: Code of Practice on Wind Loading for Building Structure
MS EN 1990	: Basic of Structural Design
MS EN 1991	: Action of Structure
MS EN 1992	: Design of Concrete Structure
MS EN 1993	: Design of Steel Structure
BS EN 1994	: Design of Composite Steel and Concrete Structure.
BS EN 1995	: Design of Timber Structures
BS EN 1996	: Design of Masonry Structures
MS EN 1997	: Geotechnical Design
MS EN 1998	: Design of Structures for Earthquake Resistance
MS 544	: Code of Practice for Structural Use of Timber
MS 1195	: Code of Practice for Structural Use of Concrete
MS EN 197	: Composition, Specifications and Conformity Criteria for Common Cements
MS EN 12620	: Aggregates for Concrete
MS 30	: Method of testing Aggregates.
MS EN 206	: Concrete – Specification, Performance, Production and Conformity
MS 523-1	: Concrete – Part 1: Specification, Performance, Production and Conformity
MS 523 -2	: Concrete – Part 2: Method of Specifying and Guidance for the Specifier
MS 144	: Steel Wire for the Reinforcement of Concrete Products – Specification
MS 145	: Steel Fabric for the Reinforcement of Concrete – Specification
MS 146	: Steel for the Reinforcement of Concrete – Weldable Reinforcing Steel – Bar, Coil and Decoiled Product – Specification.
BS EN 10025	: Hot Rolled Products of Structural Steels
BS EN 10210	: Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Steels.
BS EN 10219	: Cold Formed Welded Structural Hollow Sections of Non-Alloy and Fine Grain Steels
BS 499	: Welding Terms and Symbols

MS 837	:	Solid Timber – Determination of Moisture Content
MS 360	:	Treatment of Timber with Copper/ Chrome/ Arsenic/ Wood Preservatives – Specification
MS 1714	:	Specification for Visual Strength Grading of Tropical Hardwood Timber
MS 1064	:	Guide to Modular Coordination in Buildings
BS 8000	:	Workmanship on Building Sites. Code of Practice for Waterproofing
MS 2282	:	Masonry Units
BS 6073-2	:	Precast Concrete Masonry. Guide for Specifying Precast Concrete Masonry Units
BS EN 771-3	:	Specification for Masonry Units. Aggregate Concrete Masonry Units (Dense and Lightweight Aggregates)
BS EN 772-2	:	Methods of Test for Masonry Units. Determination of Percentage Area Voids in Masonry Units (by paper indentation)
BS 5606	:	Guide to Accuracy in Building

CIVIL WORKS DESIGN REQUIREMENTS

1.0 GENERAL

- 1.1 All design shall be in accordance with good engineering practice and shall comply with the By-Laws and latest Rules and Regulations of all Approving Authorities.
- 1.2 The following standards and specifications or their latest versions/ammanments shall be adopted by CA or the Sub- Consultant on its behalf in the design. Other standards and specifications may be used with the prior approval by JKR :
 - i. Uniform Building By-Laws (UBBL)
 - ii. JKR Standard Specification for Building Works 2014
 - iii. JKR Standard Specification for Road Works
 - iv. JKR Standard Specification for Bridgeworks (JKR/SPJ/2013/S13)
 - v. JKR Standard Specification for Structural Steel Work (JKR 20601/0191/12)
 - vi. Manual Saliran Mesra Alam (MSMA)
 - vii. Warta Kerajaan Akta Industri Perkhidmatan Air 2006
 - viii. Design Criteria and Standard for Water Supply System (Malaysia Water Association)
 - ix. Uniform Technical Guideline Water Reticulation and Plumbing (Suruhanjaya Perkhidmatan Air Negara)
 - x. Standard Code of Practice for Design and Installation of Sewerage Systems - MS 1228
 - xi. Malaysia Sewerage Industry Guidelines (Volume 2 – Volume 5) (Suruhanjaya Perkhidmatan Air Negara)
 - xii. Keperluan Pihak Berkuasa Tempatan (Local Authorities)

1.3 Survey and Subsurface Exploration

The CA or the Sub- Consultant on its behalf shall search, and study all reports on feasibility study, development plans and investigations related to the Works to enable full understanding of factors which may affect the works. Notwithstanding requirements stipulated herein the CA or the Sub- Consultant on its behalf shall ensure that all designs satisfy the aspects of aesthetics, functional requirements, safety, suitability and effectiveness completely to the intent of the Works.

2.0 EARTHWORKS

- 2.1 The earthworks shall be designed as such that the platform levels and are suitable to the functions of the project. Earth works design shall also

be optimum with balanced cut and fill minimum import and export.

- 2.2 Earthworks design shall be carried out according to good engineering practice, conforming to the Malaysian/European/British Standards and Code of Practice EN 1997 and MSMA or the latest edition published by JPS where applicable.
- 2.3 The CA or the Sub- Consultant on its behalf shall propose in their design a comprehensive erosion and sediment control plan (ESCP) conforming to MSMA requirement. These shall include provision of Best Management Practices (BMPs) such as turfing, earth drains, check dams, sediment basin and other temporary control measures. Washing bays shall be provided to remove excessive sediment from outbound vehicles at all site access points.
- 2.4 The entire site formation levels shall be designed and filled higher than the known flood levels provided by Jabatan Pengairan dan Saliran (JPS). In absence of such information the flood level shall be determined by other reasonable means. In addition, earthwork design level shall take into account minimum slope required for sewer and drain to flow by gravity, the CA or the Sub- Consultant on its behalf shall also check and ensure that earthworks levels shall not cause road to sloap beyond acceptable limit.
- 2.5 The characteristic of the soil must be studied to determine its engineering properties and its suitability as filling materials. The slope shall be designed for stability and suitable slopes protection have to be provided and stated in the drawing.
- 2.6 Earthworks shall be designed in such a way not to cause silting up of canals, streams, drains, culverts or any other drainage structures. Precautions shall also be taken to prevent earth moving plants and vehicles from affecting cleanliness of public roads or causing objectionable dust to the atmosphere.
- 2.7 Temporary drainage, turfing on slopes and open areas must be indicated in the drawing.
- 2.8 Earth retaining structures and slope stability shall be designed in accordance with Geotechnical requirements.

3.0 DRAINAGE SYSTEM

- 3.1 The drainage works shall consist of all required design and construction of the drainage system and shall conform to the requirements of Jabatan Kerja Raya, Jabatan Pengairan dan Saliran and Local Authorities.
- 3.2 Proper sustainable drainage system shall be provided and designed in compliance with MSMA. All drains shall be properly designed and constructed to give the best hydraulic features. There shall be no flooding, ponding, silting-up either during construction or after completion of the works.
- 3.3 Drainage system shall be designed with regard to both operation and ease of maintenance. Adequate gradient shall be provided to enable self/cleansing flow.
- 3.4 Drainage system shall include construction of drains, sumps, culverts, scupper drains, cascading drains, subsoil drains, interceptor drains and pumping stations where necessary
- 3.5 Drains shall be designed around buildings, on both sides of the roads and at other necessary locations to prevent flooding, settlement, erosion and instability of soil and slopes. All perimeter drains around buildings shall be covered or concealed where necessary.
- 3.6 A minimum drain reserve of 1.5 m wide shall be provided for on both sides of the road. Surface runoff, stream and river flow near the roadway shall be computed and from such computation design shall be made for drainage system of the road which includes culvert, roadside drain, subsoil drain, interceptor drain, etc. All drainage design shall be in accordance with the guidelines and criteria established by JKR as well as procedures in MSMA. The structural design of reinforced box culverts shall be in accordance with Eurocode 2 and the loading shall be in accordance with that of MS EN 1991
- 3.7 Final discharge point shall be identified and approved by JKR and relevant authorities. Drainage system outside the boundary within the vicinity of the project shall also be considered in overall project design. If necessary, the drainage system shall be upgraded in order to ensure adequate and fully functional drainage system is provided for the project.
- 3.8 The Stormwater Quantity Design Criteria shall comply to MSMA or the latest edition published by JPS.

- 3.9 Surface drains shall be designed in accordance with MSMA and shall cater for efficient removal of storm water from road surface, erosion protection and slope stabilisation.
- 3.10 Side walls of drains, wing walls and apron of culverts shall be properly designed to prevent erosion or scouring.
- 3.11 All structural works such as culvert and related components are to be designed and constructed in accordance with the relevant Malaysian/ European/ British Standards and Codes of Practice.
- 3.12 All deep sumps, deep drains shall be covered with high strength grating to ensure safety of pedestrian or vehicles. All drains at the entrances and exits to buildings as well as public area must be properly covered by suitable cover slabs or grating.
- 3.13 Other safety structures like parapet wall, guardrails shall be provided where necessary.

4.0 ROAD WORKS

- 4.1 The starting point for the proposed alignment of the internal road network will form a junction with the existing roads towards the site. The alignment shall be proposed by the CA or the Sub- Consultant on its behalf.
- 4.2 The road works shall comprise the following major components:
 - a. Access road(s) from the Federal / State and municipal road including all the works required by Local Authorities/ JKR;
 - b. An internal road network within the site complete with stream crossing;
 - c. Earth retaining structure where necessary along the proposed road;
 - d. Drainage system to drain out water from areas along the road to suitable discharge points;
 - e. Road intersections, road markings, road furniture, traffic control devices, public utilities service culvert, relocation/protection of existing services, street lightings, traffic lights, pedestrian sidewalk, landscaping, environmental protection and all other associated works;
 - f. Hard standing at required areas; and
 - g. Carrying out traffic study and/or ~~Traffic Impact Assessment (TIA)~~

and Road Safety Audit (RSA) when required by the PP/ Local Authorities.

- 4.3 All designs shall optimally conform to Arahan Teknik (Jalan) JKR and other approved International Standard (when required) in respect of visual elegance, functional adequacy, safety, suitability, robustness, ease of maintenance, cost effectiveness and aesthetics.
- 4.4 The CA or the Sub- Consultant on its behalf shall collect and analyse all available data, records, proposals, and drawings. Any further study, survey or investigation shall be carried out if additional information is required for the design and construction of the whole works.
- 4.5 The CA or the Sub- Consultant on its behalf shall verify ground details such as topographical features, existing tracks and location of existing utility services to confirm the information contained in the existing survey drawings. Additional field survey shall be proposed if further information is required.
- 4.6 The CA or the Sub- Consultant on its behalf shall identify all public utilities inclusive of High Tension Transmission lines affected by the works and provision for relocation and protection of services to the satisfaction of the relevant utility authorities or companies.
- 4.7 The CA or the Sub- Consultant on its behalf shall identify all associated drainage facilities comprising culverts, sub-surface and surface drainage works and the relocation, repair and removal of existing drainage structures where required in full compliance to all JKR / JPS / Local Authorities requirements.
- 4.8 **Relocation / Protection of Utility Services:**
The CA or the Sub- Consultant on its behalf, during the design stage, liaise with all affected utility companies or authorities regarding existing utility installations on the necessity of relocation/protection or diverting such installations. The CA or the Sub- Consultant on its behalf shall, if required, propose locations of these installations, put up detailed plans and proposals for the relocation, temporary or otherwise, of such services if affected by the Works
- 4.9 The CA or the Sub- Consultant on its behalf shall carry out and prepare detailed analysis, design, drawings and specifications following the approval of the preliminary design by the Government. This shall include the following:

- a. Detailed analysis and design of the Works;
- b. Scale plans and drawings for the complete construction of the Works. These shall include:
 - i. Layout plans of the earth retaining structure and road showing details of geometric elements and existing ground levels;
 - ii. Detailed setting out plans for the road alignment, intersections, slope protection, drains and culverts and other related structures all to a suitable scale including the invert levels and reduced levels at appropriate intervals and locations;
 - iii. Typical cross-sections of the road, culverts, connecting roads, temporary diversion roads and crossings, earth embankments, retaining walls, etc. showing the various dimensions of the elements at appropriate locations;
 - iv. Longitudinal sections of the road, culverts, connecting roads, temporary diversion roads and crossings, earth embankment, retaining wall, etc. showing the existing levels, proposed levels, super/elevation and invert levels of drains and culverts;
 - v. Drainage and sub-soil drainage plans, showing details such as type, size and length and other dimensions of the proposed drainage system;
 - vi. Structural drawings for the structures shall include the engineering design of the foundations, and the design of the earth retaining structure;
 - vii. Plans showing road layout, lane markings, traffic signs including advance directional signs and Traffic Management Plan during construction Plans showing proposal for environmental protection and mitigation works. Plans showing details of public utility services, which shall include 'ducting'; and
 - viii. Land acquisition plans as the case may required.

4.10 Road Design Criteria:

- a. Road Geometrics - The geometric design of the road and bridge structures shall satisfy the minimum criteria for JKR R3 / U3 standard laid down in Arahan Teknik (Jalan) 8/86 (Pindaan 2015) / "A Guide to Geometric Design of Roads", where appropriate. In selecting the design alignment, the following requirement should be considered:
 - i. Avoid if possible, any land acquisition and minimum overall construction cost;

- ii. Minimizing services relocation works; and
- iii. Minimizing the number of rivers, stream/canal crossing.
- b. Vertical Alignment - A desirable grade shall be allowed for the approach roads. Lane width shall be a minimum of 3.0m with an additional marginal strip of 0.25m throughout the whole stretch.
- c. Road Shoulders - Road shoulder shall be a minimum of 1.5 meter on both side unless conditions require otherwise.
- d. Road Median (if required) shall be of 3.0 m wide.
- e. Pedestrian Walkway -The pedestrian walkway shall be a minimum of 2.0m wide throughout the whole stretch of the road on both sides of the road or only at one side of the road where space is restraint for the construction of the walkways.
- f. Pavement -The pavement for roadwork shall be of flexible type and designed in accordance with the Arahan Teknik (Jalan) or REAM Guidelines. The design life of the flexible pavement shall be 10 years.
- g. Intersection and Access - The layout, design and type of control at intersections shall be prepared to suit the traffic volume.
- h. Temporary Control Devices and Signs -Temporary control devices and signs during construction shall be following relevant Arahan Teknikal Jalan JKR Guidelines with respect to traffic control devices, temporary sign and work zone control.
- i. Road Marking - The design covers all road markings such as centre line, edge line, chevron, arrows, etc. The marking shall be made from reflective paints. Types and colour of the markings shall be designed in accordance to Arahan Teknik (Jalan) 2D/85 published by JKR.
- j. Guardrails - The design of traffic guardrails shall be designed in accordance with REAM Guidelines.

5.0 EXTERNAL WATER SUPPLY SYSTEM

- 5.1 The design shall consist of all required component of external water supply system in order to provide reliable and enough water supply to the proposed project. The external water supply system shall be

designed and implemented in harmony with other utilities and surroundings to meet the Client's needs in terms of functionality ease of operation and maintenance and durability.

- 5.2 The information together with other relevant data shall be evaluated and use as the basic of design.
- 5.3 The total water demand for the project shall be estimated based on the basic function of the proposed project.
- 5.4 The criteria for estimating daily water demand and total water demand shall be based on the Uniform Technical Guideline (UTG) or as per specified in Design Guidelines for Water Supply Systems published by The Malaysian Water Association (MWA) or other relevant guidelines published by State Water Authorities (SWA).
- 5.5 The SWA shall provide the source of water supply. In the case where the unable to supply the water quantity required, the CA or the Sub-Consultant on its behalf shall propose alternative supply subject to the approval of the SWA and the PP. The CA or the Sub- Consultant on its behalf shall be responsible to identify and connect to the SWA supply mains.
- 5.6 The design may comprise but not limited to the following items:
 - a. Tapping from the approved SWA supply mains
 - b. Distribution pipes from tapping points to elevated water tank or roof top storage tanks of the proposed buildings with/without pumping system or with/without suction tank depending on the available pressure at the tapping points;
 - c. Suction tank and booster pump house complete with Mechanical & Electrical (M & E) system and automatic control system, where pumping system is required;
 - d. Elevated water tank;
 - e. Instruments and meters;
 - f. Testing and commissioning; and
 - g. All ancillary works necessary for the completion of the project.
- 5.7 Any item which is not specifically stated in the Scope of Works but is necessary for the completion of the project shall deem to be included and provided for in terms of design.
- 5.8 The design of the system shall comply with the Uniform Technical Guideline (UTG) published by Suruhanjaya Perkhidmatan Air Negara or

Related Water Authorities.

- 5.9 The CA or the Sub- Consultant on its behalf shall propose distribution pipes in complete and functional reticulation system for cold water supply and external fire hydrants for the project.
- 5.10 In case of available pressure at the tapping point is not adequate, pumping system shall be required for the distribution of water to all the building blocks of the project. The system shall consist of suction tank, pump house, M&E equipment and pumping mains to the roof tanks. However, subject to practicality and number of blocks in the project, the CA or the Sub- Consultant on its behalf may need to design external elevated water storage tank of nominal capacity equivalent to the required storage of the total water demand. Water shall be pumped to this storage tank and then gravitated to all the buildings' roof tanks.
- 5.11 Material for all water tanks shall be approved the by PP and the water authorities.

6.0 SEWERAGE SYSTEM

- 6.1 The design of the system shall comply with the Malaysian Sewerage Industry Guidelines (MSIG) published by SPAN.
- 6.2 The sewerage works shall cover design and submission for sewerage authority's approval.
- 6.3 The CA or the Sub- Consultant on its behalf proposal for the Works shall include the following details and information:
 - a. Description on the scope of Work
 - b. Layout plan including sections, details and components of the system
 - c. Design report
 - d. Material and component specifications
 - e. Original technical information for all proposed system
 - f. Submission to Certifying Agencies
- 6.4 If there is an existing public sewer system for the area, the sewerage pipelines within the sites shall be connected to system.
- 6.5 The Works to be carried out shall include the following: -
 - a. Sewerage pipelines including Sewage Treatment Plan (STP) or all

- the pipework connecting to the public sewer.
- b. Connection of building soil drainage system to the sewerage pipelines;
- 6.6 The STP or septic tank system shall be optimally designed with minimum maintenance.
- 6.7 Pipe shall be laid in straight line, tightly jointed and at correct gradient to ensure smooth flow of the effluent and prevent blockages or damages to the pipes.
- 6.8 Adequate cover and bedding shall be provided to all pipes to avoid damage due to external load and ground condition. Backfilling shall be done after satisfactory leakage test. All material shall conform to relevant Malaysia Standards and of type approved by SPAN and/or relevant Local Authorities. The minimum diameter of pipes used shall also meet the requirements set by SPAN and/ or relevant Local Authorities.
- 6.9 The sewerage reticulation shall be designed to flow by gravity unless site condition dictated otherwise. The pipes shall not be laid under the road pavement without proper protection.
- 6.10 All manholes shall be of pre-cast and installed at not more than 100 meter apart at all junction and turning point.
- 6.11 Pre-cast concrete manholes shall conform to Specification for Precast Concrete Pipes and Fittings for Drainage and Sewerage – M.S. 881 and Specification for Unreinforced and Reinforced Concrete Manholes and Soakways/BS EN 1917:2002. Manholes shall be constructed with pre-cast concrete sections surrounded by in-situ concrete.
- 6.12 Manholes cover to be watertight and capable of withstanding external loading and conforming to Code of Practice for Design and Installation of Sewerage Systems – MS 1228/ EN 124:1994
- 6.13 The location of inspection chambers and manholes on roadways shall be avoided.
- 6.14 If pump station is required, the system shall be designed in accordance with the following:
- a. Malaysian Sewerage Industry Guidelines (MSIG) published by SPAN and/or relevant Local Authorities.
 - b. Standard Code of Practice for Design and Installation of Sewerage

Systems – M.S. 1228

- 6.15 The standards of effluent discharge from sewage and wastewater treatment plant shall comply with Standard A, Environmental Quality Act.
- 6.16 In general, the STP shall be planned and designed to meet the following standard:
 - a. The STP shall be activated sludge system and shall be approved by SPAN and/or relevant Local Authorities
 - b. Compliance with effluent quality requirement
 - c. Optimized capital and operating costs of the plant
 - d. Meeting local environment and aesthetic requirements, including the proximity to the nearest habitable premises, direction of the

prevailing winds, local zoning requirements, socio economic aspects and compatibility of the treatment processes with the present and future land receiving waters.

7.0 — RAINWATER HARVESTING*

- ~~7.1 — Rainwater Harvesting shall be designed whenever indicated to recycle rainwater for non-portable use such as cleaning and landscaping. If the location of Rainwater Harvesting Tank located inside the building, the CA or the Sub-Consultant on its behalf shall coordinate with Mechanical Consultant to design the tank.~~
 - ~~7.2 — The system utilizes the principal of collecting and using precipitation from a roof top and other means, above ground collection surface.~~
 - ~~7.3 — Harvested rainwater collected shall comply to the requirement of Architectural Needs Statement. The rainwater must be filtered or treated to an appropriate quality suitable for intended use.~~
 - ~~7.4 — The CA or the Sub-Consultant on its behalf shall advice the Architect for sizing of Gutter, numbers and sizing of rainwater downpipe (RWDP).~~
 - ~~7.5 — Rainwater Harvesting System must consist of catchment, conveyance, storage and distribution system. It shall enhance a water quality for the intended use.~~
 - ~~7.6 — The rainwater harvesting shall include potable water supply (by pass) and triggering system where there is insufficient rainwater supply or drought season.~~
 - ~~7.7 — If the above ground storage to be proposed, it shall be protected from direct sunlight and constructed using appropriate materials or have specially constructed su barriers.~~
 - ~~7.8 — Where pump is to be used in the rainwater harvesting system, it shall be listed and approved for the use with water application system.~~
 - ~~7.9 — The water quality shall comply with Jabatan Alam Sekitar, SPAN for the National Water Quality Index and/or relevant water authorities.~~
- (*delete if not required)

TERMS OF REFERENCE FOR ROAD SAFETY AUDIT

1.0 Objectives of Road Safety Audit

The objective of Road Safety Auditing is to identify road safety deficiencies at various stages in the development of road projects/network so that they can be eliminated or mitigated at the most opportune time to reduce costs and minimize disruption to planning, design, construction and operation, and ultimately to enhance the safety of the road environment.

Scope of Work

Road Safety Audit shall be carried out in accordance with the Guideline For The Safety Audit Or Roads And Road Projects In Malaysia prepared by JKR and shall include audits at the following stages of the project:

Stage 1 Audit - Planning and Feasibility Stage of the Project Development

The Stage 1 Audit will be carried out during the Planning phase, where a number of alternative proposals are being considered for the project. Audit is to be made of each alternative, the results of which (to the extent relevant) should be included in the evaluation process.

Stage 2 Audit - Preliminary Design Stage

The Stage 2 Audit will be carried out at the end of the preliminary design phase where the Functional Layout has been prepared and land acquisition requirements are being determined.

~~Stage 3 Audit - Detailed Design Stage~~

~~This audit must be done at an appropriate stage towards the end (but not at the end) of the detailed design, or as soon as it is possible to determine the safety implications of the design and when changes can be made at the most opportune time to avoid costly redesign. This may necessitate separate audit checks as various elements of the project reach the desired stage of design.~~

~~The audit work at this stage includes auditing the suitability and workability of the proposed traffic management that will be carried out during the construction. The Guidelines on the Estimation Procedures for Traffic Management prepared by JKR will be used as a basis for the traffic management procedures.~~

~~Stage 4 Audit - At the Construction/Pre-Opening Stage~~

~~Road Safety Audit Stage 4 shall include two distinct aspects as follows:~~

- ~~a) Audit of the compliance of the works to the Stage 3 Audit (Detail Design)~~

~~to ensure that the decisions of JKR with regards to the Stage 3 Audit are 'carried through' in the construction. In particular the audit shall include a final detailed check of the project just prior to it being 'opened to traffic'.~~

~~b) Audit of Traffic Management through and in the vicinity of the project during the construction phase. This includes the observation of the effectiveness of the Traffic Management Plans (TMPs) prepared by the contractor / consultant and the devices employed during the night. The scope of work shall include:~~

~~i) Auditing the TMPs during the Design Phase~~

~~ii) Auditing the changes to the TMPs and Work Zones during the Construction Phase. This is to be carried out at every Stage 4 audit and additional every three (3) months or as required by the Supervision Officer. The audit shall be carried out based on the latest Traffic Management Safety Reports prepared by the Traffic Management Officer from the contractor's counterpart.~~

~~The audit at this stage will be carried out three (3) times during the construction duration:~~

~~a) RSA Stage 4 (Part 1) or Verification Audit to be carried out after the issuance construction and traffic management drawings.~~

~~b) RSA Stage 4 (Part 2) to be carried out when the construction work's progress is about 50%.~~

~~c) RSA Stage 4 (Part 3) to be carried out during the pre-opening of the project. Both day and night audit will be required~~

~~Should the Supervision Officer require additional audit, he shall ask the Road Safety Auditor to carry out the additional audit and the additional fees shall be agreed upon by the Supervision Officer and the Road Safety Auditor.~~

Stage 5 Audit – Operational Stage

~~There are two types of Stage 5 audit:~~

~~a) On new road projects~~

~~b) On existing road~~

~~The audit at this stage is to ensure that the roads are safe for public use.~~

~~The Stage 5 audit for new projects shall be carried out within three (3) to six (6) months after the opening of the project to the public.~~

~~The project development shall not proceed into the next stage of audit before resolution of each of the road safety items identified from the previous audit.~~

~~JKR reserved the right to commence the audit at the appropriate stages~~

3.0 Use of Road Safety Audit Check Lists

The Road Safety Audit Guidelines issued by JKR detailed 'Check Lists' for each of the above stages of Audit. These Check Lists should be used as a guide and 'reminder' of the items to be considered and it needs to be recognised that they do not necessarily provide a complete list of the issues or points to be checked. It is the auditor's responsibility to critically examine all aspects of the project which may have adverse safety implications, considering carefully the need of all road user groups in the development of the road projects.

4.0 Management of Road Safety Audit

The process flowchart in Appendix 1, 2, 3, 4, 5, 6 and 7 shall be used as a guide in the management of road safety audit.

5.0 Road Safety Auditors

5.1 Roles of Auditor

The principal role of the Auditor is to ensure that safety deficiencies/problems/hazard are identified before they are locked into the design and/or become a safety problem. The Auditor is expected to highlight all the safety deficiencies in a design/existing road.

The Auditor will look into:

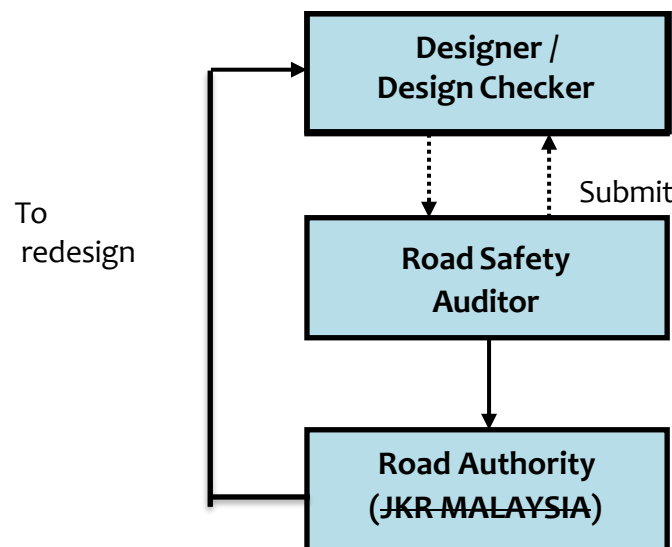
- a) Adoption of appropriate standards
- b) Compliance and non-compliance of standards that will have road safety implications

The Auditor's primary role is to look into the safety repercussion of compliance to standard or otherwise and highlight the possible consequences wherever possible of major road safety deficiencies.

The Auditor is expected to use his/her experience and wisdom in dealing with the design checkers in these overlapped areas.

The following flowchart indicates the position of the Auditor in relationship with other parties:

Flowchart



5.2 Independence of Auditors

The auditors must be independent of project planners, designers and construction companies involved in the project and have no business or other company associations with them.

6.0 Qualification of Road Safety Auditor

A qualified Road Safety Auditor shall be an engineer that have a good understanding of the Driver/Vehicle/Road Environment interaction and have experience in accident investigation and countermeasures. The auditor shall also fulfill the following requirements:

- Minimum ten (10) years working experience as Civil Engineer or eight (8) years working experience as Civil Engineer with Masters' Degree qualification in road engineering areas or six (6) years working experience as Civil Engineer with Doctorate qualification in road engineering areas; and
- Minimum of six (6) years experience in roads area that is minimum

three (3) years experience in road design and minimum three (3) years experience in road safety; and

- c) Is a professional engineer registered with the Board of Engineers Malaysia for a minimum of two (2) years.
- d) Attended and obtained a certificate in Road Safety Audit course from

Stage 1 to Stage 5 that is recognized by JKR Malaysia.

Notwithstanding the above, the auditor needs to be accredited with JKR Malaysia and any other requirements stipulated in the agreement.

7.0 Reporting of the Road Safety Audit

Each stage of the Road Safety Audit shall be reported, in writing, generally as set out in the JKR Guidelines and shall be submitted to the Client within 2 weeks of the audit being done or otherwise as agreed in writing.

The report should specifically describe the safety deficiencies, potential or real, which have been identified along with the relevant references to accepted standards, practices and road safety principles. The points should be illustrated wherever practicable by 'marking-up' on the plans or other relevant drawings and / or by colour photographs of the items concerned. The report may include the auditors' suggestions for eliminating or otherwise treating the safety problem identified, but this is not an essential requirement.

The report should not be simply a copy of the 'Check List' annotated with 'ticks' or 'crosses' or 'yes' / 'no' answers, or in any other way submitted as the Safety Audit Report.

A summary of audit of the audited items shall be prepared by the Auditor together with the audit report.

8.0 Handling of Road Safety Audit Report

8.1 Response Report

A Response Report will be prepared by designer before any completion meeting at any stage of audit. This report is based on the Summary of Audit by the Road Safety Auditor. A Response Report is a document that allows the designer to respond the Road Safety Auditor's comments or recommendations.

8.2 Completion Meeting

Within 2 weeks of receipt of the Road Safety Audit Report in every stage, JKR/Client shall conduct a completion meeting. In this meeting, the findings are presented by the Road Safety Auditor and discussed. Decisions on actions are to be agreed upon and formally documented.

8.3 Compliance Report

A compliance report will then be prepared by the designer based on the Summary of Audit from the Stage 3 Road Safety Audit Report. The Compliance Report is a document indicating designer's declaration that matters agreed upon in the Road Safety Audit Stage 3 completion meeting has been incorporated in the revised detailed design engineering drawings.

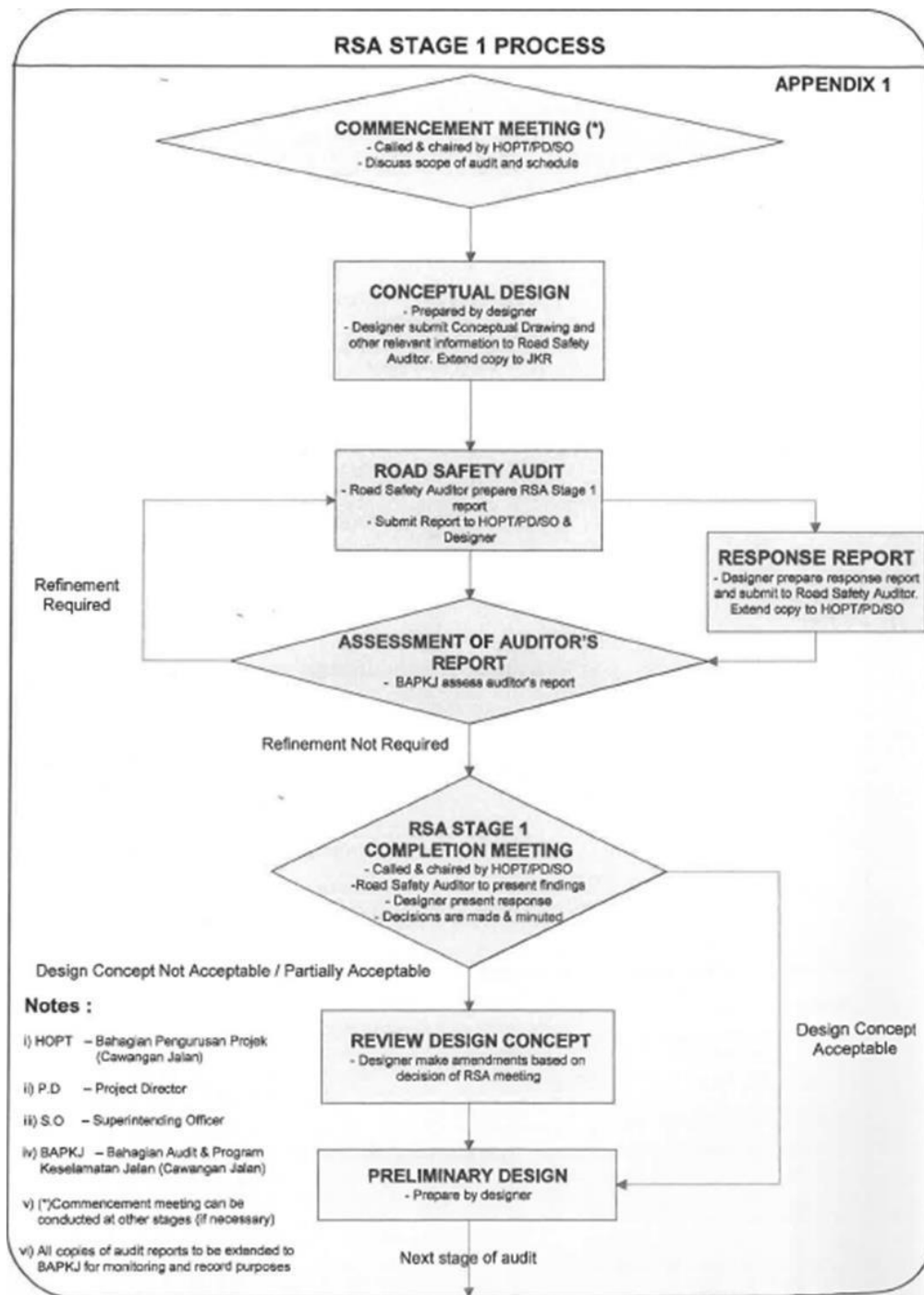
8.4 Compliance Audit

Compliance Audit needs to be carried out by the Road Safety Auditor after receiving the Compliance Report from the designer. This audit produces the Compliance Audit Report which confirms all matters agreed upon in the Road Safety Audit Stage 3 completion meeting has been incorporated by the designer in their detailed design engineering drawings.

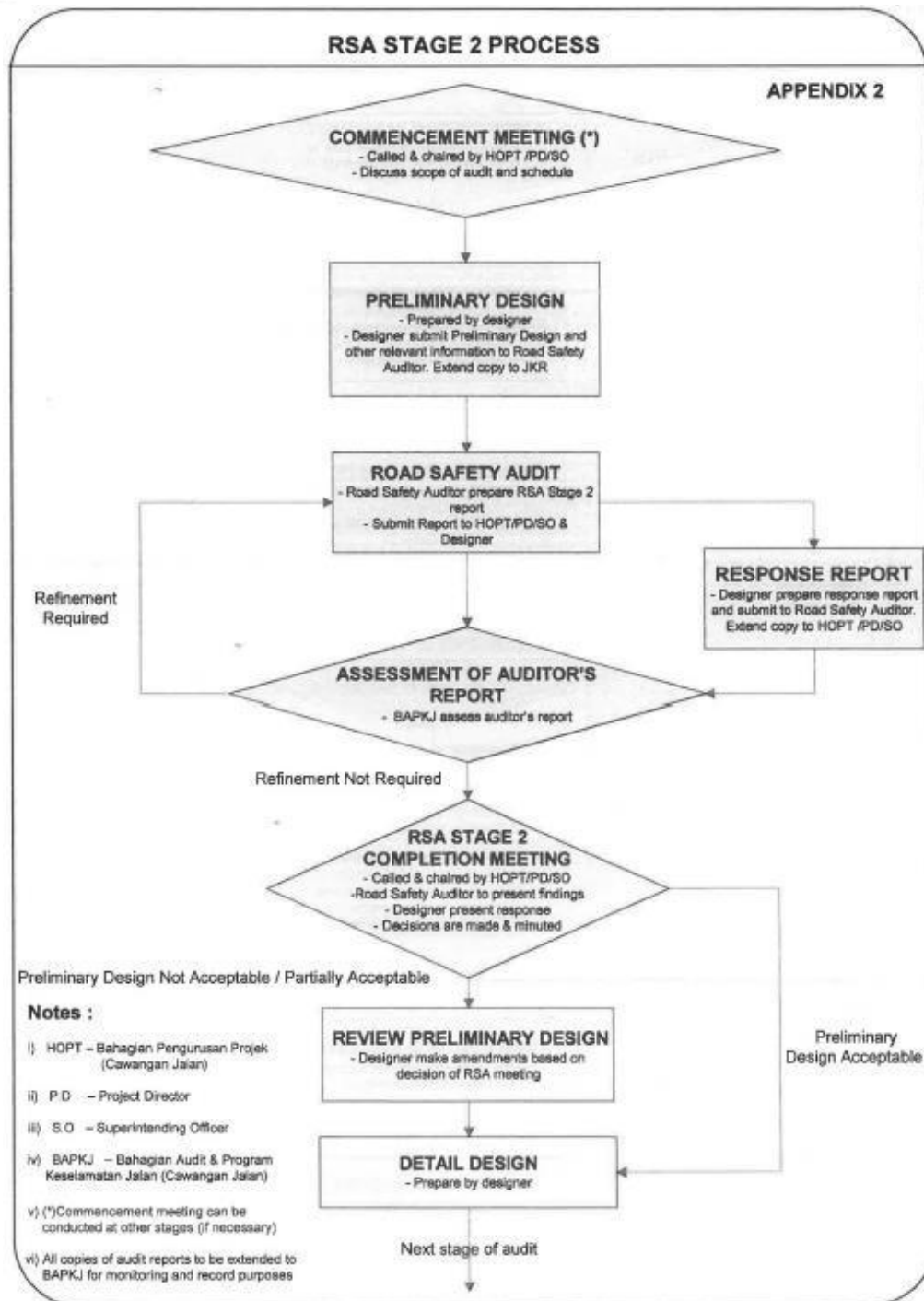
8.5 Verification Audit

A Verification Audit (Road Safety Audit Stage 4 Part 1) is to be carried out by the Road Safety Auditor to ensure that all decisions during design stage are implemented in the construction drawings. This audit produces the Verification Audit Report which verifies all matters agreed upon in the completion meeting of the previous Audits have been incorporated in the construction drawings.

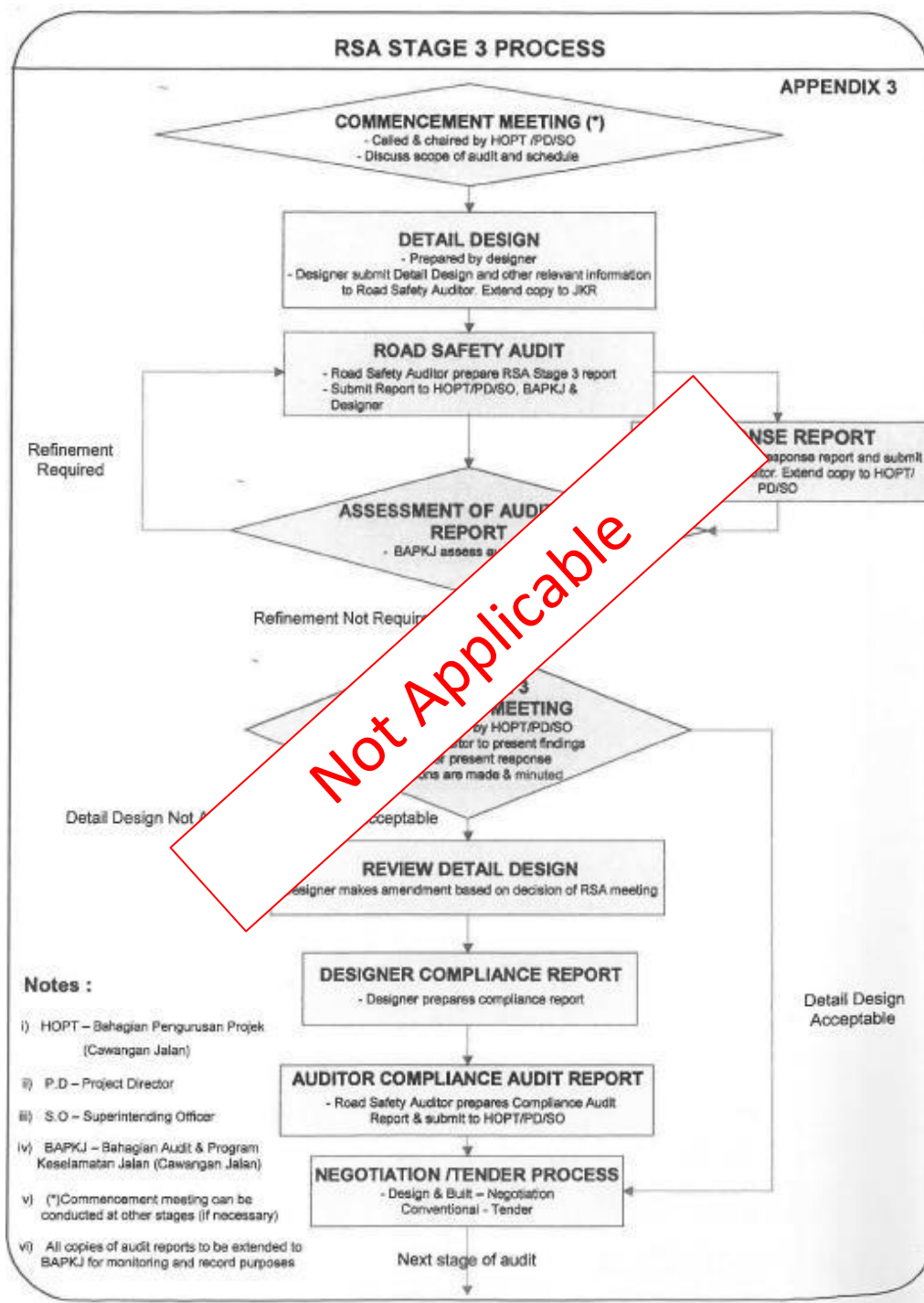
PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



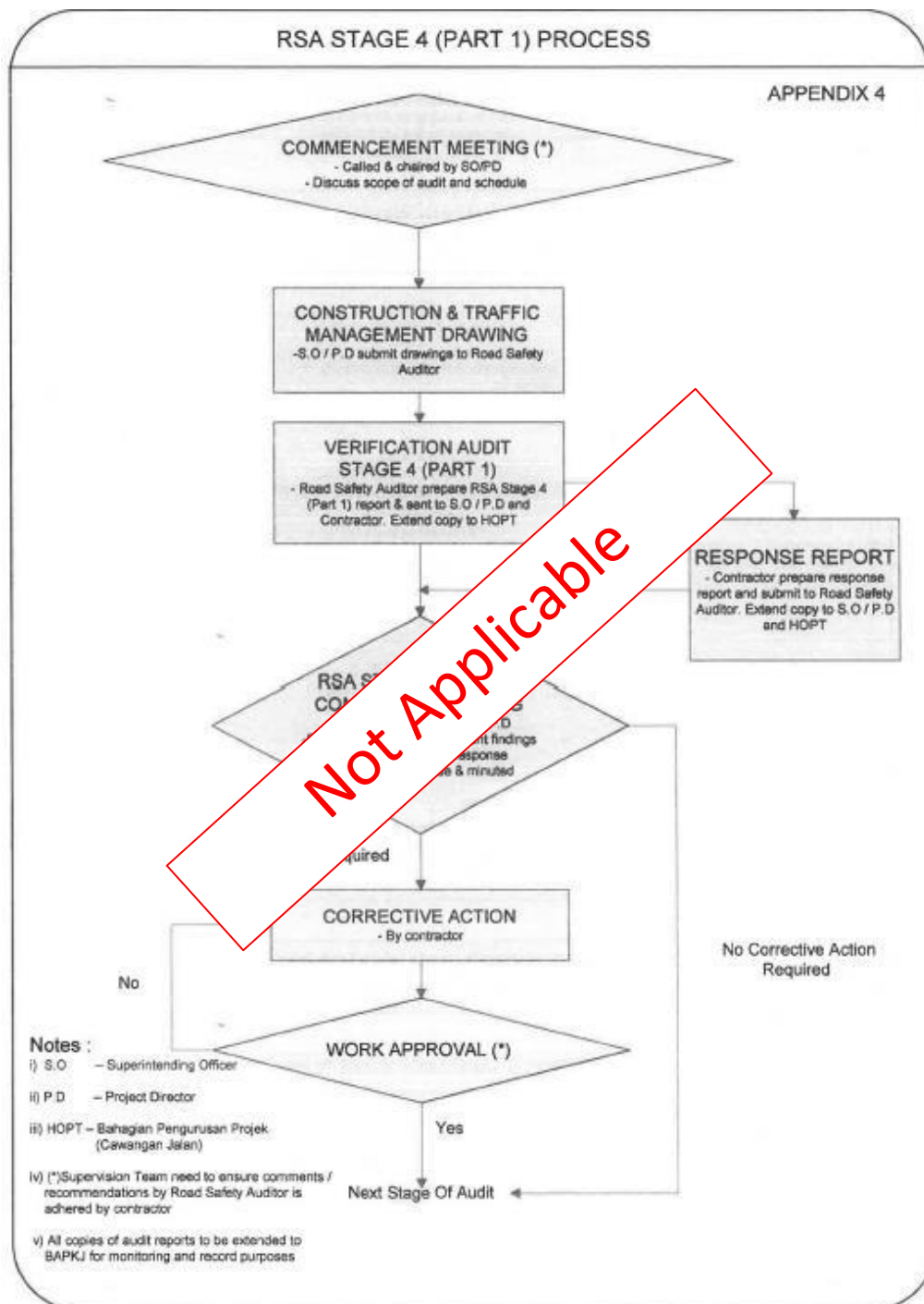
PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



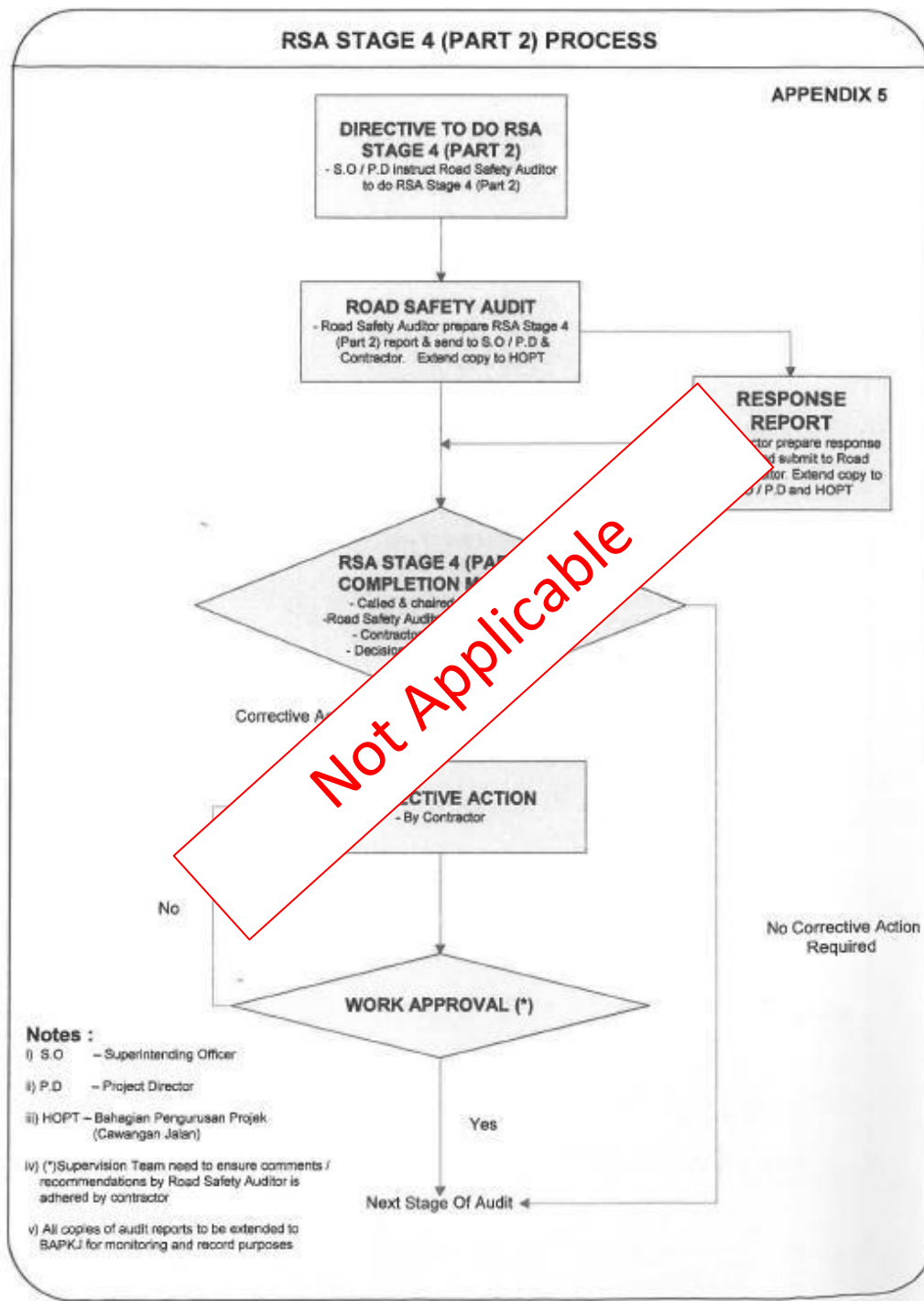
PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



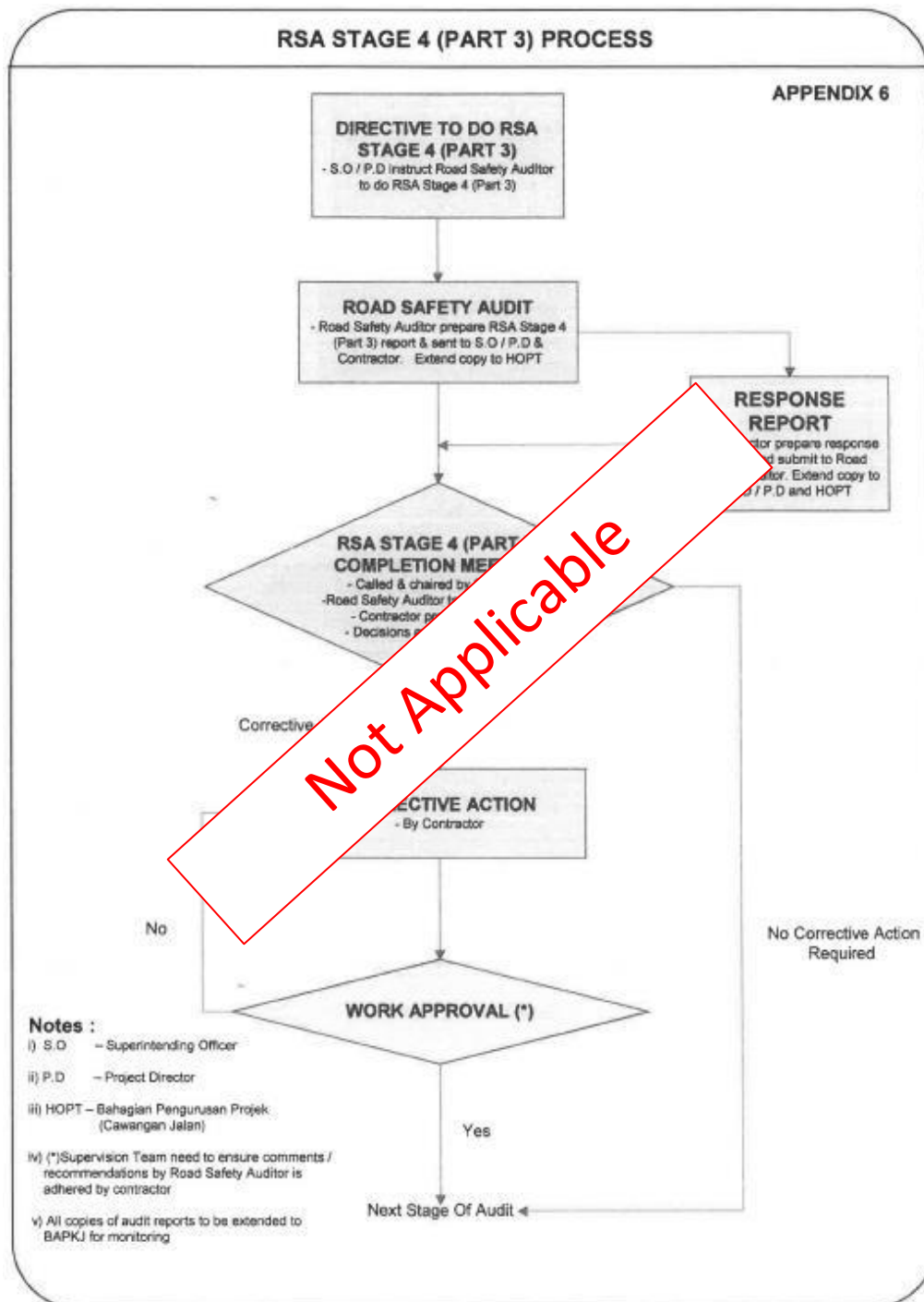
PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



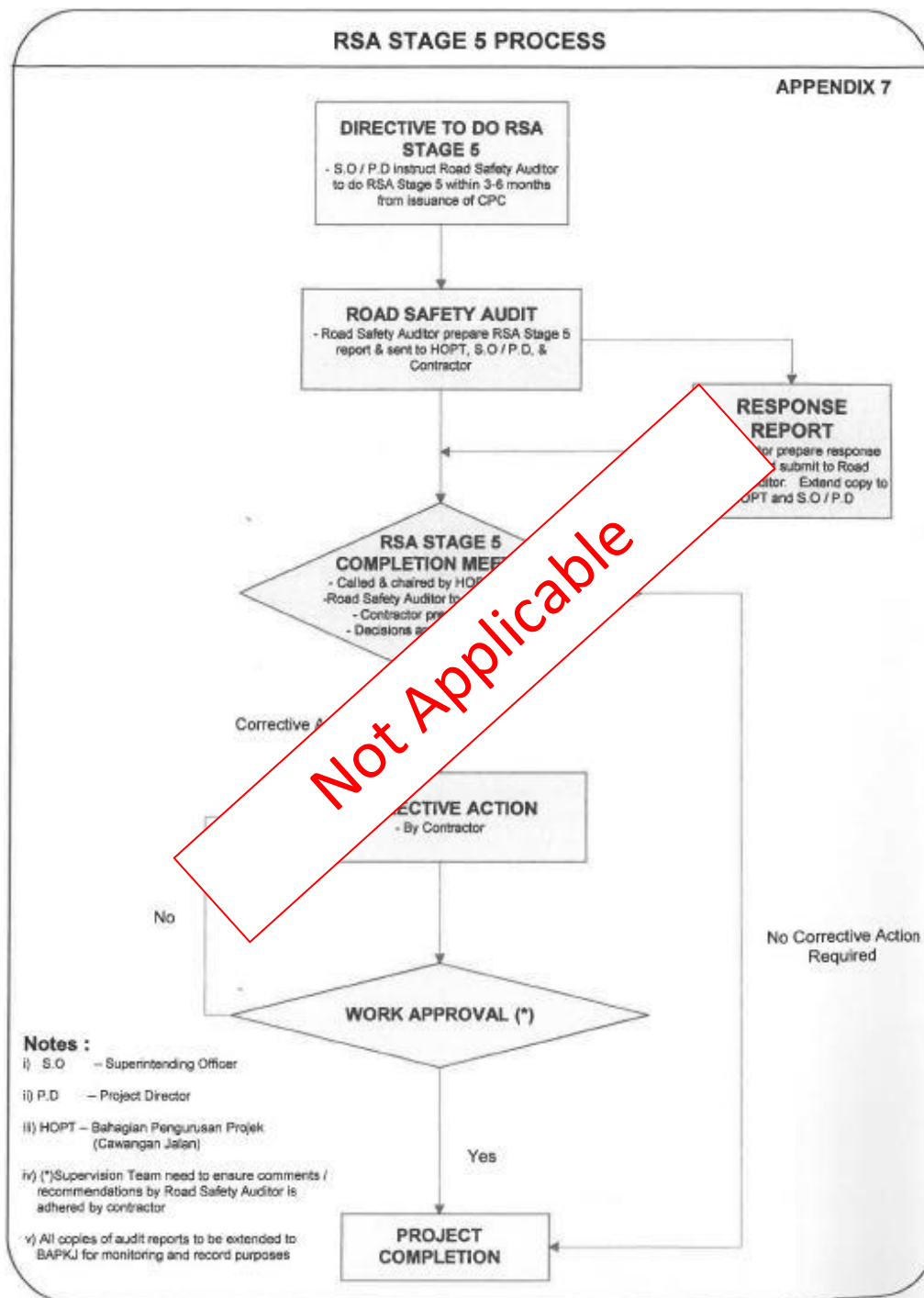
PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



FORMAT FOR FINAL DESIGN REPORT

1. The title page should contain the following information:
 - i. Name of the Project
 - ii. Name of the Client
 - iii. Address of the Client Name and Address of the Submitting Engineer
 - iv. BEM Registration No. of the Submitting Engineer
 - v. Approving Authority and its Address*
 - vi. Approved Building Plan Approval No.*
 - vii. Date on which construction work is due to commence
(*Delete if not required)
2. The design report should include but not limited to the following information:
 - a) Clear indication of the functional frame, load transfer and stability aspects of the structural scheme.
 - b) Typical design data such as:
 - i. Type of foundation structure
 - ii. Concrete grades for the various structural elements
 - iii. Design stresses for the materials used for construction, i.e. concrete and reinforcement bars
 - iv. Imposed dead loads and live loads for the various structural elements
 - v. Design wind speed
 - vi. Minimum design lateral load due to wind load and notional load
 - vii. Design codes of practices, standards and references used for the analysis and design
 - viii. Engineering softwares used for the analysis and design
 - c) Sufficient design calculations to establish the form and size of all the principal structural element, both for the superstructure and substructure.
 - d) Sufficient design calculations for the stability analysis and elemental design for the stabilizing frames and walls for the superstructure
 - e) General arrangement plans, sections to show the dimensions, layout and the disposition of the structural elements with reinforcements details.
 - f) Complete structural details for temporary works with precautionary measures taken to avoid damages to adjacent properties
 - g) Construction sequence for the structural works
 - h) Specifications of the materials.

Appendix 2.3 – Scope of Mechanical Engineering Services

1.0 Introduction

Upon accepting the appointment and assignment specified herein, the Majlis expects the CA or the Sub-Consultant on its behalf to design mechanical systems and to execute construction supervision as described in 3.0 Description of Works.

2.0 Objective Of The Works To Be Carried Out

To provide complete design and to supervise mechanical systems and services works for the project, taking into account its functionality, maintainability and reliability.

3.0 Description Of Works

- i. To design the mechanical services works for the project inclusive of its functionality, maintainability and reliability.
- ii. To carry out supervision of mechanical services installation in accordance to the said design.
- iii. List of mechanical services (Refer to Project Brief and Appendix A)

4.0 Scope Of Consulting Services

4.1 General

The CA or the Sub-Consultant on its behalf shall undertake all works herein described to achieve the objectives mentioned in section 2.0 of this Terms of Reference unless such works has been implicitly excluded in his appointment. In carrying out the work, the Consultant shall cooperate fully with all Majlis Departments/ Agencies/ Local Authorities and other consultants appointed for the project.

The CA or the Sub-Consultant on its behalf shall plan and perform the work in a manner so that, all facilities are perfectly coordinated both from the point of view of logical progression of design, etc. and inclusive with the implementation schedule of physical works. As a result, the CA or the Sub-Consultant on its behalf shall provide a bar chart or work programme of both; the works called for and the implementation of project.

4.2 Detailed Engineering Services

The scope of work to be carried out by the CA or the Sub-Consultant on its behalf shall be inclusive but not limited to the following:

4.2.1 Preliminary Stage

- (a) Feasibility surveys including :
 - establishing load patterns;
 - establishing the availability of services;
 - determining the requirements for the upgrading of existing services, if any;
- (b) CA or the Sub-Consultant on its behalf any local or other approving authorities on matters of principle in connection with the mechanical and electrical design of the works.
- (c) Providing sufficient preliminary information, mechanical services requirement and approximate estimates based on unit volume, unit surface area or similar basis of estimation regarding the works to enable the Majlis or the other Consultant and Architect to prepare architectural schematic design plans and budget estimates for the project.
- (d) Preparing a preliminary report giving :
 - preliminary designs, design criteria and policy;
 - sketch plans showing proposed designs;
 - materials, methods and sequence of construction;
 - proposal of plant, machinery and equipment including their layout;
 - cost estimates, supported by approximate bills of quantities for the Works;
 - evaluation of possible time schedules for the design, tendering and construction stages of the project;
 - any other relevant information; and
 - making such modifications to the preliminary report as may be required by the Majlis, including preparing revised cost estimates.

4.2.2 Design Stage

- (a) Preparing detail engineering design, and tender drawings after acceptance of the preliminary report by the Majlis;
- (b) Providing all relevant information and drawings on requirement for Builder's Works, Electrical Works, etc. necessary for the successful installation and commissioning of the works to all concerned parties in a timely and well co-ordinate manner;
- (c) Preparing such condition of contract, specifications and schedule as may be necessary to enable the Majlis to obtain tenders or otherwise award a contract for carrying out the works;
- (d) Providing estimates of costs in the relevant schedule of prices and schedule of rates;

- (e) Obtain such approvals as are necessary for the works from the various Majlis Agencies, Local Authorities, Utilities and Service Providers; and
- ~~(f) Incorporate all requirements from MyCREST/Penarafan Hijau JKR (pH JKR) rating schemes where applicable.~~

4.2.3 Tender Stage

- (a) Advising the Majlis on the calling of tenders; and
- (b) Preparing tender documents, evaluating, reporting and making recommendations on tenders' receipt.

4.2.4 Construction Stage

- (a) Advising on preparation of contract documents relating to pricing bills of quantities or pricing and agreeing schedule of rates;
- (b) Preparing any further designs and drawings to enable the Contractor to carry out the works;
- (c) Making amendments to the drawings or design on the instruction of the Majlis. Any amendments or redesign carried out because of deficiencies or errors in the consultant's design shall be at the expense of the consultant and will not be reimbursed;
- (d) Attending site meetings and any other meeting as directed by the Majlis;
- (e) Examining Contractor's proposals & details including shop drawings/working drawings and mock-ups to ensure they comply to the specification/standard etc.;
- (f) Arranging for inspection and testing of materials, plant, machinery and equipment supplied under the contract;
- (g) Giving all necessary instructions relating to the Works to the contractors;
- (h) Valuing works in progress for interim/certificate including variations;
- (i) Appointing office and resident site staff as required subject to prior Majlis approval;
- (j) Assisting in setting disputes or differences that may arise between the Majlis and contractors, excepting litigation & arbitration;

- (k) Supervising and endorsing all required start-ups and Testing, Adjusting, Balancing and Commissioning (TABC) for all completed works;
- (l) Delivering to the Majlis duly signed and endorsed 'As- built' drawings prepared by the Contractors and such other records and manuals prepared by the Contractors as may be necessary for subsequent operation and maintenance of the works;
- (m) Preparing the items mentioned in (l) should the Contractors fail to do so; and
- (n) Supervising constructions as per requirements of MyCREST/ pH-JKR (if applicable).

4.2.5 Defect Liability Period

Performing any other duties which are necessary under the contract for the execution of the works up to the end of defect liability period or maintenance period, such as supervision or maintenance works, rework / rectification on the systems, attending to complain from the Majlis about the performance of the system and preparing for final handing over to the Majlis upon the expiry of defect liability period.

4.2.6 Any Other Duties

The CA or the Sub-Consultant on its behalf will be required to carry out such duties as are described elsewhere in these Terms of Reference and in the Agreement.

4.3 Detailed Engineering Design

4.3.1 All engineering design and specifications shall conform to the rules and regulations of all relevant authorities including, but not limited to, the following :

- (a) Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP),
- (b) Suruhanjaya Tenaga (ST),
- (c) Pemasangan Elektrik untuk peraturan pendawaian IEEE (Ed. 16),
- (d) Piawaian Malaysia (MS),
- (e) Piawaian British (BS),
- (f) International Electromechanical Commissioning (IEC),
- (g) Jabatan Kerja Raya,
- (h) Jabatan Bomba dan Penyelamat,
- (i) Undang-undang Kecil Bangunan Seragam (UBBL),
- (j) Majlis Perbandaran/ Tempatan,
- (k) Jabatan Alam Sekitar,
- (l) All other local Authorities/Organizations having jurisdiction over the installation of the works.

- 4.3.2 The mechanical systems design and specifications shall generally comply with the latest relevant Malaysian or British Standards or codes of practice and with the requirement of the Mechanical Engineering Branch of the Jabatan Kerja Raya. The relevant standard codes of practice to be complied such as :-

~~4.3.2.1 Fire-fighting Systems~~

- ~~(a) N.F.P.A (National Fire Protection Association, USA),~~
- ~~(b) F.O.C (Fire Officers Committee, U.K),~~
- ~~(c) A.S (Australian Standards).~~

~~(As spelt out in the Uniform Building By-Laws 1984).~~

~~4.3.2.2 Air Conditioning and Mechanical Ventilation System~~

- ~~(a) ASHRAE (American Society for Heating, Refrigeration and Air-Conditioning Engineers),~~
- ~~(b) SMACNA (Sheet Metal And Air Conditioning Contractors, National Association)~~

- 4.3.3 The metric system of units shall be adopted in all design calculations, specifications and drawings. Drawings shall be a minimum of A1 size i.e. 594cm x 841cm and transparencies are to be prepared in ink on stable reproducible material and have title blocks approved by the Majlis.

All drawings and detailed calculation, whether preliminary or final, shall be signed by at least one partner of the Consultant and all plans submitted for approval shall also bear the Professional Engineer's seal of the partner concerned. The Professional Engineer with Practising Certificate (PEPC) shall be registered with the Board of Engineers Malaysia.

4.4 Specifications and Tender Documents

- 4.4.1 The CA or the Sub-Consultant on its behalf shall prepare complete tender documents based on the standard Majlis conditions of contract, form of tender and other documents currently in use for mechanical engineering works. Prior consultation with the Majlis will be necessary before the tender documents are drawn up.
- 4.4.2 Where Standard Specifications are available from JKR, the consultant shall ensure that they are used. Any specifications used shall also be consistent with current JKR Standards, unless approval has been obtained from the Majlis to deviate.

4.4.3 Three (3) draft copies of the tender documents shall be submitted for the Majlis's review at least eight (8) weeks before the date scheduled for the calling of tenders. Final tender documents shall only be printed after the draft documents have been approved by the Majlis. The CA or the Sub-Consultant on its behalf shall be informed of the number of copies he has to furnish to the Majlis.

4.4.4 A complete set of the tender documents and drawings (AutoCAD/Revit/NavisWorks format) shall also be submitted to the Majlis in digital format in compact discs, thumbdrive etc.

4.4.5 The CA or the Sub-Consultant on its behalf must ensure that contractors are made aware of the commissioning requirements and extend of demonstrations they will be required to complete prior to acceptance of their works in his specification

4.5 Evaluation of Tender

The CA or the Sub-Consultant on its behalf shall produce evaluation report and recommendation within one (1) week after the receipt of the submitted tenders from the Majlis.

If the CA or the Sub-Consultant on its behalf do not prepare the evaluation report according to the Majlis's requirements, the Majlis reserves the right to deduct a certain amount from the Consultant Fee.

4.6 Supervision of Works

4.4.6 The CA or the Sub-Consultant on its behalf shall appoint, subject to the Majlis's approval, site supervision officers, according to the following criteria :

Bil.	Value of Mechanical Works	Resident Engineer	Inspector of Works
1	Below than RM5,000,000.00	0	1
2	More than RM5,000,000.00	1	1

4.4.7 The Mechanical Resident Engineer's or/and the Mechanical Clerk of Works' scope of works shall include but not limited to the following :

- i. To carry out standing supervision of mechanical services installation works at site.

- ii. To produce monthly progress reports of mechanical services installation works at site including QA/QC reports.
- iii. To provide necessary input for mechanical services installation coordination works.
- iv. To issue Interim Payment.
- v. To inspect equipment delivered at the site.
- vi. Other works deemed necessary to complete the works.

5.0 **INFORMATION TO BE PROVIDED BY THE MAJLIS**

5.1 Notwithstanding clause 6.3 of the Consultancy Service Agreement (CSA), the Majlis shall provide the Consultant with the following :

- (a) Relevant guidelines of standard mechanical JKR specifications (if deemed relevant);
- (b) Sistem Pengurusan Bersepadu JKR (SPB) documents (if deemed relevant).

6.0 **MATERIAL AND WORKMANSHIP**

All materials and workmanship shall be specified to comply with Malaysian Standard and Codes of Practice. Where these are not available then British Standards or its equivalent may be adopted instead. If departure from the Malaysian or British Standard or Code of Practice is considered desirable, prior consultation with the MBSJ is necessary. Materials of Malaysian origin are to be specified throughout in preference to imported materials and the use of proprietary names is to be avoided in the specification. Where this is unavoidable or where materials of foreign manufacture have to be specified, the prior approval of the Majlis has to be obtained.

7.0 **TECHNOLOGY TRANSFER/TRAINING PROGRAMME**

The Majlis may wish to assign one or more professional staff to the consultant for 'on job training' experience with the works. A decision will be taken on this matter at the time of contract negotiation and the Consultant shall be prepared to accommodate the Majlis requirement in this regard.

8.0 **SUBMISSION OF REPORTS, DOCUMENTS AND DRAWINGS**

8.1 Implementation schedule

Within 2 weeks after the appointment of the Consultant, he is to submit his proposed implementation schedule for the overall design of this project for approval by the Majlis. The items should include the following:

- (a) Preliminary report and approval,
- (b) Review and approval of drawings and tender documents,
- (c) Preparation and submission of final drawings and tender documents,
- (d) Prequalification period (if required),
- (e) Tender period,
- (f) Evaluation of tenders and Majlis approval.

The Consultant shall make every effort to complete their assignments before the dates stipulated in the implementation schedule.

8.2 Preliminary Report

The CA or the Sub-Consultant on its behalf shall submit three (3) copies of the preliminary report and drawings to the Majlis before carrying out the detailed design of the works. These shall be submitted according to the implementation schedule agreed upon in 8.1. and shall generally be not later than 6 months after the appointment of the CA or the Sub-Consultant on its behalf. The Majlis shall generally furnish its comments / approval within one month of the date of receipt of the report and drawings.

8.3 Progress Report

The CA or the Sub-Consultant on its behalf shall submit three (3) copies of progress report to the Majlis within the first week of each month, showing the progress of his work. The first report is to be submitted within 4 weeks after the appointment of the CA or the Sub-Consultant on its behalf. The report shall be in the format that is approved by the Majlis.

8.4 Final Design Report / Calculation

Three (3) copies of final design report and three (3) copies of design calculation and drawings shall be submitted to the Majlis on completion of the final design.

The report shall give a detailed description of any investigations carried out together with the result and findings. The scope of works involved, the criteria or rationale used for each of the design components and the events and decisions that were made as regards to design changes along the way. The design report shall be in a format that is approved by the Majlis.

All design calculation shall be properly bound and set out in an orderly manner. The design calculation submitted must be complete and legible. The design philosophy and relevant standards, codes of practice or guidelines used in the design and specifications must be indicated. Where computer programme used, its input and assumptions made must be included.

Any failure to comply or any incompleteness shall result in the report not being accepted and it being returned to the Consultant for re-submission.

8.5 Test Record Sheet and Certificate of Completion

Three (3) copies of the Test Record Sheets, Final Acceptance Record Sheets, Factory Acceptance Report together with the appropriate calculation to prove the final result, and the Certificates of Completion shall be submitted to the Majlis on the date of hand over of the works. The final Acceptance Record Sheets and the Certificates of Completion shall be in format approved by the Majlis. They shall be signed by the CA or the Sub-Consultant on its behalf.

8.6 "As-built" Drawing and Documents

The CA or the Sub-Consultant on its behalf shall verify and endorse the mechanical system 'as-built' drawings prepared by the Contractors not more than three (3) months of the date of final completion together with service and maintenance manuals prepared by the Contractors for each system and service to Majlis Representative (GR).

A complete set of the test records, final acceptance record sheets, and certificates of completion, 'as-built' documents and drawing (AutoCAD/Revit/NaviWorks format) shall also be submitted to the Majlis in digital format in compact disc, thumb drive etc.

8.7 Defects Liability Period

Inspecting and compiling final defect list at the end of Defects Liability Period and to monitor and certify the Works that have been carried out.

At the end of Defects Liability Period, the Consultant shall certify that all defects have been carried out and then shall prepare and recommend the certificate of making good defects and closing of account to the Majlis.

9.0 PROJECT COORDINATION

The Majlis reserves the right to assign a project coordinator for close monitoring during the design period until the completion of the project.

10.0 LIAISON WITH OTHER AGENCIES

In case the consultant requires the co-operation of Majlis Departments and Agencies, the Majlis may provide liaison and may assist the CA or the Sub-Consultant on its behalf together information required for the completion of project.

11.0 REMUNERATION PROCEDURE

All reimbursable items, especially out of pocket expenses, shall be claimed on a monthly basis. Any reimbursable claim which are outstanding after three (3) months shall not be entertained.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

12.0 **AGREEMENT**

The CA or the Sub-Consultant on its behalf shall prepare ten (10) sets of agreement (format CSA 2014-Engineering (Amendment 2018) - Pekeliling Perbendaharaan Malaysia PK 3.8) for signing not later than four (4) months after the date of the Letter of Acceptance.

APPENDIX A : DESCRIPTION OF WORKS

Mechanical services required :

~~1. Air Conditioning, Mechanical Ventilation and Exhaust Systems~~

- ~~i. Air Cooled Split Ducted~~
- ~~ii. Variable Refrigerant Flow System~~
- ~~iii. Air Cooled Split System~~
- ~~iv. Mechanical Ventilation~~

~~2. Fire Fighting Protections System~~

- ~~i. Hose Reel System~~
- ~~ii. Conventional Fire Alarm System~~
- ~~iii. Fire Suppression System~~
- ~~iv. Portable Extinguisher~~

~~3. Internal Cold Water and Sanitary System~~

- ~~i. Internal Cold Water Plumbing System~~
- ~~ii. Sanitary Plumbing System~~
- ~~iii. Pumping System~~

4. Other Mechanical Requirements equipment, materials or works required for the proper functioning and operational of the project.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDIX B : DELIVERABLES SUMMARY FOR CONSULTING ENGINEER

BIL.	DELIVERABLE	DURATION
PRELIMINARY STAGE		
1.	Design concept report	14 days from the finalised project brief, site location and project cost
2.	Preliminary estimates for mechanical works (PDA)	7 days from the finalised SOA
DESIGN STAGE (I)		
1.	Confirmation of mechanical requirement for Consultant of other disciplines	14 days from receipt of 1:100 scale preliminary architecture drawings
2.	Preliminary design	30 days from receipt of 1:100 scale preliminary architecture drawings
DESIGN STAGE (II)		
1.	Calculation sheets and detailed design drawings	45 days from receipt of 1:100 scale final architecture drawings
2.	Specifications	7 days from mechanical detailed drawings completed
TENDER STAGE		
1.	Tender documents (tender drawings, specifications, schedule of prices, etc.)	14 days from mechanical detailed drawings completed
2.	Tender reports	7 days from the receipt of JKR28 Form
CONSTRUCTION STAGE		
1.	Shop drawings/working drawings	30 days from the receipt of Contractors' working drawings
2.	Testing & Commissioning (T&C) reports	7 days from T&C
3.	Recommendation for CPC & CCC	14 days from letter of handing over project (Contractor to MBSJ)
DEFECT LIABILITY PERIOD (DLP) STAGE		
1.	CMGD report	14 days before closing of defects meeting
2.	Recommendation for closing of account	3 months from CPC

Appendix 2.4 – Scope of Electrical Engineering Services

1.0 Scope of Consulting Services

1.1 General

Upon accepting the appointment and assignment specified herein, the Government expects the CA or the Sub- Consultant on its behalf to provide the necessary fully functional electrical services and systems for the project.

Based on the scope of Information & Communication Technology (ICT) services mentioned in Appendix II, if in the Consultant absence of competency and does not have registration codes with Ministry of Finance (MOF) (340601 - *Kajian Telekomunikasi* and 340603 - *Kajian Pengurusan Infrastruktur ICT* and 340605 - *Kajian Pengurusan Maklumat ICT*), the Consultant shall engage an ICT Consultant¹ upon his tender submission to carry out the ICT services. The ICT Consultant shall fulfill the minimum requirement as indicated in Appendix III.

An official appointment of the ICT Consultant shall be made.¹ ICT Consultant is referred as a qualified sub consultant appoints by the Consultant (Electrical Consulting Engineers) to carry out the ICT services.

The scope of Electrical Consulting Engineers work to be carried out by the CA or the Sub- Consultant on its behalf shall be inclusive but not limited to the following: -

1.1.1 Preliminary Stage

- (a) The CA or the Sub- Consultant on its behalf shall perform feasibility surveys including establishing load patterns and establishing the availability of services.
- (b) The CA or the Sub- Consultant on its behalf shall investigate and obtain the electrical data/load and information on communication (Telecommunications and Information & Communication Technology (ICT)) facilities for the existing buildings (if any) and all other relevant data that are necessary for the planning of the Works.
- (c) Depending on the complexity and nature of project, an initial client approval on the design concept may be required especially for ELV and ICT services to indicate the scope of works involved. A further advice or approval from other government agencies such as Pejabat Ketua Pegawai Keselamatan Kerajaan Malaysia, Polis DiRaja Malaysia and Jabatan Penerangan on the concept design may be required

for projects with high national interest. The relevant cost estimates shall only be prepared after completion of concept design.

- (d) The CA or the Sub- Consultant on its behalf shall prepare system proposal and investigation report to which contain:
 - (i) Preliminary designs, design criteria and policy
 - (ii) Sketch plan showing proposed designs
 - (iii) Materials, methods and sequence of installation
 - (iv) Proposal of equipment including their layout
 - (v) Provide approximate estimates regarding the Works to enable to prepare architectural schematic design plans and budget estimates for the Project
 - (vi) Evaluation of possible time schedules for the design, tendering and construction stages of the Project
 - (vii) Any other relevant information
 - (viii) Making such modifications to the preliminary report as may be required including preparing revised cost estimates.

1.1.2 Design Stage

The CA or the Sub- Consultant on its behalf shall prepare detail engineering design and tender drawings after acceptance of the preliminary report by the Government.

The CA or the Sub- Consultant on its behalf shall provide information and drawings on requirements for Builder's Works etc. necessary for the successful installation and commissioning of the Works to all concerned parties in a timely and well co-coordinated manner.

On completion of the final design work, the CA or the Sub- Consultant on its behalf shall prepare a detailed Bill of Quantities for all items required, and measurements.

The CA or the Sub- Consultant on its behalf shall also prepare a detailed cost estimate based on the Bill of Quantities.

The CA or the Sub- Consultant on its behalf shall obtain such approvals as necessary for the Works from the various Agencies/Authorities.

1.1.3 Tender Stage

Where necessary, the CA or the Sub- Consultant on its behalf shall prepare pre-qualification notices, issuing Questionnaires to prospective tenderers and evaluating their suitability to enable tenders to be called.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Calling of tenders, evaluations, reports and recommendations on tenders received.

1.1.4 Construction Stage

The CA or the Sub- Consultant on its behalf shall:

- (a) Preparation of contract documents relating to accepted tenderer for NSC
- (b) Preparing any further designs and drawings to enable the Contractor to carry out the works;
- (c) Examining contractor's proposals & details including shop drawings/working drawings, mock-ups and its conformed to specification/standard etc.;
- (d) Arranging for inspection and testing of materials, plant, machinery and equipment supplied under the contract;
- (e) Issuing recommendation for payments to contractors;
- (f) Supervising constructions as per requirements of ~~MyCrest / PH JKR (if applicable)~~.

1.1.6 Any other duties

The Consultant will be required to carry out such duties as are described elsewhere in this Terms of Reference and in the Agreement.

1.2 DESIGN WORK

The CA or the Sub- Consultant on its behalf shall liaise with the Electricity Supply Authority and/or Electricity Supply Company on the electricity supply system for the project and Telekom Malaysia (TM) or Communications Company for the Telecommunications and ICT work to ensure that the requirements are fully complied with.

The CA or the Sub- Consultant on its behalf shall investigate and obtain the electrical data/load and information on communication (Telecommunications and ICT system) facilities for the existing buildings (if any) and all other relevant data that are necessary for the design of the Works.

Particular attention shall be given to the client needs especially of ELV and ICT services where requirements are very project specific.

1.2.1 Design Criteria

(a) Electrical Works

The design and drawings prepared shall be based on the following:-

- (i) MS IEC 60364 – Electrical Installations Of Buildings
- (ii) Electricity Supply Act 1990
- (iii) Electricity Supply Regulations 1994
- (iv) Relevant Malaysian Standards / British Standards / IEC Standards
- (v) Malaysian Standards Code of Practice / British Standards Code of Practice.
- (vi) Chartered Institution of Building Services (CIBSE UK) Code of Practice
- (vii) Uniform Building By-laws 1984
- (viii) Fire and Rescue Services Department requirements
- (ix) Occupational Safety and Health Act
- (x) JKR Technical Circulars, JKR standard specifications and current JKR practice
- ~~(xi) Penarafan Hijau JKR (pH JKR) / MyCREST~~
- (xii) Guidelines of Utility Authorities / Companies
- (xiii) Department of Environment requirements
- (xiv) City Hall or Local Authority requirements
- (xv) Renewable Energy Specifications & Guideline
- (xvi) All other requirements of relevant Authorities.

(b) Telecommunications Works

The design and drawings for the telecommunications work shall be based on JKR Specifications, the Guide Books and guidelines issued by TM and Suruhanjaya Komunikasi & Multimedia Malaysia (SKMM).

(c) Information & Communication Technology (ICT) System

The design and drawings for the ICT system shall be based on the following:-

- (i) Garis Panduan ICT MAMPU di Sektor Awam
- (ii) Garis Panduan Suruhanjaya Komunikasi & MultiMedia Malaysia (SKMM)
- (iii) ANSI/TIA 568-B.1 - General Requirements
- (iv) ANSI/TIA 568-B.2 - Balanced Twisted Pair Cabling Components
- (v) ANSI/TIA 568-B.2-1 - Category 6 Transmission Performance

- (vi) ANSI/TIA 569-A -Pathway and Spaces
- (vii) ANSI/TIA 606 - Administration
- (viii) ANSI/ EIA/TIA 942 – Telecommunications Infrastructure Standard for Data Center
- (ix) JKR Specifications

(d) **Extra Low Voltage**

The CA or the Sub- Consultant on its behalf shall be obliged to ascertain the actual requirements if any, for all extra low voltage system (audio visual, public address system, security system, sound reinforcement system, etc.) prior to carrying out any work on such systems.

Depending on the complexity and nature of project, client endorsement may be required for the layout, placement and quantities of the ELV services. For project of high national interest, the approval of other government agencies such as Pejabat Ketua Pegawai Keselamatan Kerajaan Malaysia, Polis DiRaja Malaysia and Jabatan Penerangan may be required.

Infrastructure for the IP-based ELV services shall be designed for that services alone and separated from any other ICT network. If such condition arises where the IP-based ELV services need to be integrated into a shared common ICT network, consideration on bandwidth requirement, power over ethernet etc shall be taken into account.

The design and drawings for any such system shall be based on JKR Specifications and guidelines, if available. If such documents are not available, reference shall be made to widely accepted good industry practices.

(e) **Design Drawings**

The CA or the Sub- Consultant on its behalf shall prepare design drawings on A1 size sheets. Dimensions are to be in metric units. Standard JKR Electrical symbols shall be used for all the drawings.

The title panel is to be placed at the bottom right hand corner of the drawings. All drawings, whether preliminary or final shall be signed by a Partner/Director of the Consultant and all plans submitted for approval shall also bear the Professional Engineer's (of electrical discipline) seal of the Partner concerned.

The Professional Engineer shall be registered with the Board of Engineers Malaysia.

1.3 BILL OF QUANTITIES AND COST ESTIMATE

- (a) The CA or the Sub- Consultant on its behalf shall submit a preliminary cost estimate for budgetary purpose immediately after the completion of the preliminary design work.
- (b) On completion of the final design work, the CA or the Sub- Consultant on its behalf shall prepare a detailed Bill of Quantities for all items required, inclusive of all quantities and measurements.
- (c) The CA or the Sub- Consultant on its behalf shall also prepare a detailed cost estimate based on the Bill of Quantities.
- (d) The CA or the Sub- Consultant on its behalf shall provide minimum _____ copies of NSC tender documents for each electrical system involved at least three (3) weeks before the date scheduled for calling of tenders.
- (e) A complete set of the tender documents and drawing (AutoCAD format) shall also be submitted in soft copy using external hard disc.

1.4 EVALUATION OF TENDERS

The CA or the Sub- Consultant on its behalf shall produce tender evaluation report and recommendation within seven (7) days after the receipt of the NSC's submitted tenders from the Government.

2.0 DELIVERABLES

2.1 Preliminary Report

The CA or the Sub- Consultant on its behalf shall submit three (3) copies of the preliminary report and drawings to the Government before carrying out the detailed design of the works. These shall be submitted according to the implementation schedule agreed upon in 8.1. and shall generally be not later than 6 months after the appointment of the CA or the Sub- Consultant on its behalf. The Government shall generally furnish its comments / approval within one month of the date of receipt of the report and drawings.

2.2 Progress Report

The CA or the Sub- Consultant on its behalf shall submit three (3) copies of progress report to the Government within the first week of each month, showing the progress of his work. The first report is to be submitted within 4 weeks after the appointment of the CE. The report shall be in the format that is approved by the Government.

2.3 Final Design Report / Calculation

Three (3) copies of final design report and 3 copies of design calculation and drawings shall be submitted to the Government on completion of the final design.

The report shall give a detailed description of any investigations carried out together with the result and findings. The scope of works involved, the criteria or rationale used for each of the design components and the events and decisions that were made as regards to design changes along the way. The design report shall be in a format that is approved by the Government.

All design calculation shall be properly bound and set out in an orderly manner. The design calculation submitted must be complete and legible. The design philosophy and relevant standards, codes of practice or guidelines used in the design and specifications must be indicated. Where computer programme used, its input and assumptions made must be included.

Any failure to comply or any incompleteness shall result in the report not being accepted and it being returned to the CE for resubmission.

2.4 **Test Record Sheet and Certificate of Completion**

Three (3) copies of the Test Record Sheets, Final Acceptance Record Sheets, Factory Acceptance Report together with the appropriate calculation to prove the final result, and the Certificates of Completion shall be submitted to the Government on the date of hand over of the works. The final Acceptance Record Sheets and the Certificates of Completion shall be in format approved by the Government. They shall be signed by the CE.

2.5 **“As-Built” Drawing and Documents**

The CA or the Sub- Consultant on its behalf shall verify and endorse the ‘as-built’ drawings of mechanical system and maintenance manuals prepared by the contractors for each system and service to Government Representative (GR) prior the issuance of the Certificate of Practical Completion.

A complete set of the test records, final acceptance record sheets, and certificates of completion, ‘as-built’ documents and drawing (AutoCAD format) shall also be submitted to the Government in softcopy using external hard disc.

Appendix 2.5 – Scope of Quantity Surveying Services

1.0 SCOPE OF CONSULTING SERVICES

The scope of Quantity Surveying services to be carried out by the CA or the Sub-Consultant on its behalf shall comprise the following:

Basic Professional Services

- (a) Preparing Preliminary Estimates including preparing the Preliminary Detailed Abstract (PDA) and Cost Plans including up to 4 revisions of preliminary estimates and cost plans due to amendments to layout and scope of works;
- (b) Preparing Bills of Quantities, Tender Table Document and other Tender Documents necessary for calling of tenders excluding tender for mechanical and electrical works, interior design works or landscaping works;
- (c) Preparing Departmental Tender Estimate;
- (d) Preparing the “As Tendered Detailed Abstract” (ATDA);
- (e) Preparing Tender Report;
- (f) Preparing Contract Documents;
- (g) Preparing Tender Documents, Tender Estimates, Tender Reports and Contract Documents for works allowed under Prime Cost (P.C. Sum) and Provisional Sums other than those under the charge of Mechanical and Electrical Consultants, Interior Designers or Landscape Consultants for their respective works;
- (h) Valuing works in progress for Interim Valuation/Certificates, including measurement of variation excluding mechanical and electrical works, interior design works or landscaping works and including the verification and incorporation of the amounts recommended by the consultants for their respective works;
- (i) Preparing Revised ATDA (if necessary) and Adjustments of Contract Sum.
- (j) Preparing Final Account for the whole works including the incorporation of the final accounts by the Mechanical and Electrical Consultants, Interior Designers or Landscape Consultants for their respective works;
- (k) Preparing ‘As Completed Detailed Abstract’ (ACDA).

Additional Services *.

Preparing of Cost Analysis based on accepted Contract Sum.

2.0 DELIVERABLES

The CA or the Sub-Consultant on its behalf shall submit the deliverables within the time and stage as specified in approved implementation schedule. The deliverables to be provided by the CA or the Sub-Consultant are as follows:

(a) **PDA**

As the preliminary design of the Project is being developed, the CA or the Sub-Consultant or the Sub-Consultant on its behalf shall give advice on cost implications of the design as and when required by the design team. Upon the finalisation of the preliminary design of the project, the CA or the Sub-Consultant on its behalf shall prepare PDA and any revision thereof as and when directed by the GR not later than seven (7) days from the receipt of the preliminary drawings.

(b) **Bills of Quantities**

The CA or the Sub-Consultant on its behalf shall prepare Bills of Quantities and other tender documents within one (1) month from the receipt of the final drawings to enable the tender to be called in accordance with the implementation schedule. The Bills of Quantities shall follow the latest Standard Method of Measurement requirements and the format approved by the GR and shall be measured firm unless otherwise instructed in writing by the GR.

(c) **Tender Documents**

The CA or the Sub-Consultant on its behalf shall prepare complete tender documents based on the Standard Government Conditions of Contract, Form of Tender, Specifications and other documents currently used in JKR, in compliance with the JKR Quality Assurance System.

The CA or the Sub-Consultant on its behalf shall submit

- (i) three (3) copies of the Tender Table Documents and sufficient copies of tender documents to be issued to the tenderers within seven (7) days before the date the tender notice is scheduled to be advertised, and
- (ii) a copy of dimension sheets showing detailed calculation of the quantities of items in the Bills of Quantities and soft copy of the Bills not later than three (3) months after the award of the tender.

* Delete if not applicable

(d) **Departmental Tender Estimate**

The CA or the Sub-Consultant on its behalf shall prepare an estimate of the cost of the Project based on detailed pricing of the Bills of Quantities. The estimated cost of the project shall be attested by a registered Quantity Surveyor and shall be submitted together with the priced Bills of Quantities to the GR under a confidential cover not later than seven (7) days before the closing date of the tender.

(e) **ATDA and Letter of Acceptance**

The ATDA and the Letter of Acceptance shall be submitted to the GR not later than three (3) days after the receipt of the instruction.

(f) **Contract Document**

The CA or the Sub-Consultant on its behalf shall submit the (1) original Contract Document and (2) certified true copy Contract Document to the GR for the signatory by the Officer empowered to sign the contract within sixty (60) days after the date of countersigned of the Letter of Acceptance (L.A) by the Main Contractor. The CA or the Sub-Consultant on its behalf shall prepare certified true copies of the Contract Documents and distribute the same to the relevant parties the soonest possible but in any case, shall not exceed ninety (90) days from the date of countersigned of the Letter of Acceptance (L.A) by the Main Contractor. The original Contract Document shall be delivered to the GR for the safe keeping.

(g) **Cost Analysis**

The CA or the Sub-Consultant on its behalf shall prepare and submit two (2) copies of Cost Analysis on accepted Contract Sum in an approved format not later than two (2) months from the date of signing Contract Document.

(h) **Interim Certificate**

The CA or the Sub-Consultant on its behalf shall submit to the Government eight (8) copies of the Interim Certificates in a format approved not later than three (3) working days after the date of valuation.

(i) **Variation Works**

The CA or the Sub-Consultant on its behalf shall prepare all necessary documentation in the approved format and submit to the Government not later than fourteen (14) days after the issuance of the Instruction for Variation Works. Measurements and valuation of the variation works must be prepared the soonest possible, as work progresses.

Adjustment to the Contract Sum must be made in the approved format, not later than two (2) weeks from the date of receipt of the variation work drawings or from the date of completion of the variation works, whichever is earlier.

(l) **Revised ATDA**

The CA or the Sub-Consultant on its behalf shall, if required by the Government, prepare and submit a report on the financial progress of the project and revise the ATDA within fourteen (14) days from the date of receipt of the instruction and all necessary information from other related parties.

(m) **Statement of Final Account and Final Certificate**

Statement of Final Account (SOFA) of the Contract must be finalised not later than six (6) months after the issuance of the Certificate of Practical Completion (CPC).

Final certificate must be submitted to the Government within three (3) months after the expiry of Defect Liability Period (DLP) for the whole of the works or three (3) months after the issue of Certificate of Making Good Defect (CMGD) whichever is later.

(n) **ACDA**

The CA or the Sub-Consultant on its behalf shall submit the ACDA to the Government not later than one (1) month from the date of the approval of the final certificate.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Appendix 3 – Guide to Provision Number of Supervision Staff

Bilangan kakitangan tapak dan pengalaman yang diperlukan bagi projek ini adalah seperti berikut:

Jawatan	Pengalaman (Tahun)	Bilangan	Tempoh Penyeliaan
Jurutera Tempatan (RE) - (Ijazah)	20	1	24 bulan
Jurukur Bahan (QS) – (Ijazah)	-	-	-
Penolong Jurutera Tempatan (ARE) – (Ijazah)	-	-	-
Penyelia Tapak (COW) – (Diploma)	10	1	24 bulan

TERMS OF REFERENCE FOR BRIDGES AND VIADUCTS STRUCTURES

1.0 General

This term of reference shall apply to the design and construction of all bridges and viaduct structures or parts of structures to be undertaken for Malaysian Government Projects. This term of reference shall be read in conjunction with latest version of JKR Arahan Teknik, Nota Teknik, Specifications for roadworks and any other documents approved by JKR. Any digression of stipulated herewith or reference documents in the design or construction shall seek the approval from JKR.

1.1 Geometric Standards

The bridge geometric standards shall conform to JKR R5 Arahan Teknik (Jalan) 8/86 (Pindaan 2015) : A Guide On Geometric Design Of Road and shall be read together with the Project Brief or Government Need of Statements.

1.2 Materials

1.2.1 The bridge and viaduct structures shall be of steel or concrete construction. The Contractor shall use local materials, particularly locally produced steel. Other materials can be only be used upon approval from JKR. Designer and contractor are also highly recommended to use sustainable material in the design and construction.

1.2.2 Materials used shall be in compliance with related specifications approved by JKR and shall possess adequate durability and protection against environmental deterioration. Minimum grade of concrete allowable is Grade 40 N/mm² of cube strength. Where the bridge structures or elements of the structure are subjected or prone to chlorides, sulphate or to any other detrimental effects that may cause durability issue, high performance concrete or any other type as approved by JKR shall be used.

1.3 Design Requirements and Considerations

1.3.1 The design and construction of the bridge and viaduct structure must adhere to the following requirements and considerations:

- (i) **Functionality:** The bridge and viaduct structure must be fully functional for its intended use, connecting way from one point to the other, allowing passage for traffics under the required serviceability limit state condition throughout its design life as given by the approved standards.
- (ii) **Safety:** The bridge and viaduct structure must be designed with adequate factor of safety in compliance with approved code of practices, design standard and specifications during construction and at service condition.
- (iii) **Robustness:** The bridge and viaduct structure must be designed with adequate robustness at ultimate limit state condition. The structures should be designed so that they are not reasonably damaged or sudden collapse to the effects of accidents. In particular, situations should be avoided where damage to small areas of a structure or failure of single elements may lead to collapse of major parts of the structure. The design must also allow for adequate redundancy to avoid any sudden failure.
- (iv) **Durability:** The bridge and viaduct structures shall be designed with adequate durability to withstand the service conditions for which it was

intended use over a prolonged period without significant deterioration and major maintenance.

- (v) **Maintenance:** The bridge and viaduct structures shall be designed for ease of inspections, maintenance and replacements of the various parts, such as bearings, expansion joints, stay cables and others. Suitable access facilities shall be provided and incorporated in the bridge structure where access is not possible by normal means.
- (vi) **Aesthetic:** The bridge and viaduct structures shall be designed with aesthetically pleasant that is in harmony and blend in with surrounding and localities. The structure must also have a right geometrical proportionality in span length and expressively form of structural anatomy where necessary.
- (vii) **Economics:** The cost of design and construction of the structure must be cost-effective and well-proportioned to its functional requirements. The consultant must provide a value for money in selecting materials and method of construction of the bridge.

1.3.2 The design of bridge and viaduct structure component must endure to utilize the Industrial Building System (IBS) as follows:

- (i) Minimum percentage of IBS component utilization calculated based on cost of structural works shall be fixed at 70%;
- (ii) Foundation works shall not be included in accounting for percentage of IBS used in the structure.
- (iii) For cast in-situ construction that deploys repetitive method or procedure such as balanced cantilever, movable scaffolding system or other labour saving method, the maximum score for reusable formwork allowed is only 50%.
- (iv) All reinforcement for the precast reinforced concrete structure shall be cut and bent off-site with the compliance to MS 146 as well as BS 4466 and BS 5400.
- (v) The Consultant Engineer (CE) or Contractor must submit calculation for percentage of IBS content when submitting structural drawing for verification.

1.3.3 Appropriate investigations and data collection shall be carried out to determine the best design. The investigations shall include at least the followings:

(i) **Hydraulic and hydrological data**

Hydraulic and hydrological data are required to determine the soffit and deck finished levels, river training geometry, scour depth estimation, scour protection, drainage networks and other related measures.

Investigation and evaluation of the complete hydraulic and hydrological data shall be carried out to determine the design flood flow capacity, tidal effects/water tide, flood level, flow velocity, rainfall, waterway width, catchment area, river slope and other measures.

The return period or annual recurrence interval (ARI) to determine the design discharge of the waterway or local drainage shall be in accordance to DJ 1/2001: Design of Highway Bridges for Hydraulic Action.

All design data used in the design calculations shall be submitted to JKR.

(ii) **Weather and climatic data**

Weather and/or climatic data shall be obtained in the case where it has significant impact to the bridge structure. Where it is envisaged that wind loadings may have a significant effect on the stability and serviceability design of the structure, appropriate wind tunnel testing shall be carried out.

(iii) **Seismic Consideration**

Seismic consideration must be accounted for in the design of long-span lifeline structure or depending on the nature of the project as directed by JKR. The seismic considerations shall follow the relevant Malaysian guideline where applicable or other related codes. The guideline or code used shall be subject to approval of JKR.

(iv) **Navigational requirements for navigable bridge**

The navigational requirements of the bridge shall be confirmed with the relevant authorities to determine soffit levels, minimum navigational spans, protection against vessel impact, appropriate navigational lighting, maritime/aviation navigational aids etc.

- 1.3.4 Bridges of total length not exceeding 60.0 meters with skews not exceeding 30° shall be designed as an integral bridge.
- 1.3.5 For multi-span bridge, the superstructure shall be structurally continuous with the minimum use of expansion joints as possible. Continuity connection by using the tied deck slab only is not allowed. Whenever possible, the abutment shall be designed as a semi-integral type without the needs of having the expansion joints.
- 1.3.6 Where the substructures are slender and flexible enough to abridge the bending moments at the superstructure, the bridge shall be designed with integral pier crosshead between the superstructure and substructure without the needs of having any form of bearings.
- 1.3.7 Beam of less than 30.0 m span shall be designed and constructed by using the JKR standard Beam Sections where applicable. Other types of beam may be used subjected to the approval of JKR. The contractor and consultant are responsible to undertake and carried out the stability calculation and checking during the launching and positioning of beam prior to deck slab and diaphragm casting. The contractor and consultant must also ascertain that adequate bracing system is properly designed and placed onto the correct positions and subject to approval of JKR
- 1.3.8 A single pier crosshead that is carrying a 6-lane carriageway on a single deck shall be designed and constructed as a precast prestressed element members. The construction of the crosshead shall be in the form of segmental construction.
- 1.3.9 Public utility services

Where applicable, the bridge shall be designed to cater for water pipe under full service load conditions, telecommunications and/or other utility services cables

or ducting. Details of the utility services cables or ducting shall be obtained from relevant agencies or authorities by the Consultants. High tension or high voltage cables or ducting shall not be permitted at anywhere on the bridge.

1.3.10 Bridge Parapets

Bridge parapets shall be precast and of New Jersey Barrier type. Bridge parapets shall be design and construct with decorative façade and subject to approval of JKR. Cast in-situ parapets shall use formworks (Type F3 - smooth surface). All parapet bridge shall be applied with aesthetical surface coating on inner and outer side of the parapet. Parapet on the bridges that are located in the area subjected to environmental conditions of chloride and sulphate attack shall be coated in accordance to clause 1.4.14.

Bridge parapet shall be installed with reflector plate at minimum interval of 1.5m spacing. The reflector plate shall also be installed at the guardrail on both approaches towards the bridge.

1.3.11 Pier protection system

Any pier structures that are located in the major river or within the navigable channel shall be provided with pier protection system in the form of fenders, dolphin, etc. Data for riverine traffics, vessel or laden weight shall be obtained from relevant agencies.

Erosion protection measures to the approach embankments, abutments, piers and/or riverbed/riverbank shall be provided where necessary.

1.3.12 Surface Coating

Protective surface coating shall be applied to the structures that are exposed to environmental condition of chloride or sulphate attacks. The coating shall be applied to all exposed members of the superstructure and substructure and/or to the area deemed to be subjected to environmental condition attacks or to a specific area as directed by JKR.

Surface coating for aesthetical purpose without the needs of protective surface coating shall be applied in case where the structures located in the major town, or as an iconic monumental structures at which the area is not prone to environmental condition attacks .The surface coated area shall be determined by JKR.

Surface coating to serve as the function of protective as well as for aesthetical purpose shall be applied where the structures are located in major town and also subjected to environmental condition attacks. The surface coating shall be mixed and combined in a single application and shall not be applied in layer on top of the other.

1.3.13 Lighting

All bridges shall be provided with road lighting including the suitable lighting post, supports and cabling. The spacing of the post shall be based on the illumination requirements. For bridge span less than 20m, the lighting shall be provided at both approach part of the bridge inclusive of supports, post, cabling and all related items to the completeness of road lighting.

Bridge lighting shall be of linear lighting system fixed to the bridge. The light fixture shall be of appropriate brightness aimed at the roadway and shielded to prevent glares to motorists. The used of facade, spotlight and floodlight lighting at the bridge shall be testing and commissioning as approved by JKR. Where required by the navigational authorities, appropriate navigational lighting aids shall be provided.

1.3.14 Outlet drain pipe or rain water downpipe shall be provided on the deck at suitable position as to collect the surface runoff from the deck and discharge to the nearest discharging point inclusive of all collector pipes. The minimum size of outlet pipe shall be 150mm depending on the amount of surface runoff and spacing of the outlet pipe. Scupper drain on the deck may be provided as appropriate.

1.3.15 Access for inspection under the bridge in the form of staircase or platforms must be incorporated in the design. Adequate height clearance at the abutment area must be provided for the bearing inspection.

1.3.16 Cast in-situ box culvert:

Box culvert of size 1.5 m and above in height and/or width shall be designed as cast in-situ type including the approach slab. Culverts with the height of embankment or fill is more than 3m shall be designed and constructed as cast in-situ box shaped type. The foundation of the culvert shall be based on-site soil bearing pressure. Sand bedding layer shall not be used as the base layer of the culvert.

1.3.17 Precast box culvert and precast arch bridge shall be properly designed to satisfy the following conditions:

- (i) The segments must be analysed and designed as rigid frames;
- (ii) Minimum top and bottom slab thickness is 200 mm;
- (iii) Minimum wall thickness is 200 mm;
- (iv) All joints between precast section shall be provided with tongue, groove and lifting hooks to pick up sections;
- (v) Water proofing, geotextile fabric or wrap shall be placed over joints;
- (vi) The joint exterior shall be covered with a minimum of 225 mm wide wrap centre on the joints;
- (vii) To prevent precast section from pulling apart during or after construction, minimum four (4) longitudinal 12.7 mm diameter low relaxation polypropylene sheathed prestressing strands with corrosion inhibitor or other approved post-tensioning device, shall be placed in position through preformed holes in the corners of the precast units;
- (viii) Prestressing strand with minimum 183 kN breaking load shall be provided. Each strand shall be stressed to 137 kN or equivalent to 75% ULS;
- (ix) These end anchorage forces must be considered in the box culvert design;
- (x) The exposed end of the sheathed prestressing strand shall be removed after post-tensioning. No part of the strand or the end fittings shall extend beyond 50mm inside the hand-hold pocket. The pocket shall then be filled with non-shrink grout;
- (xi) Recommended allowable weight of precast section is below 18 metric tonnes.

1.3.18 Retaining structures at approach embankment

The maximum height of any type of retaining structure at approach embankment shall be maximum of 6.0m unless approved otherwise by JKR.

- 1.3.19 Stringent measures shall be taken to prevent long-term discontinuities and unacceptable driving condition as a result of differential settlement between the bridge and the approach embankments.

1.3.20 Footbridges

Footbridges shall be designed in compliance to BD 29/17 or as approved otherwise by JKR. For dual carriageway with permitted speeds in excess of 50 km/h, a single span shall be provided spanning both carriageways to avoid the need for support in the central reserve. Both ramps and staircases shall be provided for access.

The staircase of the footbridge shall have minimum tread width of 260mm and a maximum riser of 180mm. The inclination angle of the steps shall be maximum of 34°.

1.4 Design Criteria and Parameters

- 1.4.1 Latest Malaysian, British Standards, Eurocode and Codes of Practice shall be adopted for design of structures. The principal standards but not limited to are as the following:

- (i) The latest version of British Standard Institution BS 5400: Steel, Concrete and Composite Bridges, BS EN 1990, BS EN 1991, BS EN 1992, BS EN 1993 and BS EN 1994.
- (ii) Bridge loading shall follow The Highways Agency, UK BD 37/01: Loads for Highway Bridges, BS EN 1992-2. Prestressed member should be design for Class1 under Load Combination 1 with HA and HA+30 units HB. Load Combinations 2 to 5 is designed for Class 2 with HA and HA+45 units HB.
- (iii) Integral bridges shall follow BA 42/96 Amendment No. 1: The Design of Integral Bridges.
- (iv) Foundations, Retaining wall structures and Reinforced Earth shall follow BS 8004: Foundation, BS 8002 : Code of Practice for Earth Retaining Structures , BD 3/78: Reinforced and Anchored Earth Retaining Walls and Bridge Abutments for Embankments [Rev. 1987], BS EN 1997 : Geotechnical Design.
- (v) Vehicle Impact shall follow BD 60/04: Design of Highway Bridges for Vehicle Collision Loads or BS EN 1991:Part 2 :Traffic Loads On Bridges.
- (vi) Vessel impact
Shall establish appropriate ship collision forces and follow the latest version of AASHTO Guide Specification And Commentary For Vessel Collision Design of Highway Bridges, Second Edition (2009) , BS EN 1991:1-7: Accidental Action.
- (vii) Expansion Joints in Bridge Decks
Shall follow BD 33/94 and BA 26/94. Expansion Joints for Use in Highway

Bridge Decks. The expansion joints shall be guaranteed by the manufacturer to have a minimum effective live of 10 years in the prevailing climate and traffic condition.

- (vii) Parapet shall be in accordance to BD 52/93: The Design of Highway Bridge Parapets and in compliance to Arahan Teknik (Jalan) 1/85 (Pindaan 1/89) Manual on Design Guidelines of Longitudinal Traffic Barrier and REAM GL- 9/2006 :Guidelines on Design and Selection of Longitudinal Traffic Safety Barrier.
- (viii) The bridge and viaduct structures shall be designed to satisfy for aesthetics requirement by following REAM - GL 1/1999: Guidelines on Bridge Aesthetics.
- (ix) Footbridge design shall follow BD 29/04: Design Criteria for Footbridges

1.4.2 Durability

The bridge and viaduct structural elements shall be designed for enhance durability (if applicable) in accordance to The Highways Agency, UK BA 57/01 : Design For Durability. Reinforcement cover: in designing concrete members, nominal cover derived from BS5400: Part 4 Table 13, shall be increased by 10mm in accordance to BD 57/01 in the case of the bridge or structural elements of the bridge are subjected to abrasive chloride attack.

- 1.4.3 Design crack widths for reinforced concrete shall be in accordance to BS5400 part 4 and/or EN 1992-2 or as directed by JKR.

1.4.4 Earthquake loading

Earthquake loading for long-span lifeline bridges or bridges that required to be designed with seismic loading as directed by JKR, shall be taken as 1.0 in ULS and in Load Combination 4 only. The Peak Ground Acceleration (PGA) value depends on the project location and shall be taken as follow:

- a) Peninsular Malaysia and Sarawak: 0.08g
- b) Sabah : 0.17g

In considering earthquake loading no relieving effects from bearing friction will be considered.

- 1.4.5 Drainage: drainage facility for the bridge deck shall be suitably provided and the bridge deck shall have a minimum cross fall of 2.5%.
- 1.4.6 Reinforced earth wall shall be designed to Department of Transport Highways and Traffic Departmental Standard BD 3/78 (Revised 1987) Reinforced and Anchored Earth Retaining Walls and Bridge Abutments for Embankments. Reinforced earth structures shall have a design life of 120 years.

1.4.7 Approach embankment

Approach embankment for viaducts and structures shall conform to Geotechnical Design Criteria for Road Work to minimize any differential settlement at abutments.

Embankment must be designed with zero differential settlement at the connecting

point to the bridge abutment and gradual settlement of **1 in 500** within 50m away from the abutment towards the toe of the approach embankment. Appropriate soil treatment must be provided in the case of SPT of the underlying soil is less than 5. Consultant must provide detail calculation of expected differential settlement with respect to the proposed type of soil improvement at the embankment area.

1.4.8 Differential Settlement

Where differential settlement is likely to affect the structure in whole or in part, the effects of this parameter should be taken into account.

- (i) When designing a structure, the value of differential settlement shall be taken as 12.5 mm at serviceability limit state (SLS).
- (ii) The structure shall be checked for differential settlement of 38.0 mm at ultimate limit state (ULS).

1.4.9 Surface finishes: the surfacing designed thickness shall be taken as 100 mm thick asphaltic concrete.

1.4.10 Bridge Clearances

- (i) For bridge over river the freeboard and horizontal clearance shall be in accordance to DJ 1/2001 requirements and approved by Jabatan Pengairan dan Saliran (JPS), Jabatan Laut or relevant authorities;
- (ii) For bridge over Keretapi Tanah Melayu Berhad (KTMB) railway lines the bridge vertical and horizontal clearance shall be approved by KTMB;
- (iii) For bridge over road the vertical and horizontal clearance shall be approved by the relevant Road Authority.

1.4.11 Prestressing anchorages shall not be located at top flange face of T-beams or any other beams.

1.4.12 Half joint shall only be allowed as the temporary seating of precast beams onto the integral in situ crossheads.

1.4.13 Elastomeric bridge bearings shall be of natural rubber and shall be in accordance with the specification proposed by the Committee on Natural Rubber in Construction, Rubber Research Institute, Malaysia. Bridge bearing shall be designed with adequate stability in all directions during the beam launching and placement prior to deck slab casting.

1.4.14 Coating

The detail mix design and application of protective surface coating system for exposed concrete surfaces or areas where it deemed to be subjected to environmental condition attacks shall be in accordance to Section 9 (Concrete) Specification for Roadworks. Similar condition apply in the case of protective surface coating in combination with aesthetical surface coating. The minimum effective life of both protective systems shall be in excess of 20 years. Compulsory sample testing of paints is required.

1.4.15 Anti-corrosion protective system

The steel materials used for the bridge structures shall follow BS 5400: Part 6. A comprehensive anti-corrosion protective system in accordance with BS 5493 or equivalent shall be submitted and approval by JKR. The minimum effective life

of such protective system shall be in excess of 20 years. Compulsory sample testing of paints is required.

1.4.16 Launching of precast elements

Utmost precautions shall be taken to eliminate any danger to workers and general public while launching precast elements. All lifting equipment shall be designed, such that if the primary lifting mechanism fails, a secondary mechanism will ensure that the precast element does not fall.

Upon erection, a fail-safe method shall be used to temporarily secure the precast unit until the permanent fixing arrangements are implemented.

All precast unit must be braced adequately and maintained stable at all time. Bracing system must be designed to ensure stability of the precast unit prior to the fixed arrangement of the unit or structural members.

1.4.17 Temporary works

The risks for each case shall have to be considered and appropriate safety factors allowed in the design. The minimum safety factor at ULS shall be taken as 1.5 if the safety of the general public is at risk.

1.4.18 Bridge furniture and traffic signs on the bridge or at approaches shall be in accordance to that specified separately in the relevant sections of roadwork.

1.4.19 A plaque shall be fixed on the inner face of the parapet or wingwall of each bridge. The shape and dimension of the plaque shall be as approved by the PD or S.O and shall be of yellow brass with bold face alphabets. The wordings on the brass plaques shall be as follows: -

JAMBATAN	:	Name of bridge
TARIKH	:	Month and year of completion of bridge
PEREKABENTUK	:	Name of Designer
KONTRAKTOR	:	Name of Contractor
BEBAN	:	Design loading
RENTANG	:	Bridge spans, type of beam and bridge system (semi integral / fully integral)
ASAS	:	Type, size, and length of pile

TERMS OF REFERENCE FOR BRIDGE ASSESSMENT PROCEDURE

2.0 Introduction

This bridge assessment procedure shall be adopted if the Need Statement requires rehabilitation, upgrading works and replacement. It involves careful consideration for the treatment of the existing stock of structures (bridges and culverts) to attain the desired objectives of ensuring structural safety, quality, serviceability, durability and economy.

2.1 Bridge Replacement Policy

The general policy is to save existing structures. The Contractor shall follow this Bridge Assessment Procedure and prepare a report to cover the assessment of existing structures.

The objective of this report is to access: -

- (a) The conditions of the existing bridge based on visual inspection,
- (b) The hydraulic capacity of an existing structure based on site investigation and discharge capacity
- (c) The existing structures capacity based on theoretical calculation.

If one or all the criteria given above are not satisfied, the existing structure will either be replaced, upgraded or rehabilitated as deemed necessary.

2.2 Bridge Assessment Procedure

The Bridge Assessment Procedure is a nine (9) steps procedure as shown in Figure 1. The three types of assessment to be carried out are explained below:

(a) Visual Assessment

The condition of the existing structures to be inspected by checking defects of each structure through visual inspection, giving particular attention to primary members such as longitudinal beams, cross heads and abutments. The inspections condition existing structures can be referring JKR Annual Bridge Inspection Manual as a guidance. The defects shall be divided to:

(i) Material defects

These includes spalling of concrete, corrosive of steel reinforcement and abrasion of piers and abutments.

(ii) Structural Defects

Structural defects are caused by the inability of the structural member to resist the load imposed on it and can be in the form of cracks, settlement or deformation.

(iii) Hydrological Defects

This includes silting and erosion due to fluctuation of water level and inadequate discharge capacity of the existing section.

(b) Hydrological Assessment

The aim of this assessment is to ensure that the existing structure provides adequate opening for the designed flood frequency discharge. Also the foundation structure is to be checked for scouring effects.

(c) Analytical Assessment

The loading shall be JKR Specification for Bridge Live Loads

- (i) Long Term Axle Loads (LTAL) combined with KEL
- (ii) Special Vehicle (SV20) loading

Method of analysis should ideally consider of all the significant aspects of behaviour of a structure governing its response to loads and imposed deformations.

(d) Structural Member Resistance

(i) Evaluation Code shall follow:

- BD 21/01 : The Assessment of Highway Bridges And Structure, Department of Transport UK.
- BD 44/95 : The Assessment of Concrete Highway Bridges and Structures, Department Of Transport UK.

(ii) Partial /Load Factors

Dead Load	=	1.15
Superimposed Dead Load	=	1.75
If premix was measured	=	1.25
Live Load LTAL	=	1.5
Live Load SV	=	1.3

(iii) For material Strength Without Drawings (Unknown)

f_y	=	230 N/mm ²	=	γ_{ms}	=	1.10
f_{yv}	=	230 N/mm ²	=	γ_{mv}	=	1.15
f_{cu}	=	20 N/mm ²	=	γ_{mc}	=	1.20

(iv) Calculation of Member Resistance by Statistical Method

This method shall be used to obtain percentage of steel for reinforced concrete bridges without flexural reinforcement details. The use of this method is restricted to:

- 1) Simply supported reinforced concrete bridges
- 2) Bridges in Peninsular Malaysia
- 3) Bridges constructed between 1950 and 1972
- 4) Bridges spanning between 6 -15 metres.

The Formula is:

$$\begin{aligned} \% \text{ steel} &= 0.015 \times R_{cindex} - 0.2 \\ R_{cindex} &= \frac{100 \times S.L^{1.326V}}{W.D^2} \end{aligned}$$

S = The girder spacing(mm);

L = Span length (mm);
W = The girder width (mm);
D = The effective depth (mm) - 0.9 of the total depth

(e) Rating System

The load carrying capacity of a bridge is assessed based on the ratio of the available resistance of a member to the effective of live load

$$\text{Rating} = \frac{\Phi R - \alpha D}{\alpha L}$$

ΦR = Factored resistance of a member
 αD = Effect of the factored dead load on a member
 αL = Effect of the factored live load for LTAL

$$\text{SV Rating} = 20 \cdot \frac{\Phi R - \alpha D}{\alpha L_{sv}}$$

where αL_{sv} = effect of the factored SV20 loading on the member

(f) Decision Making

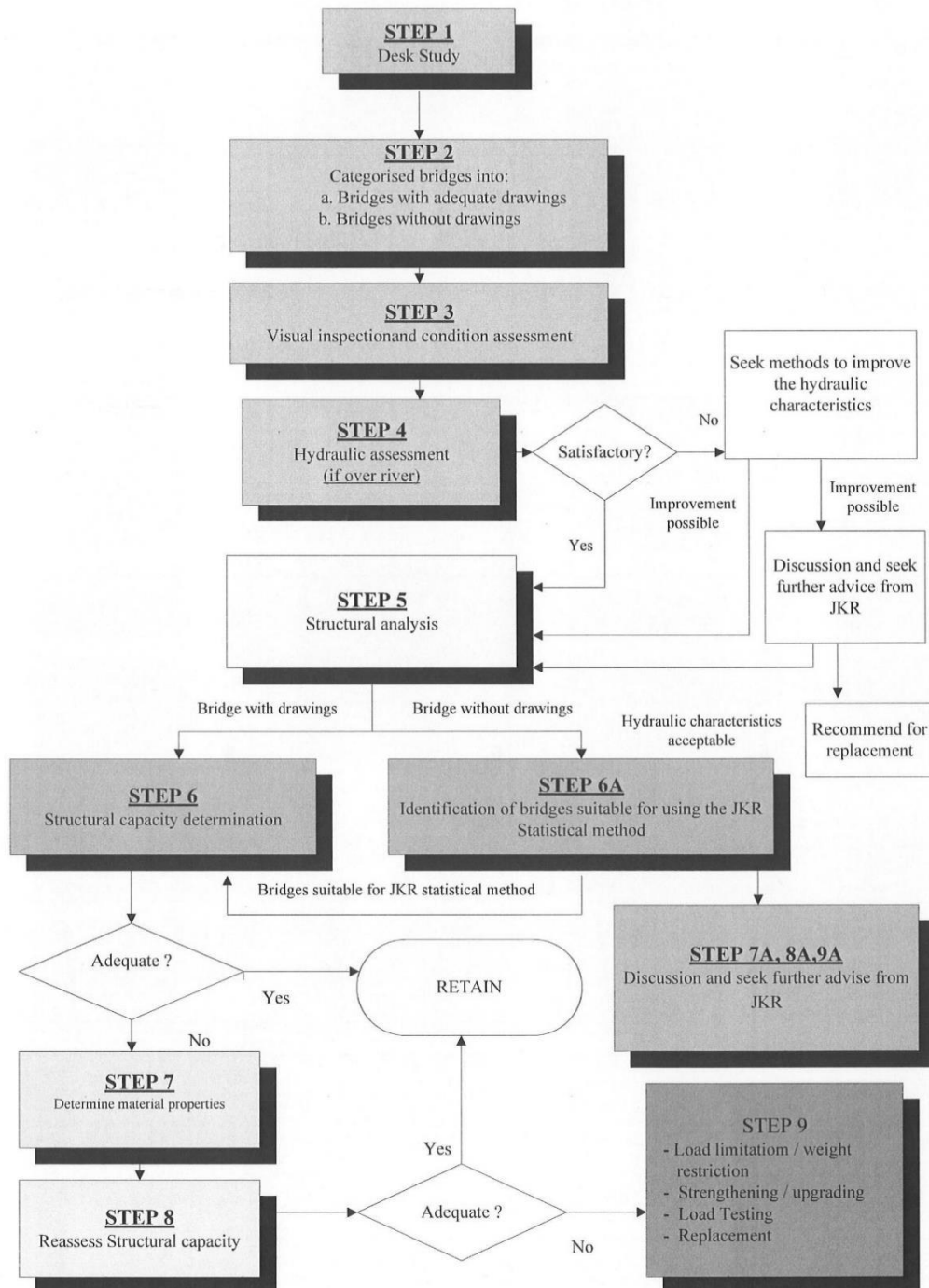
Widen when Rating > 0.8 LTAL
Replace when rating < 0.8 LTAL

2.3 Reporting On the Bridge Assessment

The detail report shall be submitted in writing to JKR within 2 weeks of the assessment being done or otherwise as agreed in writing.

It shall include a summary of the consultant's recommendation as shown in Figure 2

FIGURE 1: BRIDGE ASSESSMENT PROCEDURE



PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

FIGURE 2 : SUMMARY OF CONTRACTOR'S RECOMMENDATION

No.	Structure No/River Name	Bridge Type	Span Length (m)	Carriageway Width (m)	Year Built	Consultant's Report				JKR Comments	
						Hydraulic	Condition	Analytical	Recommendation	Opinion	Consultant's Action

TERM OF REFERENCE FOR SURVEY WORKS

CONTENTS

	Page
1.0 Background and Objective	1
2.0 Scope of Works	1
3.0 Licensed Land Surveyor (LLS) Service Period	1
4.0 Services Specifications for Survey of Road Details	2
5.0 Services Specifications for Topographical Survey Works	21
6.0 Services Specifications for Bridge Works	34

APPENDIX

- Appendix A1 : Ground Markers On Normal Surface
- Appendix A2 : Ground Markers On Hard Surface
- Appendix A3 : Certified by Licensed Land Surveyor (LLS)

1.0 Background and Objective

The purpose of the detailed ground survey is to provide all the necessary data and information required for undertaking the engineering design review for project and also for the necessary land acquisition and application.

2.0 Scope of Works

The proposed road alignment corridor is to be fully located and surveyed. The corridor width is to be appropriately increased where relevant to cover existing road reserves and also major details like rivers, railway line, lot boundaries, interchange site, new alignment routes and or as decided by the Government.

The exact location of the alignment of the corridor is subject to changes on Site by the Government's Representative.

3.0 Licensed Land Surveyor (LLS) Service Period

The determination of the LLS Service Period is based on project implementation schedule which is shown in **Appendix A5**.

This schedule should be a reference to the LLS to prepare a proposed work execution schedule in the Technical Proposal (Cadangan Teknikal)

The Final Account Claim and consultant declaration on the total payment received must be finalized within 4 months before the end of services.

SERVICES SPECIFICATIONS FOR SURVEY OF ROAD DETAILS

1. Basic Professional Land Surveying Services for survey of road details

The Services to be rendered by the LLS in this paragraph include the provision of all expert technical advice and skills, which are normally required for the Works for which the LLS has been engaged.

1.1 General

The Services to be provided by the LLS as listed herein and as detailed in subsequent sections: -

- 1.1.1 Prior discussion with relevant authorities such as MBSJ and, LC before the physical commencement of work on site.
- 1.1.2 Study all relevant information and maps provided and obtain additional data if necessary for the proper execution of the works.
- 1.1.3 Consultation with the GR and setting out.
- 1.1.4 Setting out of survey alignment.
- 1.1.5 Field survey and picking up of mapping details for subsequent submission of 3 dimensional digital data in DWG (Autocad) format.
- 1.1.6 Establishment of Permanent Ground Markers for survey control such as Survey Markers, Bench Marks, and Temporary Bench Marks.
- 1.1.7 Preparation of land acquisition base plans in accordance to JKR guidelines as contained in *Arahan Teknik Jalan 7/85 (Garis Panduan Untuk Penyediaan Pelan Pengambilan Balik Tanah bagi Projek Jalan Persekutuan)* and as specified in Sub-paragraph 1.5.6 below.
- 1.1.8 Preparation of plans in accordance to *Arahan Teknik (Jalan) No. 6/85 (Guidelines for presentation of Engineering drawings)* or as specified in the Terms of Reference.
- 1.1.9 Compilation, processing and preparation of data in accordance to 3D DWG format (Autocad).
- 1.1.10 Pegging of centre line for Design Road Alignment and establishment of Permanent Ground Markers for Design Road Alignment Centreline such as IPs, RMs, and TBMs.

- 1.1.11 Provide services for data verification in the event of any discrepancy in survey data during construction.

1.2 Accuracies, Tolerances, Errors and Corrections

Wherever accuracies or tolerances are specified herein, they are defined as Maximum Errors or statistically based root mean square errors (r.m.s.e.) as follows:

-

1.2.1 Maximum Errors

Maximum errors are only used for fieldwork misclosures [sub-paragraphs 1.3.1 and 1.3.2] and plotting of map grids and control points [sub-paragraph 1.4.3]. All errors exceeding the maximum allowable tolerance including consequential errors shall be corrected by the LLS at his own expense.

1.2.2 Root Mean Square Errors

The root mean square errors (r.m.s.e.) are related to checks on representative dimensions or levels and the following conditions have to be satisfied: -

- (a) At least 67% of all readings must be correct to or better than the r.m.s.e.
- (b) At least 90% of all readings must be correct to or better than 1.65 times the r.m.s.e.
- (c) All readings must be correct to or better than 3 times the r.m.s.e.

All readings not complying with the above 3 conditions including consequential errors shall be corrected by the LLS at his own expense.

1.2.3 Method and Location of Corrections

The LLS shall agree with the Government the method, location and extent of the work to be corrected.

1.3 Fieldwork

1.3.1 Grid and Planimetric Control Accuracies

- (a) For Peninsular Malaysia, planimetric control shall be calculated based on the relevant State Cassini-Soldner Grid lines projection as agreed by the Government. Where necessary, the State origin shall be transformed into the equivalent Rectified Skewed Orthomorphic Projection (Malaya) point and all coordinates shall follow the same transformation factor.
- (b) Azimuths shall be checked by solar observations at appropriate intervals and the survey traverses shall be tied up to any nearby trigonometrical points or standard traverse points or permanent GPS points or Boundary Mark. The closing error of the traverse shall be 1:4000 or better.
- (c) The LLS shall determine the grid coordinates of all junctions and intersection points so marked, and the bearings and distances of all straight sections of the routes relative to the specified grid system.

1.3.2 Height Datum and Vertical Accuracies

All heights supplied by the LLS shall be related to the latest published values of JUPEM Bench Marks at the time of survey.

All Temporary Bench Marks shall be connected by a closed levelling net which shall be tied to a minimum of two JUPEM Bench Marks unless otherwise agreed by the Government.

Vertical misclosures within the levelling net and between JUPEM bench marks shall not exceed the lesser of the following: -

- (a) $\pm 16 \text{ mm}$
- (b) $\pm (20 \sqrt{K}) \text{ mm}$ where K is the sum of the distances levelled in kilometers.

JUPEM Bench Marks which exceed these tolerances shall be omitted from the adjustment. The LLS shall inform the GR and JUPEM whenever the JUPEM Bench Marks are found to be damaged or in error.

All levelling shall be done in sections of approximately 1 km. in length.

1.3.3 Permanent Ground Markers

Permanent Ground Markers shall include the following: -

- (a) Intersection Points (IPs)
- (b) Reference Marks (RMs)
- (c) Survey Markers (SMs)
- (d) Temporary Bench Marks (TBMs)
- (e) Pegging
- (f) Tangent Points (TPs)

The LLS shall construct, coordinate and height of Permanent Ground Markers to the satisfaction of the Government at the location where points are required to form a reference system for future setting out of the Works at the approximate locations indicated on the Drawings, clear of future construction works and as agreed with the Government.

The types of marker which will be considered acceptable for the appropriate general ground surface conditions. Alternative forms of marker submitted by the LLS may however be considered.

The Government will indicate on the Drawings the likely types of the Permanent Ground Markers to be installed within the Site. The final locations and types of markers shall be agreed with the Government before emplacement. All Permanent Ground Markers shall be clearly and legibly inscribed to distinguish between IP, RM, SM, TP and TBM.

There shall be a joint inspection and handing over of all Permanent Ground Markers to the GR.

1.3.3.1 Intersection Points

The LLS shall establish Intersection Points along the proposed road alignment and shall be numbered in accordance to the plan given by the Government.

1.3.3.2 Reference Marks

The LLS shall erect at least two (2) RMs for each IP. To ensure accuracy, RMs shall be placed at least 25 m away from the IP. and the base of the triangle which they form with the apex should be at least 15m. apart. Each point of this triangle shall be visible from the two other points.

1.3.3.3 Survey Markers

Whenever required by the Government, the LLS shall erect permanent Survey Markers at locations indicated in the Drawings or as agreed by the Government.

1.3.3.4 Temporary Bench Marks

The LLS shall establish Temporary Bench Marks at approximately 1 km. intervals and reference it to the JUPEM Datum. Reduced levels of these temporary bench marks shall be clearly and legibly inscribed and referenced for identification for the subsequent construction stage.

1.3.3.5 Pegging

The surveyor shall be using suitable type of wood for all pegs. At least 10cm of the peg should be visible above ground level and painted with red colour

1.3.4 Deliverables

The LLS shall supply two copies of the following to the Government on completion of fieldwork and survey adjustment: -

- (a) Schedules of all Permanent Ground Markers (IPs, RMs, SMs, TBMs) giving the reference numbers, coordinates and heights above JUPEM's datum.
- (b) Descriptions of Permanent Ground Markers and JUPEM Bench Marks giving the types of marker constructed and location sketches.

- (c) Copies of the most recently available JUPEM Triangulation Station descriptions for each station used for the Works, giving the reference number, coordinates, height above JUPEM's Datum, and description of position.
- (d) Copies of the most recently available JUPEM Bench Mark lists used for the Works, indicating Bench Marks used, Bench Marks found to be damaged or destroyed and the readjusted heights of any JUPEM Bench Marks found to be out of tolerance.
- (e) Diagrams of the plan control net showing the connections between Permanent Ground Markers and JUPEM Triangulation Stations, and with loop closures or residuals.
- (f) Diagrams of the levelling net indicating the connections between Permanent Ground Markers, Temporary Bench Marks and JUPEM Bench Marks with misclosures.
- (g) Where applicable, description of the Local or State grid giving the origin, scale factor, and parameters used for transformation from the Local Grid to the National Grid.

The LLS shall supply to the Government immediately after initial completion, advance copies of the above results in order for the Government to carry out a check survey.

1.3.5 Survey of Watercourses

1.3.5.1 Streams and Rivers

The LLS shall survey all streams, rivers and watercourses crossing the line of the routes. These include all watercourses whether there is water or no water flow at the time of surveying. The survey shall extend to the following minimum distances on either side of the route centre lines (distances measured along the channels), or up to the edge of the Survey corridor, whichever is the greater: -

Major Rivers exceeding 10 m width 250 m.

Rivers/Streams between 5 -10 m width 150 m.

Watercourse less than 5 m width 50 m.

The locations of channel edges and other significant features shall be recorded and levels shall be taken along the bank slopes and channel inverts at intervals of not more than 20m or 10m at anticipated sites for bridges and culverts (cross-section points shall not exceed 5m.).

Details of existing adjacent bridges shall be recorded as described in Sub-paragraph 1.4.7.

1.3.5.2 Urban Drainage

The LLS shall survey all top and bottom edges and invert levels of urban drains at intervals not exceeding 10 m, showing all significant changes of level and direction of flow. The type, width and depth of each section of different drainage system (including sumps) shall be recorded.

1.3.5.3 Culverts

All the relevant details of the culvert as described in Sub-paragraph 1.4.8 shall be recorded.

1.3.5.4 Flood Information

The LLS shall record the maximum flood level at each river crossing. Existing water surface at suitable points shall be taken along the channel. Each reading shall be taken at intervals not exceeding one hour and the mean, maximum and minimum of 12 hour readings shall be recorded.

In areas where tidal effects are significant, the LLS shall gather all the necessary information as an appendix to the mapping in a form agreed by the Government.

1.3.6 Details of Junctions and Existing Roads

The LLS shall survey all junctions to enable the designer to design the junction properly.

A corridor width of 100 m and shall be taken for a distance of not less than 150 metres up and down the proposed intersection of the road or as required by Government.

All metalled roads, main roads and footpaths or tracks having the width greater than 2 m shall have a minimum of two (2) points defining both edges of the carriageways. Consecutive points along the road feature shall not exceed 20 m in rural areas and 10 m in urban or built-up areas. More points are generally needed to define curved features such as slip roads, islands, etc.

Levels of the road centre line shall be recorded for metalled / paved roads having widths greater than 6.0 metres. The main destination of the road from the junction shall be recorded by the LLS.

1.3.7 Strip Survey

The LLS shall carry out a strip survey contours at 1 meter within 20 metres interval together with the detail of the strip. The width / area of the strip is as indicated in the Terms of Reference.

The LLS shall carry out all field work necessary to accurate at the specified intervals and detailed physical features of the terrain. Sufficient control height points and spot heights shall be taken to ensure accuracy of the contour lines.

The LLS shall carry out all fieldwork suitable for the digital data required for Autocad program.

1.3.8 Setting-out of Survey and Road Alignment -

1.3.8.1 Consultation with GR before Setting-out of Survey Alignment

Before setting out, proposals for the detailed survey should be submitted to the Government before the work is being carried out. The LLS has to consult and follow the Government's instructions either verbally on site or in plans on the locations of all Permanent Ground Markers and other aspects of setting out of the Survey Alignment. If instructed by the Government, the LLS shall submit field survey plans showing the sufficient details as described in Sub-paragraph 1.5.2 so as to enable the Government to make the decisions in choosing the best alignment of the road. The LLS shall make any minor adjustment on the setting out of the Survey Alignment when requested by the Government provided such request is made before all the plans are submitted.

1.3.8.2 Setting out of Design Road Alignment

The LLS has to set out the centre line of the proposed road alignment essentially in two (2) stages as follows: -

- Stage 1 - Setting out of survey alignment and monumenting of SMs and TBMs based initially on drawings supplied as stated in Sub-paragraph 1.3.3 and modified appropriately to suit site conditions and/or as directed by the Government.

- Stage 2 -
 - a) Final Setting Out and Monumenting

The LLS shall carry out works for the Final Setting Out and pegging of the Centre Line including Tangent Points (TPs) and horizontal curves and monumentation of all Intersection Points (IPs), Reference Marks (RMs) and TBMs of from the Approved Final Design Road Alignment based on the design from the earlier surveyed data.

 - b) Setting Out of Reserve Boundaries (Road Reserve)

The LLS shall demarcate along both sides the Road Reserve with hard wood pegs painted in red such that the pegs are intervisible between each other or at all

points where the Road Reserve is crossing the affected land boundaries, where it is required by the PTG/Land Office.

The LLS shall provide at least one senior survey technician and other supporting staff to pick up the line to set out, giving bearings and distances. The LLS when requested by the Government shall provide all the assistance and necessary information regarding the survey and show the Government's representative on the ground the whole setting out whenever required to do so.

1.3.8.3 Cross-Sections along the Road Alignment

Cross sections shall be taken along the centreline of the proposed road alignment at the interval of 25m and up to the corridor width. Adjacent points along the cross-sections shall not exceed 10m. Levels are to be taken at the road edges (levels to be taken on adjacent shoulders if level difference are significant) and centreline, top and bottom of kerbs, invert levels of drains and at any change in gradient.

1.3.8.4 Longitudinal Profile along the Road Alignment

Carry out longitudinal profiling with levels to be taken at every 25 metres or less to indicate change in terrain.

1.4 Plan Drawing

1.4.1 Unit of Measurement

Metric units shall be used throughout.

1.4.2 Scale

Mapping on final drawings shall be plotted to a scale of 1:1000 or as specified in *Arahan Teknik (Jalan) 6/85* or as agreed by the Government.

1.4.3 Grid and Detail Accuracy

Mapping shall be based on the Grid System as defined in Sub-paragraph 1.3.1. Grid lines and Permanent Ground Markers shall be drawn to an accuracy of ± 0.3 mm maximum tolerance.

Well defined points of detail shall be plotted in their true positions at map scale to ± 0.3 mm root mean square error when coordinated scaled off the map from the nearest grid line are compared with coordinates determined by measurement on the ground from the nearest Permanent Ground Marker. (90% of a representative sample of well defined points shall be within ± 0.5 mm).

Master transparencies shall be permitted to have an additional tolerance for shrinkage of their stable based material not exceeding ± 0.3 mm per metre.

1.4.4 Features To Be Shown:

1.4.4.1 Buildings/Structures

- (a) The plinth line of all permanent buildings.
- (b) Construction type of building, whether Wooden (W), Semi-Concrete (SC), Concrete (C), Double-Storey (D), and etc.
- (c) Ruins or partially demolished buildings or foundations - by the walls and masonry visible at the time of the survey.
- (d) Names and type of usage of all buildings, schools, and etc.
- (e) Buildings under construction.

1.4.4.2 Boundary Features

- (a) Fences and gates
- (b) Boundary stones located/used for fieldwork
- (c) Land parcels and their lot numbers
- (d) Walls
- (e) Burial grounds (Indicate whether Muslim, Chinese, Christian, Hindu, and etc.)
- (f) Historical sites

1.4.4.3 Railways

- (a) Gauge faces of railway running rails
- (b) Level crossings
- (c) Platforms
- (d) Bridges (over roads, river, etc.)
- (e) Station buildings
- (f) Telegraph poles (indicate the reference numbers)

1.4.4.4 Roads, Tracks and Footpaths

- (a) Kerb line or edge of surfacing to carriageways.
- (b) Tracks
- (c) Pedestrian bridges and footpaths
- (d) Traffic islands (similar to kerb line).
- (e) Destination of road from junction level
- (f) Bridges (over Railway, rivers, etc.)

1.4.4.5 Road Furniture

- (a) Kilometer post (value to be noted)
- (b) Bus stop facilities
- (c) Traffic signal posts and controllers
- (d) Guardrails
- (e) Road signs

1.4.4.6 Industrial

- (a) Tanks (indicate type of material stored e.g. fuel, gas, water, and etc.)
- (b) Sewage disposal works details
- (c) Chimneys (substantial)

1.4.4.7 Slopes and Earthworks

- (a) Cutting and Embankments
- (b) Terraced slopes
- (c) Borrow pits / Quarries
- (d) Retaining walls

- (e) Rock outcrops
- (f) Mining tips
- (g) Indicate date of survey if on-going earthworks are present and mark the affected area.

1.4.4.8 Services and Utilities

- (a) Transformers (boundary fences only)
- (b) Electricity Sub-Stations and switch boxes (boundary fences only)
- (c) Pylon lines (indicate levels at lowest point at sag and at pylon towers).
- (d) Pylon bases
- (e) Pylon reference numbers and voltage of transmission.
- (f) Radio, TV station masts or towers
- (g) Telecom poles
- (h) Electricity poles
- (i) Fire hydrants
- (j) Water Mains pipes and Stop valves (Indicate diameter of pipe)
- (k) Manholes (circular and square)

1.4.4.9 Survey Controls

- (a) JUPEM's Trigonometrical Stations where available
- (b) Permanent GPS points
- (c) Permanent Ground Markers (IPs, RMs, TBMs, etc.)
- (d) JUPEM Bench Marks used (Indicate reference number and height level)

1.4.4.10 Woods, Trees & Recreation Areas

- (a) Playing fields
- (b) Prominent trees and diameters
- (c) Land-use and vegetation, and etc.

1.4.4.11 Water, Drainage and Coastal Features

- (a) Lakes
- (b) Ponds or mining pools
- (c) Reservoirs
- (d) Rivers (Name to be indicated)
- (e) Streams
- (f) Ditches. (width and depth to be indicated)
- (g) Canals
- (h) Wells. (Diameter or width to be indicated)
- (i) Swamps
- (j) Lined drains (width, depth and type to be indicated)
- (k) Water towers
- (l) Culverts
- (m) Waterfalls
- (n) Jetties
- (o) The top of banks of all water features over 1.0 metre wide shall be detailed and the bottom of banks as indicated by the water level at the time of the survey. The direction of flow of all rivers, streams and watercourses shall be indicated.
- (p) Slopes with a height greater than 1.0 metre of too sharp a gradient to be shown by contours, including river and stream banks are to be shown on conventional markings and the top and bottom of slopes are to be shown as dotted lines.
- (q) Slope conventions shall be drawn as near as possible to indicate the actual shape of the slope face, i.e. all berms and terraces shall be detailed.

Any other features not listed, which are requested by the Government shall also be shown.

1.4.5 Contours

Where required, contours shall be shown at vertical intervals as described in Sub-paragraph 1.3.7 and shall be correct to within the tolerances given below when a representative sample of points on contour lines is checked by measurement from the nearest JUPEM Bench Mark or height control point.

Contour Interval	r.m.s.e.	90% Tolerance
0.50m	±0.15m	±0.25m
1.0m	±0.30m	±0.50m
2.0m	±0.60m	±1.00m
3.0m	±0.90m	±1.50m

Where steep slopes are encountered and it is not practicable on the plan to represent each contour fully throughout, its length, the LLS may with the Government's approval terminate certain intermediate contours.

Any contour which can be brought within this vertical tolerance by moving its plotted position in any direction by not more than 0.5 mm or one-tenth of the horizontal distance between contours, whichever is the greater, shall be considered acceptable.

Index contours shall be shown using continuous thick lines. Contour and spot heights shall be differentiated from other details. The value of each contour shall be indicated along the contours at intervals not exceeding 200 mm and/or the edges of the Mapping Area.

Where because of undergrowth, on-going earthworks, swampy areas, or other obstructions, the ground surface is obscured, or access is restricted, and provided the Governments prior agreement is obtained, contours can be shown by broken lines to indicate that their accuracy cannot be guaranteed.

1.4.6 Spot Heights

Spot heights shall be shown on the Final Drawings at spacing not exceeding 20 m. at the following locations: -

- (a) at salient points such as hilltops, bottoms of depressions and saddles.
- (b) along the centre and edges of all roads and public accesses, at road intersections and significant changes of gradient.
- (c) at water level at the time of survey along rivers, streams, major watercourses and ditches.

(d) on bed levels of rivers, streams, canals and other watercourses.

In flat areas, where the horizontal distance between contours generally exceeds 40 m. Supplementary spot heights shall be shown at intervals not exceeding 20 m. parallel to the contours.

Spot heights shall be correct to within the tolerances given below when a representative sample is checked by measurement from the nearest JUPEM Bench Mark; or

Map Scale	r.m.s.e.	90% Tolerance
1:500	± 0.06m	± 0.10m
1:1000	± 0.12m	± 0.20m
1:2500	± 0.30m	± 0.50m
1:10000	± 1.00m	± 1.60m

1.4.7 Bridge Details

Where required the bridge details shall be shown on a separate drawing for each bridge (see Sub-paragraph 1.5.4) in a form agreed by the Government. They shall not be shown on the map.

The bridge details shall include: -

- (a) The coordinates and levels of the four corners of the bridge (points shall be are on the adjacent road surface), the two edges of the piers, abutment and wing walls.
- (b) The coordinates and levels of the bridge deck on the intermediate piers (if any) of the bridge.
- (c) Length, width and type of construction of bridge.
- (d) The type and location of services adjacent to the bridge.
- (e) The co-ordinates and levels of the centre line and the two edges of the road on the bridge at approximate intervals of 5 metres.

- (f) The cross-sectional clearance envelope at the two sides of an overpass bridge (with respect to the road centre line passing underneath) showing all the relevant levels, offsets and skew angle.

1.4.8 Culvert Details

Details of each culvert are to be shown on the Survey plans and a separate tabulation of the following information is to be submitted with the plans: -

- (a) Type of culvert and diameter;
- (b) Chainage of culvert at the road centre line;
- (c) Skew angle of the culvert from the centre line;
- (d) Length of culvert from each side of the centre line;
- (e) Invert levels of the inlet and outlet;
- (f) A sketch of the inlet and outlet structures including all visible dimensions to a scale of 1:200.

For major culverts (diameter $\geq 2.0\text{m}$) the outlet structures are to be properly measured and modelled as 3D strings as described in Sub-paragraph 1.5.5.

1.5 Preparation and Submission of Plans and Data

The LLS shall provide the Government with two sets of prints together with one set of Master transparency for all drawings prepared. The drawings required are as follows:-

1.5.1 Location Plan and Alignment Control Plan

Location plan of the proposed roads to a suitable scale such that the area under study can be put into a single standard A1 size sheet. The chainage of the survey alignment shall be indicated for ease of reference to the detail plans.

Alignment control plan shall be prepared as described in *Arahan Teknik (Jalan)* 6/85.

1.5.2 Preliminary Survey Plans and Data

The plans and data shall contain all the essential details so as to enable the Government to make decisions in choosing the best alignment of the proposed road.

The details may include the following: -

- (a) Contours
- (b) Grid Lines
- (c) Structures, buildings or any obstructions
- (d) River crossings
- (e) Rock outcrops
- (f) Swampy areas
- (g) Existing roads, tracks, railways, etc.
- (h) Transmission lines

The LLS shall provide other additional details and data wherever instructed by the Government.

1.5.3 Final Survey Plans

The plans shall be shown in a scale of 1:1000. These shall show the Alignment, Permanent Ground Markers, chainage and all other features as described in Paragraph 1.4.

1.5.4 Detail Plans for Bridges and Culvert Sites

The sites shall be produced in a scale of 1:500 showing features and levels as detailed in Sub-paragraphs 1.3.5.1 and 1.3.5.3.

Details of any adjacent existing bridges as described in Sub-paragraph 1.4.7 as well as culverts in Sub-paragraph 1.4.8 shall be shown as a separate figure with all the relevant dimensions in a suitable scale.

1.5.5 Plans for Junction or Site Details

Wherever shown on the drawings or as instructed by the Government, the LLS shall provide plans that show details of Junctions or Site to a scale of 1:500. These details shall be as described in Paragraph 1.4 and any other additional details as instructed by the Government.

1.5.6 Land Acquisition Plans

The LLS shall compile and prepare precomputed plans for property, land acquisition and applications purposes from the JUPEM's Cadastral Standard Sheets and the latest Revenue Sheets; Litho-Sheets; from the Land Office and other relevant Government agencies to the same scale where applicable all in accordance with JKR guidelines as described in latest *Arahan Teknik (Jalan)* 7/85.

The drawing shall show the following: -

- (a) Lot boundaries
- (b) Lot numbers
- (c) Existing total lot areas computed based on coordinates (Determination of areas by measurement is not permitted).
- (d) Land use indicating type of cultivation, etc.
- (e) Types of buildings indicating permanent or semi-permanent and usage
- (f) The existence of burial ground if any falls within the survey corridor.
- (g) Other relevant details as instructed by the Government

Land lots that are partially within the mapping area shall be presented showing the whole area of that lot.

All coordinates shall be computed and all calculations shall be presented as an appendix in a neat and clean form as agreed by the Government. Coordinates shall be presented based on the transformation factor as described in Sub-paragraph 1.3.1.

The drawing of this plan shall include the preparation of the final land acquisition plan and the computation of the area to be acquired.

1.5.7 Format of Drawings to Be Submitted

1.5.7.1 Format for Presentation

Unless otherwise specified in the Terms of Reference, all formats of drawings submitted including the title block shall conform to JKR Guidelines as contained in *Arahan Teknik (Jalan)* 6/85 (Guidelines For

Presentation of Engineering Drawings). All drawings shall be to A1 size unless otherwise specified.

Unless otherwise specified all text and annotations shall be in English.

All legends any symbols used in the drawings shall be those currently used by JKR for the standard MOSS drawing output and approval must be obtained for any departure from accepted practice.

RSO (Malaya) grid lines shall be shown by symmetrical lines at 100 mm. intervals for Peninsular Malaysia; while RSO (Borneo) Grid lines shall be shown by symmetrical lines at 100 mm. intervals for Sabah, Sarawak and FT of Labuan.

For Peninsular Malaysia, State Cassini-Soldner grid lines (if so required by the Government) shall be shown at 100 mm. intervals by symmetrical crosses (10mm. North-South and 10mm East-West). Coordinates shall be shown outside the band of detail, or at the sheet edges at 100m. interval.

1.5.7.2 Preliminary Copies

Preliminary copies shall be submitted in the form of stable based paper printed by diazo process. Every sheet of the drawings shall be marked as Preliminary copy.

1.5.7.3 Final Drawings

All Final Drawings shall bear the name, signature and qualification of the LLS as well as the name and address of his company.

Final Drawings shall consist of two (2) set of paper prints and if necessary further copies until approved. One (1) set of readable / editable softcopy plans on compact disks (CDs) shall also be provided in Autocad format.

1.5.8 Format of Data to be Submitted

The LLS shall submit the survey data in CD-ROM or DVD-ROM in .DWG (Autocad 3-D) format.

1.6 Date of Submission of Drawings and Data

1.6.1 Survey Drawings and Data for Preliminary Design

Drawings and data listed under Sub-paragraph 1.5.2 are to be prepared and submitted to the Government within 2 weeks after completion of the relevant field works and prior to the preparation of other drawings.

Whenever necessary the plans and data may be delivered in stages as instructed by the Government.

1.6.2 Completed Survey Drawings and Data

All survey drawings and data are to be prepared and submitted to the Government within 4 weeks or as instructed by the GR, whichever is earlier, after completion of the relevant field works. All services to be performed under the Terms of Reference shall be completed within the duration of Services as stipulated in Clause 3.1 of this Agreement.

1.7 Field Books and Final Survey Report

All field books and computer data must be properly kept and shall record truthfully all the survey work carried out and verified by JUPEM. The LLS shall do all workings in proper books, adequately in good style and according to best practice. All field books shall be done in ink. Unsatisfactory works and errors shall be struck off and there shall be no superimposed writing or erasure.

The GR may check the field books now and then to ensure that a high standard of work is maintained. He may request the LLS to carry out some spot checks if he has reasonable doubt on the accuracy of the survey work. The LLS shall comply with such requests unless he can prove to the Government's representative's satisfaction that such checks are unnecessary.

The LLS may propose the use of electronic equipment for the purpose of booking. The type of equipment is subject to the Government's approval.

On completion of survey work, all field books and computer data shall be properly labelled and compiled and submitted to JKR and shall remain the property of the Government.

All field books and survey data, plans and drawings shall be duly certified by the LLS.

SERVICES SPECIFICATIONS FOR TOPOGRAPHICAL SURVEY WORKS

2.0 Scope of Works

2.0.1 Survey Area

The details of the extent of the works to be surveyed is given in the attached plan.

2. Basic Licensed Land Surveying Services for topographical survey works

The Services to be rendered by the LLS in this paragraph include the provision of all expert technical advice and skills, which are normally required for the Works for which the LLS has been engaged.

2.1 General

The Services to be provided by the LLS as listed herein and as detailed in subsequent sections: -

- 2.1.1 Prior discussion with relevant authorities such as JKR, PDRM, land office and local authorities before the physical commencement of work on site.
- 2.1.2 Study all relevant information and maps provided and obtain additional data if necessary for the proper execution of the works.
- 2.1.3 Field survey and picking up of mapping details for subsequent submission of digital data in DWG (Autocad) format.
- 2.1.4 Establishment of Permanent Ground Markers for survey control such as Survey Markers (SMs) and Temporary Bench Marks (TBMs).
- 2.1.5 Compilation, processing and preparation of data in accordance to DWG format (Autocad).

2.2 Accuracies, Tolerances, Errors and Corrections

Wherever accuracies or tolerances are specified herein, they are defined as Maximum Errors or statistically based root mean square errors (r.m.s.e.) as follows: -

2.2.1 Maximum Errors

Maximum errors are only used for fieldwork misclosures [sub-paragraphs 2.3.1 and 2.3.2] and plotting of map grids and control points [sub-paragraph 2.4.3]. All errors exceeding the maximum allowable tolerance including consequential errors shall be corrected by the LLS at his own expense.

2.2.2 Method and Location of Corrections

The LLS shall agree with the Government the method, location and extent of the work to be corrected.

2.3 Fieldwork

2.3.1 Planimetric Control

For Peninsular Malaysia, planimetric control shall be calculated based on the relevant State Cassini-Soldner Grid lines projections as agreed by the Government. For Sabah, Sarawak and the Federal Territory of Labuan, planimetric control shall be calculated based on the relevant Rectified Skew Orthomorphic (Borneo) Grid as agreed by the Government.

Azimuths shall be checked by solar observations at appropriate intervals and the survey traverses shall be tied up to any nearby trigonometrical points or standard traverse points or permanent GPS points or Boundary Mark. The maximum closing error of the traverse shall be 1:4000.

Survey should be started from the Local Survey Datum.

Existing boundary marks within and adjacent to the Work site shall be located. Replacement with temporary markers shall be done when the boundary marks are found to be missing or out of positions.

2.3.2 Height Control and Connection

All heights supplied by the LLS shall be related to the latest published values of JUPEM Bench Marks at the time of survey. Where possible, the Height Control shall be based on JUPEM Bench Mark proven in its height accuracy. However where the JUPEM Bench Mark is not available within 5km radius from the site, an Assumed Height of the TBM may be

adopted with the approval of the Government. TBM shall be established not more than 1 km interval.

JUPEM Bench Marks which exceed these tolerances shall be omitted from the adjustment. The LLS shall inform the GR and JUPEM whenever the JUPEM Bench Marks are found to be damaged or in error.

At least three (3) Temporary Bench Marks (TBMs) shall be established at the Work site and indicated the same on plan. The TBM shall be of solid construction and shall be of concrete.

All Temporary Bench Marks shall be connected by a closed levelling net which shall be tied to a minimum of two JUPEM Bench Marks unless otherwise agreed by the Government.

All levelling shall be done in sections of approximately 1 km. in length.

Vertical misclosures within the levelling net and between JUPEM bench marks shall not exceed the lesser of the following: -

- (a) ± 16 mm
- (b) $\pm (20 \sqrt{K})$ mm where K is the sum of the distances levelled in kilometres.

Levelling shall be carried out with spot height at 10 m. interval & contour lines should cover the whole of site and 20 meters beyond the boundaries.

2.3.3 Permanent Ground Markers

Permanent Ground Markers shall include the following: -

- (a) Survey Markers (SMs)
- (b) Temporary Bench Marks (TBMs)

The LLS shall construct, provide coordinates and heights Permanent Ground Markers to the satisfaction of the Government at the location where points are required to form a reference system for future setting out of the Works at the approximate locations indicated on the Drawings, clear of future construction works and as agreed with the Government.

The types of marker which will be considered acceptable for the appropriate general ground surface conditions. Alternative forms of marker submitted by the LLS may however be considered.

The Government will indicate on the Drawings the likely types of the Permanent Ground Markers to be installed within the Site. The final locations and types of markers shall be agreed with the Government before emplacement. All Permanent Ground Markers shall be clearly and legibly inscribed to distinguish between SM and TBM.

There shall be a joint inspection and handing over of all Permanent Ground Markers to the GR.

2.3.3.1 Survey Markers

Whenever required by the Government, the LLS shall erect permanent Survey Markers at locations indicated in the Drawings or as agreed by the Government.

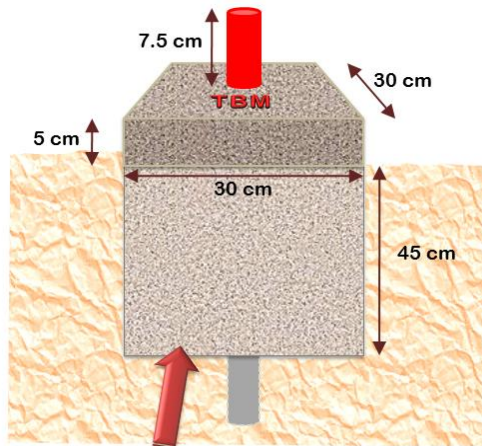
2.3.3.2 Temporary Bench Marks

The LLS shall establish Temporary Bench Marks at approximately 1 km intervals or a minimum 3 TBM/ Site or 1 TBM/ 10ha and reference it to the JUPEM Datum. Reduced levels of these temporary bench marks shall be clearly and legibly inscribed and referenced for identification for the subsequent construction stage.

The LLS shall supply two copies of diagrams of the levelling net indicating the connections between Permanent Ground Markers, Temporary Bench Marks and JUPEM Bench Marks with misclosures. to the Government on completion of fieldwork and survey adjustment.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

1. Paip berkonkrit



Pecahan bahagian konkrit:
1 bahagian simen : 2 bahagian pasir : 4 bahagian batu baur

2.3.4 Topographic Detail Survey

All details and up the full width of the approach road fronting the land shall be picked up, inclusive of the following: -

- (a) North Point;
- (b) All boundary marks;
- (c) Road names, pavement, side tables, road islands, meridian and intersections;
- (d) Visible manhole, inspection cover, sump and their invert levels, if necessary;
- (e) Water supply pipes and water mains-water pressure;
- (f) Drain, culvert and invert levels – direction of flow;
- (g) Electricity and telegraph poles and pylon;
- (h) Existing temporary and permanent buildings in and around sites;
- (i) Fencing – types and weight;
- (j) River, stream, inverts and flood levels;

- (k) All others visible obstacles for future construction, e.g. flood levels, and etc;
- (l) Prominent trees 0.3 metre in circumference and bigger; and
- (m) Railway track, rock, outcrops and etc.

2.3.4.1 Survey of Watercourses

(a) Streams and Rivers

The LLS shall survey all streams, rivers and watercourses crossing or located adjacent to the Work site. These include all watercourses whether there is water or no water flow at the time of surveying.

(b) Urban Drainage

The LLS shall survey all top and bottom edges and invert levels of urban drains at intervals not exceeding 10 m, showing all significant changes of level and direction of flow. The type, width and depth of each section of different drainage system (including sumps) shall be recorded.

(c) Culverts

All the relevant details of the culvert as described in Sub-paragraph 2.4.7 shall be recorded.

(d) Flood Information

The LLS shall record the highest flood level/ water level at each river crossing. Such information shall include date, year and time. Existing water surface at suitable points shall be taken along the channel.

In areas where tidal effects are significant, the LLS shall gather all the necessary information as an appendix to the mapping in a form agreed by the Government.

2.4 Mapping

2.4.1 Unit of Measurement

Metric units shall be used throughout.

2.4.2 Scale

Mapping on final drawings shall be plotted to a scale of 1:1000.

2.4.3 Control and Detail Accuracy

Mapping shall be based on the Planimetric Control as defined in Sub-paragraph 2.3.1. Permanent Ground Markers shall be drawn to an accuracy of ± 0.3 mm maximum tolerance.

Well defined points of detail shall be plotted in their true positions at map scale to ± 0.3 mm root mean square error when coordinated scaled off the map are compared with coordinates determined by measurement on the ground from the nearest Permanent Ground Marker. (90% of a representative sample of well defined points shall be within ± 0.5 mm).

2.4.4 Features to Be Shown:

2.4.4.1 Buildings/ Structures

- (a) The plinth line of all permanent buildings.
- (b) Construction type of building, whether Wooden (W), Semi-Conc.(SC), Concrete (C), Double-Storey (D), and etc.
- (c) Ruins or partially demolished buildings or foundations - by the walls and masonry visible at the time of the survey.
- (d) Names and type of usage of all buildings, schools, and etc.
- (e) Buildings under construction.

2.4.4.2 Boundary Features

- (a) Fences and gates
- (b) Boundary marks located/used for fieldwork
- (c) Land parcels and their lot numbers
- (d) Walls

- (e) Burial grounds (Indicate whether Muslim, Chinese, Christian, Hindu, and etc.)
- (f) Historical sites

2.4.4.3 Railways

- (a) Gauge faces of railway running rails
- (b) Level crossings
- (c) Platforms
- (d) Bridges (over roads, river, etc.)
- (e) Station buildings
- (f) Telegraph poles (indicate the reference numbers)

2.4.4.4 Roads, Tracks and Footpaths

- (a) Kerb line or edge of surfacing to carriageways.
- (b) Tracks
- (c) Pedestrian bridges and footpaths
- (d) Traffic islands (similar to kerb line).
- (e) Destination of road from junction level
- (f) Bridges (over Railway, rivers, etc.)

2.4.4.5 Road Furniture

- (a) Kilometer post (value to be noted)
- (b) Bus stop facilities
- (c) Traffic signal posts and controllers
- (d) Guardrails
- (e) Road signs

2.4.4.6 Industrial

- (a) Tanks (indicate type of material stored e.g. fuel, gas, water, and etc.)
- (b) Sewage disposal works details
- (c) Chimneys (substantial)

2.4.4.7 Slopes and Earthworks

- (a) Cutting and Embankments
- (b) Terraced slopes
- (c) Borrow pits / Quarries
- (d) Retaining walls
- (e) Rock outcrops
- (f) Mining tips
- (g) Indicate date of survey if on-going earthworks are present and mark the affected area.

2.4.4.8 Services and Utilities

- (a) Transformers (boundary fences only)
- (b) Electricity Sub-Stations and switch boxes (boundary fences only)
- (c) Pylon lines (indicate levels at lowest point at sag and at pylon towers).
- (d) Pylon bases
- (e) Pylon reference numbers and voltage of transmission.
- (f) Radio, TV station masts or towers
- (g) Telecom poles
- (h) Electricity poles
- (i) Fire hydrants
- (j) Water Mains pipes and Stop valves (Indicate diameter of pipe)
- (k) Manholes (circular and square)

2.4.4.9 Survey Controls

- (a) JUPEM's Trigonometrical Stations
- (b) Permanent GPS points
- (c) Permanent Ground Markers (TBMs, etc.)
- (d) JUPEM Bench Marks used (Indicate reference number and height level)

2.4.4.10 Woods, Trees & Recreation Areas

- (a) Playing fields
- (b) Prominent trees
- (c) Land-use and vegetation, and etc.

2.4.4.11 Water, Drainage and Coastal Features

- (a) Lakes
- (b) Ponds or mining pools
- (c) Reservoirs
- (d) Rivers (Name to be indicated)
- (e) Streams
- (f) Ditches. (width and depth to be indicated)
- (g) Canals
- (h) Wells. (Diameter or width to be indicated)
- (i) Swamps
- (j) Lined drains (width, depth and type to be indicated)
- (k) Water towers
- (l) Culverts
- (m) Waterfalls
- (n) Jetties

The top of banks of all water features over 1.0 metre wide shall be detailed and the bottom of banks as indicated by the water level at the time of the survey. The direction of flow of all rivers, streams and watercourses shall be indicated.

Slopes with a height greater than 1.0 metre of too sharp a gradient to be shown by contours, including river and stream banks are to be shown on conventional markings and the top and bottom of slopes are to be shown as dotted lines.

Slope conventions shall be drawn as near as possible to indicate the actual shape of the slope face, i.e. all berms and terraces shall be detailed.

2.4.5 Contours

Where required, contours shall be shown at vertical intervals as described in Sub-paragraph 1.3.7 and shall be correct to within the tolerances given below when a representative sample of points on contour lines is checked by measurement from the nearest JUPEM Bench Mark or height control point.

Contour Interval	r.m.s.e.	90% Tolerance
1.0m	±0.30m	±0.50m
2.0m	±0.60m	±1.00m
3.0m	±0.90m	±1.50m

Where steep slopes are encountered and it is not practicable on the plan to represent each contour fully throughout, its length, the LLS may with the Government's approval terminate certain intermediate contours.

Any contour which can be brought within this vertical tolerance by moving its plotted position in any direction by not more than 0.5 mm or one-tenth of the horizontal distance between contours, whichever is the greater, shall be considered acceptable.

Index contours shall be shown using continuous thick lines. Contour and spot heights shall be differentiated from other details. The value of each contour shall be indicated along the contours at intervals not exceeding 200 mm and / or the edges of the Mapping Area.

Where because of undergrowth, on-going earthworks, swampy areas, or other obstructions, the ground surface is obscured, or access is restricted, and provided the Governments prior agreement is obtained, contours can be shown by broken lines to indicate that their accuracy cannot be guaranteed.

2.4.6 Spot Heights

Spot heights shall be shown on the Final Drawings at spacing not exceeding 20 m. at the following locations: -

- (a) at salient points such as hilltops, bottoms of depressions and saddles.
- (b) along the centre and edges of all roads and public accesses, at road intersections and significant changes of gradient.
- (c) at water level at the time of survey along rivers, streams, major watercourses and ditches.

(d) on bed levels of rivers, streams, canals and other watercourses.

In flat areas, where the horizontal distance between contours generally exceeds 40 m. Supplementary spot heights shall be shown at intervals not exceeding 20 m. parallel to the contours.

Spot heights shall be correct to within the tolerances given below when a representative sample is checked by measurement from the nearest JUPEM Bench Mark; or

Map Scale	r.m.s.e.	90% Tolerance
1:500	± 0.06m	± 0.10m
1:1000	± 0.12m	± 0.20m
1:2500	± 0.30m	± 0.50m
1:10000	± 1.00m	± 1.60m

2.4.7 Culvert Details

Details of each culvert are to be shown on the Survey plans and a separate tabulation of the following information is to be submitted with the plans: -

- (a) Type of culvert and diameter;
- (b) Chainage of culvert at the road centre line;
- (c) Skew angle of the culvert from the centre line;
- (d) Length of culvert from each side of the centre line;
- (e) Invert levels of the inlet and outlet;
- (f) A sketch of the inlet and outlet structures including all visible dimensions.

2.5 Preparation and Submission of Plans and Data

The LLS shall prepare site plan with boundary dimensions and bearings to scale of 1:000 or as agreed the GR covering the whole site and including the area up to the full width of approach road adjacent to the site and indicate on it all the details as listed in Sub-paragraph 2.4.4.

The LLS shall state whether site is liable to flooding, and if it is, state the highest water levels experienced or likely to experience.

2.5.1 Key Plan and Location Plan

Key Plan and Location Plan of the proposed site shall be shown to a suitable small scale such that the area under study can be included into a single standard A1 size sheet as part of the Final Survey Plan.

2.5.2 Final Survey Plan

The plan shall consists of site plan, Key Plan and Location Plan.

2.5.3 Detail Plans for Culvert Sites

Details of any adjacent existing culverts in Sub-paragraph 2.4.7 shall be shown as a separate figure with all the relevant dimensions in a suitable scale.

2.5.4 Format of Drawings to Be Submitted

2.5.4.1 Format for Presentation

All drawings shall be to A1 size unless otherwise specified.

All legends and symbols used in the drawings shall be those currently used by JKR for the standard MOSS drawing output and approval must be obtained for any departure from accepted practice.

For Peninsular Malaysia, State Cassini-Soldner grid lines (if so required by the Government) shall be shown at 100 mm. intervals by symmetrical crosses (10mm. North-South and 10mm East-West). Coordinates shall be shown outside the band of detail, or at the sheet edges at 100m. interval.

2.5.4.2 Final Drawings

Approved Final Drawing shall be plotted on suitable paper material.

The LLS shall submit one (1) set of hardcopy plans on tracing paper, two (2) sets of paper prints and one (1) set of readable / editable softcopy plans on compact disks (CDs) on in Autocad format.

All Final Drawings shall bear the name, signature and qualification of the LLS as well as the name and address of his company.

2.5.4.2 Computer Input Requirement

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

~~The LLS shall supply the digital data ground model data suitable for input to the Government computer as specified below :~~

~~Government Computer~~

~~Make : HP~~

~~Model Number : Pavilion 23fi~~

~~Operating System : Windows 7~~

~~Main Software : Civil 3D~~

~~The data shall be supplied as specified below in order of preference :~~

~~a) USB Flash Drive~~

~~Format : Windows 7~~

~~Capacity : 4 Gigabyte and above~~

~~b) Digital Versatile/ Video Disc~~

~~Format : Windows 7~~

~~Capacity : 4.7 Gigabyte~~

~~c) Compact Disc~~

~~Format : Windows 7~~

~~Capacity : 700 megabyte~~

~~_____ The data shall be supplied with an index scheduling the contents and
_____ referencing and shall remain the property of the Government.~~

2.6 Date of Submission of Drawings and Data

All survey drawings and data are to be prepared and submitted to the Government within the duration of Services as stipulated in Clause 3.1 of this Agreement.

SERVICES SPECIFICATIONS FOR BRIDGE WORKS

3.0 SCOPE OF SERVICES

3.1 General

The scope of survey services to be provided by the Surveyor shall be as listed herein under and as detailed in subsequent paragraphs:-

- (a) Prior discussion with relevant authorities such as JKR, JPS, Police and Land Offices before the physical commencement of work on site.
- (b) Study of all relevant information and maps provided and obtain additional data if necessary for the proper execution of the proposed works.
- (c) Field survey and picking up details.
- (d) Consultation with the Engineer and Setting Out.
- (e) Levelling and establishment of Temporary Bench Marks (TBM)
- (f) Preparation of plans and data suitable for bridge/culvert design.
- (g) Pegging of centre line and cross-sectioning.
- (h) Pegging of right-of-way (if required)

3.2 Field Survey and Setting Out

3.2.1 General

The surveyor shall perform all field survey work necessary to locate accurately the locations and dimensions of the following features within the corridor of the existing structure at every location for survey of:-

- (a) Existing roads, tracks and paths, JPS reserve and ROW line.
- (b) Existing structures above and below the ground level indicating whether temporary, semi-permanent or permanent and whether dwelling, industrial or other use, type of construction and any other relevant particulars.
- (c) Existing drains including their type of construction.
- (d) Natural vegetation and type of plantation.
- (e) Existing water main, LLN and Telecom overhead lines and underground cables, Telecom manholes, fire hydrants, pylons etc.
- (f) Highest known flood levels.

3.2.2 Consultation with Client before Setting Out

Before setting out, proposals for the detailed survey should be submitted to the Government before the work is being carried out.

3.2.3 Monumenting of Existing Bridge/ Culvert and Road

The Surveyor has to set out and peg the centreline of the existing bridge/culvert and the right-of-way limit where appropriate.

The Surveyor when requested by the Government shall provide all the assistance and necessary information regarding the survey and show the Government's representative on the ground the whole setting out whenever required to do so.

For setting out of the centre-line on existing bridge/culvert and roads, steel rod pins or spikes must be used. These spikes shall be permanent in nature.

There shall be a joint inspection and handing over of all BM's and TBM's to the Government's representative after pegging out or setting out have been completed.

3.3 Levelling

3.3.1 Levelling to Establish Temporary Bench Marks

The Surveyor shall establish temporary bench mark(s) and relate it to Survey Department Datum (Ordinance Datum). Reduced Level of this temporary bench mark(s) shall be clearly and legibly inscribed on the mark(s) and referenced for identification for the subsequent construction stage. The location of bench mark(s) must be clearly described and indicated on the plans to be submitted. This TBM(s) shall be located well away from the construction limits. The maximum error in spot levels shall not both exceed $\pm\sqrt{0.02K}$ metres where K is the horizontal distance in kilometres from the nearest Permanent Bench Mark.

3.3.2 Surveys at Bridge/Culvert Sites

The Surveyor shall survey to the distances as shown in Fig. i on either side of the road and bridge centre-line. The Government may request the Surveyor to extend these distances where it is required.

The locations of channel edges and other significant features shall be recorded and levels shall be taken along the bank slopes and channel inverts at interval of 3m. A minimum of 3 cross-sections showing all significant changes of level are required at both sides of the channel. The cross-sections, one of which shall be taken along the existing structure centre-line shall extend to a distance not less than **20.0m** from one bank tops on either side of the stream.

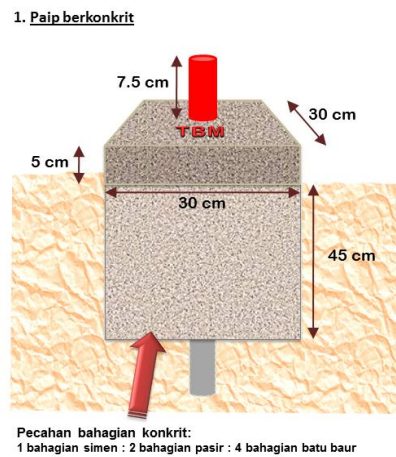
The Surveyor shall record the maximum flood level at each river crossing. Existing water surface at suitable points shall be taken along the channel. Each reading shall be taken at intervals not exceeding one hour. The Surveyor shall indicate on the Plan and Longitudinal Profile the chainage and reduced level of the lowest point of all depressions along the route including direction of flow.

3.4 Booking For Survey

The Surveyor shall do all workings in proper books, adequately in good style and according to best practice. All fields shall be done in ink. Unsatisfactory works and errors shall be struck off and there shall be no superimposed writing or erasure. The field books must be kept properly. On completion of the survey works, all field books shall be properly labelled, certified and submitted to the Government and will remain the property of the Government.

3.5 Reference Markers (TBM)

To ensure accuracy, reference markers shall be placed at least 25m away from the mark (i.e. IP's or TBM's). There shall be at least **2 TBMs** and the base of the triangle which they form with the apex should be at least 15m apart.



3.6 Colour Codes For Pegs.

All pegs should be colour-coded with paint on site to indicate their purpose. A consistent colour code as specified below must be retained throughout the survey.

PEG COLOUR CODE	
PEG FUNCTION	COLOUR
Centre Line pegs for all work	Red
Off-set pegs from centre line	White
Right of Way (ROW)	(Specified Design)

4.0 PREPARATION AND SUBMISSION OF PLANS AND DATA

4.1 The Surveyor shall provide the Government with soft and hard copies for all the drawings prepared. All soft copies submitted must be in Autocad Release 12 or .dxf format. The

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

hard copies submitted shall comprise of one set of tracings with 2 sets of prints. The drawings required are as follows:-

(a) **Key Plan**

The key plan shall be indicated with Longitude and Latitude reference to the proposed site.

(b) **Site Plan**

- i) The site plan is required in 1/8 inch to a chain scale or a preferred scale used for land acquisition in the district.
- ii) Each lot shall be provided with the coverage of land area with C.P. references (if any) and the name of Mukim, District and reference of sheet number has to be given.

(c) **The Survey Plan and Longitudinal Profile**

The plan view and the longitudinal profile should be shown in the same plan and shall be as follows:-

(i) **Top Section of Plan-View (With Spot Levels)**

These shall show the existing road and structure centre-line, chainages of centre-line markers, locations and levels of Temporary Bench Marks, contours of corridor surveyed, channel profile (100 meters upstream and downstream), direction of water flow, existing structure, existing roads (100 meters of both side of structure), Reference markers and other features that may be required for design considerations.

Scale : Horizontal (1 : 300 preferred)

(ii) **Bottom Section of Plan-Longitudinal Profile**

These shall show the longitudinal profile of the road and structure centre-line, cross-section of the rivers, position of existing structure, highest know flood level (if any), water level during surveying (time and date shall be stated) and other features needed for design considerations for a distance 100 meter on both side of the existing structure.

Scale : Horizontal (1 : 300 preferred)
Vertical (1 : 100)

(d) **Cross-Sections**

(i) **Cross-sections of channels/ rivers**

Drawings of all the cross-sections across the channel/river shall be plotted in consecutive order to a scale of 1 : 200 for horizontal and 1 : 100 for vertical. The drawings shall show details of ground levels, invert levels and chainage as required. Refer to Figure (ii).

(ii) **Cross-sections along the centre line of the existing road/ Bridge**

Drawings of all the cross-sections along the centre line of the existing road, shall be plotted in consecutive order, to a scale of 1 : 200 for horizontal and 1 : 100 for vertical. The drawings shall show details of ground levels and distances from the centreline of the existing road.

4.2 **Format of the Plans and Drawings**

All formats of plans submitted including the title block shall conform to JKR Guidelines as contained in Arahan Teknik (Jalan) G/85 (Guidelines For Presentation of Engineering Drawings). All drawings shall be to A1 size unless otherwise specified.

All legends and symbols used in the plans shall be those currently used by the JKR and approval must be obtained for any departure from accepted practice.

For the preparation of drawings, the followings format is preferred:-

<u>Colour</u>	<u>Pen Size</u>	<u>Layers</u>
White	0.18	Public Services; Existing Slope
Cyan	0.18	River & Drain; Contours & Spot Level
Green	0.25	Road
Yellow	0.35	Lettering; Existing Bridge
Magenta	0.50	Lot Boundaries and Road Reserve

4.3 **Date of Submission of Plans and Data**

All survey plans and data are to be prepared and submitted to the Government within 2 weeks after completion of the each site. However, all services to be performed under the Terms of Reference shall be completed within...months of the date of appointment. The surveyor is to submit his time schedule showing each item of work and the time required to the Government for approval.

5.0 **FIELD BOOK**

All field books must be properly kept and shall record truthfully all the survey work carried out. The Government's representative may check the field books now and then to ensure that a high standard of work is maintained. He may request the Surveyor to carry out some spot checks if he has reasonable doubt on the accuracy of the survey work. The Surveyor shall comply with such requests unless he can prove to the Government's representative's satisfaction that such checks are unnecessary. On completion of survey work, all field books shall be properly labelled and submitted to JKR and shall remain the property of the Government.

6.0 **SURVEY STAFF ETC.**

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

The Surveyor shall provide such staff, instruments and equipment, tools, materials, tentage, transport, etc, and will ensure the completion of the work to the standards and within the time schedules specified. All technical staff employed by the Surveyor for the execution of the works shall be suitably qualified and experienced in route location work. Party leaders shall possess the minimum qualification of technician surveyor.

A professionally qualified surveyor shall be provided to take charge of the survey parties and provide day-to-day liaison with the Government's representative.

7.0 **GOVERNMENT INDEMNITY**

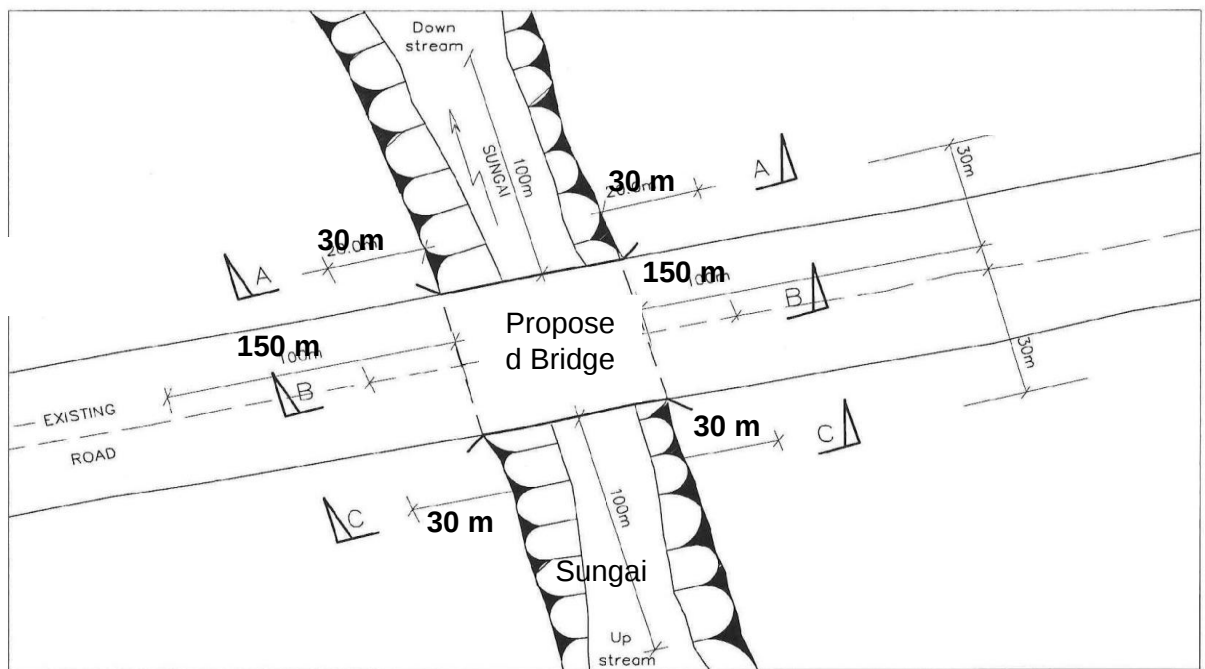
The Surveyor shall be responsible for any damage to life and property that may arise out of his work and he shall take out all necessary insurance cover to indemnify the Government from any claims of compensation that may arise out of his work.

8.0 **REMUNERATION**

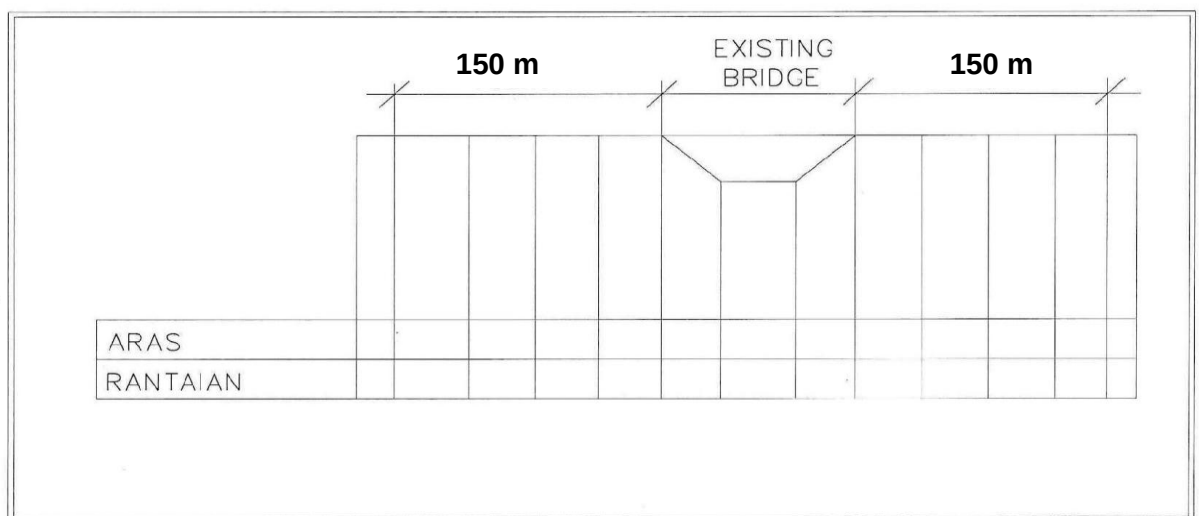
The fees payable to the Surveyor firm shall follow the approved Treasury's rates of payment (Jadual Fee Ukur Kejuruteraan 2001 - Part I P.3)

The Surveyor's fees for the rendering of services mentioned under the Scope of Work and elsewhere in the Terms of Reference, shall be deemed to cover all materials, services, wages, allowances, investigations, field surveys, equipment, transport, computations, preparation of plans, overheads, profits and other fees and expenses as stated in the Memorandum of Agreement between Government and consulting Surveyor for Professional Services.

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN



PLAN



KERATAN MEMANJANG JALAN SEDIADA

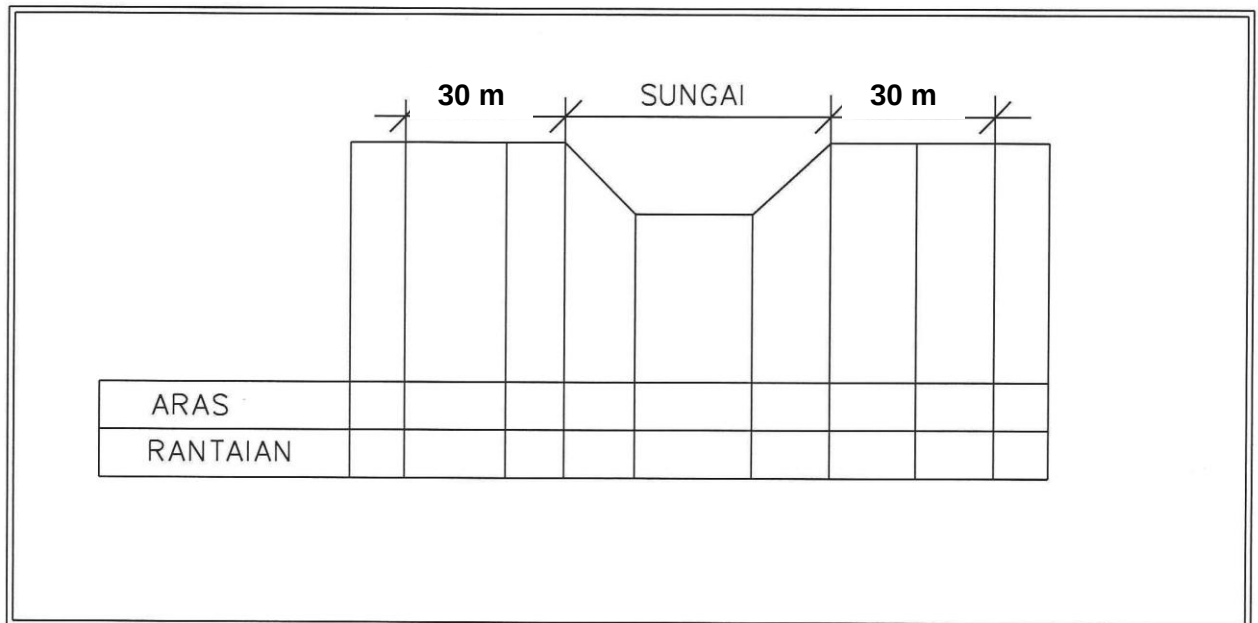
Figure (i)

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

KERATAN LINTANG SUNGAI
CROSS - SECTION OF RIVER

Sejauh **30 m** dari kedua-dua belah tebing sungai.
*A distance of **30m** from the river bank at both sides.*

- (i) Dari garis tengah jalan sediada.
At centreline of existing carriageway.
- (ii) **10 m** dari garis tengah jalan sediada - di hulu sungai.
*At **10 m** from centreline of existing carriageway - upstream.*
- (iii) **10 m** dari garis tengah jalan sediada di hilir sungai.
*At **10 m** from centreline of carriageway - downstream.*



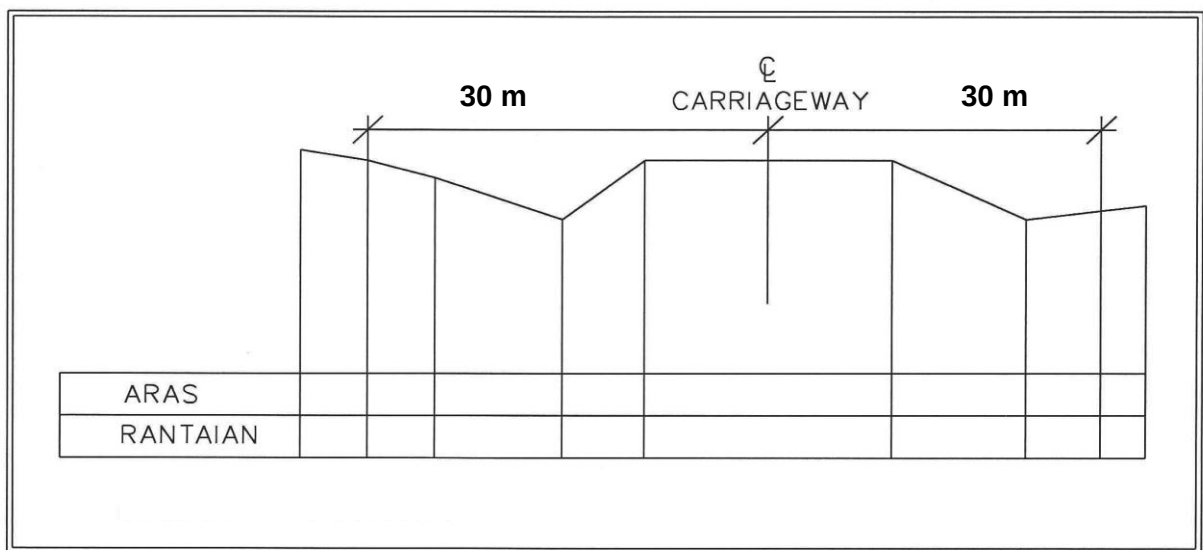
KERATAN LINTANG SUNGAI

Figure (ii)

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

KERATAN LINTANG JALAN SEDIADA
CROSS - SECTION OF EXISTING ROAD

- (i) **30 m** dari garis tengah jalan di kedua-dua belah jalan.
30 m corridor from centreline of carriageway, on both sides of road.
- (ii) Kedudukan tembok-tembok landas jambatan sediada.
Position of existing abutments.
- (iii) Keratan lintang pada setiap jarak sepanjang **20 m** dari kedua-dua tembok landas jambatan sediada.
Cross section of 20 m intervals from existing abutments at both approaches.



KERATAN LINTANG JALAN SEDIADA

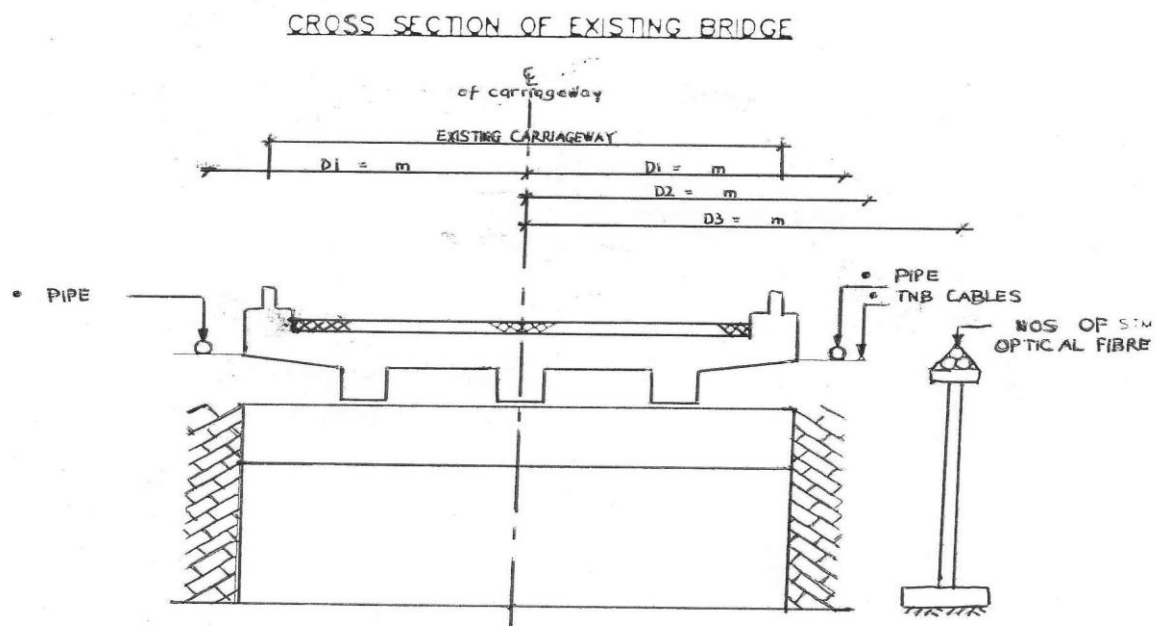
Figure (iii)

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

KERATAN LINTANG JAMBATAN SEDIADA
CROSS - SECTION OF EXISTING BRIDGE

Sejauh **11 m dari garis tengah jambatan** sediaada dengan mengambil kira semua kedudukan dan jarak kemudahan awam yang ada di kedua-dua sisi jambatan.

Up to a distance of 11m from centerline of existing bridge showing all the location and distance of existing public services on both sides of the bridge.



SPECIAL INSTRUCTIONS TO THE LLS

ACAD Drawing

All layer in ACAD drawing shall following as below:

Bil	Definition	Layer's name	Colour
1.	Contour	Contour	
Red			
2.	Lot	Boundary Lot	Brown
3.	Lot No.	Lotno	Brown
4.	Road	Road	Green
5.	Text	Text	White
6.	Public Services	PUS	
Magenta			
7.	Building/Fence	Bld	
Red			
8.	Slope/Cut/Fill	Slope	Cyan
9.	Culvert	Culvert	Blue
10.	Drain/Invert Level	Drain	Blue
11.	Bridge	Bridge	Blue
12.	River	River	Blue
13.	Spot Height Text	Spotht	White
14.	Spot Height Point (3D x,y,z)	Point	Yellow
15.	Traffic Sign	Sign	White
16.	Railway Track	Railway	
Red			
17.	Detail/TBM/Travers Station	Detail	White
18.	Grid/Utara	Grid	White
19.	Vegetation	Veg	Green
20.	Title Block/Frame	Tblock	White
21.	Others	Others	White

ACAD 3D Format

Surveyor was required to provide ACAD 3D for all 3 dimensional string.

Filing Conventions

The following shall be the conventions used for this project:

- a. Restrict the filename length to eight characters
- b. The filename extension shall be as follows:

Survey data files	-	.SUR
Digit files	-	.DIG
MOSS Input files	-	.MOS
MOSS Draw files	-	.DRW
MOSS macro input files	-	.MCR
MOSS Genio input data	-	.DAT
ACAD 3D	-	.DWG
Data Exchange File	-	.DXF

Any additional extensions may be used with prior approval from the Government.

Work Directory

Main Directory Pathname for working area is :

Data Tapes

For MOSS Users in Windows 11 operating environment

The LLS shall submit the data in two set of Compact Disc containing:

Tape 1- Only working files (i.e. MODEL.FIL and MACRO.FIL containing the complete and error free digital models plus other relevant MOSS files).

Tape 2 All input data from the Survey work.

For other Users

The LLS shall submit the data in Compact Disc or in USB Flash Drive in GENIO format as defined in the MOSS manual. For Apollo DOS emulation software requirement all filenames have to be with .DAT extensions.

DIGITAL GROUND MODELS (DGM's)

METHODS

The data shall be presented by the LLS in a form suitable for input to the MOSS String Digital Ground Model program, and as defined in the MOSS User Manual which is available from the Government or the local agent for the software.

GRID

The coordinates of the DGM shall be referred to the grid system.

STRING LABELLING

All strings shall be labeled as requested. Any additional labels may be considered and the LLS shall submit the list for approval prior to their usage in the DGM.

MODELS

The DGM shall incorporate two (2) types of digital models as follow:-

- a) Ground Model
- b) Property Model

Ground Model

The ground surface over the required area shall be simulated by strings of coordinated information along characteristic lines on the terrain. The model shall consist of a combination of three dimensional (3D) and contour (2D) strings.

The existing road surface over the required area shall be simulated by 3D strings of coordinated information along characteristic lines on the existing carriageway. Any other strings that do not affect the accuracy of the ground surface may be assigned a null level. The LLS shall obtain prior approval by the Government for any strings that are to be digitized but that does not absolve the LLS from the subsequent accuracy and definition of the model. The features to be included in the Ground Model shall be as requested.

Property Model

This model shall be stimulated by a series of 3D null level strings and text strings and include the following:-

- a) Strings of land lots (null level strings)
- b) Lot numbers (Text strings)
- c) Reference no. for certified plan no. (Text Strings).

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Coordinate of each lot shall be computed and stored as separate strings according to the MOSS GENIO string format. All boundary coordinates shall be calculated based from known information on the Certified Plans.

Any land lot that is partially within the mapping area shall be computed and stored containing the information of the complete lot. No scaling or digitizing work is allowed unless there is no proper lot information and with prior written approval from the Government.

THREE (3) DIMENSIONAL STRINGS

These strings represent man made and angular features or break lines in the terrain. Each 3D string shall be recorded as a series of three dimensional points (easting, northing and level). Features recorded shall include tops and toes of embankments, brows of hills and dips of hollows, highway boundaries, channels, lines of carriageway, footpaths, banks or rivers and streams, railway lines etc.

The general shape in plan of individual traffic islands shall be represented by separate 3D strings with points at sharp changes of direction, levels being given for the adjacent carriageway surface. Supplementary strings sufficient to indicate the approximate vertical profile of paved islands shall be provided. These will also be required on grassed islands where there are insufficient contours (2D strings) to describe their surface shape.

If the highway is kerbed the edges of carriageway are to be defined immediately adjacent to the kerb face except where the kerbs divide a difference in levels (eg. central medians), the top of the kerbs are to be outlined.

Where there are auxiliary traffic lanes, lay-bys, junctions or breaks in the central reservation additional strings will be required along the edge of the carriageway which carries the through traffic.

3D strings shall also be used to define the ground where 2D strings are inadequate. Closer spaced points to define curved 3D strings are required unless special survey options in MOSS to define curves are used.

TWO (2) DIMENSIONAL STRINGS

These are contour strings and shall be recorded as a series of two dimensional points (easting and northing) together with the associated string level.

In models consisting of 2D and 3D strings the 2D strings shall be recorded throughout the area of the model except in the following instances: -

- a. **Highways:** Upon carriageway, the features are to be represented by 3D strings only.
- b. **Flat Areas:** In flat areas where the horizontal distance between contours exceeds 40m, the contours shall be supplemented by a series

of 3D strings so that the distance between adjacent strings and also between adjacent points on the strings shall not exceed 20 m.

- c. **Steep Areas:** Where steep slopes are encountered and it is not practical on the plan to represent each contour fully throughout its length, the LLS may with the Government's approval adopt a 3D string representation. In such instances the slope shall be bounded by a 3D string and any changes of slope or berms within this area shall also be depicted by 3D strings.
- d. **Densely vegetated areas or rock outcrop areas:** Where vegetation is so dense that the ground is completely obscured, contour strings may be replaced by 3D point strings the spacing of which shall be agreed with the Government.
- e. **Temporary features:** Where features appear to be temporary such as stockpiles and spoil heaps, they should be represented by contour strings as if permanent unless directed otherwise by the Government.

ACCURACY AND DEFINITION

a. 3D Strings

The levels and co-ordinates of recorded point shall be correct to within the r.m.s.e. tolerances stated in Table 1. 90% of these must be within 1.65 times the values stated, when a representative sample of points is checked by measurement from the nearest Survey Department Bench Mark or height control point.

Table 1: Tolerances of levels and co-ordinates of directly recorded points on strings

Carriageways & Hard Surfaces		Other Surfaces		Major Bridge Decks	
Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
± 0.06m	± 0.15m	± 0.10m	± 0.30m	± 0.01m	± 0.10m

The spacing of points along 3D strings shall be such that the maximum vertical and horizontal errors of interpolated points shall not exceed those given in Table 2.

Table 2: Total error of interpolated points on strings

Carriageways and Hard Surfaces		Other Surfaces		Major Bridge Decks	
Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
± 0.12m	± 0.30m	± 0.20m	± 0.60m	± 0.02m	± 0.20m

b. 2D Strings

Sufficient points shall be recorded on the contours so that the digital representation of the contour shall conform to the standards specified.

c. Strings formed of Spot Heights

Strings formed of Spot Heights shall be accurate to the Accuracy Level as stated in Table 1 above.

GENERAL STRING DETAILS

A string may start or finish at any point providing it is not more than 10m outside the boundary of the block for which the data is being recorded.

Continuity between blocks shall be provided either by mathematically precise matching at break boundaries or in the form of a short overlap between the end of one string (e.g. in Block 1) and the start of another string (e.g. in Block 2). Where a string stops at another string boundary there must not be any gap between the two strings.

If a string passes outside a block by more than 10m then loops back into the block, another string must be started prior to re-entry into the block, and the loop section recorded with the data for the adjoining block. Short overlaps shall be provided to maintain continuity.

If a string is a closed loop within the block, or within 10m of the block boundary, then it shall be closed with mathematical precision or by means of a short overlap at the start.

Survey Station Strings

These (4D) strings consist of points with Easting, Northing, Levels and the four character station number or name. MOSS default string labeling to store all main stations is PSSA.

Null Level Strings

These strings consist of points with Easting and Northing coordinates and assigned levels of -999.0. They are generally additional information so as to complete the definition of the ground model. MOSS program does not include them when performing the analysis functions (e.g. SECTION).

These null level strings may include the following: -

- a. Cartographic features such as tadpole symbol for slopes, vegetation symbols, etc.
- b. Land lot strings in the Property Model.
- c. Additional structures or buildings (with prior approval from the Government).

Text Strings

These strings form a group of information data (usually digitized or interactively added) in the Ground Model that may include the following:-

- a. Cartographic information such as vegetation type, land use, lot numbers, etc.
- b. Names and/or usage of prominent buildings and structures.
- c. Destination of road leading to and from the existing main road and where there are discontinuities of the road within the Mapping Area.

Unless otherwise stated all text shall be in ENGLISH and the following text shall the precise real world bearing:-

1. Road destination / type
2. River name / type

All other text may optionally have zero bearing.

Point Strings

These strings (with suffix 'P' for the labeling) could be either with or without levels and may include the following:-

- a. Spot level strings
- b. Utilities such as telecom or electrical poles
- c. Survey Station Strings (MOSS default label PSSA)

MOSS program does not include these strings when doing the analysis SECTION but include them when doing the CONTOUR and TRIANGLE except those with null levels.

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

MOSS STRING DATA FORMAT SAMPLE

2D strings format for contour lines

```
MOSS
GENIO,GROUND MODEL
001FORMAT(6F12.3,A4)
080,ZX,4=120.000,0.0,0.0,7=2
    34006.109  93790.720
    34001.339  93790.243
    33996.896  93790.714
    0.000      0.000
080,ZI,4= 122.000,0.0,0.0,7=2
    33792.611  93639.062
    33792.824  93635.414
    33791.057  93630.116
    33791.529  93618.834
    33791.095  93610.991
    33791.514  93605.465
    0.000      0.000
999
FINISH
```

Format for 3D feature strings with levels

```
MOSS
GENIO,GROUND MODEL
001FORMAT(6F12.3)
080,L0,5=0.0,0.0,7=3
    33870.994  93599.374  120.360
    33860.906  93587.641  120.190
    33837.023  93570.033  120.120
    0.000      0.000      120.120
999
FINISH
```

Format for 3D null level strings (e.g. Boundary, cartographic symbol strings)

```
MOSS
GENIO,GROUND MODEL
001FORMAT(6F12.3,A4)
080,OL,5=0.0,0.0,7=3
    34084.613  93755.397  -999.000
    34050.003  93732.622  -999.000
    33997.803  93697.401  -999.000
    29431.640  92471.117  -999.000
    0.000      0.000      -999.000
080,V,5=0.0,0.0,7=3
    34050.993  93805.595  -999.000
    33989.360  93763.940  -999.000
    33953.750  93740.073  -999.000
    33863.065  93678.688  -999.000
    0.000      0.000      -999.000
999
FINISH
```

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Format for 4D Survey stations points

MOSS
 GENIO,GROUND MODEL
 001FORMAT(4F12.3,A4)
 003,ORDR,4=1,1,2,3,4
 080,PST ,7=4
 34039.010 93797.000 120.170 STN1
 33244.500 93054.700 125.310 STN2
 32620.110 92486.380 132.950 IP01
 28894.260 92060.400 155.150 TBM2
 26413.500 86520.370 141.930 RM10
 26249.490 85565.320 124.870 SM23
 0.0 0.0 0.0
 999
 FINISH

Format for text / annotation strings

MOSS
 GENIO,GROUND MODEL
 001FORMAT(4F12.3,/,11A4)
 080,*T,5=0.0,6=0.0,7=12
 34039.010 93797.000 0.200 90.000
 SCH
 33244.500 93054.700 0.200 93.340
 KE KUALA LUMPUR
 32620.110 92486.380 0.200 90.000
 BM NO. 214
 28894.260 92060.400 0.200 90.000
 SG. HUSNI
 26413.500 86520.370 0.200 90.000
 BOX CULVERT
 26249.490 85565.320 0.250 90.000
 MUSLIM CEM.
 0.0 0.0
 999
 FINISH

PERKHIDMATAN PERUNDING SECARA LEAD CONSULTANT (LC) BAGI PROJEK CADANGAN MEMBINA JALAN
SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA
KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

Format for cross-sections along master alignment

MOSS

GENIO,CROSS-SECTION MODEL,ROAD MODEL

082,MS01,,G

1000.000 12

-30.020 126.810 -23.960 126.590 -20.550 126.350 -16.370 126.410
-8.980 126.120 0.000 126.230 6.200 126.490 13.460 127.790
19.210 129.770 24.670 132.090 28.860 133.800 32.100 134.180

1025.000 11

-35.270 124.510 -27.980 124.740 -22.400 124.830 -17.600 124.990
-16.380 126.470 -8.400 125.990 0.000 125.950 6.000 125.470
11.590 125.240 25.980 126.410 36.340 127.030

1050.000 11

-37.290 130.560 -31.460 129.560 -25.140 129.110 -18.350 125.610
-9.300 125.410 0.000 125.300 6.000 124.800 11.790 124.670
17.990 124.550 23.990 124.410 30.100 124.390

1075.000 11

-31.400 124.320 -23.000 124.430 -18.260 124.380 -12.370 124.540
-6.390 124.540 0.000 124.730 9.000 124.620 17.990 124.590
23.980 124.730 31.940 125.180 37.960 125.780

999999.9

FINISH

6D Master Alignment String

MOSS

GENIO,ROAD

001FORMAT(6F12.3,A4)

080,MS01,5=0.0,0.0,7=6

34067.410	93780.900	120.658	0.000	4.118	999999.900
33984.543	93724.926	120.314	100.000	4.118	999999.900
33901.676	93668.952	120.264	200.000	4.118	999999.900
33818.809	93612.978	120.802	300.000	4.118	999999.900
33735.942	93557.005	121.633	400.000	4.118	999999.900
33653.075	93501.031	122.465	500.000	4.118	999999.900
33570.208	93445.057	123.297	600.000	4.118	999999.900
33487.341	93389.083	124.129	700.000	4.118	999999.900
33464.351	93373.554	124.359	727.744	4.118	999999.900
33449.862	93363.739	124.505	745.244	4.114	-2200.000
33435.452	93353.809	124.650	762.744	4.102	-1100.000
33421.202	93343.652	124.796	780.244	4.083	-733.333
33407.198	93333.158	124.942	797.744	4.055	-550.000
33405.416	93331.775	124.960	800.000	4.051	-550.000
33332.533	93263.507	125.758	900.000	3.869	-550.000
33273.196	93183.185	126.441	1000.000	3.687	-550.000
33270.057	93177.947	126.478	1006.106	3.676	-550.000
33261.367	93162.758	126.584	1023.606	3.648	-733.333
33253.042	93147.365	126.688	1041.106	3.628	-1100.000
33244.962	93131.842	126.792	1058.606	3.616	-2200.000
33237.007	93116.255	126.895	1076.106	3.612	999999.900
33226.172	93094.959	127.037	1100.000	3.612	9 99999.900
33180.829	93005.830	127.630	1200.000	3.612	999999.900
33170.867	92986.248	127.760	1221.970	3.612	999999.900

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN
SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA
KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

33159.495	92963.985	127.908	1246.970	3.617	2550.000
33147.905	92941.834	128.056	1271.970	3.632	1275.000
33135.883	92919.915	128.204	1296.970	3.656	850.000
33134.387	92917.280	128.222	1300.000	3.660	850.000
33079.857	92833.524	128.815	1400.000	3.778	850.000
33015.874	92756.748	129.407	1500.000	3.895	850.000
32943.321	92688.013	130.170	1600.000	4.013	850.000
32863.201	92628.269	131.273	1700.000	4.130	850.000
32776.623	92578.342	132.545	1800.000	4.248	850.000
32684.783	92538.922	133.818	1900.000	4.366	850.000
32666.254	92532.470	134.068	1919.621	4.389	850.000
32642.450	92524.833	134.386	1944.621	4.413	1275.000
32618.500	92517.664	134.704	1969.621	4.428	2550.000
32594.481	92510.730	135.022	1994.621	4.433	999999.900
32589.310	92509.246	135.091	2000.000	4.433	999999.900
32521.669	92489.838	135.987	2070.370	4.433	999999.900
32493.184	92481.683	136.364	2100.000	4.435	8437.454
32459.319	92472.137	136.811	2135.185	4.441	3857.138
32425.368	92462.901	137.259	2170.370	4.453	2500.000
32396.685	92455.470	137.636	2200.000	4.465	2500.000
32299.270	92432.911	138.905	2300.000	4.505	2500.000
32102.124	92399.563	141.112	2500.000	4.585	2500.000
0.000	0.000	141.112	2500.000	4.585	2500.000

999

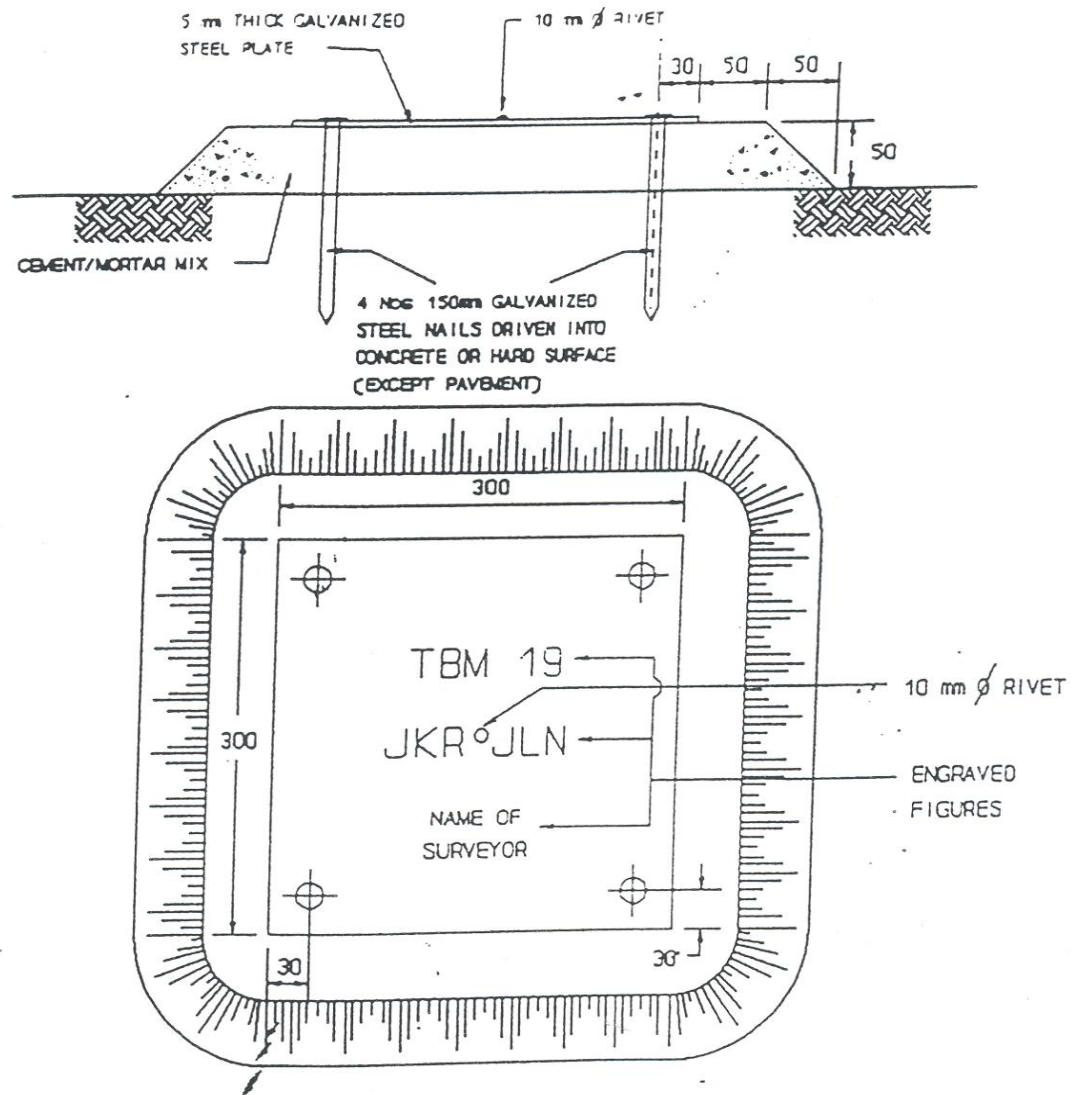
FINISH

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDICES

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDIX A1

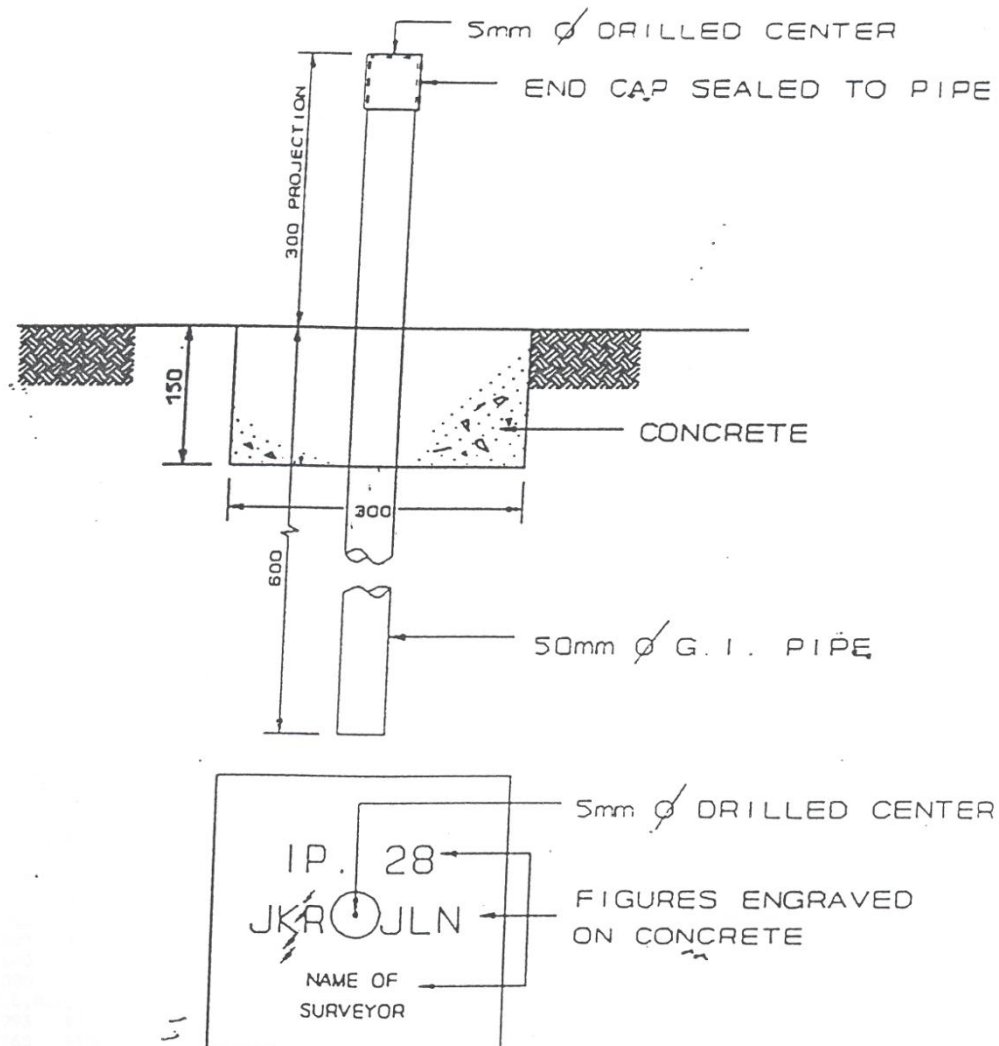


GROUND MARKERS ON HARD SURFACE

NOT TO SCALE (ALL DIMENSIONS IN MILIMETER)

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDIX A2



GROUND MARKERS ON NORMAL SURFACE

NOT TO SCALE (ALL DIMENSIONS IN MILIMETER)

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDIX A3

CERTIFIED BY LICENSED LAND SURVEYOR (LLS)

I certify that these field notes consisting of pages are a correct and complete record of the observations and measurements made by or under the immediate personal direction and supervision in the field of(1)... that the survey was effected in strict conformity with the Licensed Land Surveyors Regulations, that the standard of accuracy of the survey is class as defined in those Regulations and that the survey was completed on the day of

I undertake to accept full responsibility for the correctness of the survey.

.....(2)..... Surveyor, Licensed under Ordinance No. 11 of 1958.

NOTE:-

(1) Name, signature and qualification of the Qualified Surveyor in charge of the survey parties.

(2) Name, signature and qualifications of the Licensed Surveyor.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

TERM OF REFERENCE

FOR

UNDERGROUND UTILITY SURVEY WORKS

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

APPENDIX B - TOR UNDERGROUND UTILITY SURVEY WORKS

SERVICES SPECIFICATIONS FOR UNDERGROUND UTILITY SURVEY WORKS

1. BACKGROUND AND OBJECTIVE

The Government of Malaysia intends to carry out detailed engineering survey – Underground Utility Survey Works in the State of Selangor.

The purpose of the detailed ground survey is to provide all necessary data and information required for undertaking the engineering design for project (Underground Utility Survey Works)

SPECIFICATIONS

1. SCOPE OF WORKS

The scope of works shall include the supply of all labour and use of machineries, equipment and materials required for the complete sub-surface detection, investigation and mapping of underground utilities for the above project inclusive of the followings:

- construction of survey reference grid with Global Positioning System (GPS).
 - surface reference line survey.
 - complete underground utilities detection including but not limited to the markings of power and telecommunication cables, sewer, water and gas pipes.
-
- a) The LLS is to use GPS and electronic survey total station to construct a survey control point network, coordinate, in which the position of all survey works and detected services will relate.
 - b) All survey results will be in State's Cassini Soldner coordinate system.
 - c) Survey plan shall indicate layer but not limited to pavement edges, kerb lines, road edges, traffic dividers and valve/manhole covers.
 - d) All existing utilities shall be detected /surveyed within the specified area as in Appendix A.
 - e) The conductive services such as cables & pipes is to be located, pin pointed and traced using electromagnetic cable and pipe detection instruments and these positions are recorded in X, Y and Z coordinates on to a field data logger before transferring to the computerized utility information database.
 - f) Non-metallic services to be detected using Ground Penetrating Radar (GPR) whenever soil conditions allow.
 - g) Relating attribute data to the service, i.e. materials, diameters, type, ways and voltages to be logged and retained wherever and whenever possible.
 - h) The LLS is to provide digital plans to the client, containing information on all underground services within the project area.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

- i) The LLS is to maintain an estimated accuracy level of +/- 10 cm horizontally and +/- 10 % from the actual depth vertically of all buried services located up to 3 meters deep.
- j) Wherever possible, the works are to be carried out during the daytime. However, due to traffic conditions, the detection and survey works, where necessary can be conducted at night till 6.00 a.m.
- k) The LLS using available electromagnetic techniques and equipment (electromagnetic cable locator, pipe detectors and GPR) at its disposal is to locate all buried PVC, asbestos, concrete and other non-metallic service. The LLS will undertake to advise the client of any problems it experiences or potential hazards it anticipates.
- l) As a general practice, the LLS will be liable to any damages to underground utilities due to the negligence of LLS staff. In this respect, the LLS is to detect and locate all metallic and accessible non-metallic services.
 - a. Electromagnetic cable locator and pipe detectors can be used to detect metallic/conductive services such as iron and steel pipes for water, gas, sewer, oil, electric cables, copper telecommunication and control cables.
 - b. Ground Penetrating Radar (GPR) can be used to detect non-metallic services such as sewer, water and drain pipes, accessible ducts (i.e. empty protection pipes for optic fiber and other cables) and other accessible nonconductive underground objects, if the soil contents and conditions permit.

2. SUBMISSION OF SURVEY PLANS, UTILITIES, DIGITAL DATA AND RECORDS

Upon the satisfactory completion of the whole works, the LLS shall submit the survey results as follows:-

i. Hardcopy Requirements

Paper Quality	Minimum 80 GSM ink-jet media paper
Printing Quality	Full standard colour coding
	Utilities
	Individual colour coding.
	Electric (red), Telecommunication (green), Water and Raw water (blue), Sewer and Force Sewer (brown), Gas (magenta), Drainage (grey) & Others (black).

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

	Non-Utilities Individual symbol. Traverse point, GPS point, chainage symbol, kilometre post, street name, edge of street, wall line, fence, bush, leaf tree, fountain, statue, palm tree, river bank, shore line, rail road, shelter roof, pillar, traffic signage, boundary stone & others. JUPEM standard coding: Full compliance with latest MS 1759. Submit two (2) copies of report consist of i.e. Introduction, Objective, Methodology, Findings on Every Plan and Summary.
Submittals	Three (3) complete sets of colour coded maps.
Scale	Metric scale: 1:100 ~ 1:1000
Paper size	ISO A3 ~ A0 size

ii. Softcopy Requirements

File System	3D (*.xy), AutoCAD (*.dwg) & type of files as requested.
Media type	DVD-R; USB Flash Drive
Submittals	One (1) set of storage media (DVD, USB Media & etc.)

iii. Detection and Survey Requirements

System	State Cassini Coordinates System (GPS) i) State Cassini Coordinates System ii) Malaysian Rectified Skew Orthomorphic (RSO) where required
Underground Utility Technologies/ Devices	i) Electromagnetic Field/ Electromagnetic Locator ii) Magnetic Field/ Magnetometer iii) Radar/ Ground Penetrating Radar (GPR) iv) Electronic Distance Measuring Device (EDM)/ Total Station v) Real Time Kinematic (RTK) GPS/ Aplikasi MyRTKNet

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

	vi) Latest technology/ device where required
Electromagnetic Site Investigation (Full Detection/Survey)	Full detection / survey of the required area.
Attributes Information	▪ Comply with latest MS 1759 ▪ Physical characteristic (size, material type, PVC, etc.) ▪ Depth of network ▪ Number of ways (Telecommunication / TNB) If any related information ▪ Contractor's name ▪ Historical data of utility laid ▪ When laid

Nevertheless, the LLS shall issue to MBSJ / contractor part of any of the above items as and when required by MBSJ. All data and drawing shall be recorded and plotted in a format required and approved by JKR. All the above mentioned items submitted shall become the properties to JKR.

3. PRECAUTIONS TO BE TAKEN

The LLS shall observe and comply with the following procedures to ensure that the Detection Works carried out are not injurious to other parties:-

- i. The LLS shall provide proper traffic management systems and schemes during the course of the Detection Works. Traffic control devices (including temporary signs/roadside furniture) shall be provided in accordance with the relevant JKR Arahan Teknik (Jalan) publications or other relevant local authorities standards and guidelines.
- ii. The LLS shall not cause the Detection Works to disrupt the normal functioning of existing services and utilities and shall not disconnect any of the services and utilities without the written approval from the relevant authorities and companies. The Contractor shall make good, at his own expense, any damage whatsoever to existing services and utilities in accordance with the instructions

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

and to the complete satisfaction of the relevant authorities and companies concerned, and shall keep MBSJ indemnified at all times from all claims, costs and expenses which may be brought against or incurred by MBSJ for or in account of any damage to the said services and utilities.

- iii. The LLS shall be responsible for clearing any site obstructions and obtaining any permit that may be necessary for the carrying out of the Detection Works.
- iv. All personnel shall be equipped with Personal Protection Equipment (PPE) such as reflective clothing either yellow or orange florescent in the compliance/ requirement of Department of Safety & Health (DOSH) and Team Leader is provided telecommunication tools for field communication.

(Subject to compliance with JKR traffic management requirements)

4. ATTRIBUTES

4.1 Quality Level Attributes

4.1.1 General

The quality level attribute of an underground utility feature is the most important information aside from its alignment or presence in a utility map. As such due care should be given to precisely indicate the quality level of an underground feature especially in hardcopy maps given the fact that in any congested corridor, the horizontal and vertical separation between utility features could be reduced to several decimeters, and at plotting scale such separation may be difficult to discern. Careful usage of the following cartographic elements can help in ensuring a reliable indication of the quality level of underground features.

4.1.2 Labelling

This is also one of the methods of differentiating between the quality levels, utility type, ownership, date of depiction, accuracy of surveyed appurtenances, end points of any utility data, active, abandoned, or out-

of-service status, size, condition, number of jointly buried cables and encasement.

4.1.3 Symbol Embedding

Symbol embedding can also be used to indicate the different quality levels of underground utility data.

4.1.4 Colour

Colour is frequently used to indicate type which can be used in conjunction with other methods. (*Please refer Attachment I*)

4.1.5 Line Weight

Line weight can be used at actual scale to depict the size of the utility. However, it has the effect of obscuring other data if the line size is large.

4.1.6 Layer

Occasionally layers are used to portray various attributes. For example, quality level 'A' data could be on one layer, quality level 'B' data on another, and etc. All layers must be turned be on to present the complete utility information particularly in a geographic information system.

4.1.7 Annotation

Annotation should be used with care as to ensure that it does not obscure other utility data.

4.2 **Utility Depiction Legend**

In most cases, an underground utility map should be provided with a separate utility legend to clearly indicate the methods of quality level differentiation and other utility attributes.

4.3 **Parcel Boundaries**

Parcel boundaries shown shall be derived from the National Digital Cadastral Database (NDCDB) currently maintained by JUPEM.

4.4 Lot Numbers

Lot numbers of all parcels as depicted in the NDCDB shall be shown whenever possible.

4.5 Names of Building, Street, Road and River

Official names of buildings as well as names of streets, roads and rivers shall be shown.

4.6 North Arrow

An arrow-like symbol indicating the direction of the grid north and the true north shall be shown.

4.7 Scale Representation

Since maps must necessarily be smaller than the areas mapped, their use requires that the ratio or proportion between comparable measurements be expressed on the map. This is called map scale and should be the first thing which the map user becomes aware. Scale should be expressed as a statement of map distance in relation to earth distance or a graphic (or bar) scale or both.

4.8 Plan Date

The date of the plan should be prominently displayed.

4.9 Marginal Information

Marginal information may include such items as section, town, city and state names, scale, north arrow, legend and disclaimer, among others.

4.10 Disclaimer

Disclaimers are used to limit and define the map author's responsibility for the content, accuracy and currency of the map. Although some maps may require specialized disclaimers, the following disclaimer represents one suggestion: *"Not to be treated as a map depicting property boundaries"*

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

5. METADATA

Metadata are commonly defined as the data about data or the data about the processes performed on the data. The major uses of the metadata are:

- i. To maintain an organization's internal investment in geospatial data;
- ii. To provide information about an organization's data holdings to data catalogues, clearing houses and brokerages; and
- iii. To provide information needed to process and interpret data to be received through a transfer from an external source.

Thus, in order to facilitate their use, underground utility maps produced shall be accompanied with appropriate metadata which complies with Malaysian Standard for Geographic Information – Metadata.

6. COLOUR CODE

The color code and utilities marking procedure shall follow “PEKELILING KETUA PENGARAH UKUR DAN PEMETAAN BILANGAN 1 TAHUN 2016” for “GARIS PANDUAN KOD WARNA DAN PENANDAAN BAGI PEMETAAN UTILITI BAWAH TANAH” and “PEKELILING KETUA PENGARAH UKUR DAN PEMETAAN BILANGAN 2 TAHUN 2016” for “GARIS PANDUAN PENERIMAAN DATA DIGITAL DAN PELAN UTILITI DARI JURUUKUR TANAH BERTAULIAH (JTB) OLEH JABATAN UKUR DAN PEMETAAN MALAYSIA (JUPEM)” see attached. The utility code according to MS1759: 2015 is automatically amended by following JUPEM latest utility code circular.

CODE	COLOUR	TYPE
<i>421 – Water Pipe, Steel</i>		<i>Single Line</i>

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

UTILITY CODE

According to MS 1759: 2004, the utility codes, for example are:

<i>UC – Water Supply</i>	
Feature Code:	<i>UC0110</i>
Feature Name:	<i>Water Pipe.</i>
Description:	<i>A string of interconnected pipes use for transporting water.</i>
Feature Class:	<i>Line.</i>
Possible Attribute:	<i>Name (NAM), Water Pipe Type (WIT), Grade Location (GRL)</i>

Both of these codes are important in order for user and services providers easily to understand and determine the type of subsurface utility in maps.

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

CODE LIST

GENERAL

Code	Colour	Type
101 - Triangulation point	250	Symbol
102 - Traverse point	250	Symbol
103 - Bench mark	250	Symbol
104 - GPS Point	250	Symbol
105 - Chainage symbol	250	Symbol
106 - Kilometer post	250	Symbol
107 - Help control point	250	Symbol
108 - Street name	250	Text
110 - Point (ground surface)	250	Symbol
113 - Edge of street	250	Single line
114 - Street centreline	250	Single line
115 - Culvert	250	Single line
116 - Kerbstone	250	Single line
117 - Sidewalk edge	250	Single line
118 - Road edge, uncertain	250	Single line
120 - Wall	Yellow	Hidden line
121 - Wall line	Yellow	Hidden line
122 - Fence	44	OFB
123 - Bush	82	Symbol
124 - Leaf tree	82	Symbol
125 - Conifer	82	Symbol
126 - Fountain	82	Symbol
127 - Statue	82	Symbol
128 - Palm tree	82	Symbol
131 - River bank	191	Single line
132 - Shore line	200	Single line
133 - Bridge edge	200	Single line
134 - Rail road	200	Tracks
135 - Ditch bank	250	Single line
136 - Ditch bottom	250	Single line
137 - Slope edge	132	Fenceline 1
138 - Shelter roof	200	Single line
139 - Staircase	200	Single line
141 - Pillar	200	Single line
143 - Traffic sign	200	Symbol
144 - Boundary stone	200	Symbol
145 - Wall	200	Single line
150 - Space object	200	Symbol
- Land Lot	33	Single line
- Lot Text	201	Number

WATER PIPE

Code	Colour	Type
401 - Manhole Cover	Blue	Symbol
402 - Water Chamber Cover	Blue	Symbol
403 - Water Valve Chamber	Blue	Symbol
405 - Water Reservoir	Blue	Symbol
409 - End Of Pipe	Blue	Symbol
411 - Water Valve Cover	Blue	Symbol
412 - Water Valve	Blue	Symbol
414 - Water Meter	Blue	Symbol
415 - Tap	Blue	Symbol
416 - Fire Hydrant	Blue	Symbol
417 - Water Statue	Blue	Symbol
420 - Water In General (Main)	Blue	Single line
421 - Waterpipe, Steel (Main)	Blue	Single line
422 - Waterpipe, Iron (Main)	Blue	Single line
423 - Waterpipe, Plastic (Main)	Blue	Single line
424 - Waterpipe, Asbestos (Main)	Blue	Single line
425 - Waterpipe, Fibre Glass (Main)	Blue	Single line
430 - Water In General (Crossing)	Blue	Single line
431 - Waterpipe, Steel (Crossing)	Blue	Single line
432 - Waterpipe, Iron (Crossing)	Blue	Single line
433 - Waterpipe, Plastic (Crossing)	Blue	Single line
434 - Waterpipe, Asbestos (Crossing)	Blue	Single line
435 - Waterpipe, Fibre Glass (Crossing)	Blue	Single line
476 - Proposed Water Pipe	174	Dashed
499 - Pipe Not In Use	Blue	Single line

RAW WATER

Code	Colour	Type
501 - Manhole Cover	Blue	Symbol
502 - Chamber Cover	Blue	Symbol
503 - Chamber	Blue	Symbol
509 - End Of Pipe	Blue	Symbol
511 - Valve Cover	Blue	Symbol
512 - Valve	Blue	Symbol
515 - Tap	Blue	Symbol
520 - Raw Water In General (Main)	Blue	Single line
521 - Raw Water, Steel (Main)	Blue	Single line
522 - Raw Water, Iron (Main)	Blue	Single line
523 - Raw Water, Plastic (Main)	Blue	Single line
524 - Raw Water, Asbestos (Main)	Blue	Single line
525 - Raw Water, Fibre Glass (Main)	Blue	Single line
530 - Raw Water In General (Crossing)	Blue	Single line
531 - Raw Water, Steel (Crossing)	Blue	Single line
532 - Raw Water, Iron (Crossing)	Blue	Single line
533 - Raw Water, Plastic (Crossing)	Blue	Single line
534 - Raw Water, Asbestos (Crossing)	Blue	Single line
535 - Raw Water, Fibre Glass (Crossing)	Blue	Single line

ELECTRIC

Code	Colour	Type
202 - Electric chamber cover	Red	Symbol
203 - Electric chamber	Red	Symbol
206 - Electric duct	Red	Single line
207 - Sub station	Red	Single line
209 - End of cable	Red	Single line
210 - Lamp post	Red	Symbol
211 - Traffic light	Red	Symbol
212 - Sign pole	Red	Symbol
213 - Low tension pole	Red	Symbol
214 - Medium tension pole	Red	Symbol
215 - High tension pole	Red	Symbol
216 - Pole transformer	Red	Symbol
217 - Electric cable statue	Red	Symbol
220 - Electric in general	Red	Single Line
221 - Distribution cabinet	Red	Symbol
222 - Transformer cabinet	Red	Symbol
223 - Building transformer	Red	Single line
231 - Lamp post cable	Red	Single line
232 - Traffic light cable	Red	Single line
233 - Sign cable	Red	Single line
234 - 0.4 kV cable	Red	Single line
236 - 11 kV cable	Red	Single line
237 - 33 kV cable	Red	Single line
238 - 132 kV cable	Red	Single line
239 - 275 kV cable	Red	Single line
241 - Protection pipe	Red	Single line
252 - Joint	Red	Single line
253 - T-joint	Red	Single line
254 - Cable lifting	Red	Single line
291 - End of protection pipe	Red	Single line
292 - End of protection pipe	Red	Symbol
276 - Proposed power cable	30	Dashed
299 - Cable not in use	Red	Single line

DRAINAGE

Code	Colour	Type
701 - Drainage Manhole Cover (Circle)	250	Symbol
702 - Drainage Chamber Cover	250	Single line
703 - Drainage Chamber	250	Single line
709 - End Of Pipe	250	Single line
720 - Drainage In General	250	Single line
722 - Drainage, Material Iron	250	Single line
723 - Drainage, Material Plastic	250	Single line
724 - Drainage, Material Asbestos	250	Single line
726 - Drainage, Material Concrete	250	Single line
727 - Drainage, Material Clay	250	Single line
728 - Drainage, Material Brick	250	Single line
776 - Proposed Drainage	Black	Dashed
799 - Pipe Not In Use	250	Single line

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

CODE LIST

GENERAL

Code	Colour	Type
101 - Triangulation point	250	Symbol
102 - Traverse point	250	Symbol
103 - Bench mark	250	Symbol
104 - GPS Point	250	Symbol
105 - Cabbage symbol	250	Symbol
106 - Kilometer post	250	Symbol
107 - Help control point	250	Symbol
108 - Street name	250	Text
110 - Point (ground surface)	250	Symbol
113 - Edge of street	250	Single line
114 - Street centreline	250	Single line
115 - Culvert	250	Single line
116 - Kerbstone	250	Single line
117 - Sidewalk edge	250	Single line
118 - Road edge, uncertain	250	Single line
120 - Wall	Yellow	Hidden line
121 - Well line	Yellow	Hidden line
122 - Fence	50	Symbol
123 - Bank	50	Symbol
124 - Leaf tree	50	Symbol
125 - Conifer	50	Symbol
126 - Fountain	50	Symbol
127 - Statue	50	Symbol
128 - Palm tree	50	Symbol
131 - River bank	250	Single line
132 - Shore line	250	Single line
133 - Bridge edge	250	Single line
134 - Rail road	250	Single line
135 - Ditch bank	250	Single line
136 - Ditch bottom	250	Single line
137 - Slope edge	250	Fence line 1
138 - Shelter roof	250	Single line
139 - Staircase	250	Single line
141 - Pillar	250	Single line
143 - Traffic sign	250	Symbol
144 - Boundary stone	250	Symbol
145 - Wall	250	Single line
150 - Space object	250	Symbol
- Land Lot	250	Single line
- Lot Text	250	Number

ELECTRIC

Code	Colour	Type
202 - Electric chamber cover	Red	Symbol
203 - Electric chamber	Red	Symbol
206 - Electric duct	Red	Single line
207 - Sub station	Red	Single line
209 - End of cable	Red	Single line
210 - Lamp post	Red	Symbol
211 - Traffic light	Red	Symbol
212 - Sign pole	Red	Symbol
213 - Low tension pole	Red	Symbol
214 - Medium tension pole	Red	Symbol
215 - High tension pole	Red	Symbol
216 - Pole transformer	Red	Symbol
217 - Electric cable statue	Red	Symbol
220 - Electric in general	Red	Single line
221 - Distribution cabinet	Red	Symbol
222 - Transformer cabinet	Red	Symbol
223 - Building transformer	Red	Single line
224 - Lamp post cable	Red	Single line
225 - Traffic light cable	Red	Single line
233 - Sign cable	Red	Single line
234 - 0.4 kV cable	Red	Single line
236 - 11 kV cable	Red	Single line
237 - 33 kV cable	Red	Single line
238 - 132 kV cable	Red	Single line
239 - 275 kV cable	Red	Single line
241 - Protection pipe	Red	Single line
242 - Joint	Red	Single line
253 - T-joint	Red	Single line
254 - Cable lifting	Red	Single line
261 - End of protection pipe	Red	Single line
262 - End of protection pipe	Red	Symbol
276 - Proposed power cable	Red	Dashed
299 - Cable not in use	Red	Single line

TELECOMMUNICATION

Code	Colour	Type
302 - Telecom chamber cover	Green	Symbol
303 - Telecom chamber	Green	Symbol
306 - Telecom duct	Green	Single line
307 - Telecom tunnel	Green	Single line
309 - End of Telecom cable	Green	Single line
311 - Telephone pole	Green	Symbol
312 - Telephone booth	Green	Single line
313 - Emergency telephone	Green	Symbol
317 - Telecom statue	Green	Symbol
320 - Telephone general	Green	Symbol
321 - Telecom distribution cabinet	Green	Symbol
322 - Telecom internal cabinet	Green	Symbol
331 - Telephone central	Green	Single line
332 - Building telephone central	Green	Single line
341 - Telecom house connection	Green	Single line
342 - Local network cable	Green	Single line
343 - Telecom trunk cable	Green	Single line
344 - Optic fibre cable	Green	Single line
345 - Control cable	Green	Single line
346 - Cable TV	Green	Single line
352 - Joint	Green	Single line
353 - T-joint	Green	Single line
354 - Cable lifting	Green	Single line
370 - Other communication (private, army, etc)	Green	Single line
376 - Proposed Optic Fibre duct	Green	Dashed
377 - Optic fibre duct	Green	Single line
381 - Optic fibre chamber	Green	Single line
382 - Optic fibre manhole	Green	Single line
391 - Protection pipe	Green	Single line
392 - End of protection pipe	Green	Single line
399 - Cable not in use	Green	Single line

WATER PIPE

Code	Colour	Type
401 - Manhole Cover	Blue	Symbol
402 - Water Chamber Cover	Blue	Symbol
403 - Water Valve Chamber	Blue	Symbol
405 - Water Reservoir	Blue	Symbol
409 - End Of Pipe	Blue	Symbol
411 - Water Valve Cover	Blue	Symbol
412 - Water Valve	Blue	Symbol
414 - Water Meter	Blue	Symbol
415 - Tap	Blue	Symbol
416 - Fire Hydrant	Blue	Symbol
417 - Water Statue	Blue	Symbol
420 - Water In General (Main)	Blue	Single line
421 - Waterpipe, Steel (Main)	Blue	Single line
422 - Waterpipe, Iron (Main)	Blue	Single line
423 - Waterpipe, Plastic (Main)	Blue	Single line
424 - Waterpipe, Asbestos (Main)	Blue	Single line
425 - Waterpipe, Fibre Glass (Main)	Blue	Single line
430 - Water In General (Crossing)	Blue	Single line
431 - Waterpipe, Steel (Crossing)	Blue	Single line
432 - Waterpipe, Iron (Crossing)	Blue	Single line
433 - Waterpipe, Plastic (Crossing)	Blue	Single line
434 - Waterpipe, Asbestos (Crossing)	Blue	Single line
435 - Waterpipe, Fibre Glass (Crossing)	Blue	Single line
476 - Proposed Water Pipe	Blue	Dashed
499 - Pipe Not In Use	Blue	Single line

RAW WATER

Code	Colour	Type
501 - Manhole Cover	Blue	Symbol
502 - Chamber Cover	Blue	Symbol
503 - Chamber	Blue	Symbol
509 - End Of Pipe	Blue	Symbol
511 - Valve Cover	Blue	Symbol
512 - Valve	Blue	Symbol
515 - Tap	Blue	Symbol
520 - Raw Water In General (Main)	Blue	Single line
521 - Raw Water, Steel (Main)	Blue	Single line
522 - Raw Water, Iron (Main)	Blue	Single line
523 - Raw Water, Plastic (Main)	Blue	Single line
524 - Raw Water, Asbestos (Main)	Blue	Single line
525 - Raw Water, Fibre Glass (Main)	Blue	Single line
530 - Raw Water In General (Crossing)	Blue	Single line
531 - Raw Water, Steel (Crossing)	Blue	Single line
532 - Raw Water, Iron (Crossing)	Blue	Single line
533 - Raw Water, Plastic (Crossing)	Blue	Single line
534 - Raw Water, Asbestos (Crossing)	Blue	Single line
535 - Raw Water, Fibre Glass (Crossing)	Blue	Single line

SEWER PIPE

Code	Colour	Type
601 - Sewer Manhole Cover (Circle)	Red	Symbol
602 - Sewer Chamber Cover	Red	Symbol
603 - Sewer Chamber	Red	Symbol
609 - End Of Pipe	Red	Symbol
620 - Sewer In General	Red	Single line
621 - Sewerpipe, Steel	Red	Single line
622 - Sewerpipe, Iron	Red	Single line
623 - Sewerpipe, Plastic	Red	Single line
625 - Sewerpipe, Concrete	Red	Single line
627 - Sewerpipe, Clay	Red	Single line
628 - Sewerpipe, Brick	Red	Single line
676 - Proposed Sewer Pipe	Red	Dashed
699 - Pipe Not In Use	Red	Single line

DRAINAGE

Code	Colour	Type
701 - Drainage Manhole Cover (Circle)	Blue	Symbol
702 - Drainage Chamber Cover	Blue	Single line
703 - Drainage Chamber	Blue	Single line
709 - End Of Pipe	Blue	Single line
720 - Drainage In General	Blue	Single line
722 - Drainage, Material Iron	Blue	Single line
723 - Drainage, Material Plastic	Blue	Single line
724 - Drainage, Material Asbestos	Blue	Single line
726 - Drainage, Material Concrete	Blue	Single line
727 - Drainage, Material Clay	Blue	Single line
728 - Drainage, Material Brick	Blue	Single line
776 - Proposed Drainage	Blue	Dashed
799 - Pipe Not In Use	Blue	Single line

FORCE SEWER

Code	Colour	Type
802 - Force Sewer Chamber Cover (Circle)	Red	Symbol
803 - Force Sewer Chamber	Red	Symbol
807 - Pumping Station	Red	Symbol
809 - End Of Pipe	Red	Symbol
811 - Valve Cover	Red	Symbol
812 - Valve	Red	Symbol
820 - Force Sewer In General	Red	Single line
821 - Force Sewer, Steel	Red	Single line
841 - Pressure Air Pipe	Red	Single line
899 - Pipe Not In Use	Red	Single line

GAS PIPE

Code	Colour	Type
902 - Gas Chamber Cover	Red	Symbol
903 - Gas Chamber	Red	Symbol
907 - Pumping Station	Red	Symbol
909 - End Of Pipe	Red	Symbol
911 - Gas Valve Cover	Red	Symbol
912 - Gas Valve	Red	Symbol
917 - Gas Statue	Red	Symbol
920 - Gas In General	Red	Single line
921 - Gas Pipe, Steel	Red	Single line
923 - Gas Pipe, Plastic	Red	Single line
941 - Oil Pipe	Red	Single line
951 - Regulator	Red	Single line
953 - T-joint	Red	Single line
970 - Proposed Gas Pipe	Red	Single line
999 - Pipe Not In Use	Red	Single line

TELECOMUNICATION

Code	Colour	Type
302 - Telecom chamber cover	Green	Symbol
303 - Telecom chamber	Green	Symbol
306 - Telecom duct	Green	Single line
307 - Telecom tunnel	Green	Single line
309 - End of Telecom cable	Green	Single line
311 - Telephone pole	Green	Symbol
312 - Telephone booth	Green	Single line
313 - Emergency telephone	Green	Symbol
317 - Telecom statue	Green	Symbol
320 - Telephone general	Green	Symbol
321 - Telecom distribution cabinet	Green	Symbol
322 - Telecom internal cabinet	Green	Symbol
331 - Telephone central	Green	Single line
332 - Building telephone central	Green	Single line
341 - Telecom house connection	Green	Single line
342 - Local network cable	Green	Single line
343 - Telecom trunk cable	Green	Single line
344 - Optic fibre cable	Green	Single line
345 - Control cable	Green	Single line
346 - Cable TV	Green	Single line
352 - Joint	Green	Single line
353 - T-joint	Green	Single line
354 - Cable lifting	Green	Single line
370 - Other communication (private, army, etc)	Green	Single line
376 - Proposed Optic Fibre duct	104	Dashed
377 - Optic fibre duct	Cyan	Single line
381 - Optic fibre chamber	Cyan	Single line
382 - Optic fibre manhole	Cyan	Single line
391 - Protection pipe	Green	Single line
392 - End of protection pipe	Green	Single line
399 - Cable not in use	Green	Single line

SEWER PIPE

Code	Colour	Type
601 - Sewer Manhole Cover (Circle)	Brown	Symbol
602 - Sewer Chamber Cover	Brown	Symbol
603 - Sewer Chamber	Brown	Symbol
609 - End Of Pipe	Brown	Symbol
620 - Sewer In General	Brown	Single line
621 - Sewerpipe, Steel	Brown	Single line
622 - Sewerpipe, Iron	Brown	Single line
623 - Sewerpipe, Plastic	Brown	Single line
626 - Sewerpipe, Concrete	Brown	Single line
627 - Sewerpipe, Clay	Brown	Single line
628 - Sewerpipe, Brick	Brown	Single line
676 - Proposed Sewer Pipe	14	Dashed
699 - Pipe Not In Use	Brown	Single line

FORCE SEWER

Code	Colour	Type
802 - Force Sewer Chamber Cover (Circle)	Brown	Symbol
803 - Force Sewer Chamber	Brown	Symbol
807 - Pumping Station	Brown	Symbol
809 - End Of Pipe	Brown	Symbol
811 - Valve Cover	Brown	Symbol
812 - Valve	Brown	Symbol
820 - Force Sewer In General	Brown	Single line
821 - Force Sewer, Steel	Brown	Single line
841 - Pressure Air Pipe	Brown	Single line
899 - Pipe Not In Use	Brown	Single line

GAS PIPE

Code	Colour	Type
902 - Gas Chamber Cover	Magenta	Symbol
903 - Gas Chamber	Magenta	Symbol
907 - Pumping Station	Magenta	Symbol
909 - End Of Pipe	Magenta	Symbol
911 - Gas Valve Cover	Magenta	Symbol
912 - Gas Valve	Magenta	Symbol
917 - Gas Statue	Magenta	Symbol
920 - Gas In General	Magenta	Single line
921 - Gas Pipe, Steel	Magenta	Single line
923 - Gas Pipe, Plastic	Magenta	Single line
941 - Oil Pipe	Magenta	Single line
951 - Regulator	Magenta	Single line
953 - T-Joint	Magenta	Single line
976 - Proposed Gas Pipe	Black	Single line
999 - Pipe Not In Use	220	Single line

PERKHIDMATAN PERUNDING SECARA *LEAD CONSULTANT* (LC) BAGI PROJEK CADANGAN MEMBINA JALAN SAMBUNG DARI PERSIARAN LESTARI PERDANA 5 MELALUI PERSIARAN ARIF DI TAMAN DESAMINIUM SEHINGGA KE PERSIARAN LESTARI PUTRA, BANDAR PUTRA PERMAI, DAERAH PETALING, SELANGOR DARUL EHSAN

UTILITY CORRIDOR SURVEY