Soil Carbon in South Australia

Volume 1: Soil Carbon Forward Plan

DEW/PIRSA/Landscape South Australia

Susan Sweeney, Amanda Schapel (PIRSA), Craig Liddicoat and Tim Herrmann

Department for Environment and Water
March, 2021

DEW Technical note 2021-04

Government of South Australia

Department for Environment and Water

Department for Environment and Water
Government of South Australia
March 2021

81-95 Waymouth St, ADELAIDE SA 5000
Telephone +61 (8) 8463 6946
Facsimile +61 (8) 8463 6999
ABN 36702093234

www.environment.sa.gov.au

ISBN 978-1-925964-96-7

Preferred way to cite this publication

Sweeney S, Schapel A*, Liddicoat C & Herrmann T (2021). *Soil Carbon in South Australia Volume 1: Soil Carbon Forward Plan*, DEW Technical Note 2021/04, Government of South Australia, Department for Environment and Water, Adelaide.

*PIRSA

Acknowledgements

This Soil Carbon Forward Plan, which informs strategy development, policies and action within SA Government to enhance the health and long-term storage of carbon in South Australian agricultural soils, is a culmination of many years of collaboration between DEW, PIRSA and Landscape SA (and their predecessors) in project work to develop a greater understanding of soil carbon.

The authors wish to thank Timothy Cavagnaro, University of Adelaide, Mary-Anne Young, Jennifer Barwick PIRSA, Daniel Hanisch, Louisa Perrin, Graham Green DEW and James Hall Landscape SA for reviewing this document.

Landscape cover photo – Amanda Schapel - PIRSA

Contents

Purpose

The purpose of this collaborative DEW/PIRSA/Landscape SA Soil Carbon Forward Plan[1] is to inform strategy development, policies and action within SA Government to protect and improve the health and productivity of our soils and enhance the long-term storage of carbon in South Australia's agricultural and rangeland soils.

Rationale

There are many benefits from protecting and restoring soil carbon, including sustaining and improving soil health, productivity, resilience and ecosystem services. There is also the potential for carbon sequestration in soils to offset carbon emissions and reduce the deleterious effects of climate change. In many systems, the historical depletion of soil organic carbon (SOC) stocks represents an opportunity to restore soil carbon through a variety of land management approaches. It is important to identify and implement practices that maintain or improve soil carbon whilst balancing and improving economic sustainability and global food needs.

This Soil Carbon Forward Plan represents an operational strategy that will focus on priority and strategic actions to progress the understanding of the potential for South Australian soils to store soil carbon, including opportunities, barriers and research gaps. It will also identify how to encourage more landholders to take up management practices that will improve carbon storage and reduce soil-based emissions, resulting in enhanced productivity and environmental co-benefits. It will provide direction and inform priorities for:

- DEW and PIRSA climate change teams, Landscape SA regions, Australian government, agribusiness advisors, researchers, funding bodies and land managers.
- Soil monitoring and reporting requirements to support Report Cards, state and regional landscape plans and other reports
- Initiatives under the South Australian Government Climate Change Action Plan and Carbon Farming Roadmap

It will also provide:

- Strategic and technical advice regarding options and practical implementation of carbon sequestration and offset policy
- Assessment of opportunities to increase soil carbon, implications for productivity, risks due to a drier/warmer climate, soil modification, land use and management practices, research priorities and carbon farming policy options.
- Targets and potential actions to increase average SOC in all SA agricultural soils and regions to at least 75% benchmark levels and to reduce soil based GHG emissions.

[1] Note that this Soil Carbon Forward Plan is a living document that will likely be updated each year so look for the most recent year when downloading.

Scope and vision

This Plan will:

- Identify factors, opportunities, knowledge gaps, strategies and actions required to optimise SOC in SA soils*
- Provide information for Government agencies' policies, programs and actions.
- Represent an active resource, updated over time.

*Note: the agricultural zone (southern SA) is emphasised in the current Plan due to the greater knowledge and data that is available for this zone. Information and priorities for rangelands soils are expected to develop over time.

Links to other initiatives/strategies

- South Australian Government Climate Change Action Plan
- DEW's Carbon Farming Roadmap
- DEW's Climate Change Science and Knowledge Plan for South Australia

Sustainable Agricultural Network

Government policies, management, technical capacity and project implementation related to soils and their use in agriculture, currently spans DEW, PIRSA and Landscape SA. These agencies have complementary aims of working to improve the health and sustainability of SA soils. Minimising degradation, improving soils and sustainable economic development (DEW/Landscape SA focus) are closely linked to land use, management and the productivity of plant-soil systems (PIRSA focus). Collaboration, coordination and complementary skill sets of DEW, PIRSA and Landscape SA provides a greater influence on land managers by combining productivity, profitability, improvement in soil health and building natural capital.

The DEW, PIRSA and Landscape SA agencies' collaboration is known as the Sustainable Agriculture Network and provides a mechanism to disseminate and gather consistent information across the regions, to support state-wide planning, management and reporting needs such as this Soil Carbon Forward Plan.

Background

The benefits of Soil Organic Carbon (SOC) and the ecosystem services it provides are well documented. Key amongst these is providing a primary means of absorbing and reducing earth's greenhouse gas emissions. SOC is the store of carbon in the soil that readily exchanges (acting as a sink or source) with carbon in the atmosphere. It is estimated that worldwide, soils contain approximately double the carbon present in the atmosphere, and approximately three times the carbon contained in living plants and animals.

Soil organic matter (SOM), of which SOC is a key component, is critical for: protecting against erosion; as a water purifying medium; a sink and ameliorating agent for organic wastes and environment pollutants; and supporting biogeochemical-nutrient cycles (e.g. the worldwide carbon and nitrogen cycles), therefore helping to sustain life on earth. Increased SOM/SOC improves soil structure thereby improving drainage and aeration, and boosts retention and cycling of water and nutrients for plants. These functions are fundamental not only for agricultural production but also for whole ecosystems.

An adequate amount of SOC is important for a healthy community of soil microbes (i.e. microbiome - comprising invertebrates, bacteria, fungi, viruses) that provides many benefits to plant growth. Microbial activity, supported by SOC, helps turnover nutrients and deliver them in plant-available forms. SOM/SOC can also help provide diverse microbial habitats and feed stocks, which support microbial diversity. In turn, this microbial diversity can provide disease-suppressing capacity to soils, through competitive exclusion and diverse defensive mechanisms against potential pathogens. The soil life supported by SOM/SOC provides much of the world's terrestrial biodiversity, while SOM and soil biodiversity together provide ecosystems with much of their resilience and resistance (i.e. capacity to withstand disturbance).

SOC is derived from plant and manure residues, biological detritus and root exudates via photosynthesis of atmospheric carbon. SOC levels are primarily controlled by soil type (especially clay content), soil condition (e.g. soil pH), climate and land management.

Historically, it is understood that considerable SOC was lost upon clearing, burning and initial cultivation of land for agriculture, due to the mineralisation and of mostly perennial organic matter supply from growing biomass or litter. Subsequent losses of SOC have mainly occurred due to soil erosion. Lesser production of above and below-ground biomass by crops and pastures (from exhaustion of soil nutrients, disease and pests as well as the growing of mostly annual crop and frequently annual pasture species), extensive soil disturbance by cultivation and over-grazing have also contributed to SOC loss.

However, a dramatic improvement in farming practices since the mid-1940's has stabilised much of the historic soil erosion and, in many areas, started the process of restoring soil carbon. Intensification of cropping rotations in the 1980's placed increasing pressure on soil C, although this was balanced to some extent by the widespread adoption of no-till and stubble retention systems, and increased biomass production from agronomic practices such as appropriate fertilisation and growing a range of crop and pasture types to control disease. As biomass inputs to soils from these annual systems are high, increased soil carbon storage might be expected. However, the counteracting influence of microbial breakdown of soil carbon is likely to be accelerated in highly productive, biologically active soils. Also, the effect of different forms of plant residue inputs (e.g. simple post-harvest crop residues vs. grazing-induced sloughing of root materials in pasture systems vs. inputs of composts/manures/biochars) on soil carbon processes and storage, warrants further investigation.

Current evidence suggests there have been moderate improvements in SOC from 1989 to 2007, particularly under permanent pasture. Changes since 2007 are not known due to a lack of publicly available data. There is potentially significant opportunities across many soils and land use systems to further increase SOC towards an upper storage limit, while simultaneously improving soil health, increasing crop and pasture productivity, supporting ecosystem services and offsetting carbon emissions.

Optimal SOC levels for each soil type, climate and land use combination, need to be determined to provide realistic targets for land managers and to accurately gauge the potential for SOC increase. Decreased rainfall and increased temperature under projected climate change scenarios represent a risk for the stability of soil carbon stores in the future.

State of soil carbon in SA (circa 1990-2000)

Initial work has been undertaken consolidating and analysing existing soil and biophysical knowledge and data to understand baseline soil carbon values using data from commercial soil testing laboratories and SA's soil mapping datasets (Figure 1). From this analysis, it is estimated that the 0-30cm SOC stocks of cleared agricultural land is around 320 Mt. The dominance of data from 1990 to 2000 strongly influences this analysis.

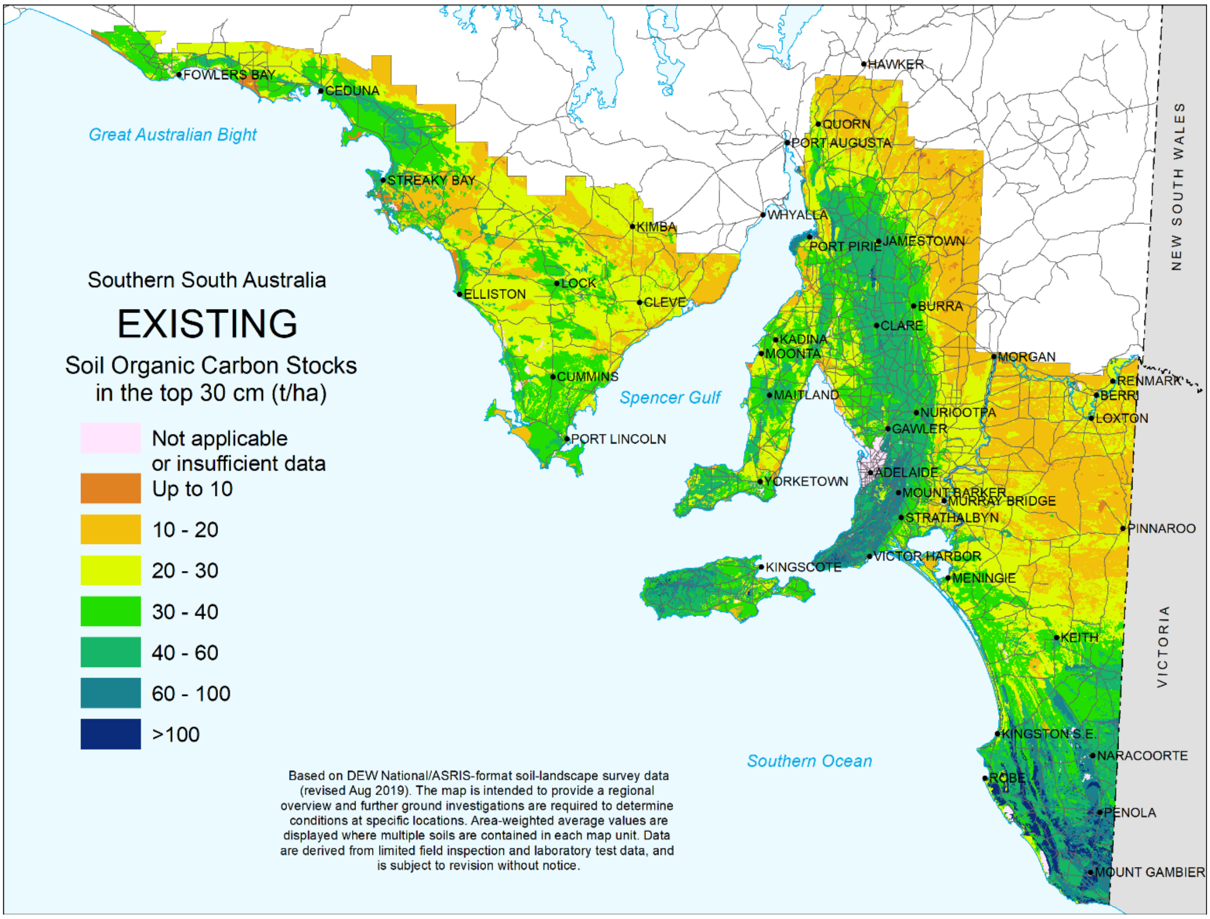

Fig 1. Existing surface SOC 1990-2000 (based on DEW ASRIS-format data). Reliable data for rangelands is currently not available.

How much more soil organic carbon can be stored in SA's soils?

Analysis of two separate extensive datasets provides indications of the potential to increase SOC storage in SA's agricultural soils. Regional benchmark SOC concentrations (mass %) have been determined for the State and individual agricultural districts by soil texture and land use, based on approximately 36,000 soil laboratory test results over the period 1989-2007, identified by post code or Hundreds (refer to Schapel et al. 2020[2] for benchmark SOC% values).

Using the State's soil attribute mapping datasets (circa year 2000), the likely distributions of SOC stocks (t/ha, 0-30 cm depth) within various soil types and rainfall zones were then determined to assess and map a hypothetical 'opportunity' to store additional SOC. The scenario below (Figure 2) assumes that SOC stocks have the potential to increase up to the 75th percentile of SOC stock values for all soils of the same soil type and rainfall zone. Increasing SOC storage in soils to this extent could increase existing SOC stocks by over 100 Mt to around 450 Mt. In this scenario, no opportunity for increase is assumed where SOC stocks were already below the 25th percentile (due to limiting conditions) or above the 75th percentile (already close to upper potential). This work represents a "first pass" modelling exercise based on existing DEW national/ASRIS-format soil mapping datasets.

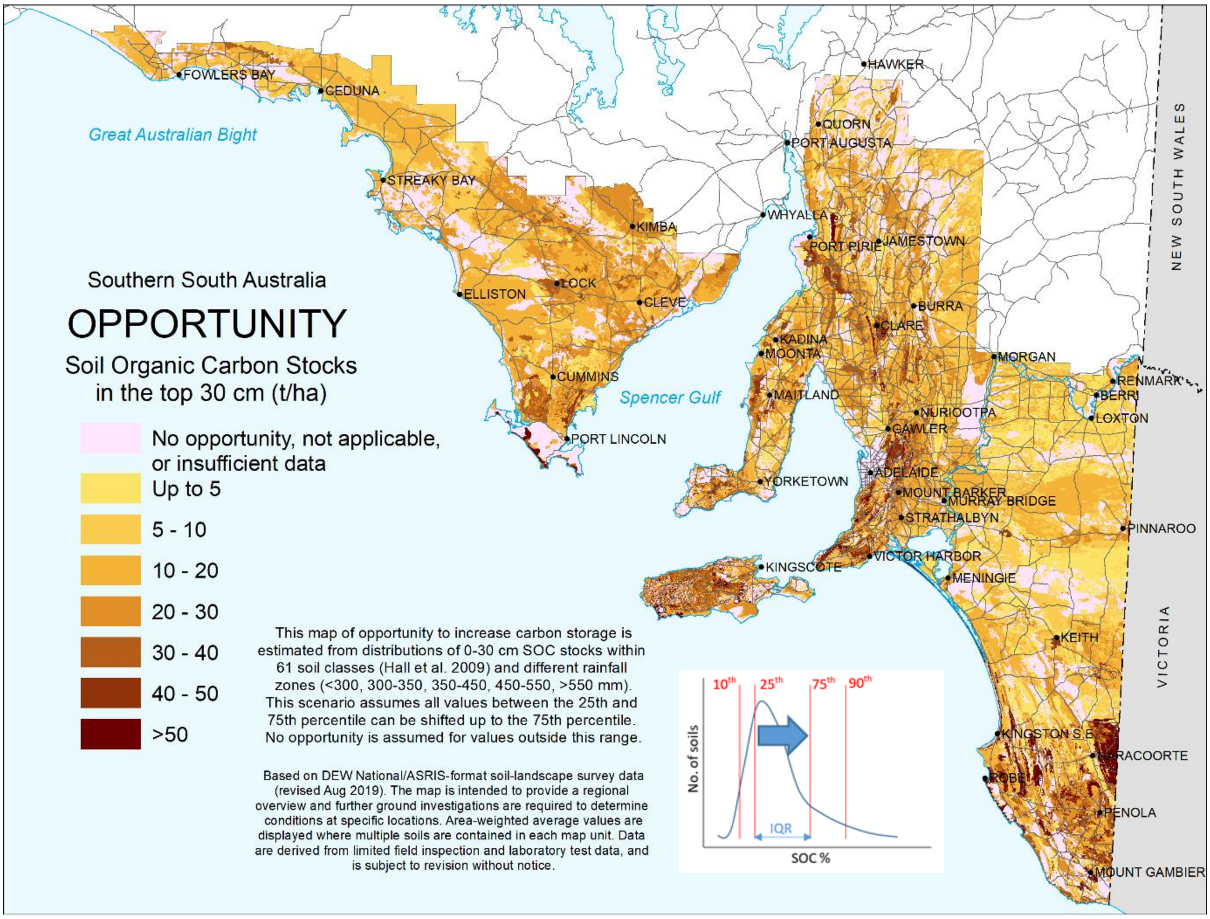

Fig. 2. Opportunity for surface soil OC % - all values between the 25th and 75th percentile can be shifted to the 75th percentile. Reliable data for rangelands is currently not available.

The following outcomes and actions identify approaches to achieve these soil carbon opportunities in South Australia.

---

[2] Schapel A, Liddicoat C, Sweeney S, Herrmann T (2020). State Soil Carbon Baseline: Part 1 – Data analysis 1989-2007. Department for Environment and Water and Primary Industries and Regions South Australia, (in preparation).

Outcomes and Actions:

Intent: Inputs of SOC equals or exceeds SOC losses across the agricultural soils of South Australia.
Note: Cost: Low = 50K, Med = 50-200K, High > 200K, **Ease:** 1 hard – 5 easy, **Impact**: 1 low impact – 5 high impact

Theme 1. **Development of a South Australian Soil Carbon Monitoring Program**

Outcome 1. Enhanced data collection and monitoring of SOC status for SA soils is achieved through strategic sampling, partnerships with regional groups and soil stakeholders, collaborative projects, and improved soil data management and availability.

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
1.1	Negotiate acquisition of SOC data from commercial test labs (esp. 2007-2020; 2020-2030)	1-3	High, esp. 2007-20	Low	4	5	DEW, landscape boards, PIRSA, Universities, Ag industry, farm consultants, agribusiness, RDCs, NCST, Commonwealth
1.2	Establish and maintain long term soil C monitoring program and sites to ensure representative up-to-date soil data collection. Repeat at regular intervals (e.g. 5 or 10 year). Noting 10-year timeframe for reliable measurement.	3-5	High	Med - High	3	5	
1.3	Encourage landscape boards and other collaborators to include appropriate SOC measurements in existing soil test programs, and particularly for activities supported by government funds, to provide data to the State Soil Site database (managed by DEW).	1-3	High	Existing	5	4	
1.4	Upgrade the State Soil Site database to improve input and access to data, enabling public/non-public and quality-flagged data to provide for recording of SOC data from a range of sources and appropriate analysis and reporting	1-3	High	Med	3	5	
1.5	Secure legacy project soil C data into the State Soil Site database.	1-5	Low	Low	4	3	

Theme 2. **Data analysis and reporting**

Outcome 2. Data management, analysis, mapping and understanding of SOC variability and change is improved

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
2.1	Develop correlation between laboratory and DEW's national/ASRIS-format spatial data.	1-3	High	Low	4	3	Research Bodies; PIRSA; DEW; Industry Groups, landscape boards; Farming System Groups, NCST
2.2	Analysis of SOC trends (2007-2020), subject to data availability	3-5	High	Low	5	5	
2.3	Revise SOC targets from new information (2007-2020)	3-5	High	Low	5	3	
2.4	Update state-wide and regional SOC trend reports every 3-5 years	1-3	High	Low	5	3	
2.5	Revise spatial analysis maps and scenarios to quantify the SOC opportunity and identify areas with the greatest potential for increased carbon storage (Linked to Action 7.4)	Every 5	High	Low	3	5	
2.6	Model the impact of climate change on SOC (decreased rainfall, increased temperature)	3-5	Med	Med	2	5	
2.7	Investigate methods of capturing, analysing, and mapping SOC data to improve understanding of SOC variability and change (e.g. in-paddock yield mapping, landscape mapping tools and software)	1-3	Med	Low	4	4	
2.8	Report on progress towards actions in the Soil Carbon Forward Plan	1-5	High	Existing	4	4	

Theme 3. Information and extension needs of land managers and industry is understood.

Outcome 3. Information and extension needs of land managers and next users is understood to drive development of information resources and extension activities

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
3.1	Develop communication and extension plan.	1-2	High	Low	4	3	Land managers, advisers, industry groups, DEW, boards, PIRSA, RDCs, Commonwealth
3.2	Identify the information format, requirements and learning platforms for land managers and next users regarding practices to maintain and enhance SOC. (May included targeted market research).	1-3	High	Low	4	4	
3.3	Improve understanding of barriers and enablers for land managers to enhance SOC	1-3	High	Low	4	4	
3.4	Regular survey of land managers conducted to determine adoption of practices and understanding relating to improving SOC (may include adaptation of LM telephone)	Every 3-5	High	Low-Med	4	3	

Theme 4. **Information resources are developed**

Outcome 4. Information resources using existing knowledge on practices that maintain and improve SOC are developed.

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
4.1	Develop and maintain a compendium of historic and current SOC improvement/management trials and demonstrations	1-3	Med	Low	4	4	Land managers, advisers, industry groups, DEW, landscape boards, PIRSA, Universities, CSIRO, RDCs, Commonwealth
4.2	Develop a summary of 'best bet' principles for maintaining and improving SOC including management of soil constraints, options to optimise biomass production and minimise losses of SOC – covering key soil types, climate zones and industry types.	1-3	Med	Low	4	4	
4.3	Develop suitable information resources for different audiences and learning platforms e.g. industry, next users, land managers.	1-3	High	Low - Medium	4	5	
4.4	Monitor recent and innovative developments in tools, technology, and research	1-5	Med-High	Existing - Low	4	5	
4.5	Provide data and information on the status, trend and opportunities to increase SOC	1-5	High	Existing	4	5	
4.6	Identify and compile potential sources of organic amendments (OA) including quantity and quality through collaboration with relevant industries.	1-3	High	Low	3	4	
4.7	Compile resources and information on restoring SOC in situations where SOC is much lower than expected.	1-5	Med-High	Low	4	4	
4.8	Regularly update information resources based on new knowledge and understanding, tools and methods.	1-3	High	Low	3	5	
4.9	Keep up to date on and contribute to latest information on C accounting measurement and methodologies.	1-5	High	Existing	5	3	

Theme 5. **Partnerships and collaboration developed to implement Soil Carbon Forward Plan**

Outcome 5. All collaborators working together to achieve strategic goals associated with SOC.

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
5.1	Support South Australian Government Climate Change Action Plan and ensure alignment with other strategies such as: • Carbon Farming Roadmap • South Australia's Food Waste Strategy • State Government's Growth State initiative • The food, wine and agribusiness sector plan •	1-5	High	Existing	4	4	Landscape boards, DEW, PIRSA, EPA, Universities, CSIRO, RDCs, Land managers, advisers, industry groups, Commonwealth, NCST
5.2	Support related Commonwealth initiatives including: • National Soils Strategy • National Soil RD&E Strategy • Agriculture Stewardship Package • Technology Investment Roadmap • Emissions Reduction Fund	1-5	High	Existing	4	4	
5.3	Support landscape boards to incorporate appropriate soil health strategies (including SOC) in their plans and assist with their reporting.	1-5	High	Existing	5	5	
5.4	Support soil and land management initiatives and strategies of research agencies, agricultural industries and affiliated organisations.	1-5	High	Existing	4	5	
5.5	Liaise with research organisations, industry groups, landscape boards and government agencies at State and / or regional level to identify and help develop collaborative SOC projects.	1-5	High	Existing	4	5	

Theme 6. **Increased Awareness, Technology transfer, Extension and Implementation on Farm**

Outcome 6. Practices that maintain and improve SOC are promoted and adopted to land managers

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
6.1	Provide information resources to next users through networks and electronically (linked to Carbon Farming Hub).	1-5	High	Low	4	5	Land managers, advisers, industry groups, DEW, landscape boards, PIRSA, RDCs, Commonwealth
6.2	Develop & implement training resources/ programs to build understanding and capacity of next-users to advise and support land managers	1-5	High	Med	4	5	
6.3	Encourage establishment of demonstration sites and development of case studies that provide local adaptation of practices. Data and learnings used to inform other resources and activities.	1-5	High	Low	4	5	
6.4	Encourage land managers to participate in state-wide/local SOC monitoring programs.	1-5	High	Low	5	3	
6.5	Promote the opportunity to restore SOC in sites/situations identified as low in SOC.	1-5	Med	Low	4	4	
6.6	Provide information on soil amendments including organic and clay, appropriate application rates and methods for application	1-3	High	Existing - low	3-4	5	

Theme 7. **Appropriate and relevant research and development is conducted on SOC**

Outcome 7. Consolidate expert state of knowledge, identify knowledge gaps, and shape new research to improve soil health, productivity and offset GHG emissions

Actions	Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
7.1 Develop first-pass soil C opportunity scenario matrix. Consolidate DEW-PIRSA knowledge via a matrix of scenarios (rainfall zones, surface textures/soil types/soil conditions, major farming systems) – to outline existing understanding of major SOC influences, benchmarks, potential pathways and magnitude of SOC opportunity, challenges, confidence, and knowledge gaps. (Linked to Action 4.2)	1	High	Existing - Low	4	4	DEW, PIRSA, SARDI, CSIRO, RDC's, Universities, landscape boards, Farming system groups, Commonwealth
7.2 Facilitate workshop(s) to gather expert opinion on the state-of-knowledge, key knowledge gaps and inform the development of SA soil carbon research priorities. Consideration should be given (but not limited) to the following: • Review of first-pass soil C opportunity matrix (above) • Practices to enhance and protect SOC • Mechanisms of carbon gain or loss that are poorly understood but highly relevant to SA soils • Assess state of knowledge on reasons for SOC variability by soil type, land use, rainfall (and implications for geographic regions, e.g. Ag Districts, rangelands) • Local research and trials of new/different approaches to build soil C and reduce GHG emissions incl.: farming and management systems, soil modification (e.g. claying), addressing constraints, amendments, etc.	1-2	High	Low	4	4	

	• Improved and cheaper soil C measurement methods, incl. hand-held spectral instruments, analytical tests, remote sensing, modelling, etc. • Sampling protocols and integration with spatial soil C quantification methods • Modelling sequestration rates, e.g. under scenarios of land use and management change, climate change, etc. • Whole lifecycle analyses for carbon (including emissions) • Understanding co-benefits • Estimating economic returns • Understanding the role of soil microbiomes; and potential microbial indicators for trajectory of soil C sequestration vs. decline • Exploring soil carbon opportunities for rangelands • Possible opportunities to sequester inorganic carbon in semi-arid zones via the oxalate-carbonate pathway, while maintaining soil health						
7.3	Synthesise workshop outcomes by publishing a summary of 'DEW-PIRSA / SA Soil Carbon Research Priorities'. This might be via a web page that could also track relevant research activities as they emerge.	1-2	High	Low	4	5	
7.4	Test and refine soil carbon opportunity assessments, including opportunity matrix (see Action 7.1), and state-wide models and maps (see Action 2.5)	1-5	High	Low	3	5	
7.5	Scope potential research opportunities and commence engagement with researchers	1-3	High	Existing - Low	4	4	
7.6	Consider partnering in soil carbon research projects	1-10	Med	Low - Med	4	4	

Theme 8. **Understanding and Reduction of Soil GHG emissions**

Outcome 8. Build knowledge on understanding and reducing soil-related GHG emissions and ensure alignment with Carbon Farming Roadmap

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
8.1	Be informed of research and tools involved with quantifying soil GHG sources and sinks	1-3	High	Low	4	5	DEW, PIRSA, SARDI, CSIRO, RDC's, Universities, landscape boards, Farming system groups, Commonwealth
8.2	Understand and raise awareness of practices that reduce soil GHG emissions (e.g. CO_2 and N_2O) in SA soils.	1-3	High	Low	4	5	
8.3	Develop and update tools to assist producers make informed decisions on reducing soil GHG emission rates.	1-3	High	Low	3	4	
8.4	Investigate alternative /new products or methods for reducing soil GHG emission rates.	1-5	Medium	Medium	2	5	
8.5	Develop and deliver extension material to build industry knowledge and capacity to reduce soil GHG emissions.	1-3	High	Low	4	5	

Theme 9. **Greater understanding of the economic value of SOC**

Outcome 9. The economic value of SOC is better understood.

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
9.1	Identify and compile recent information on the value of SOC, includes soil health, productivity and environmental co-benefits	1-5	5	Low-Med	3	5	DEW, PIRSA, SARDI, CSIRO, RDC's, Universities, landscape boards, Farming system groups, Commonwealth
9.2	Understand the economic cost and benefits of protecting and improving soil SOC for different environments and farming systems	1-3	5	Low-Med	3	5	

Theme 10. **Soil Carbon Forward Plan progress.**

Outcome 10. The progress of the Soil Carbon Forward Plan is regularly documented and reported on.

Actions		Time Frame (years)	Priority	Cost	Ease	Impact	Collaborators
10.1	Report on progress of Soil Carbon Forward Plan (SCFP).	ongoing	High	Low	4	5	DEW, PIRSA, CSIRO, RDC's, Universities, landscape boards, Farming system groups, Commonwealth
10.2	Annual update of SCFP	ongoing	High	Low	4	5	
10.3	Securing funding to implement the SCFP	ongoing	High	Med	2	5	

Glossary

ASRIS — Australian Soil Resource Information System

Biodiversity —The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems.

DEW — Department for Environment and Water (Government of South Australia)

Ecosystem services — All biological, physical or chemical processes that maintain ecosystems and biodiversity and provide inputs and waste treatment services that support human activities.

GHG — Greenhouse Gas

Landscape SA — Under the Landscape SA Act, nine landscape boards facilitate the sustainable management of South Australia's landscapes; represented by community members committed to partnering with the community, Aboriginal peoples and landholders.

Mineralisation — The conversion of organic N in crop residues, animal manure or humus into mineral N by the action of the microbial biomass.

PIRSA — Primary Industries and Regions South Australia (Government of South Australia)

SOC — Soil Organic Carbon - the carbon component of decaying plant matter, soil organisms and microbes. Soil organic carbon is the fraction of soil that passes through a 2 mm sieve.

SOM — Soil Organic Matter is different to organic carbon in that it includes all the elements (hydrogen, oxygen, nitrogen, etc.) that are components of organic compounds, not just carbon. Organic matter is difficult for laboratories to measure directly, so they usually measure total organic carbon. A conversion factor of 1.72 is commonly used to convert organic carbon to organic matter:

Organic matter (%) = Total organic carbon (%) x 1.72

Soil Carbon Stock — Carbon stock is calculated from the measured total organic carbon (%) in the soil, and is used as the base measurement in soil carbon accounting. In order to calculate carbon stock, it is necessary to know the soils bulk density and account for any gravel that might have been present prior to sieving in preparation for analysis. The final carbon stock value is measured in tonnes per hectare (t/ha) and is a tangible value that can be used in soil carbon models to determine a soils capacity for carbon sequestration. It also provides landholders the ability to calculate total soil carbon storage on their property.

For example - for the top 10cm of soil measured at 1.2% total organic carbon and 1.4 g/cm^3 bulk density

10,000 m2 in one hectare x 0.1 m soil depth x 1.4 g/cm^3 bulk density x 1.2 % = 16.8 t/ha.

Soil Health — The ability of the soil to function as a living ecosystem in relation to its natural capacity. A healthy soil sustains biological productivity, maintains environmental quality, promotes plant, animal and human health, and is resilient and profitable.

Government
of South Australia

Department for
Environment and Water