The **Australian Controlled Traffic Farming Association (ACTFA)** welcomes the Parliamentary Inquiry into Agricultural Innovation and has prepared the following submission.

Synopsis

The heavy machinery used in large-scale agriculture damages Australian soils and reduces farm productivity and water use efficiency. Controlled traffic farming (CTF) minimises this damage by restricting machinery wheels to precise permanent traffic lanes. Crop production is optimised in permanent cropping beds unaffected by wheel traffic, and good layout of permanent traffic lanes optimises drainage, logistics and field efficiency. CTF therefore becomes the essential foundation for the other innovations detailed below. It is also the ideal basis for developing 'data intensive farming' which collects and collates data on crop management. However CTF development and adoption is constrained by incompatible machinery dimensions and a research focus on 'disciplines' rather than developing optimised farming 'systems'.

In response to each of the inquiry terms of reference, ACTFA recommends that Australia places greater emphasis on:

1. Greatly increasing adoption of CTF in all plant based industries, to protect soil resource and markets.
2. Improving telecommunications in rural areas for increased data collection, transfer and analysis.
3. Promoting CTF as the prerequisite management platform for innovation in agriculture.

The Australian Controlled Traffic Farming Association (ACTFA)

ACTFA is dedicated to improving the profitability and sustainability of Australian agriculture through the promotion and support of CTF systems, see: www.actfa.net. Its successes include 9 CTF conferences (including the 1st International CTF Conference) and making a significant contribution to the research, development and extension of CTF and sustainable farming principles, including these two projects.

> GRDC Project ACT00004 "Application of controlled traffic farming in the low rainfall zone".
> *Led by ACTFA with partners in Victoria, NSW and SA, this five year $2.25M project aims to help farm businesses in the LRZ, a region of very large, low input farms, make decisions about CTF adoption.*
>
> AOTGR2-0062 "Nitrous oxide emissions reductions from controlled traffic farming".
> *ACTFA was granted $1.4M from the Commonwealth's Carbon Farming Futures 'Action on the Ground' program for on-farm investigation of the effects of CTF on soil emissions of nitrous oxide (N_2O).*

The interaction between production practices, not the individual practices, drives the productivity and sustainability of Australian farms, so ACTFA has developed a holistic systems approach to CTF. This typically doubles sustainable productivity by creating platforms for the application of innovative technologies and practices. Typical practices that combine in a CTF system include 2 cm (GNSS) guidance supporting well

designed, effective farm layouts, centimetre resolution satellite and aerial imagery, and efficient yield monitoring. Constantly identifying and filling technology and communications gaps is also essential.

This brief submission adheres specifically to the terms of reference, as published on the Parliament of Australia website. Additional information and supporting evidence can be provided at any time.

Terms of Reference 1. Improvements in the efficiency of agricultural practices due to new technology, and the scope for further improvement

The efficiency of agricultural practice in the grains, horticulture, cotton and sugar industries would be improved by widespread adoption of CTF. Such wider adoption would:

- Improve Australia's productive land by minimising random compaction damage by heavy machinery;
- improve crop productivity on those uncompacted soil;
- maximise the amount of rainfall harvested and used by plants, yet prevent waterlogging;
- allow new areas to be opened up for food production, such as the north and the high rainfall south;
- allow machine standardisation for efficiency and interchangeability;
- increase the application efficiency and the efficacy of all crop inputs, and reduce off site impacts;
- provide a platform for data collection, transfer and analysis; and
- maintain Australia's agricultural markets by improving product reliability, quality and traceability.

Supporting evidence is summarised in Attachment 1. Productivity and sustainability impacts of CTF

Terms of Reference 2. Emerging technology relevant to the agricultural sector, in areas including but not limited to telecommunications, remote monitoring and drones, plant genomics, and agricultural chemicals

CTF is the ideal basis for the development of 'data intensive farming'; where all aspects of crop management are collected automatically and used to constantly improve efficiency. Precise information, at the individual row and plant scale, will become vital to improve productivity and for quality assurance and marketability.

To remain competitive, Australian farmers will require constant improvements to information management, and must embrace technology that can leverage real time and historic data to continuously improve their farming practices at the enterprise and business levels.

The achievement of maximum economic benefits in Australia from 'big data' is made very difficult by telecommunication constraints, including insufficient internet bandwidth and non-contiguous network coverage, which restrict the timely transfer of data between growers, advisors, marketers and customers.

Terms of Reference 3. Barriers to the adoption of emerging technology

Despite its major benefits at the farm and national scales, knowledge of CTF among crop producers is not widespread. They struggle to access the information needed for sound business decisions about adoption.

Even in the grains industry, where adoption is highest, machine track and operating width incompatibility is a major constraint. Adoption is particularly inhibited by this issue in the horticulture industry.

The tendency towards 'discipline' rather than 'systems' research and adoption is also a constraint. ACTFA submits that Australia would benefit from increased emphasis on extension and adoption of CTF.

A robust feedback mechanism between farmers, consultants and researchers must be developed and maintained. Marketers of Australia's produce must engage with producers, using data to work together to ensure our products are preferred by consumers here and overseas. CTF will underpin all these benefits if programs can be developed that refine the system and increase adoption.

Attachment 1. Productivity and sustainability impacts of CTF.

Controlled traffic farming systems (CTF) use precise guidance and matched equipment to optimise productivity by keeping all heavy field traffic on permanent lanes in layouts designed for efficient drainage and logistics. Despite ample evidence of these benefits (below) full adoption of CTF is still limited by inadequate knowledge in grain production, and by incompatible farm equipment in other major cropping industries.

Energy: CTF reduced power requirements by 30% [in] harvesting [1,] and 50% in soil engaging (seeding) [18], operations respectively. *It is the reason for a 10 – 40% reduction in fuel costs per crop [2].*

Soil Structure: in the absence of wheels and tillage, visible, measurable improvement in soil structure and porosity spread slowly down the soil profile[8]. This was why CTF soil had ~50% better maximum infiltration rate[5] and plant available water storage capacity [8]. *It is the major driver of yield improvements of between 7% [22] and 15% [6].*

Less Runoff and Erosion. Reduced run-off [6, 19,] ensures less soil [23], nutrient and herbicide loss and waterway pollution [7]. *Erosion reduces long-term productivity, and pollution represents an immediate waste of expensive inputs [14]*.

No-Till Compatibility: standing residue lasts longer in CTF, which also eliminates tillage repair of harvest traffic ruts. The precision guidance facilitates interrow planting and shield spraying. These are all associated with greater residue levels, reduced soil evaporation, *improved yields and reduced costs [13].*

Soil Health: earthworm numbers in long-term CTF soil were ~ 100% greater than wheeled no-till[10, 11], with beneficial effects on most soil biota. *Valuable outcomes include suppression of soilbourne diseases [15].*

Timeliness: hard, compacted traffic lanes allow field operations to start sooner after rain. The average reduction in delay was 8 days (sub-tropical cropping [9]) and 2-3 days (dryland [3]), improving the efficiency and flexibility of all planting, spraying, fertilising and harvesting operations, *and facilitating productive use of the increased soil water[13]*.

Crop Yield: replicated trials report mean yield gains of 7%, [22] 12% [3]and 15% [6], but these trials cannot capture the impact of CTF system synergies, such as improved timeliness, which allow system intensification and greater conversion of rainfall into biomass and grain. *Synergies are the major contributor to increased productivity and profitability[24].*

Soil Emissions: trials in dryland grain [21] confirmed overseas results [12, 17, 21] showing that the improved soil structure in CTF produced roughly half the nitrous oxide emissions and absorbed (rather than emitted) methane. Denitrification usually occurs under similar conditions, *another reason why CTF should improve nitrogen efficiency[13].*

Soil Carbon: greater yield, biomass production and residue retention, combined with minimum soil disturbance might be expected to have a positive effects on soil organic matter, soil carbon balance, *and long-term productivity.*

Economics: reduced costs and increased yields of CTF systems have been shown to provide economic benefits of *$50 – $100/ha [2,4,16]* in a range of environments from sub-tropical Queensland to Western Australia.

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