

3. Developing investment priorities for the Corangamite Soil Health Strategy

The SHS aims to guide investment in a range of actions that will enhance natural and built assets in the Corangamite region and protect them from a number of soil-based threats or threatening processes.

A logical process with supporting criteria and ranking system was developed to determine which threats pose the greatest risk to assets, and the locations within the region where the risks and potential losses are greatest.

In Section 2 of the strategy, the concept of 'Relative Asset Value' was introduced. In this section, the concept of Relative Risk Value is introduced and explained, together with summary lists of high-ranking locations and threats.

Relative Risk Value draws together the perceived value of the asset, the relative severity of the threat at that location and the area that is currently or would be affected.

3.1 Landscape zones in the Corangamite region

The Soil Health Strategy has adopted and used the concept and boundaries of the 15 landscape zones that define the 15 sub-catchment areas within the Corangamite region. These zones were identified in the Corangamite Regional Catchment Strategy and are shown in *Figure 3.1*.



Figure 3.1: Fifteen landscape zones in the Corangamite region

3.2 Assessing risk to assets – Relative Risk Value

Relative Risk Value is determined using the equation below. The components are:-

Relative Asset Value – The concept of this factor is discussed in Section 2 with values for secondary asset classes appearing in *Table 2.1*. These values are from 1 to 10 with 10 as the most valuable.

Area under threat has been established through electronic interrogation and analysis of Geographic Information System (GIS) data, working through and storing data on a landscape zone basis. The area under threat is determined from:

- the location of each class of asset determined from the GIS with the location data stored for reference
- the different threats identified from the individual images they create in the GIS. A computer program 'looks up' the individual threats with a complementary program calculating the incidences or the area in ha over which the threat intersects with each asset. For example, the GIS can 'see' roads and the threat of salinity. The computer is then programmed to interrogate the GIS data and report the intersections of salinity with roads.

Relative severity of the threat is the potential magnitude of the impact of the threat on the asset. For example, a landslide will destroy a house, and will therefore have greater severity on the asset compared with soil acidification, which may slightly decrease agricultural production in a paddock.

$$\text{(A) Notional value of asset} \times \text{(B) Area under threat} = \text{(D) Relative Risk Value} \\ \text{(C) Relative severity of the threat}$$

After completion of the first 'run' of the data gathering and calculations of Relative Risk Values, a 'sensitivity test' was conducted on the results to ensure that the process was truly indicative of the values sought. The results of the sensitivity test confirmed the validity of the concept of Relative Risk Value and its calculation via the formula. Examples and further detail on the process used to determine Relative Risk Values are explained in *Appendix B*.

3.3 Relative Risk Values across Landscape zones and for various threats

Relative Risk Values were established for 10 key soil threatening processes in each of the 15 landscape zones. This produced 143 Relative Risk Values for threatened assets across the region.

Relative Risk Values could not be determined for three other threats – 'soil contamination', 'soil organic carbon decline' and 'biota decline' because there was insufficient information available.

Calculated Relative Risk Values were ranked from 1-143 (*Appendix B*). The highest 20 Relative Risk Values indicate potential investment priorities, are matters for attention and are listed (*Table 3.1*).

Five of the 12 threats were noted in the 20 highest Relative Risk Values. These threats are: landslides, sheet/rill erosion, gully/tunnel erosion, secondary salinity and acid sulphate soils. All five threats impact public assets and have the potential to impact all primary and secondary asset classes identified in the SHS.

A program of research and field work was carried out to validate the 20 highest Relative Risk Values before these were carried forward into the remainder of the strategy. The validation processes used and the final ranked priorities based on Relative Risk Value are outlined in Section 3.5.

A further assessment was made using the Relative Risk Values by landscape zone to determine the ranking of the threats against each other, taken on a Corangamite region basis i.e. the aggregate values across the 15 landscape zones.

Water erosion had the highest aggregate Relative Risk Value, which was calculated by adding sheet/rill and gully/tunnel erosion together. Water erosion is widespread and has the capacity to impact on all asset classes, particularly water quality and agricultural production (*Fig. 3.2*).

Secondary salinity had the second-highest aggregate Relative Risk Value, mostly because secondary salinity is relatively widespread and often interacts with large areas of agricultural production and high-value biodiversity areas (*Fig. 3.2*). It also has the potential to impact on water quality, built infrastructure and cultural heritage sites.

Landslides had the third highest aggregate Relative Risk Value in the region and also have the potential to impact on all asset classes (*Fig. 3.2*). Landslides have the highest Relative Severity Value (*Table B2*) because they are capable of severely impacting valuable and irreplaceable natural assets, destroying buildings and other built infrastructure and, sometimes, taking human life.

Acid sulphate soils (ASS) had the fourth-highest aggregate Relative Risk Value. These soils were often found in wetlands and have the potential to impact on all asset classes with potentially catastrophic results.

Soil structure decline, waterlogging, nutrient decline and soil acidification had lower Relative Risk Values because they only impact agricultural production (*Fig. 3.2*) and not high-value public assets.

Wind erosion potentially causes an impact on a range of assets. However, the likelihood of wind erosion events is relatively low compared with other threats to soil health in the region and therefore it had a lower Relative Risk Value (*Fig. 3.2*). However, during drought conditions the likelihood of wind erosion will increase significantly.

Soil-Threatening Process	Landscape Zone	Relative Risk Value
Landslides	Gellibrand	3167
Secondary salinity	Lismore	2886
Acid sulphate soils	Bellarine	2748
Gully/tunnel erosion	Woody Yaloak	2501
Sheet/rill erosion	Woody Yaloak	2317
Secondary salinity	Stony Rises	1925
Landslides	Curdies	1903
Landslides	Otway Coast	1872
Sheet/rill erosion	Thompsons	1804
Secondary salinity	Woody Yaloak	1646
Sheet/rill erosion	Moorabool	1154
Secondary salinity	Murdeduke	1090
Gully/tunnel erosion	Leigh	938
Landslides	Upper Barwon	917
Gully/tunnel erosion	Moorabool	893
Sheet/rill erosion	Upper Barwon	752
Gully/tunnel erosion	Upper Barwon	743
Sheet/rill erosion	Leigh	734
Potential acid sulphate soils	Thompsons	557
Landslides	Aire	548

Table 3.1: 20 highest Relative Risk Values for soil threats in the Corangamite region

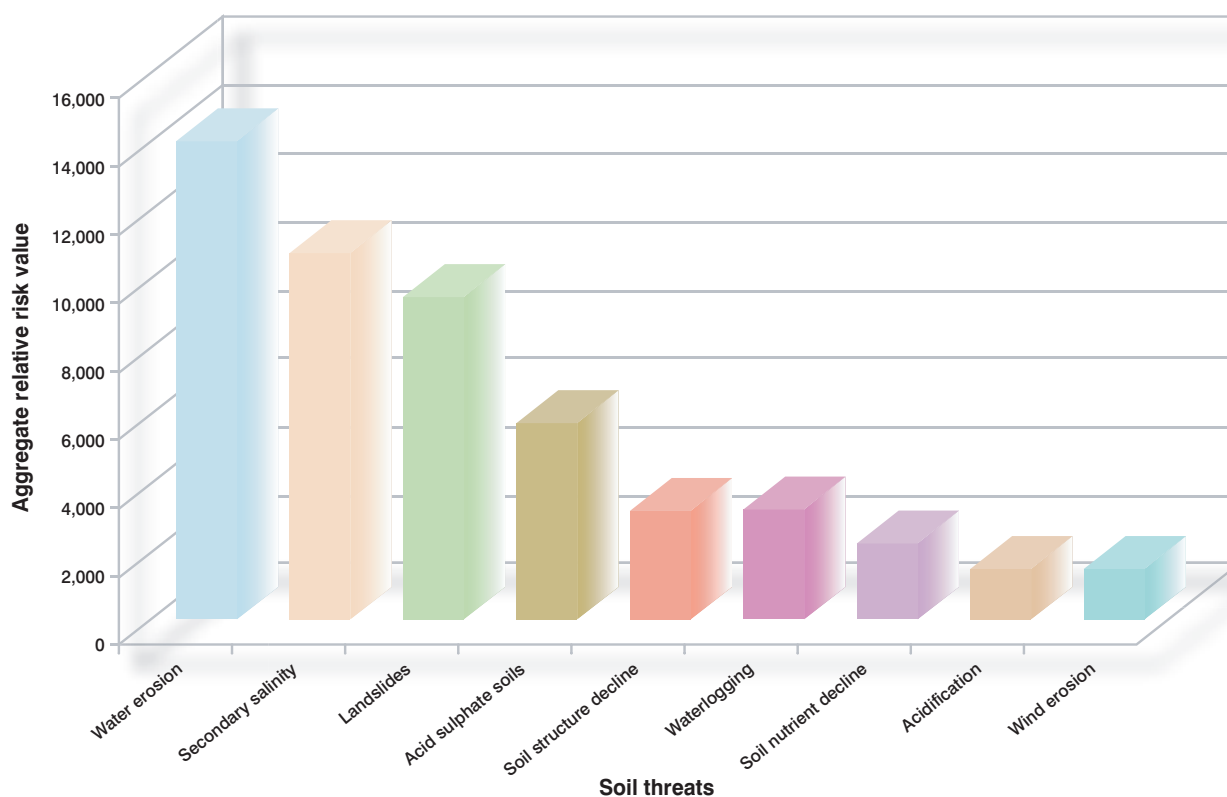


Figure 3.2: Aggregate Relative Risk Values for each soil threat in the Corangamite region

The aggregate Relative Risk Values of all threats were calculated for each landscape zone in the Corangamite region (Fig. 3.3).

Woody Yaloak, Gellibrand, Bellarine and Thompsons landscape zones had the highest aggregate Relative Risk Values. Aire, Middle Barwon, Murdeduke and Hovells had the lowest aggregate Relative Risk Values.

Generally, those landscape zones with the higher aggregate Relative Risk Values have significant landslide, water erosion, secondary salinity and/or acid sulphate soil risk. Those with lower aggregate Relative Risk Values are generally characterised by fewer hills and gentle slopes with threats that predominantly have impacts on agricultural production.

3.4 Assets and threats to assets in each landscape zone

This section describes the:

- assets in each landscape zone
- principal threats to these assets
- Relative Risk Values (Table 3.2) and importantly
- the detailed location of assets under threat in each landscape zone.

This section also describes which assets may be at possible risk from these threats.

Further details of land use, threats to assets and Relative Risk Values for each landscape zone are given in *Appendix C*.

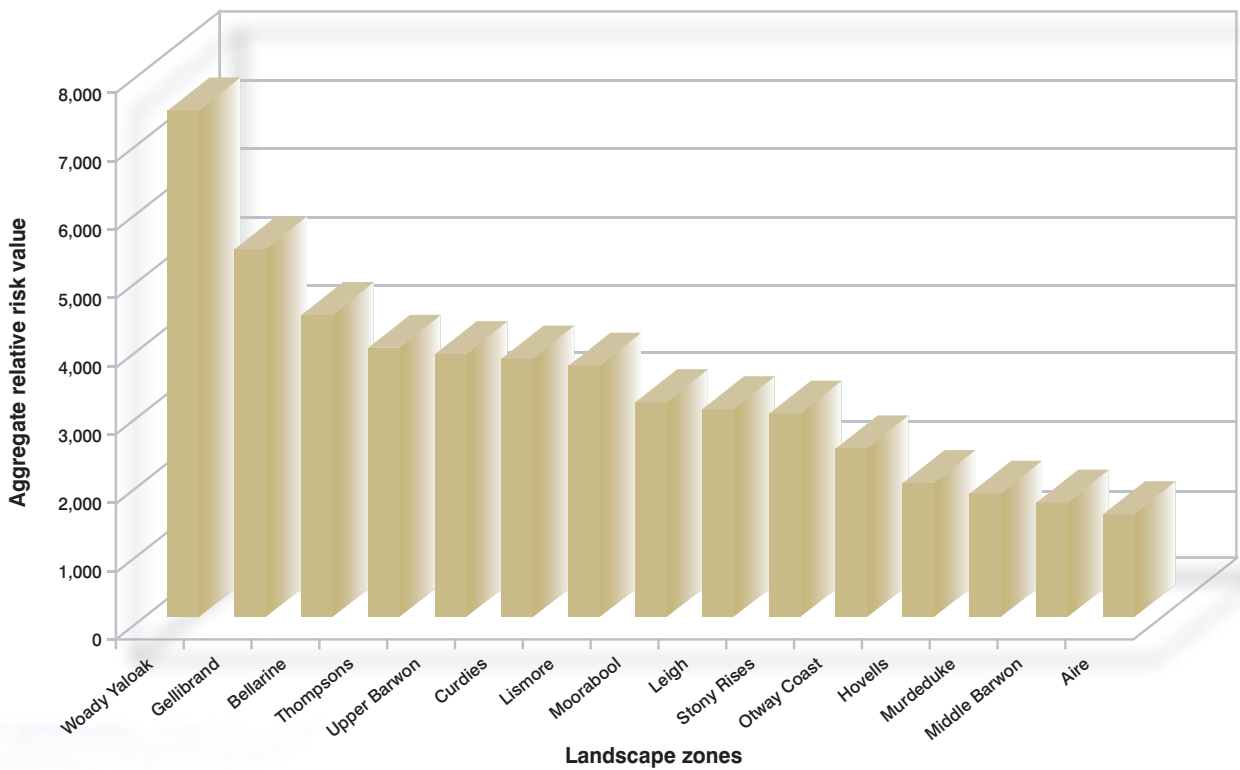


Figure 3.3: Aggregate Relative Risk Values from soil threats for 15 landscape zones in the Corangamite region

Landscape Zone	Summary of assets considered in the threat matrix	Five highest threats to assets with individual Relative Risk Values
Woody Yaloak	<ul style="list-style-type: none"> • 2117 km of waterways including the Woody Yaloak River, Naringhil Creek, Misery and Moonlight creeks , Kuruc-a-ruc Creek and Ferrars Creek. • 91 wetlands (0.8% of area). • Native vegetation conservation significance potential: 5.5% of total landscape zone is very high, 6.7% of total landscape zone is high. • 1000 km of roads, excluding the more recently subdivided areas west of Ballarat. 	<ol style="list-style-type: none"> 1. Gully/tunnel erosion (2,501) 2. Sheet/rill erosion (2,317) 3. Secondary salinity (1,646) 4. Acid sulphate soils (246) 5. Waterlogging (232)
Gellibrand	<ul style="list-style-type: none"> • 3107 km of waterways, including the Gellibrand River and coastal wetlands. • 47 wetlands (0.3% of area), with the coastal wetlands of the Lower Gellibrand River as significant assets. • Native vegetation conservation significance potential: 11.0% of total landscape zone is rated very high, 17.1% of total landscape zone is high. Many of these are included in national and state parks. • 548 km of roads including part of the Great Ocean Road. • Coastal assets include beaches, coastal cliffs, sea stacks (i.e. the Twelve Apostles), marine parks and sanctuary, cultural and heritage assets, (including Aboriginal archaeological sites, shipwrecks and buildings). 	<ol style="list-style-type: none"> 1. Landslides (3,176) 2. Secondary salinity (424) 3. Acid sulphate soils (398) 4. Sheet/rill erosion (336) 5. Soil structure decline (273)
Bellarine	<ul style="list-style-type: none"> • 425 km of waterways, including the Lower Barwon River in Geelong. • 139 wetlands (9.6% of area), including wetlands of international, national, state and local significance. The Lake Connewarre State Game Reserve is highly ranked. • Native vegetation conservation significance potential: 9% of total landscape zone is rated as very high, 14% of total landscape zone is rated as high. • At least 1243 km of roads, not including many of the urban roads in more recent subdivisions. • Major provincial City of Greater Geelong, including industrial and port facilities. • Cultural and heritage assets include many Aboriginal archaeological sites and Victoria's early pastoral settlement history. Coastline and marine parks. 	<ol style="list-style-type: none"> 1. Acid sulphate soils (2,748) 2. Secondary salinity (485) 3. Gully/tunnel erosion (317) 4. Soil structure decline (167) 5. Soil acidification (167)
Thompsons	<ul style="list-style-type: none"> • 1048 km of waterways and 56 wetlands (1.9% of area). • Native vegetation conservation significance potential: 4.6% of total landscape zone is very high, 25.6% of total landscape zone is high. • 713 km of roads, not including the more recently subdivided areas of Torquay and other coastal towns. • Coastal assets including beaches, cliffs and shore platforms, which are highly valued as tourist assets. Cultural and heritage assets, including Aboriginal archaeological sites, are associated with the coast. 	<ol style="list-style-type: none"> 1. Sheet/rill erosion (1,804) 2. Acid sulphate soils (557) 3. Landslides (518) 4. Secondary salinity (236) 5. Wind erosion (195)

Table 3.2: Individual assets under threat within landscape zones, showing their locations and the top five Relative Risk Values (described by threat) in each landscape zone (continued next page)

Landscape Zone	Summary of assets considered in the threat matrix	Five highest threats to assets with individual Relative Risk Values
Upper Barwon	<ul style="list-style-type: none"> • 1822 km of waterways including the Barwon River. • 53 wetlands (1.0% of area) including The Sanctuary (Lake Thurrumbong). • Native vegetation conservation significance potential: 3.2% of total landscape zone is very high, 15.9% of total landscape zone is high. Most are included in the Otway Ranges. • 533 km of roads and rural infrastructure. Birregurra is the main urban centre. 	<ol style="list-style-type: none"> 1. Landslides (917) 2. Sheet/rill erosion (752) 3. Gully/tunnel erosion (743) 4. Secondary salinity (525) 5. Soil structure decline (268)
Curdies	<ul style="list-style-type: none"> • 1891 km of waterways, including the Curdies River and estuary. • 93 wetlands (1.3% of area) including Lake Purrumbete. • Native vegetation conservation significance potential: 6.6% of total landscape zone is rated as very high, 10.2% of total landscape zone is rated as high. • 876 km of roads, including a section of the Great Ocean Road. • Coastline including beaches, coastal cliffs and sea stacks (e.g. Bay of Islands), marine sanctuary and marine parks which include significant cultural and heritage assets. 	<ol style="list-style-type: none"> 1. Landslides (1,903) 2. Waterlogging (482) 3. Soil structure decline (416) 4. Secondary salinity (399) 5. Soil nutrient decline (175)
Lismore	<ul style="list-style-type: none"> • 736 km of waterways and 187 wetlands (22.5% of area), including Ramsar and significant wetlands, such as Lake Corangamite. • Native vegetation conservation significance potential: 0.9% of total landscape zone is very high, 3.9% of total landscape zone is high. • 622 km of roads, including highways. Other infrastructure includes significant railway and power lines. • Cultural and heritage assets, especially Aboriginal archaeological sites associated with the lakes, waterways and wetlands. 	<ol style="list-style-type: none"> 1. Secondary salinity (2,886) 2. Waterlogging (228) 3. Acid sulphate soils (225) 4. Soil structure decline (165) 5. Wind erosion (78)
Moorabool	<ul style="list-style-type: none"> • Urban water supply catchments for the City of Ballarat, City of Greater Geelong and other urban centres (e.g. Meredith, Bannockburn). • 2151 km of waterways, including the Moorabool River and tributaries. 132 wetlands (1.1% of area). High value groundwater resources (Bungaree GMA). • Native vegetation conservation significance potential: 9.3% of total landscape zone is very high, 16.6% of total landscape zone is high. • 978 km of roads excluding the more recently constructed urban and peri-urban roads of newer subdivisions around Geelong and Ballarat. Extensive peri-urban development. 	<ol style="list-style-type: none"> 1. Sheet/rill erosion (1,154) 2. Gully/tunnel erosion (893) 3. Waterlogging (230) 4. Soil structure decline (219) 5. Landslides (136)
Leigh	<ul style="list-style-type: none"> • 1689 km of waterways, including the Leigh River and Leigh River Gorge. • 74 wetlands (0.8% of area), including Lake Wendouree which has high recreational value. • Native vegetation conservation significance potential: 5.2% of total landscape zone is very high, 11.7% of total landscape zone is high. • 1224 km of roads, not including the more recently constructed urban roads in Ballarat. • A portion of the City of Ballarat, which includes significant educational facilities, industry, mining, transport corridors and heritage assets. 	<ol style="list-style-type: none"> 1. Gully/tunnel erosion (938) 2. Sheet/rill erosion (734) 3. Secondary salinity (502) 4. Waterlogging (196) 5. Soil structure decline (192)

Table 3.2: (Cont.)

Landscape Zone	Summary of assets considered in the threat matrix	Five highest threats to assets with individual Relative Risk Values
Stony Rises	<ul style="list-style-type: none"> • 946 km of waterways and 535 wetlands (9.2% of area), including Ramsar and significant wetlands such as Lake Beeac and Lake Cundare. • Native vegetation conservation significance potential: 6.4% of total landscape zone is very high, 10.0% of total landscape zone is high. • 1054 km of roads, excluding the more recently subdivided areas around Colac and Camperdown. • Cultural and heritage assets include Aboriginal archaeological sites and buildings associated with the early pastoral settlement. • Urban centres of Colac and Camperdown, including manufacturing and service industries. 	<ol style="list-style-type: none"> 1. Secondary salinity (1,925) 2. Soil structure decline (256) 3. Waterlogging (254) 4. Soil nutrient decline (211) 5. Soil acidification (144)
Otway Coast	<ul style="list-style-type: none"> • 1282 km of waterways, mostly mountain streams. Barham River is the largest catchment. • Wetlands (<0.1% area). • Native vegetation conservation significance potential: 7.8% of total landscape zone is very high, 2.5% of total landscape zone is high. A significant proportion of the native vegetation is in the Great Otway National Park. • 284 km of roads, including the Great Ocean Road. • Cultural and heritage assets and high-value tourist sites. 	<ol style="list-style-type: none"> 1. Landslides (1,872) 2. Soil structure decline (225) 3. Soil nutrient decline (197) 4. Waterlogging (149) 5. Acid sulphate soils (81)
Hovells	<ul style="list-style-type: none"> • 251 km of waterways, with Hovells Creek and Limeburners Bay as the most significant. • 44 wetlands (3.0% of area), includes Ramsar and significant wetlands around Point Lillias and Point Wilson. • Native vegetation conservation significance potential: 16.1% of total landscape zone is very high, 10.4% of total landscape zone is high. • At least 694 km of roads, not including many of the more recently constructed suburban roads in Lara and Geelong. • Portions of the City of Greater Geelong, including significant urban and industrial infrastructure. • Cultural and heritage assets include Aboriginal archaeological sites and historical sites associated with the early pastoral settlement of Victoria. 	<ol style="list-style-type: none"> 1. Acid sulphate soils (506) 2. Sheet/rill erosion (444) 3. Soil structure decline (244) 4. Secondary salinity (243) 5. Gully/tunnel erosion (240)
Murdeduke	<ul style="list-style-type: none"> • 460 km of waterways, including Warrambine Creek and Mia Mia Creek. • 65 wetlands (4.1% of area), including Ramsar and significant wetlands (Lake Murdeduke). • Native vegetation conservation significance potential: 9.1% of total landscape zone is very high, 6.9% of total landscape zone is high. • 236 km of roads, rail line and minor rural infrastructure. • Cultural and heritage assets, including Aboriginal archaeological sites. 	<ol style="list-style-type: none"> 1. Secondary salinity (1,090) 2. Waterlogging (218) 3. Soil structure decline (196) 4. Wind erosion (93) 5. Acid sulphate soils (93)

Table 3.2: (Cont.)

Landscape Zone	Summary of assets considered in the threat matrix	Five highest threats to assets with individual Relative Risk Values
Middle Barwon	<ul style="list-style-type: none"> • 703 km of waterways including the Barwon River. • 104 wetlands (1.8% of area), mostly very small (Wurdee Boluc Reservoir and Lake Gherang are exceptions). • Native vegetation conservation significance potential: 14.8% of total landscape zone is very high, 9.2% of total landscape zone is high. • Infrastructure assets including 458 km of roads, along with main railway and power lines. Parts of the City of Greater Geelong and peri-urban fringe. 	<ol style="list-style-type: none"> 1. Secondary salinity (296) 2. Sheet/rill erosion (294) 3. Soil structure decline (268) 4. Waterlogging (257) 5. Landslides (107)
Aire	<ul style="list-style-type: none"> • Many of the 989 km of waterways are high-value assets because of their pristine condition. In particular, the Aire River estuary is a high-value environmental asset. • Wetlands (0.2% of area). • Native vegetation conservation significance potential: 17.8% of total landscape zone is rated as very high, 5.4% of total landscape zone is rated as high. • 152 km of roads. • Great Otway National Park. • Cape Otway coastline and associated marine parks. 	<ol style="list-style-type: none"> 1. Landslides (548) 2. Acid sulphate soils (402) 3. Soil nutrient decline (184) 4. Soil structure decline (145) 5. Wind erosion (118)

Table 3.2: (Cont.)

3.5 Validation of Relative Risk Values

The Relative Risk Value analysis described in Section 3.2 was based on various assumptions. To validate the results of the analysis, a process was applied to test and modify the results according to field assessment by the strategy team and previous documented and evidence-based investigations by third parties.

The Relative Risk Value analysis assumed that if an asset appeared in the GIS data to intersect with a threat that was known to have an impact, such as a landslide impacting on a road or a waterway, then an actual or potential risk was present.

However, this assumption may have been flawed, potentially for a variety of reasons. For instance:

- identified intersection sites may be stable and unlikely to change over time, thus presenting a potential threat with little or no chance of developing and becoming a real threat to the subject asset
- alternatively, a threat may be shown by on-ground inspection to be too distant from the asset to pose an actual risk. Intersection sites may not have been mapped accurately in the GIS analysis and therefore a threat may not actually be near an asset
- some intersection sites may have been ameliorated since the GIS data were taken and with the passage of time there may no longer be a risk to assets.

As a result of these potential flaws, a field inspection was carried out for erosion and landslide intersection sites with a search of past investigation reports for secondary salinity and acid sulphate soils.

Validation of Relative Risk Value was conducted for the highest 20 Relative Risk Values: landslides, secondary salinity, sheet/rill erosion, gully/tunnel erosion and acid sulphate soils within the landscape zones that appear in Table 3.1.

Further results of the validation of Relative Risk Values are described in Appendix D.

The background report, 'Validation of Priority Areas for Landslides and Erosion' describes in detail the processes used and results found during the field verification of landslide and erosion risk.

Validation of landslide risk

Validation for Relative Risk Values for landslides was carried out in the Gellibrand, Curdies, Otway Coast, Upper Barwon and Aire landscape zones, using a field assessment technique. The technique validated the potential or actual risk to assets, particularly in those localities where multiple landslides could be found – i.e. the most landslide-prone areas.

The ranking of landscape zones altered slightly as a result of the field assessment. There was strong evidence of landslide risk, particularly to built infrastructure in Gellibrand and Otway Coast (Fig. 3.4), but there was less evidence in the Curdies, where agricultural production was the main asset under threat (Table 3.3).

Priority Landscape Zones	Asset Classes					Verification of risk score	Revised rank according to verification
	Land use	Water Quality	Bio-diversity	Infrastructure			
1. Gellibrand	3	4	1	4.5	12.5	1	
2. Curdies	3.5	2	1	4	10.5	3	
3. Otway Coast	2	2	3	5	12	2	
4. Upper Barwon	2	4.5	1	1	8.5	4	
5. Aire	1	3	2	2	8	5	

Table 3.3: Field verification scores for landslide risk in the highest Relative Risk Value landscape zones. Risk to assets is indicated as: very high-5; high-4; medium-3; low/medium-2; low-1.



Figure 3.4: Remediated landslide next to dwelling in the Barham Valley (Otway Coast)

Photograph: A. Miner 2006

Validation of erosion risk

Validation of Relative Risk Values for erosion threats was carried out using a field assessment technique. This was carried out in those landscape zones where gully/tunnel and/or sheet/rill erosion had shown high Relative Risk Values: Woody Yaloak, Moorabool, Leigh, Upper Barwon and Thompsons.

Verification found that erosion was mapped accurately, but differentiation of the threats and risks to assets from sheet, rill, gully and tunnel erosion was inconsistent in the GIS analysis.

Consequently, it was decided that in those landscape zones where sheet/rill erosion and gully/tunnel erosion occurred in the highest 20 Relative Risk Values, these should be ranked together.

Verification of Relative Risk Values for erosion changed the ranking of some landscape zones from their GIS-derived position.

On-site field assessment verified that erosion is a high risk in Woody Yaloak and Moorabool, particularly threatening water quality in creeks and rivers (Fig. 3.5). There was little evidence to verify that erosion is a high risk in Thompsons (Table 3.4).

Priority Landscape Zones	Asset Classes					Verification of risk score	Revised rank according to verification
	Land use	Water Quality	Bio-diversity	Infrastructure			
1. Woody Yaloak	4	4	3	2		13	=1
2. Moorabool	3	5	3	2		13	=1
3. Thompsons	1	2	2	1		6	5
4. Upper Barwon	2	3	2	1		8	4
5. Leigh	2	3	3	2		10	3

Table 3.4: Field verification scores for water erosion in the five highest Relative Risk Value landscape zones. Risk to assets is indicated as: very high-5; high-4; medium-3; low/medium-2; low-1.



Figure 3.5: Severe sheet, rill and gully erosion contributing large sediment loads with potential nutrient discharge into Moonlight Creek (Woody Yaloak)

Validation of acid sulphate soil Relative Risk Values

Relative Risk Values for acid sulphate soils appeared in the 20 highest Relative Risk Values in the Bellarine and Thompsons landscape zones (*Table 3.1*). The validation of acid sulphate soil risk in the Bellarine Landscape Zone used the results from the mapping of acid sulphate soils in the City of Greater Geelong investigation carried out in 2005 (CSIRO 2005).

The conclusion from the CSIRO study was that although acid sulphate soils are found throughout the City of Greater Geelong, they are mostly confined to public conservation and resource areas, and are unlikely to be disturbed by road or urban development activities and therefore unlikely to pose an actual risk.

An exception to this in the Bellarine Landscape Zone is the tidal flat adjacent to the smelting plant at Point Henry. The site at Point Henry was the only one tested which had any acid sulphate soil potential and this was considered marginal at most (CSIRO 2005).

There was no or little information available to verify the risk of acid sulphate soils in the Thompsons Landscape Zone. Consequently, it had to be assumed that the Thompsons Landscape Zone was similar to Bellarine and that most potential acid sulphate soils are to be found in wetlands that are already designated as conservation areas.

A potential acid sulphate soils mapping study completed by CSIRO in March 2007 identified more potential risk sites across the Corangamite region. However, not enough potential acid sulphate soil sites were identified that could warrant any landscape zone to be placed higher in the top 20 priorities.

Validation of Relative Risk Values for secondary salinity

During the development of the Corangamite Salinity Action Plan, field verification of salinity risk was conducted. Results from this salinity verification study were used to verify the high Relative Risk Values for secondary salinity that had been produced from the GIS analysis in this Soil Health Strategy.

Landscape zones in which verification was carried out included: Lismore, Stony Rises, Woody Yaloak and Murdeduke. This study validated the Relative Risk Values for secondary salinity.



3.6 Investment priorities for the Corangamite Soil Health Strategy

Benefit-cost analysis

The first draft of the Corangamite Soil Health Strategy was developed in 2003. At the time, the Corangamite CMA Sustainable Agriculture and Land Management Implementation Committee felt that a benefit-cost analysis was needed as a central component of the Soil Health Strategy. An economic consultant was briefed to carry out the work.

The 2003 benefit-cost analysis concentrated on private costs and benefits (URS & RMCG 2003).

In 2005, further funding became available and the Soil Health Steering Committee of the day decided to invest in improving the benefit-cost analysis, particularly to assess public costs and benefits. A further investigation was carried out in 2005. This work highlighted the fact that the study was problematical since many pertinent factors could not be

quantified (e.g. value of water quality for aquatic ecosystems). For this reason, the 2005 benefit-cost analysis delivered indicators based on only some of the quantifiable costs and quantifiable benefits, but omitted those that defied quantification (URS 2005).

In general, the majority of benefits without a market value were not considered in the analysis. This greatly undervalued the public benefits derived from investment in management actions to improve soil health. For example, investment of one dollar in on-ground works to address gully erosion is calculated to return four cents in reclaimed agricultural production and improved farm access. However, the benefit of improved water quality in waterways and wetlands, the preservation of significant flora or fauna species, the protection of property, utilities, roads, heritage sites, etc., were not included in the analysis.

Table 3.5 outlines the benefit-cost ratios calculated for the five priority threats, the costs of implementing actions, marketable benefits used and non-marketable benefits not used in the analysis.

Soil-threatening process	Benefit-Cost Ratio	Management actions costed in the economic analysis	Benefits considered in the economic analysis	Benefits not considered in the economic analysis
Landslides	7.89	Development of tools and policies through the municipal planning schemes.	Reduction in catastrophic damage to environmental and infrastructure assets, loss of life, damage to infrastructure.	Reduction of sediments into waterways and wetlands. Preservation of biodiversity areas and heritage sites.
Secondary Salinity	4.04	On-ground works including vegetation, fencing & drainage.	Reduction in damage to infrastructure and utilities and agriculture production.	Reduction of salinity in waterways, wetlands and significant biodiversity areas.
Sheet/rill erosion	0.48	On-ground works including earthworks, fencing, and revegetation.	Reclaiming agricultural production and preventing the loss of production land.	Reduction of sediments into waterways and wetlands.
Gully/tunnel erosion	0.04	On-ground works including earthworks, fencing, revegetation and engineering works.	Retaining land from erosion, reclaimed production, better farm access.	Reduction of sediments into waterways and wetlands. Preservation of biodiversity areas, infrastructure, buildings, utilities and heritage sites.
Potential acid sulphate soils	5.88	Mapping occurrences and informing relevant stakeholders.	Avoiding damage to housing, buildings and infrastructure.	Maintaining water quality, fish numbers, aquatic ecosystems and human health.

Table 3.5: Summary of the costs and benefits considered in the economic analysis

High value public assets

The benefits that are realised from various soil health management actions will depend on the effectiveness of specific actions in reducing the threat to specific assets.

For example, on-ground works to reduce or stop active gully erosion in a Proclaimed Water Supply Area will have a greater benefit than on-ground works to reclaim an inactive gully outside the area.

In a similar vein (see the relative risk assessment outlined in Section 3.2 and *Appendix B*), it should be noted that the notional Relative Asset Value does not discriminate between the relative values of the same asset class.

Some high-value assets for priority areas are outlined in *Table 3.6*. The validation process outlined in the previous section considered the higher consequences on those high-value public assets (e.g. Ramsar Wetlands and WSPA). This influenced the risk score established from validation and influenced the ranking of the top 20 priority areas.

Ranked investment priorities

Ranked investment priorities will help guide investment. These priorities have been based on their validated Relative Risk Values, with high-value public assets at risk (e.g. water supply reservoirs, Ramsar wetlands).

If left without treatment, those that appear in the highest 20 priorities all have the potential for significant adverse impacts on public assets.

Table 3.6 outlines the final ranking of the 20 investment priorities in the SHS.

Final Rank	Landscape Zone	Threat	Relative Risk Value	Validation of risk to assets	High-value public assets at risk
1	Gellibrand	Landslides	3167	Very high	WSPA, tourism, Great Ocean Road
2	Lismore	Secondary Salinity	2886	Very high	Ramsar Wetlands
3	Woody Yaloak	Gully/tunnel Erosion	2501	Very high	Ramsar Wetlands
4	Woody Yaloak	Sheet/rill Erosion	2317	Very high	Ramsar Wetlands
5	Stony Rises	Secondary Salinity	1925	Very high	Ramsar Wetlands
6	Otway Coast	Landslides	1872	Very high	Great Ocean Road, Otway coast, tourism, national park
7	Curdies	Landslides	1903	Very high	High value estuary
8	Moorabool	Sheet/rill Erosion	1154	Very high	WSPA
9	Moorabool	Gully/tunnel Erosion	893	Very high	WSPA
10	Woody Yaloak	Secondary Salinity	1646	Moderate to high	Ramsar Wetlands
11	Murdeduke	Secondary Salinity	1090	Moderate to high	Ramsar Wetlands
12	Leigh	Gully/tunnel Erosion	938	Moderate to high	Threatened species
13	Leigh	Sheet/rill Erosion	734	Moderate to high	Threatened species
14	Upper Barwon	Landslides	917	Moderate	WSPA
15	Aire	Landslides	548	Moderate to high	Heritage river
16	Upper Barwon	Sheet/rill Erosion	752	Moderate	WSPA
17	Upper Barwon	Gully/tunnel Erosion	743	Moderate	WSPA
18	Thompsons	Sheet/rill Erosion	1804	Low to moderate	
19	Bellarine	Acid Sulphate Soils	2748	Low to moderate	Ramsar Wetlands
20	Thompsons	Acid Sulphate Soils	598	Low to moderate	

Table 3.6: Final ranked 20 investment priorities, based on risk to assets, benefit-cost analysis and high-value public assets at risk. Note, for each landscape zone high to very high ecologically significant areas are found.