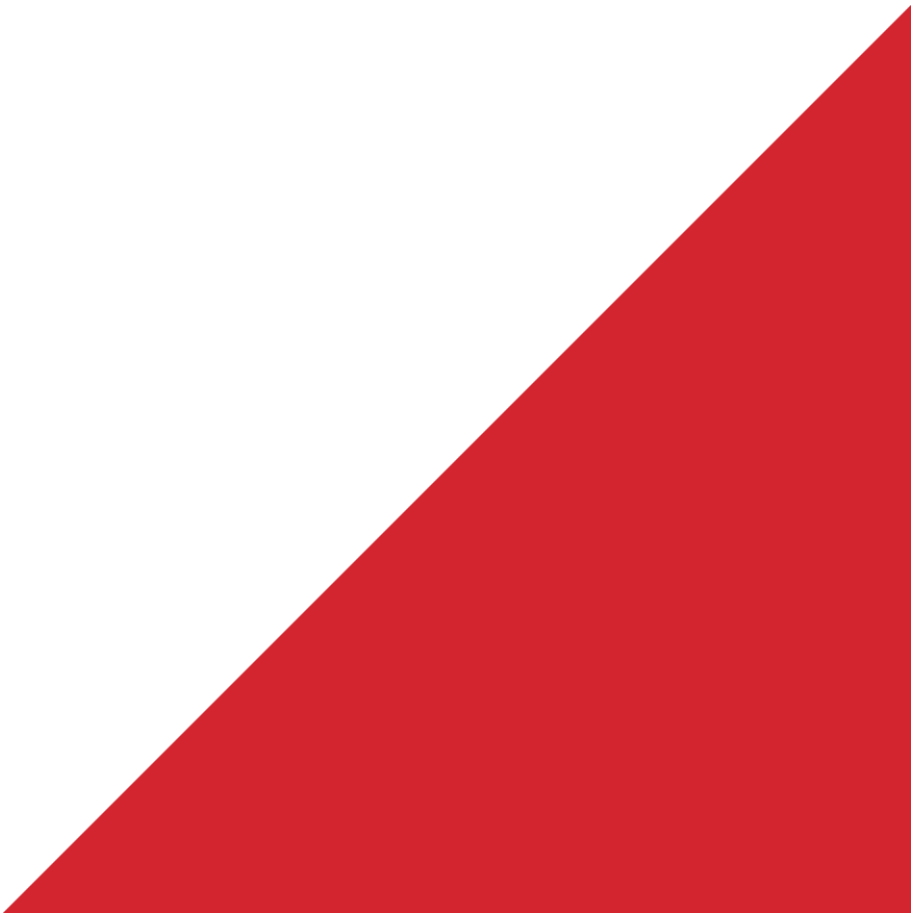
Slope Instability and Erosion Susceptibility

Review of submissions



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Date: December 2014
Reference: 353194.00 3WWR
Status: Final

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1 Background

The purpose of this report is to review the methodology used for identifying erosion susceptibility on the Natural Hazard maps of the Proposed Kāpiti Coast District Plan 2012. The report also considers seven submissions which raise concerns about erosion susceptibility notations applying to specific sites or locations.

The Kāpiti Coast District Council has adopted a precautionary and risk-based approach to hazard management in its Proposed District Plan 2012. That approach includes avoiding new development in areas subject to high risk from hazards, if the risk cannot be mitigated, and allowing a greater level of development, especially if the risk can be mitigated, in areas subject to lower risk where the hazard has a low probability or long recurrence interval. The basis of this approach to hazard mitigation is provided in Policies 9.1 & 9.2.

"Policy 9.1 – Identify Hazards

The extent of flooding, seismic, slope instability and erosion hazards in the District will be identified on the District Plan maps."

"Policy 9.2 – Risk based approach

A risk-based, all hazard approach will be taken to subdivision, land use, and development within areas subject to the following natural hazards:

a) Flood hazards;
b) Earthquake hazards;
c) Fire hazards;
d) Slope instability and erosion; and
~~e) Coastal erosion hazards.~~

Hazard risk categories will be developed for flood, earthquake, and erosion hazards to guide minimising the risk of loss of life and damage to property caused by these hazards, while allowing appropriate use in lower risk areas."

Flood and earthquake hazards affect relatively large spatial extents, and therefore can be mapped at an appropriate District scale. Mapping slope instability and erosion at a scale which is appropriate for District Planning, however, is more problematic. This is because of:

- The relatively small size of many landslides and erosion sites within the Kāpiti Coast District ('the District');
- The large percentage of unaffected slopes and terrain even following extreme events; such as the 2003 and 2004 rainstorms. Even in the worst affected catchments following the 2004 rainstorm event in Manawatu over 70% of the slopes remained unaffected;

- The potential impact of slope instability and erosion is often greater downslope, within the runout and deposition zones, and yet these are seldom considered;
- The infrequent nature of landsliding episodes;
- The essentially 'one-off' nature of most slope instabilities where all the weak material is eroded leaving a more stable slope following the erosion event than before;
- The complex interaction of potential slope instability with climate, vegetation cover, and land use etc.

Consequently, it is generally not feasible to map areas of potential slope instability and erosion at the 'lot' scale. It is this fine resolution mapping which is necessary for District planning. Any attempt to do so is extremely expensive and still problematic. For example, the coarser the scale of the mapping the lower the cost but also the greater potential difference between the mapped and 'actual' site-specific risk. Since the ratepayers carry the cost of any District-wide mapping exercise, the scale chosen is generally constrained. This can limit the actual benefits when attempting to map potential slope instability and erosion sites.

Furthermore, any mapping of the susceptibility to slope instability and erosion carries the potential for assuming liability - for both areas which erode and which were not mapped, and areas which were mapped as being at risk but are stable. Reconciling differences between the mapped risk and the 'actual' site-specific risk is both time-consuming and expensive.

Consequently, any slope instability and erosion assessment, to be accurate and effective, must be carried out at the subdivision or individual development scale. It is appropriate that the cost of any assessment is borne as a component of the development, which directly receives any benefit of the assessment, rather than by the entire community for whom any benefits are at best indirect.

2 Slope instability

Landslips pose a significant risk, not only to existing properties within the District but also to regional and nationally significant infrastructure; including transport routes such as SH1 and the rail corridor. In the southern and south-eastern parts of the District the terrain is steep and slopes have a higher potential for failure. Predictions of changing weather patterns from climate change suggest that there could be more frequent and intense rainstorm events and these may cause more damage to erosion prone land and increase risk to people and property. To guide development and decision-making the erosion prone land within the District is shown on the Natural Hazard Planning maps contained within the Proposed District Plan. The relevant parts of the District Plan policies specific to erosion and slope stability, and surrounding explanatory text, are quoted below:

"9.4 Erosion and slope stability

….The erosion prone land within the District is shown on the Natural Hazard Planning maps. The erosion susceptibility mapping was undertaken in a study for the Ministry for the Environment. The maps show erosion risk categories from very high to no risk."

"Policy 9.18 Erosion risk assessment

When assessing applications for subdivisions and developments which are located on land which has a moderate or high erosion risk, a risk management approach will be taken and Council will consider a range of matters that seek to reduce the risk to people and property, including:

…

Explanation

The areas of moderate or high erosion prone land are illustrated on the district planning maps. People wanting to undertake subdivision or development on land which has a moderate to high susceptibility to erosion will be required to provide a geotechnical assessment as part of their subdivision or land use consent application. Subdivision and development will not be undertaken on land where there is an erosion risk that cannot be remediated."

"Policy 9.19 Erosion risk avoidance

Subdivision and development on land identified in the District Plan maps as having moderate or high erosion risk will be avoided, unless a comprehensive engineering and geotechnical report demonstrates that the land is sufficiently stable for the subdivision or development activities proposed.

Explanation

Areas prone to erosion have been identified in the District Plan Natural Hazard maps. These areas are steep hill country areas where little development is anticipated. These areas are commonly used for forestry activities and less commonly for pastoral farming and rural living."

These policies are followed by 9.4.3 Erosion and Slope Stability Rules and Standards.

3 Basis for *Natural Hazard* maps

3.1 Introduction

No District-specific mapping of the susceptibility to slope instability and erosion has been undertaken. Rather, the approach adopted by Council has been to use existing mapping. This was produced by other agencies for a different purpose.

In 2010 the Government proposed a National Environmental Standard (as regulations under the Resource Management Act 1991) for Plantation Forestry. A key component of the NES was developing an erosion susceptibility classification (ESC), which would be used to identify land where forestry activities would be permitted or require resource consent (Bloomberg *et al.*, 2011). The ESC was to be used to analyse the risks of erosion, sedimentation and environmental harm associated with plantation forestry activities in New Zealand. It is this classification which forms the basis of the erosion susceptibility notations which appear on the Natural Hazards maps in the Proposed District Plan.

The project was undertaken by the University of Canterbury's School of Forestry and underwent a rigorous validation process by land management experts, regional council staff, and an independent expert peer review panel.

The conceptual model of landslide risk adopted was:

Erosion risk = erosion susceptibility x frequency of triggering events x downslope /downstream consequences

Erosion susceptibility is therefore only one component of erosion risk, which also depends on the frequency of triggering events (usually high intensity rain storms) and the nature of the downslope/downstream values or infrastructure impacted by the erosion (consequences).

Erosion susceptibility itself has two components; predisposing factors such as slope and lithology which determine the inherent susceptibility of a land unit to erode, and preparatory/mitigating factors, which respectively increase or reduce erosion susceptibility above or below this inherent level.

3.2 Methodology

This section provides some background to the methodology used for developing the ESC for the proposed NES for Plantation Forestry. Various methods for estimating erosion susceptibility in New Zealand were reviewed prior to developing the ESC. The decision was made to adopt the potential erosion severity values in the NZ Land Resource Inventory (NZLRI) and Land Use Capability (LUC) database. These erosion severities range from 0 (negligible) to 5 (extreme), and were classified into both a three-class and four-class erosion susceptibility classifications (ESC).

Other candidate models; HEL (Dymond *et al.*, 2006) and NZeem (Dymond *et al.*, 2010) are partially based on process models of erosion, and therefore have limitations when developing an ESC. Furthermore, a detailed comparison of the NZLRI, HEL and NZeem for use in mapping the land susceptible to mass movement affecting soil carbon stocks was made by Basher *et al.* (2010). They concluded that *"Of the three different approaches used to define susceptibility to mass movement, potential erosion from the NZLRI provides the most robust and defensible definition..."*

In 1970 the Soil Conservation and Rivers Control Council requested that the Ministry of Works and Development prepare a series of national resource surveys, one of which was to be an erosion map of New Zealand. The object was to present the erosion type and its severity, together with the potential for erosion, at a scale of 1:250,000.

In 1973 it was decided to publish the field sheets, at a scale of 1:63,000, which had been compiled as the 'New Zealand Land Resource Inventory'. The mapping technique involved the identification of areas which were homogeneous in rock and soil type and slope. Within these units the vegetation cover and the erosion type and severity were also mapped. A total of 89,873 map units were recorded with a median area of 154ha. Initially, in 1973, the smallest area delineated was 60ha but by 1979 this had been reduced to 20ha. It should also be noted that while a particular type and severity of erosion was mapped within each unit this did not mean that the entire unit was affected by this form of erosion, just that it was present to some extent in a particular unit.

To normalise the effect of preparatory/mitigating factors on erosion susceptibility, the assumptions used in the NZLRI were adopted when estimating potential erosion severity i.e. land is under permanent pasture vegetation and there are no soil conservation works, or earthworks that might destabilise the land (I. Lynn *pers. comm.,* 26 April 2011). This means that all land units are compared purely on the basis of their predisposition to erode, with a correction for differences in erosion susceptibility caused by different vegetation cover, intensity of earthworks, or other preparatory factors.

Using this system, all map units (polygons) in the NZLRI were assigned to ESC classes. GIS analysis was used to produce maps and tables depicting the spatial distribution of the ESC classes. Towns, quarries and the Department of Conservation estate were excluded from this analysis, and classed as "Undefined".

The limitations of an ESC based on 1:50,000 scale mapping were discussed including how risks from erosion in plantation forests may be managed at a more detailed scale of 1:5000 to 1:10,000 required for accurate mapping of, and planning for, erosion risks. It should be noted that while the process for 'down-scaling' is provided within Bloomberg *et al.* (2011) similar information is not provided within the Proposed District Plan.

3.3 Reliability

The ESC was consequently compiled at a spatial data at a 1:50,000 scale, with a minimum size polygon of approximately 20ha. Therefore the ESC derived from the NZLRI is necessarily coarse, and in some cases polygons assigned a specific ESC are likely to include a complex of sites with different erosion susceptibilities.

The intention was that the ESC act as a decision rule for the activity status of forestry operations under the Resource Management Act (RMA). The next stage would involve the planning and execution of forestry operations, with an appropriate level of regulation under the RMA. At that stage more detailed consideration of local conditions, and of the likely

effects of topography, soils, drainage and intense rainfall statistics becomes both possible and necessary to refine the larger-scale ESC classification and make operational decisions that manage risk to acceptable levels.

The NZLRI database contains data that are now approaching 40 years old. It was recommended that regular (5-yearly) review and updating of the ESC be undertaken. Any suitable new LUC mapping should be substituted for the NZLRI data to derive more accurate mapping and estimates of potential erosion severity.

The ESC based on 1:50,000 scale mapping was therefore only the first step in management of erosion risks from plantation forests. To account for important variation in erosion susceptibility at a site level, planning and regulation at a scale of 1:5000 to 1:10,000 is required. It should be noted that this 'down-scaling' has not been undertaken in respect of the use of the ESC within the Proposed District Plan.

Site-level planning also allows for identification of consequences, and downslope values that may be impacted by erosion. These include receiving water bodies, infrastructure and buildings, as well as human safety and welfare. It was strongly recommended that the NES for plantation forestry will require development of site-level planning processes, so that operational planning and management of harvesting and earthworks are done to a uniform high standard throughout New Zealand.

4 Recommendation

The basis for the Erosion Susceptibility mapping within the Proposed District Plan was therefore developed as a component of the proposed NES for managing plantation forestry. The mapping scale (i.e. 1:50,000) was chosen on the basis of existing data sets to provide a consistent national coverage. It was recognised that the ESC mapping was only the first step in management of erosion risks from plantation forests. To account for important variation in erosion susceptibility at a site level, planning and regulation at a scale of 1:5000 to 1:10,000 is required. This 'down-scaling' has not been undertaken in respect of the use of the ESC within the Proposed District Plan.

The cost of 'downscaling' the ESC to a site, or even a subdivision level, across the entire Kāpiti Coast District would be prohibitive. However, without this 'downscaling' the current ESC is inherently unreliable at the site-specific scale. It is considered impractical, and neither cost-efficient nor cost-effective, to map areas susceptible to slope instability and erosion at the 'lot' or site-specific scale necessary for District planning. Any attempt to do so would be extremely expensive and problematic.

Furthermore, to map the susceptibility to slope instability and erosion carries the potential for assuming liability; for both areas which erode and which were not mapped, and areas which are mapped as being at risk but are stable. Reconciling differences between the mapped risk and the perceived site-specific risk is both time-consuming and expensive.

It is therefore suggested that the 'erosion susceptibility' notations be removed from the Natural Hazard maps which appear in the Proposed District Plan. This will require consequential amendments to associated policies and rules.

The cost of any slope instability and erosion assessment, to be accurate and effective must be carried out at the subdivision or individual development scale. Since it is the development which directly receives any benefit of such an assessment, rather than by the entire community, it is the development which should meet the costs of assessing the erosion and slope stability hazard and implementing any hazard mitigation strategies.

The Kāpiti Coast District is potentially affected by a wide range of natural hazards, however, the magnitude and significance of a particular hazard varies throughout the District. While some of these hazards tend to affect relatively large contiguous areas, others are more localised in their effects. Consequently every location is potentially affected by a unique set of hazards with a distinct risk profile. It is considered impractical to determine these risk profiles for every location within the District.

Therefore, rather than attempting to provide information regarding every hazard at every location, the District Plan could focus on providing guidance for consideration during the resource consent process. This guidance could include the various types of hazards, and their potential magnitudes, which should be considered. Appropriate guidance material could be developed from the *"Executive Summary"* and section 3 *"Issues, Challenges and Trends" from the Kāpiti Coast District Plan Review Discussion Document "Natural Hazards & Managed Retreat"*.

5 Submissions review

Blackburne, M.Y. & S.A. (Submission 44-11)
Seeks to remove the moderate erosion susceptibility notation on 41 Blackburne Road.

It is likely that some of the area shown on Map 18C which is in dispute has a 'Moderate Erosion Susceptibility'; either directly from slope instability, or indirectly as a result of debris flows and the deposition of material on the flatter foot slopes.

The removal of the ESC from the Natural hazard maps will address the submitter's concerns.

Ballinger, V. (Submission 90-2)
Seeks to amend Map 20C so as to reduce the area shown as having moderate erosion susceptibility.

It is likely that some of the area shown on Map 20C which is in dispute has a 'Moderate Erosion Susceptibility'; either directly from slope instability, or indirectly as a result of debris flows and the deposition of material on the flatter foot slopes.

The removal of the ESC from the Natural hazard maps will address the submitter's concerns.

Winstone Aggregates. (Submission 92-155)
Seeks to amend Map 10C by deleting the 'Moderate Erosion Susceptibility' annotation within the Waikanae Quarry site at 15 Reikorangi Road (Lot 1 Deposited Plan 26401).

It is likely that some of the area shown on Map 10C which is in dispute has a 'Moderate Erosion Susceptibility'. However, the ESC mapping upon which the Natural Hazard maps are based explicitly excluded 'quarries'. The inclusion of this area therefore is a function of the age, quality, and scale of the data underlying the original ESC mapping.

The removal of the ESC from the Natural hazard maps will address the submitters' concerns. The inherent erosion susceptibility of the quarry is likely mitigated by the quarry management plan.

Heerdegen, R. & Rosier, J. (Submission 172-9)
Opposes the identification of the areas adjoining the Waitohu Stream as "very high" in terms of its susceptibility to erosion and seeks to have it amended to "moderate".

It would appear that the submitter has misinterpreted the *'Urban Relocatable Build'* notation on Map 01C as *'Very High Erosion Susceptibility'* in which the 'orange hatches' slope in the opposite direction.

The Urban Relocatable Build notation formed part of the Coastal Hazard Management Areas were withdrawn from the Proposed District Plan on 30 October 2014. This should meet the submitters' concerns. Notwithstanding this, the removal of the ESC from the Natural hazard maps may also address matters of concern to the submitters.

Richmond, J. (Submission 426-8 & 426-11)
Seeks to amend the moderate erosion susceptibility area identified on the submitter's land in negotiation with the submitter.

It is likely that at some of the area shown on Map 18C which is in dispute has a 'Moderate Erosion Susceptibility', either directly from slope instability or indirectly as a result of debris flows and the deposition of material on the flatter foot slopes.

The removal of the ESC from the Natural hazard maps will address the submitter's concerns.

Waitohu Stream Care Group, (Submission 458-9)
Opposes the identification of the areas adjoining the Waitohu Stream as "very high" in terms of its susceptibility to erosion and seeks to have it amended to "moderate".

This submission seeks the same relief as 172-9 R Heerdegen & J Rosier, referred to above. It would appear that the submitter has misinterpreted the 'Urban Relocatable Build' notation on Map 01C as 'Very High Erosion Susceptibility' in which the 'orange hatches' slope in the opposite direction.

The Urban Relocatable Build notation formed part of the Coastal Hazard Management Areas were withdrawn from the Proposed District Plan on 30 October 2014. This should meet the

submitter's concerns. Notwithstanding this, the removal of the ESC from the Natural hazard maps may also address matters of concern to the submitter.

Pope, T. (Submission 547-11)

Supports the Paekakariki Scarp Very High Erosion Susceptibility area indicated on Map 16C but seeks to have the zone amended to extend significantly inland to include all land that is susceptible to slope failure and/or erosion over time back to the angle of natural repose.

The mapping of Erosion Susceptibility ensured that a consistent methodology and analysis was applied across all areas. To maintain this consistency a strong 'scientific' argument would be required for any changes – especially when the requested changes are undefined in spatial extent.

While not addressing the specific concern of this submitter, the removal of the ESC from the Natural hazard maps makes further discussion unnecessary until some land development or subdivision proposal is forthcoming. Given the nature of this terrain, its severe limitations, and the constraints on any development, such a proposal is considered highly unlikely.

6 References

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Bloomberg, M.; Davies, T.; Visser, R. & Morgenroth, J. 2011: Erosion Susceptibility Classification and Analysis of Erosion Risks for Plantation Forestry. Unpublished report produced for the Ministry for the Environment by the School of Forestry, University of Canterbury, Christchurch. 17 May 2011.

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Dymond, J.R., Betts, H.D., Schierlitz, C.S. (2010). An erosion model for evaluating regional land-use scenarios. Environ. Model. Softw., 25(3), 289-298.

http://www.mfe.govt.nz/land/proposed-nes-plantation-forestry (Updated 15/10/2014)

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