

EROSION AND SEDIMENT CONTROL STANDARD FOR STATE HIGHWAY INFRASTRUCTURE

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ABSTRACT

The NZ Transport Agency (NZTA) is developing an Erosion and Sediment Control Standard for State Highway Infrastructure. With careful planning and design, adverse effects of sediment discharges resulting from construction and maintenance activities can be avoided or minimised.

Over 80% of attendees at a nationwide series of technical workshops sponsored by NZTA on stormwater treatment said there was a need for NZTA to develop a standard for erosion and sediment control. Similarly consultation with Roding NZ found that a lack of clarity and certainty around erosion and sedimentation control expectations could increase cost by over 5% making a project unprofitable and unsustainable.

The Standard aims to provide greater clarity to consultants and contractors as to NZTA expectations for preparation and execution of erosion and sediment control plans, the Standard will avoid unnecessary duplication and uncertainty, thus improved value-for-money solutions.

The Standard achieves value-for-money; national consistency and compliance with all regional plans by ensuring sensitive receiving environments are identified and protected. A two-hour web based learning program for project managers and practitioners introduces, educates and evaluates understanding of the Standard.

KEYWORDS

Erosion, sedimentation, NZTA, state highway, environmental standard

PRESENTER PROFILE

An Environmental Specialist for NZ Transport Agency based in Christchurch I specialise in water quality, erosion and sediment control, and environmental management systems. I am also a member of the RCA Stormwater Working Group and the New Zealand representative for Student and Young Professionals for the Environmental Institute of Australia New Zealand.

1 INTRODUCTION

The NZ Transport Agency (NZTA) is committed to:

- lowering environmental impacts,
- social and environmental responsibility, and
- improving the contributions of state highways to the well-being of New Zealand.

As part of this commitment in September 2009 the NZTA environmental team initiated development of an Erosion and Sediment Control Standard for State Highway Infrastructure (the Standard). The Standard is a key document toward implementation of the Environmental Plan objectives:

- ES1 Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition.
- ES2 Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas.
- ES3 Use bio-engineering and low-impact design practices where practicable.

The NZTA also has an intention in regards to erosion and sediment control to lead in the:

- promotion and use of appropriate design methods;
- development and application of practices that minimise risk of erosion and sediment deposition;
- implementation of erosion and sediment control measures;
- identification of risk and problem areas;
- use of best-practice methods unique to each situation to ensure effectiveness;
- early identification of new projects that have a higher risk of erosion;
- identification of and support for new techniques and methodologies including research and implementation as appropriate;
- consultation with council authorities to ascertain problem areas and agree upon solution; and
- protection of sensitive receiving environments.

In 2009 NZTA sponsored nationwide technical workshops on the *Draft Stormwater Treatment Standard for State Highways*. Attendees responded to a questionnaire on whether there was a need for the NZTA to develop a similar standard for erosion and sediment control. Over 80% of the attendees agreed. Similarly, consultation with Roding NZ found a lack of clarity and certainty around erosion and sedimentation control expectations could increase cost over 5% making a project unprofitable and unsustainable.

The standard will help NZTA meet the legislative requirements of the Resource Management Act 1991 to avoid, remedy and mitigate adverse environmental effects from erosion and sedimentation from state highway activities. Because it will provide greater clarity to consultants and contractors as to NZTA expectations for preparation and execution of erosion and sediment control plans the Standard will avoid unnecessary duplication and uncertainty, thus improved value-for-money solutions.

From September 2009 to August 2010 the *Draft Erosion and Sediment Control Standard for State Highway Infrastructure* and the accompanying *Draft Erosion and Sediment Control Field Guide for Contractors* (commonly referred to as the Field Guide in this report) was developed. Three leading New Zealand erosion and sediment control specialists were used in the development;

1. Earl Shaver, Aqua Terra International Limited
2. Graeme Ridley and Michael Dunphy, Ridley Dunphy Environmental Limited
3. Gregor McLean, Southern Skies Environmental Limited

The Standard was developed in sections, all of which had one of the specialists in the role of the principle author, secondary author, and reviewer. Each section was also reviewed by NZTA environmental specialist and senior legal counsel.

The *Draft Erosion and Sediment Control Standard for State Highway Infrastructure* and *Draft Erosion and Sediment Control Field Guide for Contractors* was released for wider public consultation in September 2010. The following consultative methods to gather feedback from NZTA staff, consultants, contractors, regulatory authorities and interested members of the public are currently or proposed to be undertaken as funding becomes available;

- www.nzta.govt.nz
- Email notification
- Value-for-money road test assessment
- Technical workshops
- Regulatory authority one on ones
- Presentations

The basis of this paper is to present the results of the value-for-money road test assessment.

2 VALUE FOR MONEY ROAD TEST ASSESSMENT

2.1 METHODOLOGY

The Draft Standard was “road tested” on three capital projects; each project having its own unique environmental characteristics as outlined in section 2.2. The three projects were;

1. SH20 Mount Roskill Extension
2. SH18 Greenhithe Deviation
3. Christchurch Southern Motorway

The basic premise of the road test is to compare what was done on each project to what would have been done had the Standard been in place. Therefore a report will be commissioned on each project from the developers of the projects erosion and sediment control plan or consent methodology. The report will describe the project, environmental factors, designed solutions, the designed solutions had the Standard been applied to the project and general comments on the standard [see Appendix A].

The designed solutions capture necessary information on the design philosophy, project requirements, erosion and sediment control practices, cost and time. This will allow a value-for-money assessment of the Standard to take place. The value-for-money assessment will document financial implications of the Standard compared to current practice. The value-for-money assessment is a critical factor in consideration of the Standard for approval.

2.2 PROJECT BACKGROUND

All three projects were four lane motorway developments, however, the Christchurch Southern Motorway required the duplication of the existing motorway as well as an extension through greenfields. Between the three projects, two regional council consenting authorities were involved; Auckland Regional Council (SH20/SH18) and Environment Canterbury (CSM), and the three projects provided a range of engineering and environmental factors in which to assess the draft standard against.

2.2.1 SH20 MOUNT ROSKILL EXTENSION

SH20 Mount Roskill Extension forms part of the Auckland Western Ring Route, the project extended SH20 4km through the suburb of Mount Roskill, a highly urbanised environment and included;

- Two full diamond interchanges
- Two dedicated bus shoulder lanes
- Provision for a future rail line
- Four bridges
- Two cable-stay pedestrian/cycle bridges
- Significant retaining walls

The site was constrained by a relatively narrow designation corridor and drained towards the Waterview Estuary via Oakley Creek. The site area was approximately 43ha involving approximately 33ha of earthworks. The soils along the route generally consisted of weathered Miocene Waitemata materials overlain by alluvium and peat deposits, and in the vicinity of the Mount Roskill volcanic cone the Waitemata Group was overlain by layers of volcanic tuff ash, scoria and basalt flows. The Waitemata Group are highly susceptible to erosion; however, due to the relatively low site slopes and associated low runoff velocities, the actual potential on the project was generally low (Worth, 2011).

2.2.2 SH18 GREENHITHE DEVIATION

SH18 Greenhithe Deviation forms part of the Auckland Western Ring Route, the project upgraded 5.5km of SH18 to a four lane motorway from SH1 Constellation Drive interchange in Albany to the Upper Harbour Bridge in Hobsonville, and included;

- Three interchanges
- Four road bridges
- Several large fill embankments
- Modifications to the local road network to facilitate construction
- Noise walls
- Retaining walls

The site was constrained by a narrow designation crossing a number of steeply incised stream valleys and several sensitive ecological areas, which posed practical problems for the installation of temporary silt control devices. The project drained into Lucas Creek/Paremoremo Estuary which discharges into the Upper Waitemata Harbour. The site area was approximately 55ha involving approximately 45ha of earthworks. The soils are characterised by high plasticity, high winter groundwater levels and low permeability, this combined with the rolling topography of the site and numerous gullies which contracted overland flows meant robust erosion control measures were required during construction (Jarvie, 2011).

2.2.3 CHRISTCHURCH SOUTHERN MOTORWAY

The Christchurch Southern Motorway will connect the Brougham Street Expressway (SH73) in the east with Main South Road (SH1) in the west is approximately 10.5km in length. There are three distinct sections to this project;

- Upgrade to a four-lane median separated motorway between Collins Street and the Curletts Road interchange with full interchange access at both Barrington Street and Curletts Road, (3km).
- New four-lane median separated motorway built, between the Curletts Road interchange and the intersection of Halswell Junction and Springs Roads with underpasses at Aidanfield Drive and Awatea/Dunbars Roads, (5km).
- Upgrade Halswell Junction Road from Springs Road to Main South Road (SH1), with traffic lights at Shands Road intersection and upgrade to the Springs Road roundabout, (2.5km). (NZTA, 2011)

The project crosses a number of former landfill sites, which require the removal of waste material to undertake ground improvements. Groundwater is present within 1m of the surface and the project drains to the Heathcote and Halswell River catchments. The site area and earthworks are approximately 50ha. The soils comprise mainly the Yaldhurst Member of the Springston Formation, which includes;

- Flood channel infill materials generally comprising gravels and sands
- Overbank alluvial silt deposited during flooding
- Peat deposits formed in well established swamps

The erosion potential is low due to the flat terrain; however, some steeper areas are associated with the batters of the existing Christchurch Southern Motorway (McLean, 2011)

2.3 STANDARD VS CURRENT PRACTICE

The aspect of erosion and sediment control for the three projects were assessed as to what happened and what would have occurred had the draft NZTA standard been in place. Five key elements were assessed;

1. Design philosophy
2. Project requirements
3. Erosion and sediment control practices
4. Cost
5. Time

This provides a valuable insight into how the draft standard would be applied in its current form, and will help in further refinements to the standard prior to it being finalised for use on all Highway projects.

2.3.1 DESIGN PHILOSOPHY

The objectives for the design on all three projects would now require the erosion and sediment control objectives of the NZTA environmental plan, as stated in the introduction of this paper. While they should have already been considered on the three projects, it would not result in any significant changes to the erosion and sediment control philosophy.

The design criteria of the NZTA draft standard varies against Auckland Regional Council's TP90 and Environment Canterbury's erosion and sediment control guidelines. Most notably the design storm selection in the NZTA draft standard uses a risk based approach outlined in the ANZECC guidelines, so instead of the blanket 5% AEP event used in TP90,

a different event could be selected. This would have been the case for SH18 Greenhithe Deviation.

The storage device sizing is also based on the design storm event which would have required increases in storage volumes on SH20 Mount Roskill Deviation and SH18 Greenhithe Deviation of between 30-80%. On the Christchurch Southern Motorway the use of decanting earthbunds for catchments of 1.5ha would have exceeded the maximum allowable catchment of 0.3ha in the NZTA draft standard without an exception approved, therefore, sediment retention ponds would have been required.

2.3.2 PROJECT REQUIREMENTS

Adoption of the NZTA draft standard would not result in significant changes to the requirements on the three projects assessed. This is due to;

- The local consent requirements still being in place, unless a regulatory authority was to adopt the NZTA standard for state highway infrastructure.
- The draft standard still leaves phasing up to the discretion of the regulator, however, the draft standard does promote phasing and staging as a means to reducing the impact of sediment on the receiving environment.
- Winter construction is still to be approved by the regulator.

One small difference between the draft standard and TP90 is however in the provision for decommissioning works and ponds. The draft standard contains specific guidance, which is similar to that in Environment Canterbury's guidance, and it is in accordance with industry best practice. By having the guidance in the draft standard, it provides consistency between state highway projects.

2.3.3 EROSION AND SEDIMENT CONTROL PRACTICES

Adoption of the NZTA draft standard would not result in significant changes to the erosion and non-sediment contaminant control measures used on the three projects. In regards to non-sediment contaminants, the individual project environmental management plans deal with this well.

Sediment control practices varied between the draft standard and what was carried out on the three projects due to the design criteria in the draft standard often requiring larger ponds or ponds instead of decanting earth bunds as in the case of the Christchurch Southern Motorway.

The need for larger ponds may require more attention to the erosion and sediment control measures prior to seeking a designation, as it is noted that both SH20 Mount Roskill and SH18 Greenhithe Deviation both had constrained designations available. However, the requirements for erosion and sediment control will still need to be taken into account alongside other site characteristics.

The draft standard compared with TP90 also requires forebays for all ponds, which would increase the excavation required for each pond and for sediment silt fences to be cleaned out when accumulated sediment reaches 20% of the fabric height vs 50% in TP90.

2.3.4 COST

The cost implications of adopting the draft standard as it currently stands would see little difference in the costs associated with the consenting process and erosion and sediment control design.

The cost of constructing erosion and sediment control measures would likely increase due to the increased size in device storage on these three projects. For SH20 Mount Roskill

and the Christchurch Southern Motorway the increase in cost would be minor. However, SH18 Greenhithe Deviation would have experienced an increase of approximately \$750,000 or about a 20% increase in the cost for erosion and sediment control – going from 3.4% of the total construction costs to 4.2%.

Monitoring costs on SH18 Greenhithe Deviation would also likely to double from \$200,000 to approximately \$400,000. However, this would allow the regulator and NZTA determine the baseline water quality conditions and assess what impact the works were having on the receiving environment.

It is important to note here that SH18 Greenhithe Deviation was completed late and erosion and sediment control works were subject to variation claims. While some delays to the Contract were due to the Contractor's controls which required rebuilding, it was generally insignificant to the overall construction timeframe, but it did affect the budget cost.

2.3.5 TIME

If the draft standard was adopted and was the basis for the preparation of erosion and sediment control plans, approval of the plans may take longer from the regulator if they are not familiar with the standard in comparison to their own guidelines.

Construction of individual practices may also take longer due to the increase in size; however, it is likely that it would be absorbed by the overall construction program.

3 CONCLUSIONS

The value-for-money assessment conducted against SH20 Mount Roskill Extension, SH18 Greenhithe Deviation and the Christchurch Southern Motorway shows the draft standard will have some cost implications compared with current practice. However, the results are limited by the draft standard only being assessed against the three projects and from only two regulatory authority jurisdictions. The assessment would benefit from being widened to capture a range in the size of NZTA projects and other regulatory jurisdictions.

While differences between applying the standard vs current practice are primarily the result of using the risk based approach to determining the design event. This is seen as a step forward by the authors of the standard as this allows for the standard to be applied nationally across a range of localised environments.

Before the standard can be finalised, the draft will need further assessment and would benefit from workshops to discuss the content of the standard by NZTA, consultants and the regulators.

ACKNOWLEDGEMENTS

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APPENDIX A

Erosion and Sediment Control: Project Review Report Requirements

The report will contain all four parts but will replicate part 3 for what was undertaken and what would have occurred had the Standard been applied to the project.

Part 1: Project Description

A brief description for the following bullet points is to be provided to outline the context for the project.

- location of the project,
- project delivery method [e.g. design construct, alliance etc]
- scope of the project,
- site constraints, and
- natural site features that influenced the construction approach [e.g. streams, wetlands, estuary, vegetation, cultural, etc]

Part 2: Environmental Factors

Insert a table providing the background environmental factors for the project.

- terrain

- site area
- size of the earthworks
- volume of material moved
- topography [average site slope]
- catchments [the areas impacting upon the erosion and sediment control practice selection]
- drainage features
- geotechnical limitations and opportunities
- soils
- erosion potential
- site flooding history
- design storm event
- VKT at time of completion
- catchment classification [urban, peri-urban, or rural – see <http://www.nzta.govt.nz/resources/national-state-highway-strategy/docs/national-state-highway-strategy-2007.pdf>]
- receiving environments [sensitivity of the receiving environment to sedimentation <http://www.nzta.govt.nz/resources/research/reports/315/index.html>]

Part 3: Designed Solutions

How the project was delivered and what would have changed had the erosion and sediment control standard been in place.

- Design Philosophy
 - objectives
 - criteria
 - references – regional plans, erosion and sediment control design manuals or guidance used
- Project Requirements
 - Local consent requirements,
 - Phasing – was/is the earthworks phased, if so, what criteria were used?
 - Winter construction – did construction continue over the winter, if so, were additional practices required or were earthworks done a more limited basis? If not, what was done in preparation of shutting the site down?
 - Were any temporary measures designed to be converted into permanent stormwater controls?
 - What controls were in place for dewatering, sediment removal and disposal?
 - What provisions were in place for decommissioning works and ponds?
- Erosion and Sediment Control Practices – provide an outline of the practices used under the following headings.
 - Erosion Control
 - Sediment Control
 - Non-sediment Contaminants
- Cost
 - Resource consents – include the costs of the AEE, council fees, other professional services
 - Final design – cost of producing the final design
 - Construction – costs involved in the construction of the erosion and sediment control practices. Please provide a breakdown of the costs to the degree possible.
 - The erosion and sediment control proportion of the total project cost
 - Monitoring costs – costs associated with monitoring the practices
- Time

- Resource consents – time from the submission of the application to consent approval
- Final design – time taken to prepare the final design
- Construction – time required to construct the practices
- Monitoring – the frequency of monitoring

Part 4: General Comments

General comments in relation to erosion and sediment control on the project and on the Standard.

- Were there design or construction issues that caused problems and time delays with the consenting agency? If so, please describe.
- Was the project completed on time and within budget? Did erosion and sediment control issues cause any delays or cost over-runs?
- Would the draft NZTA Erosion and Sediment Control Standard have provided any assistance in design, construction or decommissioning?
- Any other general comments?