

Chapter 3

Land Disturbance Issues

NELSON TASMAN
**EROSION AND SEDIMENT
CONTROL GUIDELINES**

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3 LAND DISTURBANCE ISSUES

3.1 Introduction

Erosion and sedimentation are natural processes which can be accelerated and exacerbated by development, construction, vegetation removal and other land disturbing activities and land uses. Studies have identified sediment yield increases from bare soil during storms of 32 times that of pastoral land and 100 times that of undisturbed or stable areas (Senior, 2003; Hicks, 1994).

Sediment yields can vary greatly depending on site characteristics (Moores, Pattinson, 2008; Larcombe, 2009) and land uses. In particular, one of the greatest impacts of urbanisation on receiving waters can come from soils eroded during urban construction (Williamson, 1993). This erosion can have an enormous impact immediately downstream of new earthworks. Discharged sediment can greatly alter the stream channel morphology and smother aquatic life. Water draining from these catchments can remain very turbid even during low flows.

Table 2 indicated the levels of soil loss that can occur from storm events, the results are for the Auckland region, but similar outcomes could be anticipated in the Nelson Tasman region.

Table 3-1 Annual soil loss in Auckland

ANNUAL SOIL LOSS IN AUCKLAND REGION*

Land-Use	Measured (Tonnes/km ² /year)	Predicted Average Annual Soil Loss (Predicted over 20 year period) (Tonnes/km ² /year)
Pasture	49	46
Market Gardening	49	52
Developed Urban – Industrial	107	100
Developed Urban – Residential	24	24
Earthworks	6,600	16,800

* **Reference:** “Storm Sediment Yields from Basins with Various Land Uses in Auckland Area” – National Institute of Water and Atmospheric Research (July 1994).

The impacts of erosion and sedimentation have been investigated in many countries, over many decades and such impacts have been well studied in New Zealand. There can be economic impacts associated with increased deposition of sediments downstream. Sediments can clog culverts and fill in drainage channels, storm drain systems, estuaries, wetlands, harbours and marina areas. Significant public expenditure is required to maintain these areas. Sedimentation can also damage important fisheries such as Tasman Bay scallops and affect recreational enjoyment of receiving environments (eg swimming and fishing). In addition to economic impacts, there are environmental impacts related to reduction in light penetration due to elevated turbidity and smothering of bottom dwelling aquatic organisms by sediment deposition. These environmental impacts can have wide ranging implications for other species and future generations.

3.2 Erosion and Sediment Processes

There is a direct relationship between erosion and sediment control. Simplistically, erosion is detachment of soil particles from the ground's surface by wind or water. The detached particles become sediment once entrained by water (rainfall or overland flow) or dust when entrained by wind.

Erosion is the process whereby the land surface is worn away through physical, chemical or biological processes resulting in detachment and transport of soil particles.

Sediment is made up of detached soil particles.

Sediment yield is the amount of sediment discharged from a catchment reaching or passing a point of interest in a given period of time. Sediment yield estimates are normally given as tonnes per year or kilograms per year.

Erosion control is stopping the soil particles being detached.

Sediment control is stopping the deposition of eroded soils to an inappropriate receiving environment such as adjacent properties, unique habitats, streams, lakes and Coastal Management area where sediment can cause environmental harm to both habitat and ecology values.

3.2.1 Erosion

Erosion is a natural process and even land covered by native vegetation has erosion including landslides, slips, etc. However, land disturbing activities, including vegetation removal, dramatically increases erosion rates. Natural erosion is generally considered in geological terms (hundreds of years), whilst accelerated erosion from our activities is considered frequently from an annual basis.

Soil erosion is initiated by the impact of raindrops hitting the ground and preventing that erosion is a key element in an overall erosion and sediment control strategy.

The primary means of limiting this erosion is to provide either permanent or temporary vegetative or synthetic cover to dissipate the raindrop impact and reduce soil erosion potential.

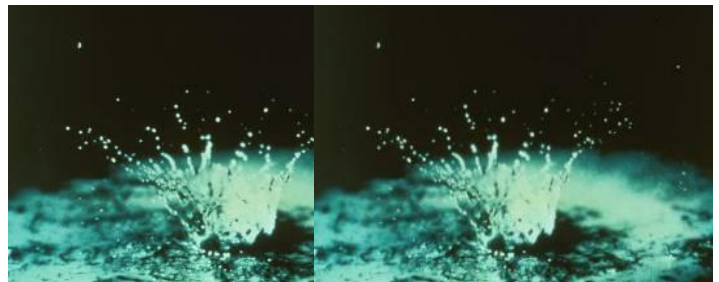


Figure 3-1 Raindrop hitting the ground

Other types of erosion are discussed in section 3.4 and relate to situations once raindrops have hit the ground. They relate to stormwater flow concentration and the impacts that has on sediment production.

Erosion control is the key first step in reducing site erosion and reducing the amount of work that sediment control practices have to do. This is especially true of land disturbing activities in Separation Point Granites (refer section 3.3.2), which are highly erodible due to their lack of cohesion. Erosion control is also an important element in reducing potential erosion due to high winds.

3.2.2 Sediment Control

Sediment control involves the implementation of practices that, in general, promote deposition or sedimentation, in order to prevent sediment leaving the site where they were generated. A basic premise of most sediment control practices is that they slow the flow of water until the sediments, through gravity, fall to the bottom of the water column, where they settle.

If sediment is not captured on-site by sediment control practices, sediment loadings to receiving systems are increased and economic and environmental effects could occur.

There are factors that dictate the potential sediment yield from a site and therefore determine how your site should be managed including the specific selection and design of erosion and sediment control measures.

These factors include:

- Rainfall
- Soils and geology
- Slope length and angle
- Size of disturbance
- Management practice installed.

3.2.2.1 Universal Soil Loss Equation (ULSE) - as a means of estimated sediment yield

The USLE is a simple model originally developed for agricultural practices in the USA. It is a suitable sediment yield estimation tool for activities such as earth working operations.

Rather than providing an accurate estimate of actual total sediment yield the most beneficial use of the USLE is to help identify variations of potential sediment yields across a particular site. It is critical that a site is divided up into logical sectors based on gradient, slope length and surface cover. Other factors are the proximity and nature of the receiving environment. Once completed the USLE will then allow the erosion and sediment control methodology to be tailored to suit the site's variations.

While the overall estimate of yield is indicative of the magnitude of sediment likely to be discharged, the range of assumptions required in the USLE calculation means that it should not be relied on as an accurate assessment of actual total yield.

The USLE is represented by the following equation.

$$A = R * K * (LS) * C * P$$

Where:

A	=	soil loss (tonnes/hectare/year)
R	=	rainfall erosion index (J/hectare)
K	=	soil erodibility factor (tonnes/unit of R)
LS	=	slope length and steepness factor (dimensionless)
C	=	vegetation cover factor (dimensionless)
P	=	erosion control practice factor (dimensionless)

Further information on determining the input factors and using the USLE is provided in Appendix 13.6.

The USLE can be used in a number of ways when developing erosion and sediment control plans:

- To calculate the total estimated sediment yield for a site.
- To identify the sub-catchment areas of a site at greatest risk of sediment generation allowing targeted location of erosion and sediment controls.
- To identify suitable controls and design specifications that will be able to cope with the estimated sediment yields.
- To assess the proposed erosion and sediment controls by comparing calculations – with and without the controls included or with alternative control approaches.

3.2.3 Rainfall

Important aspects of rainfall to consider are the intensity, duration and frequency. Frequent rainfall can result in ground wetness which makes soils more prone to erosion forces. High intensity and long duration rainfall can result in significant levels of erosion, initially from rain drop impact and then from overland flow causing rill, gully and channel erosion.

The Nelson / Tasman District has highly variable rainfall. Annual rainfall can range from approximately 1000 mm/year in the east up to 5 - 500 mm/year in western areas. Rain falls on average between 100 and 150 days per year with higher elevations having up to 200 rain days per year. The highest intensity rainfall events over a short duration (<1 hr) are more likely to occur in summer due to convectional activity but they can occur at any time in any place.

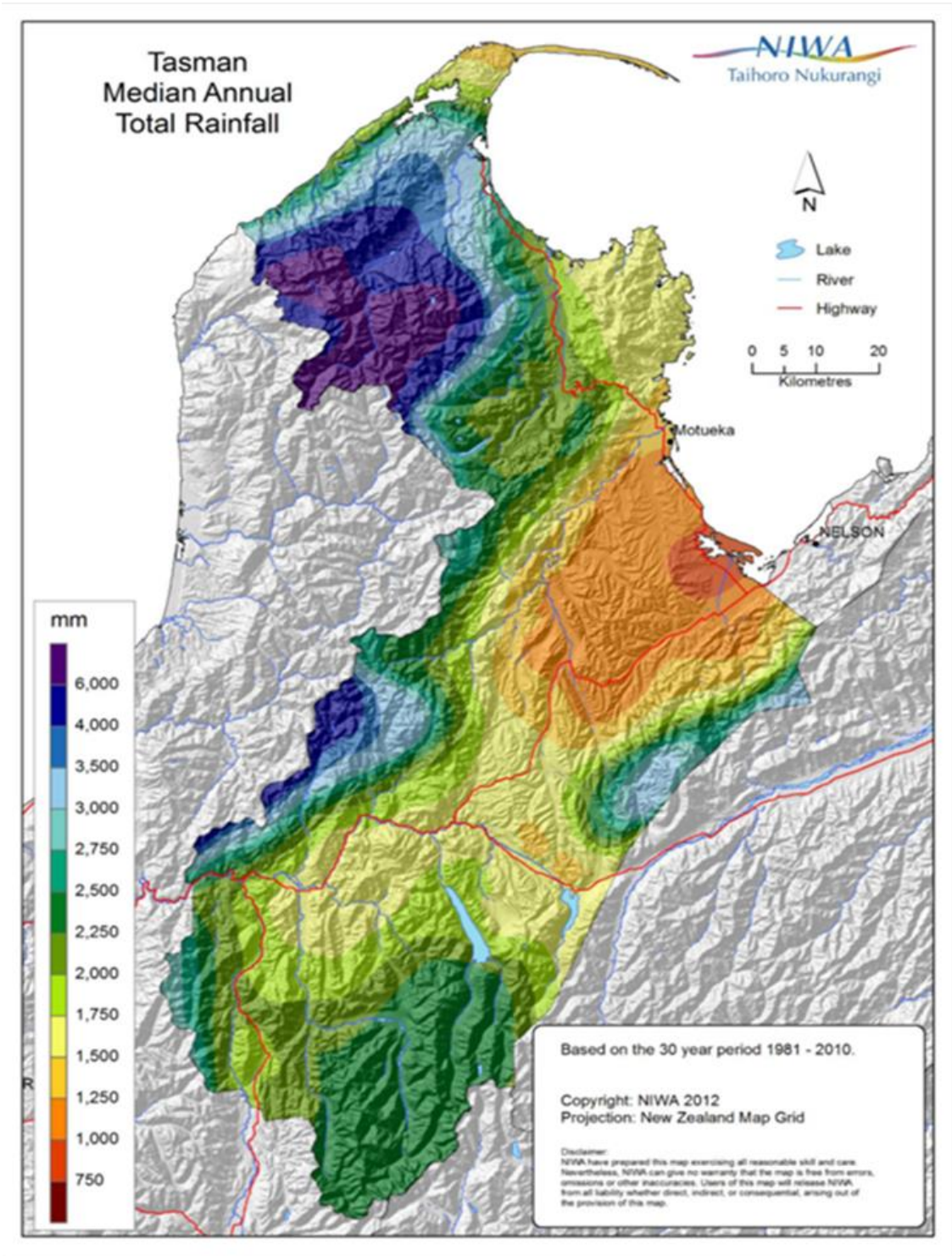


Figure 3 2 NIWA Total Median Annual Rainfall in the Tasman District

3.2.4 Soils and Geology

Many characteristics of soils, including texture, acidity, moisture retention, drainage and slope have an influence on the soils' vulnerability to erosion. The following soil characteristics have primary importance in determining soil erodibility:

- Texture
- Organic matter content
- Structure, and
- Porosity.

3.2.4.1 Soil texture

Soil texture relates to the sizes and proportions of the particles making up a soil. Sand, silt and clay are the three major classes of soil particles. Sand has a coarse texture while silts and clays are fine textured. Soil texture relates to erodibility as sands have a higher infiltration potential and reduce the volume of surface runoff and thus have less erosion. Clays are bound tightly together and resist erosion, but once erosion starts it is difficult to trap these finer soils.

3.2.4.2 Organic matter content

Organic matter is primarily plant and animal litter in various stages of decomposition. Organic matter improves soil structure and increases permeability, water retention capacity and soil fertility. Organic matter, which is primarily found in topsoil, reduces runoff and erosion potential.

3.2.4.3 Structure

Soil structure includes the arrangement of particles into aggregates (groups of particles) and the size, shape and distribution of pores both within and between the aggregate.

There are a number of factors that influence soil structure (Rowell, 1994). These factors include the following:

- Physical processes:
 - Drying and wetting which cause shrinkage and swelling with the development of cracks and channels.
 - Freezing and thawing which create spaces as ice is formed.
- Biological processes:
 - The action of plant roots, which remove water resulting in the formation of spaces by shrinkage, release organic materials, and leave behind organic residues and root channels when they die.
 - The action of soil animals which move material, create burrows and bring mineral and organic residues into close association.
 - The action of micro-organisms which break down plant and animal residues, leaving humus as an important material which binds particles together.

The formation of soil structure thus requires both physical rearrangement of particles and the stabilisation of the new arrangement. Stability is particularly associated with organic materials linking mineral particles together and with clay minerals and sesquioxides (eg Al_2O_3).

Over a period of time loose, freshly cultivated soils consolidate. Consolidation is natural settling due to the force of gravity. A soil under vegetation does not consolidate as its structural stability enables it to withstand natural forces.

3.2.4.4 Porosity

Soil porosity is of vital importance in the ability of soils to support plant, animal and microbial life. The spaces hold water, allow for drainage, allow entry of oxygen and removal of CO₂ from the soil, allow for root penetration into the soil and are indirectly responsible for modifying the mechanical properties of soils.

Soil porosity depends on the structure of the soil. It varies depending on:

- Texture and organic matter content
- Depth in the soil profile
- Management, as this causes changes in organic matter content over time and applies forces to soils which may either loosen or compact them.

Compaction causes a reduction in porosity due to external forces being applied to the soil. The most common examples of compaction are vehicle movement on the soil or under the feet of animals. These restrict the passage of water into and through the soil increasing runoff potential and soil erosion.

Organic matter and the associated biological activity in soils are of major importance in maintaining soil porosity.

3.2.5 Slopes

Key fact:

The erosion of soil from a slope increases as the slope increases and lengthens - **the erosion rate triples as slope doubles** (Senior, et.al, 2003) and erosion rate is 1.5 times when slope length doubles.

Steep slopes contribute a disproportionate level of sediment for the same sized disturbed area on less steep slopes.

Slope length and steepness are critical factors in erosion potential, since they determine to a large extent the velocity of surface runoff. The energy and erosion potential of flowing water increases as the square of the velocity increases.

3.2.6 Size of disturbance

Greater areas of site disturbance increase erosion potential and sediment yield.

At low levels of site disturbance (4-10% of total site area), median sediment loadings are predicted to increase approximately 4-fold over existing land use sediment loadings. However, for maximum disturbance by earthworks (100%) the predicted increases in median loads range from about 40 to over 80-fold (NIWA, 1997).

Removal of vegetative cover, including vegetation and topsoil, increases surface runoff and erosion potential. Vegetation enhances evapo-transpiration, which tends to dry soils out between storm events. Vegetation also has a roughness associated with it which impacts on flow velocities across it.

Table 3-2 (ARC, 2000) shows the increased time that water takes to travel across various surfaces. Longer travel times reduce the potential for erosion of land surfaces.

Table 3-2 Roughness Coefficients for Various Surface Covers and Travel Times

Surface	Roughness Coefficient (unit less)	Travel Time (hours) ¹
Bare soil	0.011	0.014
Pasture	0.13	0.093
Grass (short)	0.15	0.109
Grass (taller)	0.24	0.159
Bush (light understory)	0.40	0.24
Bush (dense understory)	0.80	0.447
1 Assumed 50m length, 12% slope, and 83 mm of rainfall		

3.3 Vulnerable Geology and Soils in Tasman District

Tasman District has a high diversity of geology and soils. While consideration of site geology and soils should be undertaken for all sites, three geologies in particular have been identified as causing specific concern in managing erosion and sediment control.

These are:

- Moutere Gravels (Moutere Clays)
- Separation Point Granites
- Karst Landscapes.

The extent of these geologies is shown in Figure 3-3. Sites within these areas - and in the case of Karst Landscapes, sites draining to this area – need to consider the specific erosion potential and sediment transport characteristics of these geologies and select appropriate site management methods and control practices.

3.3.1 Moutere Gravels

Moutere Gravels (often also referred to as Moutere Clays) are clay-bound gravels capped by strongly weathered and leached soils. The soils are characterised by shallow loamy topsoil that is easily eroded when bare of vegetation. The subsoils are deep clay bound gravels. Whilst they are generally stable disturbed sites can be a significant source of clay particles. Erosion potential is moderate, increasing in severity on steeper slopes.

They cover about 750,000 ha and tend to be located in gently to strongly rolling downs and hill country and they can be found on steep coastal cliffs

Earthworks in Moutere Gravels are to be carefully considered with erosion and sediment control practices used as integral components of the earthworks. Due to the very fine clay particles present in these soils, once eroded the clays are very difficult to trap and therefore flocculation is often required to achieve adequate controls of suspended sediment loads (refer Chapter 9, Section 5). Sites with Moutere Gravels should have the soils subject to a chemical treatment bench test to determine the need for and benefits of flocculation. A focus on minimising erosion when working on these soils will help reduce the need for sediment control.

3.3.2 Separation Point Granites

The Separation Point Granites are a strip of granitic bedrock in the order of 10 kilometres wide that extends for over 100 kilometres from Abel Tasman National Park in the north to Mt Murchison in the south as shown in Figure 3-3. It is sand derived from these rocks that form the golden beaches of Abel Tasman National Park.

At the land surface this rock is deeply weathered. This weathered surface can be up to several metres in depth and is extremely erodible and readily breaks down to its constituent components forming coarse sand. Because of the highly erodible nature of the Separation Point Granites particular care is needed when undertaking any form of land disturbance. It is also important that erosion and sediment controls used in these areas are designed to cope with high intensity storms and maintained so as to remain effective until the site is adequately stabilised.

There are several key points to be considered when undertaking land disturbance in separation point granites:

- Keep disturbed areas small through site staging
- Implement site perimeter controls even in very small disturbed areas
- Site earthworks should avoid concentrating stormwater flows
- Stabilise disturbed areas immediately upon completion of earthworks
- Stage site works to allow for progressive stabilisation
- If site work ceases for more than seven days, temporary stabilisation should be provided.

The extent of the Separation Point Granite terrain is mapped as **Land Disturbance Area 2** in the Tasman Resource Management Plan planning maps. There are specific rules pertaining to land disturbance activities undertaken on this geology.

3.3.3 Karst Landscapes

Karst landscapes are primarily of concern due to their vulnerability to the effects of sedimentation as receiving environments. The impacts of soil erosion and sedimentation in karst landscapes can be severe. These impacts can also occur from works in other geologies that are located upstream or upslope of karst landscapes.

Karst landscapes are a consequence of the presence of soluble bedrock with soil ravelling (collapse into underground fissures and caves) primarily influenced by the intrusion of surface water.

These landscapes are present in parts of Golden Bay, along the Takaka Valley, Takaka Hill and the Arthur Range and south-west of Tapawera around Mt Owen (refer Figure 3-). Many of these areas are held within Department of Conservation land.

From an erosion and sediment control context there are three key issues:

1. The impact that water has on karst landscapes.
2. The impact that sediment entry could have on filling in natural caves, causing drainage changes and subsequent problems.
3. The adverse impact on downstream receiving systems, as contaminants can pass rapidly through the subsurface system with little or no change.

Activities in Karst landscapes (or upstream from karst landscapes) should identify and protect karst features, including streams, sinkholes, springs and cave entrances, from land disturbing and construction activities such as transport of sediment, construction materials, chemicals and equipment into these vulnerable systems. Changes that may alter drainage patterns and concentrate flows should be avoided and vegetation and a no-go buffer should be retained around any sinkhole or cave entrance. Sediment retention and stormwater ponds should only serve small areas and require impermeable liners. Site disturbance should be minimised as far as practicable.

Further information on karst landscapes and managing effects of land disturbance on them is available in section 3.3.

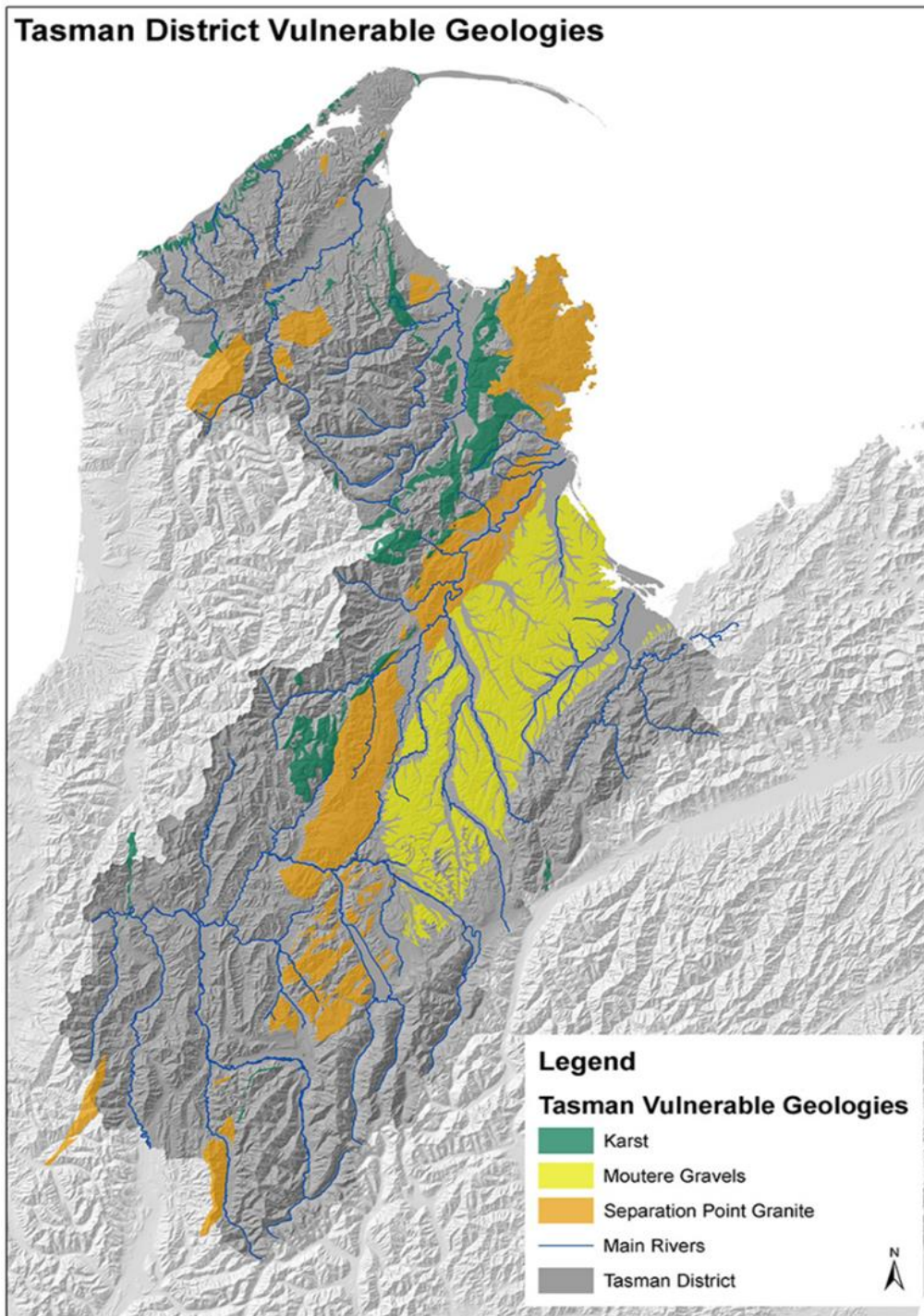


Figure 3-3 Locations of Vulnerable Geologies in Tasman

3.4 Vulnerable Geology and Soils in Nelson District

The Nelson City area is predominantly hilly with only relatively small areas of low-lying land in the valleys of the Maitai, Wakapuaka and Whangamoā rivers, at Stoke and at the head of Nelson Haven. By far the majority of the land area is classified as Class VIe or Class VIIe in the New Zealand Land Resources Inventory worksheets. These classifications describe the land as steep to very steep with erosion susceptibility and past erosion damage as major factors limiting potential land use. In other words, much of Nelson's land area is known to be naturally susceptible to soil erosion.

The NRMP planning maps identify areas of erosion or slope risk through the Land Management Overlay, and Slope Risk Overlays. These are shown in Figure 3-4 below.

3.4.1 Land Management Overlay

The Land Management Overlay defines land that is especially sensitive to activities that cause erosion and sedimentation, particularly vegetation clearance, soil disturbance and earthworks. This tends to be those hill country areas with less stable underlying geology. Other hilly areas with more stable geology is not mapped but erosion and slope stability risk is managed by reference to the predominant slope of the land in the NRMP rules on vegetation clearance, soil disturbance and earthworks, with land with a slope angle of 6 degrees being lower risk, and 6 to 25 degrees low to moderate risk. The Land Management Overlay area is deemed high risk.

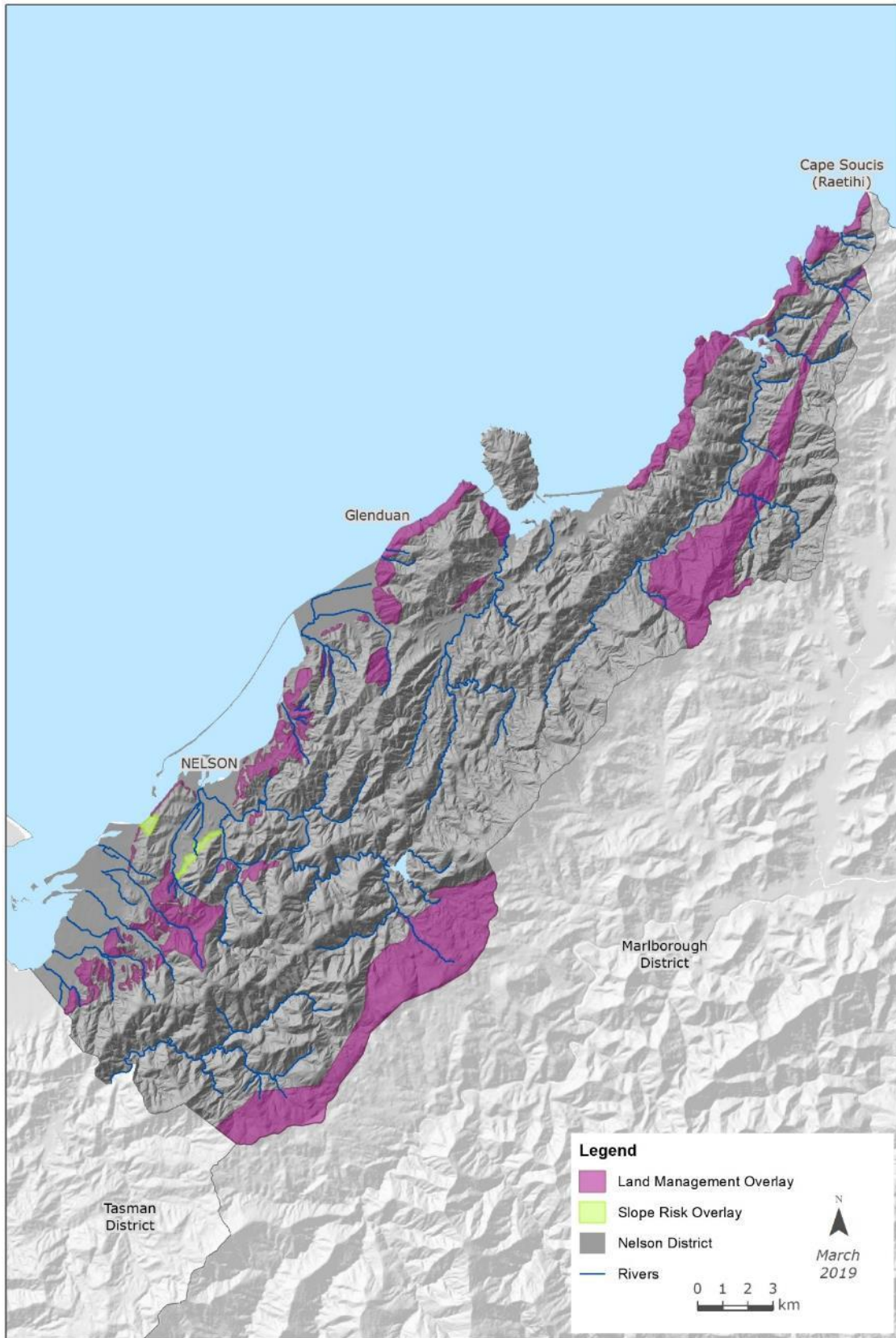
3.4.2 Slope Risk Overlays

There are three slope risk overlays in the NRMP as shown on Figure 3-4. These are the Grampians Slope Risk Overlay, the Tahunanui Core Slope Risk Overlay and the Tahunanui Fringe Slope Risk Overlay. These overlays define two areas where there is a known or potential risk of slope movement or failure. These are differentiated from the Land Management Overlay as the predominant risk is landslide as opposed to erosion.

The Tahunanui Slump Core Risk Overlay comprises the Tahunanui Slump, an active landslide, which is slowly settling with sporadic bursts of more rapid movement. Because of the risk, developments including buildings and earthworks are controlled by the NRMP.

The Tahunanui Fringe Slope Risk Overlay is on the edge of the Core Risk Overlay. It includes the head and side scarps of the landslide along with ground marginal to the scarps, and where earthworks and drainage may impact on the Tahunanui Slump.

The Grampians Slope Risk Overlay extends from the vicinity of Seymour Avenue to Bishopdale and comprises an area underlain by generally weak rocks of the Late Cretaceous and Tertiary periods. There are pre-historic large rotational landslides on localised areas, but current slope movement is ill-defined. The overlay includes stable land whose stability could be threatened by inappropriate earthworks or drainage. All earthworks, other than minor garden landscaping involving cuts of not more than 0.6m in height and fill on any one site of not more than 3m³.



The map is an approximate representation only and must not be used to determine the location or size of items shown, or to identify legal boundaries. To the extent permitted by law, the Nelson City Council, their employees, agents and contractors will not be liable for any costs, damages or loss suffered as a result of the data or plan, and no warranty of any kind is given as to the accuracy or completeness of the information represented. Nelson City Council information is licensed under a Creative Commons Attribution 4.0 International License, and the use of any data or plan or any information downloaded must be in accordance with the terms of that licence. For more information please contact us. Cadastral information derived from Land Information New Zealand. CROWN COPYRIGHT RESERVED.

Figure 3-4 Nelson City Vulnerable Geologies

3.5 Types of Erosion

There are eight main types of erosion associated with land disturbing activities (ARC, 1999):

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Splash 2. Sheet 3. Rill 4. Gully | <ol style="list-style-type: none"> 5. Tunnel 6. Channel 7. Mass movement 8. Wind. |
|--|---|

3.5.1 Splash Erosion

When ground vegetation is removed from an area being earth worked, the soil surface is exposed to raindrop impact.

Some of the splashed particles may rise as high as 0.6 m above the ground and move up to 1.5 m horizontally (Goldman, Jackson, Bursztynsky, 1986).

When raindrops hit bare ground, the soil aggregates are broken up and soil structure is destroyed.



Figure 3-5 Schematic of Raindrop Splash

3.5.2 Sheet Erosion

Sheet erosion is caused by water sheeting across the soil surface. Sheet flow itself generally isn't the means of erosion but the flow conveys soil particles that have become detached through splash erosion.

When rainfall intensity exceeds the soils ability to absorb the rainfall overland flow is initiated. Initial runoff tends to be in the form of sheet flow, where the runoff is in a shallow dispersed flow where there is no concentration of flow. It can be a significant erosion process as it can cover large areas.

The shallow flow rarely moves more than a few metres before the onset of flow concentration due to surface irregularities.



Figure 3-6 Sheet Erosion into an Estuary

3.5.3 Rill Erosion

Rill erosion is the transition area where sheet flow becomes concentrated flow. At this point, the velocity of flow increases and is accompanied by increased turbulence. The energy of water is increased as the flow depth increases, and this provides greater ability to detach and convey soil particles. Rills are small but well-defined channels that may be only 10-20 mm deep.



Figure 3-7 Rill Erosion on a Highway Embankment

3.5.4 Gully Erosion

Gully erosion is a complex process that is not fully understood. Some gullies are formed when runoff cuts rills deeper and wider or when the flows from several rills come together and form a larger channel. Gullies can erode in both uphill and downhill directions (Goldman, Jackson, Bursztynsky, 1986).

The following are the processes which act in the formation of gullies:

- Waterfall erosion at the head of a gully
- Channel erosion
- Raindrop splash
- Diffuse flow from the side of the gully or from seepage, and
- Slides or mass movement of soil within the gully.



Figure 3-8 Gully Erosion - photo courtesy of BOPRC and Ridley Dunphy Environmental

A gully may develop and grow rapidly, and their formation may generate a considerable amount of erosion.

3.5.5 Tunnel Erosion

An important way that tunnel erosion occurs in the Tasman District is in Karst (limestone) areas where water dissolves the limestone and creates underground flow paths.

Further discussion of Karst landscapes is provided in Section 3.3.3 and Chapter 4, section 3.

In other areas, runoff which flows directly into the subsoil via surface cracks, rabbit burrows, or old root holes may cause erosion. Once formed, tunnels continue to enlarge during subsequent wet periods. Eventually tunnels reach a point where the roof collapses resulting in sinkholes or the formation of gullies. Tunnels may range in size from a few centimetres to several metres in diameter.



Figure 3-9 Tunnel erosion

3.5.6 Channel Erosion

Channel erosion is a major source of sediment nationwide. The erosion of channels results from the conveyance of concentrated flows, whose velocities scour the channel boundaries. Channel erosion is a natural occurrence, but accelerated channel erosion is caused by a change in land use that increases the volume and rate of stormwater runoff.



Figure 3-10 Channel Erosion

3.6 Mass Movement

Mass movement is the erosion of soil or rock by gravity-induced collapse. It is usually triggered by groundwater pressure after heavy rain, but can also have other causes, such as stream bank undercutting or earthworks undercutting the base of a slope. Movement can be either rapid and near instantaneous or slow and intermittent. Earth and soil slip movement are also often noted after the removal of vegetation from critical slopes associated with earthworks (ARC, 1999).

Mass movement can cause major problems on earthworks sites and geotechnical investigations should be undertaken where possible to avoid critical slope failure.

3.6.1 Wind Erosion

Strong winds can occur at various times of the year in Tasman. Most areas can also be subject to wind erosion during times of drought. Wind erosion effects can occur during horticultural planting times and on earthwork sites when areas have been cleared of vegetation and soil moisture deficits allow for transport.

There are three ways that soil moves due to wind:

1. Suspension
2. Creep or
3. Saltation.

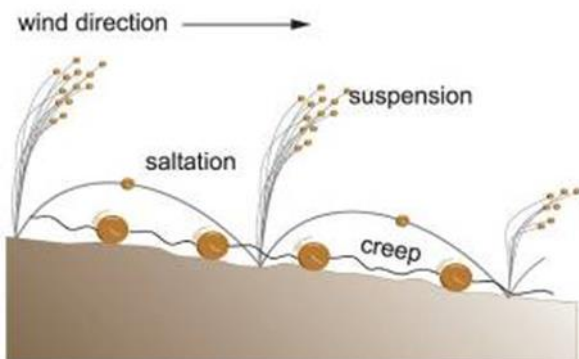


Figure 3-2 Schematic of Types of Wind Erosion



Figure 3-11 Mass Slumping in McConnon Creek Catchment



Figure 3-12 Wind Erosion on Ruby Bay Bypass

3.6.2 Other existing soil contaminants

In addition to contaminants from construction equipment and materials, land disturbance can mobilise existing contaminants already in the soils present on site.

Land previously used for horticulture can contain pesticides (eg DDT), fungicides and herbicides. Former orchards can contain copper sulphate, timber treatment sites can contain arsenic, chromium and copper, and sites with underground tanks can contain hydrocarbons.

The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES-SC) identifies the permitted or consent status for activities on contaminated soil, including removing or replacing a fuel storage systems, sampling the soil, **disturbing the soil**, subdividing land, and changing the use of the piece of land. The NES-SC covers land where activities included on the Ministry for the Environment's Hazardous Activities and Industries List (HAIL) have been or are being undertaken (refer to the NES-SC for full wording).

The NES-SC also identifies the two methods by which a person (at their own cost) may establish whether or not a piece of land is covered by the NES-SC, namely:

- 1) "By using information that is the most up-to-date information about the area where the piece of land is located that the territorial authority:
 - a) holds on its dangerous goods files, property files, or resource consent database or relevant registers; or
 - b) has available to it from the regional council.
- 2) The other method is by relying on the report of a preliminary site investigation:
 - a) stating that an activity or industry described in the HAIL is, or is not, being undertaken on the piece of land; or
 - b) stating that an activity or industry described in the HAIL has, or has not, been undertaken on the piece of land; or
 - c) stating the likelihood of an activity or industry described in the HAIL being undertaken, or having been undertaken, on the piece of land.

A preliminary site investigation is defined in the regulations as an investigation that:

- (a) *is done by a suitably qualified and experienced practitioner; and*
- (b) *is reported on in accordance with the current edition of Contaminated Land Management Guidelines No. 1—Reporting on Contaminated Sites in New Zealand, Wellington, Ministry for the Environment; and*
- (c) *results in a report that is certified by the practitioner."*

A preliminary site investigation would initially be a desktop study that would include a site history, site visit and discussions with Tasman District Council and Nelson City Council. The results of this would determine the need for more intrusive site testing.

(Note: in Nelson and Tasman the Councils have both territorial and regional authority functions).

3.7 Nutrients

Nutrient discharges are closely related to sediment discharge levels as water discharging from construction sites carries both soil and nutrients that naturally occur in the soil. Soil nutrients can include the following elements that are necessary for normal plant growth: Potassium, Magnesium, Phosphorus, Calcium, Nitrogen and Sulphur. Generally, nitrogen has the greatest levels in soil.

Excess nutrients in receiving water bodies can cause algal blooms, lowering of water oxygen levels affecting aquatic life and creating nuisance odours.

3.8 Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are found in the asphalt and tar used in road construction and repair and as by-products of fuel burning. It is possible for PAHs to leach into sediment and runoff during rain events. As a pollutant, PAHs are of concern because some compounds have been identified as causing cancer, mutations and birth defects (carcinogenic, mutagenic, and teratogenic) and some can build up in the tissues of people and wildlife (bioaccumulate).

3.9 Metals

Metals can be present on site naturally within soils (in particular in ultramafic soils in the Richmond Ranges), from previous soil contamination (eg orchards, sheep dips, etc) or from materials used onsite (eg zinc roofing, agrichemicals).

Metals are of concern as in sufficient concentrations they can cause acute or chronic poisoning and a wide range of adverse health effects. In addition, some metals bioaccumulate – meaning they increase in concentration in a biological organism over time, compared to the concentration in the environment. This is of particular concern in areas used for food gathering – for example in estuaries where shellfish may become toxic.

Metals in soils are often bound to fine sediments and therefore minimising fine sediments in runoff may reduce total metals concentrations being discharged.

3.10 Non-sediment contaminants

In addition to sediment, some land disturbing activities, in particular construction, can contribute other contaminants to receiving systems, impacting human health, water quality and aquatic wildlife. The control of non-sediment contaminants should also be considered on individual projects, especially if fuel or other potential contaminating materials are stored on site. The same practices that are used for controlling sediment may provide for control of non-sediment contaminants, but each site should consider the range of potential contaminants that will be present to ensure that the required controls are in place and there is no inappropriate discharge.

3.10.1 Construction Materials

Construction can involve the use of a wide variety of materials with the potential to produce metal, wood, plastic off cuts and other debris that can be blown or washed downstream if not properly managed.

Cement is probably the single most important non-sediment contaminant discharged from building sites. In addition, chemicals associated with construction materials, machinery and equipment (such as creosote, chromium and arsenic treated wood, paint, adhesives, solvents and vehicle oils, fuel and grease) can leach or wash from equipment and materials during storm events. Asphalt and concrete contain chemicals that can alter pH or have toxic effects to aquatic organisms. In addition, commonly used landscaping and farming materials such as fertiliser, mulch, lime and pesticides can contribute nutrients, oxygen-demanding material and toxic contaminants.

3.11 Sediment Transport Pathways

The ways in which sediment can move off site and the proximity of the disturbed area to a receiving system are vital when considering the possible impact that site works can cause. Key ways that sediment can move across and off site include (refer 3-14):

- Wind blown
- Overland flow
- Concentrated flow - such as in streams
- Vehicle movements – in particular via wheel treads
- Physical dumping (both legal and illegal)
- Stormwater pipes and structures, or
- Natural features such as karst sinkholes.

Some pathways transport sediment more rapidly than others providing less opportunity for deposition to occur prior to discharge. For example, having unprotected stormwater drains on site would allow for almost 100% delivery to the receiving environment.

In a similar fashion, where the disturbed land activity is near or adjacent to the receiving environment there is little buffering available, and sediment can be transported rapidly.

Identification of all potential pathways is necessary to provide context on potential receiving system impacts and assist in developing effective erosion and sediment control plans with appropriate controls located in appropriate places.

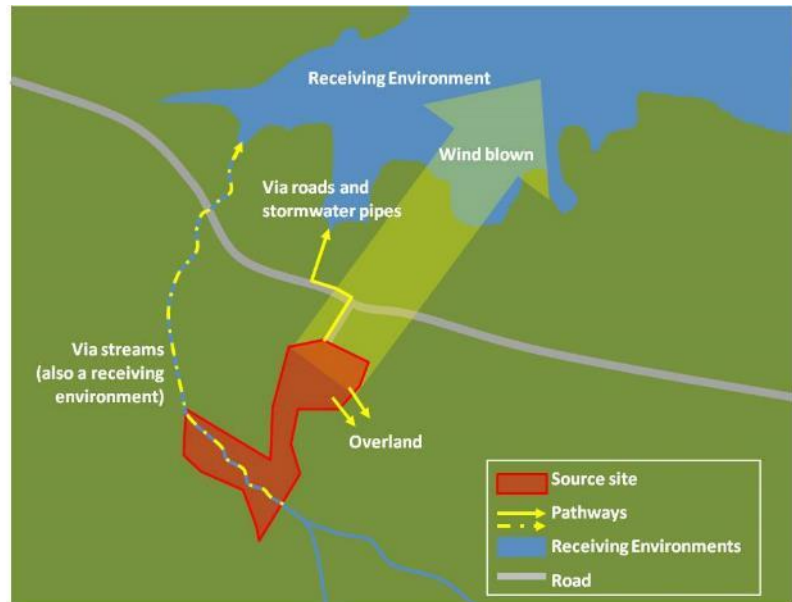


Figure 3-14 Source, Pathway and Receiving Environment