# The Value of SCIRT

**Final Report**
**30 June 2018**


**What we are here for:**

***Creating resilient infrastructure***
***that gives people security and confidence***
***in the future of Christchurch.***

## Report

This report has been prepared in accordance with the Australian Government National Alliance Contracting Guidelines, Guidance Note 4, Reporting Value-for-Money Outcomes, September 2015. It summarises the value for money achieved on the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) project. Enquiries regarding the report can be directed to SCIRT Learning Legacy:

https://scirtlearninglegacy.org.nz/contact

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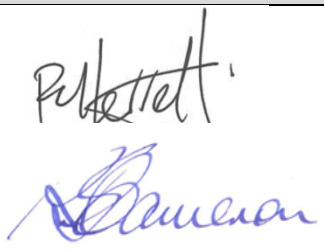
| Report Authors | Ross Herrett,<br>Rod Cameron |  | 11/04/2019 |

# Glossary* for Value of SCIRT

**AA** – Alliance Agreement

**ACC** – Accident compensation scheme

**ACENZ** – Association of Consulting Engineers New Zealand

**AFG** – Audit Framework Group

**Alliance** – Collaborative venture between owner participants and non-owner participants to deliver a project

**AOC** – Actual out-turn cost, the actual cost of a project

**ASCE TCLEE** – American Society of Civil Engineers' Technical Council on Lifeline Earthquake Engineering

**Asta** – Scheduling tool

**BAU** – Business as usual

**Brunel International Lecture** – Recognises international excellence by a civil engineer

**Brunel Medal** – Recognises international excellence in civil engineering

**CCC** – Christchurch City Council

**CCDU** – Central City Development Unit of CERA

**CCTV** – Closed-circuit television

**CCEG** – Civil Contractors' Environmental Guide

**CERA** – Canterbury Earthquake Recovery Authority

**CGG** – Client Governance Group

**CIPP** – Cured in place pipe (lining)

**Commercial model** – Creating, delivering and capturing value

**CMT** – Client management team

**CPI** – Cost performance indicator (CPI)

**Critical 8** – Eight critical operational safety risks, in a disaster recovery plan

**CSA** – Cost-sharing agreement

**CTOC** – Christchurch Traffic Operations Centre

**Delivery Earned Value Analysis** – Special method of measuring project progress

**Design Earned Value Analysis** – Special method of measuring project progress

**DO** – Design organisation

**EAA** – External alliance auditor

**ECan** – Environment Canterbury

**ECI** – Early constructor involvement, the role of constructors early in a project

**EERI** – Earthquake Engineering Research Institute, the United Nations, World Bank and European Union-funded body

**EGM** – Executive general manager

**EIR** – External information request

**FFC** – Forecast final cost

**FOR REAL** – Focused staff recruitment and skills development campaign

**Forward Works Viewer** – Interactive web-based platform to observe active and planned works geographically to aid coordination and planning and enable the mitigation of spatial and traffic conflicts

**GIS** – Geographic Information System

**HAIL** – Hazardous Activities and Industries List (relating to ground conditions)

**Handover** – Handover of project to asset owner

**hdpe** – High-density polyethylene

**HIGG** – Horizontal Infrastructure Governance Group

**HiViz** – Web-based frontend reporting and analysis portal

**HIMT** – Horizontal infrastructure management team

**IAA** – Initial Alliance Agreement

**ICE** – Institution of Civil Engineers

**IE** – Independent estimator

**IPCT** – Infrastructure programme coordination team

**IPSG** – Infrastructure programme steering group

**IPTG** – Infrastructure programme transition group

**IRMO** – Infrastructure Rebuild Management Office

**IRTSG** – Infrastructure Rebuild Technical Standards and Guidelines

**IST** – Integrated services team

**JD Edwards** – Financial system

**KPI** – Key performance indicator (performance measurement)

**KRA** – Key results area (performance measurement)

**LDO** – Lead design organisation

**LINZ** – Land Information New Zealand

**Limb** – Alliancing payment model in three parts from project cost to share of “pain/gain”

**LoS** – Level of Service or Design Guide 43, assessing asset life and avoiding repair of non-critical assets

**LTIFR** – Lost time injury frequency rate

**LTP** – CCC long term plan

**MBIE** – Ministry of Business, Innovation and Employment

**MCA Tool** – Multi-criteria analysis tool

**Microsoft Project** – Scheduling tool

**MoU** – Memorandum of Understanding

**MTIFR** – Medical treatment injury frequency rate

**NCR** – Non-conformance report

**NOP** – Non-owner participant

**NOR** – Notice of requirement instructions to Delivery Teams

**NZPI** – New Zealand Planning Institute

**NZQA** – New Zealand Qualifications Authority

**NZSEE** – New Zealand Society of Earthquake Engineers

**NZTA** – New Zealand Transport Agency

**OAG** – Office of the Auditor-General

**OP** – Owner participant

**OPS** – Overall Performance Score

**Optimisation process** – Funder review of project list

**P&G** – Delivery team preliminary and general overhead cost allowances in budgets.

**Pain/Gain** – Pain/gain formula determines and apportions any excess costs or cost savings regarding a project target cost

**P50** – Idealised value

**PI** – Professional indemnity

**Pipe dips** – Pipe profilometer programme measures grade fluctuations in gravity wastewater pipes to assess vertical misalignment

**PRINZ** – Public Relations Institute of New Zealand

**ProjectCentre** – Information, process flow and document management

**PSAG** – Professional Services Advisory Group

**QA** – Quality Assurance

**Red zone** – Post-disaster worst-affected area

**RFP** – Request for proposal

**Risk register** – Risk management tool

**SCIRT** – Stronger Christchurch Infrastructure Rebuild Team

**SCIRT Learning Legacy** – The SCIRT Learning Legacy website documents and shares SCIRT lessons and innovations. It makes freely available the resources and tools to benefit organisations and communities worldwide

**Service strike** – Contact with underground utilities can cause damage, injury and death

**SPI** – Schedule performance indicator

**TOC** – Target out-turn cost, the target cost of a project

**Trenchless technology** – Pipe repairs involving directional drilling, driving or inserting pipes or linings into a damaged pipe, without dig and lay techniques

**TRIF** – Total recordable injury frequency

**12d Model** – Engineering and surveying software package

**3W** – Three waters (water, storm water and wastewater)

**UC** - University of Canterbury

**Value register** – Sits within Project Centre and allows for the capture and management of innovations, engineering gains, lessons, asset system improvements, and safety and environmental initiatives

**VfM** – Value for Money

**WAVE -** the “wide-angle view expected” frontline leadership programme

**Worksafe** – Workplace health and safety regulator

**Zero Harm** – An industry expression of safety focus

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Appendix B International Post-Disaster Rebuild Mechanisms

Appendix C CCC Report

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# 1 Executive summary

## 1.1 Introduction

This document outlines the performance and achievements of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) to the end of the programme or work, June 30, 2017.

It includes reporting at the level above individual teams and projects.

The format and structure broadly follow the template in Appendix B of the National Alliance Contracting Guidelines, Guidance Note 4, Reporting Value-for-Money Outcomes produced by the Australian Government Department of Infrastructure and Regional Development.

It demonstrates the truth of the SCIRT slogan ***'There is value in everything we do.'***

## 1.2 Achievement of alliance objectives

SCIRT achieved or exceeded the key Alliance Agreement (AA) objectives.

It delivered value through:

- Lifting the 'zero harm' performance of all alliance participants to industry best practice. The AA set a target <10 total recordable injury frequency rate (TRIFR). SCIRT achieved a <5 TRIFR rate and 2.8 million working hours without a lost time incident.
- Demonstrating best long-run value for money and increasing productivity and resource utilisation as the work progressed.
- Demonstrating environmental responsibility. The SCIRT *Civil Contractors' Environmental Guide* was promoted by Environment Canterbury (ECan) and Civil Contractors New Zealand as regional best practice.
- Maintaining an open and honest dialogue with residents regarding the rebuild. Independent surveys consistently confirmed a high level of community satisfaction with SCIRT's proactive communications.
- Maintaining high levels of customer service. SCIRT built rapport with affected residents and businesses, conscious of the impact of its work. It worked hard to minimise disruption.
- Establishing an interim level of service for water, wastewater and roading for all residents.
- Doing the right thing, at the right time to the right standard with minimal rework. SCIRT applied industry-leading business processes to complete work on a large scale in a short time frame. It ensured repairs were in accordance with owner requirements, done in priority order and met prescribed quality standards before completion was certified.
- Returning built assets that were more resilient than pre-earthquakes to the Christchurch City Council (CCC).
- Being innovative at all levels and disseminating new ideas and lessons to infrastructure providers throughout New Zealand
- Coordinating work with fellow rebuild organisations. SCIRT played a leading role in central city programme coordination and helped establish the Christchurch Traffic Operations Centre (CTOC) and the web-based wider industry Forward Works Viewer.
- Ensuring the infrastructure sector maintained a sustainable market condition during the rebuild while maximising local resources to deliver the work.
- Lifting sector-wide workforce capability by developing the skills of individuals and subcontractors and delivering additional resources to the market by recruiting and training people who were unemployed or from other industries.

## 1.3 Best price for the right scope

Ultimately, the programme scope was determined by the SCIRT owner participants (OPs). They did not agree on a "budget" for the horizontal infrastructure rebuild until 2013, nor fully confirm the scope until December 2015, a year before the targeted construction completion.

These decisions, along with the time required for damage assessment, resulted in the use of target out-turn cost (TOC) estimates for individual projects, rather than a single TOC for the whole programme. As a result, SCIRT had added flexibility to respond to change.

Independent reviews of project TOCs and the estimating process confirmed that "best prices" were set. The delivery teams achieved, on average, actual out-turn costs (AOC) within less than 1 per cent of TOC. In a post-disaster environment of uncertainty and limited resources, this illustrated a lean and efficient organisation.

The unique competitive-collaborative alliance model achieved value from the competition between delivery teams for a share of the work and the collaboration and sharing of experience, expertise and lessons between those teams and with and between design teams.

CCC, the primary asset owner and part funder, and the government as a funder, might have had differing views on the amount of work to be included in the jointly funded rebuild programme, but robust, positive discussion and evaluation, and the SCIRT project prioritisation process, ensured work was completed in a decreasing order of priority and criticality.

For all the above reasons, this meant the "right scope" was completed for the available funds.

## 1.4 Owners' standards and requirements

The owners' standards and requirements were addressed in SCIRT governance and management plans, procedures and processes. Generally, they were met or exceeded during the programme.

## 1.5 Post-disaster infrastructure rebuild

SCIRT rebuilt infrastructure immediately following a disaster, within the early years of the recovery of Christchurch following the earthquakes of 2010 and 2011. Many aspects of SCIRT should be therefore considered within the wider range of value that it could and did bring to the city as an agent for recovery. These are reported integrally within this report and are not treated in isolation from the template.

Similarly lessons from SCIRT captured in the Learning Legacy and the concept for a national disaster readiness and rebuild entity ENGAGE are explained in this report.

# 2 Background

There was no approved business case or owners' VfM statement for SCIRT.

SCIRT was established in 2011 to reinstate publicly owned horizontal infrastructure in the city of Christchurch, including state highways, local roads and water, storm water and wastewater utility services, damaged during the Canterbury earthquakes in September 2010 and February 2011.

Restoring services quickly was essential to the success of the broader earthquake response and recovery. However, there was no contingency plan for a rebuild programme of this magnitude. Therefore, the owners had to select and establish a delivery vehicle amid a major disaster response. Nevertheless, the SCIRT creation process met the intent of an approved business case and owners' VfM statement. It would be possible – utilising the process documentation – to construct a "de facto" business case and VfM statement for SCIRT.

## 2.1 The business case

### 2.1.1 The investment decision

#### 2.1.1.1 The problem

The 2010 earthquake was centred 35 kilometres to the west of Christchurch. Moderate damage to the city's horizontal infrastructure was largely confined to discrete areas.

CCC established the Infrastructure Rebuild Management Office (IRMO) and engaged five contractors in collaborative design and construct, cost reimbursement contracts to carry out repairs to the city's horizontal infrastructure in loosely defined geographical areas.

At the time of the February 2011 earthquake, the design and construction organisations were variously advanced in rebuild design. Construction was under way at some sites.

The city-centred 2011 earthquake increased the damage in intensity and scale by an order of magnitude, severely compromising transportation, water, storm water and wastewater networks and leaving many areas without essential services or safe access.

Most of the damaged infrastructure was owned by the council, while the remainder was controlled by the New Zealand Transport Agency (NZTA).

Central and local government stakeholders and the IRMO contractors reflected on the bigger challenges in repairing the city's infrastructure. As a result, the government and the council determined a different approach was necessary.

#### 2.1.1.2 The solution

The initial SCIRT concept was proposed during discussions between industry and government leaders. It was developed within a few weeks by a small team of industry professionals drawing on the NZTA experience with alliance delivery models.

In a recommendation to the government, NZTA, CCC and the embryonic Canterbury Earthquake Recovery Authority (CERA), the formation of a city-wide rebuild alliance with the IRMO contractors was proposed.

(See Appendix D for the report and recommendations to the council.)

The alliance and rebuild programme would be funded by New Zealand taxpayers and Christchurch ratepayers – together with a small amount of insurance funds – through CERA, NZTA and CCC.

#### 2.1.1.3 The benefits

The scale and costs of the earthquake damage were very significant in human terms. From the outset, it was understood that the infrastructure rebuild would lead city redevelopment and that would help drive recovery through the generation of security and confidence across the community.

The SCIRT programme would complete the restoration of essential water, storm water and wastewater services initiated by the Civil Defence emergency response and IRMO, thereby reducing public health risk to acceptable levels and improving the quality of residents' lives.

Repairs to roads, retaining walls and bridges would re-establish transportation routes and, together with services restoration, enable businesses and service providers to resume operations and take a big step towards normality for Christchurch residents.

### 2.1.2 The project management decision

#### 2.1.2.1 The procurement process

A request for proposal (RFP) issued on April15, 2011 sparked the SCIRT formation. All five contractors responded to the proposal.

On May 4, 2011, SCIRT began with an Initial Alliance Agreement (IAA). Under the agreement, the alliance participants had 120 days to prepare and submit a fully developed agreement and establish a high-performance structure. The new entity would have to make an immediate start when the full agreement was signed.

The successful conclusion of the initial agreement was reached in September 2011 with the signing of the Alliance Agreement (AA), establishing a clear structure, functions and processes, together with objectives and an over-arching strategy.

**Figure 1 Sign-up: People pen their SCIRT support.**

#### 2.1.2.2 Capacity to deliver

The unprecedented scale of the rebuild programme required a resourcing focus. It was important to maximise local participation. However, neither the local market nor any one national organisation had the capacity to deliver those resources alone.

The participation of the five national contracting organisations ensured resource availability and programme management capability.

Relationships with professional services providers under the IRMO programme also could be leveraged to provide the necessary services.

#### 2.1.2.3 Project management strategy

The objectives and requirements of a post-disaster rebuild differed significantly from those of a "business as usual" (BAU) major project. A "standard" alliance model would not provide the best value. SCIRT was shaped by unique circumstances. In some ways, it was an experimental and atypical alliance.

It was clear that, with the rebuild work likely to be defined, designed and priced in piecemeal fashion as the asset assessment programme progressed, a programme of separate rebuild projects would be the logical approach.

This, in turn, suggested an organisational structure comprising a programme management team responsible for the asset assessment programme and the definition, design and pricing of projects. These would then be allocated to construction teams to deliver.

## 2.2 The owners' VfM statement – Part A owners' project objectives

### 2.2.1 Objectives and benefits of government investment

#### 2.2.1.1 Project background

Refer Section 2.1 above.

#### 2.2.1.2 Link to government policies

The Civil Defence Emergency Management Act (2002) establishes the roles and responsibilities of national and local government in the response to a natural disaster, such as the Canterbury earthquakes. The act requires the preparation of national and local Civil Defence emergency management plans.

Regarding funding, the National Civil Defence Emergency Management Plan (2015) states that the objectives of any government financial support to local authorities are to:

(a) provide support by meeting some of the costs incurred in managing the response to, and recovery from, an emergency; and

(b) provide the minimum level of assistance required to restore to an affected community the capacity for self-help; and

(c) return an affected community to a state in which normal social and economic activity can be resumed as quickly as possible.

#### 2.2.1.3 The service benefits of the investment

Refer section 2.1.1.3 above.

#### 2.2.1.4 Objectives specific to the alliance

The following objectives are stated in Section 1.3.1 of the AA. They have a notional hierarchy. However, they indicate the issues of concern to the government and the council.

a) Lift the zero harm performance of all alliance participants to industry best practice in New Zealand:

i) TRIFR 10 per 1,000,000 worker hours worked, 12 months rolling average.
ii) Zero Department of Labour infringement, prohibition or improvement notices issued.
iii) Zero environmental infringement notices issued.

b) Demonstrate best long-run value for money and demonstrate environmental responsibility:
   i) Maintain a cost database in relation to work under the alliance which demonstrates increasing productivity and resource utilisation as the work progresses.
   ii) Undertake work by matching capability to the scale and complexity of the work.
   iii) Provide a key reference for construction costs for the total rebuild effort across Christchurch.
   iv) Reduce and recycle to eliminate waste.

c) Maintain an open and honest dialogue with all residents over the rebuild effort:
   i) Work to ensure messages to communities are coordinated with other rebuild efforts (e.g. housing).
   ii) Be proactive with communication and make it face-to-face where possible.
   iii) Do what we say we will do.
   iv) Communicate in simple language.

d) Maintain high levels of customer service in the rebuild effort:
   i) Plan the work so when we go in, we do it once, do it quickly and do it well.
   ii) Build rapport with affected residents and go the extra mile where required.
   iii) Present ourselves as tidy and professional and be conscious of the impact our work has on residents going about their normal day-to-day lives.
   iv) Coordinate all work to minimise disruption to the customer.

e) Establish, for all residents, an interim level of service for water, wastewater, storm water and roading within six months;
   i) Make urgent and temporary reconnection of services a priority as this will improve quality of life and increase confidence in the rebuild effort.
   ii) Keep people in their houses where practically possible to increase well-being and take pressure off other infrastructure.
   iii) Acknowledge that this means there will be some additional cost if, subsequently, houses are retired or rebuilt.

f) Quickly protect the environment and reduce future health hazards:
   i) Stop pumping raw sewage into the Avon and Heathcote rivers within four months.
   ii) Rehabilitate the environment and clean up all residual waste within 12 months.
   iii) Minimise further health hazards due to a winter lift in the water table.

g) Do the right thing, at the right time to the right standard every time. Complete the rebuild effort to prescribed standards with minimal rework:
   I) Complete the rebuild work in accordance with the network and facilities rebuild strategy.
   ii) Undertake the work in the correct priority order to achieve best value for money whilst minimising the impact on the community.
   iii) Incorporate innovations and greater resistance to withstand subsequent seismic events.
   iv) Ensure whole life performance of new assets meets industry asset management standards.

h) Return the built assets to CCC with proof they will be more resilient than they were before:
   I) Clearly articulate long-term asset performance.
   ii) Comply with appropriate infrastructure design standards.
   iii) Hand over asset information and operations manuals in relation to the alliance works, which set a benchmark for New Zealand.
   iv) Accept a defects period of one year minimum for each project.

i) Incorporate ideas currently not known:
   I) Work hard on innovations at all levels.
   ii) Break down unsustainable cost structures on assets or services to ensure CCC has the lowest whole of life cost structures moving into the future.
   iii) Disseminate all new ideas to all infrastructure providers throughout New Zealand.

j) Coordinate the work with others doing rebuild work:
   i) Establish a forum to share planning efforts.
   ii) Coordinate work within areas to avoid excessive disruption.
   iii) Adjust priorities to ensure coordinated work is undertaken.
   iv) Maximise use of underground trenches and/or trenchless technology to accommodate all services.

k) Rebuild Christchurch ensuring the infrastructure sector maintains a sustainable market condition:
   i) Establish the lowest cost structures to the rebuild effort.
   ii) Maximise the use of local resources to deliver the work, provided those resources can be obtained at prices and on terms that are competitive with similar resources available from elsewhere.
   iii) Maintain appropriate systems to ensure and prove the market is sustainable.

l) Purposefully lift the capability of the sector-wide workforce:
   i) Return CCC-embedded resources back to the CCC as more capable than when they went in.
   ii) Lift the capacity of all subcontractors.
   iii) Establish greater capability for current specialist infrastructure activities.
   iv) Do something meaningful to reduce the level of unemployment in Christchurch.
   *v)* Target delivering a new wave of skilled resources into the market.

### 2.2.2 Project costs and scope

#### 2.2.2.1 Overall funding

Earthquake-related repairs to the horizontal infrastructure were jointly funded by the New Zealand government (CERA and NZTA) and CCC.

Post-February 2011, funding was initially provided on an indemnity basis.

In 2013, a cost-sharing agreement (CSA) was reached between the funders for the earthquake recovery programmes, including horizontal infrastructure repairs.

The CSA allowed for $2.94 billion for horizontal infrastructure work, including but not defining the SCIRT programme, with the Crown contributing $1.8b and the council $1.14b.

The CSA stipulated that water, storm water and wastewater (3W) work would be funded by CERA and CCC, with roading infrastructure repairs funded by NZTA and CCC. It stipulated the amount NZTA and CERA would each provide accordingly.

It was agreed that CERA would fund 60 per cent of qualifying 3W works and NZTA would fund 83 per cent of qualifying road, bridge and retaining wall work.

CERA funds would come from government appropriation while NZTA funds would come from operating revenue.

The CSA made no provision for asset improvement, repairs covered by insurance, or capital projects planned by CCC prior to the earthquakes.

Where it made sense to include such work in the SCIRT programme, it would be funded 100 per cent by CCC.

The CSA was the outcome of negotiations between the Crown and the council based on their information, without consultation with SCIRT. The CSA allowed for the independent review and adjustment of the agreement, if required.

#### 2.2.2.2 Scope of alliance works

Under Schedule 4 of the AA, the scope of alliance works included:

a) Developing and maintaining an estimated out-turn cost of the alliance works.

b) Repairing and reinstating the water supply, storm water drainage and wastewater drainage systems, including reticulation, pressure mains, pumping stations, reservoirs and waterways, to a standard and level of service comparable with the level immediately prior to the September 2010 earthquake.

c) Repairing and reinstating the local road network to a standard and level of service comparable with the level immediately prior to the September 2010 earthquake.

d) Repairing and reinstating the state highway network to a standard and level of service comparable with the level immediately prior to the September 2010 earthquake, as generally specified in the document “STATE Contract No. 10/11-149, Stronger Christchurch Infrastructure Alliance, Alliance Agreement (Draft), SCOPE FOR STATE HIGHWAY NETWORK REINSTATEMENT”.

e) Incorporating identified renewal and improvement projects into the work as required.

f) Agreed further works.

Although not expressly stated, the alliance scope included the assessment of the earthquake damage to the infrastructure that enabled the scope of necessary repairs and reinstatement to be fully defined. It would take three years to complete that assessment.

The scope definition also demanded an understanding of what was required to “repair and reinstate” infrastructure “to a standard and level of service comparable with that which existed immediately prior to the September 2010 earthquake”.

A guide, entitled *Infrastructure Rebuild Technical Standards and Guidelines* (IRTSG), was initially issued for this purpose.

Further guidelines were created or issued during the SCIRT programme to provide clarification, including which work qualified for CSA funding.

#### 2.2.2.3 Alliance budget

Initially, no alliance budget was set. In April 2011, external consultants said the SCIRT programme would cost between $1.7b and $2.8b, with a “P50” value of $2.2b.

The first budget was to be established when enough damage assessment was completed to enable the total programme cost to be estimated with enough accuracy.

SCIRT created its first total cost estimate in October 2012, suggesting savings leading to an estimate of $2,496 million.

SCIRT treated that figure as a budget, which stood until the CSA.

As it transpired, no agreed budget was formally established for the SCIRT programme. The CSA provided funders with an overall budget for repairing earthquake damage to horizontal infrastructure. However, it was not clear how much of that budget was allocated to the SCIRT programme. SCIRT was also required to complete non-CSA work.

#### 2.2.2.4 Developing the TOC

With a programme of projects, it was logical that TOC setting would be progressive, project by project, and reported cumulatively.

TOCs would evolve as market conditions and actual costs and productivities changed or were better understood.

TOCs had to be built up from first principles using a master pricing schedule updated at least every six months with input from the funders-appointed independent estimator (IE). The SCIRT Board (or alliance manager under delegated authority) had to approve each TOC. Designers and delivery teams had to provide a set of standard deliverables for each project to inform the estimators, and there had to be a reasonable level of agreement between SCIRT estimators and the IE before TOCs could be submitted for approval.

#### 2.2.2.5 Independent verification of project cost

The AA made provision for two independent roles to enable verification of project and programme cost:

- An external alliance auditor.
- An independent estimator.

The external alliance auditor had to ensure the NOPs received their exact entitlement in respect of all payments due.

The IE had to:

- Validate the TOCs.
- Confirm the valuation of variations to TOCs was reasonable.
- Help maintain and confirm the master pricing schedule.

**Figure 2 TOC vox: TOC verification discussions included multiple interests.**

#### 2.2.2.6 Benchmarking project costs

The benchmarking of external supply prices and internal delivery achievements was established from the start by SCIRT and independent estimators. All benchmarks were subject to regular monitoring, review and reporting.

#### 2.2.2.7 Game-breaking performances

Several AA objectives were game-breaking.

SCIRT was set up to facilitate and promote game-breaking performances in various areas. These included the commercial model, peak performance plans, encouragement of innovations from design and construction, “value initiatives” and key results area (KRA) and key performance indicator (KPI) processes.

The KRAs and KPIs measured performance in achieving non-price alliance objectives. The AA required that exceptional performance be rewarded in two ways:

1) KPI scores were weighted and combined to establish an overall performance score (OPS) to help determine Limb 3 (pain/gain) payments.
2) The project allocation to constructor delivery teams was influenced by comparative cost and non-cost performance (NCP). The KPIs helped assess each delivery team’s NCP.

### 2.2.3 Programme risks and risk management

The AA was silent on risk, except to require a Risk and Opportunities Management Plan. This separately identified programme and project risks and the processes for identifying, allocating and managing both.

Programme risks were reviewed and reported monthly by the management team champions and, at least, annually with board involvement.

(A copy of the programme risk register showing initial high or extreme risks only is included in Appendix D.)

#### 2.2.3.1 Key project risks

Key (design and “engineering” works) project risks, their allocation and their management were detailed on project risk registers created during concept design and updated by project teams as the project progressed through design and construction.

During the design process, one or more risk workshops involving designers, constructors and functional specialists helped identify and develop project risk controls.

SCIRT's integrated services team (IST), which incorporated the design teams, managed risks until the project was allocated to a delivery team. The delivery team then took over risk management.

Key project risks and their management were also addressed in programme management plans drafted in conjunction with the AA, including the SCIRT Design Management Plan and the SCIRT Construction Management Plan.

#### 2.2.3.2 Community, stakeholder and environmental risks

Community, stakeholder and environmental risks were particularly significant after a natural disaster.

The loss – or unreliability – of essential services was just one of many issues for an earthquake-affected residential or business community. Street works during the infrastructure rebuild created further issues.

There were high expectations of the government, the council and other SCIRT stakeholders to deliver effective solutions in a timely and efficient manner for the least cost and disruption while maintaining an acceptable interim level of service.

Programme stakeholders included other response and recovery programme managers. Close coordination maximised collective delivery, particularly for central city projects.

Key community, stakeholder and environmental risks and their management were also addressed in programme management plans drafted in conjunction with the AA, including the SCIRT Stakeholder Management Plan and the SCIRT Environmental Management Plan.

Community, stakeholder and environmental risks specific to projects were managed at project level, as described in Section 2.2.3.1.

#### 2.2.3.3 External risks

External risks to the SCIRT programme included natural disasters and, particularly, the prospect of further earthquakes and flooding.

In the short term, aftershocks could threaten construction work and the risk of more earthquakes required design consideration (to provide "resilience").

The earthquakes caused vertical ground displacements and localised slumping into waterways, increasing the significant flood risk for parts of the city.

Key external risks and their management were addressed in programme management plans drafted in conjunction with the AA, including the SCIRT Emergency Response Plan and the SCIRT Design Management Plan.

#### 2.2.3.4 Timelines

The AA took effect from September 1, 2011. It set September 1, 2016 as the programme practical completion target, with final programme completion a year later at the end of the defects liability period on the last project.

The likely five-year construction period timeline included a ramp-up phase in the first year, followed by steady throughput until a steep wind down.

#### 2.2.3.5 Critical interfaces

The critical interfaces for the SCIRT rebuild programme included:

- Central city cordon – access to the central city required the relaxation of the inner-city cordon, established to manage safety and security during initial building assessment and demolition activities.
- Residential red zones – infrastructure repair requirements depended on future use decisions. Access to Port Hills red zones required demolition and "making safe" work to be completed by others.
- Central city blueprint – the central city redevelopment plan featured street and river corridor modifications and land use changes, including several significant "anchor projects", that could affect infrastructure rebuild requirements.
- Other infrastructure projects – coordination would be required with NZTA and CCC. Both had ongoing maintenance and renewal work programmes and some capital projects requiring work on the same networks that SCIRT would be repairing. Utility network operators would also be carrying out work in the same road corridors, including the ultra-fast broadband roll-out programme.
- Transportation network – occupation of road space to enable rebuild works required coordination with road controlling authorities to maintain traffic flows.
- Utility networks – isolating parts of the water, storm water and wastewater to carry out repairs required coordination with council operational teams to ensure flows could be diverted or suspended without compromising the network. Coordination with other utility operators would be required to safely carry out repair work in the presence of other buried and overhead services.
- Property owners – coordination to maintain access and minimise disruption to residents, businesses, developers, contractors and service providers.
- Programme funders – working with CERA, NZTA and CCC to confirm rebuild programme scope and funding.

### 2.2.4 Key success factors for the alliance

The owners' critical outcomes that would determine project success or failure could be inferred from the AA and from the alliance objectives reproduced in section 2.2.1.4.

The owners' expectations for the alliance itself, determining its success or failure, could similarly be inferred from the AA and its objectives.

## 2.3 Owners' VfM Statement – Part B standards and requirements

### 2.3.1 Governance

#### 2.3.1.1 Governance Framework

The AA established a leadership team (the SCIRT Board) to govern the alliance, with all eight alliance participants represented. It normally met monthly.

Board decisions had to be unanimous.

The OPs required a separate governance body to manage "client issues", such as scope and funding, and to provide the board with clear and singular direction.

In 2011, the funders formed the Client Governance Group (CGG). In 2013 – following the signing of the CSA and an Office of the Auditor-General programme review – CGG was replaced by the Horizontal Infrastructure Governance Group (HIGG).

#### 2.3.1.2 Owners' reserved powers

The OPs reserved the power to determine the alliance scope of work and to terminate the alliance at any time and complete the remaining work by other means.

Funding decisions were the sole preserve of the OPs, which held the required regulatory consents. SCIRT external communications were also subject to OP approval.

#### 2.3.1.3 Governance practices and standards

The board was expected to follow New Zealand best practice in corporate governance practices and standards.

The CGG and HIGG were expected to govern according to public sector best practice.

#### 2.3.1.4 The owners' representatives

At least one SCIRT management team member had to be from an OP.

However, it was intended that OP staff would be seconded to fulfil functional IST roles, along with staff seconded from design consultancies and the NOPs.

#### 2.3.1.5 Stakeholder communications

Formal communications to alliance participants were limited to monthly operational reports from management to the board meeting and a monthly board report to the CGG/HIGG.

The Stakeholder Management Plan outlined the strategies and processes for communication with external stakeholders. Public communications would be managed and carried out by SCIRT, but subject to OP approval.

#### 2.3.1.6 Legislative compliance and approval requirements

The Canterbury Earthquake Recovery Act 2011 included provisions to streamline legislative compliance for earthquake recovery activities. This paved the way for global environmental consents for the SCIRT rebuild programme.

Other regulatory authorities were proactive in following the intent of the Act. However, SCIRT was generally required to follow normal processes to obtain the consents and approvals that were usually required for infrastructure work.

### 2.3.2 Performance measurement – KRAs/KPIs

The agreement stipulated five KRAs – safety, value for money, our team, customer satisfaction and environmental – selected by the board to reflect the nature of the challenge, the post-disaster rebuild environment and the alliance objectives that focused on doing better than normal industry standards.

From two to four KPIs were set for each KRA, with scoring measures and rankings in four ranges, from unsatisfactory through to outstanding. The scores were used in monthly reporting of delivery team performances across their projects.

The scores were weighted and combined for delivery team project performance measurements, which, together with financial performance, shaped work allocation as a central function of the commercial model.

KPIs were generally lead indicators, showing performance and trends on matters that influenced behaviours, rather than lag indicators measuring outcomes. For example, the safety KPIs included risk identification, workforce engagement and active visible leadership. (Lag indicators were not used because they did not shape behaviours at the time, but only after the events. They also brought the risk of a focus on the measure, rather than the benefit of behavioural change.)

The agreement set the contribution of each KRA to the OPS, which adjusted the “pain/gain” at the programme completion.

KPI results were reported monthly, and subject to annual review by the board and management team.

Other performance measurements were established by management for specific purposes, as reported in the results achieved.

#### 2.3.2.1 Game-breaking performances

Game-breaking performance was identified from the “outstanding” range of KPI scoring and when special goals were set by management. These were part of the value initiatives, or peak performance planning, explained subsequently.

#### 2.3.2.2 Innovations

The capturing and sharing of innovations were significant features of SCIRT, arising from objectives item b) and as a KPI within the value KRA. The KPI changed to reflect the evolution of SCIRT activities.

### 2.3.3 Quality and standards

#### 2.3.3.1 Applicable corporate specific standards

Applicable corporate specific standards came from the management and operation of each delivery team, which worked under the rules and processes of its parent company. These

applied, to project management and quality assurance and commercial processes, records management, and reporting etc.

#### 2.3.3.2 Applicable technical and engineering standards

Relevant industry technical and engineering standards applied across site operations, design and construction. SCIRT developed additional standards and specifications related to design and construction arising from ground and seismic conditions.

#### 2.3.3.3 Applicable public sector standards

Public sector standards for design and construction came from industry regulations and from CCC and NZTA. For CCC, these included “Infrastructure Design Standards” and “Construction Standard Specifications”. For NZTA assets, standards were, generally, as specified in the document, “STATE Contract No. 10/11-149, Stronger Christchurch Infrastructure Alliance, Alliance Agreement (Draft), SCOPE FOR STATE HIGHWAY NETWORK REINSTATEMENT circa”. It was to be read in conjunction with the full NZTA standards, guidelines and specifications.

#### 2.3.3.4 Outside BAU standards

The agreement objectives focused on raising standards by lifting zero harm performance, incorporating ideas currently not known, and lifting the workforce performance.

Other objectives that focused on the post-disaster rebuild and recovery were outside the common standards.

SCIRT created a variety of standards, but raised safety and communications standards, as described in the following achievements.

#### 2.3.3.5 Quality metrics

SCIRT used a range of quality KPIs within the value KRA. Other metrics were measured and reported, from time to time, as recorded in the achievements.

The NOPs each provided ISO-certified quality systems to their delivery teams across all construction management operations.

### 2.3.4 Reporting

#### 2.3.4.1 Requirements

SCIRT management provided a monthly operational report to the board, which addressed each team discipline and included comprehensive data from across the business.

A monthly summary report by the board chairman and executive general manager was presented to the CGG/HIGG.

The “Value of SCIRT” was reported as interim reports on the organisation’s evolution.

There were no requirements for VfM reporting.

(The overall reporting structure is shown in section 2.6.)

### 2.3.5 Professional services

#### 2.3.5.1 Owners' independent advisers

A range of independent advisers were employed by the funders and asset owners. At an operational level, advisers focused on the verification of cost allowances into budgets and the validation of TOCs; the monitoring of input costs and the auditing of incurred costs. While the agreement anticipated independent design verification, this was not considered necessary for most of the design work, being straight-forward and repetitive.

In addition, the CGG/HIGG managed an audit framework group that conducted financial and operational audits (explained in the achievements).

#### 2.3.5.2 Engaged professional services

The engagement of professional services was significant for SCIRT because design work was carried out by staff from local consulting engineering enterprises. At the peak, this involved four teams, each with 44 engineers, draftspersons, and administrative support, drawn from about 18 consultancies.

## 2.4 The SCIRT Value Framework

### 2.4.1 Introduction

Rebuild following a disaster is not simply "rebuild the damage', because a wide range of other, overlapping, factors are involved:

- interests of those immediately affected must be balanced with social, economic and environmental considerations, which is a major challenge in a natural disaster response.
- while the immediate response typically prioritised the return of essential services over economic value, the rebuild phase needed to address the delivery of economic value.
- SCIRT was structured to deliver value via rapid establishment and response, substantial delivery capacity and the commercial model, along with numerous lower-level attributes (as described following).

The SCIRT rebuild had several complications:

- The work scope could not be defined at the outset because the assets were below ground, partly damaged and not easily observed.
- The rebuilt infrastructure needed to be more resilient, so subsequent earthquakes did not repeat the damage. This required design input and option evaluations.

As a result, conventional business case financial definitions and value monetary measures of BAU projects were not applicable. The SCIRT business case was framed by rebuild need, plus a complex structure of aims and objectives that kept the enterprise effectiveness in focus.

### 2.4.2 Foundations

In addition to work sequencing and coordination, more needs were present:

- Rapid entity establishment, to get work under way, described as "**Getting started**", including prompt definition of the scope and type of work, requiring time-consuming investigations for buried assets.
- Enhancements to assets or systems might be justified, or funding limitations might apply, reducing the scope. Therefore, an appropriate rebuild scope definition was required, described as "**Doing the right work**".

- Carefully managed decision-making for the work sequence, integrating utility system operations and stakeholder and community needs, described as "**Doing the right work in the right order**".
- A focus on progressive improvement through all phases, especially in the manner of doing work, described as "**Progressively getting better at what we do**".

**Figure 3 Before and after: Cycle path improvements on track.**

### 2.4.3 Rebuild challenges

The following table describes the set of challenges against these foundations:

| Value foundations | Rebuild challenges |
|---|---|
| Getting started | Huge scale – biggest civil rebuild in NZ history<br>Damage and scope unknown<br>Urgent output requiring fast establishment<br>Commercial control<br>Safety and process management consistency |
| Doing the right work | Asset/damage assessment<br>Information sharing<br>Timely client inputs<br>Definition of scope and standards<br>Resilient, best practice design<br>Risk management |
| Doing the right work in the right order | Project prioritisation<br>Constraints management<br>Interface coordination with other rebuild<br>Robust planning<br>Deployment flexibility |
| Progressively getting better at what we do | Uniform high standards<br>Achieving high-volume delivery<br>Input and output cost control<br>Comprehensive measurements and reporting<br>Encouraging and capturing innovations<br>Continuous improvement<br>Focus on delivering value |
| | |

**Figure 4 Table of value foundations and rebuild challenges**

SCIRT met these challenges, as the following explanation shows.

### 2.4.4 Alliance advantages

An alliance delivery model presented significant advantages for the rebuild as summarised following, with many also meeting the challenges described in the above table:

| Value foundations | Alliance advantages |
|---|---|
| Getting started | • A mix of public and private entities with common goals<br>• Shared responsibilities with alignment of objectives and focus on outcomes<br>• Availability of resources and control over them<br>• Existing home organisation systems and procedures |

| Value foundations | Alliance advantages |
|---|---|
| Doing the right work | • Robust systems<br>• Capture of information<br>• Clarity of reporting structure<br>• Simplicity of decision-making framework<br>• Flexibility within commercial framework, suiting work scope uncertainty<br>• Ability to adapt scale to variable needs and uncertain scope<br>• Ability to deal with changing environment (including earthquake risk) |
| Doing the right work in the right order | • Programme of projects approach, enabling scale-ability<br>• Delivery on many available work fronts<br>• Flexibility of deployment<br>• Ability to change focus and direction<br>• Collaboration with other rebuild programmes<br>• Resource focus and management – across projects and programme |
| Progressively getting better at what we do | • Programme specific clarity of cost and non-cost objectives<br>• Robust quality control process throughout all operations<br>• Sharing best practice and lessons<br>• Innovation encouragement and capture<br>• Development and upskilling of industry resources<br>• A focus on value |
| | |

**Figure 5 Table of value foundations and alliance advantages**

## 2.5 SCIRT features

In order to meet the challenges presented by the Christchurch rebuild, SCIRT was created with a unique set of features:

- Multiple OPs because the assets had different owners and different funding processes applied.
- Multiple NOP constructors, from existing contractual arrangements, maximising resources.
- A sequenced programme of separate projects spread across the city, maximising resource use.
- A unique competitive element to the commercial model, wherein construction teams vied for work.

Because of the scale of design work involved, design resources were drawn from many consultancies, making it impractical for designer participation as alliance principals.

The following sections describe the commercial model, the structure and key workings of the entity, identifying how these features met the needs and challenges.

### 2.5.1 Organisational structure

In order to best meet the challenges of the rebuild and the competitive element of project delivery, SCIRT had a structure, with three primary components:

- A board for governance and strategic direction, comprising one member from each OP and NOP.

- An integrated services team of managers and staff running the whole programme, including a production line of projects, but not including managing or carrying out construction.
- Separate delivery teams for the construction of projects by their own choice of engagement with market suppliers or subcontractors, or by using their own resources.

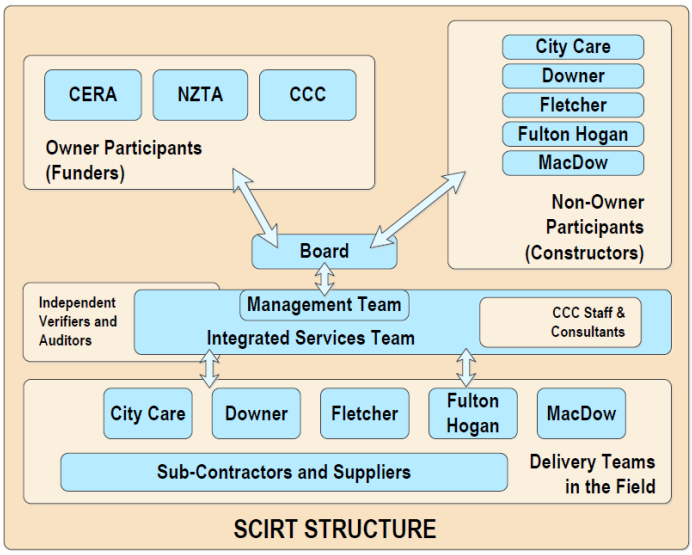



**Figure 6 SCIRT structure**

### 2.5.2 Production line

The rebuild required that asset damage be identified as the initial part of the work, followed by the definition and prioritisation of projects, concept and then detailed design (project by project), cost estimation creating project budgets (with independent review), followed by construction and hand over to the asset owners.

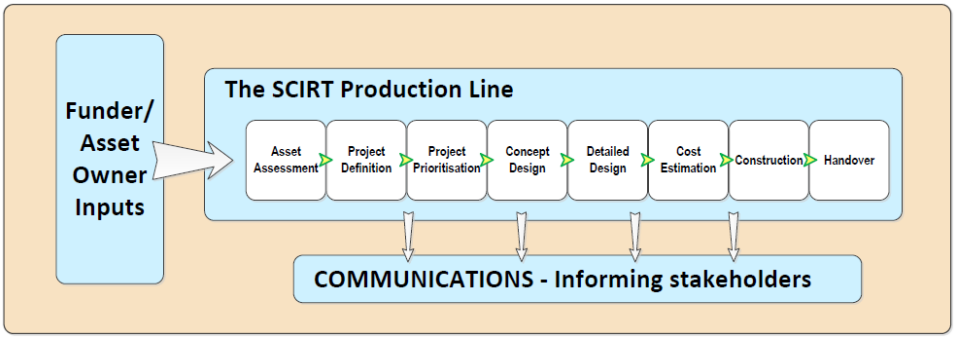



**Figure 7 SCIRT project production line**

This production line was applied to many projects at a time, with the intention of generating a steady output for the five constructors and their many project site teams. This was consistent with the spread-out nature of the assets across the city, which enabled many work fronts, simultaneous activities, diversity of resource sources, and shortened time frames. It also supported the variable intensity of the rebuild arising from different asset importance and fragilities, ground conditions, and shaking intensities.

### 2.5.3 Management plans

The functional interactions within the structure and the various operational methods were defined by a comprehensive suite of 30 management plans mostly created by management in the lead-up to the agreement, with board oversight.

### 2.5.4 Commercial model

#### 2.5.4.1 Target Out-turn Cost (TOC)

A TOC was created and set for each project, rather than the whole programme, because:

- Asset investigation lead to differing project definition in size and complexity.
- Projects were spread over time, sequenced to rebuild needs and variable investigation and project definition workload.
- Delivery teams required a budget to measure financial performance on each project.

This project-by-project TOC setting was a fundamental SCIRT feature, vital to its workings.

#### 2.5.4.2 Costs and fees

Under the commercial arrangement, NOPs were reimbursed costs plus a fee based on project budget, subject to performance incentive, and including the following components:

- All participants were reimbursed costs for staff and expenses contributed to the IST and for agreed overheads.
- NOPs were paid for the actual construction and site administration costs of their delivery teams, who worked exclusively for SCIRT, set as an annual TOC.
- NOPs were paid a corporate overhead and profit fee as a percentage mark-up on the total TOC value of the work delivered.
- The fee was modified by the amount of pain/gain difference between the targeted and actual cost of delivery, with the balance of pain or gain shared 50/50 with the OPs.
- The share of pain/gain was modified by a performance factor to a limit of not more than ±10% by a score outcome from non-cost KPI measures.
- The pain/gain was aggregated across all NOPs and allocated to each based on percentage of work delivered, measured by cumulative TOCs for each, (not AOCs).

The following diagram illustrates the fee structure (identified as payment “Limbs”):

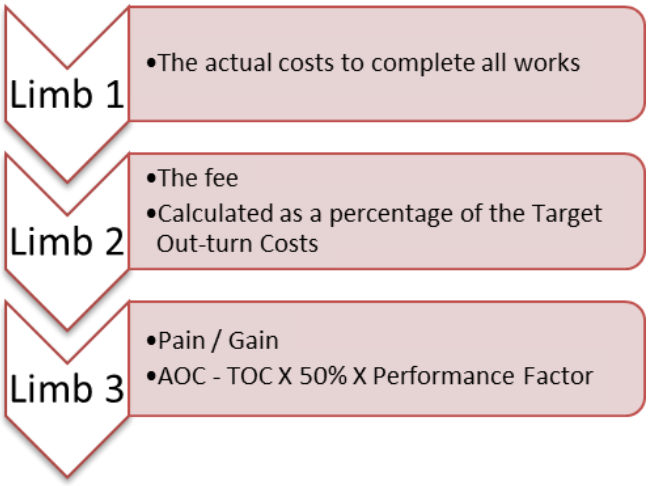



**Figure 8 SCIRT fee structure**

#### 2.5.4.3 Competition for work

The NOPs provided the construction management resources, and these worked in effect as independent 'branch offices' of each parent company, competing for SCIRT projects exclusively. Projects were allocated fully designed and pre-priced with a TOC, becoming their budget, which the team completed as best they could, utilising a 40 per cent minimum proportion of subcontract resources.

#### 2.5.4.4 Project allocation

The project allocation to delivery teams was a foundation element of the commercial model, driving value outcomes. Initially, projects were allocated to teams as an equal spread. However, as team cost and performance data were gathered from projects, the number of projects and amount of work allocated to a team was based on performance, as well as logistical and total workload considerations.

Therefore, delivery teams needed to perform well to gain more work, to maximise fee income.

The monthly performance review was based on costs achieved against budget (50 per cent) and a structured mix of KPIs (excluding safety). This process added delivery performance tension to the construction cost tension created by delivery teams striving to beat the TOC.

Work allocation became continuous on a monthly basis as projects became available. The non-cost performance review was based on the past six months to a year, depending on the nature of KPIs.

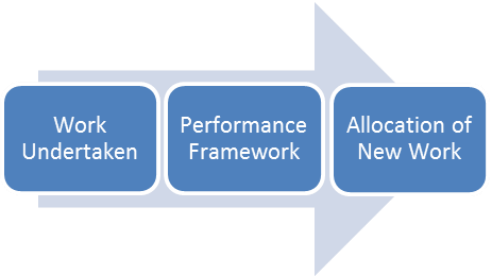



**Figure 9 SCIRT project allocation process**

The practical outcome of this set of arrangements was that good performance was rewarded with better returns and poor with lesser. The sting for all teams was that a single poor performer reduced the returns to all, which gave rise to non-financial collaboration to lift everyone's performance, which is discussed further later.

### 2.5.5 Control of money

The commercial model also facilitated the comprehensive control of funds, a vital feature in post-disaster rebuild and recovery.

The following figure illustrates the progressive build-up of project and programme cost, subject from the outset to estimations with independent review, and then incurred costs are either based on agreed rates also subject to review, or competitive market offers.

The subsequent stages of cost build-up are as described in the commercial model and are subject to reviews at each stage.

The costs incurred and payments made to the market, were open book at constructor level, and subject to IST oversight and monthly independent audit. Audits were present at all subsequent stages.

This review and audit focus on supply price regularity had the added benefit of minimising the chances of subcontractor or supplier fraud, because commodity pricing irregularity would be readily visible and any fluctuations of cost of work achieved would also be obvious. Many players

Funders had a high degree of assurance that the rebuild monies were carefully and securely controlled.

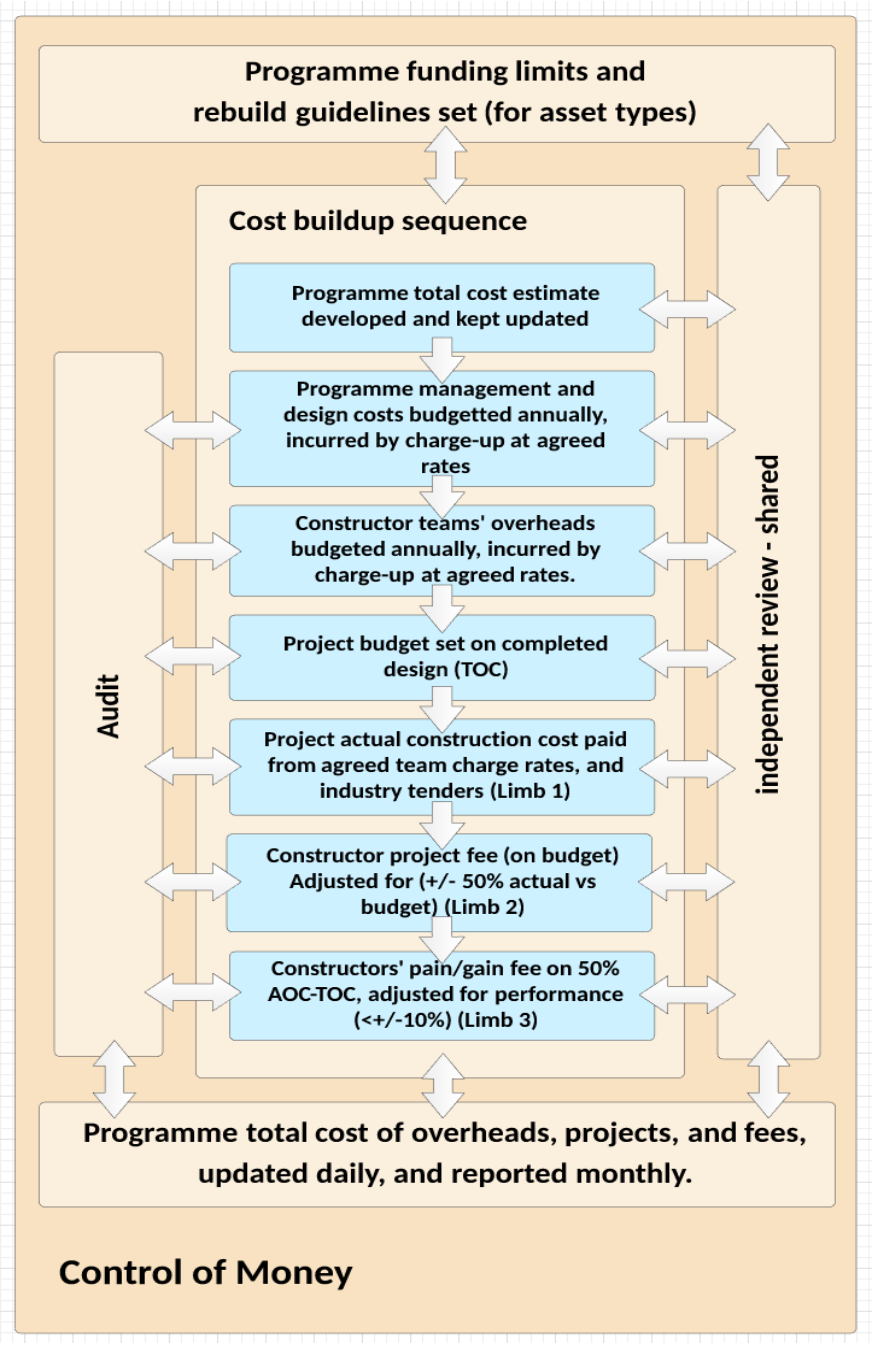



**Figure 10 Control of money**

### 2.5.6 Early constructor involvement (ECI)

ECI was a feature of SCIRT project evolution, with an initial concept design where contractor input was sought to identify hazards such as traffic management, resourcing and site management issues. As design progressed, contractor methodologies were developed and applied to the design to ensure innovative construction methodologies and design solutions were incorporated. The knowledge and benefits were captured in the work design and, therefore, informed the cost estimate.

Specific risk items might be identified at this stage, enabling “risk” to be “designed out” or “allowed for” in the project estimate, reducing any general risk contingency allowance.

### 2.5.7 Benefits of structure and commercial model

In addition to the significant positives of an alliance relationship contract, there were several benefits from the SCIRT structure.

| Features | Benefits of structure |
|---|---|
| An integrated services team (IST) under one roof | • A repeatable project delivery process<br>• The sharing of best practice, communications and innovations<br>• The rapid formation of design teams<br>• Aided an early constructor involvement process<br>• Set common high standards for the rebuild programme<br>• Independent verification in close proximity<br>• Facilitated an independent audit of “open book” commercial transactions<br>• Lead to the development of a high-performance culture. |
| Separate delivery teams | • Delivery teams used their own resources and systems, competing for project allocation<br>• Delivery team self-performed in safety, quality, cost management, completion and handover of construction<br>• Price competitiveness to achieve an AOC better than TOC<br>• Focus on performance measures derived from programme objectives<br>• Facilitated use of local resources |
| Overall structure | • Enabled fast establishment<br>• Optimal communication between IST teams<br>• Ease of design, documentation and construction standardisation<br>• The sharing of ideas, experience and innovations<br>• Inherent drive for raising standards<br>• Construction optimisation and productivity improvement<br>• Best use of local resources |
| | |

**Figure 11 Features and benefits of structure**

### 2.5.8 Benefits of the SCIRT model

| Features | Benefits |
|---|---|
| The commercial arrangement created several drivers for beneficial behaviours | • A focus on performance from competition between delivery teams to increase the work share (fee income)<br>• Performance improvement in cost and non-cost target areas, from a competitive allocation process (work share)<br>• Attention to best overall outcomes (pain/gain share)<br>• Team support for each other, to minimise loss-making from pain/gain spread across all teams |

| | |
|---|---|
| | • Collaboration with ideas, methodology and resources for better results<br>• A focus on outstanding outcomes (KRAs and KPIs)<br>• An overall performance factor to improve pain/gain (not exceeding 10 per cent)<br>• All teams striving to perform to their best, to secure a good share of the work, to deliver it for best cost and to perform well on each project, because of the combination of all the measures<br>• Downward cost pressure and uplifting performance<br>• An overall incentive to raise the performance of all |
| SCIRT created key advantages over the conventional delivery and standard alliances | • Work delivery was carried out by parallel process, from investigations to handover, greatly shortening time frames<br>• Standardisation of process, minimising the design and documentation effort<br>• Progressive resource management shared in parallel with the project production line<br>• Cost estimation was separate from delivery and independently verified, giving confidence in budgets<br>• The unique competitive focus on achievements flowed through the programme, aligning commercial drivers with high-performance outcomes |
| | |

**Figure 12 Commercial features and benefits**

### 2.5.9 International experience by comparison

Joint research by the University of Auckland and the University of Canterbury on the international experience of post-disaster response and rebuild delivery approaches, provided context to the appropriate rebuild of Christchurch infrastructure. There were many similarities between the Christchurch situation and international experience and the above alliance delivery advantages showed close alignment with international experience.

The research findings are summarised in the document in Appendix C, *International Post-Disaster Rebuild Mechanisms*.

It should be noted that SCIRT met all “the 10 characteristics that are favoured in large-scale post-disaster reconstruction”.

## 2.6 Reporting

### 2.6.1 Reporting reflects structure

The reporting chain of SCIRT related directly to the organisation structure.

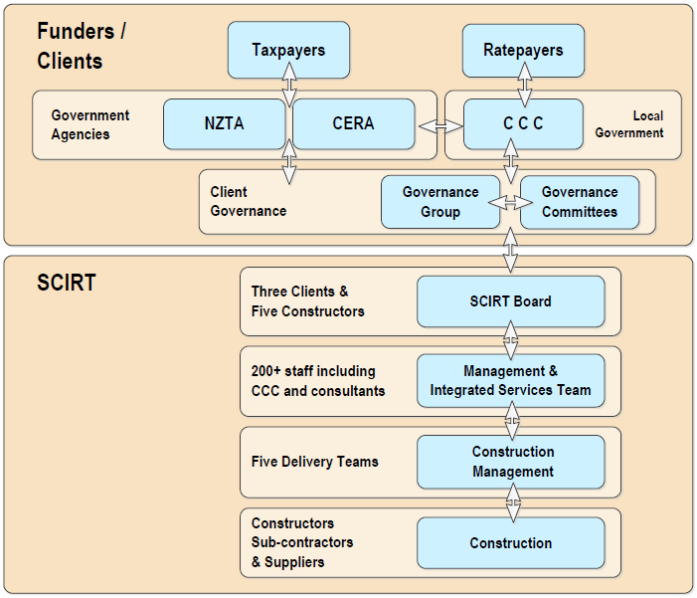



**Figure 13 SCIRT reporting structure**

### 2.6.2 Business systems

SCIRT's business systems were purpose-built for an enterprise managing a programme of projects. Every project was structured as a series of activities, defined by gates, allowing information and reporting to be identified in the sequenced advancement of each project and summed across groups or all projects as needed.

The system was developed around four key enterprise packages, chosen as readily available and proven, meeting the needs of project management:

- JD Edwards – financial system
- ProjectCentre – for formal information, process flow and document management
- Asta and Microsoft Project – scheduling tools
- Geographic Information System (GIS) – more than 600 layers of spatial information

It collected data on costs, project workflows, schedules and locations. A data warehouse held the information and fed into two reporting platforms: HiViz, a purpose-built web-based front-end reporting and analysis portal, and GIS Viewer for detailed spatial information.

The system was a foundation component of the Commercial Management Plan and was leading-edge, integrated business intelligence and geographical information.

The platforms displayed up-to-date information on projects, programme or enterprise, depending on user requirements.

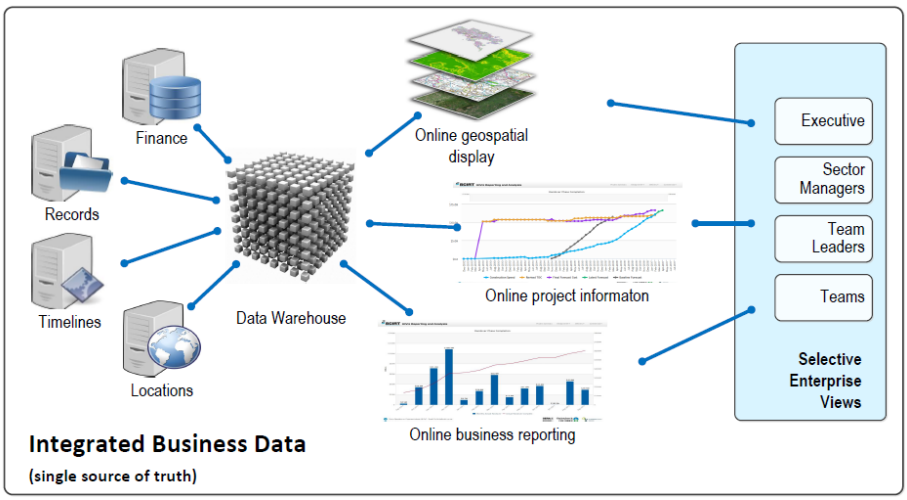



**Figure 14 SCIRT business information**

The structure ensured a single source of truth, viewable through the selective lenses of users, to meet their needs. The information was "live", being updated daily as data was added and, monthly, for financial information from the delivery teams.

The powerful technology, which attracted CCC interest, could have many applications in the building and construction industries. Its principles were capable of extension to integrated people and asset information as could be required in future disaster infrastructure rebuilds.

### 2.6.3 Progress reports

The business systems created monthly management team reports for the SCIRT Board and from the board to the HIGG.

The quarterly, poster-style "performance dashboard" set of about 12 data tables and graphs was sent to stakeholders. Other reports were created to order.

Refer to section 8.1.3 for further commentary.

# 3 Achieving the owners' objectives

## 3.1 Alliance objectives

The broadest objective of service restoration was achieved. All utilities functioned satisfactorily under NZTA and CCC operations management.

The following table shows the alliance objectives and summary status of achievement, with references to this report.

| Agreement objectives | Status and report reference |
|---|---|
| a) Lift the zero harm performance of all alliance participants on the project to industry best practice in New Zealand: | The safety record reached aspirational levels, exceeding industry best practice, including a period with TRIFR of <5.<br>SCIRT achieved 2.8 million worker hours without a single lost time injury. |
| i) Total reportable injury frequency rate (TRIFR) 10 per 1,000,000 man hours worked, 12 months rolling average; | SCIRT achieved and lowered the objective to 5 in 2014 and surpassed this later that year, going below 5 during 2015.<br>SCIRT achieved a total of 2.8 million work hours in about 18 months between Sept 2015 and January 2017, without a single lost time injury. |
| ii) Zero Department of Labour infringement, prohibition or improvement notices issued; | Long periods without notices occurred, as shown in figure 16. Close working relations with the Department ('Worksafe') was a feature of operational management.<br>At PPC SCIRT had achieved 20 months without a notice |
| iii) Zero environmental infringement notices issued. | At March 31, 2017, there had been no notices issued during the previous 16 months and only 20 of any type in over five years. |
| b) Demonstrate best long run value for money and demonstrate environmental responsibility: | The value-for-money objective was addressed in a comprehensive manner. (This report explains that in detail.)<br>Environment responsibility was recognised by authorities. |
| i) Maintain a cost database in relation to work under the alliance which demonstrates increasing productivity and resource utilization as the work progresses; | Cost databases were maintained by the TOC team and, separately, by the independent verifier.<br>(For productivity, see earned value CPI following.) |
| ii) Undertake work by matching capability to the scale and complexity of the work; | Refer to the Procurement and the Design and Construction Plans which address this issue.<br>Capability was only an issue due to limited resources of specialist subcontractors, such as pipelining, but, generally, not so otherwise. |
| iii) Provide a key reference for construction costs for the total rebuild effort across Christchurch; | SCIRT staff participated in MBIE information sharing throughout the programme. However, that had an MBIE focus on work throughput ($) and resourcing, rather than costs.<br>The estimators and independent verifiers monitored costs and reported regularly to SCIRT clients. |
| iv) Reduce and recycle to eliminate waste. | Waste minimisation was a KPI initially but was not found to be needed with the type of work being done, and with the commercial drivers of SCIRT giving emphasis to cost minimisation. Materials were reused or recycled wherever possible. |

| Agreement objectives | Status and report reference |
|---|---|
| c) Maintain an open and honest dialogue with all residents over the rebuild effort: | SCIRT was a leader in rebuild dialogue and regular, targeted, face-to-face and telephone surveys demonstrated dialogue was very successful in building community confidence in recovery. |
| i) Work to ensure messages to communities are co-ordinated with other rebuild efforts (e.g. housing); | SCIRT messaging was shared with local centres of activity, as well as with residents and business. |
| ii) Be proactive with communication and make it face-to-face where possible; | This was a positive, successful feature of SCIRT. (Refer to the Stakeholder Management Plan, in the SCIRT Learning Legacy, and the following results.) |
| iii) Do what we say we will do; | (ditto) |
| iv) Communicate in simple language. | (ditto) |
| d) Maintain high levels of customer service in the rebuild effort: | It is inevitable that digging up streets affects local residents and businesses, however SCIRT worked to minimise effects and support locals. The approach to interaction and support brought about new and improved levels of community interaction to CCC and the industry. |
| i) Plan the work so when we go, in we do it once, do it quickly and do it well; | Doing work once remained as an objective, but the mix of work within a project together with network constraints and changes in funding affected project scope and schedules, resulting in the necessity to revisit projects.<br>Performance monitoring ensured a focus on minimising delays and SCIRT crews proceeded quickly. |
| ii) Build rapport with affected residents and go the extra mile where required; | This was a feature of communications and of construction management and was recognised as a success. (Refer to communications data.) |
| iii) Present ourselves as tidy and professional and be conscious of the impact our work has on residents going about their normal day to day lives; | Presentation of SCIRT sites in delineation, signage and tidiness, together with interaction with residents and business, was a central focus of construction management. Tidy, well signposted sites and interactive traffic management were a recognised feature and a success. |
| iv) Coordinate all works to minimise disruption to the customer. | Initial processes were enhanced by a 2014 initiative 'Work with Business". It raised delivery team awareness of interaction and potential impacts on small business. |
| e) Establish, for all residents, an interim level of service for water, wastewater, storm water and roading within six months: | In summary, this did not become a SCIRT responsibility, due to CCC repair and restoration activities in place as SCIRT was formed. |
| i) Make urgent and temporary reconnection of services a priority as this will improve quality of life and increase confidence in the rebuild effort; | This work was done by CCC operations teams as part of initial disaster response. SCIRT was not deployed to assist CCC nor was any such work scope included in the programme. |
| ii) Keep people in their houses where practically possible to increase well-being and take pressure off other infrastructure; | As above – this was not a SCIRT function. |
| iii) Acknowledge that this means there will be some additional cost if, subsequently, houses are retired or rebuilt. | (Such circumstances did not arise) |
| f) Quickly protect the environment and reduce future health hazards: | As for item e) above. |

| Agreement objectives | Status and report reference |
|---|---|
| i) Stop pumping raw sewage into the Avon and Heathcote rivers within four months; | Continuous pumping in bulk was progressively reduced by CCC operations crews and SCIRT, as pumping mains and key lines were restored. Short periods of pumping to river continued to be a practical option, especially due to high rainfall events, throughout the programme, but diminished over time. |
| ii) Rehabilitate the environment and clean up all residual waste within 12 months; | Rehabilitation and clean-up were CCC Operations activities. |
| iii) Minimise further health hazards due to a winter lift in the water table. | No specific action was taken or needed. |
| g) Do the right thing, at the right time to the right standard every time. Complete the rebuild effort to prescribed standards with minimal rework: | SCIRT completed the evolving definition of scope of work in a sequence agreed with stakeholders. The rebuilt work was to best current industry standards of design and construction. However, partial rebuild and localised repair, that was a funder requirement in some instances, logically have lesser network life expectancy.<br>Rework of installation not meeting standards, was limited to approximately 1 per cent of turnover. |
| i) Complete the rebuild work in accordance with the network and facilities rebuild strategy; | Funding shaped the strategy to focus on limiting rebuild to damage repair. The basis of assessing repair changed over time, largely due to funding changes. |
| ii) Undertake the work in the correct priority order to achieve best value for money whilst minimising the impact on the community | Prioritisation and sequencing of work was a significant focus, with considerations including utility operations and neighbourhood community and traffic impacts. Surveys showed community support was high and traffic impacts were modelled, understood and minimised. |
| iii) Incorporate innovations and greater resistance to withstand subsequent seismic events; | The capture and incorporation of innovations were features of SCIRT. Earthquake resilience was, in general, a feature of both design detailing and construction materials and techniques. |
| iv) Ensure whole life performance of new assets meets industry asset management standards. | Design and construction were based on materials and specifications to best industry standards. The level of service approach to network design and the remaining asset life consideration of scope definition, both kept focus on asset life performance. |
| h) Return the built assets to CCC with proof they will be more resilient than they were before: | The asset information of repair, rebuild, and state of observed-only assets was comprehensive and very informative of asset life, the ability to resist seismic forces and remaining issues. Therefore, SCIRT met and exceeded this requirement, to the level permitted by rebuild scope. |
| i) Clearly articulate long-term asset performance; | Asset performance became a yardstick that defined damage repair and partial rebuild, both from the physical performance of network and from remaining asset life.<br>The basis of design could be found in SCIRT design guidelines that were created in response to changing levels of funding and rebuild parameters.<br>(This is explained in the Scope story in the Learning Legacy.) |
| ii) Comply with appropriate infrastructure design standards; | SCIRT worked with asset owners to create infrastructure rebuild design standards, relating these to CCC and appropriate industry standards. |

| Agreement objectives | Status and report reference |
|---|---|
| iii) Hand over asset information and operations manuals in relation to the Alliance Works which set a benchmark for New Zealand; | Handover involved passing on the physical descriptions of as-built asset information and locations, including assets evaluated but not worked on, together with the total spend of work and overhead proportionately ascribed back to that asset.<br>This level of information across the hundreds of thousands of assets worked on, and the speed and efficiency in which it was done, were benchmarks for the industry.<br>It provided new levels of asset management information.<br>The huge amount of information involved was made possible by the latest technology of SCIRT's business and geographical information systems. |
| iv) Accept a defects period of one year minimum for each project. | All projects carried a one year defects period. |
| i) Incorporate ideas currently not known: | New ideas were incorporated across the board, where possible or permitted, and been made available through a purpose-built learning legacy. |
| i) Work hard on innovations at all levels; | Innovation encouragement and incorporation was a feature of SCIRT. |
| ii) Break down unsustainable cost structures on assets or services to ensure CCC has the lowest whole of life cost structures moving into the future; | Whole of life cost structures were taken out of SCIRT's hands by the overall scope reduction that resulted from the cost-sharing agreement. Remaining asset life evaluation continued to shape project scope, within the programme funding constraints. SCIRT created rebuild guidelines interpreting the impact of the external scope reduction pressures. |
| iii) Disseminate all new ideas to all infrastructure providers throughout New Zealand. | Industry briefings, published professional papers and the SCIRT Learning Legacy continued to be the medium for sharing new ideas. |
| j) Coordinate the work with others doing rebuild work: | Coordination within the central city was outstanding; elsewhere was good and smart ideas, were incorporated or arose as a result, some of which were transferred to Auckland and Wellington projects. |
| i) Establish a forum to share planning efforts; | Formal internal and external channels of communication were set up, including functional groupings, and ECI inputs, together with parallel operational lines of communication.<br>SCIRT contributed to land use planning forums coordinated by CERA.<br>Wider communication networks were established for the intensive central city rebuild, including innovative online techniques of information sharing. |
| ii) Coordinate work within areas to avoid excessive disruption; | Particular focus was given to local and network traffic impacts both with SCIRT teams and nearby activities. |
| iii) Adjust priorities to ensure coordinated work is undertaken; | Priorities were, in part, set by the outcomes of coordination of needs and impacts. |
| iv) Maximise use of underground trenches and/or trenchless technology to accommodate all services. | A central-city shared trenching initiative was launched by SCIRT, with limited take-up by others, and trenchless technology was used frequently, where economically justified. |

| Agreement objectives | Status and report reference |
|---|---|
| k) Rebuild Christchurch ensuring the infrastructure sector maintains a sustainable market condition: | SCIRT worked with the market for labour, supplies and subcontracts, while not being constrained by it. It monitored the markets. |
| i) Establish the lowest cost structures to the rebuild effort; | The cost structures of SCIRT were very lean, as shown by following data. No comparable information is available from other rebuild projects. |
| ii) Maximise the use of local resources to deliver the work provided those resources can be obtained at prices and on terms that are competitive with similar resources available from elsewhere; | Local resources were utilised as fully as possible while having regard for appropriate levels of experience and competence. SCIRT established training programmes for basic entry skills to bring new people into the industry. (Refer to section 9) |
| iii) Maintain appropriate systems to ensure and prove the market is sustainable. | Labour and subcontract market engagement and evaluation was continuous throughout the time of SCIRT, as lead by delivery teams, including for work by specialist suppliers or subcontractors. |
| l) Purposefully lift the capability of the sector-wide workforce: | SCIRT influence across the sector was very significant, locally and nationally. |
| i) Return CCC embedded resources back to the CCC as more capable than when they went in; | CCC resources gave strong endorsement in exit interviews to the SCIRT work environment, methods and results. |
| ii) Lift the capacity of all subcontractors; | Delivery teams supported and worked with subcontractors to get better performance and cost results. |
| iii) Establish greater capability for current specialist infrastructure activities; | The scale of the programme allowed an active focus on lifting of capabilities by rewarding specialists with ongoing work at competitive cost structures. SCIRT established standards that encouraged subcontractors to lift capacity. |
| iv) Do something meaningful to reduce the level of unemployment in Christchurch; | SCIRT was active in promotion of opportunities and training, working with local and national industry training bodies. |
| v) Target delivering a new wave of skilled resources to the market. | The “FOR REAL” campaign and the SCIRT training centre were deliberate and successful initiatives for introduction new workers to the market. |
| | |

## 3.2 Related achievements

### 3.2.1 Safety

#### 3.2.1.1 Initiatives

SCIRT had a strong emphasis on safety and created the following initiatives now used by other programmes in the rebuild and external organisations including NZTA:

- Drug and alcohol programme
- Raising the bar in minimum personal protective equipment standards
- PPE for women
- Helping establish the Canterbury Rebuild Safety Charter
- A “Critical risks” focus for site operations
- Recognising and celebrating good performance with the **Bill Perry Award**, judged and issued quarterly, for all teams engaged in SCIRT
- “Safety in Design” procedure

- Utility location, logging and protection requirements
- Tidy Site campaign

#### 3.2.1.2 Values

SCIRT developed and promoted a set of safety values and identified critical safety risks at programme level (common to all sites) for safety promotion to all workers. Safety performance improved overall, through:

- Setting Health and Safety as a KRA
- The use of KPIs and delivery performance scoring to drive appropriate behaviours
- The establishment of “minimum conditions” of performance for critical risks
- Providing active, visible, Site Leadership Group presence, including regular site safety visits by board members.

#### 3.2.1.3 Critical risks

(Refer to Risk Management section 5 for further explanation of the critical risk concept.)

#### 3.2.1.4 Canterbury Rebuild Safety Charter

The SCIRT Board supported management to become active in the Canterbury Rebuild Senior Leaders’ steering group, formed to develop the Canterbury Rebuild Safety Charter, with the aim of engaging those working across all elements of the Canterbury rebuild.

The charter established key commitments agreed to work toward, including “minimum standards of performance” in 10 areas, providing tools and guidance to achieve the standards, to be utilised by all organisations signed up to the Charter.

This group continued to work closely with Worksafe NZ, MBIE, ACC and rebuild programmes across Canterbury to deliver a “zero harm rebuild”.

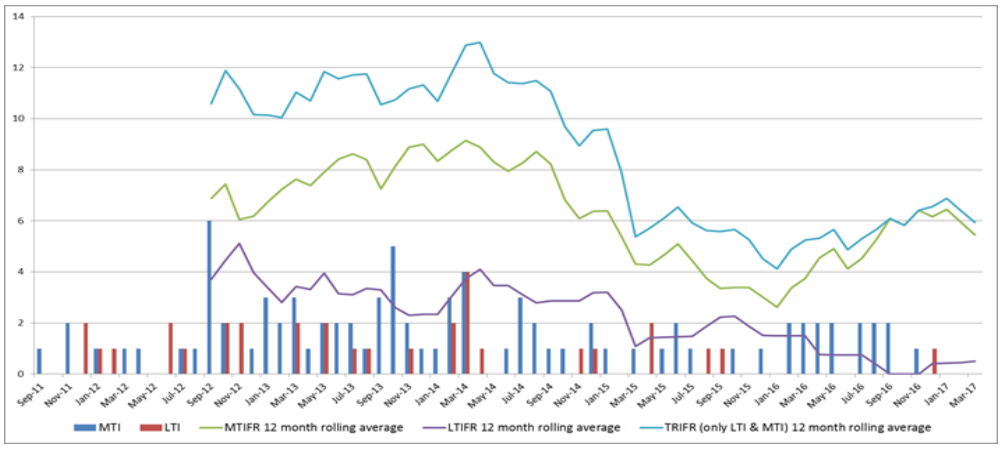
(Refer to the SCIRT Learning Legacy for more information on safety and the charter, and to achievements for results.)

#### 3.2.1.5 Results

(The following figure shows achievement data as a 12-month rolling average.)

The TRIFR dropped below the goal of 10 in October 2014 (for the previous 12 months) and stayed at or below 6 for the reminder of the programme.

A period of about 16 consecutive months from September 2014 had no lost time injuries in more than 2.8 million worker hours.




Note:

- MTIFR - Medical treatment injury frequency rate
- LTIFR - Lost time injury frequency rate
- TRIFR - Total recordable injury (MTI + LTI)
- All frequency rates based on 1 million hours worked

**Figure 15 Monthly injury incidents**

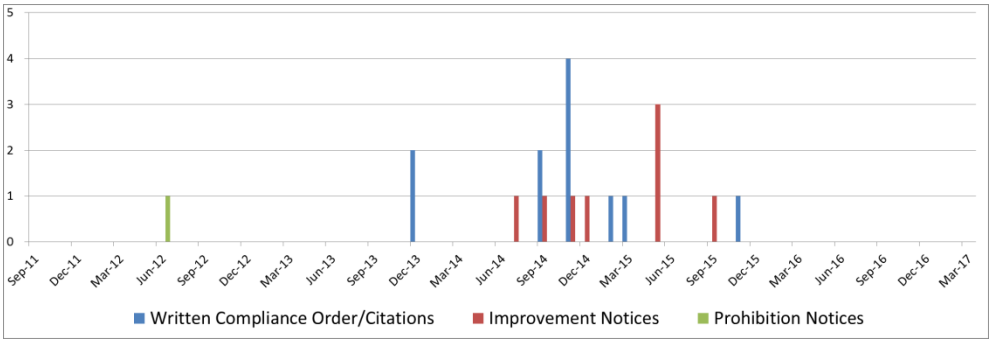



**Figure 16 Worksafe notices**

### 3.2.2 Subcontractor utilisation

The use of subcontracts varied between delivery teams and over time. Over the programme, 64.8 per cent of construction cost was completed by subcontract, far exceeding the minimum stipulated in the agreement. This demonstrated a significant apportionment of work to wider industry and the local subcontractor economy.

### 3.2.3 Utility and service strikes

A natural hazard of digging up streets is the unintentional encountering of existing utilities such as water or gas pipes and telecommunications or electricity cables. Separately, overhead cables might be broken by moving machinery. These recognised hazards are part of normal construction and, with a strong focus on lifting performance, SCIRT set out to minimise such occurrences, risks to staff, disruptions, and repair costs.

Utility strikes increased with turnover, reaching alarming numbers, presenting a special challenge. A KPI was introduced and a campaign commenced to raise awareness from

management and delivery leadership, through safety and operational groups, and into site start-up and toolbox conversations.

With impending central city work and increased utility density, it was decided to address the risks directly, by making 'hydro excavation' mandatory for confirmation of utility location and depth, prior to opening-up pavements. This process formality improved attitudes and results, justifying the costs involved.

Another key improvement arose when the KPI focus changed from recording strikes to identifying the number of services that had been successfully passed, shifting the focus to acknowledging successes rather than highlighting failures.

Throughout the programme, any strike that involved high hazards was subject to delivery team formal analysis and reporting.

Service strike risk remained a high priority throughout the programme, because of the potential consequences involved. (The following diagram shows the changes in strike rates over time.)

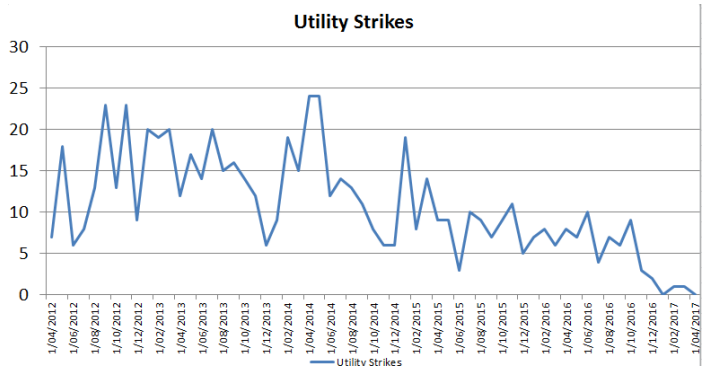



**Figure 17 Utility strikes over time**

### 3.2.4 High Performance Culture

The SCIRT culture was a significant factor in the organisation's success. It was formed by a deliberate, planned approach to fostering team member engagement and learning.

#### 3.2.4.1 Fundamental principles

Five principles founded the SCIRT culture:

- Human resources (HR) focused on organisational development, with the HR and peak performance manager as a creator of culture, as a partnership of shared approaches with the executive general manager and working closely with other SCIRT leaders.
- In a post-disaster rebuild and recovery situation, a spirit of cooperation and a focus on outcomes were key, based on the commercial model but emphasised by the board through management and leadership teams to the workers in the field. A "generosity of spirit" to work together and do the right thing by the people of Christchurch was encouraged, building on post-disaster attitudes.
- The fostering of culture through language shaping behaviours; with collective behaviours making the culture, driven by intentionality.
- The SCIRT culture flowed to "best for Christchurch" and on to the public via community interactions and messaging. (See the community survey results.)

- Achieving balance in the tensions within the model: collaboration and competition, the noble purpose, emerging scope versus budget needs, high performance and well-being, getting work done while learning, investing in developmental activities and achieving value and productivity and safety.

#### 3.2.4.2 Intentionality via Peak Performance Plan

A key aspect of the culture development was intentionality, driven through a Peak Performance Framework and annual Peak Performance Plan, "to create resilience and high performance in an environment of uncertainty" and achieve outstanding programme outcomes. The plan sought to optimise the team member experience, align teams, and enhance engagement and well-being. Activities, an outcome focus, impact assessment and reviews (and surveys) were integral to the plan.

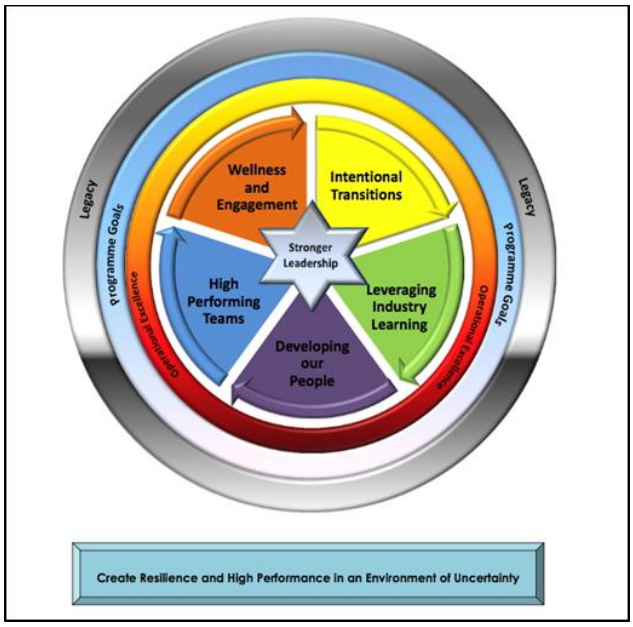



**Figure 18 The SCIRT Peak Performance Framework**

Four overarching plans were created, beginning with the cultural development of IST, and shared with five delivery teams who were given the opportunity – supported by a peak performance coach – to adopt and adapt the central framework for their teams.

#### 3.2.4.3 Laying the foundations

One of the fundamental culture principles was the belief that "language shapes behaviours and collective behaviours form a culture".

In June 2011, a workshop of the SCIRT Board and the management team, facilitated by an Australian coaching organisation, helped lay the foundations for the new entity. The key workshop outcomes included the formation of a "what we are here for" statement to articulate SCIRT's "noble purpose".


**Figure 19 The noble purpose**


**Figure 20 The right frame of mind – SCIRT's mindsets values and behaviours**

These outcomes were continually used by leadership when speaking with their teams. They were featured in inductions, internal communications and newsletters. They became the language that shaped the behaviours which, in turn, formed a distinctive culture.

To help shape the culture, the home building for IST which housed more than 300 people at the peak, was open plan, so people could connect and share.

Functional leadership groups were established, with representatives from the delivery teams, IST and, in some cases, the clients. They set objectives, established terms of reference and shared lessons. Collaboration was part of the structure. Team rituals evolved, becoming engagement mechanisms.

For more information, see the Learning Legacy story on "Laying the foundations".

#### 3.2.4.4 Leadership is key

At the centre of the Peak Performance Framework was "stronger leadership". Leaders "carried" the language and "built" the culture through their actions. Therefore, capable and engaging leaders were key ingredients in the creation of a high-performance environment.

Several initiatives helped develop leadership capability, including defining the framework; establishing the leadership WAVE ("wide-angle view expected") for middle leaders; providing

one-on-one coaching; group coaching for emerging leaders; the provision of 'The Leadership Circle' reviews for senior managers; and the implementation of a frontline leadership programme.

By the end of SCIRT, more than 220 senior and middle leaders had undergone coaching and 80 frontline leaders had attended an extensive leadership development programme.

Engagement surveys and exit interviews showed that the investment in capability paid off in terms of team members' views of SCIRT leadership.

#### 3.2.4.5 Learning is vital

"Developing our people" was a key aspect of peak performance. By bringing that mindset to life and planning activities to enhance learning, SCIRT became a "learning organisation".

A KPI was set in the "our team" KRA for the operational workforce and a Project Managers' Learning Forum was established so the five delivery teams could learn from each other.

**Figure 21 Educated approach – The Project Managers' Learning Forum in action**

The SCIRT Training Centre was established to lift the capability of the operational workforce. More than 8000 attendances were recorded for short courses (see the story on the SCIRT Training Centre). Support was provided to about 180 operators to achieve a national qualification in their field.

In 2014, a survey of team members showed that 96 per cent of respondents believed that SCIRT had helped them grow professionally.

Harnessing the power of learning boosted engagement and lifted performance outcomes.

#### 3.2.4.6 Unrelenting expectation of high performance

Where the "noble purpose" motivated people to join SCIRT and engaged team members, setting and achieving high targets also bolstered engagement as people wanted to be on a "winning team".

From day one, leadership underlined that SCIRT was a high-performing team; it had to be to deliver the outstanding outcomes required to achieve the "noble purpose".

SCIRT leadership "talked a high-performing team into existence", and publicly recognised that achievement. High performance was achieved via breakthrough challenges. Three key challenges resulted from a change in context: a shift to the design level of service approach to define work scope (where more than 300 people attended breakthrough thinking workshops); the halfway point in the programme when team members were invited to

"reignite" and commit to the challenges ahead; and the "finishing strong, ahead of schedule, safely" breakthrough challenge for completion of the programme, when more than 500 people attended workshops to commit to the final leg of the programme.

Additionally, performance in the KRAs – safety, environment, value, community and our team – was measured monthly, reported quarterly and the bar reset higher annually, to prompt higher performance.

At a team level, a variety of challenging targets were set by teams and performance was transparent and highly visible.

At an individual level, performance objectives and development goals were set and reviewed on a quarterly basis.

#### 3.2.4.7 Well-being

Well-being was a vital part of a "piece of the pie" in the Peak Performance Framework. Well-being incentives existed as KPIs and delivery team well-being champions were identified and shared their initiatives each month.

The team initiatives were based on the "five ways to well-being": connect, give, take notice, keep learning and be active, which featured in the Canterbury District Health Board "All right?" campaign.


**Figure 22 All right? campaign – The five ways of well-being**

Additionally, regular surveys highlighted the positive impact of the well-being focus, which flowed through to community interaction.

#### 3.2.4.8 Measure and respond

Engagement and team member experience and organisational culture were lead indicators in performance. As a result, SCIRT used several methods to measure alignment, engagement, well-being and the "people experience". Most importantly, SCIRT responded quickly to that feedback.

In 2012 and 2014, extensive reviews of the impact of the Peak Performance Plan were conducted by external parties. Both showed the plans were working.

#### 3.2.4.9 Peak Performance Plan

A "Peak Performance Plan" and framework was created in January 2012 to define activities for building and sustaining outstanding performance, which allows for deliberate reviews of effectiveness. The plan was reviewed on a 12 to 18-month cycle.

The 'Our Team' KRA and its KPIs demonstrated the effectiveness of the plan through high levels of engagement and alignment shown by independently administered staff surveys.

These were conducted 6-monthly, 7 times. The stability of the results are attributable to the concerted effort in maintaining a positive and outcome focused environment for teams and individuals to perform at their best, despite factors that impacted on the team delivering outstanding outcomes.

The December 2012 Review of the Peak Performance Plan by NZTA and University of Canterbury affirmed the role of the plan in SCIRT, including:

- 'In our view SCIRT has made **extraordinary progress** towards it goals over a very short timeframe; undoubtedly the Board and leadership teams' focus on both creating and expecting a **culture of high performance** has been an integral part of SCIRT's success.
- (the plan) to be an **intentional strategic framework** which has enabled its workforce to perform effectively and at pace…..highly commended for the clarity and effectiveness of the plan…. a best practice example of intentionally designing key organisational structures and processes to develop a **high-performance culture**.'

That review was supplemented with another in 2013.

The April 2014 review was by "Resilient Organisations" attached to the University of Canterbury. Positive affirmations of the role of the Peak Performance Plan included:

- "From the perspective of outcomes and external validation, there is little doubt that SCIRT has been an outstanding success. Two factors particularly stand out as the basis for SCIRT's success in delivering value – the quality of its people and its high-performance work culture."
- "SCIRT has performed effectively on all the above dimensions (of Organisational Resilience) and, based on the reviewers' broader consulting and research experience, can be considered an exemplar of how organisations involved in recovery and rebuild after a major disaster can deliver value."

A further external review was conducted in May 2015, but the emphasis was on the impact of the Peak Performance coaching support to determine whether further investment would provide returns. With comments like the one below about the impact of Peak Performance coaching on behaviours, the SCIRT Board endorsed its continuation through to 2016:

*"How we operate has changed. Our alliance behaviours have improved, changing from "what's good for xxx (company) to "what's good for the SCIRT (programme)". The coaching has been an important part of this because of the regular coach (contact and) individual conversations. Coaching starts with the basics and becomes more complex."*

The people involved will emerge from SCIRT with awareness and attitudes focussed on improvements in capability of individuals and teams that will benefit home organisations. This awareness is engendered through a three-monthly performance review conversation focussed on development and growth of the SCIRT team members.

#### 3.2.4.10 Assisting production ramp-up

Another demonstration that the Peak Performance Plan was an effective tool was the speed of ramp-up of the whole production line, each element of which was formed and quickly grown to handle significant volumes of work:

- Asset assessment providing reliable information.

- Project definition and prioritisation shaping the sequence of works (until first-half 2014) to reflect many external and internal factors.
- Design delivered reliably at low cost (until 2014 interventions arising from CSA)
- Planned transitions out of asset assessment and designer staff as demand fell.
- Cost estimating on a consistent basis (incorporating an independent review process).
- Construction growing to large daily throughput.

All of which were supported by business systems, HR and communications that grew and performed in parallel.

In summary, the outputs intended from the Peak Performance Plan were achieved.

#### 3.2.4.11 Finishing strong

In the latter half of 2014 with just over two years to go, SCIRT board and management recognised that a focus on completion was timely. This led to the establishment of a completions forum and the creation of a programme of activity over the next two years which came to be titled 'Finishing strong, ahead of schedule – safely'.

The programme was created with engagement of the WAVE leadership network and lead to a range of initiatives with project completion teams, as well as growth of awareness throughout the organisation. The following diagram is an example of the structure used to create performance objectives and achievements, which were reported against and kept in active review.


**Figure 23 Finishing strong focus and goals**

The segments were WAVE workshops and the goals in each were created by small leadership teams comprising a range of disciplines. Several of the delivery teams took this framework and applied it to their finishing circumstances and challenges. The activity was wound up in mid-2016 when it had achieved its purpose.

### 3.2.5 Value Register

The "Value Register" was a feature within the ProjectCentre database project management system used by SCIRT. The register provided for the capture and management of a variety of information, including:

- Innovations (value propositions, initiatives or value-added achievements).
- Value engineering gains (from studies),
- Lessons learnt (positive or not).
- Asset system improvements.
- Safety initiatives.
- Environmental initiatives.
- Donations to the rebuild.

Entries were managed to promote, monitor and report innovations as they advanced from initial ideas to working results as described following.

### 3.2.6 Innovations

From the outset, SCIRT board and management recognised that innovations would be an important part of delivering best value. Therefore, the encouragement and use of ideas and alternative solutions became an active feature of every step in the project production line, including but not limited to design and construction.

#### 3.2.6.1 Innovation evolution

Identification, proving up and capturing innovations began with designers who captured ideas then addressed them in seven technical groups who met regularly to address issues and ideas. The groups included asset assessment and ECI personnel, for site condition and construction knowledge and asset owner subject experts, designer technical leads and managers. The group outputs fed into procedures, guidelines, designs and standard construction details.

A parallel programme of construction discipline and best practice groups, including asset owners and designers, also met regularly to discuss and resolve issues or ideas, the outcomes of which were documented in best practice guidelines or "Notice of Requirement" formal instructions.

Examples of outputs from both processes include dewatering guides, trench shield processes, a suite of data capture tools and processes (linked to business and geographic information systems) and cctv processes for site, review, archive and access.

The systems and processes involved would subsequently become part of new ways of data capture and sharing that were leading-edge in the industry, which have become part of the ENGAGE initiative, which aims to take lessons forward to new ways of addressing disasters, throughout New Zealand.

From 2014, as project allocation progressively became based on performance measurement, delivery teams gave added focus to innovation and value initiative KPIs. This resulted in raising throughput and standard of ideas, practical application and the publicity of their work through newsletters etc.

Innovations were withdrawn as a KPI by the board from July 2015, to reduce administrative workload, to allow focus on completion and the formal processes ceased.

SCIRT innovations and value initiatives had been studied by academics, with some resulting papers or publications reproduced in the SCIRT Learning Legacy.

#### 3.2.6.2 Innovation management

Innovations from designers and value initiatives from construction teams were processes by staged review, before release for common use, and duplication when used by others. A monthly report was created and circulated to all delivery teams and further afield across the NOP construction companies, with favourable feedback.

The tool was adapted for delivery team environment and safety initiatives, for separate KPIs.

#### 3.2.6.3 Statistics

In excess of 3000 items were logged in ProjectCentre and those accepted resulted in the following statistics:

| Initiative Category | Processed | Replicated |
|---|---|---|
| Value | 893 | 296 |
| Environmental | 183 | 23 |
| Safety | 710 | 75 |
| Declined | 138 | --- |
| Not progressed | 53 | --- |

The shared value initiatives have been categorised into areas of benefit as follows:

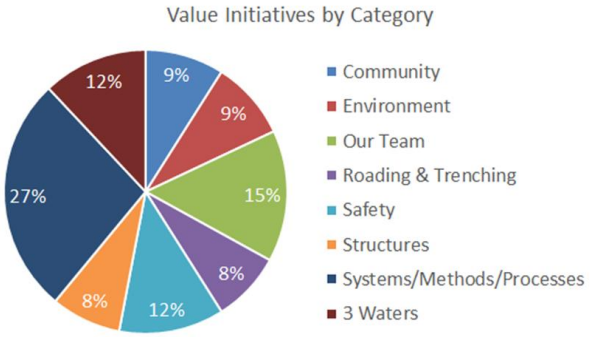



**Figure 24 Shared value initiatives from delivery teams.**

#### 3.2.6.4 Monetary value

Putting a monetary value on an innovation was not straightforward, because efficiency gains were difficult to isolate and the benefits of take-up by others were not clear. Therefore, most of the innovations were not valued. However, the commercial team reviewed the design and construction items where cost was clearly identifiable and estimated:

- One-off project benefits totalled more than $40m.
- Replication benefits were about $18m.

Additional significant benefits were present, such as the use of statistical methods for damage assessment, saving perhaps $25m on CCTV costs alone, and pipe lining in lieu of replacement, saving approximately $65m.

The transformation of sophistication in cctv and pipe data records that arose from the assessment process can't be quantified but are very significant for CCC and the industry generally.

Related undefined benefits arose from the focus that the KPI process brought to the teams in the field, where identifying and publicising their innovative thinking and achievements raised consciousness of the benefits of improvements.

### 3.2.7 Raising standards and standardisation

Standards and standardisation were primarily addressed within the designer work streams and included new earthquake-resistant designs, construction details, materials and testing.

#### 3.2.7.1 Design standards

As SCIRT design advanced, new and standardised specifications, procedures and construction detailing continued to be developed, reviewed and accepted. They would also be useful for future use by CCC and other local government or supply authorities nationally.

Work to date included:

- Six engineering specifications particular to SCIRT.
- In all, 73 standard design details (many shared widely).
- A total of 62 designer guidelines.
- Best Practice Guide (containing many subjects).
- Construction guides.
- Construction standards.

The raising of standards was also facilitated by the large number of teams and crews involved in work throughout SCIRT. For example, the need to obtain consistent and accurate results efficiently from such things as site surveys or soil sampling or CCTV observations created many procedural lessons and improvements and an innovative automated transfer process of electronic data.

These were disseminated transferred formally and informally, within teams and across the industry.

The competitive tension between project delivery teams, vying for work based on cost and non-cost performance indicators, also become a driver for higher construction standards. Poor standards impacted on quality scoring and risked rework that might cost money and add to the risk of out-turn costs exceeding budgets. Both impacted on future work allocation to a delivery team. Therefore, the teams had an inherent and highly visible incentive for focusing on raising standards.

KPIs also played an important part in raising standards through the item itself and by the process of annual reviews, when raised score levels gave increasingly challenging goals.

#### 3.2.7.2 Asset owner interface

There was a formal process for bringing matters from design and construction standards to the OPs' attention through a Scope and Standards Committee (reformed in 2013 and rebranded), which reported to the CGG/HIGG. More than 500 reports were submitted into this process.

### 3.2.8 Improvements to asset systems

Improvements to asset systems arose through numerous SCIRT initiatives, beginning with standard specifications and design details for construction and from construction innovations that fed back into design. Such innovations and changes were recorded in the Value Register.

### 3.2.9 Environment and heritage

Several field initiatives were established across the SCIRT programme:

- Waste going to landfill was reduced to about 5 per cent. This was due to a variety of initiatives including reusing spoil and materials on SCIRT sites, and on non-SCIRT sites; designs that minimised the creation of waste; desktop assessment and a risk-based approach to contaminated land waste.
- A contribution to the knowledge of Christchurch's early history was made via archaeological findings reported to CCC by specialist consultants retained by SCIRT.
- The development of new systems and procedures for working with, and beside environmental issues, including wastewater over-pumping and coal tar within road-making material.
- The preservation of community assets such as trees and heritage, through the creation of simple procedures for project delivery staff.
- Heritage maintenance from such as bridge heritage restoration and stone re-use in retaining wall facings.
- The creation of environmental awareness training material used by SCIRT teams and adapted into a Civil Contractors' Environmental Guide for the industry.
- Recognition of stand-out performance via the "environmental superstars award".

| Description | Mar-17 | LTD | | |
|---|---|---|---|---|
| Quality of Environmental Auditing Result - Programme | 97% | 95% | 12 month average | |
| Environmental Hazards | 5 | 5,011 | | |
| Environmental Opportunities | 12 | 39,558 | | |
| Environmental Team Initatives | 0 | 266 | | |
| Community Organised Events | 0 | 86 | | |
| Number of Environmental Incidents | 0 | 1,066 | | |
| Infringement Notices | 0 | 0 | | |
| Abatement Notices | 0 | 2 | | |
| Criminal Legal Proceedings | 0 | 0 | | |
| Fines | 0 | 0 | | |
| Environmental Near Miss | 1 | 742 | | |
| Environmental Audits | 39 | 6,673 | | |
| Major Environmental Non-compliance | 0 | 5 | | |

**Figure 25 Environment statistics.**

### 3.2.10 Formal communications

SCIRT generated several regular reports and updates through a variety of media, including:

- Newspaper and radio, mainly for traffic impacts.
- Information and statistics on the SCIRT website.
- E-newsletter to all staff, and others as requested.
- *Hemline* newsletter to all staff, and others as requested.
- Occasional SCIRT updates to OP staff.
- Monthly operations report to the board and a board report to the CGG/HIGG.
- Three-monthly SCIRT performance dashboard to OP key stakeholders.
- Monthly wall map of current projects, showing six status from concept design to completion, for internal and OP organisations.
- A variety of annual reports to stakeholders.
- This report, which has been updated from time to time.

### 3.2.11 Communications and Stakeholder management

Communications and stakeholder management was recognised from the outset as a vital element of SCIRT, with the leader a key member of the management team.

The communications and stakeholder management plan confirmed the scope as having a primary focus on communications with residents and businesses. Separate joint communications plans for horizontal infrastructure were established with OPs for communications strategy and a Canterbury-wide plan.

Built on alliance objectives, the plan included comprehensive sets of objectives for internal and external communications, many of which deliberately overlapped with HR and value objectives and processes, adding an important integration of intention.

In general terms the Management team was responsible for setting objectives and standards and for addressing programme-wide initiatives and issues with stakeholders and wider public, whilst the delivery teams were responsible for communications at street level relating to their individual projects, working to agreed presentation formats and interaction styles.

The goal of the plan was to set a new benchmark for post-disaster communication and the following results demonstrate that this was achieved.

### 3.2.12 Dialogue with residents and businesses

Since SCIRT was formed, a great deal of written communication was produced and a heavy emphasis placed on engagement with people, face-to-face.

At March 31, 2017, just prior to completion of most work in the field, SCIRT communications had generated the following statistics:

| Communication Initiative | Number |
|---|---|
| Work notices and updates produced | 8585 |
| Number of work notices and updates delivered | 1,768,518 |
| Face-to-face interactions from door-knocking and drop-ins | 41,112 |
| Meetings/presentations/briefings | 3197 |

| | |
|---|---|
| Community consultation projects (following April 2012 CCC policy change) | 99 |
| Number of school visits | 170 |
| Public display/event | 133 |
| Public display/event attendance | 35,141 |
| Newspaper advertisements | 5336 |
| Email updates produced | 636 |
| Email updates recipients | 24,773 |
| Website updates | 7,764 |
| E-newsletters | 226 |
| Tweets | 6,907 |
| Signage installed (excluding traffic signage) | 5,309 |
| Responses to CCC and delivery team hotline | 21,533 |
| Responses to SCIRT Information email | 14,195 |
| Media coverage items | 1520 |

**Figure 26 Communication statistics**

**Figure 27 Work notice discussion**

The material for the public was created with a strong emphasis on accuracy of description of work, its potential impact and the amount of time needed. Surveys showed that these were highly regarded by readers, as informative and reliable.

The SCIRT communication team worked to minimise duplication of effort by sharing resources and ensuring consistency across projects and delivery teams. It also collaborated regularly at public displays and other community events.

SCIRT ran a “Making it our business” support programme to ensure delivery teams and site crews anticipated and minimised the impacts of work on businesses that they were passing, setting a variety of recommendations, processes and communications to engage as effectively as possible, including signage and work notices to keep the local community informed.

### 3.2.13 Community satisfaction

Community satisfaction with SCIRT was assessed six-monthly by independent market research specialists. The following results were taken from the October 2016 report by Opinions Market Research Ltd.


**Figure 28 Sign of the times: Effective site signage.**

The results confirmed a very high level of satisfaction both from residents in the neighbourhood of projects and in the wider community. Given that a large proportion of the community were affected and inconvenienced by works to some degree, this represented a significant achievement.

These results were particularly important because SCIRT operations in the community reflected on both central and local government. The level of infrastructure rebuild acceptance and support reflected well on the funders.

| Subject area of survey questions | Support Level |
|---|---|
| Recognition of council as a funder | 65% |
| Recognition of government as a funder | 59% |
| Awareness of SCIRT | 72% |
| Visibility of progress | 86% |
| Priorities believed appropriate | 57% |
| Satisfaction with the way traffic is managed around worksites | 63% |
| Ease of navigation through roads affected by repairs | 50% |
| Belief that road works are a part of progress | 95% |
| Tidiness of sites | 74% |
| Satisfaction with SCIRT work in the local area | 75% |
| Satisfaction with communications | 75% |
| Sufficiency of information received | 83% |
| Acceptable standards and time frames (approx. sum) | 60% |
| Overall satisfaction with the job SCIRT is doing | 73% |
| Confidence SCIRT is doing its job well | 74% |
| Belief that SCIRT works are providing value | 76% |

**Figure 29 Community satisfaction survey data October 2016.**

**Figure 30 In touch: Community contact in action.**

| % satisfied | Oct 13 % | Apr 14 % | Nov 14 % | Apr 15 % | Nov 15 % | Oct 16 % |
|---|---|---|---|---|---|---|
| Overall satisfaction with the job SCIRT does | 83 | 77 | 77 | 83 | 76 | 73 |

**Figure 31 Overall satisfaction with the work of SCIRT.**

The following tables showed satisfaction with nearby sites and with levels of communication relating those sites.

| % satisfied | Nov 11 % | Apr 12 % | Oct 12 % | Apr 13 % | Oct 13 % | Apr 14 % | Nov 14 % | Apr 15 % | Nov 15 % | Oct 16 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Information on traffic impacts due to repairs | - | 49 | 56 | 48 | 64 | 78 | 66 | 69 | 60 | 61 |
| Approachability of the rebuild team | - | - | - | 67 | 75 | 81 | 80 | 85 | 78 | 72 |
| Clarity of information as to who to contact | - | - | - | - | 73 | 83 | 82 | 79 | 75 | 71 |
| Access to property | 83 | 77 | 77 | 76 | 78 | 85 | 85 | 82 | 76 | 81 |
| Ease of navigating roads affected by the repairs | 61 | 59 | 57 | 54 | 66 | 55 | 57 | 51 | 50 | 50 |
| The way traffic around project sites is managed | - | - | - | - | - | - | - | - | 70 | 63 |
| Traffic management arrows are clear | - | - | - | - | - | - | - | - | 78 | 75 |
| Traffic signage is clear | - | - | - | - | - | - | - | - | 75 | 68 |
| Traffic management cones are well placed | - | - | - | - | - | - | - | - | 72 | 69 |
| Detours are easy to follow | - | - | - | - | - | - | - | - | 65 | 65 |
| Tidiness of sites during repairs | 75 | 75 | 78 | 74 | 77 | 72 | 80 | 77 | 74 | 69 |
| Safety practices for workers | - | - | - | - | 85 | 85 | 84 | 90 | 86 | 86 |
| Safety practices for pedestrians | - | - | - | - | 77 | 72 | 77 | 84 | 76 | 76 |
| Safety practices for traffic | - | - | - | - | 79 | 78 | 77 | 85 | 80 | 78 |
| Repairs were completed as stated | - | - | - | - | 67 | 65 | 71 | 73 | 71 | 67 |
| Repairs were completed to an acceptable standard | - | - | - | - | 71 | 65 | 76 | 74 | 71 | 70 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Repairs were completed in time frame stated | - | - | - | - | 61 | 54 | 65 | 71 | 65 | 55 |

**Figure 32 Satisfaction with site operations.**

| % satisfied | Nov 11 % | Apr 12 % | Oct 12 % | Apr 13 % | Oct 13 % | Apr 14 % | Nov 14 % | Apr 15 % | Nov 15 % | Oct 16 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Overall satisfaction with the information | - | - | - | - | 86 | 86 | 85 | 89 | 82 | 83 |
| Satisfaction that the information was sufficient | 50 | 78 | 80 | 79 | 92 | 89 | 85 | 92 | 88 | 85 |
| Satisfaction with the accuracy of the information | 58 | 67 | 79 | 77 | 84 | 87 | 85 | 88 | 81 | 82 |
| Satisfaction with the timeliness of the information | 60 | 70 | 80 | 77 | 78 | 89 | 87 | 90 | 88 | 85 |
| Satisfaction with the explanation of the impacts | - | - | - | - | 78 | 86 | 84 | 86 | 83 | 79 |
| Satisfaction with the approachability of the team | - | - | - | 63 | 71 | 84 | 90 | 87 | 73 | 71 |
| Satisfaction with knowing enough about the progress SCIRT was making in the local area | - | - | - | - | - | - | - | - | 63 | 62 |
| Satisfaction with being kept up to date on SCIRT's progress overall | - | - | - | - | - | - | - | - | 59 | 60 |
| Satisfaction with knowing enough about progress SCIRT was making across Christchurch overall | - | - | - | - | - | - | - | - | 55 | 51 |

**Figure 33 Satisfaction with communications from SCIRT.**

| **Satisfaction with communications - Total sample** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Those who received communications: sample size: | Of those who received any communications - % satisfied | | | | | | | | | | | | | |
| | Oct 11 282-291 % | Mar 12 289-300 % | Jun 12 128-268 % | Sept 12 162-343 % | Mar 13 215-395 % | Jul 13 110-375 % | Nov 13 121-380 % | Mar 14 135-375 % | Jul 14 255-566 % | Nov 14 213-569 % | Mar 15 213-541 % | Aug 15 237-577 % | Nov 15 204-576 % | May 16 240-585 % |
| Overall satisfaction | 77 | 85 | 90 | 87 | 83 | 81 | 75 | 78 | 82 | 73 | 74 | 68 | 76 | 75 |
| Service provided during contact with delivery team* | - | - | 85 | 80 | 77 | 84 | 86 | 81 | 83 | 80 | 78 | 79 | 85 | 86 |
| Timeliness of information | 69 | 83 | 89 | 85 | 77 | 84 | 86 | 84 | 85 | 86 | 86 | 82 | 83 | 85 |
| Enough information throughout the project | - | - | - | - | - | 79 | 75 | 73 | 82 | 75 | 75 | 76 | 72 | 80 |
| Clear contact for further information | - | - | - | - | - | 90 | 85 | 89 | 88 | 85 | 87 | 83 | 75 | 79 |
| Explanation of impacts | - | - | 86 | 80 | 78 | 81 | 77 | 78 | 82 | 78 | 79 | 76 | 77 | 78 |
| Accuracy of information | 67 | 81 | 88 | 80 | 79 | 81 | 84 | 83 | 88 | 81 | 84 | 79 | 76 | 78 |

**Figure 34 Overall satisfaction with communications.**

## 3.3 Programme objectives

### 3.3.1 Getting started

The fundamentals of the SCIRT establishment were completed early because:

- It was set up as intended by the alliance agreement.
- It took over IRMO projects and ramped up throughput to reach the intended peak within a year.
- It ran effectively, as evidenced by completed works, the consistent high level of throughput and the minor amount of rework.
- It was flexible regarding direction and deployment changes.
- It was recognised as an appropriate resource by stakeholders.
- It built a unique and strong culture.
- It gave attention to community interaction.

### 3.3.2 Management plans and business systems

A suite of about 30 management plans was created during the lead-up to the alliance agreement and shortly after.

(These are on the SCIRT Learning Legacy facility: https://scirtlearninglegacy.org.nz/)

Business systems supporting these plans were described in the previous section under “reporting”.


**Figure 35 Management plans**

### 3.3.3 The right work

SCIRT experienced three definitions of the work to be done:

- First, the CCC supplied guidelines
- Second, of its own making, as it sought better ways to define an appropriate rebuild.
- Third, the result of funder cost-share agreements limiting total spending and resulting new or changed rebuild parameters.

The changes from initial guidelines were followed by a rapidly renewed focus, redesign and amended work allocation to delivery teams. SCIRT absorbed these changes with some delays and associated costs (estimated at $15 million), despite significant impacts on design work and construction allocation that was under way.

(The following subsections include a summary of the progressive definition of work.)

#### 3.3.3.1 Strategic plan – OP supplied


The CERA Recovery Strategy for Greater Christchurch was issued in 2011. While it was not a defining document for SCIRT, it was notable that objectives and time frames were closely aligned.

The built environment formed a primary element in the vision and goals for the recovery and "the development of resilient, cost-effective, accessible and integrated infrastructure" was a key objective within that element, which was the central focus for SCIRT.

SCIRT objectives and the value framework also aligned with several sections of the strategy, including priorities, phases of recovery, pace of recovery, funding (which included the SCIRT rebuild cost estimates), leadership and integration, economic recovery and built environment goals. In each of these, SCIRT planned or delivered work in a manner consistent with the CERA intentions. (The following description and map of the project prioritisation illustrates that point.)

The OP definition of strategy was made clear from the outset by the *Infrastructure Recovery Technical Standards and Guidelines* (the guidelines). That document was prescriptive and, generally, defined the SCIRT scope as the repair or rebuild of earthquake damage only, with the extent defined by given measures of damage, which varied with asset types.

#### 3.3.3.2 Strategic review – provided for OPs

In September 2011, at the board's request, SCIRT commissioned and managed the preparation of a rebuild strategy to:

- Cause robust decision-making ahead of infrastructure reinstatement.
- Enable an economic, well-targeted Stronger Christchurch Rebuild Plan.

That work was completed and formally handed to the OPs in January 2012.

The recommendations were processed by the Owner Participant Strategy Committee as:

- Resolutions to transpose into long-term plans.
- Items for review and adoption by SCIRT.
- Not acceptable.

None of the recommendations to extend the rebuild into system review and improvements were adopted and, therefore, the SCIRT rebuild remained focused on damage repair.

#### 3.3.3.3 Damage rebuild scope definition

The preceding two sections described that rebuild was confined to repair from earthquake damage, but what constituted damage and what justified repair? These were addressed and revisited by SCIRT, the asset owners and the funders over four years, giving progressive scope reduction over time, as illustrated by the following diagram.

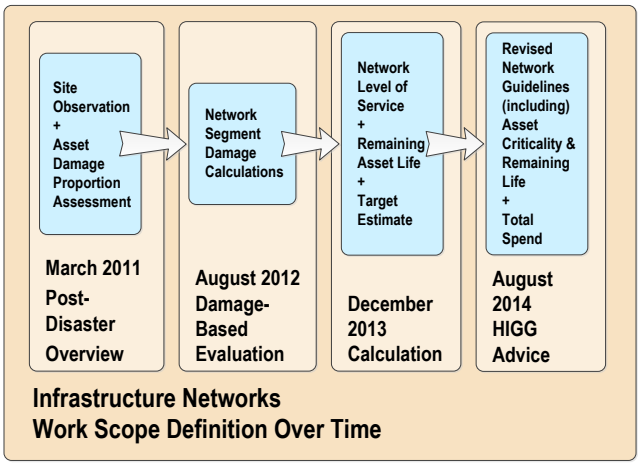



**Figure 36 SCIRT work scope definition**

The programme passed through the first year with a preliminary estimate of scope and cost of about $2.1b (+$0.9b/-$0.2b) as had been assessed by CCC field staff and consultants and calculated by CCC consultant cost estimators, within days of the February earthquake. This was based on limited observation of levels of damage and a notional scale of rebuild, at historical cost rates, escalated to allow for large-scale demand on the construction industry, but with no escalation for the undefined period of the rebuild.

During its first year, SCIRT observed enough assets in detail, along with the asset owners' defined damage rebuild parameters, to enable the creation of the first SCIRT programme estimate in October 2012. This showed a P50 figure of $2.8b, based on observed costs to date and including an escalation allowance.

#### 3.3.3.4 Network level of service scope definition

SCIRT suggested this figure could be reduced by an alternative approach to the rebuild, based on the restoration of historical "network level of service" (LoS) for most asset network types, instead of damage intervention. That suggestion was taken up by the funders.

The project evaluation changed. It began with estimate allowances spread across wastewater catchment areas, for all utilities, followed by concept design and cost estimation of the anticipated work. It ended with a LoS evaluation for the whole network for each utility.

If the level conformed to the agreed parameters, then the scope of the rebuild was set. A result under or over parameters caused the rebuild concept to be revisited.

The outcome of this process was an estimated $2.5b total, with the number of projects and their values generally reduced to some degree, depending on various project factors.

#### 3.3.3.5 HIGG advice and scope definition

In 2013, the funders created a CSA for the earthquake rebuild, including horizontal infrastructure, which would significantly change the scope of SCIRT work. However, the new funding limit did not relate to a specific scope or define any parameters. Hence, SCIRT worked with the funders in a protracted 18-month process to define what the CSA meant in practical scope and project terms.

During this interactive engagement, a new mix of parameters was generated by the combined team to define the basis of rebuild, that lead to a reduced scale of projects. The concept pricing of those projects was fed into the prioritised list to generate an outcome programme cost estimate, which in turn informed the CSA framework.

A key component of the process for the OPs was the definition of an appropriate level of funding from government, based on provisions in Civil Defence and Emergency Management legislation, regulations and plans, together with a non-specific goal of rebuilt utility networks being approximately comparable to pre-earthquake standards.

**Figure 37 Scope for change: Designer and asset owner representatives discuss scope**

#### 3.3.3.6 Project definition parameters

The parameters for consideration included network LoS, remaining asset life and operations and maintenance cost predictions.

SCIRT teams translated these parameters into new design guidelines for each asset type. The funders then decided whether the resulting mix of projects would qualify for funding, within the CSA.

This required an iterative process of parameter setting, concept design, project cost estimate outcomes, total cost review and many repetitions of the process until the total spend came to a level that was acceptable to the funders.

#### 3.3.3.7 Decision-making

Throughout these changes, the broader funder decision-making was removed from SCIRT. It was, therefore, operating in a lesser role than the agreement anticipated, of a response to evolving parameters and spend limits, rather than creating scope definition itself, to achieve a spend limit.

This imposed approach represented a fundamental shift in the SCIRT operation from a cohesive, all-encompassing body setting scope to that of a servant enterprise assisting in scope definition.

At the same time, CCC added some of its projects into SCIRT, or increased the scope or standards of some rebuild (with HIGG agreement), where timing was advantageous or integration with work areas was sensible. These additions were funded solely by CCC.

#### 3.3.3.8 Further scope reductions

During the design process, it was common to identify measures or concepts that would reduce the amount of work or cost while having little net impact on network LoS or asset life.

These ideas were put forward to the asset owner operations meeting (a weekly formal project review process that SCIRT established and ran from late 2011 until late 2015). They were put forward as reports for consideration and forwarding to the CGG Scope and Standards Committee.

More than 500 reports were put forward during the four-year committee term.

#### 3.3.3.9 Work scope for asset classes

The following summary identifies the scope definition changes that arose from the above processes, as they applied to the separate asset classes.

#### 3.3.3.10 Wastewater and storm water assets

Note that storm water assets which SCIRT was permitted to work on were largely limited to those serving road surfaces and reserves.

Creeks and streams, open channels and culverts, or drainage on private land were not included. These were removed from the SCIRT scope early in the programme by funders for several reasons, including extensive catchment modelling needs, resource consent time frames and community consultation obligations.

The changes included:

- 2011-12 Funder document *Infrastructure Rebuild Technical Standards and Guidelines* (IRTSG) (several minor revisions followed).
- May 2013 SCIRT Design Guide 43, assessing asset life and avoiding repair of non-critical assets. Also known as the “Level of Service Approach”.
- Ditto 43-A-1 – increased focus on remaining asset life – not used.
- May to August 2014 “Optimisation Process” of funder review of the project list, supported by SCIRT designers.
- August 2014 Network Guideline 43-B.
- August 2014 Design Guideline DG43-1 – concurrent with 43-B.

#### 3.3.3.11 Water supply assets

- 2011-14 IRTSG.
- May to August 2014 Optimisation Process of funder review of project list, supported by SCIRT designers.
- June 2014 SCIRT Design Guide 60, although issued, was not used until HIGG subsequent endorsement.
- August 2014 Network Guide 60 – increased focus on remaining asset life – not used.

#### 3.3.3.12 Roading assets

- 2011-12 IRTSG.
- January 2013 Design Guideline 36, addressing terminology and standard approaches.
- May to August 2014 Optimisation Process of funder review of project list, with SCIRT designer support.
- August 2014 Network Guide 36A roading review process.

#### 3.3.3.13 Rebuild resilience

In wastewater catchments, there was significant resilience enhancement with the use of "enhanced gravity" (steeper pipe grades and added lift stations), and by pressure and vacuum systems, as described in the following section.

Resilience improvement to all three water networks was achieved by using modern materials and design details in place of existing, older materials and technologies.

The modern materials policy meant existing pressure pipe networks of asbestos or concrete were replaced by uPVC, polyethylene, or glass fibre-reinforced resin assemblies, and gravity networks were rebuilt in uPVC or polyethylene in lieu of the existing ceramic or concrete pipes.

However, the rebuild was limited to damaged segments and was not, generally, catchment-wide. Therefore, resilience was incremental in rebuilt portions and proportionately less so across whole networks where existing materials remained.

SCIRT did not address resilience improvements by increased network interconnections or additional wastewater treatment plants, for example, because such system changes were not permitted. Work was limited to the rebuild of damage of existing geometries.

The design and construction standards initially included resilience concepts in pipe and trenching by the addition of filter fabrics around embedment gravels and by more conservative grading of backfill gravels and compaction specifications.

However, these provisions were studied in SCIRT research and field trials and regarded as unnecessarily conservative and not adding effective protection for the additional cost involved, with slowed rates of pipe laying. Filter fabrics were used when trenches presented drainage paths for groundwater toward open channels.

The specifications were subject to regular review and evolution, with OP support, to be more workable and affordable.

Roading resilience was lifted where modern design, materials and construction methods were improvements on existing, older roads of lesser standards.

#### 3.3.3.14 Enhanced gravity, pressure or vacuum sewers

In April 2011, CCC recognised that wastewater gravity networks in the badly damaged, liquefaction-prone and challenging ground conditions of the eastern suburbs might be better served by other technologies, rather than replicating existing networks. A workshop of asset owners, industry advisers, cost estimators and constructors generated a report identifying that enhanced gravity, pumped transfer (pressure wastewater) or vacuum (suction) technology networks could present significant installation and maintenance benefits and add system resilience within those catchments.

Enhanced gravity involved installing gravity sewers to steeper grades, to shallower depths and, consequently, with more small lift stations pumping into the adjacent gravity sewers.

Pressure sewers required receiving tanks on private property from which small pressure feeder lines pushed effluent into a wider pressure network to nearby large receiving chambers and pumping stations.

Vacuum systems sucked effluent from a small network of four to six kerbside chambers into shallow, contoured small lines to a large vacuum station, from which effluent was pumped to treatment.

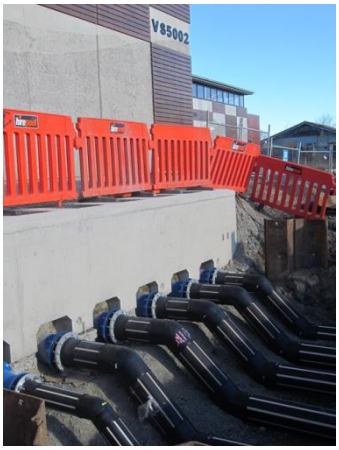



**Figure 38 Suction power: Vacuum station inlets**

#### 3.3.3.15 CCC intentions

Based on international experience, all technologies coped better than conventional gravity systems when subjected to ground liquefaction and other settlements or movements and provided the most effective solutions based on whole of life value assessments.

The concepts were taken further by SCIRT and gained approval via several submissions to the asset owner and funder Scope and Standards Committee and the CGG.

- Enhanced gravity was used throughout the relaying work in most catchments.
- Pressure was planned for more than 4750 properties.
- Vacuum was planned for 4000.

#### 3.3.3.16 Community resistance

However, pressure wastewater changes proved difficult for CCC to “sell” to a small number of landowners in the affected areas. In 2013, a court challenge resulted in CCC carrying out additional community consultation using SCIRT, before rescinding pressure in more than 2000 properties, using gravity instead, despite some work having begun and network redesign being required.

About 2000 pressure wastewater systems were installed.

In contrast, about 4000 properties were serviced by vacuum in two systems in two suburbs, with no legal action, despite about 100 properties having chambers within private property.

**Figure 39 Subtle solution: A pressure tank on private property.**

#### 3.3.3.17 Pipe lining

An important alternative technology for SCIRT and CCC was introduced in significant quantities in the form of pipe lining. This gave considerable benefits of less disruption to streets and communities, faster progress and lower costs, however there were teething problems due to the challenging ground conditions and some inexperienced operators withdrew from the programme.

SCIRT developed specifications applicable throughout NZ for design and installation of CIPP, spiral wound and folded pvc liners and established a contractor approval process to enable operator selection. These allowed marketplace selection of technology to best suit host pipe and ground and aquifer conditions and permitted patching when damage was localised.

A 50-year design life was required and loading conditions were conservative, ignoring host pipe support. It is expected that significantly more asset life will be achieved and that liners will provide some added resilience to pipe systems when subject to earthquake shaking, liquefaction or ground movements.

Nearly one third of sewer and stormwater pipe repair was carried out by lining, with total savings estimated to be the order of $65 million.

This knowledge gained by the programme is explained in detail in the Learning Legacy story, ‘considerable benefits of pipe lining’.

### 3.3.4 Right work in right order

In general terms, the whole SCIRT programme was subject to an overarching process of sequencing work areas and individual projects. This was particularly important in the early years because of the natural tension between doing the “worst first” with the need to accommodate other factors such as utility operations, network and local traffic impacts or community needs.

In subsequent years, the programme sequencing was subject to other demands such as funding and scope changes and to community objections to new technologies.

#### 3.3.4.1 Fundamentals of sequencing

The primary drivers of the work sequence were:

- Alignment with the CERA Recovery Strategy general priorities.

- The relative importance of network components (e.g. pumping mains) and work areas such as wastewater catchments.
- Scheduling of projects to achieve a steady work stream matching budgeted cash flow.
- Planning and delivery of work within the central city (within the four avenues) to immediately follow the building demolitions after cordons came down and to precede and facilitate the rebuild of the central business district.
- Scope and, hence, design and construction changes, following from the 2014 funding, rebuild parameters and project definition changes.
- Shaping programme completion in 2016.

(The aspects are described in more detail in the following sections.)

#### 3.3.4.2 Rebuild plan(s) – OP supplied

The OPs did not provide rebuild plans for horizontal infrastructure but contributed to the SCIRT process through CCC staff working within IST and the Scope and Standards Committee answering to the CGG/HIGG.

#### 3.3.4.3 Prioritised schedule of projects

The project identification and prioritisation process was developed and fully functioning within the first few months. It comprised two stages: prioritising the hydraulic catchments to initiate concept design and then project prioritisation for network assets and structures.

Prioritisation followed the sequence in the following diagram, beginning with numerical calculations of operational factors, valued and summed, using a multi-criteria analysis tool (MCA Tool). The factors included ongoing operational costs, damage states and strategic considerations, such as relief to affected areas and socio-economic factors (via OP input).


**Figure 40 The prioritisation process**

The interdependencies of assets arose from operational catchments – areas that worked as a network being grouped together – and from proximity dependencies, facilitating natural project boundaries and greater prioritisation boundaries.

An output is illustrated graphically in the following maps, based on wastewater catchments or on geographical areas, each showing priorities or sequencing of grouped projects.

The maps, which were reviewed and confirmed by the OPs, were published quarterly until the 2014 reassessment of scope and total spend, by which time the prioritisation did not need revisiting, having served its purpose.

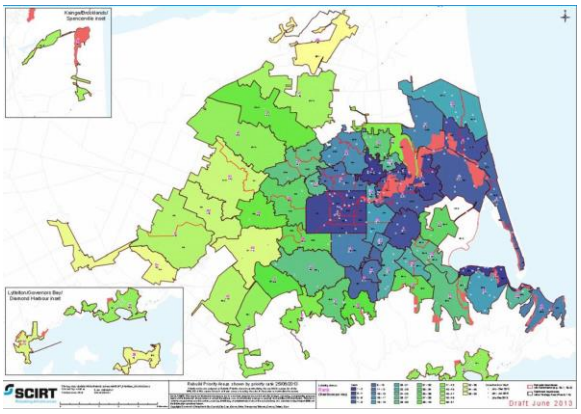


**Figure 41 Map of geographical priorities.**

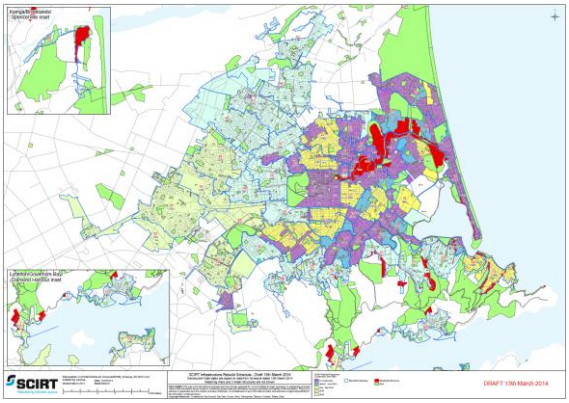


**Figure 42 Map of project priorities.**

#### 3.3.4.4 Tactical and timing focus

The schedules that emerged from iterations of the prioritisation were also influenced, in part, by resource deployment controlled by SCIRT and by external factors. The latter included servicing city rebuild projects of known timing or traffic congestion considerations, where SCIRT traffic modelling and management were used to minimise impacts.

#### 3.3.4.5 Project Schedules

Following the prioritisation, scheduling of individual projects proceeded. The times and sequences created schedules, which were automatically linked into the SCIRT business intelligence systems.

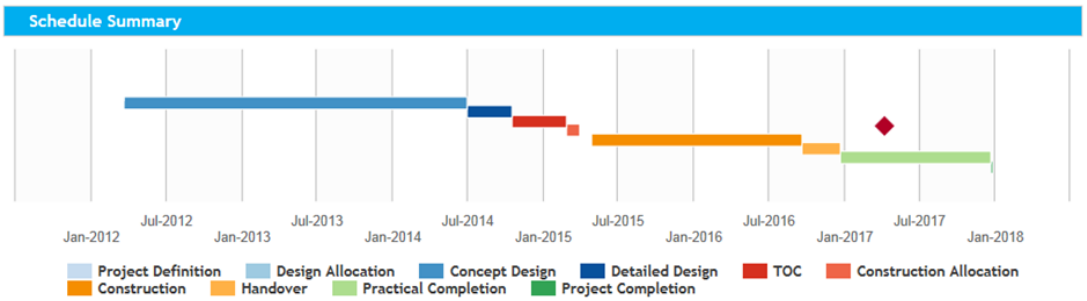



**Figure 43 Sample of Project Schedule.**

#### 3.3.4.6 Strategic decisions on residential red zone

From 2013 to 2015, SCIRT was engaged with the OPs, seeking clarification on strategies and policy for infrastructure rebuild bordering or crossing the residential red zone near the Avon River. Individual project submissions used a CERA template to facilitate the process.

This enabled OP review of differing needs and options to resolve land use issues and allowed a strategy to be defined. The process was time-consuming and, generally, inconclusive because no strategic or policy responses were received.

Mostly, individual projects could proceed when they were within historical road and service corridors crossing the zone and, in some cases, with small areas of zone encroachment. Others in, or overlapping, the zone were shelved for later work by others, after planning issues were addressed that were beyond CERA's immediate control.

A similar process was followed in the Port Hills red zone, declared in 2012, with the added feature of SCIRT being involved in a limited number of land (slope) stabilisation initiatives within the zone, preceding or combined with the infrastructure work.

#### 3.3.4.7 Integrate SCIRT plans with others

SCIRT planning and delivery within the central city's four avenues were aligned and synchronised with the CERA Christchurch Central Development Unit (CCDU) activities and with CCC key projects or maintenance activities. Other utility provider work was also considered, all being coordinated through a dedicated SCIRT central city programme manager.

This created an integrated focus on issues and time frames by facilitating joint platforms for communication and providing programme integration tools for others to use, such as the street-level forward works viewer described below.

Focus was given to facilitating the wider recovery programme, including the roll-out of the Central City Recovery Plan and the progression of the anchor projects.

The SCIRT construction schedule was integrated with other rebuild needs and established with full traffic management modelling, planning and deployment.

In 2013, SCIRT work began in the central city when access cordons permitted and continued for two years. Most of the work occurred in 2014, with up to 45 crews working within the area. More than $175m of SCIRT construction was delivered by mid-2015.

Bridge repairs in the area continued on a limited scale for the rest of the programme.

**Figure 44 Building bridges: A central city brick arch bridge repair.**

#### 3.3.4.8 Systems development

As part of the planning for that intensity of work described above, SCIRT generated a concept for an online active map view of work planned or under way. This was taken up and developed by Land Information New Zealand (LINZ) (with SCIRT input) and the Forward Works Viewer came into being. The tool showed the time sequence of the rebuild and new build below and above ground, based on information from resource and building consent applications and planned and constructed programmes.

In 2016, the Forward Works Viewer was progressively adopted as a local authority tool to be used anywhere in New Zealand where work intensity would benefit from it.

SCIRT's "Minimum Standards for Utilities in Design and Construction" and best practice approach developed at the same time was endorsed by the New Zealand Utilities Advisory Group and adopted by NZTA, CCC and CERA, with the NSW government and Auckland Transport trialling its application.

SCIRT was active in the creation of the Utilities Review Panel, a forum to foster ongoing working relationships within the utility industry nationwide, to provide leadership and identify common issues in design and construction process and to recommend solutions.

#### 3.3.4.9 Deployment flexibility

SCIRT responded to changing priorities or redeployed to sites where required, as an inherent flexibility. For example, it was aligned with the CERA Recovery Strategy and planning and development within the Christchurch central area yet changed from any of the priorities of those schemes if needed by CERA, NZTA or CCC.

Similarly, the construction schedule was consistent with the project priorities developed by SCIRT staff in conjunction with the clients and was integrated with the current plans of all interacting programmes. However, that schedule was changed as required to meet altered stakeholder need, without major cost implications.

As an example, the pressure wastewater projects, which were placed “on hold” because of the imposed community consultation process, were accommodated by rescheduling and backfilling the workload to the affected teams to maintain the overall work schedule.

This was achieved in 2013, with minimal time and cost penalties such as arise from conventional commercial arrangements. However, the delays gave rise to costs from redesign, repeat work and stand-down in 2014 and 2015, as more work was placed on hold for varying periods.

#### 3.3.4.10 Schedule matching funds

Funding requirements and availability were balanced to set the annual cash flow of SCIRT, including seasonal variances. This was an important factor in the SCIRT production line, enabling prioritisation, design, cost estimation and construction schedules to be arranged to deliver monthly throughputs and seasonal capabilities within the annual appropriation.

#### 3.3.4.11 Progress reporting

The following three samples show progress reporting of construction spend. First, over time (compared with predicted spend), its breakdown against asset type and the progressive build-up of that breakdown. (These graphs are typical of those reported monthly to the board.)

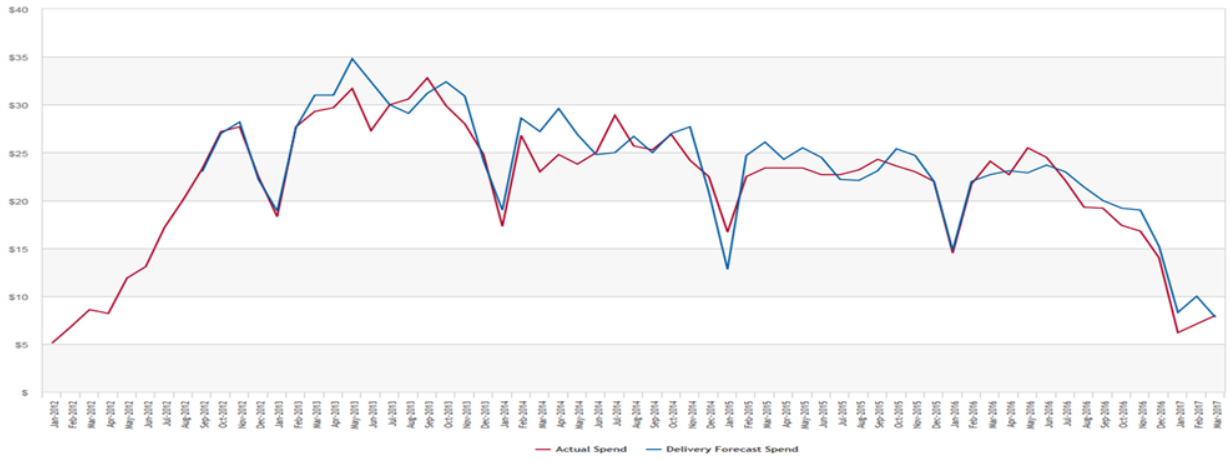



**Figure 45 Monthly construction spend against forecast.**

| | | | Network Total | Current Estimated in Scope | Percent of Network | Estimated Construction Complete | Percent of in Scope | Confirmed Handover Complete | Percent of in Scope |
|---|---|---|---|---|---|---|---|---|---|
| Wastewater | Reticulation | Km | 1,773 | 352 | 20% | 352 | 100% | 352 | 100% |
| | Pipelining | Km | | 161 | 9% | 161 | 100% | 161 | 100% |
| | Pump Stations (Repair) | No. | 164 | 45 | 27% | 45 | 100% | 45 | 100% |
| | Pump Stations (New) | No. | | 39 | | 39 | 100% | 39 | 100% |
| | Pump Stations (Decommissioned) | No. | | 9 | 5% | 9 | 100% | 9 | 100% |
| | Lift Stations | No. | | 65 | | 65 | 100% | 65 | 100% |
| Water Supply | Reticulation | Km | 3,403 | 96 | 3% | 96 | 100% | 96 | 100% |
| | Pump Stations & Reservoirs | No. | 177 | 25 | 14% | 25 | 100% | 25 | 100% |
| Storm Water | Reticulation | Km | 941 | 49 | 5% | 49 | 100% | 49 | 100% |
| | Pump Stations (Repair) | No. | 35 | 4 | 11% | 4 | 100% | 4 | 100% |
| | Pump Stations (New) | No. | | 3 | | 3 | 100% | 3 | 100% |
| Roading | Carriageway | m2 | 11,670,000 | 1,378,436 | 12% | 1,378,436 | 100% | 1,378,436 | 100% |
| | ALL Bridges/Culverts | No. | 303 | 144 | 48% | 144 | 100% | 144 | 100% |
| | Foot Bridge | No. | 118 | 36 | 31% | 36 | 100% | 36 | 100% |
| | Road Bridge/Culvert | No. | 185 | 108 | 58% | 108 | 100% | 108 | 100% |
| | Retaining Walls | No. | 1,867 | 181 | 10% | 181 | 100% | 181 | 100% |

Estimated Scope values are based on Design Input; Estimated Construction Complete values are based on the Estimated Scope prorated to project spend; and Confirmed Handover Complete values are based on final GIS As-Builts.

**Figure 46 Construction by asset type.**

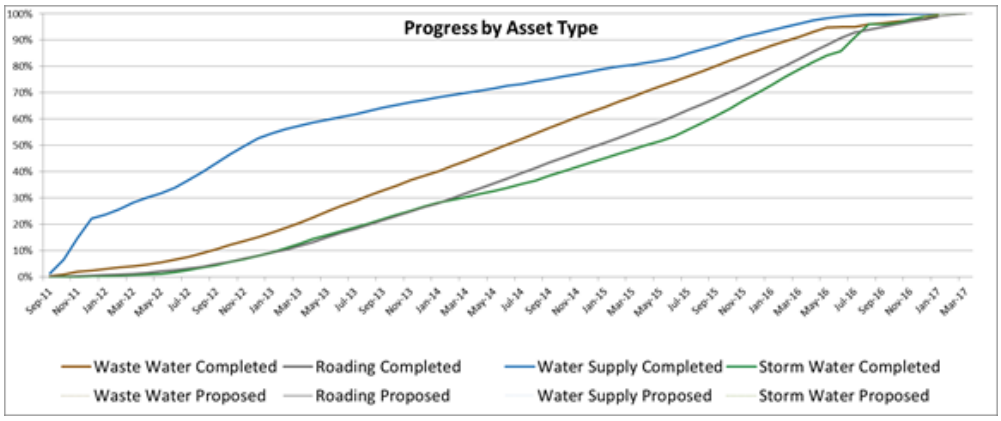



**Figure 47 Asset type rebuild over time.**

### 3.3.4.12 Maintain delivery capability

In a similar manner to the funding focus, SCIRT planned, monitored and reviewed all the segments of the project production line to ensure that capacity matched demand for each step. The resource capability processes were conventional, but the SCIRT multi-project production line created added demands on optimisation of resources.

The programme did not experience any significant mismatch of delivery and demand in construction because of the focus of process and the flexibility of the teams and the capacity of the subcontract industry.

However, there was an exception in 2016, when pipelining demands exceeded experienced, reliable, good quality specialist companies. This reflected the historical lack of use of pipelining in Christchurch, together with the difficult ground and pipe conditions, which meant some enterprises were not up to the job.

#### 3.3.4.13 Program delivery resources

Resources were continuously evaluated by management, delivery teams and parent companies to reflect the current and forecast work allocation. A lack of resources was not proven to be a significant obstacle, with construction close to planned throughput.

However, demands from the vertical rebuild were monitored, especially for labour.

### 3.3.5 Progressively getting better

SCIRT's structure and function were set up to foster improvements. This proved to be effective, with continual improvements a focus for individuals and teams. This applied to each segment of the production line where training, idea sharing, and competition created a learning environment that improved skills.

The new ways of doing things included:

- Asset assessment found quicker, more reliable processes and statistical methods.
- Designers standardised methods, solutions and construction details.
- During design, delivery teams informed designers of the best construction methods.
- Cost estimators focused on first principles understandings of construction methods and input prices.
- Schedulers continually balanced project flow with field capacity and budgeted cash flow.
- Delivery teams drove projects to beat budgets to achieve challenging target estimates.
- Communications teams refined information processes and content to improve the understanding of others.
- The HR team promoted the Peak Performance Plan and monitored results.
- Commercial processes continually evolved and enhanced output, such as with the refinement of GIS deployment, financial reporting and earned value analysis and reporting.
- Delivery teams refined skills for predicting cash flow and out-turn cost.

#### 3.3.5.1 Capability of integrated team

There was no single mechanism to portray the capability of the integrated team of the wider SCIRT because of its complexity. However, the KPIs and other measures show improvements over time.

#### 3.3.5.2 Asset assessment process

The asset assessment task was significant, with a forecast final cost of $150m or 7 per cent of programme costs. Because of this very high cost, the team kept efficiency gains as a central plank of its operations since inception, with the drivers being:

- The urgency to provide information to enable projects to be defined.
- The need to assess a range of neighbourhoods to inform wider views of the scale of work.
- Thinking ahead to identify appropriate perspectives on the state of assets and their predicted lifespans.

The resulting initiatives and achievements were:

- A land survey specification created and progressively improved.
- A damage assessment tool that combined statistical analysis with pipe types and depths with ground types to reduce the amount of expensive CCTV.

- A methodology for as-built CCTV inspection of laid pipes simplifying, standardising and speeding up of this task and improving efficiency in finding and the review of collected data.
- A methodology to assess reduction in asset life caused by earthquake events.
- Updating of the guidelines to allow greater discretion to maximise life against observed pipe structural defects.
- A process of as-built data transfer directly into 12d Model (civil engineering design software) for GIS updates (together with the designer and survey teams).
- A process for automatic verification of uploaded data.
- The completion of the water leak detection programme, including implementation of a method to apply an irrigation offset for the summer period.

#### 3.3.5.3 Asset assessment tools

New tools were created, resulting in the reduction of asset assessment cost and definition of the most effective and efficient design solutions:

- A statistical pipe data assessment tool to predict likely damage and reduce the need for expensive CCTV inspection.
- An integration tool for data transfer onto GIS platform achieving in the order of 93 per cent accuracy for assessments.
- Updating of CCC pipe-flow modelling, along with flow monitoring programme.
- The progressive creation of an asset search programme to better inform design teams.
- The inclusion of a LoS approach in the guidelines to maximise asset life, as well as the defect intervention points.

These were very significant achievements for the rebuild, with very strong potential for wider New Zealand infrastructure utilisation.

#### 3.3.5.4 Early constructor involvement

ECI was a focus of delivery leadership and management from the start and gained more attention with early reviews of TOC. The initial natural disparity of opinions on the adequacy of project budgets between the TOC and delivery teams meant both had an incentive to ensure that ECI was working effectively, shaping shared views on the approach to project methods and time sequences, leading to appropriate cost allowances.

Two independent assessments of the ECI process were conducted at the board's request and indicated that the process was appropriate. In addition, the TOC team manager studied project outcomes and found a positive correlation between ECI and better project cost performance against TOC.

By improving transparency, reducing risk and sharing responsibility, ECI powered productivity gains and cut project costs for SCIRT.

It helped ensure efficient design and planning via a more effectual approach, resulting in a streamlined work process. Providing "constructability" advice to designers; being involved in project risk assessment and management; and evaluating the project methodology and schedule to inform the project design, TOC development and planning were all part of the ECI collaborative contracting process.

Earlier involvement in preliminary designs provided transparency on project costs and boosted decision-making outcomes by constructor teams while ensuring control over deliverables. TOC input costs remained under pressure, yet a collaborative relationship was formed between a delivery team and the designer and cost estimator. However, but budgetary control remained with the TOC team and the asset owner.

It is notable that this process took some months to become a robust and reliable process, probably due to inexperience. However, the establishment of a dedicated ECI manager for each delivery team created consistency of process.

A construction schedule and methodology, resource and interface assessment, traffic staging and environmental assessment were all part of the initial “deliverables”.

By the detailed design phase for each project, these had been expanded to include an inspection and test plan, reviews and the incorporation of construction risks into a project risk register.

When the deliverables and documentation were submitted, the ECI manager and a SCIRT estimator held a handover meeting where any issues were resolved. Methodology, the project schedule and any potential risks were considered. However, pricing remained off limits to delivery team personnel, to ensure the TOC independence.

With all the information in hand, IST estimators proposed the TOC for review by an independent estimator.

Overall, ECI opened the door to improved cost certainty on each project by significantly informing the estimate process. ECI involvement brought clarity, transparency and maximum value while heading off potential risks.

#### 3.3.5.5 Design

The four design teams, tasked with both concept and detailed design, quickly developed a strong outcomes-focused culture, which was maintained through openly monitored and reported performance against time frames. A consistent delivery of documentation for $30m to $40m of completed construction value was achieved each month. This high level of output, to schedule, gave dependability to downstream activities.

The design portion of the earned value analysis shows that designer output has delivered reliably ahead of time and cost parameters.

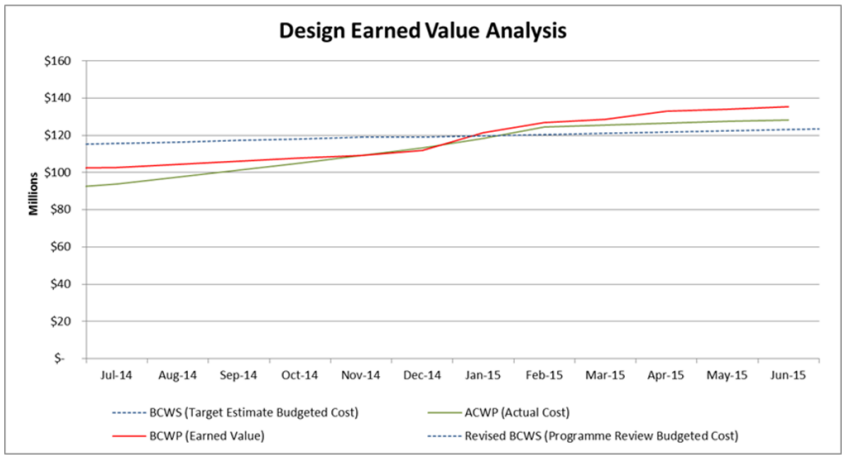


**Figure 48 Design earned value analysis.**

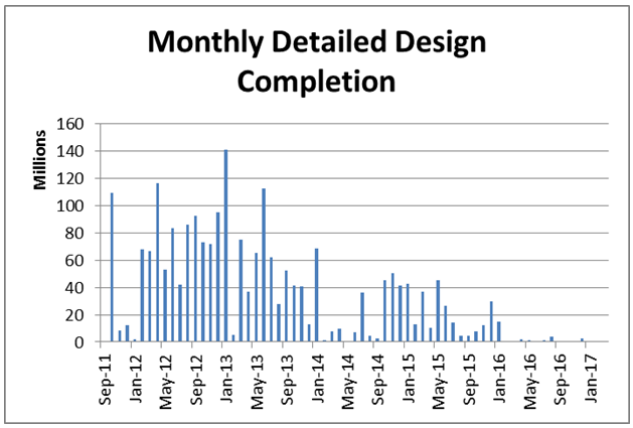



**Figure 49 Monthly design completion.**

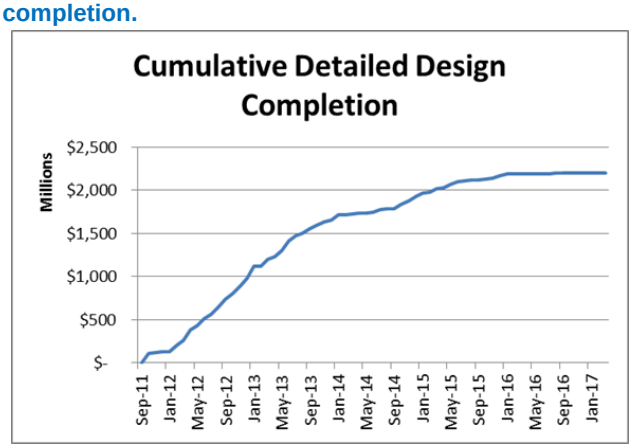



**Figure 50 Cumulative design completion**

As explained in section 4.3 following, in 2014, projects were put on hold and redesign started, once the programme budget was re-established. (The effects on workflow can be seen in the above figures as reductions in design output.)

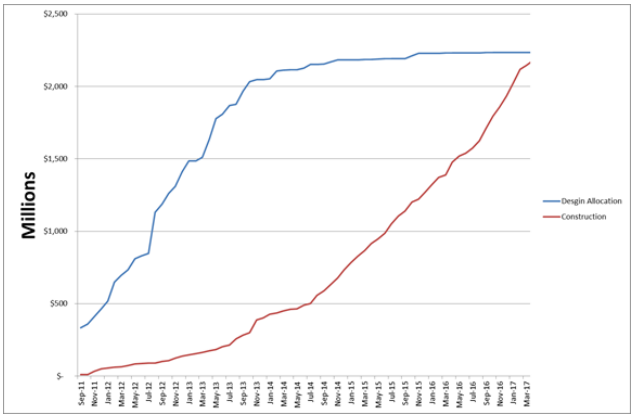



**Figure 51 Design load related to programme throughput.**

As the design work decreased, the number of designers reduced, enabling the four teams to merge into one in early 2015.

Individual initiatives created improvements to process, such as:

- The forming of subject matter technical groups, creating standardisation and innovations.
- Driving the whole process of alternative wastewater catchment solutions to achieve best-for-purpose outcomes.
- Joint development of the as-built data transfer system with asset assessment and GIS teams to significantly simplify the production of completion documentation.
- Pipelining specification reflecting local conditions and pre-approval processes to assess the capabilities of specialist subcontractors and assist delivery teams in selecting and contracting resources.

Design was completed in early 2017.

#### 3.3.5.6 Price-setting data

SCIRT cost estimators maintained a comprehensive database of materials, plant and labour costs and productivity rate data to inform the pricing process (described in section 4, following). The data was used as inputs to the project estimates and the final agreed TOC validated by the IE.

The results of a substantial 2014 external review of SCIRT cost estimation by Morrison Low and Evans and Peck was a solid confirmation of both the pricing data and process of generating TOCs. (This is explained in section 4.3 following.)

#### 3.3.5.7 Monitor delivery costs

The delivery teams, the estimating team and the IE all separately monitored actual project outcomes, including material, labour and subcontractor input costs and rates achieved in the field.

The IE also monitored individual project onsite resourcing levels, production rates and productivity.

#### 3.3.5.8 Monitor delivery performance

The KRAs of the agreement and the KPIs created by the board and management team set the framework for monitoring project delivery performance in non-cost areas (described in Section 6 following).

- Monitoring of construction productivity passed through several iterations as the nature of the work changed.
- Productivity monitoring was replaced by throughput as a performance measure in July 2015, based on earned value analysis.

#### 3.3.5.9 Award projects on performance

The allocation of projects available for construction to delivery teams was based on a fully functional two-part process defined within the Procurement Plan, using cost and non-cost performance measures. The process tracked and reported inputs and results monthly, allowing for the rewarding of good performance with a greater proportion of the work.

To enable appropriate allocation, a combined performance score for each delivery team was calculated. To reach the final delivery performance score (DPS), SCIRT considered the delivery team's performance in five key result areas:

- Safety
- Value
- Our team
- Customer satisfaction
- Environmental

The DPS was a combination of cost and time measures to determine the percentage of work to be allocated by cost (the target allocation).

Other factors included a delivery team's available capability and capacity, along with its proximity and safety record.

Generally, most projects were allocated to the delivery team that had ECI responsibility.

During any scope change – and particularly in the 2014-15 optimisation phase – project allocation was often affected because it was interrupted by a lack of funding approval.

In June 2015, the allocation process was reviewed to enable a December 2016 programme finish. Under the change, factors such as team capacity and capability played bigger roles in determining allocation.

The process ended in mid-2016 when all available projects had been awarded that could be, using the process.

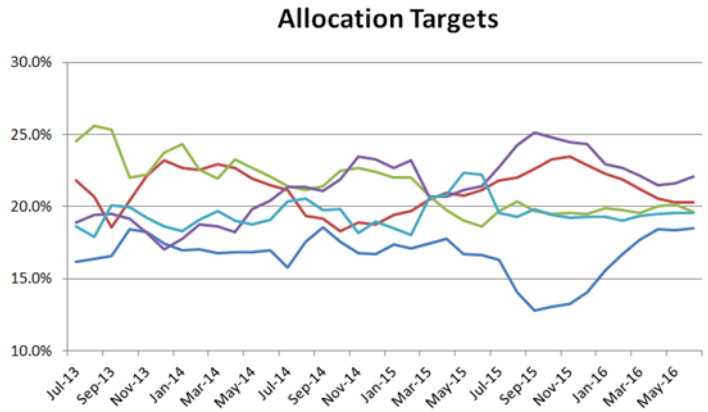



**Figure 52 Project allocation targets over time.**

### 3.3.5.10 Project handover

At the completion of individual projects, a conventional set of information and data was handed over to CCC for its records. This was a demanding process for a programme of projects of this nature, because the as-built construction and cost information needed to be attributed to individual assets, down to such detail as single access chambers for buried pipes, or lengths of pipe between two chambers.

That need, coupled with the initial inexperience of delivery site teams, meant that the process was subject to a planned development process-flow design and documentation, information transfer and data management tools, training, monitoring and reporting.

The SCIRT IST created a team member position to provide focus, plus support resources to ensure the process ran quickly and smoothly.

Project completion was added to the performance monitoring that informed the work allocation process, prompting positive results.

However, the handover of project data rate did not consistently achieve the desired time limit or level of throughput at June 2015, despite significant improvements in the past year.

(The following diagram shows a history of improvement in process.)

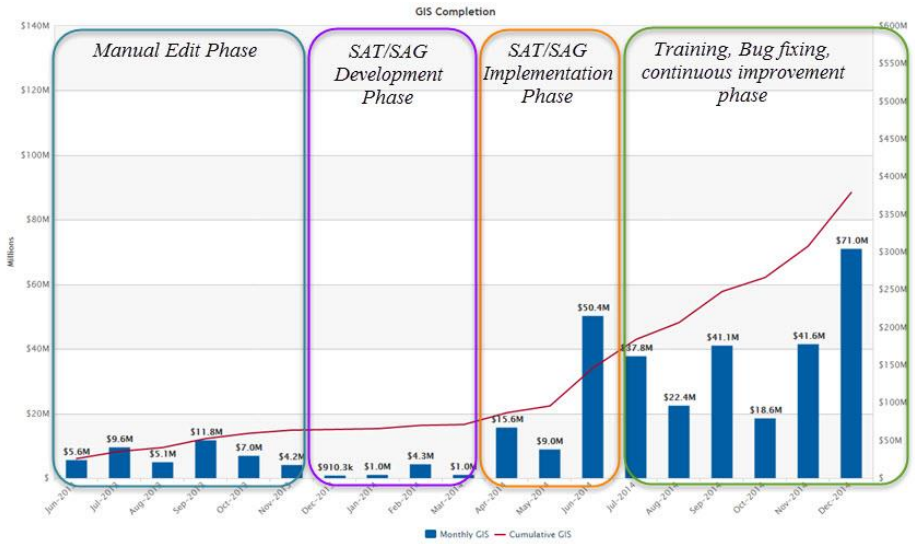



**Figure 53 Continuous improvement of SCIRT handover process.**

### 3.3.6 Programme defects liability

The agreement provided for 12 months of defects liability to follow programme practical completion. Because each project had practical and final completion, the defects liability period comprised a succession of projects reaching final completion. However, it was also a period in which any handover or scoping issues from individual projects were addressed by SCIRT and asset owners together.

#### 3.3.6.1 Working arrangement

A new 'trimmed down' structure was created to match anticipated workload, comprising the Board, convening as required, a working group (management team) and small construction, administration and professional services teams.

The working group interacted with asset owners (CCC and NZTA) for site walkover inspections and decisions on defect scope. The CityCare construction team staff and operators, worked on behalf of all NOPs, to carry out rectifications. Administration was primarily focussed on documenting scope, completion and handover, any payments, and ascribing asset values arising. The professional services included any design and documentation needed for rectifications.

#### 3.3.6.2 Defect assessment

The commercial arrangement had a flow-on effect to the attention of defects. If the work was by a sub-contract to a NOP, rectification was the responsibility of the sub-contractor, at its cost. If the work had been self-delivered by the NOP then costs would be paid, impacting AOC vs TOC and therefore pain/gain. The Board decided to limit defects by creating a simple risk decision matrix and an NPV comparator tool, to test whether the work would be completed within the programme or passed to the asset owner for longer term rectification.

Risk was assessed by a 3X3 matrix of Likelihood (low, medium, high) versus Consequence (Negligible, minor, more than minor), with high+minor, high+>minor and medium+>minor requiring repair.

If a decision was not obvious from this test, a cost comparison of 'repair now' versus NPV cost of repair at asset replacement was calculated.

#### 3.3.6.3 Result

Final completion was successfully completed in the period, for a cost of $4.8million, against a budget allowance of $4.2million, giving rise to a small increase in Limb 3 pain shared between NOPs and OPs.

## 3.4 Other achievements

### 3.4.1 Consents and approvals

SCIRT, CCC and ECan staff worked collaboratively to develop a suite of global resource consents and planning approvals to enable coordinated and cost delivery in accordance with relevant legislation. (Some of these consents are attached below.)

The consents allowed time-saving authorisation of activities, including:

- Drilling of geotechnical investigation bores.
- Works around protected trees.
- Wastewater overflows during wastewater network repairs.
- Dewatering abstraction and discharge.
- Construction and operation of pump station structures.
- Excavation/deposition of material over aquifers.
- Disturbance of soil in HAIL sites.
- Works in and around archaeological sites.

Consents were communicated to delivery teams to ensure the consistent application of consent to differing site conditions within the environmental parameters.

Training was provided to environmental team members, with the help of ECan compliance staff. Information was fed through to project engineers and site crews via toolbox sessions to upskill many who were new to the city and unfamiliar with local conditions and expectations.

The development of this framework of global consents, together with a focus on five key environmental risk areas (trees, archaeology and heritage, spills, wastewater overflows and sediment discharges) fostered a consistent approach across the programme.

This served the community well by delivering value, while enabling efficient repair and rebuild and protecting environmental values. The success of the approach was illustrated by the high

level of environmental compliance achieved for the duration of SCIRT's programme, with a very low number of environmental incidents when compared to national averages.

This approach could be readily adapted to other large-scale programmes of work, where the unified and consistent approach to environmental management was vital.

In 2013 SCIRT, CCC, ECan and Beca won the New Zealand Planning Institute Best Practice Award for its collaborative approach to developing the global consent framework.

## 3.5 Alliance structure

The structure of SCIRT did not change because the parties remained the same and it continued to provide a solid foundation to the enterprise. The lines of communication and comprehensive management planning created a consistently focused entity, functioning as intended in the agreement.

The delivery of built outcomes continued as planned and, therefore, alliance objectives were progressively addressed.

The Office of the Auditor-General carried out comprehensive audits of SCIRT in 2013 and 2016. In both cases, the alliance structure was found to suit the needs and no shortcomings regarding the structure were identified.

However, the governance structure changed, as addressed in section 8 following.

### 3.5.1 Changing outlook with time

The direction focus and achievements of SCIRT changed significantly as it progressed through its rebuild task. In addition, its terms of reference changed in response to government and CCC funding discussions and agreement

**2011** In the year of the February earthquake, SCIRT was set up with the IAA and created with the AA signed in September. It took over the work in progress of the CCC Infrastructure Rebuild Management Office (IRMO) and began design and construction based on damage repair scope definition

**2012** There was a significant focus on creating teamwork, building workload and throughput, while establishing, monitoring and reporting on performance. During the third quarter, the first estimate of the order of programme cost was created, giving rise to the first spend limit of $2,496m, starting the LoS phase of scope definition

**2013** Peak planned throughput was achieved over several months, with related bedding in of monitoring and reporting. The last quarter featured the CSA of the funders, setting out to cap spending in a manner to be determined

**2014** It was a year when the smooth operation of SCIRT was challenged by projects in design or construction being put on hold pending funder agreement on the scope of projects, or the projects, to fit with the CSA. By year end, the forward programme was broadly defined

**2015** It began with the final definition of scope and resulting redesign. There was relatively smooth continuous throughput following the redesign. In the last quarter, management and leaders began to focus on “Finishing Strong” in the final year.

**2016** There was significant effort towards the earliest possible completion of construction work in the field. The SCIRT legacy become a feature of the latter half of the year, including the creation of material for the Learning Legacy facility, to make lessons learnt available to stakeholders. A focus on completion generated a significant rise in construction throughput and following handover.

(The following diagrams illustrate the changes in throughput over time.)

### 3.5.2 Work output over time

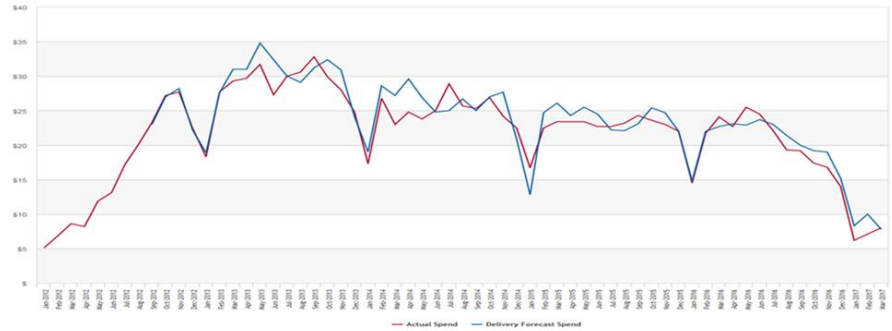


**Figure 54 Construction completion over time.**

(The figure shows construction throughput of SCIRT and absorbed IRMO work, with achievement very closely aligned with unfolding – three months ahead – prediction.)

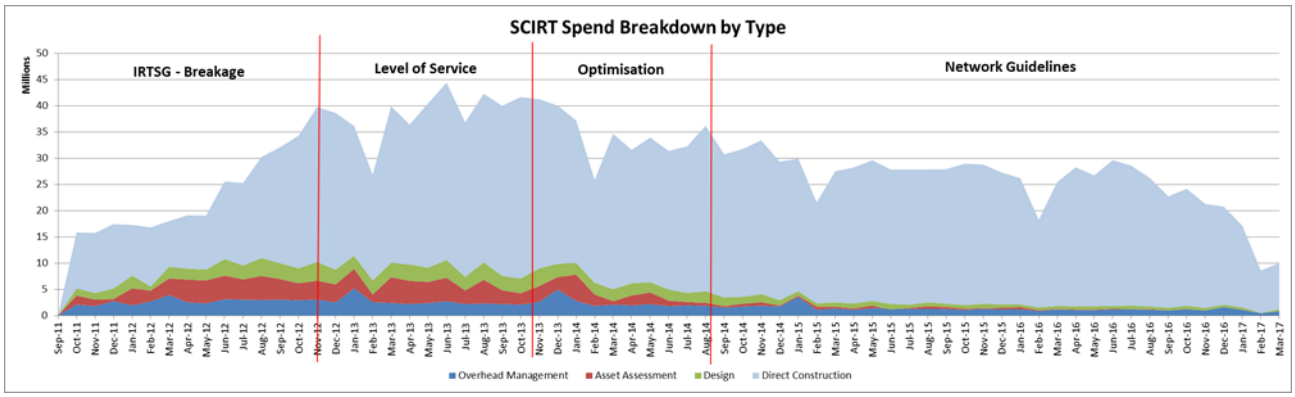



**Figure 55 Total throughput over time.**

(The figure shows total throughput (monthly spend) including asset assessment, design and management overhead.)

(The time phases are an approximate delineation of the changes in the definition of scope that are described section 2 and above.)

The LoS phase was structured to a first definition of total spend of $2,496 million. The CSA in 2013 reduced that total, but without providing clear guidance regarding a figure. Therefore, many projects were put on hold pending the definition of scope detail, which led to the marked drop in throughput shown.

During this phase, called optimisation by CERA, design workload and throughput increased as many projects were reassessed for scope or even for inclusion and once confirmed, were subject to redesign to new parameters. The completion of the optimisation process gave more complete definition to the scope, with redesign continuing for some months.

Design changes naturally led to obvious revisiting of scope and change to other activities or phases such as ECI, detailed design and cost estimation.

In 2014 and into 2015, projects were sometimes also subject to reallocation as the work share was revisited and workloads reassessed.

## 3.6 Challenges

Throughout the SCIRT programme, central challenges were either a result of the agreement or a variety of other factors:

- The objective of raising standards and translating these to the industry was an ongoing challenge, not only of achieving opportunities identified, but also making them happen in many project teams spread across five delivery teams, within short time frames. This challenge was addressed through the Peak Performance Plan, the leadership WAVE and innovation KPIs.
- The five-year SCIRT time frame was significantly longer than normal in the local construction community and, hence, created a challenge of maintenance of momentum of effort and engagement of all players. This was addressed by the Peak Performance Plan and related HR features.
- The self-assurance model of all aspects of SCIRT work created unusual industry demands of informing stakeholders of achievements. This was addressed through normal monthly reporting, quarterly statistic updates and one-off presentations.
- The evolution of scope and resulting priorities and direction naturally created challenges of definition and implementation of change, which SCIRT addressed with a continual focus on throughput of all stages in the project pipeline.
- The scope change pressures exacerbated challenges of engagement and communications with OP staff, who did not necessarily engage with the multi-party issues arising from three funding sources. This was addressed by staff engagement within IST and by presentations to the Scope and Standards Committee of the CGG/HIGG.
- Changing community expectations and declining patience with the city rebuild emerged as a reduction in patience for SCIRT in 2016, despite its high approvals ratings. This was addressed by the continued or increasing focus by delivery teams on affected communities and businesses.

# 4 Achieving the right price

## 4.1 Guide reporting structure

The SCIRT commercial model was significantly different from that anticipated by the Guidance Note 4 and, hence, reporting and commentary required a different explanation of achievements. (However, for ease of understanding, the following subsections address the guide in sequence, prior to the following commentary specific to SCIRT.)

### 4.1.1 Business case estimate

There was no business case estimate as the scope and, hence, cost prediction was progressive.

### 4.1.2 Total cost estimate

As above, the forecast final cost (FFC) was generated progressively and has been met, subject to final pain/gain impact.

### 4.1.3 TOC adjustments

A work scope change process was established whereby delivery teams or estimating teams could challenge the makeup of the project (not programme) TOC where scope had changed from any cause, including significant departure from conditions encountered.

### 4.1.4 Risk provision and contingencies

Programme risk was not priced into TOCs nor was mitigation. It was a process of the management team designed to control and avoid drastic programme-wide occurrences.

Project risk was addressed and priced through concept and detailed design, including methodology and risk mitigation action advice from ECI, all as explained separately. Risk mitigation was not costed in each case.

A general contingency for risk was applied across the project, as assessed by the TOC team.

### 4.1.5 Price verification

Price verification was achieved by the TOC team monitoring project history, market prices or advice. The IE carried out a range of tasks contributing to verification, including commercial audit of NOP billing rates, review of NOP annual P&G budgets for delivery teams and the annual budget for the IST.

Reports from the TOC team were part of operational reporting to the board and by the IE to the funders.

### 4.1.6 TOC development

TOCs were generated for each project generally from first principles estimating, supplemented by quantities and rates estimating. Each project estimate was subject to challenge by the IE team and would not progress to a project TOC until the views of the two parties were aligned on price. This was, in effect, a fully parallel process of two independent expert teams.

### 4.1.7 Selection process

The advancement of work from design to construction was different from that anticipated in the guide. SCIRT delivery teams competed for projects based on cost and non-cost achievements and the delivery of a project was subject only to the team's approach to the market. Therefore, there was no need to set up a programme-wide pricing and selection process.

### 4.1.8 Innovation

Innovation in SCIRT was reported separately in sections 2 and 3. It was not a simple add-in to the price achievement process described in the guide. Rather, innovations were an important KPI, feeding into delivery team performance and reward and, hence, added success to the programme by stimulating project delivery performance, rather than being whole of programme initiatives.

### 4.1.9 Following sections

(The following sections in achieving the right price expand on the above explanation and report on achievements as relevant.)

## 4.2 Programme estimate commentary

Predicted project costs and programme total were created and refined progressively as SCIRT passed through the first two years as rebuild parameters were refined, then subject to major review with revisiting of the basis of the rebuild during the remaining three years. The process is explained in section 3 preceding in commentary on 'the right work'. (The following table describes estimate iterations.)

| Date | Work Definition: | Estimate ($ million) | Comment |
|---|---|---|---|
| Apr 2011 | Site observations, immediately post-quake | $2,200million | Limited observations, recent cost experience with some escalation for scale |
| Oct 2012 | CCC supplied guidelines | $2,800million | SCIRT prediction including risk and escalation |
| Oct 2012 | SCIRT better ways to define rebuild | $2,500million | SCIRT cost reduction |
| Q1 2015 | Funder-provided rebuild parameters and cost-share agreement limits | $2,200million | Funder cost reduction, plus some CCC work |

**Figure 56 Programme cost estimates.**

The October 2012 first iteration of a programme estimate was based on the current understanding of damage and the rebuild guidelines. The estimate report included that an amount of about $300m could be saved through incorporation of several initiatives delivered through a LoS evaluation of the rebuild instead of a damage-based calculation.

SCIRT was instructed to adopt that approach and the resulting value of $2,496m became the target estimate. This caused the design team to amend processes to focus on the restoration of the pre-September 2010 network LoS as the outcome of the rebuild, for that sum.

The revisit of rebuild parameters of 2013-5 by OPs and asset owners created a total estimate of $2,100million, to which was added about $100million of CCC work.

### 4.2.1 Impact of scope changes

The scope changes described in section 3.2.2 significantly reduced the total cost of the programme. However, they also had an important impact on the progress and added cost of delay and re-design. The changes caused stoppage, then revisiting of design, interruption of work allocation and removed projects from consideration. It took time to identify the demarcation of project list (in vs out) and there was scope impact on key projects in delay, either from reduction of geographic extent or of types of work.

Most changes applied to projects not under construction but included many that were partially or fully designed and some ready for allocation or already allocated but not underway. In 2014 as much as $400m of work was delayed for three to six months, at the peak of reconsideration.

Some $200m of projects required redesign or documentation as a result. The order of cost of redesign was $0.5m. The cost to delivery team process and to work being stopped was assessed as at least $15m, but could be more, being hard to quantify.

The contractual and commercial agreements of SCIRT enabled these changes to occur without financial penalties, which would have happened in conventional contracts.

## 4.3 Project estimate TOC

TOC for individual projects were developed by experienced estimators working within IST using a first principles approach methodology utilising productivity rates and material cost inputs from a central estimating database.

Estimates were independently verified by a parallel process and any differences reconciled and agreed before the estimate became the project TOC. It was, in effect, the agreed project budget.

For projects completed in the early programme stages, budgets proved difficult to achieve, in part because of the very challenging ground conditions exacerbated by the seismic liquefaction. However, delivery improved and the overrun trended down (as shown in the next section).

- The estimation of TOC was regarded as rigorous.
- The estimates were regarded as reliable.

SCIRT was, therefore, confident that the rebuild was achieved for the right price.

## 4.4 TOC process review

In early 2014, the HIGG commissioned independent consultants Morrison Low, and Evans & Peck to review the SCIRT procedures of both the estimating (TOC) team and the independent verifier team. It was intended to confirm whether the generation of the cost estimate for each project followed appropriate processes and delivered relevant TOCs, including construction methodologies. It was to provide advice on possible improvements. The brief contained more than 20 request elements.

The review was completed in July 2014 and the comprehensive final report issued in October 2014. The report repeatedly described SCIRT systems and processes as sound, reliable, best practice and completely appropriate. It recommended no changes.

The report conclusions included (paraphrased):

- The process was appropriate for the nature of the projects being undertaken.
- The estimating and risk management plans, estimating guidelines, ECI and TOC processes provided procedural detail consistent with the AA requirements.
- There was multi-disciplined input into risk assessments.
- There was very good interaction between the designers and the ECI input.
- The ECI deliverables were emphasised as key inputs to inform the TOC-setting process.
- Assessment and pricing of risks were efficient and consistent with the principles of an alliance.
- The ECI process and TOC creation were transparent and robust.
- The IE team participated throughout.
- The involvement (of all players) on behalf of the owners was proficiently and professionally executed.
- The TOC-setting process was robust.
- The TOC process provided multi-disciplined input into identifying and mitigating risk and the refinement of construction methodology.
- The agreed risk contingency (in TOC) was visible and entirely consistent with best practice.
- No changes were recommended to the TOC-setting process.

This report was a confirmation of an important element of SCIRT, which, therefore would be regarded as fully fit for purpose.

## 4.5 Work scope change

The total allowed across the programme to 30 June 2017 was 2,393 changes for a combined value of $105million. (The following diagrams show the origin of changes and the approved value totals.

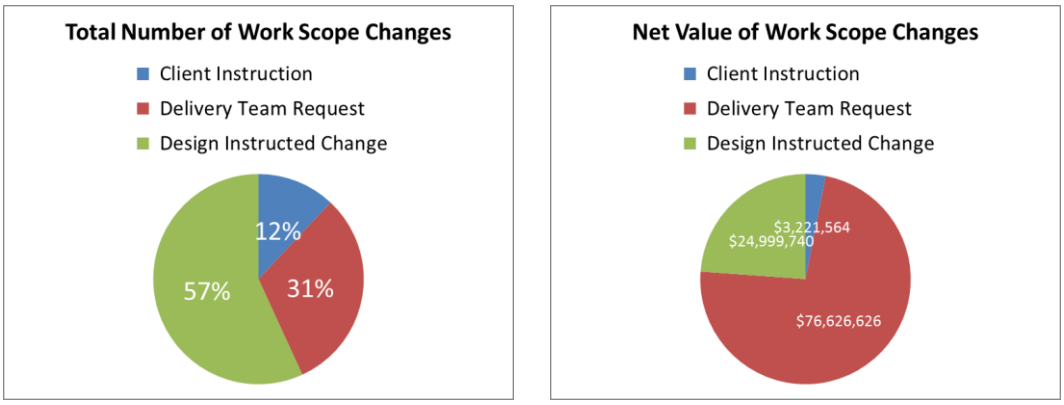



**Figure 57 Work scope changes**

## 4.6 AOC

(The following graph shows the cost performance of all delivery teams (AOC) against TOC. It shows a relatively consistent improvement.)

The programme target was an aggregated zero over-run on completion (or sooner).

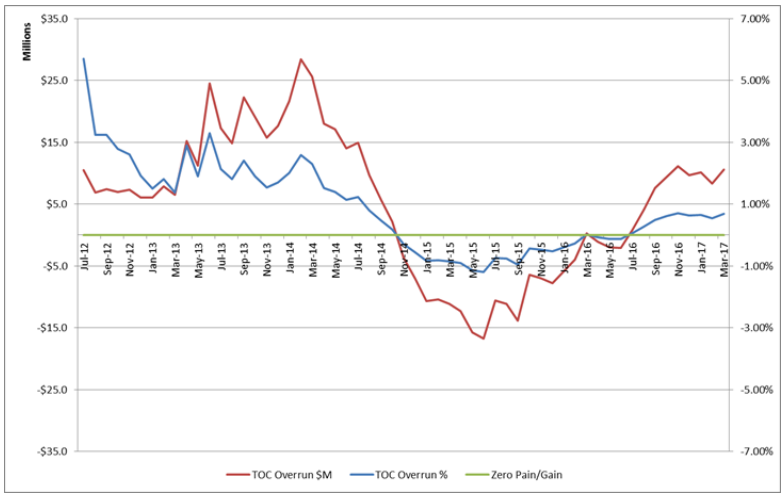



**Figure 58 Project out-turn costs versus target.**

In the final year of defects rectification, the AOC vs TOC worsened, leading to a final difference of $13million, with a funder share of $6million.

## 4.7 FFC

### 4.7.1 Programme costs

The following table shows the programme actual final cost as at 30 June 2018, at Programme Final Completion. This includes some $30million of CCC (IRMO) work on rebuild immediately prior to SCIRT, which was taken over and completed by SCIRT and $16million of CCC asset assessment work carried out for the SCIRT programme.

The proportion of the total ascribed to “pipe in the ground” at 72.29per cent was very high compared with common final cost proportions and would be higher still if asset assessment of 8.12 per cent is ignored, as a much lesser proportion would not normally apply.

| Cost Item | Actual final cost ($ rounded) | Per cent of programme (% rounded) |
|---|---|---|
| Asset assessment | $181,900,000 | 8.12% |
| Design | $158,200,000 | 7.06% |
| Delivery | $1,619,700,000 | 72.28% |
| **Total Direct** | **$1,959,800,000** | **87.45%** |
| Delivery indirect | $146,100,000 | 6.52% |
| IST indirect | $135,100,000 | 6.03% |
| **Total** | **$2,241,000,000** | **100.0%** |

**Figure 59 Programme summary costs**

The following graph is taken from earned value data at 31 March 2017 and shows the predicted convergence of actual spend with forecast total at that time, which varied due to scope fluctuations from the 2012 cost estimate, and subsequent changes arising from the parameter revisit and CSA, as described separately.

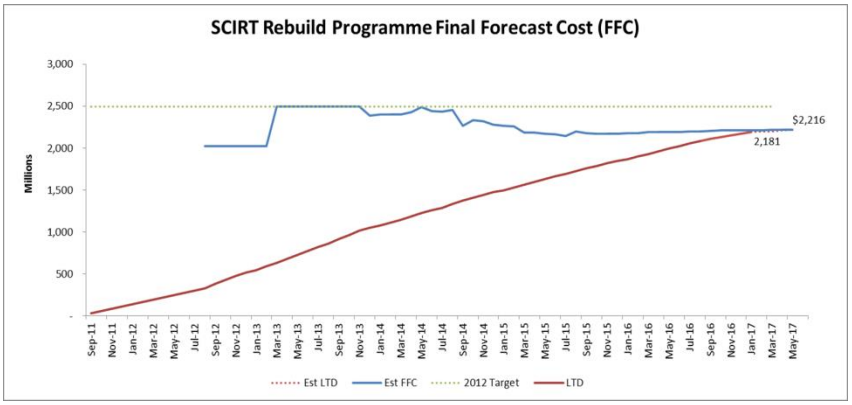



**Figure 60 Final programme forecast (blue line incomplete)**

The following table shows spend by asset type, or groups of assets, taken from actual cost reporting as at Final Completion on 30 June 2018.

| Asset | In scope | Percent of Network | Final Cost ($ rounded) |
|---|---|---|---|
| Waste Water | | | |
| Reticulation | 367km | 21% | $1,119,500,000 |
| Pipe Lining | 157km | 9% | |
| Pump station - repair | 45Nr | 27% | $164,800,000 |
| Pump station - new | 39Nr | | |
| Pump station - decommissioned | 9Nr | 5% | |
| Lift stations | 65Nr | 100% | |
| Pressure systems | | | $68,400,000 |
| Vacuum systems | | | $117,400,000 |
| Water supply | | | |
| Reticulation | 94km | 3% | $57,500,000 |
| Pump stations and reservoirs | 25Nr | 14% | $42,100,000 |
| Stormwater | | | |
| Reticulation | 47km | 5% | $133,100,000 |
| Pump station - repair | 4Nr | 11% | $9,200,000 |
| Pump station – new | 3Nr | | |
| Roading | | | |
| Carriageway | 1.25m sqm | 11% | $333,700,000 |
| Foot bridges | 36Nr | 31% | $94,500,000 |
| Road bridge / culverts | 108Nr | 58% | |
| Retaining walls | 181Nr | 10% | $95,900,000 |
| Parks | Misc. | | $100,000 |
| Other Utilities | Misc. | | $4,800,000 |
| **Total** | | | **$2,241,000,000** |

**Figure 61 Spend by asset type**

## 4.8 Spend across the city

The following map shows the spend to June 2016 by city ward, provided for general information and for comparison with the map of rebuild priorities, showing a close correlation between worst impacted areas and greatest spend.

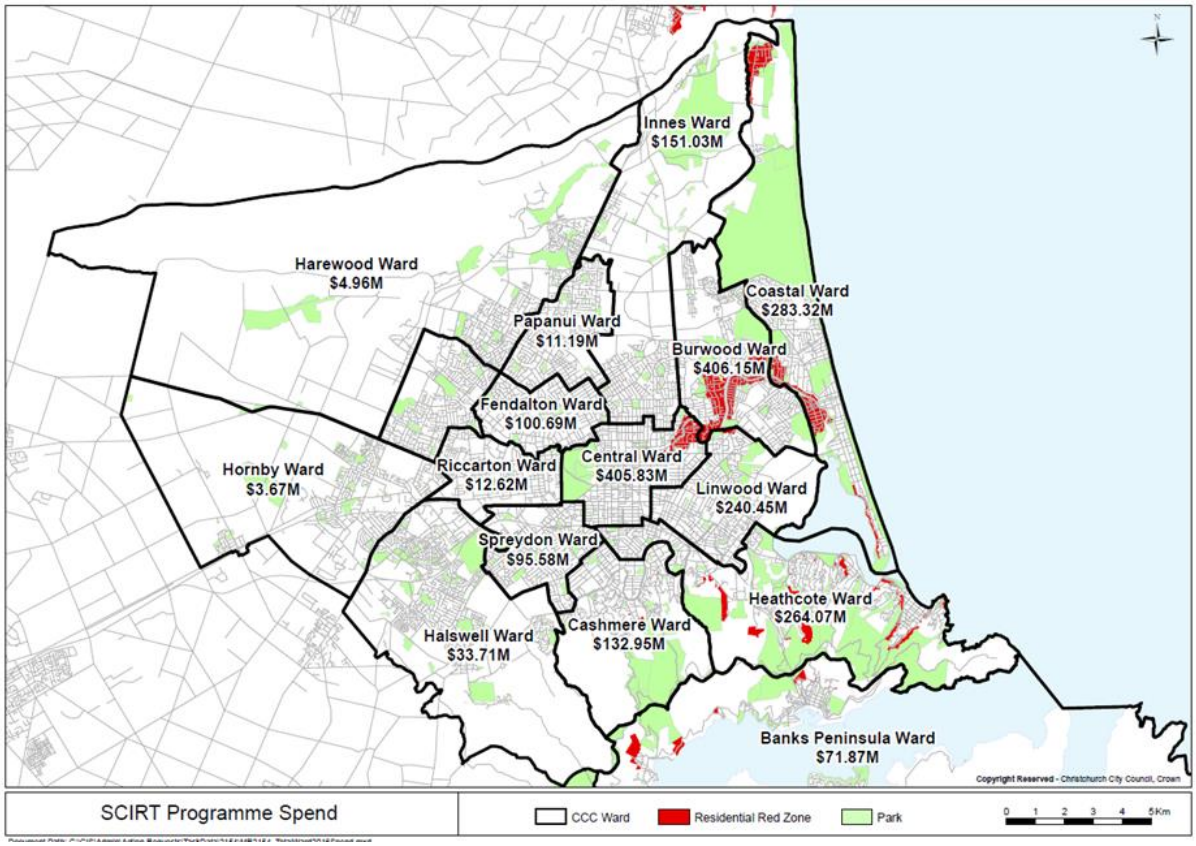



**Figure 62 Spend by city ward**

## 4.9 Independent estimate verification

A specialist cost-estimating and construction industry consultancy was used by the OPs throughout the programme to provide on-site staff to review and independently verify every project cost estimate before it could be passed into the project construction phase. In practice, the consultancy generated its own project cost estimate then worked with the SCIRT team to fully align assumptions and allowances until both agreed on the TOC value to be set. This was a validation TOC.

Both SCIRT estimators and the IE created first principles estimates, using a mix of construction experience, market advice and project delivery feedback, so that the construction process and the input costs were reliable. The delivery teams could have confidence that the resultant TOCs would be realistic, with fair market pricing.

This was a vital element of SCIRT performance, shown to be effective in this section.

### 4.9.1 Independent estimator assumptions

In conjunction with the TOC review process, the IE carried out regular six or 12 monthly reviews of the market to predict inflation and cost escalation and covered:

- Construction labour
- Salaried staff (contractors plus the SCIRT IST)
- Designer consultants' salaried staff
- Plant
- Equipment and vehicles
- Trucking
- Materials general
- Pipes (PVC, PE, GRP)
- Quarry products
- Fuel and bitumen products
- Concrete products (pipes, manholes, bridge beams)
- Steel products.

## 4.10 Independent audits

Another cost estimation consultancy provided the OP with independent verification of actual costs incurred each month across the programme, as detailed in the basis of compensation. It also reconciled the monthly claim amount to the SCIRT invoices and checked cost allocation to asset during the handover phase, prior to project practical completion.

## 4.11 Monitoring prices/containing escalation

SCIRT maintained a database of input prices, both to inform cost estimation and as a flag against market shifts. Separately, the IE monitored SCIRT and market cost data to track changes against forecast escalation.

### 4.11.1 SCIRT observations

(The following diagram shows a structured mix of monitored project input costs to date against a SCIRT analysis of construction industry-related published price indices.)

The SCIRT construction price index (SCIRT – Construction Index in the graph) tracked the changes in construction supplier prices in a basket of goods based on the project estimates prepared in that month. Relative quantities of the basket changed continually as the mix of projects changed and, hence, a "Fisher's Ideal Index" formula was used to create a normalising of the variation in quantities.

The resulting construction price index was compared to a compound index that used the PPI Input Construction, LCI Canterbury Construction and CEP Machinery indices from Statistics New Zealand combined using the same weights used in the SCIRT Construction Index.

The SCIRT Construction Index showed the containment of costs well below what might have been expected. The major changes in the last few months reflected a significant change in the labour and plant rates being used by estimators in the final few projects of the programme. The variability was due to the low number of projects being estimated.

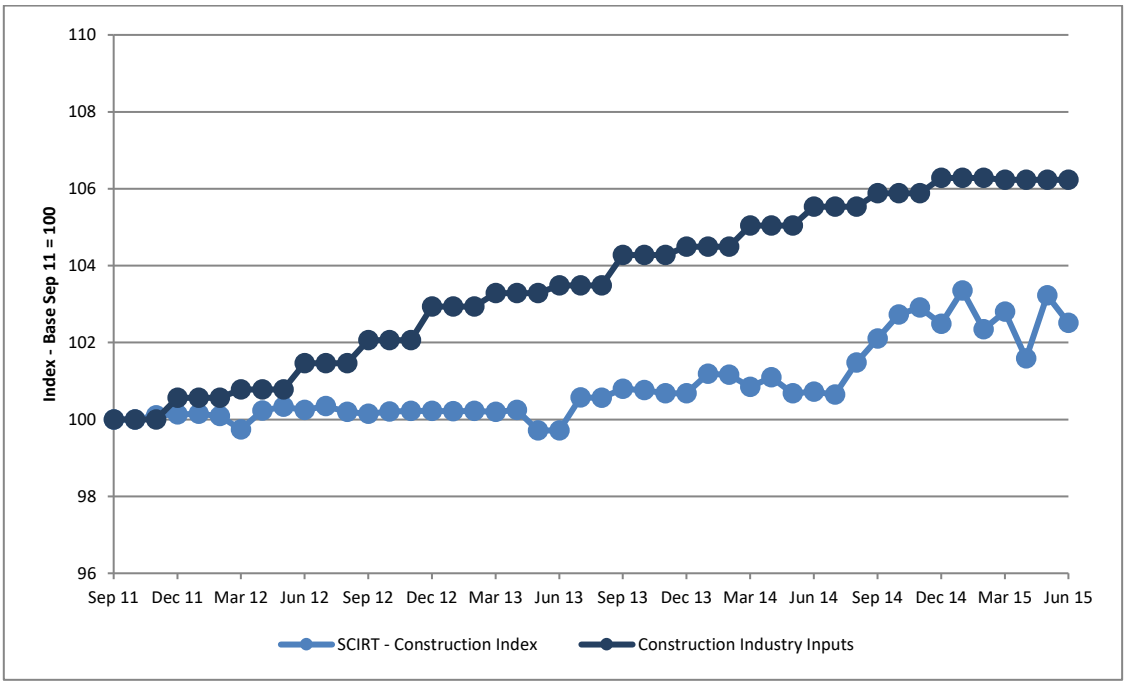



**Figure 63 SCIRT and industry Prices**

The result showed that the market index increased by about 1.6 per cent p.a. while SCIRT costs initially remained relatively constant but in the last year escalated by the order of 1.025 per cent p.a., well below market conditions.

## 4.12 Earned value

Earned value analysis is a discipline and process for assessment of the true time and cost achievements of projects against baseline forecasts. Individual project status can also be summed into a programme-level view.

Earned value analysis and reporting was in place since June 2013 and became a mature tool within a few months, for data gathering, processing and delivering reliable information.

### 4.12.1 Cost and schedule performance

(The following two graphs show the month-to-month trend of the earned value measures of the cost performance indicator (CPI) and the schedule performance indicator (SPI). The CPI includes data for SCIRT, including IST, asset assessment and design functions, while the SPI is based on data from the delivery teams only.)

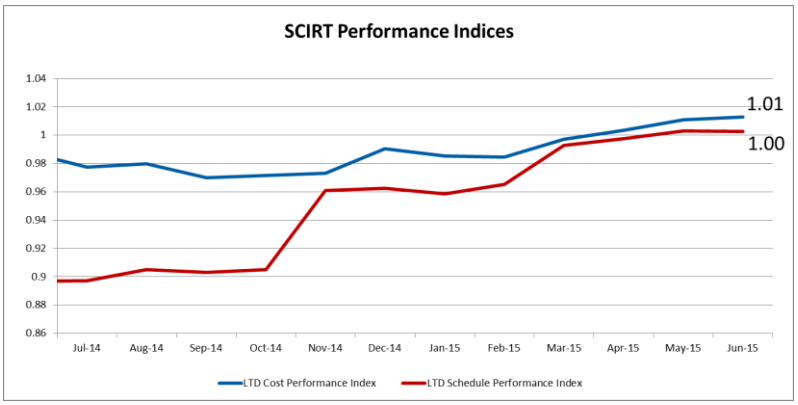



**Figure 64 Delivery earned value analysis**

In addition to the overview shown in this example, the earned value tool provided important analysis and reporting information into projects, because of the high standard of site observations that were necessary, which resulted in site administration to a high standard.

SCIRT did not incorporate earned value analysis into business systems but ran it as an independent comprehensive review tool.

### 4.12.2 Productivity from earned value

Initial productivity reporting was carried out for straightforward work such as pipe laying for smaller diameter pipes, but when the SCIRT scope diversified into a wider variety of infrastructure, the measurement detail was lacking and comparisons between dissimilar work became too difficult.

However, the earned value data was useful to compare delivery productivity because CPI or SPI could be done and could also be combined with site labour numbers from safety reporting.

(The following figure shows rate of work by team by month, with two highlights.)

First, there was a general upward trend in productivity over time, which was only lost in the last few months as workloads dropped and project finishing increased as a proportion of throughput.

Second, there were marked differences between teams where lean structures, experienced management and high levels of subcontracting lead to greater throughput during high workloads.

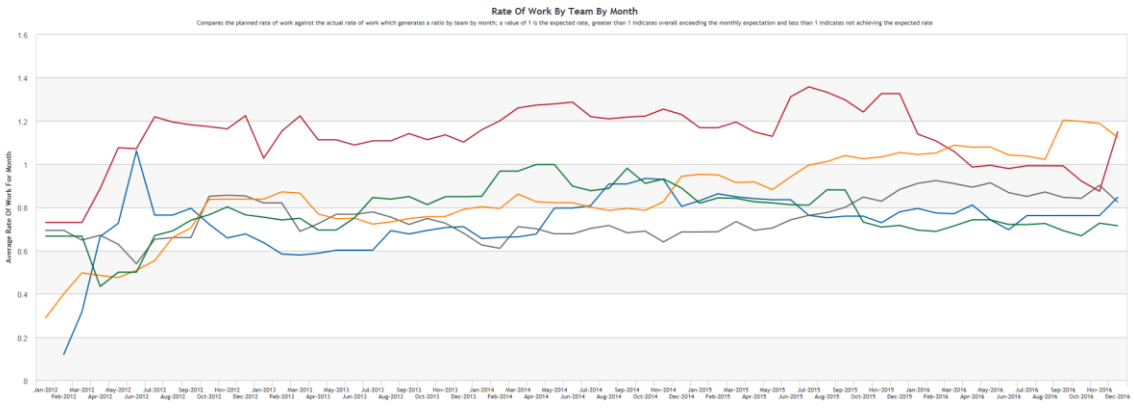



**Figure 65 Rate of work by team by month.**

# 5 Risk management

Risk management at SCIRT was framed and controlled by the Risk Management Plan, led by the value manager (until July 2015) and commercial manager (2015-16). It evolved from a two-tier process of programme (whole of operation) and project (individual project focus) risk, to include central city risks, site/construction operational safety risks, completion and quality risks and insurance risks.

This evolution was judged necessary in order to provide appropriate focus in each area, under the over-arching programme risk scope.

OP risk management was external to the SCIRT process, but the plans of each were socialised between the respective leaders.

## 5.1 Programme risks

Programme risk management was the responsibility of the management team, with the risk register established with board input. The register was reviewed annually with the board, quarterly by the team and monthly by each risk "owner". Note that programme opportunities were not addressed as part of this plan.

Risks were given cause and consequence explanations, ranked by likelihood and consequence, including the impact on health and safety, image/reputation, environment, stakeholder interest, cost, time and quality, using agreed definitions for each. The register automatically calculated a ranking.

Mitigations to be applied to the risks were addressed in the same register, described for both before and after, and a similar ranking process applied to generate a residual risk ranking, after mitigation.

The residual high programme risks received added focus and were reported in the Operational Report, in the format shown in the following table.

A condensed copy of the programme risk register is attached in Appendix D, showing only those programme risks with inherent "very high" or "extreme" inherent rankings.

## 5.2 Project risks

Risks at a project level were identified progressively through the evolution of the project production line by designers, delivery team ECI personnel and estimators. A risk register was created for each project in a similar but simpler process to the programme risk evaluation described above.

Risks were designed out or mitigations planned. Cost allowances were included in the TOC for the residual risk ranking, with allowance for occurrence probability.

The project risks and allowances were owned and managed by the delivery team as part of its construction responsibility.

A TOC allowance was included for unforeseen risks.

| Highest Programme Risks (by sector) | | Consequence of risk | Risk Level | Mitigation Against Cause | Mitigation Following Consequence | Residual Risk | Owner |
|---|---|---|---|---|---|---|---|
| 1. SCOPE / STRATEGY / PRIORITISATION | | | | | | | |
| 1.18 | Schedule risk | Project construction completion and handover to CCC slippage past March 17 | High | Increased focus on programme project delivery against schedule monitored and reported weekly | Analysis of slippage to determine root cause and what additional measures can be introduced to minimise slippage | High | Tim |
| 3. STAKEHOLDER / COMMUNITY / POLITICAL | | | | | | | |
| 3.4 | Finished work doesn't meet community expectations (e.g. road finish standard) | Loss of reputation and resulting loss of confidence; increase in issues raised puts pressure on capacity to investigate and resolve | Very High | Joint Horizontal Infrastructure Rebuild Communications Plan implemented and monitored each month. Conduct focus group research to gauge community feeling/expectations and guide comms response.<br>Proactive communication e.g. advertising campaign. | Assist Asset Owners with response to media issues arising and community complaints.<br>Respond directly with agreed messaging. | High | Linda |
| 6. RESOURCES | | | | | | | |
| 6.6 | Unplanned turnover and loss of key people | Negative impact on completions due to reduced institutional knowledge. | Very High | Programme wide retention strategies approved by the Board 2015. Each team applying strategies relative to context. | Focussed transitions and temporary labour. | High | Mason |
| 6.11 | Inexperienced staff | Increased errors and need for training | Very High | Planned succession and smooth transfer of knowledge. Keeping the right mix of new and SCIRT-experienced people. | Bring in replacements with industry experience. | High | Mason |
| 7. TEAM STRUCTURE / SYSTEMS / RELATIONSHIPS / COMMUNICATION | | | | | | | |
| 7.16 | Quality concerns and inadequacies | Errors and omissions with inefficiencies, cost of re-work, delay in handover, impact on reputation | Very High | Focus on quality assurance including audit scope, depth/quality of audits, following NCR process, ownership of quality control by line, engagement with asset owners. | NCRs and rework as appropriate and root cause investigations for significant issues and frank reporting. Focus on projects determined to be a high risk for completion. Regular review by IST to resolve significant/DT-wide quality issues. | High | David |

**Figure 66 Table of programme high risks.**

(This summary is a sample of a board report for June 2016.) The programme risks were reviewed by the management team and reported each month.

## 5.3 Critical eight operational safety risks

In January 2014, SCIRT began an initiative to identify and manage key critical risks that were judged as applying to all site operations, irrespective of the project detail. These were identified by a series of workshops of site and IST management as:

1. Service/utility strikes
2. Mobile plant and people interface
3. Traffic management and public interface
4. Lifting operations
5. Trenches and excavations
6. Confined spaces
7. Powered plant and tools
8. Working at height and depth.

A management process was created to ensure these were addressed through the evolution of each project in the following subjects from project and construction management:

1. Scope assessment
2. Hazards involved
3. Concept design
4. Detailed design and TOC
5. Pre-construction/mobilisation
6. Training and competency
7. Fitness for use plant, equipment and tools
8. Management of change
9. Safe Operation
10. Emergency management
11. Incident management, reporting and investigation.

The process was integrated with the broader project risk process and did not replace it, but simply gave focus to the recurrent critical risks.

## 5.4 Central city risks

SCIRT work within the central city (inside the perimeter avenues) involved interaction with several other work programmes and projects for infrastructure rebuild and new buildings. This shared design and construction space created risks for SCIRT that were identified and managed by a dedicated risk management plan and shared with stakeholder organisations.

Several risks were identified from the outset, including:

- Anchor projects public realm or road alignment proposals causing delays to the SCIRT programme.
- Parking restrictions imposed due to sites impacting on businesses and residents.
- Traffic access constraints causing network delays impacting on the travelling public, operating businesses and residents.

These risks were managed successfully through a collaborative approach between SCIRT, the Central City Development Unit (CCDU) and CCC. Management plans and agreed procedures were developed to obtain the alignment of all parties.

The Transport Optimisation Management Plan that arose used tools including SCIRT traffic models, the LINZ Forward Works Viewer and the communication strategy for the travelling public. The Central City Delivery Management Plan outlined best practice procedures to ensure construction minimised disruption and consistency in standards.

Remaining risks include:

- Utility services programmes, anchor projects and East frame, all with roading conflicts and especially if full road rebuild was involved.
- Finalisation of anchor project public realm proposals in areas requiring SCIRT roading repairs.
- Timing and delivery of SCIRT work before “accessible city” streetscapes were carried out, including complex logistics for such as Hospital Corner, the closure of Oxford Terrace, the Bus Interchange and the 2015 Cricket World Cup.
- Accessible city and Avon River precinct, especially for timing and delivery.
- Building demolitions.
- Bridge repair programme and access constraints arising.

## 5.5 Quality and completion risks

Quality and completion risks were treated as part of programme risk and were each addressed by the safety, quality and environment operational groups, using specific risk management initiatives as part of quality management and completion management, respectively. Statistics of achievements were reported to the board monthly.

## 5.6 Insurance risks

Insurance risks were identified and addressed by conventional process, using a multi-party working group of funders and management, under the guidance of independent insurance brokers chosen by the asset owners using a service tender process. (Refer to the governance section for more detail.)

## 5.7 OP risk management

The OPs created a risk management plan and register in the latter part of 2012, with SCIRT management input. This was replaced with a similar plan and register in the second quarter of 2015, again with SCIRT input.

# 6 NCP

## 6.1 KRAs and KPIs

KPIs were monitored regularly by the management team and formally reviewed annually to ensure they were giving focus to behaviours, contributing to continuous improvement and being a reliable input to delivery performance scoring and overall performance score. (The following table shows the changes in KPIs from 2011-2017. It does not show the achievement values set to measure performance.)

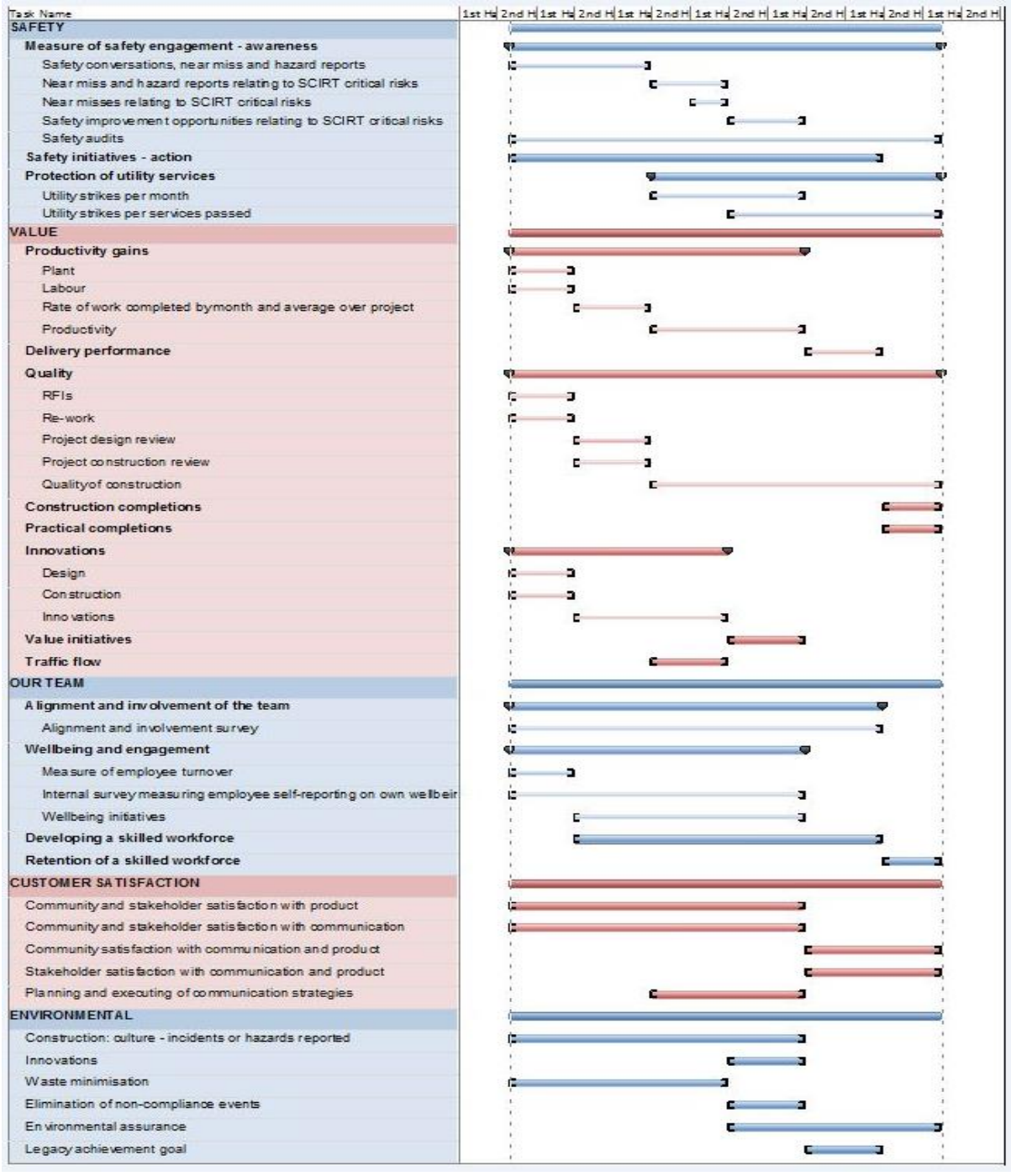



**Figure 67 KPIs over time.**

## 6.2 KRA graphical presentations

(Each of the following figures shows a summed – normalised – product of KPI for each KRA over the programme. They do not portray the annual changes in detail of KPIs over time or the levels of challenge used to evaluate performance, which also changed annually.)

Refer to the SCIRT Learning Legacy for further information on the KRA and KPI management and the separate Safety, Value etc management plans, describing the intentions, form and functioning of the performance indices.

### 6.2.1 Safety

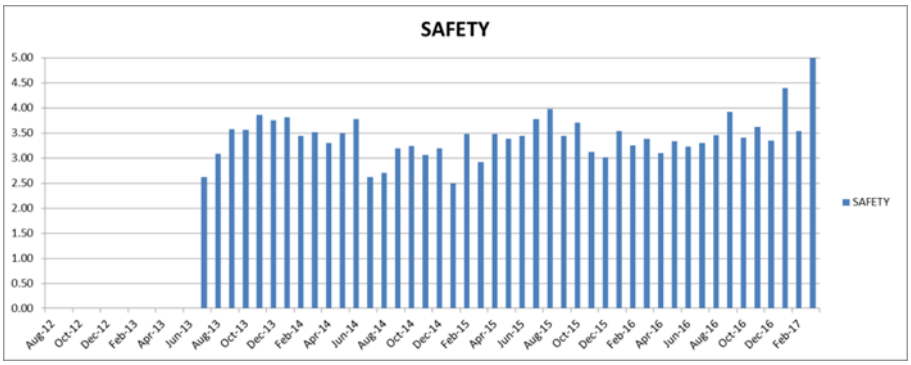



**Figure 68 Safety KRA over time.**

### 6.2.2 Value

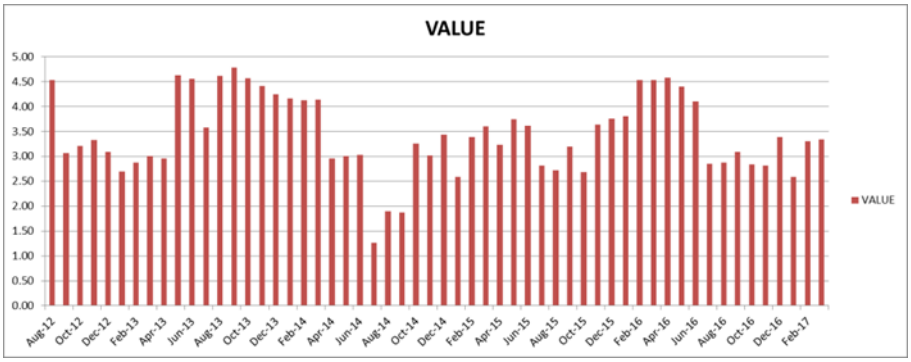



**Figure 69 Value KRA and KPIs.**

### 6.2.3 Our team

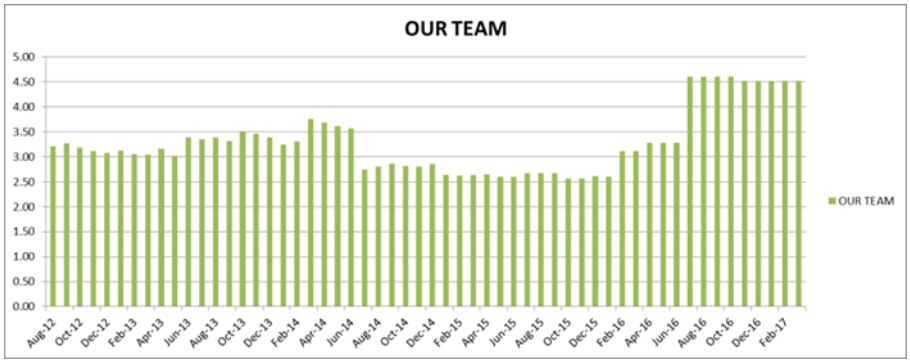



**Figure 70 Our team KRA and KPIs.**

### 6.2.4 Customer satisfaction

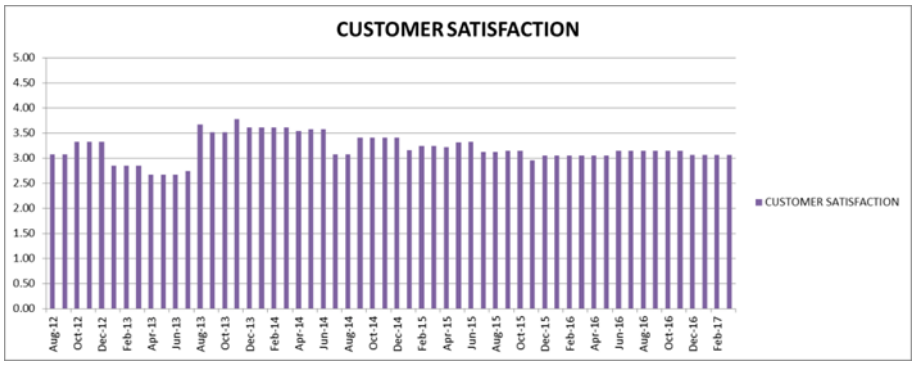



**Figure 71 Customer satisfaction KRA and KPIs.**

### 6.2.5 Environmental

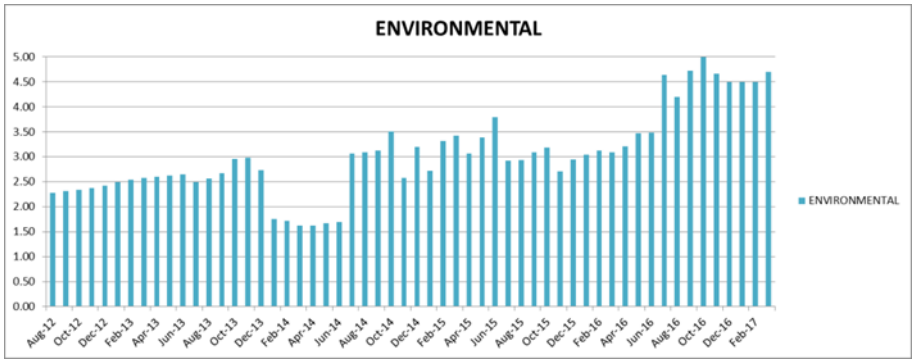



**Figure 72 Environment KRA and KPIs.**

# 7 Risk or reward outcomes

## 7.1 Work allocation

The project allocation process ran from 2013, once enough performance data became stabilised, through to 2016 when most projects had been allocated. The relative performance of teams was reported monthly to the board and varied as shown in the following figure of allocation targets, which were based on the AOC vs TOC and non-cost measures.

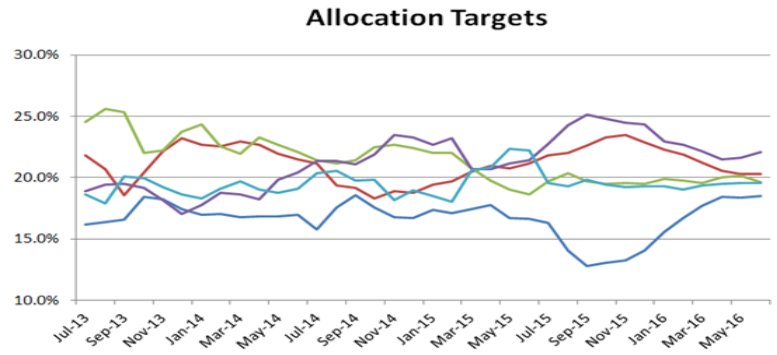



**Figure 73 Work allocation target trends.**

(This figure shows the relative targets, against the 20% average that would apply if all were performing equally)

Analysis of the fluctuations in performance scores showed a variety of contributors, including:

- Cost performance due to variable engagement and performance of subcontracts.
- Self-performance variability.
- Market factor influence on costs.

The resulting allocation was shown in the following diagram from mid-2016, when a significant proportion of construction work was still progressing. It varied slightly from target allocation due to scheduling (timing of project start), resourcing and location practicalities.

The diagram was one of a number used to assist and encourage teams to pass work through completion gates as the date for programme practical completion approached.

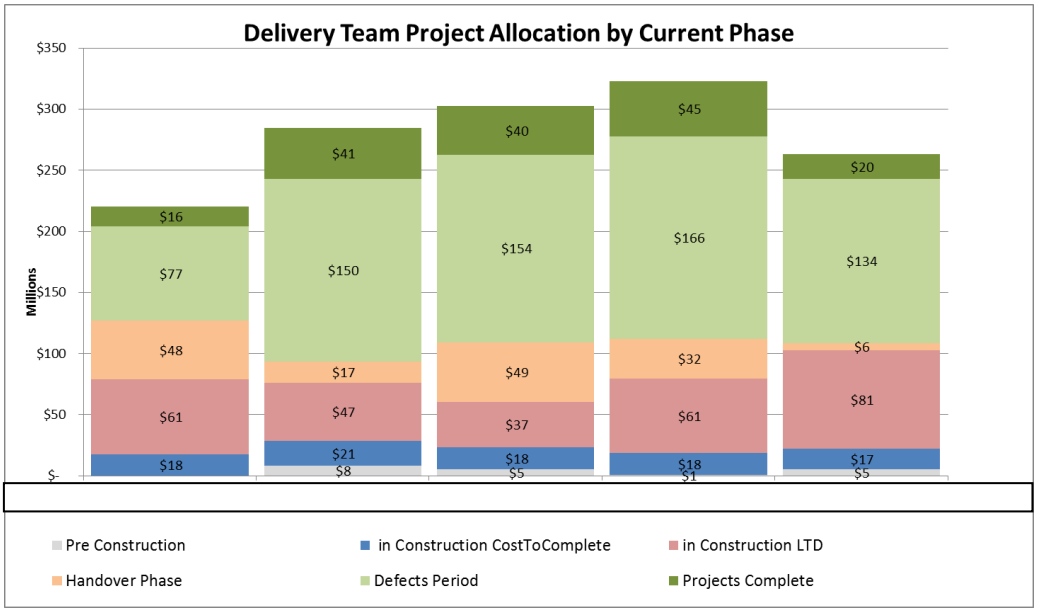



**Figure 74 Project allocation**

(This figure shows the respective total throughput of each delivery team at the time, which includes work taken over from IRMO projects at the start of SCIRT.)

## 7.2 Status of pain/gain

Project construction cost compared with budget (AOC versus TOC) changed as delivery team performance and reliability of cost estimation evolved. An important element of the Commercial Framework was the sharing of this cost under or over-run against each project TOC. The model provided for an equal split between owner and non-owner participants, which was then adjusted by a multiplier to reflect the overall outcome of the KPIs.

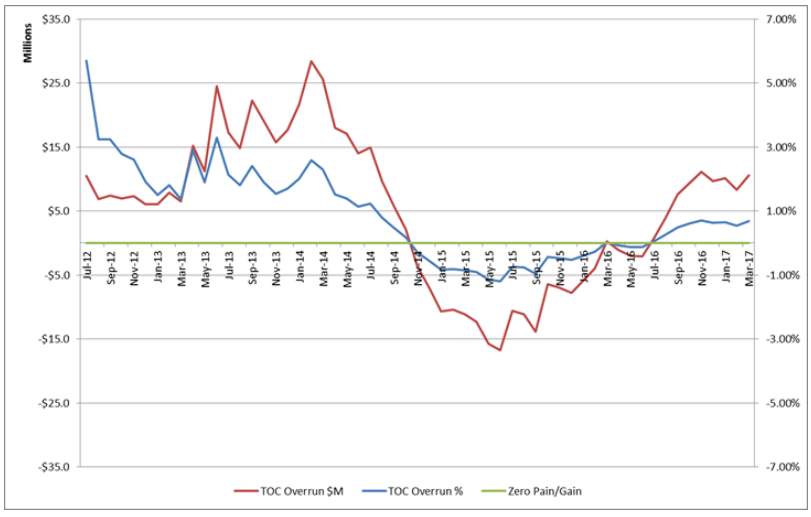



**Figure 75 Pain/gain over time**

(The status of pain/gain in the above figure shows a predictable fluctuation with initial pain replaced by gain as delivery performance has lifted and estimates have been adjusted to better reflect market factors, followed by a decline from 2015 as pricing hardened and unexpected project challenges

have been encountered. The predicted pain reached 1% or $16million by 30 June 2017 but ended at $13million at programme end at 30 June 2018.)

## 7.3 OPS

The overall performance score also varied due to cost performance changes shown above and accumulation of the non-cost factors as delivery teams came to grips with requirements of these.

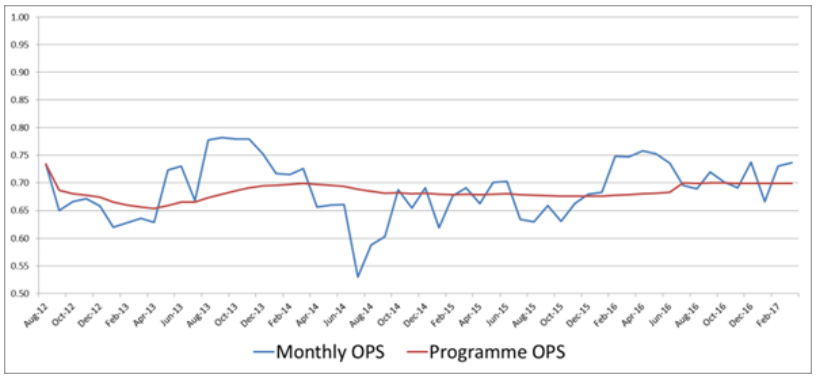



**Figure 76 Overall performance score over time.**

# 8 Governance and assurance

## 8.1 Governance framework

### 8.1.1 Challenges

At the beginning of the SCIRT rebuild programme, its governance faced several challenges, many relatively unique, including:

- Urgency of delivery – earthquake damage had severely compromised the city's infrastructure creating a public health hazard, leaving some areas without service and many of the functioning assets in a fragile state with high maintenance costs and risk of further losses of service.
- There was a sense of urgency from community need to see repairs under way, to help provide people with confidence that their lives would return to normal after the disaster.
- Unknown scope – much of the damaged infrastructure was difficult and time-consuming to inspect. Assessment of buried pipework would require remotely operated cameras which, in turn, would require the pipes to be cleaned. In many areas, ground liquefaction had filled broken pipes with silt.
- Damage, once identified, had to be confirmed to be earthquake damage and the appropriate repair determined, before it could be considered for repair by SCIRT.
- Ongoing seismic activity – aftershocks could continue for years and be significant earthquakes on their own, causing safety issues for rebuild teams, and further damage, requiring redesign and rework.
- Transition from IRMO programme – the rebuild programme initiated by the council after the September 2010 earthquake was well under way by February 2011. The four design and construct consortia involved had already mobilised substantial resources and were proceeding with rebuild assessment, design and construction work.
- Resources – more resources would be required to complete the programme within the target five years than the local market could provide. The "vertical" rebuild (commercial and residential building) was expected to be competing for much of the same resource.
- Funding uncertainty – In the absence of a defined scope, it was difficult to estimate total programme cost and to secure funding accordingly. A further complication was the multiple sources of funding, which included government (taxpayers), NZTA (road users), council (ratepayers) and council insurance, and, how costs would be shared, including for different asset types.
- Competing priorities for owners – rebuild of the horizontal infrastructure was but one of many competing priorities requiring the attention of the owner organisations and leadership in the immediate aftermath of the earthquakes. National government and its agencies would also have demands outside the Canterbury region to address.
- Three owners and five contractors – to have so many owners and contractors in an alliance was unusual and would make achieving alignment in governance particularly challenging. The owners had differing interests. All were funders but council owned the bulk of the assets being repaired and CERA was purely a funder, not an asset owner.
- The SCIRT commercial model required five major national civil contractors to compete for a share of the work but, at that same time, work closely with each other, sharing the knowledge and expertise that they would use to commercial advantage in normal business. Care would also be required to ensure trade practices compliance.
- Post-disaster environment – the physical and social impacts of a natural disaster required consideration and management. These impacts included shortage of office and residential accommodation, disruption of communications, services and supply chains and the psychosocial impacts on a community dealing with fatalities and injuries, damage to homes, loss or relocation of employment and the seemingly insurmountable task of rebuilding their lives.

- Opportunity – the situation also presented opportunities for a rebuild organisation, particularly in recruitment and organisational culture. Working for a rebuild organisation that was helping a community recover from a natural disaster was attractive to people, both local and from further afield. That common desire to "help to fix it' could be a powerful foundation for a strong culture.

Governance of the organisation would be required to adapt to objectives, requirements and priorities changing with time. Disaster recovery was a process that started with an initial emergency response phase, driven by urgency and passion, which transitioned into a more considered and structured rebuild phase that, in turn, led into a continuing recovery phase, driven by long-term strategy and objectives, which could take decades to achieve.

Although the overall goal of disaster recovery would not change, stakeholder views on exactly what recovery meant, its importance in a wider (national) context, how it would best be achieved, the required timeline and how it should be funded, would change with time and the alliance would need to be flexible and adaptable accordingly.

The final key challenge for SCIRT governance was demonstrating value for money, although in a disaster recovery context where some non-cost objectives might outweigh financial considerations it was, arguably, more appropriate to talk about simply "value'. However, considering the myriad ways in which an organisation like SCIRT could provide value, this was likely to be even more challenging.

### 8.1.2 Structures

SCIRT was a dual governance structure, which changed in detail over time. The key entities were the SCIRT Board (ALT) established in 2011 by the AA, to which the three owners and five contractors were all party, and the subsequently created CGG (Client Governance Group), replaced in 2013 by the HIGG (Horizontal Infrastructure Governance Group), which was created by a memorandum of understanding (MoU) between the three owners.

The board was "established with an overall charter to administer the alliance agreement and provide guidance to the alliance participants with respect to the work under the alliance and to provide a forum for alliance participants to discuss and resolve matters which arise between them". The board's primary goal was to 'govern the alliance so that it fulfils the alliance principles whilst delivering the work under the alliance".

All eight alliance participants were represented on the SCIRT Board, which met monthly, with all decisions required to be unanimous. The alliance manager (EGM) reported to the board.

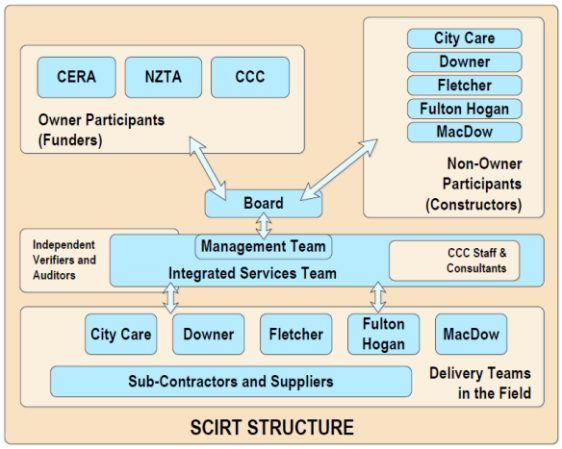



**Figure 77 SCIRT structure**

It was recognised that the OPs (CERA, NZTA and CCC) would require a separate governance body to manage "client issues" such as programme scope and funding and give the SCIRT Board clear and singular direction on such matters.

In late 2011, the three funders formed the CGG and its secretariat, the client management team (CMT). The CGG support structure included the Scope and Standards Committee, funding team, strategy reference group and communications group.

The terms of reference for the CGG were to:

1. Approve a purpose and set of performance objectives/outcomes for the horizontal infrastructure rebuild, that gave clear direction to team members who were participating in the infrastructure rebuild effort.
2. Develop and monitor governing values and behaviours that created an environment of trust and respect among participating organisations.

In 2013, following the signing of the owners' CSA and a programme review by the OAG, the CGG was replaced by the HIGG.

According to the MoU, the HIGG's purpose was "to provide effective governance of the horizontal infrastructure rebuild programme and the corresponding advice and assurance to the Crown and council on the matters as set out in the background on time, on budget and to specification".

The HIGG met monthly and comprised an independent chairperson and senior representatives from each of the three owners (who did not sit on the SCIRT Board).

The CMT was replaced by the horizontal infrastructure management team (HIMT) and the HIGG governance structure also included an infrastructure programme steering group (IPSG), infrastructure programme coordination team (IPCT), Audit Framework Group (AFG), an infrastructure programme transition group (IPTG) and the communications working group (CWG).

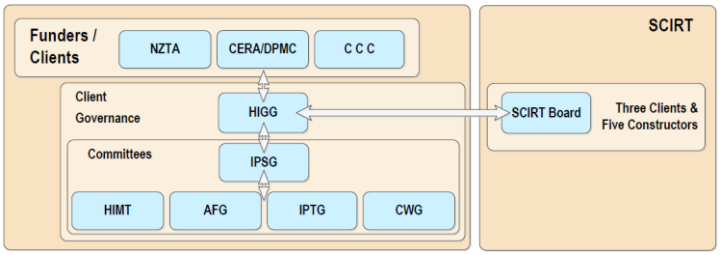



**Figure 78 HIGG structure**

Complicating the dual governance structure was a degree of non-alignment by the funders on the work being governed. The HIGG was established to oversee infrastructure rebuild work funded by the CSA, some of which was not performed by SCIRT. Conversely, some of the SCIRT rebuild programme was not funded by the CSA. The SCIRT programme included insurance funded rebuild, non-rebuild capital projects and other asset improvement work funded directly by CCC.

To foster good working relationships and alignment on key issues, the SCIRT Board and the HIGG met in focused workshop format about every six months.

### 8.1.3 Processes

#### 8.1.3.1 Provision of information

The SCIRT rebuild programme gathered and generated an enormous amount of information for various purposes, including governance reporting requirements. SCIRT established best

practice business systems to capture information provided by designers, delivery teams and other parties and to ensure it was available as required.

Base systems such as the GIS platform (geospatial information on land and assets), ProjectCentre (project tracking and data and documentation control), the JDE financial system and InfoNet (asset assessment data storage) provided data to a central repository managed and accessed by the HiViz reporting portal and other reporting software.

(The structure of the systems is described in section 2.6.2.)

Interface systems to process data included RAMM, InfoNet, PDAT, Forward Works Viewer, 12d Model, Salesforce, Candy and AutoCAD. (These are explained in the Learning Legacy in the "Business systems power rebuild" article.)

### 8.1.3.2 Presentation of information

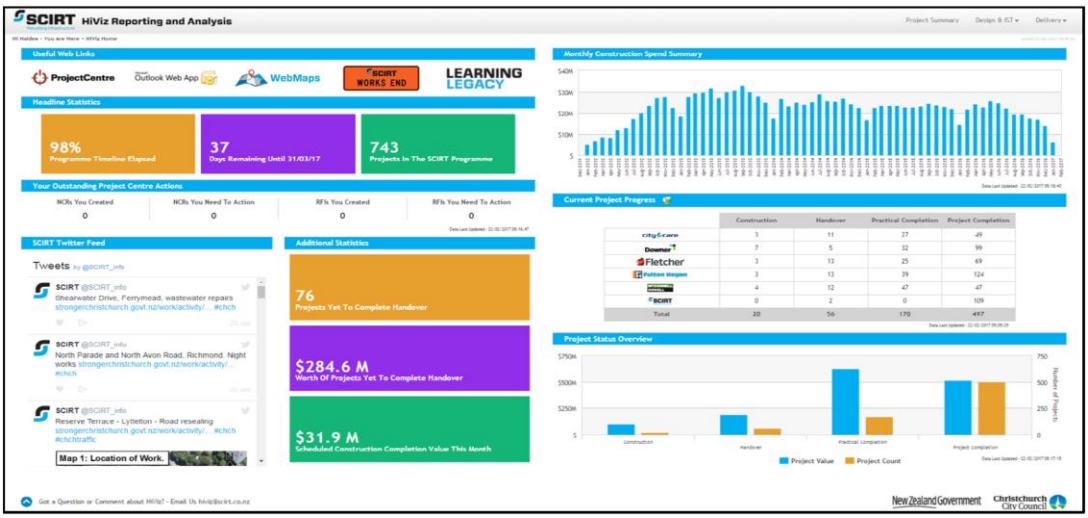



**Figure 79 HiViz screen capture**

HiViz (named from a SCIRT staff competition) provided up-to-date information on the overall programme and its component projects on a day-to-day basis. It allowed "drilling down" into specific locations (geographical), status of work and financials from project to programme and provided tailored presentations to meet specific operational and reporting requirements.

OP representatives could access HiViz and the base systems to obtain information directly, or request that specific reports to be prepared.

A formal report providing a wide range of metrics on programme performance, with explanatory narrative, was provided for SCIRT Board meetings. The SCIRT Board used the information to generate a formal report for CGG and HIGG meetings.

The CGG engaged PwC to review and recommend on reporting data and metrics and three staged reports were created. These confirmed the value framework, recommended then confirmed the earned value reporting and made general principle suggestions for further engagement. These were all absorbed into SCIRT reporting.

### 8.1.3.3 Control of information

The provision of information was controlled by business system processes. Access to data required authorisation and was, generally, limited to what individuals needed to know to perform their role. Authorised access was password protected.

An external information request (EIR) process was created to control the provision of information for use outside the programme. This required authorisation by the owners. SCIRT was not required to respond to official information requests, although information could be requested by owner representatives for this purpose.

Information made publicly available was similarly controlled. Media releases and responses to enquiries, material posted on the SCIRT website and social media and other published information was all subject to agreement with the owners, usually through the communications working group.

SCIRT proposed, and the asset owners concurred, on the suite of information and documentation required to be handed over upon project and programme completion. Designers and delivery teams entered data into business systems for collation and formatting for direct sending to the asset owners' business systems. Information not required would be archived as required.

#### 8.1.3.4 Benefits of business system

A range of benefits arose from the comprehensive and integrated systems and processes which were focused on a single data repository. At the most fundamental level was a single source of truth; with no confusion arising from different data in separate places. The benefit from the functionality was simplicity of access: all stakeholders could easily access the information. With these two benefits came the ability to readily share information, which enabled clear understanding and ready communications.

For all users, the "purity" of the SCIRT information systems was far ahead of their previous experience.

#### 8.1.3.5 Exercise of owners' powers/discretion

Exercising the primary owners' power to determine scope and funding arrangements was a key function assumed by the CGG and HIGG and their subcommittees.

Under the CGG, the power to determine scope was primarily exercised by setting guidelines for what was to be repaired and how (IRTSG), with any required clarification or discretionary judgment provided by the Scope and Standards Committee.

Provided that a project met the parameters prescribed in the IRTSG, formal authorisation for that project to proceed was not required. This changed with the CSA, OAG report and formation of the HIGG and its subcommittee structure in 2013.

The 2013 estimates of the total cost of the horizontal infrastructure rebuild were outside the funding envelope set by the CSA. The scope of the programme would require optimisation to best match funding. In 2014, all projects that had not yet progressed to construction were reviewed and, where necessary, redesigned for all work scope to new network repair guidelines, reduced in scope either across all or selected work types causing re-design, or discarded from the SCIRT programme.

From that point, all SCIRT projects required HIGG authorisation (delegated to the IPSG) in order to proceed to construction. Authorisation was subject to:

- Confirmation that the project conformed with the new network guidelines (IPCT).
- Confirmation that funding was available (IPSG).

The optimisation and subsequent project authorisation process caused significant disruption, delay and additional cost for the SCIRT rebuild programme. Costs of disruption and the

resultant loss of efficiency could be difficult to estimate but the total cost to the programme was assessed at about $15m.

The delayed authorisation of some projects until December 2015 made the programme construction completion target of December 2016 more challenging.

In hindsight, it was generally agreed that the impacts were largely due to the timing and complexity of the optimisation process that followed the CSA. Earlier agreement on the funding for the horizontal infrastructure repairs would have enabled adjustments to the scope of the SCIRT programme to be made by simply discarding whole projects from the programme, without such significant impacts on design and construction output and costs.

#### 8.1.3.6 Owners' external advice

The AA made provision for two independent consultancies to verify financials:

- An external alliance auditor (EAA)
- An independent estimator (IE)

The EAA was required to ensure that the NOPs received their exact entitlement in respect of all payments due. This required the audit of the payment claims submitted by the delivery teams to confirm that all costs claimed were genuine and valid under the AA and in accordance with agreed rates, where applicable (for resources provided by the delivery team home organisation).

A satisfactory cost audit report was required before certification of project practical completion. This ensured project costs were closed out in a timely manner and provided assurance to owners on the repair or rebuild costs to be capitalised against their assets. This process generally worked well in providing those positive outcomes for the alliance.

The IE was required to:

- Confirm TOCs were reasonable.
- Confirm that the valuation of variations to TOCs was reasonable.
- Help maintain and confirm the master pricing schedule.

The TOC-setting process for each project required parallel estimates to be prepared by estimators in the SCIRT IST and the IE. These would then be subjected to open book comparison and adjusted until reasonable alignment on TOC total value was achieved. Only then did the EGM (under delegated authority from the board) approve the TOC.

SCIRT estimators and the IE were also required to agree on the base cost and pricing data included in the master pricing schedule and used to estimate TOCs from first principles. This data was derived from actual cost data obtained from the market, locally and nationally, and subjected to joint review every six months.

The SCIRT estimating team was part of IST. Delivery team input to the TOC-setting process was limited to providing advice on construction methodology, schedule, risks, etc., which the estimators could choose to accept (or not).

The open book nature of TOC estimation, independence of SCIRT estimators from the delivery teams and the use of an IE to validate process inputs and inputs combined to ensure a robust TOC-setting process and provide the owners with considerable assurance that TOCs were fair and reasonable.

The IE was also required to validate the agreed rates for delivery team resources applied in payment claims (and audited by the EAA as above), provide 'a commercial audit of NOP billing rates' including wages, salaries and plant rates, carry out a 6-monthly review of pricing

inputs and TOC setting processes, validate work scope changes, provide annual reviews of delivery team P&G budgets, review the IST overhead budget, create an external cost inflation monitor and provide a range of monthly and as-required written and verbal reports to OPs and funders.

The AFG established as part of the HIGG governance structure initiated and managed more than 20 programme audits and reviews that programme management processes were working and providing the outcomes intended, including audits to:

- Review the TOC-setting process.
- Review the project allocation process.
- Review delivery team claims processes.
- Confirm the apportionment of actual cost and overhead to total project cost.
- Review the process of allocating cost to the three OPs.
- Verify the flow of money through SCIRT.
- Review the pain/gain reporting financial summary.
- Review the project prioritisation process.
- Review the safety management systems and health and safety protocols.
- Verify the inspection test process and quality assurance.
- Review fraud awareness and prevention measures.
- Review project and programme close-out, including claims validation.

Taken together, all audits gave satisfactory results, confirming that robust processes were in place and functioning as appropriate.

## 8.2 Effectiveness of governance

### 8.2.1 Programme reviews by the OAG

In 2013, the OAG reviewed the “effectiveness and efficiency of arrangements to repair pipes and roads in Christchurch”. It was “considered important to provide assurance to Parliament that public money is being spent in an effective and efficient way, and that the public entities involved are managing the risks of the rebuild”.

In her report overview, the Auditor-General concluded that “SCIRT demonstrates many of the good practice characteristics of alliance contracts” and that, “when relevant variables are considered, SCIRT projects seem reasonably priced”.

Other conclusions included:

- The choice of an alliance was a good fit with the post-earthquake situation, providing a useful approach for risks to be managed in a suitable way.
- SCIRT “has sound business systems that create operational efficiencies”.
- SCIRT “is capitalising on its valuable resource of highly trained specialists to develop practical solutions and project scoping is done well”.
- The AA ensured opportunities were given to other contractors.
- The project allocation process provided a good incentive for performance.
- Other benefits delivered by SCIRT included:
  - Lifting the capability of the construction sector workforce.
  - Improving the resilience of infrastructure.
  - Fostering innovation.

The overview highlighted “two major risks that could disrupt the rebuild, making it difficult for SCIRT to confidently put the right infrastructure in the right places to the right standard”.

- SCIRT's effectiveness was being increasingly hindered by a lack of clarity about roles and limited involvement from CERA.
- CERA, NZTA and CCC (the owners) did not have a common understanding about levels of service to be delivered and where.

The overview also noted that the controls provided by the IE and EAA were critical to maintaining commercial tension, driving efficiencies and providing assurance.

Report recommendations included that the owners:

- Change the governance framework to address ambiguity about roles
- (CERA) contribute more consistently to effective leadership and strategic direction for SCIRT
- Use governance arrangements to provide timely guidance to SCIRT on the priorities and direction of the rebuild.
- Agree on the levels of service and quality of infrastructure that the rebuild will deliver, in conjunction with confirming funding arrangements.
- Use a coherent framework for measuring key aspects of SCIRT's performance that integrates project performance and programme delivery.
- Ensure their auditing framework provides adequate assurance that SCIRT is well managed and delivering value for money.
- Provide feedback to improve the usefulness of SCIRT Board reporting.

This OAG report strongly influenced subsequent owner governance of the infrastructure rebuild programme, including the establishment of the HIGG governance structure.

In 2016, the OAG conducted a follow-up audit.

In her report overview, the Auditor-General concluded that "overall, the public entities had made good progress in addressing her recommendations (in the 2013 report)".

In the overview, it was noted that "the public entities have improved the SCIRT governance arrangements, including clearer roles and responsibilities, more effective guidance and clearer direction to SCIRT and improvements in reporting".

It was also noted that levels of service were now agreed, and funding arrangements confirmed but that the funding had "taken 19 months to confirm, creating uncertainty for about 30 wastewater and storm water projects for more than eight months".

This follow-up audit also "looked at the arrangements for learning and sharing lessons from managing the rebuild of the horizontal infrastructure" and the report encouraged the public entities to "continue actively and systematically identifying, recording and sharing their lessons from SCIRT and the alliance's approach".

### 8.2.2 Role of governance in achieving alliance outcomes

As described throughout this report, governance activities were the foundation of the structure and functioning of SCIRT. The Board was central to the shaping of the organisation to create the AA, including regular planned interaction with the management team, supported by a change management consultancy.

Governance gave special focus on the ramp-up phase to full production, during the first 12 months. This included continued interaction with the management team, ensuring alignment of purpose and sharing of challenges. An important element was the shared establishment and review of KPIs, where opinions of the measures and results varied, facilitating open and honest communications in the group.

Governance supported management to establish the first programme budget in the latter months of 2012, following the cost estimate, giving clear focus on scope and outcomes for the first time.

The creation of the CSA (independent of SCIRT Board or management), together with the recommendations of the first OAG report, presented the most significant challenges to governance, as the client/funder members and their respective organisations reorganised their structures and functions and addressed new parameters and priorities on limits for scope. As described elsewhere, this process took over a year, during which the Board continued to give direction within its new constraints.

In the last 18 months of construction activity, the Board supported the management team in planning and execution of programme completion.

The final phase of governance was the preparation and oversight of the 12-month period of defects liability, with its special challenges of management and delivery of work against many projects of the latter part of construction, which had scope limitations set to conform to CSA funding.

### 8.2.3 Professional services engagement

It was recognised by SCIRT that the NOP teams had the capability to construct the programme of works, and self-perform the QA, but there was a need to utilise external professional services resources to efficiently complete the definition and design of the hundreds of projects.

Several of the major Christchurch professional services providers had been integrated into the design and construct teams during the IRMO programme, and these companies entered discussions with SCIRT about how the requirements of the programme could be best served. It was determined that the best solution was to engage the providers on external services contracts, as opposed to the providers forming part of the alliance.

#### 8.2.3.1 PSAG

To more efficiently enable the negotiations to occur, the providers formed the professional services advisory group (PSAG). This allowed key members of the major providers to formulate and agree with SCIRT the conditions of the engagement, as well as provide expert assistance to SCIRT in the formation of the design teams. Under the oversight of the PSAG, the agreement conditions for the lead design organisations (LDO) could be negotiated on a level playing field. Each party had input. All signed up to the common agreement.

The agreement was based on the Conditions of Contract for Consultancy Services, 3rd Edition, 2009, familiar to all the providers. It covered all aspects of the engagement (e.g. remuneration, liabilities, insurances), and provided definition of the LDOs in their capacity as the leaders of the four design teams, and the other design organisations (DO) which would provide resources in conjunction with the LDOs. The financial terms were not common but were based on salary multipliers offered competitively by each organisation.

#### 8.2.3.2 Deployment

A key feature was staff being relocated into the SCIRT premises, formed into four multi-disciplinary teams, working with common processes to shared objectives.

The professional services providers contributed resource to all aspects of the programme, but most notably in asset assessment, survey, and design. The experience of more than 300 professionals helped shape the processes that allowed the efficient and consistent completion of more than 600 design projects.

This experience would influence the way many professional services companies would work from now on. In addition, the strong relationships forged in SCIRT, not only in the professional services industry, but also stretching into the construction industry, would endure.

The PSAG remained throughout the programme, providing the necessary link between the LDO and DOs and their home organisations.

In 2016, ACENZ recognised the effort from the organisations by awarding a Special Award at their Awards of Excellence, for the Consulting Industry's Collaboration in the Rebuild of Christchurch's Public Infrastructure.

## 8.3 Insurance

### 8.3.1 Insurance strategy

SCIRT's insurance programme was scoped with input from the alliance partners, NZTA and the Christchurch City Council, whose assets where the subject of the rebuild.

The overarching strategy was that, for reasons of economy, flexibility and simplicity, insurance would be arranged for the programme and managed by IST, rather than professional services providers and contractors separately insuring their allocated work.

Marsh Ltd was selected as the programme's insurance brokers after a tender review process conducted by an independent risk management and insurance consultant.

Factors considered during this process included:

- General Impressions and understanding of the RFP.
- Awareness of the key risk issues.
- Creativity and viability.
- Premium cost indications.
- Servicing including claims.
- Insurance options, especially earthquake risk factors/options.
- Remuneration formula and transparency.
- Personal elaboration of submission at presentation.

Marsh's success was attributed to their extensive work on coming up with a solution – using their International reach – and managing to pool together a consortium of insurers that offered SCIRT an attractive premium rate and demonstrated their understanding of the risk profile of the work to be undertaken.

Initial values of the five-year work programme were estimated at the outset and became the basis of determining professional indemnity, public liability and contract works cover requirements and premiums. Annual "actual" construction cost values, together with a proportion of overhead and margin, were then reported to the insurers for each premium year.

It was also identified at the outset that the volume of work each year would fluctuate, and that the work would be undertaken as a programme of unique projects, with each varying in value to a maximum of $10m.

Agreement on the insurance excess on each claim was reached at the outset with excesses of $250k for funders' assets, and $100k for third-party assets put in place for each claim. A limit was also set on each claim (incident) at $30m, with the annual aggregate claim value at $50m.

It was stipulated at the outset of the programme that IST would carry the cost of any insurance excess on any above excess claim from delivery teams, whereas subcontractors would be responsible for the excess costs on any claim they made on programme insurances.

### 8.3.2 Role in achieving alliance outcomes

One key differentiator from normal conditions of engagement was in the area of liability and insurance. On the basis that each of the four design teams would be made up of a collection of individuals from different organisations (more than 15 at the height of the programme), it was acknowledged by SCIRT and the PSAG that the professional services provider could not realistically be expected to hold professional Indemnity insurance for the programme. In the case of a claim, it would be too difficult to determine the liability for a design issue, and, therefore, whose insurance would be called upon?

SCIRT agreed to hold PI insurance for the programme.

Not only did this simplify the insurance situation, but it had the added benefit of opening the doors to greater collaboration between the design teams. The typically guarded nature of consulting firms was broken down in favour of the "one team, together" approach. This led to an unprecedented amount of knowledge creation and sharing across the teams, to the benefit of the programme, in both substantial time and cost savings.

### 8.3.3 Role in achieving outcomes

All project designs were generated by the IST design team and, invariably, involved a delivery team in the ECI process, so construction briefs were particularly clear to all involved in that project and, coupled with subcontractors' knowledge that they too had exposure, this significantly reduced the risk of damage to the infrastructure under repair and claims made on the SCIRT policies.

It was also a reasonable conclusion that the rebuild design and construction standards provided increased resilience, and minimal damage was reported after further earthquakes in the region.

"Insurance consequences" might also have been a factor within delivery teams as new work packages were allocated based on delivery performance, so their duty of care through the ECI process and construction phase of each project reduced the number of insurance incidents.

# 9 Key success factors

The most obvious structure of the achievements is presented in preceding section 3.1 against the objectives of the alliance agreements, item by item. In addition to those comments, there are a wider range of achievements reported in section 3.2.

The following commentary is a reflection against those achievements, identifying underlying factors driving or enabling the successes.

As SCIRT has built turnover into a “steady state” function, it is obvious there are several success factors. These are identified below, without supporting comment, as features that can be “boxed for export” for post-disaster use in other areas of New Zealand or other countries.

These factors help form the broad objective of lifting the capability of the sector-wide workforce, but also extend into a disaster recovery learning legacy, able to be used by other agencies or in other situations.

In summary terms, they are:

## 9.1 SCIRT functionality

### 9.1.1 Establishment features

- Public and private partnership – enlisting resources in a collaborative relationship
- Fast establishment – vital for post-disaster infrastructure rebuild
- Suite of management plans by industry specialists – creating the operational environment
- Business systems purpose-built from ground up managing a single data set

### 9.1.2 Process features

- An integrated production-line delivery of all projects through clear gates
- Asset assessment tools and processes-
- Design process streamlining
- Collaboration and sharing within all segments
- Continual improvement focus across the programme
- An intentional culture based on peak performance planning

### 9.1.3 Construction features

- Maintaining focus on safety
- Competitive tension between teams
- Raising performance in time, cost and quality
- Creating a collaborative environment through feedback features
- Utilising ECI in design with clear expectations of outcomes
- Training and upskilling the workforce, including smaller contractors
- Modelling and managing traffic
- Planning for central city work carefully integrated with activities of others
- Integrated communications releases to an engaged public
- Capturing and sharing good ideas and lessons learnt

### 9.1.4 Special features

- Maintaining a special culture
- Comprehensive measuring and reporting
- Getting work done
- Adaptability in the face of scope and design parameter changes.

## 9.2 Transposition of the SCIRT model

Since the early days of SCIRT, it has been acknowledged that transposition of the model into other post-disaster rebuild organisations is not only feasible, but beneficial.

This involves:

- The “process” or working model – structure and functions of multi-team funders and constructors working in a competitive/collaborative engagement
- Production line parallel processes, addressing many work fronts
- Many key operating features, including the integrated BI+GIS system
- Many tools that have been developed through the process
- The lessons learnt.

This realisation has been a contributor to the SCIRT Learning Legacy and has been acknowledged in many quarters that are engaged with SCIRT, locally and internationally.

The concept has been developed into ‘ENGAGE – for readiness and rebuild after disaster’ – see section 11.6.

## 9.3 Transposition to OPs

A wide range of SCIRT systems, functions, and procedures are appropriate to transpose into the CCC environment to complement, or add to, project, programme and asset management functions. This began with the protocols and procedures developed for the asset and cost information handover process with each project and continued into a planned engagement later in 2014 and on to 2016, known as the Transition Group.

### 9.3.1 Transition group

In late 2015, the HIGG endorsed the Horizontal Infrastructure Management Team (HIMT) to ensure a coordinated approach to the transition of HI management to the OPs. This was based on a memorandum of understanding (MoU) key role for the HIGG of “approving and implementing the transition of recovery works back to asset owners at the appropriate time”.

An October workshop plan aligned OP and NOP views on a “successful HI transition”, with the key outcomes identified. By December 2016, the work streams were either completed or progressing satisfactorily and required monitoring only.

The data and information transfer to CCC progressed, with project handover and business and GIS system intellectual property transferred by SCIRT operators working within CCC. The council hosted the hardware.

The contractual closeout of SCIRT was planned with two options available, depending on funder decisions and whether the demobilisation was on track.

The story of SCIRT was captured by the Learning Legacy website, now available in conjunction with the UC Quake Centre.

CCC would continue to progress and apply internal lessons and improvements across several areas.

"Setting-up CCC for Success" substantially become the domain of the CCC Advanced Asset Management Unit, with a framework in place and policies and strategies set to feed into the long-term plan (LTP) process. CCC staff processes would take on board the SCIRT lessons in a variety of applications. A new capital works framework delivery panel for three waters and waste was in progress. Transport was reported to be on track without change.

The governance arrangements would continue to evolve to be fit for purpose as the HI programme ended.

Seven key outcomes for a successful transition were identified and achieved:

- Definition of HI Programme – defined and implementing
- Completion of the HI Programme (on time, on budget, etc)
- Post-SCIRT delivery mechanism, including communications improvements – under way
- Maximise data resources – defined and implementing programmes
- Culture positivity and engagement – several programmes under way
- Harness key lessons – done, Learning Legacy
- Gain unqualified confidence of the Office of the Auditor-General – done.

### 9.3.2 Communications plan

In 2015, the HIGG adopted the joint agency Horizontal Infrastructure Rebuild Communications Plan to coordinate communications across all rebuild agencies. The plan – and the working group implementing it – aimed to generate public recognition of the breadth of funding and undertaking of the horizontal rebuild programme; celebrate rebuild successes; address key public perception risks as the SCIRT programme neared completion; prepare for post-SCIRT communications and give the public confidence in the repair programme while managing expectations.

## 9.4 Industry engagement

SCIRT contributes its experience or lessons to wider organisations within the engineering or construction industry in Canterbury and New Zealand.

### 9.4.1 Training

#### 9.4.1.1 Training initiatives and programmes

After identifying HR as critical to the success of the programme, SCIRT worked with an infrastructure industry training organisation (Connexis) to:

- Establish a SCIRT short course training programme (funded by the Tertiary Education Commission) for site safe, cable location, spotter training, slinging and lifting, reading and interpreting plans, concrete saw and loader operation.
- Develop industry competencies for introductory labourer, excavator operator, loader operator, roller operator, which shape the training resources from Connexis for wider industry use.
- Produce new Infrastructure Works Level 2 Training Resource.
- Establish terms of reference with the Civil Infrastructure Trades Regime to support and trial the civil trades training programme.
- Trial new training resources and tools.

SCIRT created a major initiative, "FOR REAL", to meet its objective of building capability and to address the risk of resource scarcity. The scheme aimed to fast-track new apprentices

into the workforce and offered successful candidates free training, NZQA qualifications, off-job training in a polytechnic environment and then continued on-the-job training with SCIRT workplace tutors.

More than 2500 expressions of interest were processed. More than 600 candidates were referred to the Canterbury Skills Hub. Over 150 were introduced to Civil Infrastructure Training.

The initiative successfully filled SCIRT demand in the early programme stages.

#### 9.4.1.2 Training Centre

In January 2012 a predicted shortfall of operational team members led to the Board agreeing to a proposal for a Training Centre and up to 12 experienced (10yr minimum) workplace trainers, including traffic management. Trainers all undertook NZQA 4098 - assess unit standards training and many completed a NZQA National Certificate in Adult Education Level Four.

Priority was given to on-site training, with classroom practical options. This included the provision of one-to-one training, with many recipients carrying on to New Zealand Qualifications Authority (NZQA) qualifications.

#### 9.4.1.3 Training tools

SCIRT developed upskilled resources for the programme across all levels. This developed the workforce and mitigated the risk of skills gaps. SCIRT also worked with a range of stakeholders to leave a legacy of improved training tools for the industry.

Key projects that added value included:

- Assisting the infrastructure industry training organisation Connexis to develop training resources that would form part of a programme to achieve a newly established civil trade certification. This resulted in the development and revisions of the entry level labourer (Level 2), skilled labourer (Level 3) and the skilled plant operator (Level 3) qualifications.
- SCIRT presented terms of reference to the Civil Trade Establishment Board and supported the implementation plan by funding and recruiting a project manager to drive outcomes.
- SCIRT worked with Connexis to support the filming of a “Just the Job” TV episode to showcase work as a civil engineer.
- SCIRT fostered collaboration between the NOPs to provide best value training solutions, such as sharing a Project Management Cost Control training package between delivery teams, circumventing the need for external training.
- SCIRT challenged the NOPs to step up their development of frontline leaders. Consequently, an overarching goal was set of having 50 per cent of the 150 crew leaders participate in leadership training with substance by December 2015.
- SCIRT introduced a crew leadership programme as an option for delivery team members, and selected subcontractors. As at April 2015, 55 crew leaders had commenced or completed frontline leadership training to NZQA level 3 standard.
- In October 2014, a project managers/engineers learning forum was established. This evolved in early 2015 to include peer-to-peer learning groups where the five NOP organisation team members learnt from each other about key aspects of project management.

- SCIRT collated, developed and utilised material that allowed for a shared industry view of competence for field team members and delivered on-site training for loaders, excavators, other plant and services awareness, as well as for concrete saw. Some of this material was being explored by OPs such as NZTA for wider usage.

#### 9.4.1.4 Training utilisation

Achievements included:

- More than 7,000 places short course places were filled, with a spread of subjects shown in the following table. These courses were provided at no cost for the training to participant companies within the SCIRT programme.
- On-job trainers assessed more than 1010 NZQA unit standards and assisted 63 team members to complete national qualification and were working with 100 to that end.
- At times up to 24 per cent of the operational workforce were engaged in National Certificate training - the industry average is only 6 per cent.
- More than 50 Level 4 Crew Leadership Qualification completions.
- More than 160 people completed National Certificates, and at least twice that started National Certificate training before moving on to other organisations or careers.
- Development of trade certification pathways in partnership with national industry training organisations, from Level 2 to Level 4, including the creation of a Civil Trade Qualification.

The following table shows attendee numbers for courses. More detailed data is also held for Qualification Completions, toolbox session delivery, leadership training, tutor assistance toward qualification completions and many more initiatives.

| Numbers of Attendees in SCIRT Courses | | |
|---|---|---|
| **Course** | **June** | **Total** |
| Site Safe | 36 | 2432 |
| Safety Observer | 0 | 1608 |
| Read and Interpret Plans | 0 | 234 |
| Cable Location | 4 | 794 |
| Concrete Saw | 0 | 337 |
| Spill Kit | 0 | 882 |
| Slinging and Lifting | 0 | 659 |
| Small Tools | 0 | 143 |
| Ops. Around Mobile Plant | 0 | 112 |
| **Total** | **40** | **7201** |

**Figure 80 Attendees at training courses**

### 9.4.2 Forums

#### 9.4.2.1 Procurement Forum

MBIE ran a procurement forum until 2014 that considered resource demand planning and procurement timelines for the Canterbury rebuild. From the outset, SCIRT contributed knowledge and projections of labour, worker accommodation, plant and machinery and materials demands for its programme of work.

In May 2014, the forum transitioned into a CERA commercial support group to facilitate coordination and performance monitoring of the public sector rebuild programme. The main purpose of the group was to identify and remove barriers to project delivery, through the sharing of ideas, experience and best practice. While SCIRT was excluded from any reporting requirements, it was a participant in the monthly meetings to share data and experiences with the public sector entities.

#### 9.4.2.2 Safety forum

SCIRT played a role in the formation of the Canterbury Rebuild Senior Leaders Steering Group, a formal convening of construction industry organisations, with Worksafe NZ, MBIE and ACC, to address safety issues across all programmes. The forum generated a vision statement, launched the 10 commitments of the safety charter and formed leadership, performance and communications working groups.

SCIRT created a performance assessment tool to help industry benchmark their standards.

The SCIRT EGM chaired the performance working group.

#### 9.4.2.3 New Zealand Society of Earthquake Engineers

NZSEE requested – and were provided with – a keynote presentation by SCIRT to the annual conference in Wellington in April 2013. It was well received.

#### 9.4.2.4 New Zealand Lifelines Forum

The Lifelines Committee requested presentations to describe the formation and status of SCIRT to the annual conference in November 2013, and an update in 2014 and 2015.

### 9.4.3 Presentations, papers and publications

Throughout the programme, SCIRT members presented in excess of 200 formal deliveries to visitors, interest groups, institutional or industry gatherings, forums or conferences, covering a wide range of subjects arising from SCIRT. These were too numerous and diverse to list.

Management, designer and delivery teams and individuals created and published a wide range of papers, theses and articles for publication, as part of university studies, professional development and professional and industry publications. These were likely to number in excess of 50 articles in New Zealand and internationally.

People from 33 universities engaged face-to-face with SCIRT staff in interviews, group learning and specific studies from undergraduate to post-doctoral fellowship studies.

#### 9.4.3.1 ASCE-UC Lifelines forums

SCIRT contributed to the International Lifelines forum, headed by the American Society of Civil Engineers' Technical Council on Lifeline Earthquake Engineering (ASCE TCLEE), joined by UC, in 2013 and 2014. Two staff presented at the 2015 conference in Rome, L'Aquila and Naples in Italy. Of interest was the overall function of SCIRT, the use of LoS in asset management and definition of the rebuild scope, and the role of communications in community interaction.

## 9.5 Recognition and awards

Awareness of the unique features and achievements of SCIRT grew. It began with New Zealand university academics and researchers and progressed through local institutions to international universities and industry institutions.

Earthquake-related institutions outside of universities included the Earthquake Engineering Research Institute, (a United Nations, World Bank and European Union-funded body) that sent teams to visit Christchurch in 2013, 2014 and 2016. Their interest in SCIRT ranged through damage data to pipe laying and retaining walls, the AA, data management, the GIS system design and functionality and relationships between the SCIRT rebuild and public sentiment.

SCIRT was recognised with several industry awards, demonstrating the organisation was performing well in the eyes of the bodies involved.

Awards received included:

### 9.5.1 Brunel Medal

In October 2013, SCIRT was awarded the prestigious Brunel Medal from the Institution of Civil Engineers (ICE – United Kingdom).

The institution cites:

"The purpose of this award is to recognise valuable service or achievement, which has been rendered to or within the civil engineering industry. Eligibility includes all grades of membership, local authorities, contractors, firms of consulting engineers, educationalists and any person or organisation connected with the civil engineering profession, with particular consideration being given to teams which include chartered/incorporated engineers and engineering technicians."

In awarding the Brunel Medal to SCIRT, the institution notes: "This project highlights the scale of the task and the number of people involved, showing outstanding teamwork and collaboration. This was a natural disaster of great magnitude and shows the dedication to a project of immense scale. It has placed civil engineering in the forefront of people's minds."

ICE president Barry Clarke presented the medal while visiting New Zealand. He noted that SCIRT provided an excellent foundation for collaboration in many spheres of endeavour. "SCIRT's work is outstanding and I am delighted the team has been awarded the Brunel Medal," he said.

### 9.5.2 Brunel International Lecture

Early in 2014, SCIRT EGM Duncan Gibb was awarded the prestigious Brunel International Lecture by the Institution of Civil Engineers. He created and gave the inaugural delivery in London in June 2014 and followed that with an international programme in over 30 countries to the end of 2015. His theme was "Collectively we are stronger – Engineers delivering collaborative solutions to strengthen community resilience post-disaster".

The messages were well received and led to wider recognition of the SCIRT features that could be transposed into other arenas in New Zealand and internationally.

### 9.5.3 esri – Special achievement in GIS

The esri – Special Achievement in GIS Award annually recognises organisations that use GIS "to improve our world and that set new precedents throughout the GIS community'. It is given to about 150 organisations a year, from the esri client pool of 350,000. In 2012, SCIRT was the only New Zealand recipient.

The citation states:

"Business Problem Solved – The team has built a centralised spatial database system of all the project's horizontal infrastructure data including utilities (power, gas, telco), planning, cadastral, topographic, and environmental data. It is also reading web feature services from partner rebuild agencies such as Christchurch City Council and the Canterbury Earthquake Recovery Authority (CERA) to provide a powerful online tool for various activities across the city.

The system also delivers the following:

- Spatial connections to data workflows for asset conditional assessment work being carried out across the city;
- Data modelling to build a citywide complex multi-criteria analysis (MCA) tool to prioritise assets against value and dependence;
- Integration of asset valuation information;
- Building of a spatial-based project database to manage assets within project areas spatial project reporting."

### 9.5.4 12d Model – Software

12D Model is a software database used in civil engineering design. The 2012 inaugural International Innovations Award Gold Medal was won by SCIRT, against competition from more than 60 countries, for its innovative use and adaptations in all design functions, including surveying, drainage and road design. In 2014, the SCIRT users won gold awards in each of the customisation and the drainage categories - four awards in total.

### 9.5.5 Champion Canterbury Business Awards – three

SCIRT's contributions to the Canterbury rebuild received official recognition at the Champion Canterbury Business Awards in early October 2013 when it won not only the Infrastructure Award, but also The Press Supreme Award for medium to large businesses.

Leeann Watson, general manager, Canterbury Employers' Chamber of Commerce, congratulated everyone working for SCIRT on the double achievement.

"This is a huge honour for an organisation that has only been in the market place for a short time," she said.

"The Champion Canterbury Awards are all about recognising and rewarding business success. This was our eleventh year in running what is now known and regarded as the largest business awards in New Zealand. SCIRT was one entry from more than 120 entrants and 46 finalists.

"SCIRT was recognised for taking a well-planned, strategic, collaborative approach to their part in the rebuild. You have built a big organisation, going new places in a short time frame – exactly what our city needs."

In September 2016, SCIRT was again recognised for the excellence of its civil engineering programme, winning the Champion Canterbury 2016 Infrastructure/Trades Award, medium to large businesses.

### 9.5.6 Canterbury Heritage Awards 2016

SCIRT's commitment to heritage projects was acknowledged at the Canterbury Heritage Awards in 2016.

SCIRT was equal winner of the Public Realm Saved and Restored category for the restoration and strengthening of the iconic war memorial, the Memorial Arch, standing on the Bridge of Remembrance, in the central city.

It was also highly commended in that category for the rebuilding of the historic Armagh Street Bridge and highly commended in the Seismic category for its innovation in strengthening the Memorial Arch in central Christchurch.

**Figure 81 Overarching resilience: The Memorial Arch has been restored to full glory.**

### 9.5.7 NZ Engineering Excellence Awards

In November 2013, SCIRT was a finalist in all categories applied for in the New Zealand Engineering Excellence Awards, run by the Institute of Professional Engineers New Zealand.

These were:

- Community Engagement (communications and stakeholder management team).
- 'ICEET' (GIS team).
- Water and Waste (the whole of SCIRT).
- Two of three "Young Engineer of the Year" finalists.

SCIRT won the Excellence in Community Engagement award in recognition of the extensive community engagement that was keeping the Christchurch community informed and involved.

### 9.5.8 Environmental – NZ Planning Institute

SCIRT was a recipient, with ECan, of the New Zealand Planning Institute 2013 Best Practice Award for a Collaborative Approach to a Global Consent Framework.

The citation explains:

"… .With up to 150 work sites open … (and) … .the additional complexity of extensive and ongoing investigations … presented a unique opportunity to develop a consistent consenting framework for a suite of global consents for typical construction-related activities … (which) … provided a unique environment for the five SCIRT delivery teams to work together to "raise the bar" in complying with these global consents, developing a risk-based management plan approach and developing innovative tools and techniques to address the challenges.

These solutions enabled the physical works to be carried out in an environmentally sound manner, while not slowing down the recovery with undue regulatory barriers, meaning the planning solutions have provided value for money for the people of Christchurch. These innovations are likely to leave a legacy in the environmental and construction space."

### 9.5.9 Public Relations Institute of New Zealand (PRINZ) Award 2014

In 2014, SCIRT's communications team was recognised by its peers for its comprehensive communications plan and community engagement in a post-disaster environment, receiving a Highly Commended in the Sustained Public Relations category.

### 9.5.10 List of awards

#### 9.5.10.1 2016

Champion Canterbury Business Awards 2016.

Winner, Infrastructure/Trades Award, medium large enterprise category, for the horizontal infrastructure rebuild programme

Canterbury Heritage Awards 2016

Equal Winner, Public Realm Saved and Restored, for the Memorial Arch restoration

Highly Commended, Seismic, for the Memorial Arch restoration

Highly Commended, Public Realm Saved and Restored, for the Armagh Street Bridge repair

IPWEA (Institute of Public Works Engineering Australasia) Excellence Awards 2016

Winner, Best Public Works Project, under $5m category, for the Sumner Road stage four retaining wall project

Finalist, Best Public Works Project, over $5m category, the Main Road, three lane project

Hays National Association of Women in Construction Excellence Awards 2016

Finalist, Jane Taylor, SCIRT's City Care delivery team

Finalist, Nicola Thompson, SCIRT's Fletcher delivery team

Finalist, Cherie Leckner, SCIRT's Fulton Hogan delivery team

ACENZ Awards of Excellence – Special award for 'Consulting Industry's Collaboration in the Rebuild of Christchurch's Public Infrastructure.'

#### 9.5.10.2 2015

Gough/Humes Canterbury 2015 Contractor of the Year Award,

Category C, projects between $1 million and $3 million for the Sumner Road stage 4 retaining wall earthquake repairs carried out by SCIRT's Fulton Hogan delivery team.

Category B, projects between $250,000 and $1 million for the Armagh Street Bridge earthquake repairs carried out by SCIRT's Downer delivery team.

Canstruction 2015

Winner**,** Structural Integrity Award

Winner, Best Meal Award

Civil Contractors New Zealand Awards 2015

Finalist, Connexis Company Training and Development Award

Hays National Association of Women in Construction Excellence Awards 2015

Winner, Helen Tippett Award, SCIRT Women in Construction

Highly Commended, Professional Woman of the Year, Paula Lock, SCIRT professional services manager

#### 9.5.10.3 2014

EGM Duncan Gibb awarded 10th Brunel International Lecture by the Institute of Civil Engineers

New Zealand Institute of Surveyors Award of Excellence 2014

Gold award of Excellence

Territorial Forces Employer Support Council Award 2014

Canterbury and Upper South Island regional employer of the year

Public Relations Institute of New Zealand (PRINZ) Award 2014

Highly Commended, Sustained Public Relations category

Canstruction 2014

Winner, Jurors' Favourite Award

#### 9.5.10.4 2013

The Brunel Medal

Awarded by the United Kingdom Institution of Civil Engineers for excellence in civil engineering

Champion Canterbury Business Awards 2013

Winner, Supreme Award, medium large enterprise category, for contribution to the Canterbury Rebuild

Winner, Infrastructure Award

New Zealand Engineering Excellence Awards 2013

Winner, Excellence in Community Engagement

Finalist, Water, Waste and Amenities

Finalist, Young Engineer of the Year

New Zealand Planning Institute Best Practice Award 2013

Winner with Christchurch City Council, Environment Canterbury and Beca for planning and investigations

#### 9.5.10.5 2012

Resource Management Law Association of New Zealand

Winner with Beca, Project Award 2012, for Multi-Criteria Assessment Tool

12D International Innovation Award

Winner of Gold

ITEX Computerworld Awards 2012

Finalist, SCIRT's Fulton Hogan delivery team

esri Awards 2012

Special achievement in GIS (Geographic Information System) Award

# 10 Compliance issues and approvals

## 10.1 Compliance

Overall, the SCIRT teams' compliance with the relevant approvals and rules was good, and the relationship between SCIRT team members and regulatory compliance officers was open and collaborative.

The key compliance challenges were:

- Raising the bar on safety performance, around subcontractor management and safety attitudes.
- Ensuring appropriate involvement of an arborist for compliance with tree consent.
- Ensuring dewatering discharges met the standards for discharge into surface waterways.
- Eliminating construction-related wastewater overflows to the rivers.

The key compliance strengths of the SCIRT teams were:

- Construction activities in and near waterways being carried out in an environmentally sensitive manner.
- Working on potentially contaminated land, ensuring appropriate disposal and reporting.
- Raising the standard of practise with respect to minimising risks of wastewater overflows to rivers.

### 10.1.1 Non-conformance reporting

SCIRT used a formal notification process for delivery teams to identify and plot rectification of construction errors or inadequacies if they occurred. The issue logged on ProjectCentre was automatically channelled to appropriate overseers and designers; rectification was either proposed by the team or identified in response.

Cost/benefit of rectification was estimated and reviewed before rework was ordered. An "accept as-is" consideration could be raised by the delivery team or IST, decided by IST or referred to the Scope and Standards Committee as a recommendation. Such items were reported to asset owners via the ProjectCentre record and in project handover documentation.

Items confirmed for rework were carried out by the delivery team with costs ascribed as rework. Rework by subcontractors was commonly at no cost due to subcontract performance clauses.

The following diagram shows the NCRs raised, open or closed in any given month, with different colours for each delivery team. It illustrates a variety of use of the tool over time and different rates of opening and closing non-conformances.

The tool was very useful in construction and completion quality assurance for all projects.

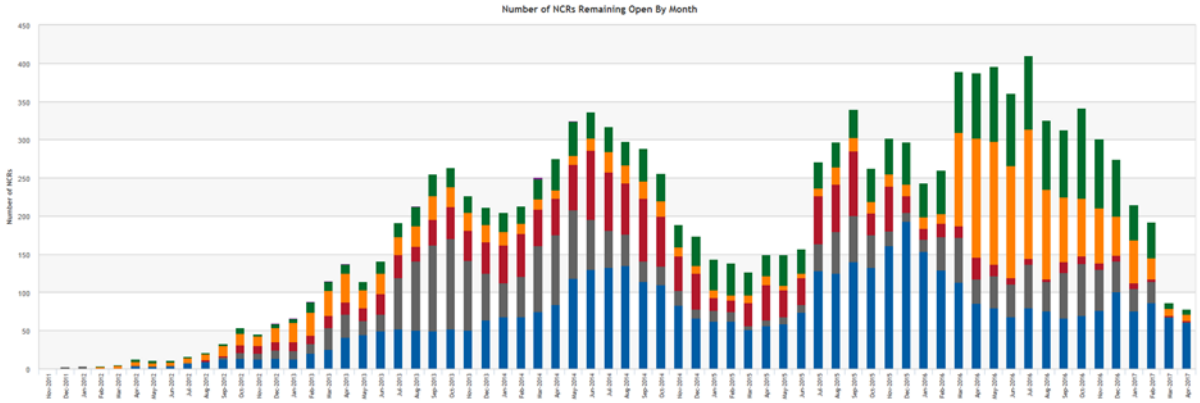



**Figure 82 NCR statistics over time**

### 10.1.2 Non-conformances

Difficult ground conditions and new technologies presented a range of challenges to work quality that took time to be addressed and overcome, with the aid of non-conformance processes.

The liquefaction-prone ground that was present in most SCIRT projects included geologically recent deposits of alluvial and glacial outwash silts and gravels, combined with coastal features of old estuaries, peat bogs and sand dunes, all unconsolidated and featuring with highly variable aquifer-fed ground water. This meant dewatering was commonly needed, mostly with trench shields, or sometimes sheet piling, to retain natural ground as well as providing worker protection.

Settlements of filled trenches could only be estimated because of the variables described and the added complication of the mass and compaction of embedment and backfill material being more dense than excavated material.

In addition to the natural features, recent and continuing shaking from earthquake aftershocks caused uneven settlements to natural ground and filled trenches.

In addition to the ground, new technologies of hdpe pipe joining and fittings, pipelining and junctions presented fresh challenges to even experienced operators, especially due to the ground conditions.

The following diagrams illustrate the cause and nature of NCRs.

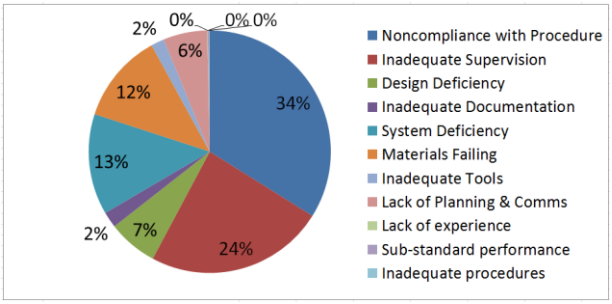



**Figure 83 NCR by cause as %.**

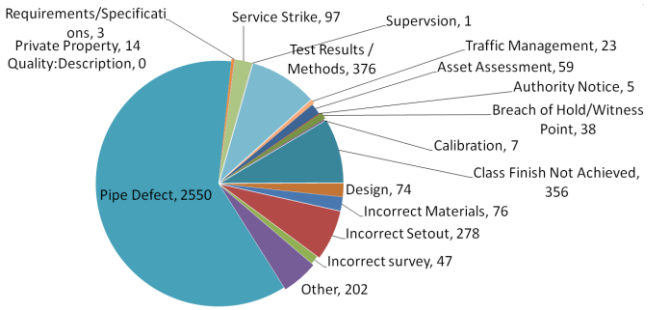



**Figure 84 NCR by type and numbers.**

#### 10.1.2.1 Pipe dips

The ground conditions described above created a very difficult work environment for pipe laying and led to uneven settlements along pipe lengths. Gradients, therefore, varied, leading to “pipe dips”. The severity of the dip and the nature of the flow dictated whether a pipe was accepted “as is” or required re-laying.

#### 10.1.2.2 Pipelining

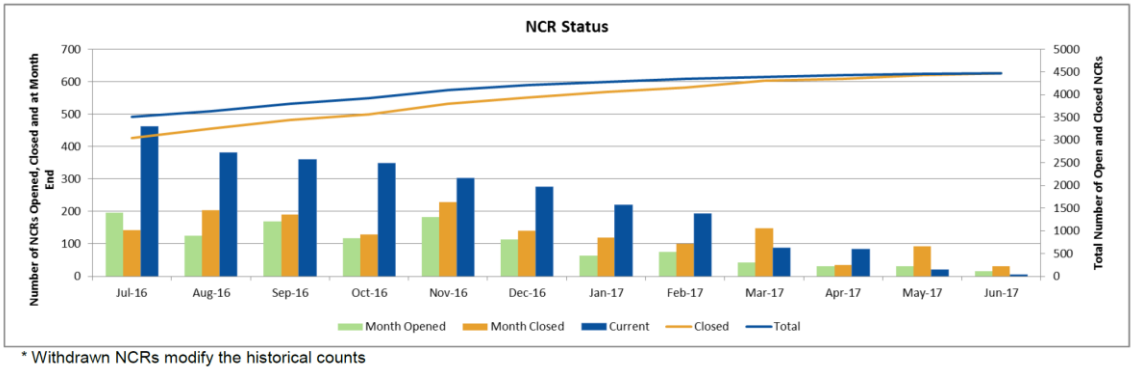
Pipelining was also challenged from variable groundwater ingress into or beside broken host pipes, affecting placement and curing outcomes along pipes.

These factors were new experiences to all contractor resources and took time to be understood and provided for, with some inexperienced contractors failing or withdrawing from the market.

### 10.1.3 Close-out

All these factors led to variable performance against specifications that challenged SCIRT and asset owners during the early stages of the programme. However, heightened awareness of the issues involved and a focus on best construction outcomes shared between all parties, lead to a minimal amount of rework and the satisfactory close-out of all non-conformances.

The following figure illustrates close-out statistics in the last 12 months of construction.




* Withdrawn NCRs modify the historical counts

**Figure 85 Completions - NCR statistics 2016-7**

### 10.1.4 Cost of rework

The following table identifies costs as at March 31, 2017 for project TOC values passing through the programme phases at that time and presents predicted costs of rework relating to those phases.

The construction and handover phases have less rework predicted, due to the simpler nature of projects at the end of the programme.

The total of rework at 1 per cent is similar to industry norms. In a practical sense, the cost per project represents one or two instances of one or two days of construction team activity in the field, which is a very low level.

This cost can also be viewed as one half of the net pain currently being reported against constructors.

| PHASE | # | Revised TOC | LTD Defects Costs | Forecast Defect CTC | Per Project | % of TOC |
|---|---|---|---|---|---|---|
| CONSTRUCTION | 3 | $ 30,989,826.70 | $ - | $ 61,000.00 | 20,333.33 | 0.2% |
| HANDOVER | 35 | $ 174,777,251.01 | $ 25,329.82 | $ 743,052.07 | 21,953.77 | 0.4% |
| PRACTICAL COMPLETION | 163 | $ 578,315,937.87 | $ 4,441,925.39 | $ 1,371,771.45 | 35,666.85 | 1.0% |
| PROJECT COMPLETION | 474 | $ 612,750,712.34 | $ 6,699,583.96 | $ - | 14,134.14 | 1.1% |
| | **675** | **$ 1,396,833,727.92** | **$ 11,166,839.17** | **$ 2,175,823.52** | **$ 19,766.91** | **1.0%** |

**Figure 86 Costs of rework**

## 10.2 Approvals

As explained in section 3.4.1, the approach taken to regulatory approvals has been to obtain global approvals for infrastructure rebuild activities where possible, simplifying process, reducing workload and time frames. It added certainty to the complex process of identifying, designing and delivering the large number of SCIRT projects.

Some project specific approvals have been obtained where a global approval cannot be applied.

SCIRT teams worked under 21 global consent approvals, and 9 project specific approvals, from Environment Canterbury, Christchurch City Council, and New Zealand Historic Places Trust.

# 11 Lessons learnt

## 11.1 Genesis

With growing interest from national and international audiences, SCIRT recognised early on in its six-year programme there was a need to identify, capture and share its lessons.

The lessons began to emerge from a variety of sources. Initially, designers began the process by identifying and progressing "bright ideas', which were reviewed, progressed and developed as appropriate by designer interest groups and logged into the value register. This was followed by the capture of construction innovations, screened to feed into the KPI, contributing to project allocation to delivery teams.

A process was developed to evaluate, document and share these items.

Following conversations with government agencies, professional and academic organisations and industry stakeholders, the concept of a formal "learning legacy" came into focus. This led to workshops and a stakeholder team defining the concept, drawn from Callaghan Innovation, Resilient Organisations, University of Canterbury CEISMIC and Quake Centre.

## 11.2 Legacy Framework

The primary objective of SCIRT's Learning Legacy was identified as "ensuring appropriate knowledge is captured to meet the needs of the interested parties and made available in a format that gives the best opportunity for lessons to be understood".

The scope of the initiative was to create and store material that:

- Described SCIRT as a post-disaster rebuild and recovery entity, its creation, objectives and functions.
- Identified lessons from challenges and successes by telling the stories involved, from the whole of the business down to detailed items such as construction methods.
- Supported the transfer of features, systems and data from SCIRT to participants as needed.
- Presented information for third-party interest.

## 11.3 Management

In 2014, Quake Centre hired a project manager to lead the initial definition and creation of a facility. This gave rise to a collection, storage and dissemination plan, with processes and a concept of a storage archive and a separate web-based interrogation tool.

The University of Canterbury CEISMIC digital library defined the structure and function of the archive and retrieval process. It would host SCIRT information.

Legacy items were identified from SCIRT's value register and SCIRT team members' suggestions. These were transferred to a legacy register and finalised using standard forms, suitable for transfer to the archive.

In August 2016, a dedicated project manager and professional writers were brought in to a SCIRT team to work with a steering group from management, all working under the guidance of a new management plan.

A web interface was created to incorporate features to satisfy audiences identified by an independent study supported by Quake Centre that covered a cross-section of stakeholders and industry.

## 11.4 Material

SCIRT's "lessons learnt" stories stemmed from all areas of its establishment and operations. They arose from its founding documentation, business systems, management plans, systems and processes, methods, designs, specifications and construction. They were primarily from within SCIRT but included external studies from academia and papers or publications written for relevant professions and industries.

Following informal consultation with stakeholders and the market research report, it was decided to group the material by themes:

- The SCIRT Model
- Governance and Decision Making
- Programme Management
- People and Culture
- Communications and Community
- Finance and Business Systems
- Design
- Construction.

## 11.5 Dissemination

It was expected that the legacy material would be accessed online but that the presence or content would also be publicised to a variety of industry and governmental agencies through papers presented at seminars and conferences.

The archive and web interface became active in March 2017. It is anticipated it will continue as a source of information, backed up by National Archives of New Zealand.

It can be accessed at: https://scirtlearninglegacy.org.nz/

### 11.5.1 EQ recovery learning

The Department of the Prime Minister and Cabinet (DPMC) worked with organisations and agencies across recovery, including the private sector, community organisations, social enterprise and government, to bring together the collective lessons from the Canterbury earthquakes. This built on earlier work by CERA. It can be viewed at: http://eqrecoverylearning.org/

### 11.5.2 NZ Red Cross earthquake recovery 2010-2017

The New Zealand Red Cross Canterbury Earthquake Appeal raised more than $NZ131m from Kiwis, other Red Cross societies and corporate donations. The funds reached Cantabrians through grants, community partnerships, outreach and well-being projects.

In March 2017, the New Zealand Red Cross launched an online report detailing the outcomes of these projects: https://www.redcross.org.nz/what-we-do/in-new-zealand/recovery-2010-2017/

## 11.6 Disaster rebuild learning legacy

### 11.6.1 ENGAGE

During 2017 and 2018 a small number of people who have worked in SCIRT created a concept for enduring disaster rebuild preparedness and action for New Zealand, named ENGAGE. This is built

on their experience and knowledge, including the published lessons from SCIRT and has been supported by UC Quake Centre.

ENGAGE is introduced at www.engagenow.org.nz

It is intended that this become a national institution, as a small core capability, maintaining a widespread network of experienced people able to contribute following a disaster. The planned framework for action is closely based on SCIRT and the supporting information system is an extension of SCIRT capability.

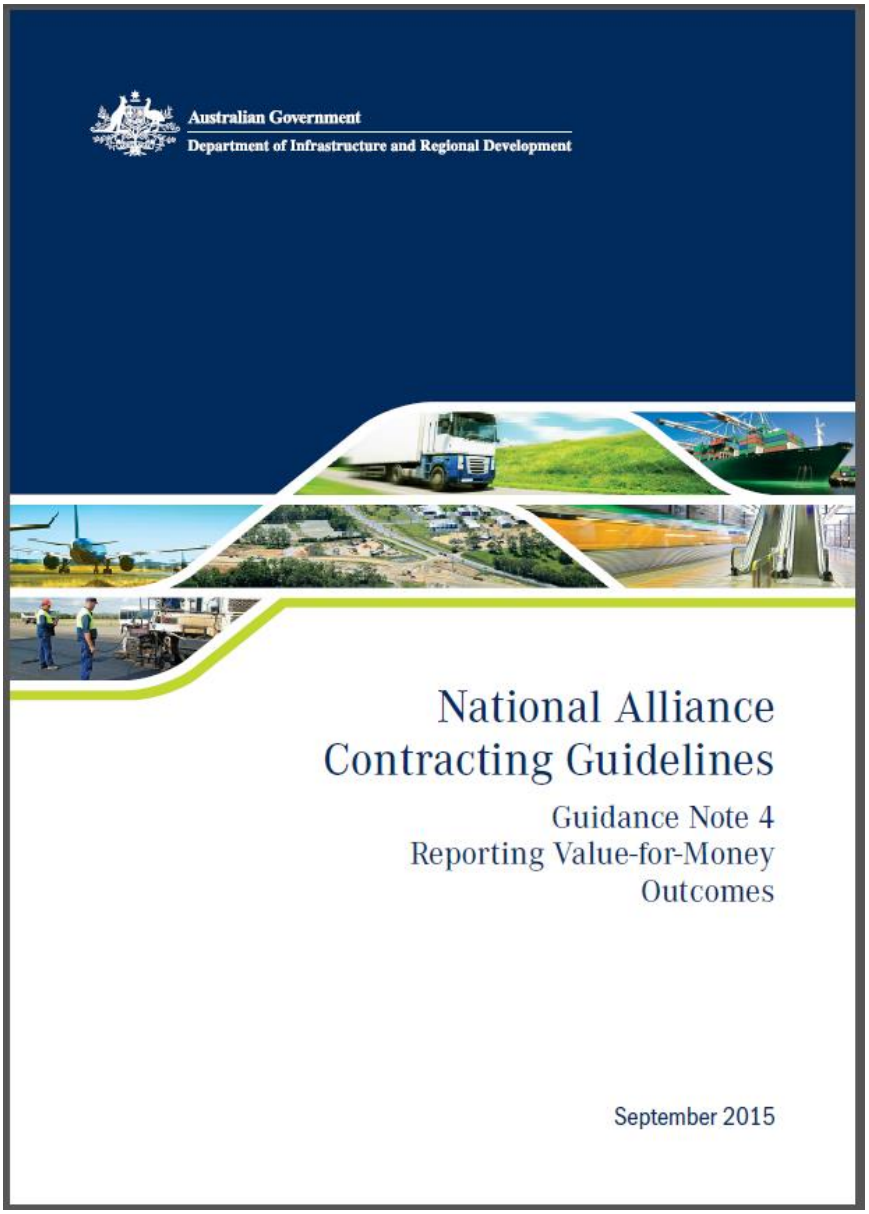
A

# Appendix A Australian Government National Alliance Contracting Guidelines, Guidance Note 4

The link below is direct to the Australian Federal Government Department of Infrastructure and Transport publication 'National Alliance Contracting Guidelines – Guidance Note 4 – Reporting Value for Money Outcomes', illustrated below.

That document sets out the structure followed by this report, being regarded as best practice for value reporting available in Australia and New Zealand.

Go to: https://infrastructure.gov.au/infrastructure/ngpd/files/NACG_GN4.pdf



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B

# Appendix B International Post-Disaster Rebuild Mechanisms

DEPARTMENT OF CIVIL AND
ENVIRONMENTAL ENGINEERING
Faculty of Engineering

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NEW ZEALAND

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The University of Auckland
Private Bag 92019
Auckland, New Zealand

15 March, 2013

Mr. Rod Cameron
Value Manager
Stronger Christchurch Infrastructure Rebuild Team
1 Magdala Place, Middleton, Christchurch, 8024
PO Box 9341, Tower Junction, Christchurch, 8149

Dear Rod,

Please find attached a brief summary report on International Post-Disaster Rebuild Mechanisms. The research has been conducted under the Resilient Organisations Research Programme.

Regards,

Suzanne Wilkinson

Suzanne Wilkinson
Associate Professor
The University of Auckland

## International post-disaster rebuild mechanisms

Post-disaster reconstruction in different disasters has been extensively researched by Resilient Organisations[1], a collaborative research team, set up in 2004, between The University of Auckland, The University of Canterbury and industry. This research [2,3,4] has shown that the characteristics that are favoured in large scale post-disaster reconstruction include:

1. An ***overlap between the design and construction*** thus an early completion of reconstruction projects would be possible
2. ***Single point responsibility***
3. ***Effective communication links*** between the parties
4. The use of the ***existing relationships*** between the parties involved
5. ***Social and economic accountability***,
6. An effective mechanism for ***quality assurance and monitoring***
7. The contract arrangement is ***"win-win"***,
8. Local ***industry familiarity*** with the rebuild delivery framework
9. The use of ***local material, labour and plant***
10. ***Flexibility*** of contracting

As the impact of the disaster increases, the rebuild delivery mechanism chosen for post-disaster changes from the traditional-separated to integrated-collaborative, simply because the scale and nature of the reconstruction following a significant and more serious disaster requires different features which are not found a traditional-separated contractual systems[5]. Analysing disasters in China, Indonesia, New Zealand and Australia, the researchers found that where small scale disasters occur (such as the 2004 Manawatu floods) and the impacts are not significant enough to generate a change of delivery/procurement methods for reconstruction, disaster reconstruction is basically managed as normal time construction[6]. However, in small scale disasters, a sense of collaborative relationships between the contracting parties is often observed[7]. However, where there are large scale disasters, such as those experienced in two Chinese disasters (flooding in Yangtze River 1998 and 2008 Sichuan earthquake) reconstruction favours collaborative environments using pre-existing relationships to produce a fast recovery[8,9]. In post-2004 tsunami, Indonesian reconstruction was, to a large extent, driven by various international NGOs on an ad-hoc basis[10]. Post-Indonesian reconstruction was characterised by sub-standard reconstruction and delays, showing that reconstruction without stakeholders of sufficient construction expertise can produce a sub-optimal recovery. Post-disaster research has discussed the usefulness of alliancing[11], suggesting that alliancing is one preferred strategy for post-disaster reconstruction, especially where well-developed communication links and established long-term relationships exist between collaborating parties, the reconstruction projects are of large scale, and the reconstruction has a high degree of complexity and uncertainty [12].

## References

1. Resilient Organisations, See: http://www.resorgs.org.nz/, for details of the full research on reconstruction following a disaster research.
2. Wilkinson S.J, Le Masurier J, Gupta, S (2004), The Development of a Contractual Framework for Disaster Reconstruction, CIB Conference, Helsinki, Finland.
3. Zuo K (2010), Procurement and Contractual Arrangements for Post-Disaster Reconstruction, PhD thesis, University of Auckland.
4. Rotimi, J. O., Wilkinson, S., Zuo, K., & Myburgh, D. (2009). Legislation for effective post-disaster reconstruction. International Journal of Strategic Property Management, 13(2), 143-153.
5. Le Masurier, J., Wilkinson, S., Zuo, K., & Rotimi, J. (2008). Building Resilience by focusing on legal and contractual frameworks for disaster reconstruction. In L. Bosher (Ed.), Hazards and the Built Environment: Attaining Built-in Resilience (pp. 264-282). London, UK: Taylor & Francis.
6. Zuo K., Wilkinson S., Le Masurier J., van Der Zon J (2006) Reconstruction Procurement Systems: The 2005 Matata Flood reconstruction experience, International Conference on Post-Disaster reconstruction: Florence, Italy, May 17-19, 2006
7. Wilkinson, S. Zuo, K. Le Masurier, J. Van Der Zon, J. (2007), A Tale of Two Floods; Reconstruction after Flood Damage in New Zealand, CIB World Building Congress, CIB2007-007, Cape Town, South Africa, 14-18 May, 2007.
8. Myburgh, D., Wilkinson, S., & Seville, E. (2008). Post-Disaster Reconstruction Research in New Zealand : An industry update.: Resilient Organisations Research Report (2008/01).
9. Zuo, K., Potangaroa, R., Wilkinson, S., & Rotimi, J. O. B. (2009). A project management prospective in achieving a sustainable supply chain for timber procurement in Banda Aceh, Indonesia. International Journal of Managing Projects in Business, 2(3), 386-400.
10. Chang, Y., Wilkinson, S. J., Potangaroa, R., & Seville, E. (2010). Resourcing challenges for post-disaster housing reconstruction: a comparative analysis. Building Research and Information: The International Journal of Research, 38(3), 247-264.
11. Le Masurier, J., Wilkinson, S, Shestakova. Y, (2006) An Analysis Of The Alliancing Procurement Method For Reconstruction Following An Earthquake, Proceedings of the 8th U.S. National Conference on Earthquake Engineering April 18-22, 2006, San Francisco, California, USA
12. Zuo K (2010), Procurement and Contractual Arrangements for Post-Disaster Reconstruction, PhD thesis, University of Auckland.

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C

# Appendix C CCC Report

Refer overleaf for a reproduction of the CCC report ‘Reinstating Infrastructure in Christchurch’

## REINSTATING INFRASTRUCTURE IN CHRISTCHURCH

| | |
|---|---|
| **General Manager responsible:** | Kevin Locke, General Manager Capital Programme Group, ph 027 645 1474 |
| **Authors:** | Geoff Mayman, Procurement and Purchasing<br>Ian Thomson, Solicitor, Legal Services |

## PURPOSE OF REPORT

1. The purpose of this report is to seek the Council's endorsement of the contract delivery model to reinstate infrastructure damaged in the Canterbury earthquakes of 4 September 2010 and 22 February 2011.

2. The report also recommends that the Chief Executive be given the authority to enter into and approve agreements and arrangements for the reinstatement work required.

## EXECUTIVE SUMMARY

3. The Council has now entered the recovery phase of its response to the earthquake. Urgent work is required to reinstate infrastructure that was either damaged or destroyed in the various earthquakes.

4. Government sought advice from New Zealand Transport Agency (NZTA) on its view of the appropriate contract delivery model for the infrastructure reinstatement. Council staff have been working with NZTA to assess the options, risks and opportunities of various delivery models.

5. Council staff and NZTA recommend that a city wide Alliance Agreement be developed with those contractors already engaged under the head contractor model to manage the reinstatement of the earthquake damaged infrastructure.

6. This proposal, and the process to be followed for its implementation comply with the relevant provisions of the Canterbury Earthquake Recovery Act 2011 and Orders in Council made under the Canterbury Earthquake Response and Recovery Act 2010.

## BACKGROUND

### Pre 22 February Response

7. At the Council meeting of 4 November 2010 Council adopted the proposal that collaborative working relationships be developed with contractors engaged to manage the re-instatement of infrastructure damaged in the 4 September earthquake in four of the worst affected areas.

8. The collaborative working arrangements were designed to achieve Council's strategic objectives, namely:
   - Contractors are deployed within the community in the shortest possible timeframe. The aim is to provide confidence to the community that the significantly damaged areas of Christchurch will be fixed in as short a period of time as possible;
   - Enough resource is procured to ensure that works are completed in the shortest possible time frames;
   - The local contracting market is utilised to its maximum extent, with fair reward for contractor performance;
   - Work and resources are coordinated with neighbouring local authorities to ensure conflict of priorities does not arise across the wider region;

- Effective contract and relationship management practices are used to successfully manage quality, cost, and overall performance of contractors to deliver value for money.

9. During November and December 2010 Council entered into negotiations and executed contracts with:
   - McConnell Dowell Constructors Ltd and The Fletcher Construction Company Ltd Joint Venture (Avonside/Dallington/Burwood)
   - Fulton Hogan Ltd (Bexley/Southshore)
   - Downer EDI Works Ltd (Brooklands/Spencerville)
   - City Care Ltd (Halswell).

10. The scope of the contracts included:
   - all wastewater pipe renewals;
   - inspection and repair of laterals from sewer main to private gully traps (subject to agreement from EQC);
   - all water main and sub main renewals in the damaged zone;
   - all storm water pipe repairs in the affected areas;
   - all road corridor repairs including road reinstatement, footpaths and lighting if required;
   - other works that are sensible to integrate into a phased reconstruction;
   - obtain all consents required to support construction and design work recognising that consents can be obtained in parallel to construction works as outlined in the Canterbury Earthquake Response and Recovery Act 2010 and associated Orders in Council.

11. An Infrastructure Rebuild Management Office (IRMO) was established to oversee the rebuild. This office was charged with oversight of design, construction management, finance, communication, programming, procurement and project administration. This team of 20 – 30 staff was resourced from within Council and the Consulting industry.

12. At 22 February 2011, all of the Head Contractors were well advanced with their investigations including further condition assessments and survey, and two of the four Head Contractors had commenced physical works on the ground and the remaining two were planning to start late February.

13. The aftershock of 22 February 2011 has resulted in much greater damage than that of the 4 September earthquake. Damage to the underground services and roads has almost quadrupled, and the areas damaged are much more widespread across Christchurch and no longer easily defined within geographic/Head Contractor boundaries.

**Post 22 February Response**

14. The significance of the aftershock of 22 February 2011 has demanded a different response from both central and local government. The Canterbury Earthquake Recovery Authority (CERA) has been established to oversee the recovery.

15. Within this context, one of Council's roles is to rebuild the City's Infrastructure. It is anticipated that Council will be required to prepare and submit to CERA an Infrastructure Rebuild Recovery Plan for their approval.

16. With so much at stake and what is likely to be a significant Crown contribution to the infrastructure rebuild, Government sought advice from the New Zealand Transport Agency (NZTA) on the appropriate form of delivery vehicle for the Infrastructure rebuild. The NZTA was well placed to give advice given its capability and experience in outsourcing in the sector.

17. At the same time as the NZTA was preparing advice, Council was reassessing its options. The NZTA and Council collaborated to ensure the best advice was prepared.

**Options for Reinstatement**

18. Consideration was given to scaling up the current contract arrangements to reflect the increased scale of the works. This was rejected because the current approach does not optimise the client / contractor interaction and the scarcity of resources that will be in high demand given the extent of work now required. More efficient management methods are required for implementation.

19. In reviewing the various methods of procuring infrastructure and professional services, the NZTA through its State Highway Portfolio Procurement Strategy 2010 document, developed a matrix of 11 criteria that needed to be considered. It was tested the Christchurch infrastructure reinstatement task against these 11 criteria, and there is a strong indication that the Alliance delivery model will deliver the best outcome. The most weighted priority is time for temporary works completion and time for complete reinstatement. This priority drives the decision towards an Alliance. Other key factors considered that promote the alliance model were the:
    - Strong positives in bringing together different organisations to work on common goals;
    - Large scale of the project;
    - High degree of complexity and risk; and
    - High potential for innovation.

20. Alternative delivery forms were considered including Early Contractor Involvement, the Managed Contractor model, and Design and Construct. While efficient models for some applications, they would fail to deliver the speed of response that an Alliance provides, would introduce more layers of complexity in administration and would not achieve as much alignment in objectives between the various parties involved.

21. While the focus is on the horizontal infrastructure (pipes and roads), the Alliance model will also provide opportunities for enhanced delivery of other private infrastructure services such as power and telecommunications (including broadband) which are located within the road corridor, as collaboration in planning and construction is certain to deliver added value for money. The Alliance model readily allows for scope changes which should support value for money for all parties, and present a full-integrated rebuild solution. At this stage works that will be outside of the scope of the Alliance would be the Christchurch Wastewater Treatment Plant, Ocean Outfall, Lyttelton Wastewater Treatment Plant, Compost Facilities, Landfill and Buildings. These works are better managed as discrete projects because of the nature of the work.

**The Alliance Model**

22. Alliances are a form of collaboration between client(s), consultant(s) and contractor(s) who mutually agree to undertake the work to target levels of quality, cost and time. Additional rewards/sanctions are put in place should performance exceed/fail to meet the targets. This leads to a high degree of trust between the parties and a focus on performing to the highest expectations.

23. The NZTA Alliances to date have all been successful. The most recently completed alliance, the Manukau Harbour Crossing, was delivered nearly 12 months ahead of schedule and under budget. The Newmarket Viaduct project is also being delivered through an Alliance and is currently six months ahead of schedule; and this procurement method is being used for the Waterview Connection project.

24. Equally relevant is that the NZTA is using an Alliance to manage the Auckland Motorway network. This operate, maintain and improve contract has many

similarities with the infrastructure reinstatement in Christchurch, and has already produced substantial savings and innovation.

25. The Council also has experience in alliancing, with the City Mall constructed using this delivery model.

26. The increase in scale since 22 February will result in a longer time for full reinstatement. It is essential that collaboration between all interested parties is maximised to reduce delays and reworks to a minimum. The Alliance model will create incentives for reducing start up times and for finishing ahead of deadlines.

27. Given the scale and social impact of the reinstatement project, it is important that opportunities in the non-cost area are not lost. There must be a focus on customer and stakeholder relations, communication of plans and progress, maximising the use of the local labour force and contractors, and driving an increase in general workforce skill levels as a consequence of the work. The Alliance model is able to provide powerful incentives that encourage high performance in these areas.

28. It is the opinion of both Council staff and the NZTA that adoption of the Alliance model will reduce overheads, streamline approvals, increase the participation of the private sector at all levels of decision making and would be the most agile for dealing with the evolving scope of the works. Both are also convinced that the model will provide the best opportunity for the multiple objectives of the clients to be realised.

**Value for Money**

29. It is expected that the Alliance will support the Council's strategic objectives and achieve value for money by demonstrating that:
    - in the current environment, there is extremely high value in adopting an integrated approach to the rebuilding of Christchurch;
    - the original contractors were procured in the last year using an approach approved by NZTA;
    - these contractors are the most appropriate contractors to use for this work in the local market;
    - the Alliance model has sufficient checks at agreed milestones to confirm value for money as the work progresses; and
    - benchmarking of labour, plant and materials would increase competition between head contractors and drive efficiency and effective use of resources.

**Setting up an Alliance**

30. An Alliance will be formed by bringing together the existing five infrastructure rebuild contractors (provides for splitting the MacDow Fletcher JV back into two stand-alone companies) with the Council (as the owner of the infrastructure) and the CERA (once fully operational, as the government's recovery manager and funder) and/or the NZTA.

31. It is proposed that the number of head contractors be limited to those five currently involved given that this number is considered the maximum for a well-functioning Alliance.

32. The incumbent head contractors are aware at CEO level of the work to explore an alliance and are supportive of the delivery model.

33. The Alliance would report to both the Council and CERA as joint Clients. The Council, as ultimate owner of the assets, would retain control of the scope and standards of the work to be performed.

34. The Council and NZTA's probity advisor for this process is Shaun McHale of the McHale Group. His role will be to approve and provide probity sign-off at various

points of the project. The Council's legal advisor for this process is Michael Weatherall of Simpson Grierson. His role will be to provide advice at various points of the project including formal review of the Alliance contract documents.

35. Staff are also using an independent expert to audit various aspects of the pricing models.

**Funding**

36. The estimate of the infrastructure rebuild is between $2-3B. This estimate will be continued to be refined to a point that it can be confirmed as a budget.

37. Council staff are preparing the funding strategy for immediate emergency response costs, the impact on its costs and revenues during the recovery phase and the cost of the infrastructure rebuild programme. The infrastructure rebuild programme will be funded through a combination of insurance, government subsidies (NZTA and other) and increased Council borrowing. This will be presented to Council as part of the 10/11 Annual Plan and subsequent LTP.

38. Until this strategy is confirmed, Council needs to continue with high priority infrastructure repairs for example, repairs to sewer pressure mains and the Christchurch Wastewater Treatment Plant.

**Legal Considerations**

39. One of the purposes of the Canterbury Earthquake Recovery Act 2011 is to provide appropriate measures to ensure that the Council responds to, and that Christchurch and its community recover from, the impact of the Canterbury Earthquakes.

40. That Act states that Canterbury Earthquakes "means any earthquake in Canterbury on or after 4 September 2010 and includes any aftershock.

41. The Canterbury Earthquake Recovery Act 2011 repeals the Canterbury Earthquake Response and Recovery Act 2010. However section 88 of the new Act states that every Order in Council made under the 2010 Act, and still in force, is to be treated as having been made under the new Act. This includes the Canterbury Earthquake (LGA 2002) Order 2010.

42. Section 101(1) of the Local Government Act 2002 requires the Council to manage its revenues, expenses, assets, liabilities, investments, and general financial dealings prudently and in a manner that promotes the current and future interests of the community.

43. Under section 101(2) of the Act the Council must make adequate and effective provision in its LTCCP and Annual Plan (where applicable) to meet the Council's expenditure needs identified in those plans.

44. The Canterbury Earthquake (LGA 2002) Order 2010 states that section 101(1) and (2) are not to prevent the Council from doing anything inconsistent with its LTCCP or Annual Plan. That also means that the Council is not required to undertake a special consultative procedure before it makes its decision.

**Consultation / Further Approvals**

45. The NZTA has completed consultation with industry groups and received support for the proposal. The Commerce Commission is also aware of this proposal and sees no issues.

46. The NZTA's procurement manual requires that approval is sought to enter into an alliance agreement. A proposal has been forwarded to NZTA to seek this approval and indications are that it will be addressed at its Board meeting on 5 May 2011.

47. The NZTA's advice has been prepared in the form of a Cabinet Paper and was considered on 18 April 2011.

**STAFF RECOMMENDATION**

It is recommended that the Council resolves that:

a) it ratifies the Chief Executive's proposal for an Alliance to be formed to deliver the reinstatement of the City's damaged infrastructure;

b) the Chief Executive is authorised to approve and enter into such agreements and arrangements as are necessary to implement the proposal;

c) the Chief Executive is to report regularly to the Council on progress with regard to the reinstatement work;

d) the Chief Executive is to exercise his authority in accordance with the relevant provisions of the Canterbury Earthquake Recovery Act 2011 and Orders in Council.

D

# Appendix D Programme risk register

Refer overleaf for a reproduction of the programme risk register, showing those risks with inherent high ranking, identified throughout the programme, together with the relevant control measures (before and after a risk item/event) and the residual ranking.

Note that this is a condensed view with key functional elements not shown, such as the risk groupings, the ranking processes for inherent and mitigated risk and the evaluation tables that feed into rankings.

Refer to the SCIRT Learning Legacy for the risk management plan for a complete explanation.

| Ref. | Risk / Cause | Consequences | Inherent | Control Measures (Who, what action, how frequent, how evidenced) | | Residual |
|---|---|---|---|---|---|---|
| 1.1 | Timing of strategic decisions not aligning with schedule demands | Sub-optimal build or sequences | VH | Request new process for strategy review by SCIRT and Clients | Project by project raising of strategic issues only reduces risk minimally | VH |
| 1.2 | Decisions from client organisations not aligning with schedule demands | delay in programme, increased cost and incomplete work scope | VH | Inform client groups (Horizontal Infrastructure Governance Group (HIGG), HIMT, IPSG, IPCT) to support discussion and decision-making | Amend schedule to fully inform consequence<br>Review project delivery methodologies to maintain fit within programme. | M |
| 1.4 | Client approvals road blocks | delay and design re-work | VH | Engage with wider decision-making; Make judicious use of Asset Owner Reps in team, and general discussions at IPCT meetings as appropriate. | Use of S&S papers to inform clients, work with HIGG and it's teams to inform external stakeholders. Use schedule to inform client of resultant delays | M |
| 1.5 | SCIRT misalignment on priority | work done in the sub-optimal order | VH | Prioritisation Process agreed with SCIRT and CGG, updated quarterly with client input into MCA tool. | Prioritisation Process agreed with SCIRT and HIGG/HIMT, updated quarterly with client input into MCA tool. | #N/A |
| 1.6 | Lack of unity between stakeholders (CERA / CCC / NZTA) | delays, funding issues, poor scope | VH | Horizontal Infrastructure Governance Group accountable for provision of single client view to provide single point of direction | Governance level conversations on-going with clients, SCIRT Board Chair and EGM presenting Report to Monthly HIGG Meeting. New group, HIMT, being formed to oversee total infrastructure rebuild i.e. SCIRT and Non SCIRT. | M |
| 1.7 | Miss-timing of SCIRT deliverables, outcomes, strategy | delay, disruption, sub-optimal outcomes | VH | Robust SCIRT business processes in place and operational | Inform HIMT of systems and procedures currently in place. | #N/A |
| 1.9 | Lack of funding effects strategy, priorities, decision-making | disruptions to workflow and delays | VH | HIGG in place and accountable. Inform HIGG promptly on consequences including costs | Inform HIGG of impacts and adjust programme scope. | M |
| 1.15 | Inability to achieve Target Estimate opportunities - insufficient scope available to challenge, Asset Owners 'block' efforts to convert opportunities | target estimate not achieved | VH | Active programme for working with Scope & Standards Sub-committee to action opportunities | Focus with HIMT and clients to release projects | H |
| 2.1 | Funders having different drivers and priorities | funding issues, delay, scope reduction | VH | HIGG mandated to achieve timely alignment | Promptly inform of consequences, reduce scope | H |
| 2.5 | Gross under-budgeted | funding issues, delay | E | Promote regular budget reviews with Client Governance Group with range included | Reduce scope/ expectations | #N/A |
| 2.17 | Competition for funds for non-SCIRT work | funding issues, delay | VH | HIGG to manage | work with HIMT to mitigate | H |
| 2.22 | Local economy - costs escalating above CPI | funding issues, delay, loss of confidence | VH | Focus on escalation through delivery and procurement processes. Assessed risk$ allowed for in estimate. | Update cost estimates as escalations become known | M |
| 2.23 | Cost Estimation Uncertainty - for Total Scope | funding issues, delay, loss of confidence | VH | Maintain a cumulative cost estimate to new design guidelines and reporting regime | Leave out scope if costs exceed expectations | M |
| 2.29 | Uncertainty of Forecast Final Cost | funding issues, delay, loss of confidence | VH | Allocate Target Estimate proportions to catchments and projects to maintain visibility of total cost prediction | Engage with clients if cost over-runs of allocations become apparent, and do so well before over-run accumulates | L |
| 3.2 | Political intervention into Programme | lack of clarity or direction, delay | VH | HIGG in place and accountable | Request and take direction from the HIGG | L |
| 3.4 | Finished work doesn't meet community expectations (eg road finish standard) | Loss of reputation and resulting loss of confidence; increase in issues raised puts pressure on capacity to investigate and resolve | VH | Joint Horizontal Infrastructure Rebuild Communications Plan updated post research focus groups that identified the concerns as moderate.<br><br>Maintaining issues management resourcing & joint management with Council where they will undertake ongoing work.<br><br>Increasing Council communications to highlight its ongoing work. | Assist Asset Owners with response to media issues arising and community complaints.<br><br>Developed Communications Plan based on Focus Group findings: Council to take the lead.<br><br>Using standard key messages in all communications. | H |

| Ref. | Risk / Cause | Consequences | Inherent | Control Measures (Who, what action, how frequent, how evidenced) | | Residual |
|---|---|---|---|---|---|---|
| 3.6 | Brand confusion – who SCIRT is? | reduced reputation | VH | Ensure site signage is in place on all sites. Continue to promote SCIRT operationally via multiple communication channels, and strategically using Communication Working Group communication plan | | L |
| 3.8 | Poor relationship with key stakeholders: lack of understanding of SCIRT, our delivery model, questions over quality and collaboration plus desire for imparting of our legacy by owner participants- particularly CCC | reduced reputation | VH | Initiate Key Stakeholder Engagement Plan. | Stakeholder managers actively engage and inform. | M |
| 3.16 | Work Schedule transparency & level of communication | reduced reputation | VH | Widely promote the quarterly updates to the schedule and continue to promote the prioritisation process. Monitor acceptance through market research | | L |
| 3.17 | Community demand for information | reduced reputation | VH | Use multiple communication channels to inform communities at the local and city-wide level; provide high levels of service | | #N/A |
| 3.18 | Competing community demands | reduced reputation, delay | VH | Maintain high profile and dialogue and use CCC and CERA as needed. | | #N/A |
| 3.20 | Frustration amongst businesses disrupted by SCIRT work | reduced reputation, delay, dispute | VH | Initiate communications and engagement programme: *Making it our Business* | Escalate to management & DL team for personal asessment and involvement in resolving issues. | M |
| 3.22 | Community concerned work won't get done after SCIRT completes its programme. | reduced reputation, delay, dispute | E | Joint Horizontal Infrastructure Rebuild Communications Plan udnerway and monitored monthly.<br>Pro-active communication e.g. media briefings. | Assist Asset Owners with response to media issues arising and community complaints.<br>Respond directly with agreed messaging. | M |
| 4.1 | Delays associated with regulatory processes | lack of clarity or direction, delay | VH | Maintain focus on regulations through dedicated SCIRT staff. Legislative and SCIRT requirements detailed in SCIRT Management Plans which are reviewed anually | | L |
| 6.3 | Accommodation shortfall | Insufficient personnel | VH | Delivery Teams provide accommodation plus encourage independent providers plus monitor closely + maximise local resource use | | L |
| 6.6 | Unplanned turnover and loss of key people | Negative impact on completions due to reduced institutional knowledge. | VH | Programme wide retention strategies approved by the Board 2015. Each team applying strategies relative to context. | Focussed transitions and temporary labour | H |
| 6.11 | Inexperienced staff | Increased errors and need for training | VH | Planned succession and smooth transfer of knowledge. Keeping the right mix of new and SCIRT-experienced people. | Bring in replacements with industry experience. | H |
| 7.16 | Quality concerns and inadequacies | Errors and omissions with inefficiencies, cost of re-work, delay in handover, impact on reputation | VH | Focus on quality assurance including audit scope, depth/quality of audits, following NCR process, ownership of quality control by line, engagement with asset owners. | NCR's and rework as appropriate and root cause investigations for significant issues and frank reporting. Focus on projects determined to be a high risk for completion. Regular review by IST to resolve significant / DT wide quality issues. | H |
| 7.18 | Death or Serious Injury to team member or public | Emotional impact on team, cost, delay, loss of reputation | VH | Continued safety focus, processes and reporting. Critical risk programme - verification of implementation of controls. Engage CTOC re implementation of traffic controls. Focus areas to end of program: Safety Culture, Critical Risks, Near Miss Reporting and Fatigue Management | DT to work for root cause investigation for significant issues. Continued focus on Critical Risk. DT Project HS audits to be reviewed to include SCIRT specific Critical Risk requirements. | M |
| 8.4 | Contaminated environment | environmental impacts, public health impacts, disruption to works, regulator action | E | Environmental Mgt Plan | Emergency response plan Crisis Management plan (clean-up - spill response plan) | L |