

Part 3: Quality Assurance

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3.1 Referenced Documents

Planning and Policy

- > Health and Safety at Work Act (2015)

Design

- > AS/NZS ISO 9000:2016 *Quality management systems - Fundamentals and vocabulary*
- > Transit New Zealand *Quality Standard TQS2: Second Edition*, June 2005
- > New Zealand Transport Agency *Safety in Design – minimum standard for road projects*
www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Zero-harm/Safety-in-design/ZHMS-Vo2-Minimum-Standard-Safety-in-Design-for-Road-Projects.pdf
- > NZS 3910:2013 *Conditions of contract for building and civil engineering construction*
- > Engineering New Zealand Practice Note 02 *Peer Review – Reviewing the work of another engineer*
www.engineeringnz.org/engineer-tools/engineering-documents/practice-notes-and-guidelines

Construction

- > Christchurch City Council *Civil Engineering Construction Standard Specifications Parts 1-7 (CSS)*
www.ccc.govt.nz/consents-and-licences/construction-requirements/construction-standard-specifications/download-the-css/
- > Worksafe New Zealand *Underground services – Guide for safety with underground services*
www.worksafe.govt.nz/topic-and-industry/excavation/excavation-safety-gpg/

Where a conflict exists between any Standard and the specific requirements outlined in the Infrastructure Design Standard (IDS), the IDS takes preference (at the discretion of the Council).

The terms, and their definitions, used in this standard are consistent with those of NZS ISO 9000 and NZS 3910.

3.1.1 Source document

TQS2 was used as a guide in the development of this section of the IDS. That standard was developed by Transit New Zealand as a framework for an acceptable quality management system for the suppliers of physical works on state highways, and came into effect as a mandatory requirement from July 1996.

The use of that standard as a basis for this Part has been with the kind permission of Transit New Zealand.

3.1.2 Guidelines

Notes have been included in Appendix I – Guidelines and further explanation. These are intended to aid in the understanding of this section, expand on the requirements and explain the application of a project quality system in more detail. Read them in tandem with the clauses in this section.

3.2 Introduction

Christchurch City Council aims to achieve well-designed and constructed assets for its ratepayers. Building and maintaining assets, regardless of whether they are created through the subdivision and development of land or the capital works process, is a partnership of developers, designers and contractors. Where quality principles are applied to both design and construction, real benefits result.

Christchurch City Council therefore requires the application of quality assurance for all physical works that result in assets being transferred to the Council. Any designer, contractor or supplier wishing to tender for capital works or any developer exercising a resource consent must implement this part.

Where the assets will be vested through subdivision, designing and constructing assets in accordance with a Project Quality System will be a condition of subdivision consent. The developer must demonstrate compliance by providing and applying the project quality system, to substantiate the release of the subdivision compliance certificate, known as the 224(c) certificate. Similarly a contractor engaging in capital works is required to provide and apply a Contract Quality Plan during the contract period, which provides the supporting structure for the quality system.

This Part provides a framework for a quality management system. It has been developed by a Council internal working party and has been benchmarked against best national practice. The quality management system must ensure that all quality assurance issues relevant to a subdivisional land development or a capital works project are effectively defined, managed and communicated to ensure that all quality requirements are achieved.

3.3 Project Quality System

The project quality system must include documented procedures relating to all management, design and construction activities. This includes the following components:

- > Project management, as described in clause 3.4;
- > Management of purchasing, as described in clause 3.5;
- > Control and inspection of the work, as described in clause 3.6;
- > Non-conformance and quality improvement, as described in clause 3.7;
- > Health and safety, as described in clause 3.8.1;
- > Environmental management, as described in clause 3.8.2.

- > The Project Quality System consists of a document trail comprising:
- > the Design Report, as described in clause 3.3.2 and illustrated in the example in Appendix II;
- > the Contract Quality Plan, as described in clause 3.3.3 and illustrated in the example in Appendix III;
- > the Engineer’s Report, as described in clause 3.3.4.

These three documents support the certificate trail, which establishes compliance with the Project Quality System. The certificate trail includes:

- > the Design Certificate (see Appendix IV) and Design Peer Review Certificate (see Appendix V), which complete the Design Report documentation;
- > the Engineer’s Review Certificate (see Appendix VI), which completes the Contract Quality Plan;
- > the Engineer’s Completion Certificate (see Appendix VII) and the Contractor’s Completion Certificate (see Appendix VIII), which complete the Engineer’s Report;
- > the 224(c) Certificate or Practical Completion Certificate.

The issue of the 224(c) Certificate or Practical Completion Certificate is therefore dependent on the application of the Project Quality System and the provision of its related documentation. This interrelationship is set out in figure 1.

Quality Assurance Flow Diagram

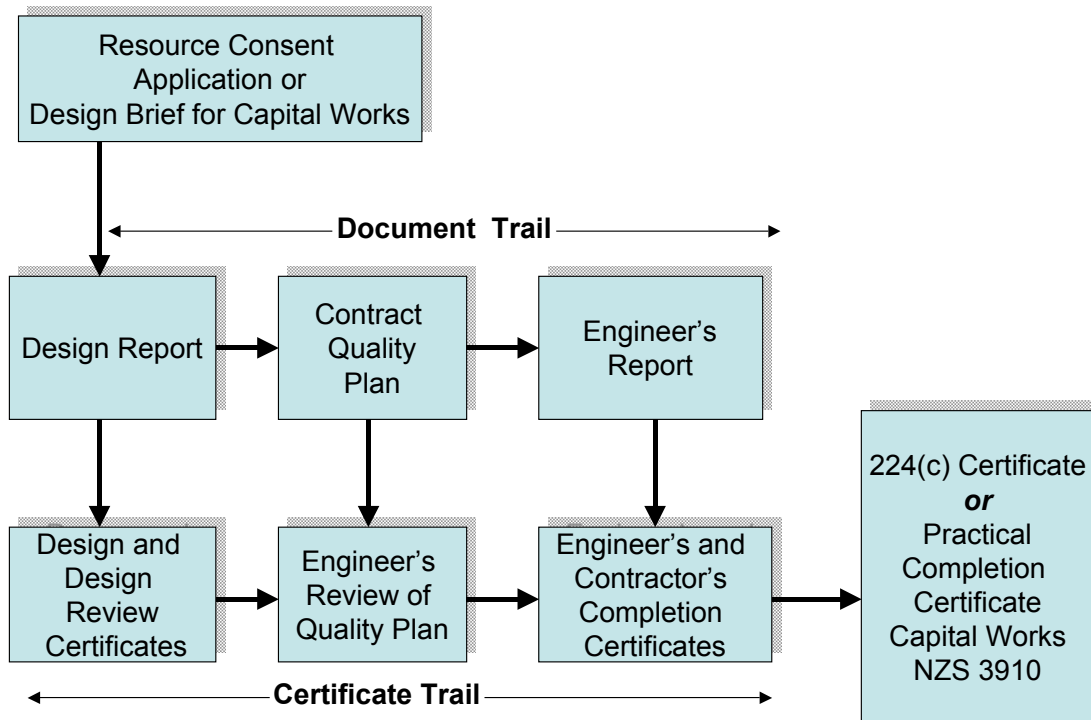


Figure 1 Quality Assurance Flow Diagram

Quality assurance responsibilities and requirements are a combination of relationships across the investigation, design and construction phases. Figure 2 explains those relationships and the point at which they are applicable.

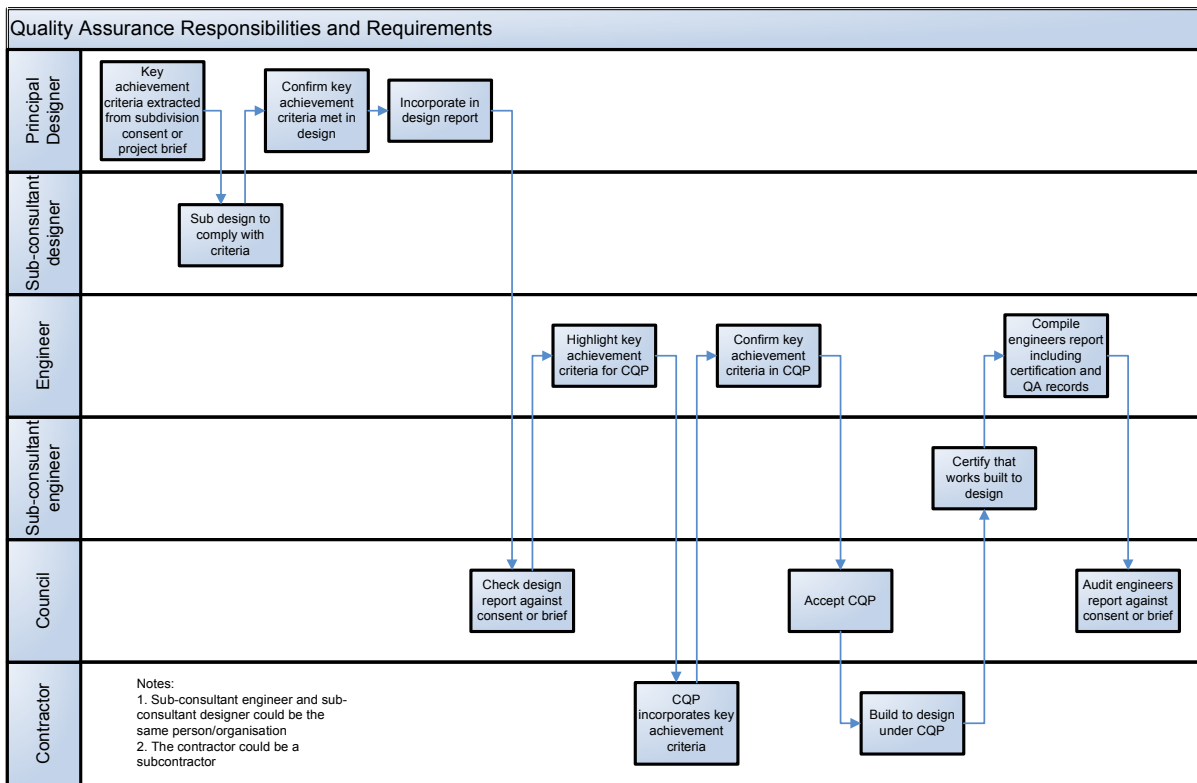


Figure 2 Responsibilities and Requirements Diagram

3.3.1 Key achievement criteria

Key achievement criteria are defined as elements of design or construction that are critical to the quality of the asset. These are typically found in the resource consent or project brief. They may also come out of particular aspects of the design e.g. the designer may require proof of levels on a weir at a particular place in the system to support compliance with a higher level key achievement criteria.

3.3.2 Design Report

Submit a Design Report, where required as a condition of consent in respect to a subdivisional land development or where specified in the project brief. Submit a Design Certificate to the Council along with the Design Report. Engineering acceptance is subject to presentation of this report.

The designer describes how s/he has:

- > Identified and addressed the design, management, administrative and legislative requirements specific to the design;
- > Planned the work to satisfy those requirements;

- > Managed communication with stakeholders and other parties to the design;
- > Reviewed/tested the design to ensure compliance with the quality requirements;
- > Recorded design activities and maintained records and evidence of compliance.

If required as a condition of consent, peer review the design in accordance with *Peer Review – Reviewing the work of another engineer*. Submit a Design Peer Review Certificate to the Council along with the Design Report.

Where aspects of the design require expertise outside of the field of knowledge of the designer, provide a Design Certificate from a suitably qualified sub-consultant designer to support the submission of the Design Report. Ensure additional information obtained from the sub-consultant designer regarding key achievement criteria or other matters is also incorporated in the Design Report.

3.3.3 Contract Quality Plan

Submit a Contract Quality Plan within the time frame and to the extent specified in the resource consent or contract. Submit an Engineer’s Review Certificate to the Council along with the Contract Quality Plan. Where specified as a deliverable in the contract or as a requirement of resource consent, the Contract Quality Plan and Review Certificate must be subject to review and acceptance by the Council, along with any major amendments. Present the Contract Quality Plan and Review Certificate before physical works commence.

The contractor describes how s/he will:

- > Identify and address the contract management (including traffic management, technical and environmental issues), administration and legislative requirements specific to the contract as detailed in clause 3.4 – Project Management;
- > Plan the work to satisfy those requirements;
- > Control (manage) the work, including that undertaken by subcontractors, to comply with requirements;
- > Manage communications with stakeholders and other parties to the contract;
- > Inspect/test the materials and work to ensure compliance with the quality requirements;
- > Address communication and reporting requirements;
- > Manage, review and update management plans to ensure they remain relevant to the requirements of the contract and work being undertaken;
- > Record contract activities and maintain records as evidence of compliance.

Provide certification upon Practical Completion through submitting a Contractor’s Completion Certificate.

Where aspects of the construction require expertise outside of the field of knowledge of the contractor, the contractor must provide a Completion Certificate from a suitably qualified subcontractor to support the submission of the Contractor's Completion Certificate. Ensure additional information obtained from the subcontractor regarding key achievement criteria or other matters is also incorporated in the Contract Quality Plan.

Where aspects of the construction require expertise outside of the field of knowledge of the contractor, the contractor must provide a Completion Certificate from a suitably qualified subcontractor to support the submission of the Contractor's Completion Certificate. Ensure additional information obtained from the subcontractor regarding key achievement criteria or other matters is also incorporated in the Contract Quality Plan.

3.3.4 Engineer's Report

Submit the Engineer's Report upon completion of physical works, where required as a condition of consent in respect to a subdivisional land development or where specified in the project brief.

The engineer describes how s/he has:

- > Identified and addressed the quality management requirements specific to the project;
- > Inspected, audited and tested the materials and work to ensure compliance with the quality requirements;
- > Recorded project activities and maintained auditable records as evidence of compliance, including any non-conformance reports.

Provide certification upon Practical Completion through submitting an Engineer's Completion Certificate. Present the completed audit records with the application for 224(c) certification.

Where aspects of the construction require expertise outside of the field of knowledge of the engineer, provide a Completion Certificate from a suitably qualified sub-consultant engineer to support the submission of the Engineer's Report.

3.4 Project Management

Clearly state the responsibility, authority, necessary qualifications and relationships of the key personnel involved in achieving quality outputs. Include these in the Design Report or Contract Quality Plan.

In the case of capital works contracts for the Council include the responsibilities for safety and environmental management programmes, in accordance with relevant legislative requirements (as set out in clause 3.8 – Safety and Environmental Management).

3.5 Management of Purchasing

3.5.1 Purchasing instructions

Purchase orders that are significant in terms of achieving the project quality requirements must be in writing. They must contain a clear specification of the requirements.

3.5.2 Material supply

Check materials purchased for the project that are significant in terms of achieving the contract quality requirements. Confirm compliance with the specified requirements prior to incorporation in the project. Note the verification of compliance either on the relevant checksheet or some other appropriate record.

3.5.3 Subcontractor quality control

The contractor is responsible for the quality of materials supplied and work performed by its subcontractors. Include appropriate quality assurance procedures in the Contract Quality Plan, to control and monitor subcontractor compliance with the contract and/or Contract Quality Plan. Conduct planned periodic audits of subcontractor activity.

These procedures do not relinquish the responsibility of the main contractor. Ensure that the subcontractor is aware of specific technical and management requirements in the contract, and that these are incorporated in the Contract Quality Plan. Ensure that the subcontractor has appropriate controls in place for the management of any specific construction risks.

3.6 Control and Inspection of the Work

Undertake the work in a planned and controlled manner to ensure that the quality requirements are realised. Demonstrate that the following has been undertaken on all projects:

- > Identify the key achievement criteria;
- > Plan how these will be realised;
- > Control the work in conformance with the project quality system;
- > Check, inspect or test the work and verify that it conforms to the specified requirements;
- > Record the results as documentary evidence of compliance.

This clause relates to both design and construction works and requires that all the processes involved are properly managed.

3.6.1 Identifying and planning

Systematically identify from the consent the key achievement criteria of the project for each discipline. Identify the key achievement criteria at each stage to satisfy all the requirements of clause 3.6.2 – Checking, inspection, testing and recording. Use these as a basis for developing the Design Report, Contract Quality Plan or Engineer’s Report. Include documentation of constraints, assumptions and base data, e.g. site investigations, in these documents.

Apply documented procedures to the extent necessary to ensure that those performing the work fully understand what is required, or where their absence could create a risk to the quality or safety of the work being undertaken.

3.6.2 Checking, inspection, testing and recording

Check, inspect or test against all the identified key achievement criteria to verify compliance during design and construction and on final completion. Specify the methods, specification references, frequency, timing, responsibilities and necessary qualifications for checking, inspection and testing in the Design Report, Contract Quality Plan and Engineer’s Report. Measure compliance against quantified acceptance criteria based on the IDS and/or specification requirements. Document the results and retain as part of the quality records.

Clearly indicate any “hold’ or “witness points” in the Design Report, Contract Quality Plan or Engineer’s Report, where the project requires checking, an inspection and/or approval to proceed (i.e. internally and/or from the Council). Establish systems to record the findings, any remedial action initiated and the final approval to proceed. Treat non-conforming work in accordance with clause 3.7 – Non-Conformance and Quality Improvement.

Where there is a requirement to use third party accredited agencies, include the details of compliance methods in the Design Report, Contract Quality Plan or Engineer’s Report.

3.7 Non-Conformance and Quality Improvement

3.7.1 Control of non-conforming work

The designer must have a procedure to ensure that design work that does not conform to the specified requirements is either:

- > redesigned to meet the specified requirements; or
- > accepted by concession from the Council.

Record all non-conforming work on the relevant design record and/or the relevant design checklist.

The contractor/engineer must have a procedure to ensure that construction work that does not conform to the specified requirements is either:

- > reworked to meet the specified requirements;
- > accepted with or without repair by concession from the Council;
- > regraded for alternative use;
- > rejected and replaced.

Record all non-conforming work on the relevant construction checksheet.

If the construction non-conformance is significant in that it either:

- > results in the need for written concession;
- > results in delay or interference to the work or to other parties;
- > indicates that the fault has occurred due to the use of incorrect work practices and/or failure of materials and could have been prevented;
- > occurs sufficiently frequently as to indicate a problem in training or procedures,

produce a Non-Conformance Report (NCR) and send to the Council.

The report and supporting documentation must clearly indicate the action to be taken to rectify the fault, the timeframe and responsibilities. It must be authorised by the designer or engineer. An example of a report is enclosed in Appendix IX – Non-Conformance Report.

In cases involving concessions, the designer or engineer and the Council must approve the proposed rectification (the corrective action) of the non-conforming work in writing and prior to implementation.

3.7.2 Quality improvement

Investigate the cause (as opposed to the symptom) of reported non-conforming work. Record proposals for improving the company's quality system on the Non-Conformance Report, to prevent the recurrence of a specific non-conformance. Send all corrective action proposals to the Council.

Ensure that the proposed corrective action is properly and effectively implemented.

3.8 Safety and Environmental Management

3.8.1 Health and safety

Consider “Safety in Design” and carry out a risk assessment appropriate to the scale of the project. Use these outputs to inform requirements for the project’s health and safety system. Refer to *Safety in Design Minimum Standard for Road Projects* and ensure the contractor applies the *Guide for Safety with Underground Services*.

A health and safety programme is mandatory for all contract quality plans submitted as part of a capital works project. It is not a Council requirement of subdivision consents.

Operate a formal health and safety programme, which complies with the statutory requirements of the Health and Safety at Work Act and any subsequent revisions and associated regulations. To the extent practical and permissible by law, health and safety policies and procedures should be integrated into the engineer’s and contractor’s quality system.

Ensure the system addresses the following as a minimum:

- > Hazard identification and assessment of control measures imposed;
- > Hazard monitoring and auditing, including frequency;
- > Emergency management;
- > Hazard monitoring and auditing, including frequency;
- > Procedures for training and supervising staff in relation to safety issues; and
- > Contact details of key personnel.

3.8.2 Environmental management

Consider environmental management in the design and carry out a risk assessment appropriate to the scale of the project. Use these outputs to inform requirements for the project’s environmental management system.

Operate a formal environmental management programme that complies with the statutory requirements of the Resource Management Act, any associated Regulations and any other specific requirements set out in any applicable resource consent. To the extent practical and permissible by law, integrate the programme into the quality system.

Ensure the Environmental Management Plan (EMP) within the environmental management system addresses as a minimum:

- > The identification of environmental risks in clause 2.5.5 – Environmental considerations and an assessment of mitigation measures imposed;
- > Emergency response and contingency management;
- > Procedures for compliance with resource consents and permitted activities;
- > Environmental monitoring and auditing, including frequency;
- > Corrective action, reporting on solutions and update of the EMP;
- > Procedures for training and supervising staff in relation to environmental issues;
- > Contact details of key personnel responsible for environmental management and compliance.

The Contract Quality Plan must identify all compliance issues relating to the Resource Management Act, including any conditions contained within the project related resource consents.

APPENDIX I

Guidelines and Further Explanation

Project Quality System (clause 3.3)

The project quality system identifies how the requirements of the project were or will be addressed. These may include quality, safety, environmental, technical and general management requirements. This may be achieved by:

- > adopting industry best practices;
- > adopting or adapting documents developed for the same or similar activity on previous jobs;
- > preparing new documents for those activities which are new or substantially different from anything undertaken previously.

Provide details of how all the identified requirements were or will be planned, controlled (managed), checked or inspected for compliance and the results recorded. Include provision for document control, including review and approval of the quality systems. The identified requirements will include the key achievement criteria but also those routine items which, through being achieved, will provide a quality asset.

For example, if a consent had a condition like “*The surface water management system shall rely on stormwater disposal to ground in accordance with the consent conditions of CRCXXX.1*”, the key requirement (achievement criteria) to ensure this condition was met would be to demonstrate that the design soakage rates for any infiltration system can be achieved on-site.

Each part of the IDS contains examples, for guidance, of records that can be provided to support the project quality system e.g. thrust block design calculations in clause 7.3.2 – Design records (Water Supply).

Design Report (clause 3.3.2)

A Design Report is a document specific to a design, which describes how the design was managed and administered in compliance with the requirements of the IDS and the resource consent or project brief.

Include a list of project personnel, their qualifications and their contact details. List the procedures and design checksheets that were used to effectively manage the design. These procedures should include the necessary qualifications of key personnel as they relate to particular tasks. Highlight exceptional aspects of the project that must be covered by the Contract Quality Plan.

For the example given above, information provided through the project quality system to support the assertion of compliance (which is more substantial as the condition is a key achievement criteria) might include, in the Design Report:

- > Methodology to determine the design soakage rate.
- > Design checksheet (see guidelines to clause 3.6.2) including the assumptions upon which the design is based (see clause 5.4.3 – Design records (Stormwater) bullets) and their source.

- > Calculations leading to the design infiltration.
- > Record of key achievement criteria for inclusion in the CQP.
- > Design Certificate.
- > Designers qualifications relevant to infiltration design.
- > Design Peer Review Certificate if required.
- > Specific requirements for OMM to preserve ongoing compliance.

Supporting information retained in the project quality system might include:

- > Alternatives explored.
- > Contractual requirements around the key achievement criteria into the CQP.
- > Quick check of the design infiltration, by an alternative method if possible.

An example of a simple proforma Design Report setting out the minimum requirements of the IDS is provided in Appendix II. It is an example only and designers may develop their own format to suit their specific needs.

Contract Quality Plan (clause 3.3.3)

A Contract Quality Plan is a document specific to the project, which describes how the contract works will be managed and administered in compliance with its requirements.

Include, or otherwise reference, the procedures and the checksheets necessary to effectively manage the contract works. These procedures should include the qualifications of key personnel as they relate to key tasks particularly the key achievement criteria e.g. the connection to the Council water reticulation must be undertaken by an authorised water installer. The following is a guideline of the information that should be included in the Contract Quality Plan:

- > A statement of policy with respect to the timing and frequency of internal reviews and/or audits of the quality plan during the project.
- > A schedule of the contractual quality records to be kept.
- > A list of subcontractors.
- > Procedures for auditing subcontractor compliance to the quality plan.
- > A schedule of inspection and/or testing of materials and/or completed works, clearly indicating 'hold' or 'witness' points.
- > Documented procedures included, or referenced, for all activities.
- > Non-conformance & quality improvement procedures included, or referenced.
- > Provisions for traffic management and environmental management plans included or referenced.

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For the example given above, information provided through the project quality system to support the assertion of compliance (which is more substantial as the condition is a key achievement criteria) might include, in the Contract Quality Plan:

(Pre-construction)

- > Engineers Review certificate.
- > Inspection and test schedule highlighting the infiltration test requirement.

(Post-construction)

- > Contractor's Completion Certificate.
- > Inspection and test schedule proving compliance is achieved.

Supporting information retained in the project quality system might include:

- > Infiltration test record sheets.

An example of a simple proforma Contract Quality Plan is provided in Appendix III. This sets out the minimum requirements the Contract Quality Plan must achieve for this standard. It is an example only and contractors may develop their own format to suit their specific needs.

Prepare site-specific Erosion and Sediment Control Plans (ESCP) in accordance with clause 4.9 – Erosion, Sediment and Dust Control (Geotechnical Requirements).

As noted above, processes and procedures for the management of subcontractors must be stipulated in the Contract Quality Plan. This is especially important where subcontractors perform a large component of the works (e.g. earthworks).

Engineers Report (clause 3.3.4)

An Engineer's Report is a document specific to a project, which describes how the project was managed and administered in compliance with the IDS, the *Construction Standard Specifications*, the Contract Quality Plan and the resource consent or project brief. It provides background information to the release of the 224(c) certificate.

The following is a guideline of the information that should be included in the Engineer's Report:

- > A schedule of the project and contractual quality records that have been kept. A summary of the quality records proving compliance is to be submitted to the Council.
- > What procedures were employed for auditing contractor and subcontractor compliance with the quality plans.

For the example given above, information provided through the project quality system to support the assertion of compliance (which is more substantial as the condition is a key achievement criteria) might include, in the Engineers Report:

- > Engineers Completion Certificate.
- > Non-conformance Reports if generated.
- > OMM as it relates to the ongoing achievement of this condition.
- > Audit and test schedule proving compliance has been achieved.

Project Management (clause 3.4)

The project management structure need only show the key positions or functions. In many companies an individual can hold more than one position or be responsible for more than one function. The designer and the engineer can be the same person or organisation.

Relate job descriptions to positions and named individuals. They can be quite simple and should only state the principal responsibilities of the position, any necessary qualifications and the reporting lines. Examples of a management structure and job descriptions for a typical subdivision and a small/medium contractor are enclosed in Appendix II – Design Report section 1 and Appendix III – Contract Quality Plan section 3.

Purchasing instructions (clause 3.5.1)

Ensure that purchasing instructions are precise; otherwise there is a significant risk of not getting what is needed. Include, as appropriate:

- > the product type, class, and size etc;
- > the quality standards;
- > the quantities;
- > the scope of the work;
- > the delivery details;
- > the completion dates.

It may not be necessary to fully describe the requirements in every case e.g. when there is a record that the supplier has previously supplied full details or a copy of the specification and that the detail is current. In this instance, it would be sufficient to order by reference to those previously supplied details.

Material supply (clause 3.5.2)

Checking for compliance should preferably be done on receipt of the materials. The verification referred to can be recorded when completing the relevant checksheet (refer to the examples given in Appendices XIII - XVII). Attach any supporting documentation to the checksheet, such as delivery dockets or supplier certificates of compliance, which provide evidence of the type, grade, and class etc of material used.

Keep records of material tests that are traceable to defined sections of the work e.g. seven and 28 day concrete crushing strength test results, basecourse sand equivalent tests ex-supplier.

Identifying and planning (clause 3.6.1)

Each project is unique in that it:

- > has technical requirements which may vary in part or full from other projects;
- > will have a different scope of work from other projects, which is also likely to alter during the course of the project;
- > will be in a different location and therefore will have different external influences from other projects;
- > will utilise different resources;
- > will have its own programme etc.

The identification of the project requirements is therefore important and must be undertaken in some systematic and documented manner. The project must be planned and managed to suit its unique set of characteristics, either by highlighting the key achievement requirements in the relevant sections of the consent, project brief or contract specification, or in a more formalised manner, by listing the requirements on a form. These key requirements must also be communicated between the various parties to the project.

The procedures should follow a standard format and be user friendly. They will describe how individual work activities are planned, controlled and inspected for compliance with the specification requirements. They will:

- > describe how the activity or task will be performed;
- > define key task responsibilities and required qualifications;
- > describe how key design parameters which directly impact on the effectiveness of the design are communicated;
- > indicate the sequence;
- > specify the resources to be used;
- > be written in precise and easily understandable language.

They should contain as a minimum the information outlined in the example in Appendix XII – Quality System Work Procedure.

Examples of work activities that would be covered by procedures include: surface and groundwater modelling; survey and setout; placement of unbound granular basecourse; stormwater pipework; traffic control. For work activities that are more or less standard, procedures from previous projects may be adopted or adapted.

Checking, inspection, testing and recording (clause 3.6.2)

The documentation requirements associated with checking, inspection, testing and recording need not be complex. The checksheets are useful in that they provide a breakdown of the checks that should be performed and, when completed, serve as a record. They should be developed for each key design and work activity and should contain the quality requirements as reminders.

The design checksheet should:

- > include the constraints, assumptions and base data;
- > identify the personnel responsible for the design;
- > record that the design has been checked and the method used;
- > provide for signing-off at the bottom of the sheet after a fully complying “design check”.

The engineer’s checksheet should:

- > identify the personnel responsible;
- > provide for signing-off at the bottom of the sheet.

Examples of engineer’s checksheets are included in Appendices XIII - XVI.

The construction checksheet should:

- > provide a checklist of the items to be inspected;
- > include the acceptance criteria;
- > identify the personnel responsible for doing the inspection;
- > contain space for recording that compliance of the individual items has been attained;
- > contain reference to further records generated by non-conformances;
- > provide for signing-off at the bottom of the sheet after a fully complying “final inspection”.

Examples of construction checksheets are included in Appendix XVII and XVIII.

An audit or inspection and test schedule should provide a full listing of all audits, inspections and tests of materials and completed works. It should clearly indicate ‘hold’ or ‘witness’ points and include signing off by the contractor, the engineer and the Council where required. A sample engineer’s audit and test schedule is contained in Appendix X and a sample inspection and test schedule is contained in Appendix XI.

Control of non-conforming work (clause 3.7.1)

It is inevitable that, even with excellent practices and controls, some degree of defective workmanship or material will occur. When it does, it is important that it is properly handled to ensure that the defects are rectified in the appropriate way.

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A non-conformance should be considered an opportunity for improvement, rather than to apportion blame. By adopting this philosophy, identifying a non-conformance provides an opportunity to learn from the mistake and (more importantly) prevent it happening again.

Note that there is a clear differentiation between what should be considered a “routine construction issue” or a “routine design step” and a non-conformance. Ensure this is understood by and communicated to all staff. A construction issue, such as soft subsoils, is often identified (and reasonably expected) during a project and does not therefore necessitate the raising of a Non-Conformance Report, unless procedures have not been followed. The inability to achieve the minimum grade on a sewer design is a non-conformance and must be reported, as is the inability to achieve a passing Benkelman Beam test or infiltration test.

A non-conformance exists, and therefore a report should be raised, in all instances where a defect in the work or design occurs that indicates that the required standard or key achievement criteria prescribed in the Design Report, Contract Quality Plan or Engineer’s Report has not been met, e.g. failure to achieve compaction results, pre-seal inspection etc. For this process to be successful it must be handled in a positive and constructive manner, without unnecessary recrimination.

Any non-conforming work that is subject to follow-on work by other parties must be clearly denoted as such to alert the other parties to its non-conforming status.

Quality improvement (clause 3.7.2)

The objective is to reduce, if not eliminate, the root causes of the recurring inefficiencies and errors which have caused or can cause non-conforming work, i.e. to find a permanent cure for the problem, not just a quick-fix. This provides a formal and disciplined procedure for identifying, investigating and correcting inefficiencies and shortcomings in a company’s work practices.

There can be significant benefits to the company from the positive application of quality improvement, through reducing the incidence of non-conforming work and improving efficiency, to reducing costs including those of rework. Common causes of non-conforming work that can be addressed are:

- > lack of training.
- > lack of resources.
- > poor communication / incomplete instructions.
- > inadequately defined work practices.
- > inadequate supervision.

Environmental management (clause 3.8.2)

Environmental management is an integral part of project management and therefore will be most efficiently operated within the framework of the project's quality system.

Design the environmental management programme in full compliance with the Resource Management Act. Specific activities that may require resource management consents or authorisations include:

- > management of stockpile material.
- > selection and management of disposal areas.
- > the use of chemical sprays and fertiliser.
- > noise and dust nuisance.
- > prevention of fuel and oil spills including the actions taken if an oil spill occurs.
- > control of silt, contaminants and stormwater runoff.
- > the alteration of, or taking water from, waterways.
- > work around protected trees.
- > redirection of groundwater.
- > excavation of HAIL sites and accidental discovery of contaminated material.
- > discharges of dewatering water, sewage, or contaminants.
- > archaeologically and culturally sensitive sites.
- > disturbance of wildlife species or habitat.
- > excavation over aquifers.

It is a legal requirement to maintain fish passage under the Freshwater Fisheries Regulations.

This is by no means an exhaustive list. There may also be Department of Conservation permits and Heritage New Zealand Pouhere Taonga authorities. Consider (if not contractually required to) developing a formal Environmental Effects Register. Also identify these matters in an assessment of environmental effects, for applications for subdivision consent.

APPENDIX II

Design Report

(contract name/subdivision name)

(contract /subdivision consent number)

Copy No _____ of _____

Version: _____

Date of Issue: _____

CONTENTS:

1	Project Personnel and Design Management	23
2	Sub-consultant Designers	24
3	Full Description of Work	25
4	Quality Control and Inspection	25
5	Environmental Management	26
6	Concessions	26
7	Design Check and Review	26
8	Design Records	26

APPENDICES: *(attach these – as applicable)*

- 1 - Design Certificate <see example in Appendix IV>
- 2 - Design Peer Review Certificate <see example in Appendix V>
- 3 - Non-Conformance Report <see example in Appendix IX>

DESIGN REPORT APPROVALS:

This Design Report has been:

Prepared by:

(Designer)

(Name/Sign/Date)

Approved by:

(Principal designer)

(Name/Sign/Date)

Reviewed by:

(Peer Reviewer)

(Name/Sign/Date)

1 Project Personnel and Design Management

Principal designer:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Developer:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Sub-consultant designer:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Design Peer Review (if undertaken):

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Part 3: Quality Assurance

The following key personnel have been involved in this design:

Name	Position Title	Responsibility

This list should include details of different design specialists, internal reviewers and auditors.

2 Sub-consultant designers

Sub-consultant designers undertook the following design activities:

Activity	Name of Sub-consultant designer

Sub-consultant designers were selected in accordance with company policies and procedures, and were provided with copies of the relevant project briefs and/or resource consents requirements and/or drawings prior to commencement of the work.

Sub-consultant designers were subject to monitoring and their work was subject to periodic internal audit.

3 Full Description of Work

This section contains a full description of the work included in the Design Report. It should include a description of:

- > *the existing pre-development site;*
- > *the proposed development;*
- > *the extent of the assets to be constructed;*
- > *all key design and quality requirements, from the Council and the developer e.g. key achievement criteria;*
- > *evidence of consultation, if applicable;*
- > *the constraints, parameters, assumptions and raw data on which the design is based;*
- > *data manipulation methods e.g. computer software, methodology.*

4 Quality Control and Inspection

Procedures and design checksheets were used to control the design and verify compliance with the quality requirements. The following documents were used for this design:

Identifier

Title

Identifier	Title

The documents can be made available for the Council's review, if requested.

Exceptional aspects of this project to be covered by the Contract Quality Plan include:

5 Environmental Management

The following Resource Consents, relevant to the design, have been obtained:

In accordance with the resource consent/s, environmental controls relating to this particular design will be outlined in the Contract Quality Plan.

6 Concessions

If, during the process of design, work is identified which does not conform to the specified requirements and will require a concession from the Council, submit a Non-conformance Report as part of the Design Report. The concession proposed will be discussed and must be approved by the Council prior to execution.

7 Design Check and Review

Undertake internal design reviews, to verify the design outlined and/or referenced in this Design Report, in accordance with “Reviewing the work of another engineer”. Include written documentation of this review, by checklist, calculations carried out by hand or another method to check design calculations, or document here.

Undertake a peer review, to verify the compliance and effectiveness of the design, in accordance with “Reviewing the work of another engineer”. Document the review here or include as an Appendix.

This review shall be specific only to those aspects of the works in which the reviewer is competent i.e. more than one reviewer may be required where the development incorporates specialised disciplines.

Record, report and action the review findings.

8 Design Records

The following design records were produced for this design and are appended where noted:

(e.g. engineering drawings, specifications, calculations, material specifications where not detailed elsewhere, photos etc.)

The following completed checksheets are appended (e.g. safety in design, risk register).

Checksheet No.

Title

Checksheet No.	Title

APPENDIX III

Contract Quality Plan

(contract name/subdivision name)

(contract /subdivision consent number)

Copy No _____ of _____

Version: _____

Date of Issue: _____

CONTENTS:

1	Contract Personnel	29
2	Document Control	30
3	Contract Management	30
4	Subcontractors	31
5	Quality Control and Inspection	32
6	Environmental Control	33
7	Non-Conformance	33
8	Contract Records	33

APPENDICES: *(attach these – as applicable)*

- 1 – Construction Programme
- 2 – Inspection & Test Schedule <see example in Appendix XI>
- 3 – Site Safety Plan
- 4 – Traffic Management Plan(s)
- 5 – Erosion and Sediment Control Plan
- 6 – Non-Conformance Report – <see example in Appendix IX>
- 7 – Contractor’s Completion Certificate <see example in Appendix VIII>

CONTRACT QUALITY PLAN APPROVALS:

This Contract Quality Plan has been:

Prepared by:

(Name/Sign/Date)

Approved by:

(Engineer)

(Name/Sign/Date)

Approved by:

(Contractor)

(Name/Sign/Date)

1 Contract Personnel

Contractor:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Developer:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Project Manager:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

Engineer:

Name: _____

Address: _____

Contact Ph (Mobile): _____ Contact Ph (A/H): _____

Telephone: _____ Fax: _____

2 Document Control

This Contract Quality Plan (CQP) has a controlled distribution as follows:

Copy No	Issued To	Date	Version No
1	<Contract Manager>	.....	.....
2	<Site Supervisor>	.....	.....
3	<All Subcontractors>	.....	.....
4	<Other>	.....	.....
5	<Engineer (for review and acceptance)>	.....	.....
6	Council (for review and acceptance)	.....	.....

This CQP will be subject to periodic review during the course of the contract. All holders of controlled copies listed above will be issued with updates to this document as and when they occur.

3 Contract Management

The following key personnel have been assigned to this contract:

Name	Title
.....
.....
.....
.....
.....

<or insert your organisation chart here>

Key responsibilities and authorities are as follows:

- a) Overall responsibility for the management of the contract and principal contact with the developer and the engineer:

.....
(Title)

- b) Authorised to address and resolve issues of dispute relating to compliance with the quality requirements of the contract and this quality plan and rectification of non-conforming work:

.....
(Title)

- c) Responsible for and qualified to the required level for the day to day on-site supervision, control and inspection of the works and communicate on such matters with the developer or engineer. Authorised to receive, on behalf of the contractor, any instructions from the developer or engineer (refer NZS 3910 clause 5.2.1):

(Title)

- d) Responsible for on-site Traffic Control activities, qualified to STMS level:

(Title)

- e) Responsible for compliance with the requirements of the Resource Management Act (Environmental Management):

(Title)

- f) Preparation and amendment of this quality plan:

(Title)

- g) Approval of this quality plan:

(Title)

4 Subcontractors

Subcontractors will undertake the following work activities:

Activity	Name of Subcontractor
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

All Subcontractors are required to operate in accordance with this Contract Quality Plan.

5 Quality Control and Inspection

Procedures, construction checksheets and inspection and test schedules will be used to control the work and verify compliance with the quality requirements. The following procedures will be adopted for this contract or will be prepared in advance and be made available on site:

Identifier	Title

These can be made available for the Council’s review, if requested.

Compliance checksheets are appended to the various parts of the CSS, which may provide initial guidance on what to consider when compiling construction checksheets.

An example of an inspection and test schedule is contained in Appendix XI. The schedule should indicate the frequency, timing, type of both inspection and/or tests required to be performed on the materials and at certain stages of construction. This schedule would be signed off as the specified activities are completed, and once completed would then serve as a Contract Record (refer clause 3.5.2 – Material supply).

In addition to the inspection and test schedule, the following key ‘Hold’ and ‘Witness’ points have been identified by the engineer as requiring inspection and approval by the engineer and/or the Council prior to further construction. They will be documented on the relevant construction checksheet.

Key achievement criteria may suggest some of these points. ‘Hold’ or ‘witness’ points could include:

- > *Site establishment;*
- > *Commencement of works;*
- > *Formwork or foundations prior to pouring concrete;*
- > *Prepared earthworks and subsoil drainage prior to filling;*
- > *Completed earthworks and prepared subgrade prior to topsoil or metalcourses;*
- > *Confirmation of thrust block ground conditions and design;*
- > *Complying polyethylene pipe weld preconstruction joint tests;*
- > *Drainage and water reticulation bends, junctions and inspection points prior to backfilling, to allow as-builting;*
- > *Utility reticulation prior to backfilling;*
- > *Water and drainage reticulation during testing;*
- > *Sterilisation of watermain;*

- > *Finished subbase before the placement of basecourse;*
- > *Finished basecourse before the commencement of surfacing or paving;*
- > *Finished surface prior to roadmarking;*
- > *Landscape areas formed and plants on site prior to planting;*
- > *Construction safety audit;*
- > *Practical Completion inspection;*
- > *Defects Liability inspection for planting;*
- > *Defects Liability inspection for roading etc.*

6 Environmental Control

The following Resource Consents, relevant to the works undertaken and/or materials used in this contract, have been received:

These have been reviewed and appropriate controls have been put in place to manage and/or mitigate the risk.

In accordance with contract requirements, *<if applicable>* environmental controls relating to this particular contract and/or the work being undertaken are outlined *<delete as applicable>* further in the attached documentation/in the site-specific Erosion and Sediment Control Plan appended. The compliance and effectiveness of management controls will be subject to periodic review.

7 Non-Conformance

If, during the process of inspection, work is identified which does not conform to the specified site requirements, a Non-Conformance Report will be prepared by the person at 3 b). The rectification proposed will be discussed and agreed with the engineer and will be stated on the NCR.

A proforma Non-Conformance Report is attached.

8 Contract Records

The following records will be produced for this contract:

(e.g. site meeting minutes, construction checksheets, photos, inspection and test schedules, test results, construction programmes, completion documentation, as-built records)

APPENDIX IV

DESIGN CERTIFICATE

Infrastructure/Land Development

ISSUED BY: _____
(Design firm or suitably qualified design professional)

TO: _____
(Owner/Developer)

TO BE SUPPLIED TO: _____
(Territorial authority)

IN RESPECT OF: _____
(Description of infrastructure/land development)

AT: _____

(Address)

_____ has been engaged by
(Design firm or suitably qualified design professional)

_____ (Owner/Developer)

to provide _____ services in respect of the infrastructure/land development described above. I have the qualifications and experience relevant to this project as set out herein and have designed the subject works.

I _____ (Designer) on behalf of _____ (Design Firm) confirm that the design is to current good engineering practice, and that it satisfies all relevant resource consent conditions.

The design firm issuing this statement holds a current policy of professional indemnity insurance of no less than \$ _____ (Minimum amount of insurance shall be commensurate with the current amounts recommended by EngNZ, ACENZ, TNZ, NZTA, INGENIUM.)

Qualifications and experience

_____ Date: _____
(Signature of designer)

Copyright waived

APPENDIX V

DESIGN PEER REVIEW CERTIFICATE

Infrastructure/Land Development

ISSUED BY: _____
(Design peer review firm or suitably qualified design peer review professional)

TO: _____ (Owner/Developer)

TO BE SUPPLIED TO: _____ (Territorial authority)

IN RESPECT OF: _____
(Description of infrastructure/land development)

DESIGNED BY: _____ (Design firm/Designer)

_____ has been engaged by _____
(Design peer review firm or suitably qualified design peer review professional) (Owner/Developer)

to provide design review services in respect of _____ aspects of the
above work, which is described in the specification and shown on the drawings

numbered _____ approved by _____ (Territorial authority)

under consent number _____ on _____ (Date)

As an independent professional, I have reviewed the design assumptions, methods, accuracy and conclusions.
I have sighted the conditions of consent to the works and the approved specifications and drawings.

In my professional opinion and based upon reasonable enquiry, this review, information supplied by the
designer and the designer's certification (copy attached),

I _____ (Design peer reviewer)

confirm on behalf of _____ (Design Firm)

the acceptability of the design and that the design complies with the above consent and current good
engineering practice, subject to the findings below if any.

_____ Date: _____
(Signature of Design peer reviewer)

_____ Member NZIS ACENZ EngNZ
(Professional qualifications)

_____ (Address)

Findings _____

APPENDIX VI

ENGINEER'S REVIEW CERTIFICATE

Review of Contract Quality Plan

ISSUED BY: _____
(Engineering consultancy firm or suitably qualified engineer)

TO: _____
(Owner/Developer)

TO BE SUPPLIED TO: _____
(Territorial authority)

IN RESPECT OF: _____
(Description of infrastructure/land development)

DESIGNED BY: _____
(Design Firm/Designer)

AT: _____
(Address)

I _____ (Engineer)

on behalf of _____ (Engineering consultancy firm)

have reviewed the Contract Quality Plan (a copy of which is attached).

I confirm the following have been provided in accordance with IDS Part 3: Quality Assurance:

- > Contract personnel and contact details listed
- > Quality policy statement enclosed
- > Contract management and responsibilities set out
- > Subcontractors listed
- > Procedures are documented and hold or witness points listed
- > Site Safety and Environmental controls detailed
- > Non-conformance process detailed
- > Contract records listed

(Signature of engineer) Date: _____

(Professional qualifications) Member NZIS ACENZ EngNZ

(Address)

APPENDIX VII

ENGINEER'S COMPLETION CERTIFICATE

Infrastructure/Land Development

ISSUED BY: _____ (Engineering consultancy firm or suitably qualified engineer)

TO: _____ (Owner/Developer)

TO BE SUPPLIED TO: _____ (Territorial authority)

IN RESPECT OF: _____
(Description of infrastructure/land development)

AT: _____

(Address)

(Engineering consultancy firm or suitably qualified engineer)

has been engaged by _____ (Owner/Developer)

to provide _____ services in respect of the construction of
the infrastructure/land development described in the specification and shown on the drawings

numbered _____ approved by _____ on
(Territorial authority)

(Date).

I, _____ (Engineer)

confirm on behalf of _____ (Engineering consultancy firm)

that I have managed the subject works and that the works, other than those outstanding works listed below
if any, have been completed in accordance with current good engineering practice, and that they satisfy all
relevant resource consent conditions.

The engineering consultancy firm issuing this statement holds a current policy of professional indemnity
insurance of no less than \$_____ (Minimum amount of insurance shall be commensurate with the
current amounts recommended by EngNZ, ACENZ, TNZ, NZTA, INGENIUM, LPMS.)

(Signature of engineer) Date: _____

(Professional qualifications) Member NZIS ACENZ EngNZ

(Address)

Outstanding Works _____

APPENDIX VIII

CONTRACTOR'S COMPLETION CERTIFICATE

Infrastructure/Land Development

ISSUED BY: _____ (Contractor)

TO: _____ (Owner/Developer)

TO BE SUPPLIED TO: _____ (Territorial authority)

IN RESPECT OF: _____
(Description of infrastructure/land development)

AT: _____

(Address)

_____ has been contracted by _____
(Contractor) (Owner/Developer)

to carry out and complete certain infrastructure/land development in accordance with a
contract, titled Contract No _____ for
_____ (“the contract”).

I _____, a duly authorised representative of _____,
(Duly authorised representative) (Contractor)

hereby certify that _____ has carried out and completed
(Contractor)

the works, other than those outstanding works listed below if any, in accordance with the relevant
resource consent conditions.

(Signature of authorised representative) Date: _____

(Contractor) (Address)

Outstanding Works

Copyright waived

APPENDIX IX

Non-Conformance Report

Contract Name/No: _____ NCR Ref No: _____

1 NON-CONFORMING WORK DETAILS:

(provide precise location, detailed description and sketches as appropriate)

Company responsible for NC

Contractor (sign/date)

2 PROPOSED CORRECTIVE ACTION

(provide details with sketches)

3 APPROVALS:

3.1 The corrective action is accepted/ not accepted/ accepted subject to attached conditions.

Engineer (sign/date)

Council (sign/date)

3.2 The corrective action has been completed.

Certified: (sign/date)

Reviewed: (sign/date)

Approved: (sign/date)

APPENDIX X

Engineer's Audit & Test Schedule

Testing		Inspection		Verification		Signed / Accepted / Date																																		
Phase	Test / Material Certificate Audit Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N		Acceptance Criteria																																	
<p>Note that the below information is an example for selected phases only. Prepare audit and test plans unique to the project, incorporating that project's quality criteria for infrastructure and materials installed on that project.</p>																																								
<p>Materials</p>																																								
TNZ M/4: AP20	All Suppliers Certificates	TNZ M/4	Y	Y	N	<table border="1"> <thead> <tr> <th>Sieve Size</th> <th>Percent Passing</th> </tr> </thead> <tbody> <tr> <td>37.5mm</td> <td>AP20 AP40</td> </tr> <tr> <td>19.0 mm</td> <td>100</td> </tr> <tr> <td>9.5 mm</td> <td>66 - 81</td> </tr> <tr> <td>4.75 mm</td> <td>55 - 75</td> </tr> <tr> <td>2.36 mm</td> <td>43 - 57</td> </tr> <tr> <td>1.18 mm</td> <td>33 - 55</td> </tr> <tr> <td>0.600 mm</td> <td>22 - 42</td> </tr> <tr> <td>0.300 mm</td> <td>14 - 31</td> </tr> <tr> <td>0.150 mm</td> <td>8 - 23</td> </tr> <tr> <td>0.075 mm</td> <td>7 - 19</td> </tr> <tr> <td></td> <td>5 - 16</td> </tr> <tr> <td></td> <td>3 - 14</td> </tr> <tr> <td></td> <td>0 - 12</td> </tr> <tr> <td></td> <td>0 - 10</td> </tr> <tr> <td></td> <td>0 - 8</td> </tr> <tr> <td></td> <td>0 - 7</td> </tr> </tbody> </table>	Sieve Size	Percent Passing	37.5mm	AP20 AP40	19.0 mm	100	9.5 mm	66 - 81	4.75 mm	55 - 75	2.36 mm	43 - 57	1.18 mm	33 - 55	0.600 mm	22 - 42	0.300 mm	14 - 31	0.150 mm	8 - 23	0.075 mm	7 - 19		5 - 16		3 - 14		0 - 12		0 - 10		0 - 8		0 - 7
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	0 - 8																																							
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TNZ M/4: AP40	All Contractors test results																																							

Testing		Inspection		Verification		Signed / Accepted / Date														
Phase	Test / Material Certificate Audit Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N		Acceptance Criteria													
						<table border="1"> <thead> <tr> <th>Fraction</th> <th>Percent within</th> </tr> </thead> <tbody> <tr> <td>19mm – 4.75mm</td> <td>AP20 AP40 28 – 48</td> </tr> <tr> <td>9.5mm – 2.36mm</td> <td>20 – 46 14 – 34</td> </tr> <tr> <td>4.75mm – 1.18mm</td> <td>9 – 34 7 – 27</td> </tr> <tr> <td>2.36mm – 0.600mm</td> <td>6 – 26 6 – 22</td> </tr> <tr> <td>1.18mm – 0.30 mm</td> <td>3 – 21 5 – 19</td> </tr> <tr> <td>0.600mm – 0.150mm</td> <td>2 - 17 2 - 14</td> </tr> </tbody> </table> <ul style="list-style-type: none"> > CBR under Vibrating hammer test over 80%. > Less than 10% fines shall pass a 2.36mm sieve after a crushing resistance test with a 130kN load. > Shall have a quality index above CB from weathering quality index test. > Shall either have a sand equivalent greater than 40 or the fraction of the aggregate passing a 0.075mm sieve shall have a clay index less than 3 or the fraction of the aggregate passing a 0.425mm sieve shall have a plasticity index less than 5. > 70% of the aggregate by weight shall have 2 or more broken faces. 	Fraction	Percent within	19mm – 4.75mm	AP20 AP40 28 – 48	9.5mm – 2.36mm	20 – 46 14 – 34	4.75mm – 1.18mm	9 – 34 7 – 27	2.36mm – 0.600mm	6 – 26 6 – 22	1.18mm – 0.30 mm	3 – 21 5 – 19	0.600mm – 0.150mm	2 - 17 2 - 14
Fraction	Percent within																			
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Testing		Inspection		Verification		Signed / Accepted / Date																								
Phase	Test / Material Certificate Audit Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N		Acceptance Criteria																							
CCC AP65	All Suppliers Certificates All Contractors test results	CSS Part 1: 31.2	Y	Y	N	<table border="1"> <thead> <tr> <th>Sieve Size</th> <th>Percent Passing</th> </tr> </thead> <tbody> <tr><td>65.0 mm</td><td>100</td></tr> <tr><td>37.5 mm</td><td>60 - 90</td></tr> <tr><td>19.0 mm</td><td>45 - 65</td></tr> <tr><td>9.5 mm</td><td>30 - 50</td></tr> <tr><td>4.75 mm</td><td>20 - 40</td></tr> <tr><td>2.36 mm</td><td>10 - 28</td></tr> <tr><td>1.18 mm</td><td>7 - 22</td></tr> <tr><td>0.600 mm</td><td>5 - 16</td></tr> <tr><td>0.300 mm</td><td>4 - 12</td></tr> <tr><td>0.150 mm</td><td>3 - 8</td></tr> <tr><td>0.075 mm</td><td>3 - 6</td></tr> </tbody> </table> <p>> CCC AP65 shall be free of organic matter.</p> <p>> Less than 10% fines shall pass a 2.36mm sieve after a crushing resistance test with a 130kN load.</p> <p>> CCC AP65 shall either have a sand equivalent greater than 25 or the fraction of the aggregate passing a 0.075mm sieve shall have a clay index less than 3 or the fraction of the aggregate passing a 0.425mm sieve shall have a plasticity index less than 5.</p>	Sieve Size	Percent Passing	65.0 mm	100	37.5 mm	60 - 90	19.0 mm	45 - 65	9.5 mm	30 - 50	4.75 mm	20 - 40	2.36 mm	10 - 28	1.18 mm	7 - 22	0.600 mm	5 - 16	0.300 mm	4 - 12	0.150 mm	3 - 8	0.075 mm	3 - 6
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Premix concrete for kerb and channel	All Suppliers certificates	CSS Part 6: 4.3	Y	Y	N	Concrete (Normal) strength 20 MPa at 28 days, slump 75mm, nominal maximum aggregate 19mm, water content under 170 kg/m ³																								

Testing		Inspection		Verification			
Phase	Test / Material Certificate Audit Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N	Acceptance Criteria	Signed / Accepted / Date
100 dia uPVC Kerb entry	All Suppliers certificates	AS/NZS 1260: 2009	Y	Y	N	SN10, factory moulded	
100 dia uPVC SN10 pipe	All Suppliers certificates	AS/NZS 1260: 2009	Y	Y	N	SN10, 100mm uPVC	
First class topsoil	All Suppliers Certificates All Contractors test results	CSS Part 1: 34.1	Y	Y	N	> Under 5% solid detritus, under 10% stone, both under 30mm diameter. > Under 25% clay, organic matter 7-20% > Loose friable, well aerated, lightly processed > pH 5.5-7.5	
Medium grade bark mulch	All Suppliers Certificates All Contractors test results	CSS Part 1: 35.2	Y	Y	N	> Under 25% wood chips, under 1% inorganic component, 100% between 11-40mm.	
Construction							
Subgrade strength	Penetrometer test at 50 metre intervals, all Contractors test results	CSS Part 6: 11.6.4	Y	Y	Y	CBR greater than 7	
Kerb and channel stringline	Check height and location of string line at every peg on day poured	CSS Part 6: 4.4	Y	Y	Y	String 100mm behind kerb location and at design level	
Subbasecourse density	Nuclear Densometer test every 25 metres All Contractors test results	CSS Part 6: 4.2	Y	Y	Y	Minimum 2100 kg/m ³ , 95% of readings exceeding 2150 kg/m ³	
Subbasecourse level	Measure depth from string line every 50 metres and at all grade changes and TPs.	CSS Part 6: 4.2	Y	Y	N	Finished levels within -25mm & +5mm of design.	

Testing		Inspection		Verification			
Phase	Test / Material Certificate Audit Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N	Acceptance Criteria	Signed / Accepted / Date
Concrete placement	All Contractors test results	CSS Part 6: 4-3	Y	Y	N	Slump 75mm	
Kerb level	Check level of kerb every 50 metres and at all grade changes and TPs	CSS Part 6: 4.4	Y	Y	N	Finished level +/- 5mm of design	
Kerb alignment and location	Check alignment and location every 50 metres and at all TPs	CSS Part 6: 4.4	Y	Y	N	Location +/- 10mm of design, max 5mm deviation, cumulative visible gaps 10mm over 3m straightedge	
Tree pit excavation	Check dimensions, subgrade condition in 1/5 th tree pits	CSS Part 2: 8.4, Part 7: 6.6	Y	Y	Y	Minimum 1000mm deep, 750mm wide, subgrade loosened for 150mm all around	
Tree pit construction	Check finished level of filling, mulch area in 1/5 th tree pits	CSS Part 2: 9.5.4, Part 7: 6.6	Y	Y	N	Finished surface +0mm, -0mm design Mulch extends 150mm outside tree stakes	
Trench excavation	Check dimensions of each fifth trench	CSS Pt 3: 8.7	Y	Y	N	Minimum 850mm to invert in drives, 750mm to invert in untrafficked areas without protection	
Pipe laying	Check fall to outlet of each fifth pipe	CSS Pt 3: 8.7	Y	Y	N	Invert level of pipe below property gully level	
Pipe haunching	Check depth of haunching of each fifth pipe	CSS Pt 3: SD 344/2	Y	Y	Y	150mm above and below pipe	
Trench backfill compaction	Clegg test each 1/5 th trench. All Contractors test results	CSS Part 4: 13.3	Y	Y	N	Backfill exceeds Clegg Impact value of 35 in the commercial crossing, 25 in other areas.	

APPENDIX XI

Inspection & Test Schedule

Material / Construction Phase	Testing		Specification Reference	Inspection			Verification	
	Test(s) / Material Certificate(s) Required Frequency	Material Certificate(s) Required		Contractor Y/N	Engineer Y/N	Hold Point Y/N	Contract Records	Signed / Completed / Date
Note that the below information is an example for selected phases only. Prepare inspection and test plans unique to the project, incorporating that project's quality criteria for infrastructure and materials installed on that project.								
Materials – Kerb and channel								
CCC AP65	One sieve analysis/500m ³		CSS Part 1: 3.1.2	Y	Y	N	Suppliers certificate Gradings	
Premix concrete for kerb and channel	Suppliers certificate/truck		CSS Part 6: 4.3	Y	Y	N	Suppliers certificate	
100 dia uPVC SN10 kerb entry	Suppliers certificate/delivery		www.ccc.govt.nz/webapps/approvedmaterials/firmAPRDetails.asp?APR_ID=58&ProductName=PVC	Y	Y	N	Suppliers Certificate	
Construction – Kerb and channel								
Subgrade strength	Penetrometer test at 50 metre intervals under kerb and channel		CSS Part 6: 11.6.4	Y	Y	Y	Metalcourse design checksheet	
Kerb and channel stringline	Check height and location of string line at every peg on each day string line used		CSS Part 6: 4.4	Y	N	N	Kerb and channel construction checksheet	
Subbasecourse density	Nuclear Densometer test every 10 metres		CSS Part 6: 4.2	Y	Y	Y	Kerb and channel construction checksheet	

Testing		Inspection			Verification		
Material / Construction Phase	Test(s) / Material Certificate(s) Required Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N	Contract Records	Signed / Completed / Date
Subbasecourse level	Measure depth from string line every 20 metres and at all grade changes and TPs	CSS Part 6: 4.2	Y	Y	N	Kerb and channel construction checksheet	
Concrete placement	Slump test where mix appears dry	CSS Part 6: 4.3	Y	Y	N	Kerb and channel construction checksheet	
Kerb level	Check level of kerb every 20 metres and at all grade changes and TPs	CSS Part 6: 4.4	Y	N	N	Kerb and channel construction checksheet	
Kerb profile	Check profile at all hand boxed sections immediately after pour	CSS Part 6: 4.4	Y	N	N	Kerb and channel construction checksheet	
Kerb alignment and location	Check alignment and location every 20 metres and at all TPs	CSS Part 6: 4.4	Y	N	N	Kerb and channel construction checksheet	
Stormwater outlets	Check outlets at invert after placement	CSS Part 6: 4.5	Y	N	N	Kerb and channel construction checksheet	
Materials – Tree pit							
First class topsoil	One sieve analysis, nutrient content and soil pH test/50m ³	CSS Part 1: 34.1	Y	Y	N	Test results Suppliers certificate	
Bark mulch	One sieve analysis/50m ³	CSS Part 1: 35.2	Y	Y	N	Gradings Suppliers certificate	
Construction – Tree pit							
Tree pit excavation	Check dimensions, subgrade condition of each pit	CSS Part 2: 8.4, CSS Part 7: 6.6	Y	Y	Y	Landscape construction checksheet	
Tree pit construction	Check finished level of filling, mulch area of each pit	CSS Part 2: 9.5.4 CSS Part 7: 6.6	Y	N	N	Landscape construction checksheet	

Testing		Inspection			Verification		
Material / Construction Phase	Test(s) / Material Certificate(s) Required Frequency	Specification Reference	Contractor Y/N	Engineer Y/N	Hold Point Y/N	Contract Records	Signed / Completed / Date
Materials – Property stormwater pipes							
100 dia uPVC SN10 pipe	Suppliers certificate/delivery	www.ccc.govt.nz/webapps/approvedmaterials/firmAPRDetails.asp?APR_ID=58&ProductName=PVC	Y	Y	N	Suppliers Certificate	
TNZ M/4: AP20	One sieve analysis/50m ³	TNZ M/4	Y	Y	N	Suppliers certificate Gradings	
Construction – Property stormwater pipes							
Trench excavation	Check dimensions once for each property	CSS Part 3: 8.7	Y	N	N	Property stormwater checksheet	
Pipe laying	Check fall to outlet for each line	CSS Part 3: 11.2	Y	N	N	Property stormwater checksheet	
Pipe jointing	Check each line doesn't leak	NZS 7643	Y	N	N	Property stormwater checksheet	
Pipe haunching	Check depth once for each property	CSS Part 3: SD 344/2	Y	Y	Y	Property stormwater checksheet	
Trench backfill compaction	Clegg test every 10 metres of trench, on all layers.	CSS Part 3: 15.4	Y	N	N	Property stormwater checksheet	
Property stormwaters	Check all properties connected	CSS Part 6: 4.5	Y	N	N	Property stormwater checksheet	

APPENDIX XII

QUALITY SYSTEM WORK PROCEDURE

Control & Inspection of Pipe Subsoil Drain Construction

1. Scope of this procedure

Subsoil drain construction other than perforated corrugated plastic pipe.

2. Responsibility & Actions

The site supervisor shall be an authorised drainlayer, where the pipe is laid in the legal road or shall be vested. Where the pipe is to be laid under a building consent, the site supervisor shall be a registered drainlayer.

The site supervisor shall be responsible for progressively inspecting the work to ensure it complies with the requirements.

The results of the inspection shall be recorded on the Pipe Subsoil Drain Construction Checksheet for defined sections of drain.

Inspection shall record the following:

- (a) Pipe type and diameter.
- (b) Trench width and depth.
- (c) Bedding and filter material and depth.
- (d) Measured grade.
- (e) Joint details.
- (f) Backfilling.
- (g) Connections.

APPENDIX XIII

ENGINEER'S H&S EXAMPLE CHECKSHEET

Health and Safety Management Plan

CONTRACTOR: _____ DATE: _____

PROJECT DESCRIPTION: _____

The following should be documented:

Requirement Met?

1. Project Description:

- | | Yes | No |
|---|--------------------------|--------------------------|
| > Brief description of the scope of the work or services | <input type="checkbox"/> | <input type="checkbox"/> |
| > Summary of major activities and types of work | <input type="checkbox"/> | <input type="checkbox"/> |
| > Specialist tasks or procedures are documented and reference to safe work procedures and training documented | <input type="checkbox"/> | <input type="checkbox"/> |
| > Areas of project requiring special consideration are documented and procedural requirements are referenced: e.g. presence of public, traffic management, notifiable work, restricted work | <input type="checkbox"/> | <input type="checkbox"/> |

2. Contractor's Health and Safety Structure and System:

- | | | |
|--|--------------------------|--------------------------|
| > Names and positions of personnel with specific health and safety responsibilities are documented | <input type="checkbox"/> | <input type="checkbox"/> |
| > Position and name of the senior person who will liaise with the Engineer on health and safety issues is documented | <input type="checkbox"/> | <input type="checkbox"/> |
| > Name and position of the on-site supervisor is documented | <input type="checkbox"/> | <input type="checkbox"/> |

3. Contractor's Induction and Safety Training

- | | | |
|---|--------------------------|--------------------------|
| > Outline of the contractor's induction procedures for employees and subcontractors | <input type="checkbox"/> | <input type="checkbox"/> |
| > Register of personnel completing the induction programme | <input type="checkbox"/> | <input type="checkbox"/> |
| > Details of employee health and safety training relevant to the project. | <input type="checkbox"/> | <input type="checkbox"/> |
| > Copies of relevant certificates attached e.g. Code of Practice for Temporary Traffic Control, Cable Location, Confined Spaces | <input type="checkbox"/> | <input type="checkbox"/> |
| > Register of persons holding authorisations, permits, competency certificates, licenses etc required for the project | <input type="checkbox"/> | <input type="checkbox"/> |

The following should be documented:

Requirement Met?

Yes No

4. Safe Work Practices and Procedures

- > List of company safe work procedures relevant to the project Yes No
- > Copies of safe work procedures, permits or notifiable work notices Yes No
- > Details of project operations subject to work permits Yes No
- > Work permit procedure documented Yes No
- > Distribution list of people (including subcontractors) issued with safe work procedures Yes No

5. Noise

- > Control measures and standards are documented with clear procedures on how to achieve the control Yes No

6. Hazard Management

- > All hazards (existing and potential) associated with the project are documented on the hazard register form Yes No
- > The hierarchy of controls has been considered (i.e. eliminate, isolate or minimise) Yes No
- > Control measures are documented with clear procedures on how to achieve the control Yes No
- > Evidence of employee and subcontractor training on control measures is included Yes No

7. Workplace Health and Safety Inspections

- > Inspection team documented Yes No
- > Frequency and type of inspection defined Yes No
- > Checklists to be used are included Yes No
- > Procedure for actioning inspection findings included Yes No
- > Hazard reporting procedures documented and form included Yes No
- > Specific areas targeted for inspections documented Yes No

8. Emergency Procedures

- > Overall emergency plan and structure for the project Yes No
- > Register of emergency equipment and locations Yes No
- > Register of current qualified first-aiders Yes No
- > Arrangements/coordination with other worksite occupants in event of emergency Yes No

The following should be documented:

		Requirement Met?	
		Yes	No
9.	Accident Reporting, Recording and Investigation		
>	Details of accident recording, reporting and investigation system and procedures	<input type="checkbox"/>	<input type="checkbox"/>
>	Details of how accidents will be notified to OSH and Engineer	<input type="checkbox"/>	<input type="checkbox"/>
>	Details of how accident statistics are to be compiled (major projects)	<input type="checkbox"/>	<input type="checkbox"/>
10.	Health and Safety Performance Monitoring (Major Projects)		
>	Details of how health and safety performance statistics associated with the project are reviewed	<input type="checkbox"/>	<input type="checkbox"/>
>	Details of how monthly health and safety performance reports will be compiled for review by Engineer	<input type="checkbox"/>	<input type="checkbox"/>
>	Nature of health and safety performance information presented to employees on a regular basis	<input type="checkbox"/>	<input type="checkbox"/>
>	Outline of auditing programme to evaluate the effectiveness of the Health and Safety Management Plan	<input type="checkbox"/>	<input type="checkbox"/>

11. Health and Safety Management Plan Review

This Health and Safety Management Plan has been:

Reviewed by: _____
(Name/Position/Sign)

Approved by: _____
(Sign/Date)

Contractor notified: _____
(Date)

Reviewed by: _____
(Council) (Name/Position/Sign)

APPENDIX XIV

Engineer's Gravity Pipe Test Checksheet

Contractor: _____ Asset (sewer/sw): _____

Project Title _____

Site And Pipeline Information

Overall length (m) _____ Location _____

Pipe material and class _____

Nominal diameter (mm) _____

Pressure Test Standards (to CSS: Part 3)

Contract document reference _____

Type of test	Select test method (delete inapplicable)		
	Visual inspection	Air test	Hydrostatic test
Reference	clause 14.2.3	clause 14.2.5	clause 14.2.4
Performance measure	No leaks or defects visible	Pressure drop less than 2kPa (0.2m) over test period	Water level does not drop over test period ¹

TEST CRITERIA (provide before testing)				TEST RESULTS		
Section tested	Length (m)	Test pressure ² (m)	Test period ³ (min)	Test Date	Pressure achieved (m) or loss (ml)	Pass/fail

Note:

- 1) See Hydrostatic test table for allowable losses under 3.0m test head on reverse of sheet
- 2) Determine hydrostatic test pressure using CSS: Part 3 clause 14.2.4. Test pressure for both types is a minimum of 3.0m.
- 3) Obtain air test period from table in CSS: Part 3 clause 14.2.5 (reproduced on reverse of sheet). Hydrostatic test period is 5 mins.

Engineer _____ Signature _____

Contractor Rep _____ Signature _____

Council Rep _____ Signature _____

Date plan accepted _____

Date and time pipe test witnessed _____ Retest required yes/no

NCR reference _____ Pipeline accepted yes/no

1. Hydrostatic Testing

Allowable losses (ml) over a 5 minute test period

Conditions: Concrete pipe, where 30kPa hydrostatic test is required.

Pipe diameter (mm)	Length of test section (m)							
	5	10	15	20	30	40	50	100
225	28	56	84	113	169	225	281	563
300	38	75	113	150	225	300	375	750
375	47	94	141	188	281	375	469	938
450	56	113	169	225	338	450	563	1125
525	66	131	197	263	394	525	656	1313
600	75	150	225	300	450	600	750	1500

2. Air Testing

Length of air test required (min:sec)

Conditions: Maximum permissible loss in a concrete or ceramic pipe is 2kPa or 0.3 PSI.

Pipe diameter (mm)	Length of test section (m)									
	10	20	30	40	50	60	70	80	90	100
150	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00
200	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00	2:00
225	2:00	2:00	2:00	2:00	2:00	2:00	2:10	2:10	2:10	2:10
250	2:00	2:00	2:00	2:00	2:20	2:30	2:40	2:40	2:40	2:40
300	2:00	2:00	2:00	2:20	3:00	3:00	3:00	3:00	3:00	3:00
375	2:00	2:00	2:40	3:40	3:40	3:40	3:40	3:40	3:40	3:40
450	2:00	2:30	3:50	4:20	4:20	4:20	4:20	4:20	4:20	4:20

APPENDIX XV

Engineer's Concrete Pressure Pipe Test Checksheet

Contractor: _____ Asset (sewer/water): _____

Project Title _____

Site And Pipeline Information

Overall length (m) _____ Location _____

Pipe material and class _____ Test water disposed of to _____

Nominal diameter (mm) _____

Pressure Test Standards (To CSS: Part 3)

Contract document reference _____

Select test method (delete inapplicable)		
Type of test	Working pressure water test	Max operating pressure water test
Reference	clause 14.3.1	clause 14.3.1
Performance measure	No pressure loss	Measured loss mm/hr not to exceed 0.3 x length m x dia mm
Test period	3 hrs	5 mins

Thrust Blocks

Block identifier	Bearing capacity (kPa)		Redesign required	New design details
	Assumed	Site verified		
<i>Add rows as necessary</i>				

TEST CRITERIA (provide before testing)			TEST RESULTS		
Section tested	Length (m)	Specified test pressure or allowable loss	Test Date	Pressure achieved (m) or measured loss (mm/hr)	Pass / fail
<i>Add rows as necessary</i>					

Engineer _____ **Signature** _____

Contractor Rep _____ **Signature** _____

Council Rep _____ **Signature** _____

Date plan accepted _____

Date and time pipe test witnessed _____ Retest required yes/no

NCR reference _____ Pipeline accepted yes/no

APPENDIX XVI

Engineer's Pressure Pipe Test Checksheet

Contractor: _____ Asset (sewer/water): _____

Project title _____

Site and Pipeline Information

Overall length (m) _____ Location _____

Pipe material and class _____ Test water disposed of to _____

Nominal Diameter (mm) _____

Pressure Test Standards

Contract document reference _____

<i>Select test method (delete inapplicable)</i>		
Type of test	Pressure rebound method	Constant pressure method
Material	PE ≤ DN315	DI, GRP, PVC, steel
Reference	clause 6.3.4.4	clause 6.3.4.1
Performance measure	Pressure rises or remains static	Make up water $Q \leq 0.14LDH_1$
Test pressure (m)	1.25 x max operating pressure but less than 1.25 x rated pressure	

Thrust Blocks

Block identifier	Bearing capacity (kPa)		Redesign required	New design details
	Assumed	Site verified		
<i>Add rows as necessary</i>				

Constant Pressure Method *Remove redundant test method*

TEST CRITERIA <i>(provide before testing)</i>			TEST RESULTS		
Section tested	Q (l/hr) ¹	Specified test pressure (m)	Test Date	Makeup water used (l/hr)	Pass / fail

Pressure Rebound Method *Remove redundant test method*

TEST CRITERIA <i>(provide before testing)</i>		TEST RESULTS				
Section tested	Specified test pressure (m)	Test Date	P ₆₀ ²	ΔV ²	Pressure plot ²	Pass / fail

Notes

- 1) Provide details of this calculation.
- 2) Provide time/pressure readings and graphed results to confirm test details, as detailed in NZS 2566.2.

Engineer _____ Signature _____

Contractor Rep _____ Signature _____

Council Rep _____ Signature _____

Date plan accepted _____

Date and time pipe test witnessed _____ Retest required yes/no

NCR reference _____ Pipeline accepted yes/no

APPENDIX XVII

CONSTRUCTION CHECKSHEET

Activity – Pipe Subsoil Drain Construction

Contract/Job: _____ Date: _____

Drain Location: _____

Task	Acceptance Criteria/ Test Frequency	Task/Completion Signature/ Comment
1. Drawings and specifications checked for requirements		
2. Pipe material > type class > diameter		
3. Filter material > specification > grading		
4. Trench > alignment check > grade (normal min 1:100) > width > depth		
5. Bedding > min depth 75mm > sockets not bearing	Yes/No	
6. Pipe laying > sockets uphill > joints clean, invert flush > joints as detailed > rings required > isolated from surface water		
7. Backfill material > specification > grading		
8. Backfill placement > layer depth > compaction		
9. Connections > as per design > location		

Arising NCR: _____

All tasks defined above have been satisfactorily completed to the standards required:

Contractor: _____ (Sign/Date)

APPENDIX XVIII

CONSTRUCTION CHECKSHEET

Activity – Basecourse Stringing

Contract/Job: _____ Date: _____

Road Location: _____

Refer to diagram on back of this sheet for measuring diagram

Ch.	L	C	R	Ch.	L	C	R

APPENDIX XIX

PUMP STATION OUTSTANDING WORK/DEFECT LIST

Workpack Ref:		Station Name:		Page No.: of							
CITY ENVIRONMENT GROUP CONSTRUCTION / COMMISSIONING WORK PACK OUTSTANDING WORK/DEFECT LIST		CITY ENVIRONMENT GROUP CONSTRUCTION / COMMISSIONING WORK PACK OUTSTANDING WORK/DEFECT LIST		CITY ENVIRONMENT GROUP CONSTRUCTION / COMMISSIONING WORK PACK OUTSTANDING WORK/DEFECT LIST							
ITEM NO.	ITEM REPORTED BY, CATEGORY, AND DISCIPLINE:				PERSON TO ACTION	PROGRESS REPORT		ITEM COMPLETED		ACCEPTED BY CEG	
	Initial	Date	Category	Discipline		Type	Initial	Date	Initial	Date	Initial	Date

The listed Defect List items **must** be completed as dictated by the stated Category before the commissioning of the asset covered by this Construction Work Pack proceeds to the next phase. Phases and Categories are detailed in the Pump Station Pre-Commissioning, Commissioning and Testing Procedure.

- > **Category A** – Complete prior to handover to CEG for Control System Commissioning
- > **Category B** – Complete prior to Clean Water Commissioning
- > **Category C** – Minor items that do not prevent commissioning
- > **Category D** – Items not part of project scope and SCIRT agreement required to incorporate

Type refers to the following:

- > **Snag (S)** - any defects/faults/problems/issues/actions identified prior plant handover
- > **Defect (D)** - any defects/faults/problems/issues/actions identified at plant handover and during Defect Liability Period

Discipline Codes: General – Gen; Civil – Civ; Mechanical – Mech; Electrical – ELEC; SCADA - EICA