DEFINITION OF SERVICES GUIDELINES

Infrastructure Construction / Civil Works

Fédération Internationale des Ingénieurs-Conseils
International Federation of Consulting Engineers
Internationale Vereinigung Beratender Ingenieure
Federación Internacional de Ingenieros Consultores

ISBN 978-2-88432-077-1

FIDIC is the international federation of national Member Associations of consulting engineers.

FIDIC was founded in 1913 by three national associations of consulting engineers within Europe. The objectives of forming the Federation were to promote in common the professional interests of the Member Associations and to disseminate information of interest to their members. Today, FIDIC membership covers some 90 countries from all parts of the globe encompassing most of the private practice consulting engineers.

FIDIC is charged with promoting and implementing the consulting engineering industry's strategic goals on behalf of Member Associations. Its strategic objectives are to: represent world-wide the majority of firms providing technology-based intellectual services for the built and natural environment; assist members with issues relating to business practice; define and actively promote conformance to a code of ethics; enhance the image of consulting engineers as leaders and wealth creators in society; promote the commitment to environmental sustainability; support and promote young professionals as future leaders.

FIDIC arranges seminars, conferences and other events in the furtherance of its goals: maintenance of high ethical and professional standards; exchange of views and information; discussion of problems of mutual concern among Member Associations and representatives of the international financial institutions; and development of the consulting engineering industry in developing countries.

FIDIC members endorse FIDIC's statutes and policy statements and comply with FIDIC's Code of Ethics which calls for professional competence, impartial advice and open and fair competition.

FIDIC, in the furtherance of its goals, publishes international standard forms of contracts for works (Short Form, Construction, Plant and Design Build, EPC/Turnkey) and agreements (for clients, consultants, sub-consultants, joint ventures, and representatives), together with related materials such as standard pre-qualification forms.

FIDIC also publishes business practice documents such as policy statements, position papers, guides, guidelines, training manuals, and training resource kits in the areas of management systems (quality management, risk management, integrity management, environment management, sustainability) and business processes (consultant selection, quality based selection, tendering, procurement, insurance, liability, technology transfer, capacity building).

FIDIC organises an extensive programme of seminars, conferences, capacity building workshops, and training courses.

FIDIC aims to maintain high ethical and professional standards throughout the consulting engineering industry through the exchange of views and information, with discussion of problems of mutual concern among Member Associations and representatives of the multilateral development banks and other international financial institutions.

FIDIC publications and details about training courses and conferences are available from the Secretariat in Geneva, Switzerland. Specific activities are detailed in an annual business plan and the FIDIC website, www.FIDIC.org, gives extensive background information.

Published by
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PREFACE

This is the second Definition of Services Guideline in a series under development to eventually cover all disciplines.

The consulting engineering industry remains largely responsible for the professional planning, design, construction inspection and management of infrastructure needed to meet the world's ever increasing demand for food, water, sanitation, shelter, health services, transportation and energy. Consulting engineers provide, on a daily basis, the solutions that improve the quality of people's lives while preserving our dwindling natural resources.

The work of the professional consulting engineer is as important today as it was a hundred years ago. However, detailed knowledge of the role that these experts play is not as satisfactory as it could be, even among those who directly engage consulting engineers. The more the services consulting engineers provide are understood, the more effective these services will be.

Figure 1 Objective of the DOS Guidelines

FIDIC has engaged the expertise and understanding of an international group of experienced industry practitioners during the preparation of these guidelines to:

a) consolidate the industry's best practice for the definition of consulting engineering services, and

b) establish a consistent basis for scoping, executing and benchmarking these services.

Through these DOS Guidelines, FIDIC will help clients and their consultants match tasks and desired outcomes with skill sets and deliverables to improve effectiveness and value for both parties.

ACKNOWLEDGEMENTS

The original FIDIC Best Practice Guidelines for the Definition of the Scope (DOS) of Services for Buildings (Structural) were prepared by the Definitions of Scope Task Group of the FIDIC Business Practices Committee (BPC). The document for Civil DOS follows the same format and has also been reviewed and refined extensively.

The Task Group for this document comprised Rick Prentice, Canada, Task Force Chair; Andrew Read, New Zealand, Chair of the Business Practice Committee; David DeLizza, USA, Committee Member; and Chris Newcomb, Canada, Committee Member.

1 PREAMBLE

These Guidelines aim to provide a clear template for the scope of a consultant's work through the different phases of a typical commission: design – procurement – construction. This will enable the client and consultant to:

- Clearly define responsibilities from the outset and communicate these to all parties involved in the project
- Define the scope of the consultant's work through the different phases of the project
- Agree, in particular, the level of design services required as this can be an area of considerable variance
- Negotiate appropriate remuneration for the standard of design service required
- Benchmark the services the client receives against best practice standards
- Provide a quality assurance reference for users.
- Provide standardisation and international portability of work phase definition
- Develop a basis for differentiating performance and scope between consultants.

The guidelines also:

- Point the user to FIDIC support documents available to assist in evaluating what level of environmental sustainability should be pursued and which design tools, such as BIM, might be applicable
- Highlight the importance of maintaining business integrity in consulting and project management

Key requirements for defining the scope of a consultant's work are summarized in Appendix A – The Consultant's Brief, which provides a short guide for clients and their consultants that is applicable to all types of projects.

1.1 Introduction

Civil engineering is a broad ranging and important aspect of consulting. There is a component of it on almost every assignment, either at the core of multidiscipline civil infrastructure projects, or in a support capacity on consulting assignments that aren't primarily civil. Many civil infrastructure projects are large and complex, requiring a unique definition of scope to meet specific needs and deliverables.

Examples of civil infrastructure projects are listed below:

- Water Resources & Storm Water Management, including Drainage Collection Systems and Flood Control.
- Municipal Water Supply, Linear Infrastructure including Storm and Wastewater & Infrastructure Rehabilitation
- Wastewater Collection, Treatment & Disposal
- Water & Soil Conservation, Marine Erosion & Protection
- Environmental Impact Assessment and Mitigation
- Water Treatment & Distribution
- Transportation, including Highways, Bridges, Retaining Walls, Pavement, Airports, Ferry Terminals, Rail, Roads and Streets
- Urban Land & Site Development
- Mining & Industrial
- Surveying and Geomatics
- Community Planning & Development
- Geotechnical Site Investigations, Foundations & Earth Structures
- Solid Waste Management

1 PREAMBLE

Table 1 elaborates and, although not exhaustive, indicates the categories for which these DOS guidelines can be utilized:

- Drainage Studies & Surveys
- Irrigation
- Land Drainage
- Urban & Community Development
- Water & Soil Conservation Engineering
- Environmental Assessments
- Groundwater Resources / Hydrogeology
- Erosion & Sediment Control
- Wastewater Collection
- Wastewater Treatment
- Wastewater Disposal
- Water Treatment
- Water Distribution
- Geotechnical Foundations & Earth Structures
- Geotechnical Site Investigations
- Geotechnical Materials Testing
- Tunnelling & Trenches Technologies
- Industrial Site Development and support facilities
- Municipal Infrastructure Rehabilitation
- Municipal Residuals Management
- Municipal Linear Infrastructure
- Marine Outfalls
- Marine Erosion Protection
- Municipal Roads and Streets
- Municipal Storm Water Management
- Municipal Wastewater Management
- Municipal Water Supply
- Mining Site Development and Support Facilities
- Structural other than Buildings (Bridges, bunkers, silos, dams, locks, nuclear tanks & shells, towers, tunnels, reservoirs, conduits, and temporary works)
- Surface Water Resources
- Surveying & Geomatics
- Solid Waste Management
- Transportation Airports
- Transportation Bridges
- Transportation Roads/Streets and Highways
- Transportation Pavement
- Transportation Rail
- Transportation Terminals
- Urban Land Development Engineering

Table 1 – Civil Infrastructure Project Examples

These Guidelines endeavour to set a benchmark for all parties. Careful identification of the client brief and needs, together with advice by consultants to the clients on the most advantageous outcomes, are important ancillary functions that should be linked to these Guidelines. The document does not provide details or checklists for sustainable design or business integrity, both key planks of FIDIC's approach to consultancy. Please refer to the relevant FIDIC Documents for information, guidance and support in these matters. It also does not dwell on the variety of tools, methods and design techniques such as BIM or infrastructure information modelling for civil work, because such tools are related to methodology not scope.

General checklists are included to help define the process for 'civil work' projects. These checklists are not intended to be taken as definitive solutions to the design process and should not be regarded as a replacement for detailed briefs, carefully developed in open consultation between client and service providers.

The intent is that they be tailored to the appropriate level of project complexity and service agreed with the client. Tick boxes have been provided for easy definition of scope. The tick boxes can be used to define the service directly related to the design process. They will be updated from time to time to reflect best industry practice.

1.2 Background

Quality design and design documentation are critical to the success of any project. Civil work is no exception. Facilities today are much more complex in all facets, including form, structure, and function. Elements are much more tightly designed than in the past. This has resulted in a situation where typical details often do not apply to large portions of the project.

The time frame for delivering projects has also reduced significantly in recent years. All stages of the programme have reduced, from the design phase through to the completion of the project, putting increased pressure on all players. Due to increased complexities, there are now more disciplines involved in planning, design and construction. Project success depends on there being a common understanding of the design process. Greater expertise as well as more detailed, frequent and broader transmission of communications is required to help coordinate a team approach to critical design elements and application of expertise during the design process.

Design documents provide decisive ties between all parties in a design and construction project. These guidelines, accessible to a wide audience of civil design engineers, and their professional colleagues, will provide direction for design focus, checklists for the level of documentation appropriate for each project, and a foundation for continual future improvement.

1.3 How To Use The Guidelines

The guidelines can be used to define responsibilities of the various parties throughout the project phases). The level of service provided by a consultant or designer could be curtailed at any of the stages. The parties identifying their process would then use this same framework to carry out the remaining steps in a coordinated manner to achieve an effective design.

The document has appended four separate categories of civil project activity. Input from specialist designers will also need to be effectively coordinated within the design team. Separate guidelines have not been created for these specialists. Appendices C1 to C4 will serve as support documentation for basic technical scope, and the broad category of civil infrastructure as well as two prevalent project types: Development projects and shallow utility project elements, which are likely to be a part of most civil infrastructure development and other projects, have been separated because they may be undertaken by the utility company or other entity than the consulting civil engineer.

Appendix C1 Technical checklists is for the Civil engineering project manager / coordinating consultant to work with the owner and team to essentially define project type and determine level of civil technical, project management and organizational input, and confirm participation in all aspects of civil work for onsite and offsite so there is no scope duplication or gaps. There are about fifteen categories of scope to be reviewed with the client and each has numerous sub-categories. Appendix C1 is intended to be the scope definition support document to establish Civil Engineering Elements.

Appendix C2 Civil Engineering infrastructure covers the numerous project types listed in Table 1 and briefly described in Section 2.2 Civil Infrastructure Project Types.

Appendix C3 has been developed specifically for urban community development civil engineering and Appendix C4 for shallow utilities such as natural gas and underground electrical power, street lighting and communication. Although civil work in nature, these tend to be owned and operated by private companies other than the municipality or government enterprise responsible for the sanitary, storm water and roadway systems.

1.4 The importance of coordination in the design process

The thorough coordination of design documents between disciplines is considered to be the most important issue confronting the consulting engineering industry around the world. These guidelines emphasize the need for a formal process of coordination of the information each discipline provides at the completion of each design phase. They will also serve as a support tool to achieve that.

Sample Coordination Checklists have been developed and assembled to assist the design practitioner. They are generally based on the civil engineer having the role of design coordinator, notwithstanding the fact that this role may be undertaken by the consultant or any party commissioned to do so. It must be emphasised that all design disciplines have a responsibility for design coordination.

The Checklists are generic and not exhaustive. Therefore, design teams are encouraged to engage the project team in a process of regular, transparent and ongoing communications that should result in dynamic checklists to suit the needs of each project.

The need for coordination extends into the Construction Phase, where roles and responsibilities for this work must be clearly defined. This is important because it is a form of risk mitigation for projects. As illustrated in the following figure, there are five formal levels in the hierarchy of controls. Definition of scope as described in this document provides the opportunity to recognize risk and either eliminate it, substitute or develop and implement engineering controls to at least isolate people from the hazard.

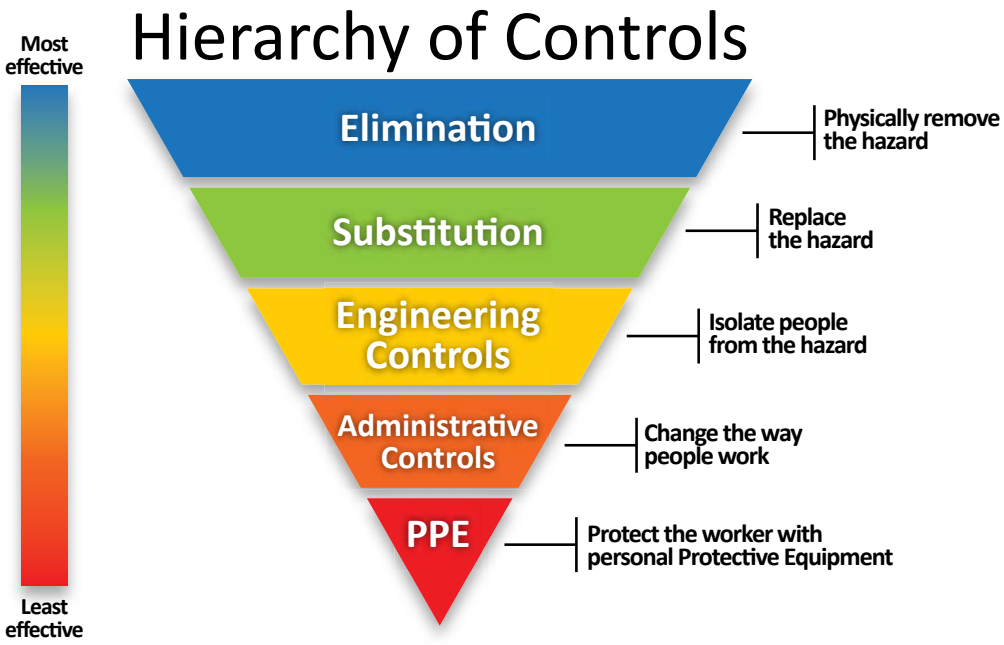

Figure 2 Hierarchy of Controls

1.5 Impact of the Procurement Methodology on Consultant Services

The input of the designers into the construction procurement methodology and the construction itself, are important in the quest for better civil projects. On some complex projects it may be appropriate to engage specialist consultants in the procurement process. See also the FIDIC Procurement Procedures Guide 2011.

The determination of construction contract procurement and conditions of contract, methodology of pricing or tendering, and execution of those contracts, should be defined at an early stage of the design process, so that documentation can be arranged accordingly. There are various project delivery methods, client-contractor-consultant relationships, scope apportionment, risk distribution, and a different role or level of consultancy service that accompanies each.

Common construction industry terminology such as conventional, design-bid-build, construction management, public-private partnership (PPP), request for proposals, call for tenders, alliance contracting and partnering are all relevant in many places around the world, and the methods that this terminology refers to are in common use. Again, this document does not aim to inform the user of the intricacies of these procurement approaches but rather to point out that the client-consultant relationship will vary from method to method, and the impact on scope needs to be established early in the services definition process.

For example, in design-build and PPP situations, the role of the engineer is less typical and may need to be specifically defined in the client-consultant professional services agreement. Consulting engineers may choose the owner's engineer role or agree to work for the contractor. In general, these two roles vary greatly. For the owner on a design build project, the goal is to prepare a Terms of Reference (TOR) so that consulting services are focussed on project definition, conceptual or preliminary design and advisory services.

For the contractor, the detailed design services of a different consulting engineer are fast paced construction detail oriented, with a minimum level of documentation to facilitate construction in accordance with the TOR. In each case, the consulting engineer is loyal to the entity that has engaged them. An overview of the different client type possibilities and corresponding services is provided in the following paragraphs.

Project Delivery Method	Consulting Opportunities	Service Elements
1) Conventional	Client-1: Project owner	• **Project planning,** • **Design brief formulation,** • **Design, cost plan and programme,** • **Contract preparation,** • **Tender documentation,** • **Calling of tenders,** • **Construction supervision, etc.**
2) Design build	Client-1: Project owner	• **Project planning,** • **Formulation of a design brief,** • **Cost plan and programme,** • **Contract preparation,** • **Tender documentation,** • **Calling of tenders,** • **Construction supervision, etc.**
	Client-2: Design build contractor (as designer)	• **Preparation and Defence of Bid Design during the bid phase,** • **Detailed Design and Certification of Construction during the execution phase.**
	Client-3: Design build contractor (as independent quality firm)	• **Certificate of Design,** • **Quantity survey,** • **Engineering site supervision,** • **Contract administration.**
3) Public-Private partnership (PPP)	Client-1: Public body/project sponsor	• **Project planning,** • **Possible delivery method,** • **Formulation of a design brief,** • **Basic design,** • **Cost plan and programme,** • **Contract preparation,** • **Tender documentation,** • **Calling of tenders, etc.**
	Client-2: Project Company / concessionaire	• **Project planning,** • **Possible delivery method,** • **Formulation of a design brief,** • **Design,** • **Cost plan and programme,** • **Contract preparation,** • **Tender documentation,** • **Calling of tenders,** • **Construction supervision, commissioning, operation and maintenance advisory, etc.**
	Client-3: Design and build contractor	• **Preparation and Defence of Bid Design during the bid phase,** • **Detailed Design and Certification of Construction during the execution phase.**
	Client-4: Investor / Lender / Insurer	• **Project evaluation,** • **Technical review of documents/drawings provided by project company,** • **Progress monitoring and evaluation,** • **Project cost and payment checking**

Table 2 – Consultant Scope Variations by Project Delivery Method

Alternate procurement processes will not reduce the civil engineering elements that need to be delivered. Scope elements will likely be distributed differently. Some project delivery methods like construction management or alliancing, may appear to be unique but are for the most part a variation of the three basic methods described above. FIDIC has various guides relating to alternative forms of project delivery.

1.6 How do the guidelines relate to management of the design process?

Design management may be undertaken by the design consultants, client, project manager, contractor or specialist design manager. Because of the varied nature of how project teams are structured, the task of design management is not addressed in these Guidelines. However, the following comments are provided:

- Design management may overlap with some of the design processes listed in the Guidelines, and include the direction of consultants, the chairing and recording of minutes of regular project meetings, administration of the design delivery programme, and managing information flow to and from the client.
- Responsibility for the design management role needs to be confirmed and formalized at the start of the project and the scope of this role either included in the consultant's service agreement or defined separately.

One example of this relates to the site dimensioning and survey. One of the keys to a successful project is good control and "set-out" of all dimensions in the documentation. On some projects the engineer acts as principal consultant, taking responsibility for dimensions. Therefore, in the Schematic Design phase it is necessary to define who is responsible for dimensions.

For more background and guidance on how these Guidelines relate to management of the design process and to agree on definition of scope for projects led by civil, refer as appropriate to two key invaluable FIDIC documents: Quality Based Selection (QBS) and Selection of Consultants. These documents are available in the FIDIC Bookstore online. (Reference Quality Based Consultant Selection Guide, September 2011, and Selection of Consultants, second edition 2013)

1.7 "Value Management" Design Reviews

Value management (VM) reviews at the appropriate stage(s) of the design process may assist in achieving successful projects. However, reviews undertaken too late can be ineffective and adversely impact on programme and costs. The sketch below graphically illustrates the opportunity of early reviews.

Generally VM reviews should be carried out at the end of the Concept and/or Preliminary Design stages, where the design has been coordinated between the design disciplines, and there is a consistent basis for a cost estimate. The necessary revisions that are identified as part of the VM review can then be introduced at the start of the next design phase.

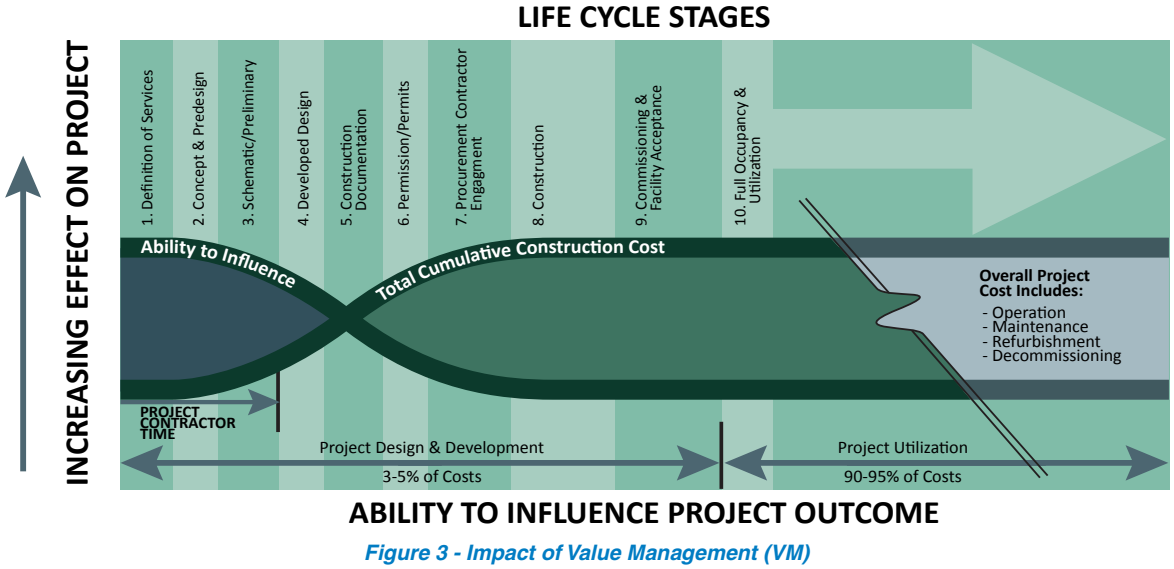

Figure 3 - Impact of Value Management (VM)

1.8 Sustainability Management – environmentally sustainable design

Sustainability and energy efficiency concerns are rapidly becoming commonplace in all areas of construction and design. All consultants, and particularly designers, should ensure that they understand the client's sustainability focus and the statutory requirements. They should then be involved in setting sustainability and energy efficiency targets.

FIDIC is a key promoter of sustainability and supports the professional design consultant in understanding what he or she can do to become a lead advisor to society in facing climate change and turning challenges into opportunities. FIDIC also has well-established guidelines in this area to help avoid climate change and to infrastructure performance in the event of severe events.

Sustainability, which includes environment, economic, water, materials, energy, health and safety, and social priorities, should be a prominent element of any project and an overarching principle under which everything else happens. More background can be found at: http://fidic.org/node/5805. These guidelines are also recommended as an ideal tool for a robust discussion between client and consultant in determining the sustainability priorities for a particular client or community. Additional background can be found at http://fidic.org/other-resources/sustainability/sustainable-infrastructure

1.9 Safety

Considering safety up front during the design process can have a positive impact on the safety of the construction process and on the long term safe use, operation and maintenance of the completed facility. Efficiencies can be gained through fewer injuries and less down time, better communication and coordination, resulting in a more effective and efficient design and building programme. FIDIC Documents are available and should be referenced.

Designers should aim to:

- Identify significant and unusual health and safety hazards relevant to the design, and consider how the facility may be safely built, operated, and maintained;
- Consider the risk from those hazards which may arise as a result of the design;
- Designers should also be aware of the hierarchy of risk control – eliminate, isolate, minimise – that underpins the modern approach to health and safety management. If possible, alter the design to avoid the risk or, where this is not reasonably practicable, follow the remainder of the hierarchy of risk control process.
- Identify, communicate and mitigate potential risk aspects to local community

The contractor controls the means and method of construction and is normally responsible for managing health and safety risks during the construction of a project. All those involved in design and construction, need to be aware of their obligations under local "Health & Safety" legislation.

1.10 Integrity Management

FIDIC has published documents related to integrity management and is a firm believer in the importance of integrity in consulting and construction, and in the procurement of those services. The Guidelines are known as the FIDIC Integrity Management System (FIMS) Part I Policies and Principles and Part II Procedures. "Recognizing that consultants operate in different regulatory environments, ranging from those in countries with rigorous anti-corruption laws, to those in countries that have poor oversight or regulations, FIMS provides a framework of functional criteria or requirements that helps channel energies towards management and mitigation of bribery and corruption risks that may be encountered in related business environments".

2 CIVIL ENGINEERING ELEMENTS AND CIVIL INFRASTRUCTURE PROJECT TYPES

These Best Practice Guidelines aim to provide a reasonable description of elements for the scope of the Civil Engineering Consultant's work in as many situations as possible, either leading or supporting other engineering disciplines through the many aspects and phases of a 'typical' commission.

2.1 Civil Elements

Civil elements found on most projects are critically important to establishing a sound technical scope and may include:

2.1.1 Site investigation – technical and environmental site assessment, site cut fill material balance, geotechnical investigation, capacity of adjacent utilities, susceptibility to flooding, and access.

2.1.2 Site grading – establish site grades to suit the development, neighbouring streets and adjacent features, calculation of earth quantities and assistance in establishing finished floor elevation(s) to facilitate functionality and barrier free access.

2.1.3 Sanitary sewers - evaluate project flow and demand calculations from other disciplines, check zoning and capacity of off-site sewers to receive increased flows from the proposed development, and assess routing options of onsite sanitary sewer connection. Determine elevations and constraints to draining by gravity.

2.1.4 Storm drainage – evaluate flow calculations, check zoning and capacity of storm sewers off site to receive increased flow, assess routing of storm connection. Determine elevations and advise of constraints in draining by gravity. Consider roof drains, onsite/yard drains, and catch basins in access road. Note storm water management needs. Review requirement for low impact development and sustainable design such as LEED BREEAM, and a number of others.

2.1.5 Storm water management – storm water management will often be required to limit peak storm runoff and ensure that the elevations of new and existing infrastructure are above flood levels. A means of storage and/or reuse on site will be required. Calculate predevelopment runoff (natural state) and compare with post development caused by increased imperviousness.

2.1.6 Water supply for domestic use, fire protection and process – check with authorities regarding offsite capacity in mains. Flow and pressure are both important. Offsite hydraulic network analysis may be necessary. New accessible fire hydrants may be required on or offsite. Confirm with Fire Marshall, collaborate with internal fire suppression systems designer, and design adequate turning radii for emergency response vehicles.

2.1.7 Access roads –Traffic entry points to site and physical attributes of access roads including width, embankment, sub-grade preparation, base, asphalt or concrete surface, drainage required for roadway including catch basins and storm water management. Analysis of impacts of additional traffic on adjacent roads and new and existing intersections.

2.1.8 Surface Parking – Receive number of stalls required from architect, evaluate surface treatments, layout, drainage, on-site storm water management, drive aisles, stall size, etc., Engage site electrical consultant for power distribution for block heaters, security and lighting. Ramp entry to underground or multi-level parking structures requires civil input.

2.1.9 Demolition and abandonment of existing utilities and structures is civil. It is generally a civil responsibility to prepare demolition plans and specifications for safe, environmentally friendly and energy sensitive removal and disposal of facilities.

2.1.10 Excavation and Backfill - disposal of contaminated, unsuitable and/or excess material. Materials management plan, compaction requirements, subsurface drainage (free-draining backfill materials, foundation drainage system). Evaluation of economic availability of fill materials, including aggregate, asphalt and concrete.

2.1.11 Temporary Erosion and Sediment Control (ESC) – Temporary ESC is critical during construction. Include complete site analysis in concert with earth moving and prime contractor who control the site and activity, including monitoring during construction

2.1.12 Erosion and Sediment Control - Permanent, designed and constructed for the long term possibly considering low impact development concepts, silt fences in drainage channels, catchbasin protection, straw wattles, and other techniques.

2.1.13 Site Development – Prepare site layout, site entrances, walkways, etc., include effective connection points, avoid entrances at busy corners, incorporate site drainage which may include storm water management facilities, Utility layout to avoid conflict.

2.1.14 Social and Economic Impacts – Public consultation to identify and mitigate impacts on the local population of the new project, including its construction. This element can include seeking means to offer collateral benefits to the neighbours and users of the project.

2.1.15 Value Engineering – In the interests of offering clients the best value for their investment, consultants should offer life-cycle costing, constructability, and creative design alternatives as fundamental services.

2.2 Project Types

Civil engineering expertise is generally applied to a broad range of civil infrastructure and other projects:

2.2.1. Civil Projects for Water Related Infrastructure

Linear Deep Services – trunk sewers, feeder water mains, storm sewer mains, planning documents such as hydraulic network analysis for water systems, neighbourhood design reports for sanitary sewer capacities and storm water management.

Water / Waste Water Treatment Facilities – hydraulics, treatment process, flow channels, inlets, outlets, odour control, deep well construction techniques, flood plain analysis, design for desirable flow characteristics. Develop plant capacity strategies, maximize efficiency of processes and participate in key aspects such as water source development, pumping, valving and reservoirs for recycling and discharge.

Rehabilitation of aging and/or underperforming existing infrastructure in densely populated areas requiring temporary customer connections, traffic diversion and control, trenchless technologies and surface restoration.

Solid Waste Management and treatment utilizing recycling facilities, food waste management and waste collection programmes compatible with long-term sustainability strategies, composting of bio-solids from waste water treatment processes, waste conveyance by pipeline or specialty vehicles, raw material receiving, and special waste and product storage and delivery.

2.2.2. Civil Input for Transportation Projects

Highways and Arterial Roads - modelling and planning, alignment, land acquisition, earth balance, roadbed design, drainage, asphalt, concrete, corridor acquisition, tunnels, interchanges, trip origin and destinations, mudslide and snow avalanche planning and protection.

Transportation access management, surface parking and parking structures, retaining walls, slope and rock stabilisation, lighting, signal, sound wall, signage and paint marking design, and safety engineering

Airports – site and facility development for specialized air transportation, runways and taxiways, high volume passenger pedestrian and vehicle handling, baggage handling, security, signage, maintenance facilities.

Light / Heavy Rail – stations, alignments, foundations, track, drainage, spill containment, overpasses, underpasses, at-grade crossings, passenger access, stations, urban utility and road relocations, lighting, communications, signals, signage and other aspects.

Bridges over waterways, valleys, transportation corridors, and railways need specialist and civil engineering input. In categories such as water resources, flood level calculations, support locations, carrier pipes,

lighting, environmental, approach roadways, and construction techniques that results in safe erection, assembly and implementation.

Marine Infrastructure - Design of ports, ferry terminals and materials handling facilities, including intermodal infrastructure for road and rail.

2.2.3. Civil work for Industrial Projects

Industrial pipelines depend on the type of product being conveyed and pressures being utilized and mostly include: foundations, access roads, drainage, multiple pumping stations, spill containment, road, rail and water crossings, public consultation, and regulatory approvals, all in response to risk assessment and mitigation tactics.

Mining – geotechnical / civil engineering for interpretation, planning, mine design, site development to suit heavy equipment for raw material or ore extraction traffic flows, materials processing, equipment maintenance facilities primarily for rural and remote locations, environmental approvals for tailings, tailings facilities management and design, and waste disposal.

Refineries - Site development for refineries and other industrial purposes, raw material input and treatment, disposal and outflow of environmentally sensitive and potentially hazardous materials. Also include air quality management and emissions controls, site drainage for spill containment, pre-treatment of waste water effluent prior to discharge to municipal systems and access, water supply and arrangement to facilitate effective emergency measures response.

2.2.4 Development Projects

Residential housing infrastructure and utilities in greenfield circumstances yielding multiple single family lots or single multiple family lots, with many infrastructure types, complete with off-site utilities as required. Each residential development project will require access road design, mass transit, storm sewers and storm water management, sanitary sewers, water supply and distribution, power, street lighting, natural gas distribution, and either fibre optics or copper wiring for telecommunications.

Health Care Facilities such as hospital, major clinic or medical research facilities that may have unique isolation requirements, need for air ambulance access, higher water use demands, special waste management and other systems or features related to medical services.

Educational Facilities with their unique requirements and **building** development projects require civil services for support to aspects being dealt with by the architect and other disciplines. Site development is a key component. The level of civil effort required will depend, to some extent, on where the proposed building project is situated. Civil engineering aspects of a building project generally include essential input to the initial site selection study in support of the design team disciplines.

2.3 Civil Complexities

To begin creating a useful definition of services, it is important to understand the elements that are described as civil engineering (section 2.1 above) in relation to the project needs being considered; possibly described in section 2.2. These two descriptions are not all-inclusive. Other major, unique aspects, that deal with complexities, may also demand significant civil input. This may be as straightforward as recognizing that there are three key categories of servicing when it comes to providing infrastructure for a new family dwelling; off-site, on-site and connection. There may be a large component of off-site capacity confirmation required and issues in providing access that would need to be dealt with before site servicing can take place effectively.

This definition of services guideline for civil does not include the scope for any of the architectural or engineering disciplines used in designing internal building systems. Other engineering disciplines, such as mechanical, undertake design of the internal building systems and bring interior connections to the building foundation, usually one meter. Site civil engineering

would be responsible to provide services from the point where they are left at the building to the main off-site services in the nearest public right-of-way.

The civil engineering discipline will often be responsible for coordinating site development requirements of other disciplines. On a building development project, for example, the civil engineer is required to liaise with the architect as well as mechanical, electrical, structural and other disciplines, and provide advice and guidance on aspects described above. Providing civil support for a site development project in a greenfield situation would be different than doing so in a built-up urban area where existing off-site infrastructure may need upsizing, rehabilitation or renewal, just to support the new development. Also, in a rural context, there will likely be a greater project specific need for all civil infrastructure, including deep and shallow services, roads, parking and traffic signals.

A basic civil drawing set may include:

1. Cover Sheet
2. Key Plan
3. Existing Topography and Existing Utilities – Off-site
4. Proposed Utilities – On-site
5. Demolition Plan
6. Excavation And Backfill
7. Utility Layout
8. Grading
9. Surface Improvements – On-site
10. Erosion and Sediment Control
11. Utility Details--Storm, Sanitary, Water
12. Roadway Details
13. Pavement Plan, Line-marking and Signage
14. Power and Street Lighting
15. Communications
16. Natural Gas Supply
17. District Heating

The procurement of professional services could be by fixed-fee, unit rate, or time and materials, depending on the project size, amount of work, timing, schedule, and other factors, and should keep in mind the value of the overall services. Similarly, procurement of the civil works could be construction management, all-included in a fixed-fee overall price. For larger civil requirements, the work could be contracted separately on a unit-rate basis. Civil services may support the architectural team with contract documentation and specification sections.

Many civil projects require specialist design input, often drawn from different consulting practices. The design specialists may include geotechnical, mechanical, electrical, process and others:

1) Planners
2) Geographers
3) Civil Sub-discipline Engineers
   a. Municipal
   b. Environmental
   c. Earthworks
   d. Hydraulic
   e. Structural
   f. Traffic
   g. Transportation
   h. Linear Infrastructure
   i. Bridge
   j. Pavement
4) Communications Specialists
5) Scientists
6) Security & Fire Safety Staff
7) Acoustic / Noise Abatement Engineers
8) Wind Specialists
9) Architects
10) Cost or Economic Evaluation Specialists
11) Public Consultation Specialists
12) Other

Table 3 - Possibilities for Specialist Design Input

Civil Infrastructure projects are complex in all facets, so many elements need to be closely coordinated and tightly designed. There is a need for detailed documentation and many interface issues. In addition to clear scope and definition of services, the quality of design documentation and coordination is crucial to the success of any civil engineering project. Input from specialist designers must be effectively coordinated with the design team.

Separate guidelines have not been created for these specialist consultants, as their work is normally coordinated by one of the Principal design consultants. The Sample Coordination Checklists have been developed on the basis of a project manager having the primary role of design coordination, as this has traditionally been the case for most civil infrastructure projects. However this is not always the case.

3. PHASES IN CIVIL INFRASTRUCTURE DESIGN AND CONSTRUCTION

There are several project delivery methods as previously outlined. The graphic below deals with only one; the phases of consultant services within a conventional design-bid-build civil infrastructure project:

Figure 4 - Civil Infrastructure Construction Phases

3.1 Definition of Services Phase

This phase is about determining the scope of the consultant's work and agreeing to the terms and conditions of the engagement. Scope will vary depending on project delivery method. Selection of the consultant should be quality-based. Quality-Based Selection (QBS) is recommended by FIDIC. This involves a formal or informal Request for Proposal (RFP) process.

In this phase key players (owner, prime, and sub-consultants) agree not only on the project scope but also on the appropriate limits of liability and expectations relating to E&O (Errors and Omissions). This may require information relating to the issues listed below. An experienced and knowledgeable owner/client will often predetermine a number of these items. QBS encourages involvement of the consultant in determining scope which opens the door for professional engineering advice in the earliest stages of project definition. This phase would ideally include:

- Determine Scope of Works (and method by which scope may be varied), purpose, goal and vision of the client.
- Establish Procurement strategy.
- Establish project delivery method.
- Agree on Definition of Services [or brief] (i.e. by using this document) and exclusions and process for scope variation.
- Agree on scope and relevant timing of services to be provided directly by client.
- Discuss with client (and document when possible) expectations and definition of both quality of services and project works.
- Agree and define the sustainability priorities to be employed on the project.
- Agree and define Integrity Management Protocols (IMP).

- Identify sub-consultants if any, and outline scope.
- Determine that consultant team includes all competencies required.
- Agree on Conditions of Engagement – note that The FIDIC White Book is recommended for all consultant engagements. These Guidelines apply to many types and forms of engagement conditions.
- Agree on Limit of Liability (for prime consultant and sub-consultants) and list any liability exclusions (e.g. asbestos, contamination and radiation).
- Define insurance and indemnification necessities.
- List information to be supplied by the client.
- List deliverables to be supplied by the consultant (reports, drawings, specifications, calculations, compliance statements, translations, etc.).
- Agree on programme (or schedule) for services.
- Demand evaluation study (if done in this phase, it would normally be carried out by the client or by separate engagement).
- Agree on fee basis and method of fee variation and payment schedule.
- Outputs: Engagement of consultant(s) / Signed Professional Services Agreement.

3.2. Pre-Design Phase including Land Acquisition

This phase generally needs to be iterative with the process of land acquisition. It is about setting up the parameters for the project and may involve:

- Advice and Consultation.
- Technical Investigation and Analysis.
- Planning - Development and adoption of a Master Plan.
- Legal Boundary Survey.
- Site Evaluation/procurement.
- Topographical Survey.
- Survey of existing facilities.
- Preliminary/desktop Geotechnical Study [or preliminary investigation].
- Environmental Status Assessment.
- Heritage/archaeological Assessment.
- Planning Constraints Evaluation.
- Regulatory Framework Evaluation i.e. reviews of laws, statutes, by-laws and regulations that may impact upon the project. This may include first contact with consent authorities to seek guidance/rulings on technical/planning requirements.
- List of consents and permits that will be required and time frames.
- Agreement with client on appropriate form of project delivery (contractor procurement).
- Preliminary estimates (+/- 30% or higher for complex work).
- Outputs: Reports, schematics, layouts and/or location sketches.

3.3. Schematic / Preliminary Design Phase

Alternative Name *– Concept Phase*

The Schematic / Preliminary Design Phase generally involves the application of a design idea to the practical implementation of the desired capital project. It's is the phase where sufficient design concepts are developed for the client and (sometimes) regulatory authorities. This phase will permit the feasibility of a project, development potential of a site, or the selection of one particular conceptual approach over others for the client to pursue. Also it may be used to define or verify the project brief - see Appendix A - and may often involve testing of different approaches/options.

During this phase, ideas (schemes/ concepts) are developed through open interaction between team members to establish key design elements. It will commonly include further refinement of preferred concept(s) to facilitate testing against inputs from team members such as cost estimates, benefit evaluations and regulatory feedback. It may provide sufficient information for communication of the design concept to a third party for initial financing, marketing or consultation purposes. During this phase, project concepts become firm schemes, where the sizes of spaces and facilities are defined and coordinated between the design disciplines. Resolution of individual details that do not impact on the key elements are normally left for the next phase. It may constitute between 20-35% of the total design effort.

At the end of this phase, the project should be clearly defined. The design is commonly referred to as being frozen at this stage to allow further work to be made to the fundamental concept, without any changes. Regulatory, planning and/ or environmental approvals (as distinct from technical compliance) are typically applied for at the completion of this phase. Note that regulatory approvals refer to applying for consent from the relevant authority – central government, local/ regional government, environmental agency, etc. This may cover use, bulk and location, appearance, environmental effects, traffic assessment, public health assessment, etc. Note that some may consider that Planning Consent Application should be an additional phase.

This phase is likely to focus on the following civil elements:

- Site-specific investigation of geotechnical contamination, etc.
- Evaluation of alternatives.
- Environmental Impact Assessment.
- Preliminary Review of utility supply capacity – power, gas, telecoms, water, waste water – and access road capacity.
- Surface Water Management / drainage.
- Preliminary sizing of primary/key civil elements.
- Description/outline of secondary civil elements.
- Pre-consent Application meetings with the regulatory authorities.
- Review Against Brief.
- Value Engineering Review.
- Preliminary Risk Assessment.
- Estimates on a unit price e.g. square metre rate basis.
- Outputs: Design features report, preliminary drawings, estimates, risk identification report, planning/ environmental consent applications.

3.4 Developed Design Phase

Alternative Name *- Design Development*

This is the phase where the scope of all design components is clearly defined and coordinated. This may involve production of detailed information along with sketch details of all significant components and their interrelationships. This phase is where each technical expert prepares documentation to define the scope of all project elements. Major input is required from all designers on the team. It may constitute between 60-65% of the total design effort.

The completion of this phase is a critical point in a project. Its scope is fully defined. As a result, cost estimates can be prepared on an elemental basis. This part usually provides satisfactory information for the client/user to clearly understand the aesthetics and functionalities of the project as well as its facilities.

On some projects the Developed Design documentation is issued for technical compliance, development consent and/or profit and overhead tender. Coordination between the design disciplines and thorough scope definition is therefore crucial at the end of this stage.

This phase may comprise:

- Analysis/design in all disciplines of primary/key elements.
- Detailed review of utility supply capacity – electricity, gas, telecoms, water, waste water.
- Plans and elevations of primary/key elements.
- Drawings of typical and key details.
- Analysis of generic secondary elements.
- Drawings showing scope/extent of secondary elements.
- Generic elemental specifications.
- Element definition to be covered by proprietary design [design and/or shop drawings by contractor].
- Cross-discipline coordination.
- Review Against Brief.
- Testing against serviceability and ultimate limit state [or overload] requirements.
- Value Engineering Review.
- Detailed-risk assessment.
- Preliminary peer review i.e. if the design is being checked by an independent engineer, then at this point, the following may be reviewed: engineering concept, load/process path, analysis/computer model, etc.
- Highlight and address Health & Safety issues for the future occupants and those who will service and maintain the facility.
- Estimates on a quantity or elemental basis.
- Outputs: Updated design features report 60% drawings, specifications, list of elements where scope has not been fully identified elsewhere in the document, estimates, updated risk identification report, etc.

3.5 Construction Documentation Phase

Alternative Names *- Detailed Design / Working Drawings / Contract Documents*

Detailed Design (Construction Documentation or Working Drawings) usually provides a level of documentation that clearly defines the design, specification and extent of all elements. The design should be comprehensively coordinated with all disciplines. The consultant's documentation should be considered 100% complete. However, the documents produced in this phase may not directly be able to be built from (i.e. "shop drawings" may be required from the contractor).

Changes to anything but detail at this stage are very disruptive and expensive, and often result in further problems as, by now, the project has become very complex and it is hard to identify all the ramifications of changes. Detailed Design documentation is most commonly used to obtain a tender for the construction of the works and is usually used to establish regulatory compliance (with codes, standards, bylaws, statutes, etc.).

Civil will focus on the following elements for this phase:

- Final analysis/design of all elements in all disciplines,.
- Plans, elevations and details of all elements, sufficient to fully define the scope, quality and the design intent.
- Full trade specifications.
- Performance-based specifications for elements to be covered by proprietary design [or design by contractor].
- Full cross-discipline coordination.
- Review Against Brief.
- Testing against serviceability and ultimate limit state [or overload] requirements.
- Final peer review.
- Update risk assessment.
- Highlight significant and unusual health & safety issues that are likely to affect construction sequence.
- Pre-tender estimates.
- Estimate of construction programme.
- Outputs: Updated design features report, Construction drawings and specifications, updated estimates, updated risk identification report, technical documentation for tenders, documentation for building consent [or permit] plus calculations where appropriate, certificates of design compliance [or Producer Statements, Design Certificates] including Peer Review reports.

3.6 Development Permit Application Phase

This phase involves obtaining regulatory approvals, typically from local or central government agencies for technical compliance issues. These technical approvals may be in the form of development permits. Regulatory planning /environmental consent/ permit is normally applied for at the completion of phase 3 – Schematic / Preliminary Design Phase. In some jurisdictions, permission may be sought at the completion of phase 4 – Developed Design. This may still be too early for some types of projects and will depend on the extent of compliance documentation necessary.

This phase may include:

- Preparation of development permit forms and payment of fees.
- Submission of drawings, specifications, calculations and design certificates.
- Review of the design by a peer reviewer.
- Response to queries raised by the regulatory authority or by a peer reviewer.
- Modification to the design or documentation at the request of the regulatory authority to incorporate consent conditions.
- Outputs: Development approval.

3.7 Construction Procurement Phase

Alternative Names *- Contract Award / Bidding / Tendering / Negotiation*

There are a number of alternative delivery methods as described in Section 1.5. This discussion on procurement is based on conventional design-bid-build, which is one of these methods. For this approach to procurement, this phase involves preparation of contractual bidding or tendering documents and the calling and letting of contracts for the construction works. In projects where alternative procurement strategies are utilized (Design-Build, Public-Private Partnerships, Alliancing and other variants) the Prime Contractor may have been engaged earlier in the process. In any event, detailed trade pricing is likely to occur at this stage.

Often, this phase may include:

- Partitioning the works to discrete contract packages.
- Preparation of contract documents (Conditions of Tendering, Conditions of Contract, Preliminary and General, etc.).
- Specification of insurance conditions, programme (construction schedule), quality plan requirements, Health & Safety plan requirements, etc.
- Specification of Integrity Management Protocols.
- Pre-qualify tenderers/bidders.
- Calling of tenders.
- Evaluation of tenders, including design alternatives.
- Negotiation with preferred bidder(s).
- Recommendation of tender acceptance to client.
- Signing of contract documents.
- Outputs: Construction contract with successful general and sub-contractors.

3.8 Construction Phase

Alternative Names *- Contract Administration (CA) / Construction Monitoring*

During this phase the physical works are built and the consultant is involved in some form of quality-control monitoring or construction observation (inspection). It is critical to define the level of monitoring and to have tied it to the original definition of services of the consultant. There are also ongoing design activities during this phase.

Construction Design is where the requirements defined in Detailed Design documents are integrated with changes that may occur during the tender and contract process, and with construction requirements such as site conditions, proprietary and performance-based design elements, erection requirements and fabrication of shop drawings to create the ones that can be directly built. (Notice that shop drawings are produced by product suppliers during this stage). Temporary Works Design is that required to safely construct the project; falsework, formwork, shoring, hoardings, crane foundations, traffic detours and the like.

Note that during this phase, documentation is usually prepared by the contractor or under the contractor's control.

Work by the civil consultant may include:

- Construction monitoring/review of quality and consistency with design.
- Review of shop drawings and proprietary design elements.
- Layout survey or confirmation of contractor layout.
- Quantity assessment.
- Issuing of instructions, variations, change orders.
- Design of changes required by unexpected conditions.
- Valuation/negotiation of variations.
- Certification for payment
- Preparation of defects lists.
- Issuance of completion certificate.

3.9 Post-Construction Phase

Alternative Names *- Commissioning / Defects Liability / Project Control*

This phase involves completion of the contract and verification of quality and scope. Work for the consultant is likely to involve:

- Settlement of final account.
- Monitoring of the commissioning of plant and equipment [this may also occur during phase 8].
- Installation of client's Fixtures, Fittings and Equipment [FF&E]
- Collection and review of as-built drawings Plan of Record (POR) and Operation & Maintenance manuals.
- Collection of all verification documentation, quality checklists, proprietary design certification, construction producer statements, and preparation of operations and maintenance manuals.
- Collection and verification of warrantees and guarantees.
- Obtaining compliance certification [Statutory Completion or Licence to Occupy temporary and permanent] from regulatory authority.
- Ongoing maintenance period inspections.
- Final inspection and sign-off.
- Post services evaluation and feedback by client (optional).

Defining the consultant's scope of work

A guide for consultants and clients that is applicable to all types of projects

Introduction

The consultant's brief is a vital document since it defines the relationship between the client and the consultant in terms of the scope of work, deliverables, the programme, and the contractual relationship.

All consultant commissions, even those that do not involve a formal selection process, require a well-defined brief.

A brief can be used for the calling of competitive proposals. However, selection on price alone will not result in the lowest overall cost for a project.

A well prepared brief will enable the consultant to submit relevant information on a range of attributes (skills, relevant experience, personnel, insurance coverage, etc.) that will then allow the client to make a selection based on quality (see FIDIC Guidelines for the Selection of Consultants, 2nd Edition, 2012).

Scope of Services

In broad terms, defining the scope of professional services can happen in one of two ways.

In the first form, a client may have a problem, or at least may require a solution, the nature of which is unknown or is not defined at the time a consultant is engaged. In this situation, a client and consultant need to work together to define the scope and likely deliverables before fees are agreed. In this scenario, it is highly unlikely that any attempt to select solely on the basis of the fees for service would result in an optimum solution.

In the second form, the client is usually able to define quite precisely the scope, services and deliverables required from a consultant. In this situation, if the client can identify a consultant or a number of consultants who will meet the requirements and expectations, then it may be appropriate to include price as a selection attribute, provided that the scope of services and deliverables is completely defined. An informed client will appreciate that full service includes consideration of alternatives and a refined design to achieve the optimum solution.

Agreement

Following both of the forms of scope definition, the scope of services becomes an integral part of an agreement for services, which forms the contract between the client and the consultant (see FIDIC Client/Consultant Model Services Agreement, 4th Edition, 2006).

Key Requirements

The key requirements for the consultant's brief are:

Client details

- Client contact details
- Nature of client's business
- Vision/objectives that the client has for the project
- Tenant/end user details (if different from the client)
- Requirements for stakeholder consultation
- Confidentiality requirements

Project details

- Description of project
- Details of location, size and estimated cost or budget
- Required outcomes
- Levels of quality required
- Clearly defined scope of services for each consultant

Project team makeup

- List of team members, e.g. client, project manager, other
- consultants, sub-consultants, contractors
- Organisation chart
- Responsibility matrix
- Likely method of contractor procurement

Technical brief

- The relevant standards to be used
- Particular requirements for the loading, services, future flexibility, etc.

- Particular requirements for durability and plant processes
- Requirements for internal/external peer reviews
- Particular or unusual site conditions (environmental sustainability or project sustainability management) requirements
- Relevant statutory requirements (if not obvious)
- Requirement to reuse existing plant/ equipment/materials

Project staging and programme

- Breakdown of design stages:
  - Schematic Design Phase (Phase 3)
  - Developed Design Phase (Phase 4)
  - Construction Documentation Phase (Phase 5)
  - Construction Phase (Phase 8)
- Timetable for delivery of documentation
- Expected timing/programme of physical works
- Requirements for early occupation, partial completion, etc.
- Impact on existing operations/occupants
- Programme for consents and approvals

Attendance and reporting by the consultant

- Requirements for attendance at, and reporting to, meetings (project control, design coordination, construction/site, etc.)
- Requirements for attendance at workshops (design review, risk assessment, project procedures, value management, etc.)

Deliverables

- Comprehensive lists of deliverables (reports, drawings, specification, etc.)
- List to include frequency/number of issues and number of sets per issue
- Guidelines/benchmarks for the quality of project documentation
- Use of Electronic Deliverables

Construction monitoring

- Level/intensity of monitoring required (see Appendix D)

Project cost control (budget)

- Method by which cost control will be measured and managed
- Value Management processes
- Relative priority of capital expenditure versus operating cost
- Cost reporting procedures

Information to be supplied by the client

- Pre-project studies
- Survey/title information
- Geotechnical information
- Existing drawings

Client approval process

- Process by which client will progressively approve the design during the documentation stages

Scope/design variation

- Process by which variations in the consultant's scope of work will be handled in terms of fee and programme

Risk management

- How risks will be identified
- How risk will be managed and mitigated

Quality assurance

- Level of quality assurance required
- Requirement for a project-specific quality plan

Contractual issues

- Conditions of engagement to be used
- Sub-consultant relationships
- Level of professional indemnity insurance to be carried by the consultant
- Limit of liability to be carried by consultant
- Level of public liability insurance to be carried by the consultant
- Basis of dispute resolution

Health and safety issues

- Detail of site access and health and safety issues during the design stages of the project
- Required role/involvement by the consultant in health and safety during the construction stages

Integrity management

- Required protocols for integrity management

Selection criteria

- Quality Based Selection
- Direct negotiation
- Other

Levels of service

- Full/partial
- Quality/quantity of documentation

Fees

- Fee basis
  - Time and disbursement
  - Percentage of total construction value
  - Percentage of discipline value
  - Lump sum
- Definitions of Normal and Additional Services
- Basis for project/fee variations

Appendix B
DETAILED TASK DESCRIPTIONS (CIVIL CONSTRUCTION)

The supplement FIDIC Definition of Services Guidelines (Civil Construction) – Detailed Task Descriptions to these guidelines gives sample checklists of task descriptions for the four phases of building construction that involve design, namely:

3 Schematic Design Phase

4 Developed Design Phase

5 Construction Documentation Phase

8 Construction Phase

The checklists are intended to cover the list of civil engineering covered in section 1.1 of the guidelines and briefly described in section 2 as civil elements and project types including drainage and sanitary systems, water supply and distribution, water and wastewater treatment, solid waste management facilities, highways and arterial roads, airport facilities, rail, bridges, marine facilities, mining, refining and residential, industrial and other development. They will also serve as a basis for scope definition for rehabilitation or renewal of civil infrastructure or aspects not specifically mentioned.

Task descriptions for the phases that do not involve design are generic across all consultant disciplines. Sample checklists for these generic tasks are not given in the supplement.

Task descriptions for the key consultant disciplines in other types of projects (building engineering / structural, HVAC, electrical, industrial process plant) will be published separately.

While the nine project phases defined in the FIDIC Definition of Services Guidelines (Civil Construction) reflect international consultation, these sample checklists should only be considered as examples. Moreover, there may be variations to these services supplied in different countries, as well as variable definitions for these services, so the sample checklists of task descriptions are best seen as guidelines.

As examples, reproduced in this appendix are the Detailed Task Descriptions for Civil Engineering.

Specialty consultancy services that may be added to the project team, as a requisite for any given project may include:

- BMS
- Disabled Access
- ELV
- Fire and Life Safety Engineering
- Infrastructure onsite/offsite
- Landscape Architecture
- Irrigation Design
- Design certification and submission for Estidama / LEED / LID
- Master Planning
- Specifications
- Submissions to Authorities for Approvals
- Signage and Way-finding
- Telecommunications
- Food Service and Waste management
- Trash disposal process
- Healthcare
- Education
- Residential
- Recreational Play Systems
- Commercial Sports
- Renderings
- Economic Feasibility / market study Enhanced Commissioning Services
- Geotechnical investigation
- Materials testing
- Specialty Lighting Design
- Structural Parking Design
- Transportation (Horizontal / Vertical)
- Water Feature Design
- Stormwater modelling
- Traffic Impact Study
- Wind Tunnel Testing
- Snow Study
- Cost Estimating / Quantity Surveyor
- Environmental Impact Assessment
- Environmental Impact Study and Reporting
- Sewage Treatment Plant Design
- Site Survey
- Establish survey control monuments
- Temporary Utility connections, roads and facilities
- Design of District Cooling Plant
- Design of Stormwater management Facility
- Design of Fuel Farms
- Design of MV Substations, electrical HV
- Design, works activities in relation to re-routing of existing utilities

Civil Engineering

Phase 3: Schematic Design Phase (Civil Construction)

Design Process

Inputs

- ☐ Client brief, including budget & time schedule
- ☐ Survey information, including legal & physical Site
- ☐ Development sketch concept drawings,
- ☐ Offsite Utility Drawings
- ☐ Preliminary fire engineering (where appropriate)
- ☐ Preliminary wind studies (where appropriate)
- ☐ Environmental Site Assessment
- ☐ Preliminary geotechnical report, including preliminary design parameters
- ☐ Design programme
- ☐ Site constraints, including planning & access issues
- ☐ Conditions of consents
- ☐ Existing building & site information/records

Design

- ☐ Civil type & form
- ☐ Site Development
- ☐ Drainage
- ☐ Water
- ☐ Sanitary
- ☐ Shallow Utilities
- ☐ Access
- ☐ Storm water management
- ☐ Identify options Special project features concepts, e.g., large canopies
- ☐ Design co-ordination of key elements with other disciplines
- ☐ Identify responsibility for control & set-out of dimensions Identify responsibility for design co-ordination & management if prime
- ☐ Evaluate & select systems
- ☐ Define site layout
- ☐ Preliminary analysis to establish civil elements
- ☐ Define key serviceability criteria
- ☐ Design co-ordination of key elements with other disciplines
- ☐ Preliminary assessment of existing features

Deliverables

Drawings

- ☐ Sketch drawings
- ☐ Drawings outline primary features
- ☐ Proposed primary layout
- ☐ Preliminary sizes of primary aspects
- ☐ Preliminary site layout
- ☐ Indicative utility and roadway alignments
- ☐ Outline system for secondary elements
- ☐ Outline durability/coating systems
- ☐ Indicative surface finish for exposed concrete
- ☐ Critical details that may have significant cost implication
- ☐ Standard utility details
- ☐ Proposed upgrading of existing utilities (where appropriate)

Specifications

- ☐ Outline specification of key Civil elements
- ☐ Specifications details on drawings where appropriate

Reports

- ☐ Sketch drawings where necessary within report
- ☐ Civil concept design brief, including flows and access, projected demands and proposed capacities
- ☐ Key risks & assumptions
- ☐ Concept report outlines key issues & options considered
- ☐ Civil Design brief, including fire protection
- ☐ Design features (options) report, with recommended option to take to developed design
- ☐ Outline of elements not covered in preliminary design drawings or design features report
- ☐ Define assumed construction methodology governing design (where appropriate)
- ☐ Highlight ‘significant’ buildability issues & significant/unusual health & safety issues arising from the development

DETAILED TASK DESCRIPTIONS (CIVIL CONSTRUCTION)

Design Process	Deliverables
☐ Address durability requirements ☐ Preliminary input to the process specialist ☐ Identify high risk and/or cost elements in development ☐ Define key elements of offsite upgrades (if required) ☐ Define design parameters for utility systems ☐ Consider buildability of proposed system, including significant health & safety issues during construction ☐ For unusual aspects or existing structures where stability may be affected by the sequence of construction, consider significant health & safety issues ☐ Assess maintenance requirements of civil components, including health & safety issues ☐ Coordinate relevant design information between disciplines	

Comments

1 The Schematic Phase is often split into concept & preliminary phases on larger projects.

2 Costing on a historical unit rate basis or preliminary elemental basis.

3 Agree roles & responsibilities for all participants in project procurement process.

4 Discuss with the client requirements and programme for client information and approvals.

5 Establish project procedures for communication, document issue, approvals, etc. Note that larger projects may have a project procedure manual or web-based document control systems.

6 Establish a design programme for key milestones & deliverables including design team coordination.

7 Where appropriate carry out discussion with a 'preferred' contractor on construction methodology.

8 Consultation with the local authority is recommended on key aspects of the design that may be considered outside the 'Acceptable Solution' & unusual/contentious issues.

9 Contribute to Value Management session, if required.

10 Agree the scale of drawing deliverables for each phase according to project type.

Civil Engineering

Phase 4: Developed Design Phase (Civil Construction)

Design Process

Inputs

- ☐ Client approval of preliminary design, including ratification of the consultant's Opinion of Probable Cost
- ☐ Final Geotechnical report
- ☐ Final site servicing and access report

Design

- ☐ Determine sizes of all primary and most secondary civil elements
- ☐ Agree serviceability performance criteria with client (e.g., fire, access, storm runoff, management, etc.)
- ☐ Civil input to architectural elements
- ☐ Confirm infrastructure capacity /demand with the design team
- ☐ Incorporate likely construction requirements (where appropriate), including consideration of significant/unusual health & safety issues arising from the project
- ☐ Key demand support details for facility maintenance systems
- ☐ Coordinate relevant information with other disciplines

Deliverables

Drawings

- ☐ Drawings (1:1000 layout plans) defining all infrastructure alignment, size
- ☐ Layout & size of civil facilities
- ☐ Generic details for typical primary elements such as manholes, hydrants, road cross sections, sampling manholes, catchbasins,
- ☐ Typical connection details for primary elements
- ☐ Define elements covered by proprietary design
- ☐ Erosion and sediment control

Specifications

- ☐ Preliminary technical specifications, including durability & serviceability issues

Reports

- ☐ Updated design brief, including emergency access and fire protection requirements s
- ☐ Updated design features report, including serviceability & maintenance issues
- ☐ Define key risks & assumptions, including environmental aspects, /buildability and significant/unusual health & safety issues.
- ☐ List elements where the scope has not been fully defined elsewhere in the documents

Comments

1. Separate primary elements from secondary for clarity.
2. Opinion of probable costs at can be produced at this stage using quantities and historical unit rates analysis on an elemental basis, or by the Quantity Surveyor utilizing typical details.
3. Design and documentation may be sufficiently developed to lodge for regulatory approvals.
4. Developed Design generally provides the level of documentation to define the scope of all civil elements.
5. Where appropriate, carry out discussions with a 'preferred' contractor on construction methodology.

Civil Engineering

Phase 5: Construction Documentation Phase (Civil Construction)

Design Process

Inputs

- ☐ Client approval of completed developed design, including ratification of the Opinion of Probable Cost.

Design

- ☐ Complete the design & coordination of all civil elements.
- ☐ Address serviceability & maintenance criteria in the design highlight significant/unusual health & safety risks arising that were identified through the design process (if any)
- ☐ Add more tasks.

Deliverables

Drawings

- ☐ Drawings defining all civil elements, including plans, elevations, sections, & details, with cross referencing.
- ☐ Define all details by either defining local standards or typical details or referencing to industry standard details or specifying forces for a propriety connection system.
- ☐ Construction sequences & positions of control/ construction joints.

Specifications

- ☐ Detailed specifications for each civil aspect
- ☐ Performance specifications where appropriate, including performance criteria for proprietary design.
- ☐ Method statements for critical construction processes governing design.
- ☐ Define deliverables from contractor, e.g., producer statements, shop drawings & testing requirements.
- ☐ Define required tolerances if different to industry standards.

Comments

1 Detailed design generally provides a level of documentation to clearly define the design of all civil elements. Design details should be coordinated with other disciplines. However, the documents produced in this phase may not directly be able to be 'built' from.

2 Reference the architectural plans or other disciplines for other dimensions (unless agreed otherwise).

3 Design and documentation of secondary architectural elements are generally shown on the architect's drawings; the structural engineer will have input where requested by the architect.

4 The contractor is responsible for managing environmental health & safety risks during the construction phase.

5 Civil drawings should dimension the main site layout reference points, critical elements, and other aspects and features that are the direct responsibility of the civil engineer.

6 The level of design detail shown on drawings in this phase varies in the industry between regions, project & procurement methodology. A major factor is the capability of the local building industry to efficiently provide the construction phase documentation. The level of details outlined in these guidelines is appropriate where the contractor has the skills & resources to efficiently provide construction phase documentation. For some projects, a greater level of detailing may need to be produced by the design consultant. The appropriate level of detailing required should be agreed with the client prior to the commencement of the project.

7 Define in appropriate specification the significant/unusual environmental, health & safety risks arising from the structure identified in the design.

Civil Engineering

Phase 8: Construction Phase (Civil Construction)

Design Process

Inputs

- ☐ Construction programme & methodology, including craneage or access restrictions
- ☐ Client approved ('For Construction') drawings & specifications
- ☐ Design & performance requirements for propriety elements

Design

- ☐ Design of proprietary systems, e.g. sewage lift station
- ☐ Detailed co-ordination required with other disciplines, site conditions, proprietary elements, erection requirements and shop details
- ☐ Prepare construction sequence and temporary erection
- ☐ Liaise with the design and construction teams to coordinate any revisions to the detailed design

Deliverables

General

- ☐ Drawings (including shop drawings and rebar schedules) on an elemental basis, including position, dimension, materials and finish of all details, including relevant material specifications (steel, timber, precast, etc.)
- ☐ Site management plans and/or method statements defining the construction sequencing and temporary erection requirements
- ☐ Details of the temporary civil works
- ☐ Revision of drawings, details and specifications arising from contract agreement, building consent and construction requirements

Materials

For non-standard conditions the following is to be provided where applicable:

- ☐ Pipe Materials
- ☐ Bedding sand
- ☐ Backfill
- ☐ Granular base course
- ☐ Asphalt Concrete type and Mix design Concrete specification for roads, walks, curb and gutter.
- ☐ Embedded items & penetrations defined and located
- ☐ Proprietary system layout drawings and connection details

Review

- ☐ Review shop drawings, technical specification and construction method statement submissions for consistency with detailed design

Comments

1. Before the commencement of construction drawings the following needs to be in place: contract details confirmed and tender accepted; sub-contract agreements confirmed; and owner-supplied components available.
2. Deliverables contain sufficient details for elements to be manufactured/constructed without reference to other documents, i.e., "the details have co-ordinated the relevant design information across all disciplines and can be built from".
3. Final determination of some dimensions may depend on the proprietary design of elements. Such proprietary design may need to be advanced to enable dimensions to be completed.
4. The contractor is responsible for managing the environmental health and safety risks during the construction phase and must prepare an Erosion and sediment control plan and report to the authorities on a regular basis.

Civil Engineering PM / Co-Ordinating Consultant

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
GENERAL CATEGORIES						
Define project type and level of civil technical, project management and organizational input						
▪ Confirm project management organizational aspects						
Confirm participation in all civil for onsite and offsite (i.e. no scope duplication or gaps)						
▪ Onsite: Storm Drainage						
▪ Site Investigation						
▪ Site Grading						
▪ Sanitary Sewers						
▪ Storm Water Management						
▪ Water Supply and Distribution						
▪ Access Roads						
▪ Surface Parking						
▪ Demolition						
▪ Excavation and Backfill						
▪ Erosion and Sediment Control – Interim						
▪ Erosion and Sediment Control – Permanent						
▪ Site Development						
▪ Civil additional support to Architecture, Landscape Architecture						
▪ Canvas all disciplines for servicing requirements						
SUB-CATEGORIES						
Site investigation –site assessment						
▪ Environmental						
▪ site cut fill material balance						
▪ geotechnical investigation						
▪ Record of capacity of adjacent utilities						
▪ susceptibility to flooding						

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ access						
▪ Civil aspects of development permit application						
Site grading plan and setup						
▪ General layout and major overflow routes						
▪ Establish site grades to suit the development						
▪ Neighbouring streets						
▪ Adjacent features						
▪ Calculation of earth quantities						
▪ Assistance to architect to establish finished floor elevation(s)						
▪ Facilitate functionality						
▪ Fine tune for barrier free access.						
Offsite						
▪ Neighborhood planning and zoning						
▪ Environmental Impact Assessment						
▪ Major overland flow routes						
▪ Access						
▪ Traffic Impact						
▪ Sanitary Capacity						
▪ Storm Drainage Capacity						
▪ Water Distribution Hydraulic Network						
Sanitary Sewers						
▪ Check for possibility of conflict with other utilities, resolve to facilitate gravity flow						
▪ Check services risers are correct size required and vertically align plan to plan						
Storm Drainage - Storm water management required to limit peak storm runoff						
▪ Obtain and review local hydrology charts / data package						
▪ Confirm and understand relevant design storms						

Appendix C1
TECHNICAL SCOPE

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ Undertake flow calculations and pipe sizing, inverts, slopes						
▪ Calculate predevelopment runoff -natural state						
▪ Compare with post development caused by increased imperviousness						
▪ Check for conflicts / potential conflicts						
▪ Advise relevant team members of constraints to gravity flow						
▪ Confirm offsite capacity						
▪ Consider also roof drains, onsite yard drains, catch basins, wick drains, trench drains,						
▪ Confirm size and fall of gutters, downpipes and overflows with hydraulics engineer.						
▪ Establish peak flow constraint requirement for retaining or detaining runoff for reuse						
▪ Calculate volume of storage required and						
▪ Explore on-site storage volume and physical options						
▪ LID – low impact development and LEED sustainability potential						
▪ Explore potential for water reuse on site for irrigation, flushing						
▪ Check services risers are correct size required and vertically align plan to plan.						
Water supply for domestic use, fire protection and/or process						
▪ Check with authorities to confirm offsite capacity in the mains						
▪ Flow rates – hydrant flow test						
▪ Pressure						
▪ Looping possibilities / need - two connection points						
▪ Offsite hydraulic network analysis may be necessary						
▪ Accessible hydrants will need to be considered						
▪ New hydrants may be required on site						
▪ Confirm with Fire Marshall and/or fire protection jurisdiction						
▪ Collaborate with internal fire suppression systems designers						
▪ Design adequate turning radii for fire trucks and other emergency response vehicles						

TECHNICAL SCOPE

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
Access						
▪ Traffic entry points						
▪ Physical attributes of access roads						
▪ Decide width, minimum turning radii, geometric standards						
▪ Structure – embankment, subgrade prep, base, asphalt or concrete surface						
▪ Drainage required for roadway, catchbasin locations, capacity						
▪ Meet the requirements of the Building Code and disabled persons access.						
Surface Parking						
▪ Number of stalls from building regulatory						
▪ Evaluate desired surface treatments						
▪ Layout, drive aisles, dimensions, stall size						
▪ Drainage						
▪ On-site stormwater management						
▪ Engage site electrical for power distribution to block heaters, lighting, security,						
▪ For parking under buildings assess access locations especially for multi-level						
▪ Structures						
Demolition						
▪ Abandonment of existing utilities						
▪ Structures						
▪ Prepare demolition plans						
▪ Specifications						
▪ Safety						
▪ Environmentally friendly						
▪ Energy sensitive removal						
▪ Removal and disposal or reuse of facilities.						
▪ Documentation of appropriate disposal						

Appendix C1
TECHNICAL SCOPE

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
Excavation and backfill						
▪ Materials management plan						
▪ Recognition and disposal of contaminated material						
▪ Unsuitable and/or excess material						
▪ Compaction requirements						
▪ Geotechnical and materials testing expertise						
▪ Submit test results and sieve analyses						
▪ Subsurface drainage (free-draining backfill materials)						
▪ Foundation drainage system						
▪ Suitable equipment						
▪ Dirt tracking cleanup plan						
Erosion and Sediment Control – Temporary						
▪ Complete site analysis						
▪ Earth moving						
▪ Prime contractor						
▪ ESC is critical during construction						
▪ Silt fences						
▪ Drainage channels						
▪ Catchbasin protection						
▪ Straw wattles						
Erosion and Sediment Control – Permanent						
▪ Long term						
▪ LID - low impact development concepts						
▪ Designed						
▪ As Constructed						
▪ Other techniques.						

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
Site Development						
▪ Check ground levels and contours						
▪ Prepare preliminary site layout						
▪ Confirm site entrances / avoid vehicular entrances at busy corners						
▪ Pedestrian access and walkways						
▪ Cost effective connection points						
▪ Research local requirements and incorporate site drainage						
▪ Locate and size storm water management facilities						
▪ Preliminary and final utility layout to avoid conflict between utilities						
▪ Co-ordinate information is correctly shown on elevation and sections						
▪ Provide buildings set-out datum and final fixed floor elevations						
▪ Provide references on plans to external						
▪ Locate all in-ground services, power poles, footpaths, existing buildings and existing features that need to be shown on site and floor plans						
COORDINATION						
▪ Verify owner / client vision and intent						
▪ Check regulatory requirements for constraining ordinances						
▪ Check site limits and zoning						
▪ Civil support documents for Traffic impact, Watershed plan, Drainage basins						
▪ Verify Limits of existing and new work and detail clearly						
▪ Verify all Civil elements and dimensions against available drawings						
▪ Compare site elevations to boundary elevations and plans. Check all features						
▪ Confirm facility floor plate and proposed finish floor elevation						
▪ Verify that all details are referenced on plans include elevations and details						
▪ Verify site access point relative to site functionality and adjacent roadways						

Appendix C1
TECHNICAL SCOPE

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ Verify site development specialists including role of Landscape Architect, site lighting						
▪ Verify emergency vehicle access and adequate fire flows						
▪ Check all dimensions						
▪ Check detail of plan enlargements against small scale plans						
▪ Where plan of site is on more than one drawing, check match of all meeting lines.						
▪ Ensure documents meet building consent requirements of Territorial Authority						
SUSTAINABILITY CERTIFICATION PROCESS						
▪ Review general concept, objectives and benefits of sustainability certification						
▪ Assess current project						
▪ Establish sustainability target						
▪ Agree scope and fee with client (design, implementation, certification, post)						
▪ Develop sustainability checklist and action items						
▪ Engage all parties in action list						
▪ Appoint internal design process sustainability coordinator						
▪ Energy modelling						
▪ Submission of documents to authorities						
▪ Coordination with third party sustainability consultant						
BUILDING / SITE / DISCIPLINE INTERFACE						
▪ Verify site dimensions against survey						
▪ Verify easements are indicated						
▪ Verify that proposed and existing grades are shown and keyed; check against survey						
▪ Verify items of demolition, clearing limits and grading limits						
▪ Verify that new site construction does not interfere with existing features to remain including poles, pole guys, manholes, drain inlets and valve boxes.						
▪ Cross check new utilities for interference; verify inverts, and clearances at crossings						
▪ Verify that underground utilities are shown on ground section drawings.						

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ Confirm plan and profile dimensions match scaled dimensions for utility structures						
▪ Verify that indicated falls match invert levels and distances						
▪ Verify hydrant and utility pole locations						
▪ Verify elevation finished grades of manhole rims, valve boxes, and other access						
▪ Confirm location, size, access and other details of substation, vault rooms, or other provision for power supply						
▪ Verify underground external wiring for building lighting is shown on site drawings						
▪ Coordinate communications and data provision with telecom providers						
▪ Confirm location of incoming services ducts (power/communications). Co-ordinate entry heights/bending radius of ducts						
▪ Check perimeter dimensions and offset from grid line against architectural						
▪ Verify that all depressed or raised slabs and penetrations are shown						
▪ Verify all slab profiles; check architectural and civil						
▪ Check location of roof drains against hydraulics (for interior drains)						
▪ Check location of roof drains against architectural (for external drains)						
▪ Check details identified as 'typical' are in fact typical, note major exceptions						
▪ Check for missing or incomplete drawing notes.						
▪ Confirm that any notes referenced as 'see other disciplines' have been covered by the other disciplines drawings						
▪ Confirm size and location of all new utilities connections to existing services						
▪ Confirm plumbing fixture, supply and drain locations match site services locations						
▪ Confirm storm drainage and internal storage locations and details against architectural						
▪ Check perimeter foundation drainage against architectural						
▪ Confirm supply size of any fixtures requiring special volume supply						
▪ Confirm all access, pressure, flow, hydrant locations and other conditions of Fire Marshall approval are met by the building and fire systems design.						

Appendix C1
TECHNICAL SCOPE

Confirm Technical Scope	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ Check for missing or incomplete drawing notes						
▪ Confirm calculations for gutter sizes; check roof drains, box gutters for overflows						
ENHANCED COMMISSIONING COORDINATION SERVICES						
▪ Engage third party commissioning agent						
TYPICAL REQUIREMENTS FOR ALL STAGES I.E. THE PRIME CONSULTANT RESPONSIBLE FOR						
▪ Coordination of drawings and design documents						
▪ Review for completeness and accuracy						
▪ Review for applicable codes, ordinances, regulations, laws and statutes						
▪ Coordinate services by design consultants with those of specialists engaged						
▪ Consult with client and owner, research applicable design criteria						
▪ Attendance at project meetings and communicate with design team						
▪ During concept design phase consider alternatives (Materials, equipment, etc.)						
▪ Conduct coordination meetings with client, incorporate results						
▪ Obtain written approval before moving on to next design stage						
SUSTAINABILITY CERTIFICATION PROCESS						
▪ Review general concept, objectives and benefits of sustainability certification						
▪ Assess current project						
▪ Establish sustainability target						
▪ Agree scope and fee with client (design, implementation, certification, post)						
▪ Develop sustainability checklist and action items						
▪ Engage all parties in action list						
▪ Appoint internal design process sustainability coordinator						
▪ Energy modelling						
▪ Submission of documents to authorities						
▪ Coordination with third party sustainability consultant						

Engineering Coordination

Specification	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
Contract terms needing owner/client input (type of contract, insurances, communications, authorities, payment terms, performance security, schedule, quality assurance, law and languages, confidentiality, claims, safety, performance certificate, value engineering, variation procedure, provisional sums, schedule of payments, turnover of completed project).						
▪ Confirm procurement strategy - conventional Unit Price, Lump Sum or Alternative Delivery Method (PPP, Design Build,)						
▪ Determine form of Conditions of Contract (CoC) or obtain copy of client preferred Conditions of Contract						
▪ Develop Preliminaries section; check contract and disciplines for compatibility						
▪ Review project file/ client preference and determine Special Conditions						
▪ Confirm whether Quantity Surveyor will provide Schedule of Quantities						
▪ Circulate CoC and Preliminaries to Client/Quantity Surveyor/Project Manager for review						
▪ Confirm specification format and style						
▪ Review progress drawings and compile draft list of all specification sections and subsections required						
▪ Confirm specification sections titles provide outline specification						
▪ Obtain and co-ordinate architect's and discipline engineer's specification sections, review and format						
▪ Request list of all 'builders work' items for all other consultants						
▪ Determine requirement for performance specifications; agree on method of performance testing, whether prime cost sum is appropriate, and amount						
▪ Prepare list of standards needed for reference; obtain those not readily available						
▪ Provide specification data request list to co-ordinate with other team members						
▪ Confirm completion schedule for specification sections and related drawing groups						
▪ Develop suggested list of alternatives with Client						
▪ Review drawings as completed, deleting proprietary names (Note: Generally the specification should reference proprietary names not the drawings)						
▪ Confirm specification of any required staging of construction; check against preliminary construction schedule.						
▪ Check schedule of finishes, material and equipment against specification indexes; confirm all finishes, material and equipment are included.						

Appendix C1
TECHNICAL SCOPE

Specification	(Included in scope)	Schematic	Developed	Detailed	Construction	Commentary
▪ Confirm that final issue of drawings matches specified Schedule of Drawings						
▪ Verify all specification cross-referencing.						
▪ Eliminate all references as 'by others'; determine and note responsible party						
▪ Check all specification references to drawings ("as indicated", "as shown") and verify they are so indicated, and that drawing references to specifications are covered						
▪ Check major equipment listings against drawings						
▪ Confirm schedule of monetary provisions						
▪ Obtain client agreement on contingency sum allowances and expenditure authority						

Phase 3: Schematic Design

Design Process	Deliverables

Inputs

- ☐ Client brief and budget
- ☐ Sketch concept drawings (eg. Facilities, Features and locations)
- ☐ Project time schedule
- ☐ Design time schedule
- ☐ Infra-structure reports, e.g. Water flow tests
- ☐ Assess supply and discharge utility requirements
- ☐ Document technical scope
- ☐ Liaise with Local Authorities

Design

- ☐ Review of client requirements
- ☐ Establish design criteria for hydraulic services
- ☐ Develop preliminary load profiles
- ☐ Develop system and/or feature concepts and identify all special requirements
- ☐ Develop functional services brief - including definition of services
- ☐ Review with applicable Authority for Codes and Standards
- ☐ Confirm contacts with Local Authorities and utility companies
- ☐ Review concepts for significant and unusual health & safety risks relevant to the design
- ☐ Confirm plant and facility circumstance and space / location requirements
- ☐ Develop services route requirements, both horizontal and vertical, and space co-ordination with other trades
- ☐ Define interface requirements with other services
- ☐ Review Preliminary Design for any health & safety risks the design may present during construction and maintenance

Drawings

- ☐ Sketch drawings (may comprise «marked-up» architectural drawings) including preliminary plant room requirements and services routes

Reports

- ☐ Concept services brief - to establish available system concepts and a broad report investigating available options and recommendations, and definition of system requirements and key assumptions
- ☐ Design standards to be used

Drawings

- ☐ Schematic drawings outlining services concepts
- ☐ Layout drawings locating facilities, risers, and primary services routes
- ☐ Preliminary plant room layouts

Specifications

- ☐ Outline services specifications
- ☐ Preliminary equipment schedules for major plant

Reports

- ☐ Utility services reports
- ☐ Design report including key design criteria, proposed system concepts and features
- ☐ Preliminary equipment weights
- ☐ Preliminary Building Services Interface Matrix
- ☐ Highlight “significant and unusual” buildability and health & safety issues.

Comments

1. To ascertain client brief and to review/consider applicable options.
2. Agree roles and responsibilities
3. Limited or no co-ordination completed at this stage.
4. Cost estimates at this stage generally cannot be on a full elemental basis, as final distribution is not well defined.
5. Systems could be priced by vendors at this stage but unlikely to get like for like comparison.

Phase 4: Developed Design

Design Process	Deliverables

Inputs

- ☐ Client approval of preliminary services design and budgetary implications
- ☐ Client approved architectural, structural and other services preliminary design
- ☐ Final Specialty Reports

Design

- ☐ Services and facility load calculations
- ☐ Major plant and services routes co-ordinated with architecture, structure and trades
- ☐ Climate implications
- ☐ Depth, Material and other selections
- ☐ Incorporate requirements of relevant specialty reports
- ☐ Develop and expand the services concepts, selection of facilities, review of plant room and services space requirements, including sizing of pipe work
- ☐ Identify utility connections
- ☐ Verify health & safety issues have been addressed in the design.

Drawings

- ☐ Single line layouts
- ☐ As per documented technical scope
- ☐ Major concepts and layouts with sections as necessary
- ☐ Decide on Drawing List: - e.g.
  - Cover Sheet
  - Key Plan
  - Existing Topo / Utilities Offsite
  - Proposed Utilities Onsite
  - Demolition Plan
  - Excavation and Backfill
  - Utility Layout
  - Grading Plan
  - Surface Improvements – Onsite
  - Erosion and Sediment Control
  - Utility Details – Storm, Sanitary & Water
  - Roadway Details
  - Pavement Plan – Line marking and Signage
  - Power & Street lighting
  - Communications
  - Natural Gas Distribution
  - District Heating

Specifications

- ☐ Technical specifications Table of Contents
- ☐ Preliminary technical specifications
- ☐ Specifications Front End Equipment schedules.

Reports

- ☐ Updated design features report including options selected
- ☐ Facility Services Interface Matrix
- ☐ Highlight buildability and any health & safety issues
- ☐ Specialist input preliminary reports
- ☐ Cost estimates as opinion of probable costs.

Comments

1. Cost estimates at this stage can be produced by Quantity Surveyor on elemental basis, with secondary elements estimated on typical details.
2. Developed Design generally provides the minimum level of documentation to clearly define the scope of all hydraulic, site, facility, offsite and and other elements.

Phase 5: Documentation Phase

Design Process	Deliverables

Inputs

- ☐ Client approval of developed design and budgetary implications
- ☐ Client approved architectural, structural and other services developed designs

Design

- ☐ Detailed system design including equipment, facilities and pipework
- ☐ Co-ordination in principle with Structure, Architecture and other Building Services
- ☐ Finalise utility supplies and capacities for discharge for both onsite and offsite
- ☐ Detailed layouts of development
- ☐ Highlight health & safety risks that were identified through the design process.

Drawings

- ☐ Completed schematic and layout drawings defining services requirements including plans, elevations, sections
- ☐ Detailed layouts for services
- ☐ Plant and facility layouts including detailed sections
- ☐ As per established drawing list

Specifications

- ☐ Contract elements
- ☐ Detailed specifications
- ☐ Detailed equipment schedules

Reports

- ☐ Status Report.

Comments

1. Detailed design generally provides a level of documentation to clearly define the design of services.
2. Design details should be co ordinated with other disciplines. However, the documents produced in this phase may not directly be able to be “built” from.
3. Co-ordination: In zones identified with appropriate clearance from structure and other services; major penetrations identified; detailed co-ordination of critical areas.
4. Define in the specification any health & safety risks that were identified in the design.

Phase 8: Construction

Design Process	Deliverables

Inputs

- ☐ For construction design phase, drawings for architectural, structural and other services
- ☐ Construction time schedule.

Design

- ☐ Production of larger scale detailed shop drawings including seismic details
- ☐ Co-ordination of all services, facility structure and architecture
- ☐ Equipment selections and technical submissions
- ☐ Facility system programming
- ☐ Detailed layouts of facilities outside battery limits.

Drawings

- ☐ Revise detailed design documentation to incorporate buildability changes agreed with contractor if they impact on the design intent
- ☐ Equipment submissions as defined in Detailed Design
- ☐ Detailed layouts of plant rooms
- ☐ Fabrication details of pipework, etc.
- ☐ Pipe work support and joint detailing. Seismic bracing.

Documentation and Review

- ☐ Review shop/fabrication and layout drawings for compliance with design
- ☐ Review equipment submission
- ☐ Drawings for record purposes
- ☐ Operation and maintenance manual submission
- ☐ Warranty and construction completion documentation
- ☐ File documentation with local jurisdiction
- ☐ Maintenance period monitoring
- ☐ Final acceptance by owner.

Comments

1. Normally prepared by the services sub-contractor to enable fabrication of the services design.
2. Deliverables contain sufficient details for elements to be manufactured/constructed without reference to other documents, i.e. “the details have co-ordinated the relevant design information across all disciplines and can be built from”.
3. Equipment ordered.
4. At completion of design record drawings, manuals and equipment details produced to indicate final installed systems.
5. The contractor is responsible for managing health & safety risks during construction phase.

Phase 3: Schematic Design

Design Process	Deliverables

Inputs

- ☐ Client brief, including budget and time schedule
- ☐ Client advice in respect to structure of design process
- ☐ Data Collection including:
  - Topographical survey
  - Existing structures and services
  - Certificate of Title
  - Other legal information
  - Geotechnical information
  - Environmental Site Assessment
  - Engineering reports on adjacent infrastructure
  - As-built measure of existing structures where additions or alterations are involved
  - Engineering reports on existing structures
  - District Plan Rules and Objectives including any existing Resource Consent
  - Other Design Constraints
- ☐ Confirmed site topographical, geotech and legal surveys
- ☐ Confirmed District Plan Analysis and Development Rules
- ☐ Concept civil and structural engineering constraints
- ☐ Concept services engineering and infrastructural constraints
- ☐ Concept fire engineering
- ☐ Concept environmental studies
- ☐ Concept acoustic advice
- ☐ Project time schedule

Tasks

- ☐ Attend regular design phase meetings with relevant parties
- ☐ Inspect site and prepare site analysis.
- ☐ Prepare Schedule of Accommodation. Agree with Client. Distribute
- ☐ Prepare Document Register
- ☐ Inspect the site and prepare site analysis diagrams

- ☐ Agreed Design Brief and Schedule of
- ☐ Accommodation
- ☐ Report on existing facilities and engineering systems if applicable
- ☐ Options Studies Report
- ☐ Conceptual drawings including:
  - Overall site plan
  - Sketches
  - Sections (indicative, sufficient to illustrate overall concept.)
- ☐ Model
- ☐ Preliminary Cost Estimate (prepared by QS)
- ☐ Concept Schedule of Materials and Finishes

Specifications

- ☐ Preliminary Schedule of internal and external character

Reports

- ☐ Updated Design Brief, Schedule of Accommodation and Project time schedule
- ☐ Schedule of Areas (Net and Gross as applicable)
- ☐ Design features (options) report (with recommended option to take to Developed Design)
- ☐ Outline of elements not covered in Preliminary Design
- ☐ Define assumed construction methodology governing design
- ☐ Highlight “significant” or unusual buildability and Health & Safety issues
- ☐ Highlight “special” project risks
- ☐ Report on Façade options and Weathering issues.

Design Process	Deliverables

- ☐ Discuss and agree with client the additional separate or sub-consultants that are to be retained and by whom i.e. Geotechnical Consultant, Surveyor, Planning Consultant, Civil, Structural, Fire, Services and Acoustic Engineers; Quantity Surveyors, Interior Designer, Landscape Architect, Specialised Project Management Services, Health and Safety Consultant, Others
- ☐ Select and recommend to client appointment of other consultants or sub-consultants: confirm fees
- ☐ Identify responsibility for dimensional control
- ☐ Identify responsibility for design coordination
- ☐ Identify responsibility for design management
- ☐ Investigate District Plan requirements, analyse, review with client
- ☐ Prepare formal / functional diagrams, develop viable options, review with Client
- ☐ Analyse Brief against design constraints
- ☐ Prepare Concept Design
- ☐ Study siting options and climatic influences; develop massing models; evaluate relationships to site context
- ☐ Test massing options against preferred functional arrangement and brief; review with client. Select model
- ☐ Evaluate provisional concepts for accommodation of systems with Structural Engineer and Building Services Engineer
- ☐ Evaluate provisional concepts for accommodation of parking and traffic requirements
- ☐ Obtain architecture concept drawing
- ☐ Prepare Feasibility Report
- ☐ Prepare concept schedule of internal and external
- ☐ materials and finishes, confirm with client, distribute to QS
- ☐ Check barrier free access requirements
- ☐ Check concept against planning and survey requirements
- ☐ Review concepts for significant health & safety risks relevant to the design
- ☐ Review scheme with Regulatory Authority planners

CIVIL DEVELOPMENT

Design Process	Deliverables

- ☐ Liaise with QS to prepare Concept Design cost estimate or take civil approach
- ☐ Check Concept Design for conformity with fire and egress requirements
- ☐ Establish provisional beam depths, duct crossovers and floor-to-floor heights
- ☐ Establish energy conservation design criteria
- ☐ Prepare sustainability/Energy Study
- ☐ Determine if environmental studies are required. If so, prepare and submit
- ☐ Coordinate all design information between disciplines
- ☐ Attend regular design phase meetings with relevant parties
- ☐ Revise Preliminary Design brief from Concept Design including all up to date information; confirm with client
- ☐ Update Document Register
- ☐ Develop list of questions affecting Preliminary Design pertinent to each external discipline, circulate
- ☐ Review Preliminary Design for significant or unusual Health & Safety Risks the design may present during construction and maintenance
- ☐ Prepare Preliminary Design work time schedule
- ☐ Review Town Planning Analysis and implications
- ☐ Establish primary reference grids and dimensions
- ☐ Evaluate provisional concepts for accommodation of services systems with engineer
- ☐ Revise Schedule of internal & external materials and finishes; evaluate lifecycle durability and maintenance implications; confirm with client & submit to QS
- ☐ Confirm compliance with disabled access requirements
- ☐ Confirm compliance with Sanitary Facilities Code
- ☐ Confirm compliance with Development Rules
- ☐ Confirm revisions; request updated Cost Plan from QS
- ☐ Prepare Preliminary Design drawings.

CIVIL DEVELOPMENT

Design Process	Deliverables
☐ Determine if specific town planning studies are required, prepare and submit ☐ Review with Town Planner and Territorial Authority personnel for advice/comment ☐ Review Design with client's marketing/real estate advisors, including plan for presentation materials ☐ Coordinate all design information between disciplines.	

Comments

1. Confirm Conditions of Engagement at outset of commission.
2. Note that the preparation of Brief is not part of Consultant's Standard Service.
3. Agree roles and responsibilities for all participants in building procurement process particularly responsibility for obtaining Resource Consents.
4. Agree with client the requirements and programme for client information and approvals.
5. Costing may be only on square metre rate basis – QS should provide Concept Cost Plan to accompany deliverables.
6. Concept and Preliminary Design phases may be combined.
7. The approved design may be submitted for a PIM at this stage to identify Resource Consent issues and to obtain existing conditions/services information.
8. Agree the scale of drawing deliverables for each phase according to project type.
9. Dimensioning and coordination is often the responsibility of the architect but this will vary with commission.
10. Advise Client on the advantages of maintaining consultant advice at every stage, and the risks incurred where this is not commissioned.
11. If a Partial Service is commissioned, confirm whether the Deliverables for the commissioned phase are affected.
12. Confirm with the client whether Design Management Services are included in the Design commission, or whether another party will manage the design process.
13. It may be necessary to obtain from the Services Engineer a schedule of notional requirements.
14. Refer to separate Coordination Checklist documents.
15. Consultation with TA is recommended on key aspects of the design that may be considered outside the "Acceptable Solution" regime, and unusual/contentious issues.
16. Cost estimates at this stage generally cannot be on a full elemental basis, as secondary elements are not well defined, but ensure independent professional cost advice is provided to the Client.
17. Contribution to Value Management sessions may be required.
18. Preliminary Design may provide a level of documentation appropriate for a Resource Consent application for less complex projects.
19. Review preliminary report and effect on site civil aspects.

Phase 4: Developed Design

Design Process

Inputs

- ☐ Client approval of Schematic Design
- ☐ Client approval of Schematic Cost Plan
- ☐ Client approval of Feasibility Report
- ☐ Reviewed and revised Preliminary Design
- ☐ District Plan Analysis
- ☐ Preliminary civil / structural engineering
- ☐ Preliminary services engineering and infrastructural constraints
- ☐ Preliminary fire engineering
- ☐ Preliminary environmental studies
- ☐ Preliminary acoustic advice
- ☐ Preliminary Drawing Register
- ☐ Current project programme

Tasks

- ☐ Attend regular design phase meetings with relevant parties
- ☐ Update Developed Design brief; confirm with Client. Distribute
- ☐ Update Document Register
- ☐ Review each sub-consultant's and other consultant's schematics to civil, verify match
- ☐ Verify that all questions from the Preliminary Design brief relating to engineering disciplines have been resolved
- ☐ Verify significant or unusual Health & Safety issues have been addressed in the design
- ☐ Confirm any revisions to Preliminary Cost Plan
- ☐ Confirm primary reference grids, Datum and dimensions
- ☐ Check preliminary internal and external Finishes Schedule; revise if necessary. Distribute
- ☐ Prepare Civil Developed Design drawings incorporating amendments into plans, elevations and sections. Distribute
- ☐ Confirm acceptability of access to fireman's lift and fire control panel
- ☐ Confirm that sanitary fixture count meets statutory requirements
- ☐ Establish location and provisional size of electrical sub-station, if required; consult power supply authority

Deliverables

Drawings

- ☐ Overall site plan including parking/ landscaping
- ☐ Sketches of critical and typical details
- ☐ Typical reflected ceiling plans

Specifications

- ☐ Developed Schedule of internal and external Materials and Finishes

Reports

- ☐ Updated Civil Design Brief Programme
- ☐ Updated design features (options) report (with recommended option to take to Detailed Design), including serviceability issues
- ☐ Outline of elements not covered in Developed Design
- ☐ Define assumed construction methodology governing design
- ☐ Highlight significant or unusual buildability and Health & Safety issues
- ☐ Highlight "special" project risks

CIVIL DEVELOPMENT

Design Process	Deliverables
☐ Confirm all service utility entry points, sizes, and requirements ☐ Confirm compliance with all Development Rules ☐ Review all plans elevations and sections, prepare details of typical construction ☐ Submit Developed Design to QS for review of cost plan ☐ Review and revise project programme ☐ Coordinate all design information between disciplines.	

Comments

1. Cost estimates at this stage can be produced by Quantity Surveyor on elemental basis, with secondary elements estimated on typical details
2. Developed Design generally provides the minimum level of documentation to clearly define the scope of all architectural elements.
3. Developed Design generally provides the minimum level of documentation appropriate for a Resource Consent application for complex projects
4. Refer to separate Coordination Checklist documents.

Phase 5: Construction Documentation

Design Process	Deliverables

Inputs

- ☐ Client approval of Developed Design
- ☐ Client approval of Developed Cost Plan and Feasibility Analysis
- ☐ Reviewed District Plan Analysis
- ☐ Review and revise Developed Design
- ☐ Developed structural engineering
- ☐ Developed services engineering
- ☐ Developed fire engineering
- ☐ Developed environmental studies
- ☐ Developed acoustic advice
- ☐ Current project programme

Tasks

- ☐ Attend regular design phase meetings with relevant parties
- ☐ Co-ordinate and check each sub-consultant and other consultants' design and drawings with the architectural drawings at regular intervals
- ☐ Update Document Register
- ☐ Confirm project drawing, CAD, Website and communication standards
- ☐ Consider buildability constraints and implications
- ☐ Highlight significant or unusual Health and Safety risks that were identified in the design process
- ☐ Confirm and respond to revisions to Cost Plan
- ☐ Review all plans elevations and sections, prepare details of typical and atypical construction
- ☐ Review tolerances established for all surfaces and materials, co-ordinate with specification
- ☐ Fully dimension all elements and Datum
- ☐ Prepare Detailed Design drawings
- ☐ Determine form of Conditions of Contract and incorporate into specification
- ☐ Obtain Client agreement on contingency sum allowances
- ☐ Coordinate all design information between disciplines as per separate co-ordination checklist
- ☐ Review provisions for PABX with Telecom and Client's real estate advisers

Drawings

Full set of drawings as per Drawing Register including:

- ☐ Cover Sheet
- ☐ Key Plan
- ☐ Overall site plan including datum, boundary definition and orientation associated earthworks, landscaping and carparking, inground and overhead services, drainage and all statutory legal title information
- ☐ Existing topography existing utilities - offsite
- ☐ Proposed utilities - onsite
- ☐ Demolition plan
- ☐ Excavation and backfill
- ☐ Utility layout
- ☐ Surface improvements on site
- ☐ Erosion and sediment control
- ☐ Utility details-storm, sanitary, water
- ☐ Roadway details
- ☐ Power and street lighting
- ☐ Communications
- ☐ Natural gas supply
- ☐ Electrical / lighting

Schedules:

- ☐ Schedule of manhole inverts, sizes and connection points

Specifications:

- ☐ Civil Specification including Preliminaries and all trade sections
- ☐ Performance Specifications for any works involving constructor design.

Design Process	Deliverables
☐ Review and confirm security system provisions with Client and responsible engineer ☐ Review and confirm communications and Data provisions with client and responsible engineer ☐ Review and confirm cleaning, refuse and waste paper removal system provisions with client and responsible engineer ☐ Confirm if energy management system is to be employed; establish brief ☐ Confirm details and compliance of Thermal Envelope including glazing with Code Requirements and/or Mechanical Design with relevant consultants ☐ Submit drawings to QS for final adjustment of Cost Plan ☐ Analyse tenders and report recommendations to client ☐ Advise Client of maintenance and durability responsibilities ☐ Obtain client approval and sign off for completed drawings and specification	

Comments

1. It is important to understand the method by which a construction contract is to be procured as this will inevitably impact on the format of the documentation produced and the design quality of the construction achieved. It is also advantageous to the achieved design quality to have input into the Prospective Contractors / Tender List. Consequently, in the Detailed Design Phase, or any phase in which it is intended to procure a tender, the Design Consultants need to:
    - Determine method of Construction Contract Procurement.
    - Determine form of Conditions of Construction Contract.
    - Prepare contract documents for client and contractor's signatures.
    - Review and prepare documentation for tender with client, including insurance details, method of tender, bond, liquidated damages and tender protocols (where required).
    - Review tenders for compliance with tender documents and respond to technical options offered.
2. Where appropriate carry out discussion with a "preferred" contractor on construction methodology.
3. Design may be sufficient to lodge for Development Permit Building Consent part way through this process.
4. Detailed Design generally provides a level of documentation that clearly defines all architectural elements. Design details should be coordinated with other disciplines. However, the documents produced in this phase may not be able to be directly built from.
5. Identify in the Specification the significant or unusual Health & Safety risks that were identified in the design.

Phase 8: Construction

Design Process	Deliverables

Inputs

- ☐ Client approval of Detailed Design incorporating changes resulting from Contract Agreement process
- ☐ Building Consent Issues register
- ☐ Construction programme and sequencing
- ☐ Contract Documents defined in sufficient detail for sub-trades to produce fabrication documents
- ☐ Heavy equipment access restrictions defined

Tasks

- ☐ Attend regular design phase meetings with relevant parties
- ☐ Update Document Register
- ☐ Prepare Construction Design drawings incorporating changes agreed as a result of tender process and negotiations
- ☐ Site safety programme issued to all parties
- ☐ Issue Shop Drawings to consultants for review
- ☐ Coordinate interface between trades and receive, review and coordinate detailed 'shop drawings'
- ☐ Review Performance specifications.

General

- ☐ Review or supply of technical specifications for contractor designed items or alternative designs
- ☐ Revisions of drawings, details and specifications as required by Contract Agreement Process
- ☐ Revisions of drawings, details and specifications as required by Building Consent Process
- ☐ Revisions of drawings, details and specifications as required by construction process

Shop Drawings

- ☐ Production of construction/fabrication/shop drawings for selected items
- ☐ Review of construction/fabrication/shop drawings for selected items.

Comments

1. Construction Design is perceived as separate from Construction Phase Observation/Monitoring or Contract Administration services
2. At conclusion of Construction Design, it should be possible to construct the works without further recourse to the design consultant for design information
3. Construction Phase Services need to be defined in the Engagement Agreement
4. Refer to separate Coordination Checklist documents
5. The Site Safety Management Plan prepared by Contractor should be circulated to all parties
6. The supply of supplementary information as required during the construction process occurs in the Construction Phase
7. Refer to the relevant discipline guidelines for engineering Shop Drawing requirements.

Appendix C4
CIVIL COORDINATED SHALLOW UTILITIES ENGINEERING

Applies to external power distribution, street / site lighting, electrical systems including: Data/Communications, Security, CCTV, MATV, natural gas distribution,

Phase 3: Schematic Design

Design Process	Deliverables

Inputs

- ☐ Client brief and budget
- ☐ Project time schedule
- ☐ Site survey information
- ☐ Project delivery methodology
- ☐ Client approval of concept services design, including confirmation of systems to be included, and budgetary implications
- ☐ Network/ utility provider requirements/ constraints
- ☐ Client approved and calculated site layouts
- ☐ Design time schedule

Design

- ☐ Confirmation of which services are required
- ☐ Identification of areas of coverage
- ☐ Review of client requirements including reliability and redundancy
- ☐ Establish design criteria and develop functional services brief
- ☐ Establish contacts with communication network providers
- ☐ Risk assessments
- ☐ Develop services route requirements, both horizontal and vertical
- ☐ Define interface requirements with other services
- ☐ Develop system architecture
- ☐ Identification of equipment requirements to provide required coverage/functionality
- ☐ Confirm spatial requirements for central and distributed equipment rooms
- ☐ Confirm methods of final distribution to outlets (trunking, floor boxes etc.)
- ☐ Identify specific power requirements (UPS, generator supplies)
- ☐ Identification of specific earthing and surge protection requirements
- ☐ Operational descriptions
- ☐ Review preliminary design for significant and unusual health & safety risks the design may present during construction and maintenance.

Drawings

- ☐ Sketch drawings (may comprise «marked-up» architectural drawings), including preliminary equipment room and riser requirements, service entry points and services routes, including general areas of coverage
- ☐ Single line diagram showing site system architecture
- ☐ for each service and interconnections with indicative capacities for each node
- ☐ Layouts drawings indicating coverage and indicating connection locations, risers and primary service routes

Specifications

- ☐ Outline Specifications
- ☐ Preliminary equipment schedules

Reports:

- ☐ Concept services brief - to establish available system concepts and a broad report investigating available options and recommendations, and definition of system requirements and key assumptions including system types
- ☐ Design Standards to be used
- ☐ Design features (options) report, with preferred options agreed/defined where possible, to take to developed design
- ☐ Preliminary electrical equipment heat loads
- ☐ Highlight “significant and unusual” buildability and health & safety issues.

Appendix C4

CIVIL COORDINATED SHALLOW UTILITIES ENGINEERING

Applies to external power distribution, street / site lighting, electrical systems including: Data/Communications, Security, CCTV, MATV, natural gas distribution,

Phase 3: Schematic Design

Comments

1. To ascertain client brief and to review/consider applicable options. Project may benefit if civil coordinates design of shallow utilities as described as long as appropriate expertise is engaged and participating.
2. Agree roles and responsibilities
3. Tendering at this stage unlikely to result in “like-for-like” bids.
4. No co-ordination completed at this stage.
5. Costing only on per point basis. Cost estimates at this stage generally cannot be on a full elemental basis, as final distribution is not well defined.
6. Where applicable discuss options with preferred vendor.
7. Systems could be priced by vendors at this stage but unlikely to get like-for-like comparison.

Appendix C4
CIVIL COORDINATED SHALLOW UTILITIES ENGINEERING

Applies to external power distribution, street / site lighting, electrical systems including: Data/Communications, Security, CCTV, MATV, natural gas distribution,

Phase 4: Developed Design

Design Process	Deliverables

Inputs

- ☐ Client approval of preliminary design and budgetary implications
- ☐ Client approved architectural, structural, site and other services preliminary designs

Design

- ☐ Co-ordination of spatial requirements, including access for installation and maintenance, with other trades
- ☐ Identification of specific locations for devices (cameras, card readers etc.)
- ☐ Identification of primary cabling routes and cabling methodology to all final outlet locations
- ☐ Confirmation of network provider connection details
- ☐ Verify significant and unusual health & safety issues have been addressed in the design.

Drawings

- ☐ Single line diagram for each system showing the entire network with cables and major equipment selected, including connections to external networks
- ☐ Updated layout drawings indicating equipment room locations, risers and service routes, including cabling methodology to final outlets (skirting, trunking etc.)
- ☐ Layouts indicating locations of devices and major consolidation points

Specifications

- ☐ Preliminary technical specifications
- ☐ Equipment schedules

Reports

- ☐ Finalised design features (options) report, including options selected
- ☐ Highlight “significant and unusual” buildability and health & safety issues.

Comments

1. Cost estimates at this stage can be produced by Quantity Surveyor on elemental basis, with final elements estimated on typical details.
2. Developed Design generally provides the minimum level of documentation to clearly define the scope of all elements.

Appendix C4

CIVIL COORDINATED SHALLOW UTILITIES ENGINEERING

Applies to external power distribution, street / site lighting, electrical systems including: Data/Communications, Security, CCTV, MATV, natural gas distribution,

Phase 5: Construction Documentation

Design Process	Deliverables

Inputs

- ☐ Client approval of the developed design and budgetary implications
- ☐ Final architectural (including furniture), structural and other services layouts

Design

- ☐ Match site and building details, connection points
- ☐ Generic duct bank selections
- ☐ Final layouts to devices co-ordinated with architecture/furniture and other services
- ☐ Detailed power & grounding requirements identification
- ☐ Detailed routes
- ☐ Interface details with other trades
- ☐ Highlight «significant and unusual» health & safety risks that were identified through the design process.

Drawings

- ☐ Completed single line diagram showing all equipment, cables and consolidation points
- ☐ Layouts drawings indicating all field devices, switching cubicles, transformers, vaults, manholes, lamp standards, duct sizes, configurations and orientations
- ☐ Equipment room outline layouts

Specifications

- ☐ Detailed technical specifications
- ☐ Finalised equipment schedules with generic equipment selections

Reports

- ☐ Power and earthing requirements provided for implementation by Electrical Engineer.
- ☐ Itemisation of works to be done by others.

Comments

1. Detailed design generally provides a level of documentation to clearly define the design of all elements. Design details should be co ordinated with other disciplines. However, the documents produced in this phase may not directly be able to be “built” from.
2. It may not be practical for designer to complete this phase prior to specific vendor solution being identified.
3. Detailed co-ordination of critical areas
4. Major penetrations identified.
5. Note appropriate clearances from structure and other services.
6. Define in the specification the «significant and unusual» health & safety risks that were identified in the design.

Appendix C4

CIVIL COORDINATED SHALLOW UTILITIES ENGINEERING

Applies to external power distribution, street / site lighting, electrical systems including: Data/Communications, Security, CCTV, MATV, natural gas distribution,

Phase 8: Construction

Design Process	Deliverables

Inputs

- ☐ Construction design phase drawings for all services
- ☐ Construction time schedule
- ☐ Network provider implementation plans

Design

- ☐ Final co-ordination with architecture and other services
- ☐ Equipment selection
- ☐ Mounting details for all devices
- ☐ Complete panel, cabinet and frame designs
- ☐ Construction details for duct bank, vault, manhole and supports (unless provided by others)
- ☐ Seismic bracing
- ☐ Cable labelling philosophy
- ☐ Provisions for access and maintenance.

Drawings

- ☐ Revise detailed design documentation to incorporate buildability changes suggested by contractor if they impact on the design intent
- ☐ Equipment submissions for “review”
- ☐ Fabrication drawings for control panels, frames, desks and cabinets
- ☐ Detailed layouts of equipment rooms
- ☐ Detailing of all tray routes and catenary grids including support/hanger details (unless provided by others)
- ☐ Seismic bracing details
- ☐ Conduit routing and installation details
- ☐ Wiring diagrams and points schedules
- ☐ Specific equipment selections
- ☐ Systems configuration and programming

Review

- ☐ Review shop/fabrication and layout drawings for compliance with design
- ☐ Review equipment submission.

Comments

1. Normally prepared by the selected vendor/ installer.
2. Deliverables contain sufficient details for elements to be manufactured/constructed without reference to other documents, i.e. “the details have co-ordinated the relevant design information across all disciplines and can be built from”.
3. Equipment ordered.
4. At completion of design As Built drawings, manuals and equipment details produced to indicate final installed systems.
5. The contractor is responsible for managing health & safety risks during the construction phase.

Appendix D
CONSTRUCTION MONITORING SERVICES

Construction monitoring for civil infrastructure has different requirements than that for buildings and building services. It is therefore recommended that underground utilities, surface infrastructure improvements, and other aspects of civil engineering development be monitored to a greater extent. There is still some variability in the Scope of Services that may need to be provided during the construction monitoring phase of the project. This could vary from providing full services, survey layout, materials testing, and other quality insurance, or contract document compliance monitoring, at one end of the spectrum, to providing only infrequent visits to the site by a qualified civil engineer familiar with the project and field, to ascertain general conformance to the contract documents.

Five levels can be defined for civil construction monitoring services. The appropriate level for a given project will depend on the type of facility or utility being constructed as well as:

- Size of the project and implications of component malfunction
- Uniqueness of the project and contractor experience on similar projects
- Complexity of construction and accessibility of components for subsequent inspection, repair or replacement if not according to plans and specifications
- Contractual requirements for quality management of the contractor
- Sustainability goals and sustainability accountability requirements.

The five levels of service each present a different type of review and are:

1. Full Services review and input
2. Monitor the outputs of another party's review
3. Representative Sample Review
4. Review Random Samples of Important Work Procedures
5. Regular Review of Completed Work Prior to Closure

These are described in more detail below, along with some benefits and dis-benefits:

Level 1 - Full Services Review

This category of service is recommended for civil infrastructure where buried utilities, road subgrade, base coarse, and asphalt are being constructed and where the consequences of failure are critical; projects involving innovative or complex construction procedures. It provides the client with the greatest assurance that the completed work complies with the requirements of the plans and specifications. For full services review adequate personnel should be maintained full time on site to constantly review work procedures, materials of construction, materials testing frequency, and components for compliance with requirements of plans and specifications and review completed work prior to enclosure, backfill, or next step, or on completion, as appropriate. In general this would include office work and fieldwork, prior to, during, and post-construction.

Office work during construction is required to prepare for and document progress, issues and completions. It should include: Preparation of monthly progress payments, organizing of supplementary consultants, the degree of programme or project management needed for efficiency of construction sequencing and preparation of 'Probable Cost Opinions" and Cost to Complete Tabulations. It is also usually the civil construction administration representative who is responsible for having copies of all pre-obtained building and site development permits, environmental approvals and sustainability constraints.

Fieldwork during construction should include: Preconstruction startup meeting with contractor, owner, inspectors, and other participating agencies and regular progress, planning and reporting meetings thereafter until substantial performance has been achieved. Provision of sufficient construction control survey data to give the contractor enough field context information to construct underground utilities and surface improvements, including rough grading, and if it is a unit price contract, then also quantity

surveys and computations. Provide liaison for natural gas and telecommunication utilities as required in order to expedite development.

Serve as client's representative with authority to apply professional discretion in the interpretation of specifications, payments for work, expediting work, in general dealing with the contractor, municipality and any other authorities during the construction period. Carry out inspections to monitor that underground utilities, curb gutters, sidewalks and roads and other facilities are constructed generally in accordance with design intent.

Prepare, submit and expedite certification in order to facilitate acceptance in as short a time as possible, subject to limitations and provisions of contract documentation, development agreement or municipal improvement agreement. This may need to include inspections of the installed utilities with regulatory authorities to verify procedures have been followed. Facilitate contractor collaboration and verify implementation in accordance with the intent of the design. Prepare deficiency lists for construction completion, substantial performance, and or substantial completion and follow through with client and contractor through to end of warranty period.

On behalf of the client, arrange for materials testing to be conducted by a separate testing agency or company appointed by the client, and submit test results to regulatory authorities. The testing company will provide testing of the backfilling operation and report on compliance with the compaction specifications. Calling for backfill compaction testing and informing results should be the responsibility of the contractor, but paid by the developer or owner, not the contractor. Charges for compaction testing should be processed by the civil engineer to the owner for payment directly to the testing company.

Post-construction: prepare and provide all necessary documentation in support of the programme assessment including any authorization for extra work. All extra work items, both during and post, should be authorized in writing in advance of expenditure. Include also for gathering of field information necessary for preparation of Plan of Record drawings for improvements being constructed and organizing of sub-consultants that may be required to complete the functions of design and resident field services. Some element of programme management may be desired by the owner to generally communicate expected milestone dates and working schedules with all contractors.

During the maintenance period, act in the field as client representative in interpretation of specifications, payments, expediting work and in general dealing with contractor, authorities and others. Undertake inspections of remedial work for civil works prior to expiry of warranty. Prepare, submit and expedite final acceptance and related documentation in the shortest time possible. Arrange for third party testing services as required. Gather field information for preparation of Plan of Record drawings.

Level 2 - Monitor Third Party Reviewer Outputs

Monitoring the outputs from another party's quality assurance programme against the requirements of plans and specifications may be the desired approach in some circumstances.

This level would entail visiting the works at the frequency agreed with the client to review important materials of construction, critical work procedures, and/or completed plant or components. The civil project representative would need to be available to advise the constructor on the technical interpretation of the plans and specifications. This would also include review, preferably at the earliest opportunity a sample of each important work procedure, material of construction, and component for compliance together with the requirements of the plans and specifications.

This level is only a secondary service. When another party is engaged, it may be appropriate for the design consultant to provide a higher level of construction monitoring or review during the period of construction and/or when the works are the subject of a performance-based specification and performance testing is undertaken and monitored by others.

Level 3 - Representative Sample Review

This level of service would be simply to review a representative sample of each important completed work prior to enclosure or completion as appropriate and be available to provide the contractor with a technical interpretation of the

plans and specifications. Regulatory agencies and developers of underground utilities, roadways and other forms of civil infrastructure usually do not consider this adequate. This level of service may be deemed appropriate for smaller projects of a routine nature being undertaken by an experienced and competent constructor and where a higher than normal risk of non-compliance is acceptable. It provides for the review of a representative sample of work procedures and materials of construction. Assurance of compliance of the finished work is dependent upon the constructor completing the work to at least the same standard as that reviewed by the representative.

Level 4 - Review Random Samples of Important Work Procedures

Review, to the extent agreed with the client, random samples of important work procedures, for compliance with the requirements of the plans and specifications and review important completed work prior to enclosure or on completion as appropriate. Be available to provide the contractor with technical interpretation.

This level of service is appropriate for medium sized civil project where a lower than normal risk of non-compliance is required.

Level 5 - Regular Review of Completed Work Prior to Closure

This level of scrutiny would encompass review at a frequency agreed with the client, regular samples of work procedures, materials of construction and components for compliance with the requirements of the plans and specifications and review the majority of completed work prior to the enclosure or on completion, as appropriate. This level of service can be matched to the requirements and is appropriate for projects where a lower than normal risk of non-compliance is required.

Recommended CM Level and Fee Computation

It is difficult to determine precisely how much fee will be required to cover level 1 service for the Construction Administration and Resident Engineering (CARE) phase of the work. One way is to anticipate the timeframe and budget on a time and materials basis and pay for actual time spent. The main reason expectations are not always precise in the end is because unforeseen circumstances and other factors inevitably cause more or less time to be spent or a specialist not anticipated may need to be called on for advice. The tables below provide additional perspective;

K	Criteria	Assessment				Value
Ka	Project Status	Small - 1	Medium – 2	Large – 3	Major - 4	
Kb	Complexity / accessibility	Routine - 2	Difficult – 4	Complex - 6	-	
Kc	Relevant Contractor Experience	Inexperienced – 6	Experienced – 2	ISO 9000 - 1	-	
Kd	Consequence of Non-compliance	Minor - 1	Moderate – 4	Serious - 6	Critical - 12	

Table D 1 – Project Complexity Matrix for Use in other than level 1

Ktotal	CM1	CM 2	CM3	CM4	CM5
5-6	Constant	n/a	Secondary Service	Secondary Service	Secondary Service
7-8	Recommended	n/a	Secondary Service	Secondary Service	Secondary Service
9-10	Recommended	n/a	Secondary Service	Secondary Service	Constant
11-12	Recommended	Secondary Service	n/a	n/a	Constant
13-14	Recommended	Secondary Service	n/a	n/a	n/a
15-16	Recommended	Secondary Service	n/a	n/a	n/a
17+	Recommended	Secondary Service	n/a	n/a	n/a

Table D 2 – Level of Construction Monitoring

Frequency of inspection is intended to be indicative of the involvement, with the actual frequency depending on the rate of progress of the works. Secondary service – this level of service is only appropriate when another party is responsible for undertaking the primary review of construction standards.

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