

Great Ocean Road Coast and Parks Environmental-Economic Account

Technical Report

This project was undertaken by the economics team in DEECA’s Strategy and Performance Division to support the strategic planning and decision making of the Great Ocean Road Coast and Parks Authority (GORCAPA).

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The new Department of Energy, Environment and Climate Action (DEECA) was established on 1 January 2023. This department includes the previous functions of the Department of Environment, Land, Water and Planning, excluding the Planning portfolio and those areas supporting it which are now part of the New Department of Transport and Planning.

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria’s land and waters, their unique ability to care for Country and deep spiritual connection to it.

We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

DEECA is committed to genuinely partnering with Victorian Traditional Owners and Victoria’s Aboriginal community to progress their aspirations.

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# List of abbreviations and acronyms

|  |  |
| --- | --- |
| ABS | Australian Bureau of Statistics |
| ASGS | Australian Statistical Geography Standard |
| BSU | Basic Spatial Units |
| CBiCS | Combined Biotope Classification Scheme |
| CICES | Common International Classification of Ecosystem Services (European Environment Agency) |
| DEECA | Department of Energy, Environment and Climate Action |
| DELWP | Department of Environment, Land, Water and Planning |
| EA | Ecosystem Assets |
| EEA | Environmental-Economic Accounts |
| EMAC | Eastern Maar Aboriginal Corporation |
| EVC | Ecological Vegetation Classes |
| GA | Geographical Areas |
| GORCAP | Great Ocean Road Coast and Parks |
| GORCAPA | Great Ocean Road Coast and Parks Authority |
| GVA | Gross Value Added |
| IPBES | Intergovernmental Panel on Biodiversity and Ecosystem Services |
| LGA | Local Government Area |
| MAES | Mapping and Assessment of Ecosystems and their Services (by European Commission) |
| OECD | Organisation for Economic Co-operation and Development |
| QALY | Quality adjusted life year |
| SEEA | System of Environmental-Economic Accounting (UN) |
| SEEA-EA | System of Environmental-Economic Accounting – Ecosystem accounts |
| VLCTS | Victorian Land Cover Time Series |
| VLUIS | Victorian Land Use Information System |
| VOLY | Value of a Life Year |
| WTOAC | Wadawurrung Traditional Owners Aboriginal Corporation |
| WTP | Willingness to Pay |

# Headline results: Great Ocean Road Coast and Parks EEA

| UN System of Environmental-Economic Accounting (SEEA) Framework | GORCAP EEA Outputs | GORCAP EEA Use |
| --- | --- | --- |
| Status of ecosystem assets in Great Ocean Road Coast and Parks  **Asset extent –** Measure spatial extent of ecosystem assets | Map of Great Ocean Road Coast and Parks | * Evidence on the current (2019) extent and distribution of ecosystems * Monitoring and reporting on management effectiveness in meeting extent targets (future) * Identifying ecosystems at risk of future pressures (future) * Identifying ecosystem restoration opportunities through comparison with historical extent (future) * Identifying key ecological interactions across space and time (future) |
| **Asset condition –** Measure health of ecosystem assets | **Ecological** **condition**   * Biodiversity   + 89 threatened flora and 70 threatened fauna species   + 63 out of 100 habitat importance for threatened species   + 45 out of 100 native vegetation score * Soil   + 21% of land at high landslip risk * Water   + 34 out of 50 inde4x of stream condition score * Carbon   + 35.5 million tonnes of CO2e stored in ecosystems   **Socio-economic characteristics**   * Location   + 87% of view from the Great Ocean Road are to non-GORCAPA area * Non-Indigenous cultural assets   + 165 assets of historical cultural heritage * Governance and management * Over 40,000ha of designated parks/reserves in the GOR region * Built assets   + 239km of walking tracks   + 7 piers and jetties | * Evidence on the current condition of ecosystems across the region * Capturing ecosystems’ intrinsic value * Identifying ecosystem restoration opportunities * Monitoring and reporting on management effectiveness in meeting condition targets (future) * Understanding how sustainable our use of the regions’ ecosystems is over time (future) * Identifying ecosystems that are currently adversely affected by pressures (future) * Identifying key ecological interactions across space and time (future) * As a basis for future research to explore “critical ecosystem characteristics” that underpin productivity (future) |
| **Productivity** of ecosystem assets in Great Ocean Road Coast and Parks  **Physical flow**  Measure the flow of ecosystem services to people | **Provisioning services**   * Biomass for food: 28,000 tonnes crops and 164,000 livestock per year * Biomass for timber: 30,000 m3 per year   **Regulating services**   * Coastal protection: 239 kilometres protected * Climate regulation: 35 million tonnes CO2e retained   **Cultural services**   * Recreation and tourism: 3.9 million visitors per year * Education: 33,000 student visitors per year * Aesthetics: 84 per cent of viewshed is undisturbed\* * Social/community cohesion: 77 voluntary groups\*   \* This is an indicator of ecosystem service provision | * Business cases * Impact assessments * Victoria’s Coastal and Marine Strategy * State of the Great Ocean Road report * Sustainable Development Goals |
| **Monetary flow**  Value ($) the benefits people receive | **Provisioning services**   * Biomass for food: $11m per year * Biomass for timer: $0.25m per year   **Regulating services**   * Coastal protection: $3m–$10m per year * Climate regulation: $60m–$150m per year   **Cultural services**   * Recreation and tourism: $60–$560m per year * Education: $0.5–$3m per year | * Evidence on the current physical quantities and values ($) of key ecosystem services produced and their distribution * Input to business cases seeking action and/or investment to maintain ecosystem extent and condition * Monitoring and reporting on management effectiveness in delivering ecosystem service flows (future) * Assessing the potential magnitude and value of ecosystem service losses associated with future pressures and risks (future) * Building the business case for investment to expand ecosystem assets in the region (future) * Estimating the long-term (capitalised asset) value ($) of ecosystems by projecting future ecosystem service flows and values (future) |
| **Scoped out ecosystem services (non-exhaustive)**  (For future assessment) | * Air quality regulation * Amenity * Biomass – energy * Flood risk regulation * Local climate regulation * Landslide regulation * Noise and odour regulation * Research * Water provision * Water quality regulation |  |

**Case study: Capturing Traditional Owner living cultural values in an ecosystem account**

Cover of Paleert Tjaara Dja
Let's make Country good together 2020-2030
Wadawurrung Country Plan

To acknowledge the values and goals that this Traditional Owner Group have for their lands

| Associated Wadawurrung Country Plan Indicator | Year | Metric | Extent/ Conidation Score | Uncertainty |
| --- | --- | --- | --- | --- |
| **Waterways, Rivers, Estuaries and Wetlands** |  |  |  |  |
| Water Quality | 2021 | Score 0-50 | 29 (poor) | Medium |
| **Inland Country** |  |  |  |  |
| Extent of volcanic grasslands | 2019 | Hectares | 0 | Medium |
| Age classes of woodlands | 2021 | % forest late mature | 47.8% | Low |
| Age classes of woodlands | 2021 | % forest mature | 22.1% | Low |
| Age classes of woodlands | 2021 | % forest regenerating | 0.3% | Low |
| Age classes of woodlands | 2021 | % forest regrowth | 0.9% | Low |
| Age classes of woodlands | 2021 | % forest senescent | 27.2% | Low |
| Age classes of woodlands | 2021 | % forest uneven-aged | 1.7% | Low |
| **Coastal Country** |  |  |  |  |
| Extent of ironbark | 2019 | Hectares | 0 | Medium |
| Extent of heathlands | 2019 | Hectares | 149 | Medium |
| **Native Animals** |  |  |  |  |
| Numbers of threatened species | 2021 | Species count | 48 | Medium |

# Executive Summary

The Great Ocean Road captures some of Victoria’s most beautiful and rugged coastline, including national tourism attractions such as the Twelve Apostles. This key environmental and economic asset is under threat from increasing levels of tourism and erosion.

In 2018, the Victorian Government released a Great Ocean Road Action Plan which set out a commitment to protect the iconic coasts, parks and scenic landscapes along the road through the creation of a new Great Ocean Road Coast and Parks Authority. Included within this action plan was a commitment to develop an environmental-economic account for the Great Ocean Road Coast and Parks that would provide the new Authority with an evidence base to inform its strategy, planning and investment decisions.

Ecosystem accounts are a type of environmental-economic account (EEA) that take stock of current ecosystem assets – in terms of their extent, location, and condition – and quantify and value the flow of ecosystem services that these assets generate for people, who enjoy benefits from them. Figure S1 sets out the ecosystem accounting framework. For the purpose of this work, reference will be made to the Great Ocean Road Coast and Parks Environmental-Economic Account (GORCAP EEA).

Figure S1. Environmental-Economic Accounts – Ecosystem Accounting framework

Figure S1. Environmental-Economic Accounts – Ecosystem Accounting framework

Text description below.

**Stock Account**

* **Status** of ecosystem assets in Victoria
* **Asset extent**: Spatial extent of ecosystem assets
* **Asset condition**: Ecological integrity of ecosystem assets

**Flow Account**

* **Productivity** of ecosystem assets in Victoria
* **Physical flow**: Measure the flow of ecosystem services to people
* **Monetary flow**: Value ($) the benefits people receive

This environmental-economic account for the Great Ocean Road Coast and Parks shows that the ecosystems within the GORCAP EEA boundary are important for threatened flora and fauna and deliver a range of ecosystem services that provide significant socio-economic value to society.

The methodological approach to GORCAP EEA development was agreed with the project steering group following the study teams’ review of economic assessments of coastal, marine and protected area assets globally, international guidance on environmental-economic accounting as well as existing data for the GORCAP EEA region.

Environmental-economic accounts are typically developed iteratively, with initial accounts focusing on priority areas that are subsequently expanded and refined over time. This GORCAP EEA has made use of the best available information at the time of the study. Given that no data has been collected specifically for the study region or for the purpose of developing an EEA, justifiable assumptions have been adopted based on data (where possible) or expert judgement in order to align readily available information with the GORCAP EEA boundary and with the principles of SEEA as best as possible. Based on this approach and the uncertainties associated with this, the results should be interpreted as indicative order or magnitude estimates that provide a proof-of-concept GORCAP EEA and a basis for future work to refine and expand the accounts to provide useful evidence on the status and productivity of ecosystem assets in the region.

The account has been developed for 2019 on the basis that this is the most recent year for which most of the necessary information exists (including the latest ecosystem extent data in Victoria) and ensures that the account is not skewed by the impact of COVID-19. Information for 2019 has been used where possible and where 2019 data is not available it is taken from the years 2015 to 2021 (some condition data precedes this but is presented for completeness). The account could therefore be more accurately described as being representative of ecosystem status and productivity over the period 2015 to 2021.

The translation of Country for the Great Ocean Road Coast and Parks environmental-economic account is demonstrated through the use of a case study for Wadawurrung Country, following discussions the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC). Exploration of the synergies between the WTOAC Country Plan and the environmental-economic account for the Great Ocean Road Coast and Parks shows that there is the potential to capture most of the indicators in the Wadawurrung Country Plan, within the existing structure of the GORCAP EEA. This would enable the GORCAP EEA to appropriately acknowledge the values and goals that WTOAC have for their lands. Furthermore, a handful of indicators within the Country Plan are already captured in the GORCAP EEA including water quality, extent of volcanic grasslands, ironbark and heathlands, numbers of native animals, forest age and threatened species.

The GORCAP EEA region consists mostly (64 per cent) of marine ecosystems (on Crown land). Forest areas make up the largest terrestrial ecosystem type (18 per cent), whilst farmland (14 per cent) also occupies a significant area (refer to Table S1 for the headline extent account). The spatial distribution of the asset extent within the Great Ocean Road Coast and Parks EEA area is defined by the outer perimeter of the Great Ocean Road Coast and Parks area (Figure S2). This means that the GORCAP EEA will capture land under the management of the GORCPA as well as non-GORCAPA managed land.

Key insights from the information compiled in the ecosystem condition account (refer to Table S2 for headline condition account) are:

* The GORCAP EEA region provides important habitat for threatened species, with 89 species of threatened flora and 70 species of threatened fauna.
* The average native vegetation condition score within the GORCAP EEA region is 45 (on a scale of 1 to 100). Within the GORCAP EEA region, the GORCAPA area native vegetation score averages 73 whilst the non-GORCAPA areas native vegetation score averages 29.
* The average habitat importance for threatened species score within the GORCAP EEA region is 63 (on a scale of 1 to 100). Within the GORCAP EEA region, the GORCAPA area habitat importance for threatened species score averages 77 whilst the non-GORCAPA area score averages 54.
* There is a significant volume of abalone biomass (32,000 tonnes) in the GORCAP EEA region, which represents 39 per cent of the total abalone biomass within Victoria.
* 41,215 hectares (21 percent) of the GORCAP EEA region is at high or very high susceptibility of landslip. 3,849 hectares (2 percent) of the GORCAP EEA is susceptible to coastal acid sulphate soils.
* Stream and estuary condition within the GORCAP EEA region is captured through index scores of 34 and 31 respectively (out of 50).
* There is a significant volume of carbon stored in the GORCAP EEA region totalling 35.5 million tonnes of carbon dioxide equivalent.
* Views from the road of the Great Ocean Road are mostly (87 percent) outside of the GORCAPA region.
* There are a large number (165) of assets of non-Indigenous historic cultural heritage within GORCAP EEA region, including 34 shipwrecks which support recreation and tourism visits.
* The existence of the ecosystems within the GORCAP EEA region is highly valued by society as demonstrated by the 40,000 hectares of national parks and nature/conservation reserves and the significant number of people (over 1,300) participating in community stewardship.

There are 7 piers/jetties within the GORCAP EEA region, approximately 239 km of walking tracks and 69 km of mountain bike tracks and bike paths which are important in supporting the recreational experience of visitors to the region.

Key insights from the information compiled in the flow accounts include (refer to Table S3 for the headline physical and monetary values estimated for each ecosystem service):

* Recreation and tourism is estimated to be the most highly valued ecosystem service based on the number of visits to the LGA’s of the GORCAP EEA region of 3.9 million per year in 2019 including domestic daytrip (2.1 million), domestic overnight (1.6 million) and international (0.2 million). Around half of these visits are estimated to be to the Surf Coast (1.8 million). Approximately 375,000 of these visits are estimated to be “active visits” that meet certain physical activity guidelines (and therefore provide a health benefit).[[1]](#footnote-2) The economic value of recreation and tourism in the GORCAP EEA region is estimated at between $61 million a year and $560 million a year in 2019. The lower bound is based on the estimated contribution of ecosystems within the region to Gross Value Added (GVA) in 2019 which benefits industry. The upper bound is based on the estimated:
  1. Welfare value (based on travel cost) of recreation within the GORCAP EEA region of $514 million in 2019 which benefits households (a proportion of this is captured by industry as GVA).
  2. Improved productivity of the Australian labour force from “active visits” by domestic visitors of $39 million in 2019 benefits Australian industry.
  3. Avoided medical costs to Australian households and government of $7 million in 2019 from “active visits” by domestic visitors, $5 million of which is estimated savings to the government and $2 million to households.
* Global climate regulation service is estimated based on avoided release of carbon stocks which total 35.5 million tCO2e in the GORCAP EEA area, with the mapped distribution of this service showing that the stock is most heavily concentrated in the region’s forests (24 million tCO2e). This ecosystem service is valued at between $63 million per year based on the avoided cost of greenhouse gas abatement or offset measures and $182 million per year based on the avoided damages to society (social cost of carbon).
* Coastal protection ecosystem service is mapped across the GORCAP EEA region. The estimated magnitude of exposure reduction is uncertain as it is based on a bio-physical modelling approach using global data and assumptions that is more suited to State/national level analysis. However, the analysis is useful because it suggests that coastal wetland (saltmarsh, seagrass and mangrove) ecosystems reduce hazard exposure to storm surges and sea level rise to varying degrees along most (239 kilometres) of the GORCAP EEA region coastline. The monetary value of this ecosystem service based on replacement cost of built infrastructure providing equivalent exposure reduction is between $3 million per year and $10 million per year or $51 million and $205 million in total over a 40 year period. This is assumed to directly benefit the government on the basis that it would fall to the public sector to provide the replacement built infrastructure in the absence of this ecosystem service (as it is a public good).
* Educational visits supported by the ecosystems of the GORCAP EEA region are estimated to total 33,000 in 2019 with high confidence, with key hotspots being mapped across the region including Anglesea (11,270 visitors), Torquay (6,854 visitors), and Warrnambool (4,646 visitors). The monetary value of these visits should be viewed as a lower bound as it is based on expenditures ($0.6 million per year) and the contribution of ecosystems to education and training GVA ($2.9 million per year) and not the true economic value of educational benefits associated with these trips including improved learning and life skills, mental health benefits and environmental awareness.
* The biomass for food estimate is driven mainly by agricultural farming, with an estimated 28,000 tonnes of arable output (crops and hay) and approximately 160,000 livestock valued at around $11 million a year based on a resource rent (i.e., isolating the contribution of the ecosystem from other inputs such as labour and machinery). Whilst this production occurs on non-GORCAPA land, the distribution of farmland suggests that the Authority could consider if there is a link between primary production (i.e., agricultural production) and the quality of water bodies (i.e., due to potential diffuse pollution) in the GORCAP EEA which score 34 on the stream index and 31 on the estuaries index out of 50. The reef habitats of the GORCAP EEA, which are on Crown land, support an estimated 269 tonnes of abalone harvesting in the GORCAP EEA region valued at approximately $0.3 million a year based on resource rent, which is expected to be an underestimate because the reef habitats within the GORCAP EEA region are important larval sources for abalone to the east of the region.

Biomass for timber is estimated to be low production (33,000 m3 per year) and resource rent value ($0.25 million per year) and is all on non-Crown land, apart from a small area (14 hectares) of plantation that is perpetually leased and which produces approximately 250 m3 per year.

Table S4 shows the aggregated supply and use table which captures the “supply” of ecosystem services from ecosystem assets owned by different economic units (Crown vs non-Crown where possible) and “used” by other economic units/beneficiaries. Key insights from the information compiled in the supply and use account are:

* There are significant estimated benefits provided to households (over $500 million a year), government (approximately $10 million a year) and industry (over $100 million a year).
* These benefits originate from both Crown and non-Crown land, with this split provided where this is possible (this is not possible for recreation and education as it has not been possible to tie the delivery of these ecosystem services to specific ecosystems/ land areas with the current data available).

Households directly benefit from global climate regulation and recreation (welfare and avoided health costs). Government directly benefits from coastal protection and recreation (avoided health costs). Industry directly benefits from timber, food, recreation (productivity gains and GVA) and education (expenditure/GVA). (There are also indirect benefits of these ecosystem services that flow across these “users”).

The uncertainty ratings (scale of 1 (low) to 9 (high)) are shown as a guide for future work to refine the analysis that’s been undertaken for this initial GORCAP EEA and improve its robustness for decision making. The remainder of this concluding section sets out suggested next steps to refine and expand the GORCAP EEA in order to further its practical use to inform decision making within the region.

Table S1. Headline extent account for GORCAP EEA in 2019

|  |  |  |  |
| --- | --- | --- | --- |
| **Asset stock characteristic** | **Estimate** | **Metric** | **Uncertainty** |
| Broad asset extent: Marine | 128,268 | Hectares | Medium |
| Broad asset extent: Alpine | 0 | Hectares | Medium |
| Broad asset extent: Shrubland | 947 | Hectares | Medium |
| Broad asset extent: Grassland | 843 | Hectares | Medium |
| Broad asset extent: Forest/woodland | 35,659 | Hectares | Medium |
| Broad asset extent: Coastal margins | 1,466 | Hectares | Medium |
| Broad asset extent: Farmland | 27,394 | Hectares | Medium |
| Broad asset extent: Freshwater and wetland | 2,171 | Hectares | Medium |
| Broad asset extent: Urban | 3,128 | Hectares | Medium |
| **Total** | **199,307** |  |  |

Figure S2. Spatial distribution of ecosystem assets across the GORCAP EEA in 2019 (DELWP, 2020)

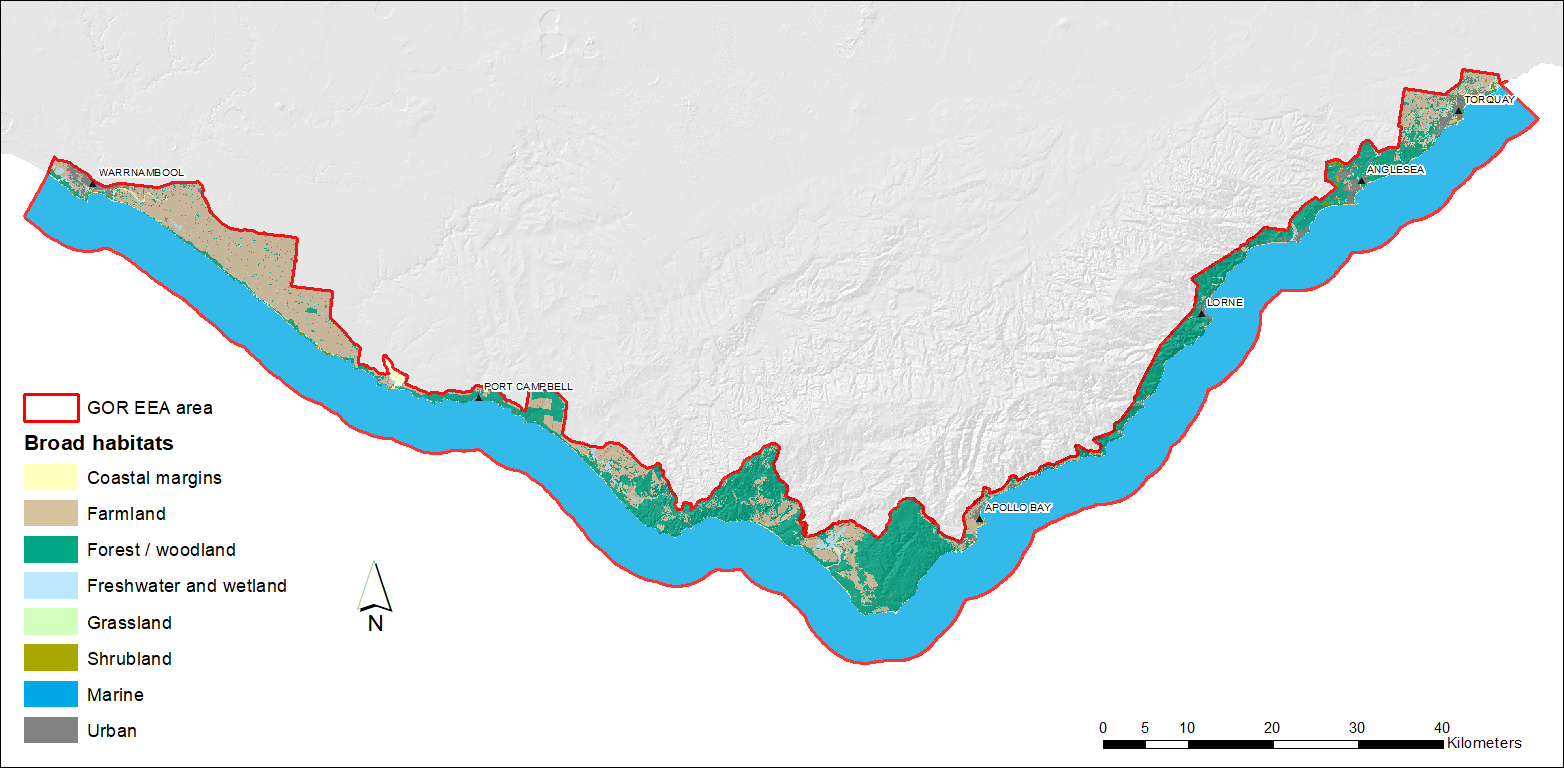


Table S2. Headline condition account for GORCAP EEA

Ecological condition – Biodiversity

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Native vegetation condition | Terrestrial | Existence/ option value | 75m grid | DELWP (2017) | 2017 | Score 1–100 | 29 | 73 | 45 | Medium |
| Habitat importance-threatened species | Terrestrial | Existence/ option value | 225m grid | DELWP (2016c) | 2016 | Score 1–100 | 54 | 77 | 63 | Medium |
| Threatened flora | Terrestrial | Existence/ option value | Point data | DELWP (2021) | 2021 | Species count | 63 | 72 | 89 | Medium |
| Threatened fauna | All | Existence/ option value | Point data | DELWP (2021) | 2021 | Species count | 53 | 64 | 70 | Medium |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Late Mature | – | – | 31.6% | Low |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Mature | – | – | 22.8% | Low |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Regenerating | – | – | 0.1% | Low |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Regrowth | – | – | 2.6% | Low |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Senescent | – | – | 23.1% | Low |
| Forest agee | Terrestrial | Existence/ option value | 1:25k | DELWP (2021d) | 2021 | % Uneven-aged | – | – | 19.9% | Low |
| Above ground vegetation biomassa | Terrestrial | Timber/Global Climate Reg | 30m grid | DELWP (2018b) | 2017 | Tonnes/Ha (forested) | – | – | 490 | Low |
| Above ground vegetation biomassa | Terrestrial | Timber/Global Climate Reg | 30m grid | DELWP (2018b) | 2017 | Tonnes/Ha (non-forested) | – | – | 227 | Low |
| Abalone biomass | Marine/ Coastal Margin | Food | 30m grid | Ierodiaconou et al (2018) | 2018 | Tonnes | – | – | 32,000 | Medium |
| Abalone biomass | Marine/ Coastal Margin | Food | 30m grid | Ierodiaconou et al (2018) | 2018 | % Victoria total | – | – | 39 | Medium |

Ecological condition – Soil

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| Coastal acid sulphate soil susceptibility | Any/All | Saltwater ecosystem services | 1:100k | DJPR (2003) | 2003 | Ha | 1,768 | 2,082 | 3,849 | Medium |
| Landslip susceptibility | Any/All | Erosion regulation | 1:250k | DJPR & A.Miner (2017) | 2017 | Ha (high and v.high) | 21,838 | 19,377 | 41,215 | Medium |

Ecological condition – Water

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| Stream condition (index) | Streams | Freshwater ecosystem services | 1:25k | DELWP (2010) | 2010 | Score 0-50 | 32 | 34 | 34 | Medium |
| Estuary condition (index) | Estuaries | Freshwater ecosystem services | 1:25k | DELWP (2021b) | 2021 | Score 0-50 | n/a b | 31 | 31 | Medium |

Ecological condition – Carbon

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Carbon stock | All | Global climate regulation | 100m grid | DISER (2021) | 2019 | tCO2e | – | – | 35,500,000 | Medium |

Socio-economic characteristics – Location

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Landscape/ seascape views from road | All | Aesthetics/ Recreation | 25m grid | DELWP (2016d) | 2016 | % of viewshed | 87%c | 13% | 100% | Low |
| Light pollution | All | Aesthetics/ Recreation | 350m | Stare (2021) | 2019 | Bortle Scale 1-9 | – | – | 1 | Low |

Socio-economic characteristics – Non-Indigenous cultural assets

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Assets of historic cultural heritage | All | Existence/ Recreation | Point data | DELWP (2019c) | 2019 | Count | 36 | 129 | 165 | Low |
| Shipwrecksd | Marine | Recreation and Tourism | Point data | DELWP (2019c) | 2019 | Count | 4 | 30 | 34 | Low |

Socio-economic characteristics – Governance and management

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CoastCare | Coastal margin | Community cohesion | n/a | DELWP | 2021 | Number people | – | – | 1,300 | Low |
| Community stewardship | All | Community cohesion | n/a | Various | 2021 | Number groups | – | – | 51 | Low |
| National parks and nature reserves | All | Various | 1:25k | DELWP (2021c) | 2021 | Ha | – | – | 33,400 | Low |
| National parks and nature reserves | All | Various | 1:25k | DELWP (2021c) | 2021 | Number | – | – | 13 | Low |
| Other conservation reserves | All | Various | 1:25k | DELWP (2021c) | 2021 | Ha | – | – | 7,500 | Low |
| Other conservation reserves | All | Various | 1:25k | DELWP (2021c) | 2021 | Number | – | – | 52 | Low |

Socio-economic characteristics – Built assets

| Condition category/ Indicator | Ecosystem | Primary ecosystem service being supported | Resolution | Source | Year | Metric | Condition ScoreNon-GORCAPA | Condition ScoreGORCAPA | Condition ScoreTotal GORCAP EEA | Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Piers and jetties | Marine | Recreation and Tourism | Point data | DELWP (2020) | 2020 | Count | 0 | 7 | 7 | Low |
| Boating Infrastructure | Marine | Recreation and Tourism | Point data | DELWP (2020) | 2021 | Count | 0 | 33 | 33 | Low |
| Walking tracks | Terrestrial | Recreation and Tourism | 1:25k | DELWP (2021d) | 2020 | Km | 17 | 222 | 239 | Low |
| Bike paths and mountain bike trails | Terrestrial | Recreation and Tourism | 1:25k | Trailforks (2021) | 2021 | Km | – | – | 69 | Medium |

a Vegetation biomass data is only available on public land. b There are no estuaries outside the GORCAPA area. c The majority of views from the GOR are to the ocean, which only a small part is within GORCAPA area. d Shipwrecks are included within “Assets of cultural heritage”. e Relative forest age dataset is only populated for public land forests.

Table S3. Summary flow (physical and monetary) accounts for GORCAP EEA in 2019 with uncertainty assessment

| Ecosystem service | Scope | Physical flow Estimate | Physical flow Metric | Physical flow Uncertainty | Monetary flow (present value, 2021 prices) Estimate | Monetary flow (present value, 2021 prices) Metric | Monetary flow (present value, 2021 prices) Valuation approach | Monetary flow (present value, 2021 prices) Uncertainty |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Coastal protection | Seagrass, mangrove, saltmarsh | 239 | km | High | $3m to $10m | $m/yr | Replacement cost | High |
| Coastal protection | Seagrass, mangrove, saltmarsh | 239 | km | High | $51m to $203m b | $m | Replacement cost | High |
| Education | All ecosystems | 33,000 | Students | Low | $0.6m to $2.9m | $m/yr | Expenditure to GVA contribution | High |
| Biomass for food: Agriculture | Farmland | 28,000 | Tonnes | High | $11.4m | $m/yr | Resource rent from market prices a | High |
| Biomass for food: Agriculture | Farmland | 164,000 | Livestock | High | $11.4m | $m/yr | Resource rent from market prices a | High |
| Biomass for food: Wild fish | Seagrass – catch increase of 4 species | 2,500 | Kg | High | $0.007m | $m/yr | Resource rent from market pricesa | High |
| Biomass for food: Wild invertebrates | Reefs – abalone harvest | 269 | Tonnes | High | $0.3m | $m/yr | Resource rent from market pricesa | High |
| Climate regulation: Carbon retention | All ecosystems | 35.5million | tCO2e | Medium | $63m to $182m | $m/yr | Carbon price to social cost of carbon | High |
| Climate regulation: Carbon sequestration | 3 broad ecosystems/20% GORCAP EEA area | 130,000 | tCO2e | Medium | $6m to $17m | $m/yr | Carbon price to social cost of carbon | High |
| Recreation/tourism: Total | All ecosystems | 3,900,000 | Visitors | High | $61m to $560m | $m/yr | GVA contribution to Welfare and avoided costs | High |
| Biomass for timber | Plantation forest | 30,000 | m3/yr | Medium | $0.25m | $m/yr | Resource rent from market pricesa | Medium |
| Aestheticsd | All ecosystems | 84 | Undisturbed view % | – | – | – | – | – |
| Social/community cohesiond | All ecosystems | 77 | Voluntary Groups | – | – | – | – | – |

a The contribution of the ecosystem to these socio-economic benefits is isolated at the monetary valuation stage in what is known as a “resource rent” calculation which strips out the contribution of other inputs (e.g., cost of human labour, machines etc) from the market price of the good/service.

b This is a capitalised value to show the total cost of building a sea wall (or alternative infrastructure) to replace the exposure reduction provided by coastal wetlands in the GORCAP EEA region over a 40 year period.

c This is not additive to the carbon retention service but is presented here to provide an alternative perspective on the ecosystem service, albeit with partial coverage (only 3 broad ecosystems / 20% of total GORCAP EEA area).

d This is used as an indicator of the delivery of ecosystem services.

Table S4. Summary supply and use account

| Metric | Household | Government | Industry | Ecosystems Crown | Ecosystems Non-Crown |
| --- | --- | --- | --- | --- | --- |
| Supply: $ AUD (2021) |  |  |  | $1m/yr – $3m/yr | $12m/yr |
| Supply: $ AUD (2021) |  |  |  | $625m/yr to $745m/yr | $625m/yr to $745m/yr |
| Use: $ AUD (2021) | $515m/yr to $640m/yr | $6m – $8m | $112m |  |  |

This initial, proof-of-concept coastal and marine account for the Great Ocean Road Coast and Parks will be a useful contribution to the potential development of Victoria-wide environmental-environmental-economic accounts for coastal and marine areas which could inform the work being undertaken as part of Victoria’s Marine and Coastal Strategy 2022 as required under the Marine and Coastal Act 2018. The information compiled in the GORCAP EEA can be used:

1. As evidence of the total value of the Great Ocean Road Coast and Parks’ ecosystem assets to the Victorian, Australian and global economy and community and the distribution of this across the region. The analysis undertaken for the GORCAP EEA suggests that the ecosystems of the region deliver a range of ecosystem services that provide significant socio-economic value to society, estimated to be worth over $100 million a year to the economy or over $700 million per year to the community for the subset of ecosystem services assessed.
2. To build the business case for investment and/or policy/management to maintain current ecosystem status and productivity. The sustained delivery of the estimated annual benefits is dependent on current ecosystem status to be maintained (at a minimum). The distribution of socio-economic value is mapped (for most ecosystem services) across the region, enabling the identification of hotspots that deliver significant value to society that could support prioritisation of actions to maintain ecosystem asset stocks by the Authority.
3. To assess the effectiveness of existing policy and environmental management and identify opportunities to enhance ecosystem status and productivity through future policy/management/investment. Information on the current status and productivity of ecosystems in the GORCAP region can be judged against policy/management targets and where performance is poor this is suggestive of the need for improvement. For example, the GORCAP EEA condition account suggests that the status of native vegetation and freshwater/estuaries could be an area for improvement which could deliver enhancements in ecosystem service delivery (i.e., improved recreational experience, greater carbon sequestration etc).
4. To improve understanding of the trade-offs in the use of contested assets (e.g., between the use of ecosystem assets for recreation or biodiversity) and land use change (e.g., loss of ecosystems for built development). The information in the GORCAP EEA can be used to estimate what will be lost if the current ecosystems in the region are degraded/destroyed under specific land-use scenarios.
5. As a basis for collaborative working with land/water management organisations by using the accounts to explore synergies across ecosystems/geographic areas. This includes impacts and dependencies of assets under the Authority’s management with other ecosystems/geographic areas.
6. As an underpinning evidence base to explore other policy and/or management issues including links to other reporting frameworks such as the Sustainable Development Goals, making the case for investing to expand ecosystem assets and estimating the magnitude and value of the loss of ecosystem service associated with pressures and risks.

Key opportunities for future work include:

* Refine the land cover extent information, using more highly resolute datasets including (potentially) Earth Observation data/the work being undertaken by Geoscience Australia (an Australian Government agency) to develop national land cover datasets utilising the FAO of the UN Land Cover Classification System.
* Expand the coverage of ecosystem condition account to include forthcoming information on ecological health and socio-economic characteristics of the marine and coastal ecosystems of the GORCAP EEA region, including from the Office of the Commissioner for Environmental Sustainability (OCES’s) coastal and marine indicator set and DEECA’s proposed programme of work to develop marine condition information across 4 pillars including (i) Structural score (ii) Econet importance features (iii) Priority marine feature scores (iv) Good ecological status;
* Refine the analytical approach to estimating the physical and monetary estimates including:
* Validate the estimates of coastal protection service using a field-based assessment.
* Explore ways to capture the true economic value of educational visits.
* Explore the specific type of arable and pastoral farming that occurs in the GORCAP EEA region.
* Assess the contribution of ecosystems in supporting the life cycle of a broader number of wild fish species.
* Refine the estimated contribution of reef habitats to abalone catch given role as important larval source.
* Expand the coverage of carbon sequestration beyond the three broad ecosystems currently assessed.
* Explore using mobile phone data and/or access movement data to quantitatively monitor recreational visitation activity.
* Seek to estimate the type of nature based activity being undertaken in the GORCAP EEA region.
* Explore methods and data to assess and value ecosystem related volunteer days and hours.
* Explore estimating the users of aesthetic view-scapes including through geo-tagged social media data.
* Refine assumption of 20 percent market value being estimated resource rent for market goods (where this has been adopted in the absence of information).
* Consider using bio-physical models (e.g., InVEST) to explore confidence in estimates and/or expand coverage of ecosystem services assessed.
* Expanding/integrating the GORCAP EEA with other information to broaden the use of the account in the following ways:
* Explore estimating physical and monetary values of ecosystem services that were scoped out of this initial GORCAP EEA including air quality regulation, landslide regulation, amenity, local climate regulation, research, noise and odour regulation, biomass – energy water provision, flood risk regulation, water quality regulation.
* Applying historical data to the framework that has been developed for GORCAP EEA to enable changes in ecosystem status and productivity to be understood over time by comparing with the GORCAP EEA for 2019. The “historical” period(s) adopted will depend primarily on data available.
* Applying projections of key variables (population, climate change etc.) to estimate the future magnitude and value of ecosystem services into the future as a capitalised value of ecosystem stocks (like the value of a house), rather than the annual value at a point in time (like the rent paid on a rental property) which can be useful in demonstrating the value of ecosystems over the long term.
* Consider integration of the GORCAP EEA information with other information to report on the Sustainable Development Goals (SDGs) which are a collection of 17 interlinked global goals designed to be a “blueprint to achieve a better and more sustainable future for all”.
* To build the business case for investment to *expand* ecosystem assets within the GORCAP EEA. The underlying data and analysis that is used to build the GORCAP EEA could be applied to estimate the physical and monetary value of prospective changes in ecosystem extent that might be delivered through future policy/ management/investment. For example, options to restore historical ecosystem extent within the GORCAP EEA could be assessed and estimates of the type, magnitude and value of ecosystem service provision could be developed to inform decision making.
* To assess the magnitude and value of the loss of ecosystem service associated with pressures and risks in the GORCAP EEA region. Key pressures on coastal ecosystems globally are climate change induced sea level rise and increasing storm intensity leading to coastal erosion and flooding; industrial expansion including fishing, forestry, agriculture, tourism, oil, gas, renewables; overfishing; pollution to water, land and air; invasive (non-native) species; urban expansion; coastal erosion and noise.

1. Whilst the LGAs cover a larger area than the boundary of the GORCAP EEA, the expectation is that this figure is a suitable representation of the number of visits taken to the GORCAP EEA region given that Parks Victoria data obtained for this GORCAP EEA estimates 2.2million visits to the Twelve Apostles alone in 2019 [↑](#footnote-ref-2)