Chapter 4

Receiving Environments

NELSON TASMAN
EROSION AND SEDIMENT CONTROL GUIDELINES
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4 RECEIVING ENVIRONMENTS

Understanding where water goes and the sensitivity of receiving environments will assist in determining requirements for erosion and sediment control for land disturbing activities and also help determine risk. Receiving environments have value, are vulnerable and require a greater level of protection than has previously been afforded.

Receiving environments from an erosion and sediment control perspective include the following:

- Adjacent properties
- Infrastructure – such as the stormwater pipe network and roads
- Karst landscapes and cave systems;
- Streams and Rivers
- Wetlands
- Lakes, farm ponds and dams
- Estuaries
- Coast; and
- Visually Significant Landscapes.

Each of these environments are discussed in the following sections.

In addition to ecological values, with all receiving environments there is potential for human interaction, whether this is for recreational purposes, water use or food gathering. Understanding who the potential users of receiving environments are should be included when considering the potential for adverse effects on a receiving environment.

4.1 Adjacent properties

Sediment, dust or sediment laden runoff can exit a property and be deposited on adjacent land, including neighbouring private properties, public roads and reserves. The adjacent land can be considered a receiving environment. When undertaking land disturbance, minimise any potential adverse impacts to adjacent land. Discharges to neighbouring properties are a common source of complaint.

Note: Good practice for erosion and sediment control still needs to be undertaken within your own property boundaries.

Dust from land disturbing activities can cause:

- Respiratory health issues
- Contamination of roof water supplies
- Crop damage
- Adverse visual effects
- Widespread nuisance.

Key elements to minimising land disturbance effects on adjacent properties include:

- Know your property boundaries.
- Understand who your neighbours are, and how erosion, sediment and dust from your site might affect them.
- Understand the sediment transport pathways for how sediment or dust may move off your site (refer Chapter 3, section 3.11) and implement appropriate controls.
- Monitor the weather forecasts and dampen down or cover exposed areas if winds are forecast, check all controls and transport pathways if rainfall is forecast.
- Check your boundaries with adjacent properties regularly, particularly after heavy rain, and if sediment has deposited assess likely remedial actions.

4.2 Infrastructure

4.2.1 Roads and Stormwater Networks

Deposition of sediment onto roads and footpaths causes a nuisance to users, can be a safety issue, and during storm events these sediments can enter the stormwater system, potentially clogging parts of the network causing flooding or discharging into local streams and coastal environments.

Key elements to minimising land disturbance effects on infrastructure include:

- Understand the sediment transport pathways for how sediment or dust may move off your site and into infrastructure networks (refer Chapter 3, section 3.11) and implement appropriate controls.
- Identify and protect all existing and new stormwater reticulation on site to avoid discharge of sediment to these networks.
- Check your boundaries with roads and footpaths regularly and remove any sediment discharged from your site promptly.
- Inspections of site vehicle access points should be made at least at the end of each working day and roads and footpaths cleared of any sediment dropped from vehicles leaving your site. Review management of your vehicle access if vehicles are tracking sediment onto roads (eg renew aggregate protection or install a wheel wash if appropriate).

4.2.2 Protection of on-site stormwater management devices

Where stormwater management devices (eg wetlands, swales, raingardens, filters, etc) are to be used permanently on site for stormwater management, it is vital that these are protected from excessive sediment discharge while construction activities are continuing in their respective contributing catchments.

This is a particular issue where Low Impact Design (LID) stormwater devices have been installed in subdivisions that then have individual site developments, which can cumulatively affect the functioning of the devices.

Figure 4-1 Rain garden construction: sediment entry is compromising future performance due to clogging

The party responsible for the LID device (usually the subdividing developer or the Council) needs to ensure the devices are protected from sediment generated by individual building sites and any other land disturbance occurring in the contributing catchment. Individual site developers should also be managing their sites to ensure sediment does not travel off site.

Use of LID devices as sediment controls during construction is not an acceptable practice unless those devices have been specifically designed for use during ongoing construction and they are reinstated once land disturbance has ceased to effectively perform their intended ongoing stormwater management function.

Failure to adequately protect devices may result in the need to reconstruct or clean out devices before they can be used to manage onsite stormwater. At subdivision stage LID device owners should consider including instruments on property record of titles (eg consent notices) to require future site developments to ensure protection of these devices.

4.3 Karst landscapes and cave systems

Karst 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 (Figure 3.3). Karst systems are vulnerable to land disturbance of any type that allows mobilised sediment to enter the system.

Karst topography is characterised by subterranean limestone ($CaCO_3$) caves and surface features carved by rain and groundwater. These areas have unique ecologies, both above and below the ground. Often the linkages of subsurface cave systems and surface features is not well known and impacts from land disturbance may have unforeseen impacts in unexpected ways.

Figure 4-2 Sinkholes in farmland, Golden Bay (Photo D. Shaw)

Within karst landscapes there is clear evidence that alteration of vegetative communities of any sort can lead to substantial and potentially irreversible impacts on the karst processes operating in that area (Urich, 2002).

Problems in karst areas can also result from transport of sediment from upslope non-karst catchment into a karst landscape.

Figure 4-3 Sinkhole in Pohara, Golden Bay draining a waterway from a residential subdivision (Photo: G. Stevens)

Environmental issues related to land disturbance in karst terrains include:

- Soils in karst terrains are moderately-well to well drained, and there is little surface runoff. Rainwater is diverted underground through sinkholes and/or by diffuse recharge through the overburden into numerous small fractures in the limestone.
- Contaminants can pass rapidly through the subsurface system with little or no modification other than dissipation.
- Long residence times, confined aquifers and lack of natural filtration create special needs regarding groundwater protection in karst, particularly where groundwater resources are used by local communities.
- Karst ecologies include rare and unusual species which can be very sensitive to changes in water flows and water chemistry that can result from sediment deposition (Richards 2003).
- Accelerated erosion and changes to water flow paths can result in flooding, subsidence or ground collapse of surface areas (Richards 2003).
- Karst landscapes often include areas that are of particular cultural and spiritual significance, as well as recreational importance eg Harwood Hole on Takaka Hill.
- Many subterranean karst systems are uncharted and sediment inputs may have unanticipated impacts on unexpected areas.

Key elements to managing land disturbance on karst landscapes or areas that drain to karst landscapes include:

- Identify all streams, sinkholes, springs or cave entrances on site and include these on any sediment and erosion control plans
- Minimise site disturbance and changes to soil profile, including minimising cuts, fills, excavation and drainage alteration
- Where possible, runoff should be maintained as sheet flow to avoid it becoming concentrated, with flows dispersed over the broadest area possible to avoid ponding, concentration or soil saturation
- Avoid changing flow patterns and volumes entering subterranean systems (eg via sinkholes). Do not direct stormwater into caves/tomos/sinkholes – whether open or closed
- Retain and enhance vegetation within and near sinkholes, springs, and cave openings to help reduce sediment movement into karst water bodies and help protect ecologies in these areas
- Install erosion and sediment controls around staging areas to prevent discharge from these sites.

- Sediment retention ponds should only be used as a last resort after all other sediment control options have been considered. In instances where they are employed, they should serve small catchment areas (< 2 ha), be lined with an impermeable liner to prevent or minimise infiltration and be located away from karst features.
- Keep the following activities away from karst features such as any stream, sinkhole, spring or cave openings:
  - Staging areas for crew
  - Equipment and refuelling of construction equipment
  - Stockpiling
  - Hazardous materials, chemicals, fuels, lubricating oils
  - Application of fertilizers, herbicides, pesticides, or other chemicals
  - Storage of construction waste materials, debris, and excess materials
  - Waste lagoons, septic systems, or storm water ponds (impermeable liners are likely to be needed)
- Contact Council if karst features, such as sinkholes, springs, and cave openings, are discovered on the project site during any aspect of project implementation for further evaluation to determine how the feature's value should be protected.
- Remove and dispose of all debris and excess construction materials properly upon project completion.
- Revegetate all disturbed areas as soon as possible and evaluate the establishment of vegetation after project completion.
- Retain sediment control structures until permanent site stabilization is completely achieved. Refer also Chapter 3, section 3.3.3.

Note: the discharge of soil, vegetation, effluent, refuse, offal, debris or stormwater into open sinkholes does not meet permitted activity rules and will require resource consent approval.

4.4 Streams and Rivers

Tasman has many different types of rivers and streams, including hill fed, lowland fed and spring fed (from both karst and gravel aquifer systems).

Streams and rivers can be identified with the following flow qualities:

Ephemeral (flowing only during or immediately after rainfall).

Intermittent (flows for part of the year, often dependent on groundwater conditions).

Perennial (flowing the majority of the time).

They can also be highly modified and be referred to as 'drains', having been straightened, channelised, diverted and stripped of vegetation (refer Chapter 11, section 2 for further discussion on this issue).

It is important to think of rivers and streams as both receiving environments and as potential sediment transport pathways to other receiving environments. Further information on undertaking activities in or around watercourses is available in Chapter 11.

4.4.1 Intermittent streams

Streams that stop flowing for a significant amount of time (weeks or months) during a normal year are classified as intermittent. They generally fall into two types (NIWA 2007):

1. Small streams at the very tops of headwaters which go dry as the stream network contracts during the dry season.

2. Larger 'mid-reach' streams or rivers may have permanent flow in their headwaters but lose water when they cross an area where the water table sometimes falls below the level of the stream bed.

Tasman has many intermittent streams. For example, many hill-fed streams in the Moutere area and mid Takaka Valley tend to have an intermittent or ephemeral flow, especially if the wetlands that once existed in the valleys have been removed. Borck Creek west of Richmond has intermittent flow in its mid reaches where it crosses over gravel deposits.

Intermittent streams often still have a well-defined bed with exposed aggregate (cobbles etc) as seen in the photos in Figure 4-4. In some cases, if no-flow periods are prolonged, fast growing plant species may colonise the bed.

Intermittent watercourses typically have ecologies suited to the intermittent nature of the water flow and can provide habitat for some rare and unique stream species. Aquatic species that rely on intermittent stream areas may utilise a number of refuges during dry periods including burrowing into the bed, surviving in the groundwater below the bed or migrating to nearby flowing sections. Riparian vegetation is particularly important in protecting many of these refuges and their dependent ecologies during dry periods (NIWA 2007).

Figure 4-4 Intermittent Streams in Tasman

4.4.2 Hill Fed streams

Just over half the streams in the Tasman district have their source of flow in hill country and a quarter of the streams are fed by mountainous areas (>1000m high).

Streams in upper catchments tend to be in the form of a series of riffles and pools. The riffles and pools, in conjunction with woody vegetation form the primary habitat for aquatic life.

Figure 4-5 Riffle and pools in an upper catchment stream

Hill fed streams can experience high sediment inputs due to the steepness of adjacent slopes, particularly in areas with readily erodible soils, however they are not as vulnerable to settlement of sediments as water velocities are higher. These streams can act as transport pathways to downstream, lower velocity water bodies where sediments settle out. Control of erosion is therefore important in hill areas flowing into streams.

4.4.3 Lowland fed streams

Approximately a quarter (24%) of the streams in Tasman are lowland-fed. There are relatively few soft, or muddy, bottomed streams, but the lower gradient portion of smaller catchments in the Moutere Hill country (in Moutere Gravels) tend to be muddy bottomed due to flatter slopes and less erosion energy to ream out the fine sediment.

Lowland streams can have slower moving water allowing greater deposition of sediments from both local and upstream sources. To an extent, sediment accumulation in streams of the lower floodplains is natural. However, this was greatly accelerated by forest clearance over the last two centuries and many streams continue to be under pressure from rural and urban sediment sources. Lowland streams provide habitat to species such as short-fin eels adapted to these conditions.

Small lowland stream ecosystems are more vulnerable to sediment effects than larger rivers and sediment impacts are greatest at times of low flow.

4.4.4 Spring fed streams

The spring-fed streams in Tasman have both karst and alluvial aquifer sources. There is karst fed streams in the Takaka and Riwaka areas (Waikoropupu springs being one of the most famous) and alluvial aquifer fed streams in lower Takaka (Motupipi), Murchison Creek, Motueka, Tapawera, Kohatu and the coastal creeks in the Waimea Plains.

Spring-fed streams are the most vulnerable stream type to sedimentation due to the absence or infrequent nature of floods that would flush out the sediment.

4.4.5 Tasman River Water Quality

Many rivers in Tasman are known for their excellent water clarity (eg Waingaro River, Upper Motueka, Upper Matakitaki and Riwaka). Average base-flow water clarity across the district ranges between 2 and 8m, with water clarity over 60m at the Waikoropupu Springs in Golden Bay.

The poorest water clarity in Tasman is found in small farmland streams, particularly those in the Moutere hills due to the type of clay soils and the associated land uses.

There are a large number of karst springs in the Tasman District that have good water clarity, particularly in Mt Arthur marble country (eg Pearse River Resurgence). The alluvial spring sites such as Motupipi River and Murchison Creek would also be expected to have high water quality, but activities in the catchments of these streams are reducing water clarity.

About 30% of the Council’s river water quality monitoring sites in developed catchments have water quality that is either moderately or severely degraded. These streams are often in smaller catchments and in urban areas where streams can contain heavy metals and elevated sediment, or in agricultural catchments where vegetation clearance and land development has caused increased water temperatures and greater accumulation of silt on the streambeds.

It is important to protect those streams with good existing water quality, as well as avoid exacerbating the situation in those with degraded water quality.

4.4.6 Tasman Aquatic Species

Twenty species of native fish exist in Tasman, most of which are nocturnal. This variety of fish makes the regions freshwater fishery one of the most diverse in New Zealand. Sediment discharges and habitat degradation (particularly from infilling the bed matrix) are regarded as major reasons for the decline in the diversity of native fish populations in pastoral and urban streams (Joy, 2009).

Excess sediment can also profoundly affect the productivity of salmon and trout streams impacting the recreational use of these fisheries in Tasman. Sediment affects spawning grounds by impeding sub-gravel flows and smothering eggs, as well as clogging habitat sites and reducing food sources.

Figure 4-6 Fly Fishing on the Motueka River (credit B. Smithies)

Figure 4-7 Examples of some of the Aquatic Species in Tasman District Streams

4.4.7 Impacts of Sediment on Rivers and Streams

The three keyways in which land disturbance and sedimentation can adversely affect rivers and streams are:

1) Habitat degradation or destruction.
2) Waterway channel capacity reduction, and
3) Water quality degradation.

Streams and rivers can be considered stable if the banks are relatively stable and the water flow and sediment load are in balance. Occasional periods of high levels of suspended solids (turbidity) or long durations of moderate suspended solids and the resulting deposited fine sediment can adversely affect physical stream habitat and food resources for stream invertebrate and fish communities. Unlike contaminants such as nutrients, the ecological response to fine sediment discharges is almost always adverse right from small concentrations (Quinn 2000).

The adverse impacts of sediment discharges on stream habitats, aquatic plants and animals have been extensively studied. The key impacts of sediment in stream and river environments are:

- Destroying aquatic habitat by filling in pool areas making the stream bottom homogeneous with little habitat diversity and limiting the types and abundance of aquatic animals and plants the waterway can sustain
- Reducing flow carrying capacity, potentially increasing flooding risks, as the stream cross-sectional area reduces due to deposition in the stream bottom
- Smothering of bottom dwelling organisms where sediment deposition occurs faster than they are able to cope with (even within low energy muddy bottomed stream reaches) - usually in the order of a 20% increase in fine sediment in the bed.
- Scattering and absorbing light, reducing light available for photosynthesis by aquatic plants and making it harder for predatory macroinvertebrates and fish to see their food
- Damage to fish and macroinvertebrate food supplies due to the destruction and degradation of biofilms on stream bed substrates and the filling of streambed features, such as crevices and interstitial spaces, where organic matter would normally collect
- Damage to the fine gills and mouth parts of macroinvertebrates and fish due to the abrasive suspended sediment and stressing of animals affecting growth and mortality rates
- Impacts on the reproduction of fish species by inhibiting the annual colonisation of headwater streams by migratory and juvenile fish and the destruction of developing eggs and newly hatched fry by shifting sediment in pools and runs.

The flow-on effect of degraded stream habitat and poor food resources in a stream is usually seen throughout the food web. Invertebrate abundance is reduced along with a change in stream invertebrate community composition; this then also impacts other species up the food chain.

Figure 4-8 provides a general indication of the impact increased turbidity has on aquatic resources (NIWA, UW ERC 2010). This illustrates increased effect with higher levels of turbidity and in particular for longer periods of time.

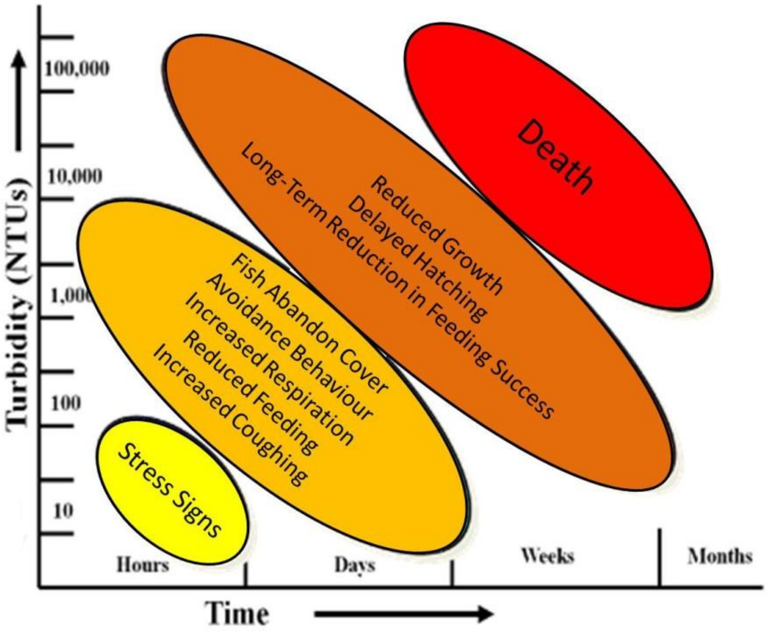

Figure 4-8 Impacts of Turbidity and its Duration on Aquatic Resources

4.4.8 Managing erosion and sediment impacts on rivers and streams

Key elements to managing land disturbance impacts on rivers and streams include:

- Understand where the streams and rivers are on your site, including both low flow channels and flood flow channels. Include these with your Erosion and Sediment Control Plans. Don't forget ephemeral channels and gullies – these can be important sediment transport pathways
- Understand what fish species might be present at your site. This will provide information on fish passage requirements, as well as assisting in determining appropriate times of the year for undertaking works in or around watercourses (refer Chapter 11 and Appendix 13.8).
- Ensure that in both low flow and flood flow areas that exposed earth is minimised and no stockpile storage occurs.
- Separate watercourse areas from land disturbance activities by appropriate sediment controls.
- Treat all watercourses – including highly modified drains and small watercourses- as both receiving environments and potential sediment transport pathways to other receiving environments downstream.

Note: resource consent may be required for works in or around rivers and streams (refer Chapter 11 on activities in and around watercourses).

4.4.9 Water Conservation Order Areas

Two Water Conservation Orders have been issued for watercourses in the Tasman District. They are for the Buller River (2001), and the Motueka River (2004).

Both rivers are relatively intact by New Zealand standards and have a diversity of sub-catchments, gorges, lakes and tarns supporting a nationally significant native fishery and sports fishery.

In the case of the Buller River, Lake Rotoiti, Lake Constance, and Lake Rotoroa have been identified as waters to be retained in their natural state. Lake Matiri has been identified as protected waters.

The purpose of these two orders is to protect the outstanding characteristics and features of waters including:

- Outstanding recreational characteristics
- Outstanding wild and scenic characteristics
- Outstanding fisheries or wildlife habitat features, and
- Outstanding scientific values.

Due to their outstanding characteristics the orders identify the following for individual components of the two watercourses:

- Waters to be retained in natural state
- Waters to be protected
- Restrictions on damming of waters
- Restrictions on alterations of river flows and form
- Restrictions on alteration of lake levels
- Requirement to maintain fish passage, and
- Restrictions on alteration of water quality – including those associated directly with sediment discharges.

The orders clearly highlight the importance of these two catchments and the orders need to be reviewed for projects contained in the Buller or Motueka catchments for requirements in specific areas. Discuss with Council staff before commencing any land disturbance work in these sensitive receiving environments.

4.5 Wetlands

Wetlands mostly occur where the groundwater table is close to or at the ground surface or where stream flow enters a flat area and water tends to pond. Wetlands are some of the most productive environments in the world, particularly in terms of species diversity and growth rates.

The TRMP and the NRMP define a Wetland as ***–'permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions'.***

A wetland could be a lagoon, salt marsh, bog, fen, swamp, shallow lake, margin of a river, and could even include some mature farm drains and dams. The look of a wetland and its mix of plants and animals will vary with local conditions (for example climate, water flow, altitude and substrate). Several different types of plant and animal communities may be present in larger wetlands, and all wetlands change over time.

Wetlands may provide:

- Flood retention and protection
- Water quality benefits
- Important nursery and feeding grounds for fish, birds and invertebrates
- Wildlife habitat
- Amenity and landscape value Important social and recreational values (eg for fishing, boating, walking)
- Important cultural values to Maori, providing traditional sources of food, plants for weaving, medicines, and taonga sites.

Wetlands provide the greatest concentrations of bird life of any habitat in New Zealand and support far more species than a comparable forest area. Migratory species depend on wetlands of suitable size, often linked to other important habitats by intact corridors.

In addition to values for birds, native fish also need wetlands. Eight of New Zealand's 27 fish species are found in wetlands while the whitebait fishery depends on spawning habitat offered by freshwater wetlands.

Wetlands are found across the District, from the mountain ranges to the coast, however more than 90% of Tasman and 99% of Nelson District's natural, lowland wetlands have gone, especially those in the lowland areas of Moutere, Motueka, Golden Bay and Waimea. In respect of private land in the Motueka and Waimea areas, 95-97% of wetlands have disappeared (TDC 2005). Few large wetlands remain and of the remaining wetlands, more than half are less than 0.5 hectares in size or are not naturally occurring.

Most of the remaining wetlands in the lowland areas below 100 metres above sea level are in private ownership and are vulnerable to economic pressure to develop land. Infilling and increases in sediment inputs are two of the key threats to these wetlands. It is vital that remaining wetlands are protected from degradation.

Key elements to managing land disturbance impacts on wetlands include:

- Understand where the wetlands are on your site, as well as downstream of your site, some wetland areas may not be immediately obvious due to degradation through grazing and vegetation removal, however given a chance these areas can regenerate or be restored. Identify these on your erosion and sediment control plans.
- Separate these areas from land disturbance activities by appropriate sediment controls.
- Ensure that no stockpile storage occurs within wetland boundaries or where sediment may enter wetlands.
- Avoid machinery and stock gaining access to wetland areas.
- Wetlands often flow to other areas, treat all wetlands – even modified ones, as both receiving environments and potential sediment transport pathways to other receiving environments.

Note: Resource Consent may be required for works in or adjacent to wetlands.

4.6 Lakes, farm ponds and dams

The TRMP defines a lake as – ***'a body of fresh water which is entirely or nearly surrounded by land but does not include any artificial pond or water supply impoundment less than one hectare in area'.***

The NRMP does not have a definition of a lake and the term lake is be found within the definition of - Water body* freshwater or geothermal water in a river, lake, stream, pond, wetland, or aquifer or any part thereof, that is not located within the coastal marine area.

In the Tasman District most large natural lakes are surrounded by conservation land and there are only five with any threat from sediment discharges (Wharariki, Killarney, Kaihoka (2) and Otuihe).

Figure 4-9 Kaihoka Lake (T.James)

Farm ponds and dams are scattered throughout the district. In peri-urban areas these may be retained and incorporated within developments as amenities. Sedimentation of farm ponds can impact on their capacity and use for stock watering and irrigation.

Do not assume that farm ponds are suitable for use as sediment retention ponds – these may also be part of a natural system and therefore receiving environments. This is particularly relevant in karst landscapes where ponds may have developed from sink hole features.

Lakes and ponds trap sediments that enter them as due to the very low flow velocities the sediment drops to the bottom. Materials that enter a lake tend to remain in the lake so they are sinks where contaminants can accumulate. Over time lakes and ponds become shallower and without natural flushing or human intervention are most likely to eventually fill in. These processes mean that shallow lakes and ponds are more susceptible to accelerated sedimentation from land disturbing activities.

While sedimentation is a key stressor, nutrient inputs are considered to be the key issue for lake health. Lakes are considered as having a moderate sensitivity to impacts from sedimentation.

Key elements to managing land disturbance impacts on lakes, ponds and dams include:

- Understanding the sediment transport pathways on your site which lead to these water bodies.
- Ensure that no stockpile storage occurs within or near lake margins or where sediment may enter waterways flowing into lakes.
- Avoid machinery and stock gaining access to lake margins.
- If works are being undertaken within lake environments ensure appropriate erosion and sediment control practices are implemented, including undertaking work in dry conditions where possible (refer Chapter 11).

Note: Resource Consent is likely to be required for works adjacent to or in the bed of a lake.

4.7 Estuaries

Estuaries are low energy, depositional zones where streams meet the sea. Estuaries are among the most productive ecosystems in the world and provide rich feeding grounds for coastal fish and migratory birds and spawning areas for fish and shellfish making them particularly important to local fisheries.

Estuaries are subject to both freshwater and marine influences, including freshwater inflow and sediment entry. Due to very shallow gradients and significant tidal influence they tend to be depositional areas subject to rapid infill due to sediment entry. In addition to the sediment being deposited due to low transporting energy, estuaries increase sedimentation through flocculation where salts combine with clay materials to enhance deposition of fine sediments. As a result of these two processes they are subject to severe degradation from land-based activities.

Over the last 150 years the rate of infilling in New Zealand’s estuaries has accelerated as a results of extensive catchment clearance, wetland drainage and land development for agriculture and settlements. Estuaries were commonly dominated by sandy sediments and had low sedimentation rates prior to human settlement (eg <0.5mm/year (Swales et al 2002, mead and Moore, 2004, Robertson and Stevens 2011).

As low energy, depositional environments the natural infill of an estuary may take hundreds of years, however accelerated sedimentation can fill an estuary in several years. The physical effects of catchment soil erosion will be greatest in the tidal creeks at catchment outlets, whereas the ecological effects of increased fine sediment loads will be more critical in the main body of estuaries (Swales et.al., 2002).

Figure 4-9 Example of Fine Sediment Deposition in Waimea Estuary

Nelson and Tasman Districts are home to several internationally and nationally significant estuaries and sand flats including:

- Waimea Inlet
- Moutere Inlet
- Motueka Delta
- Motupipi Inlet
- Ruataniwha Inlet, and
- Whanganui Inlet.

They are significant due to the rich life they support, including several threatened and migratory species of bird and are important for fish, including several commercial and recreational species. Seagrass (*Zostera*) beds are particularly important intertidal habitats in the Districts supporting very diverse and abundant ecological communities. These beds are also very vulnerable to fine sediment inputs. The Waimea estuary has lost 64% of its seagrass since 1988 (from 58Ha to 21Ha).

There are also many smaller estuary environments along the Nelson Tasman coastline such as Pakawau, Parapara, Onekaka, Onahau, Tata, Kaiteriteri and the Otuwhero inlet to name a few.

The 2010 State of the Environment report (TDC, 2009) identified that human and ecological values within the main estuaries were moderate to high, and habitats included saltmarsh, seagrass, unvegetated tidal flat habitats, and highly modified terrestrial margins.

In terms of sedimentation, the area of soft mud in some estuaries, particularly Waimea and Motupipi, was very elevated (a "poor" rating) and was expanding in area in the Waimea Estuary having increased by 26% since 2001. The soft mud area was also elevated in the Ruataniwha and Motueka estuaries and rated at "fair" levels. More recent investigations of the Moutere Estuary have shown over a 170% increase in the area of soft mud substrates between 2006 and 2013 (from 14 to 38.1% of the total substrates) and a "poor" rating.

Figure 4-12 shows the percentage of soft mud in intertidal areas of Tasman estuaries. The percentage of soft mud ranges from a low of 5% for the partially modified Whanganui Estuary, to 54% for the highly modified Waimea Estuary (note latest 2013 Moutere data included as hatched bar).

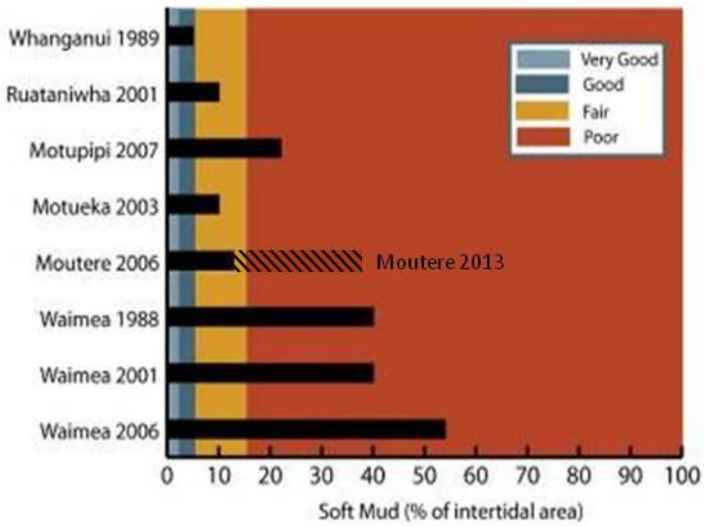

Figure 4-10 Soft Mud as a Percentage of Intertidal Area, Tasman Estuaries (Robertson and Stevens, 2009 and 2013)

Muds decrease sediment oxygenation and lower biodiversity and, if they contain low organic material, decrease productivity. As sediment anoxia (lack of oxygen) promotes nutrient release, muddy estuaries become increasingly sensitive to nutrient inputs (promoting algae growth) and further anoxia. Sedimentation is also partly responsible for the significant historical loss or modification of valuable saltmarsh habitat.

Studies (Lohrer, et.al., 2004; Gibbs, Hewitt, 2004) undertaken on the impacts of sedimentation on estuarine systems highlighted that:

- The number of individuals and taxa declined as a result of sedimentation, as did the densities of nearly every common species.
- As little as 3mm of deposited material was sufficient to significantly alter macrobenthic communities (animals living in estuary beds).
- Large depositions (over 3cm) caused macrofauna die off within 10 days.
- Thinner depositions (1.5-2cm) had an immediate effect with slow recovery (210 days).
- Repeated depositional events did more damage than single ones.

In addition to the biological and ecological effects from accelerated erosion, sediment-laden discharges are considered unappealing from an aesthetics perspective. Clean water is something that people consider to be of value as part of the ‘Clean & Green’ image of New Zealand, especially at the ‘gateway’ to Abel Tasman National Park.

Figure 4-11 Sediment Plume in Waimea Estuary from mud resuspended by wave action

Key elements to managing land disturbance impacts on estuaries include:

- Understand the sediment pathways on your site which lead to estuaries, this could be directly if works are in coastal areas, via overland flow or streams and stormwater networks. Windblown dust can also deposit sediments into nearby estuary environments
- Ensure that no stockpile storage occurs within estuary margins or where sediment may enter water bodies
- Avoid machinery and stock gaining access to estuary margins
- If works are being undertaken within coastal environments, ensure appropriate erosion and sediment control practices are implemented.

Note: Resource Consent may be required for works in or adjacent to estuarine areas.

4.8 Open coasts

Open coasts are dynamic environments and go through constant change. Tasman has a diverse coastline, from the rugged exposed west coast through to the relatively sheltered Golden Bay and Tasman Bay.

Sedimentation is a natural component of coastal environments. However, accelerated sedimentation can be an ongoing concern on coasts with sediment plumes creating visual pollution, impacting on light penetration and potential adverse impacts on coastal reef communities and offshore aquaculture fisheries.

Consideration of sedimentation issues on offshore areas is difficult to assess as much less is known about the various modes and mechanics of transport to be able to make an accurate assessment of potential impacts.

Figure 4-12 West Coast (near Patarau) Inlet

There are issues related to littoral drift and offshore sediment transport along, towards or away from the coast.

There are few studies that have documented these effects. Monitoring of the Motueka River plume as part of the Motueka Integrated Catchment Management project showed that the influence of the river plume extended out to around 7 km offshore from the river mouth and the detectable sedimentation footprint covered an area of about 180 km^2, including areas with significant existing and potential fishery values. (Cawthron 2010).

Key elements to managing land disturbance impacts on open coasts include:

- Understand the sediment pathways on your site which lead to the coast, this could be directly if works are in coastal areas, via overland flow or streams and stormwater networks. Windblown dust can also deposit sediments into nearby coastal environments.
- Ensure that no stockpile storage occurs within coastal margins or where sediment may enter water bodies.
- Avoid machinery accessing coastal margins.
- If works are being undertaken within coastal environments, ensure appropriate erosion; and sediment control practices are implemented.

Note: Resource Consent may be required for works in or adjacent to coastal areas.

4.9 Visual Landscapes

The visual impacts of land disturbance can affect any area able to see the site. Many effects are temporary, only occurring for the duration of works and progressively reducing following permanent stabilisation of exposed sites. However, there are some land disturbing activities that result in permanent changes to the environment which can have ongoing adverse visual effects. These include:

- Batter faces from roads, tracks, landings and building sites cutting across slopes
- Changes to ridgelines from recontouring activities
- Removal and change of vegetation cover
- Destabilization of soils and slopes resulting in ongoing erosion and development of bare scarp faces.

Key aspects for managing the visual effects of land disturbance include:

- Considering where your site could be seen from, in particular publically accessible sites such as parks, reserves, beaches and roads.
- Knowing if your site is in an area (eg the Coastal Environment) or contains a feature (eg a ridgeline identified on the TRMP planning maps) which have specific land disturbance controls.
- Identifying layouts and routes for roads, tracks, landings and building platforms that:
    - Complement land contours and minimise the need for significant earthworks
    - Minimise batter heights
    - Uses less visibly prominent parts of sites
    - Minimises road and track lengths and numbers
    - Enables permanent stabilisation or revegetation of exposed soils
- Retaining and utilising existing trees and vegetation and/or undertake planting to help hide exposed batter slopes from view.
- Ensuring batter slopes are not overly steep, using benching if necessary, to enable permanent revegetation, particularly on dry north facing slopes.
- Utilising suitable techniques for stabilising exposed areas both temporarily during works and permanently following works completion (refer Chapters 8 and 9).

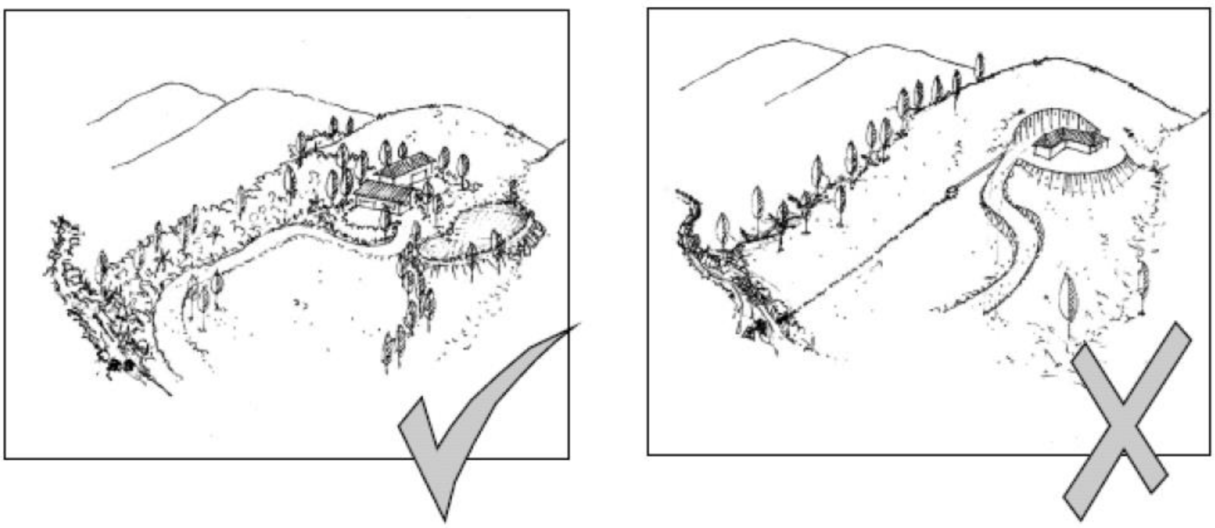

Figure 4-13 Consideration of landform in road layout and building platform design

The TRMP permitted activity rule includes conditions on the visual effects of land disturbance. Refer to the TRMP to confirm resource consent requirements in this regard.

Figure 4-14 Visual impact of land disturbance