2021-22 Investment Call – WALRC Producer identified RD&A priorities

Table 1: Identify new research, development or adoption gaps, activities and strategies to achieve the desired outcome/s.

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sustainable Feedbase Resources	**Outcome - Multispecies forage crops for better livestock production** - Objective - Mixed species fodder crops to adapt to a changing climate, to reduce feedbase variability and to enhance farming systems	Field research taking existing knowledge about agronomic, physiological and nutritional value of forages to determine best bet multi species combinations to test the hypothesis that multi species fodder crops improve livestock performance. The final years of this work would naturally include Producer Demonstration Sites to demonstrate the research outcomes.	Research into this priority will be conducted under Terms of Reference "Matching feed supply in a variable landscape to a changing climate".

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sheep Productivity	**Birth Injury in Lambs - Improved understanding of the causes of dystocia, and new or modified interventions to reduce dystocia and birth injury which enhance lamb and ewe survival.** **Key Outcome – Propose new or modified interventions to reduce birth injury in lambs and enhance survival of the dam and lamb**.	The recent review of previous studies found that 54% of lamb mortalities were associated with dystocia in Australian studies conducted since 1990. Dystocia is estimated to reduce national farm profit by $672 million per year or $16.00 per ewe joined (L.LSM.0027). There are major gaps (basic and applied research required) in understanding how breeding decisions and ewe management may reduce the proportion of ewes and lambs impacted by dystocia and improve the survival of lambs that are born with birth injury. This lack of knowledge means that while risk factors can be identified, there is limited evidence to support current recommendations. Apart from foeto-pelvic disproportion being a risk factor for birth injury, there are several other possible contributing factors which require further resolution.	This priority is currently being called for through the Sheep Reproduction Strategic Partnership (MLA Donor Company call). This Terms of Reference is focused on "Defining fitness to lamb" and applciations should: a) Investigate and analyse existing datasets where fitness to lamb control points and dystocia have been measured or may be indicated. b) Collate information on known and potential risk factors. c) Conduct field studies to test the impact of a range of factors on incidence of dystocia. This may include factors such as age, genotype, seasonal condition, BCS and metabolic state. d) Evaluate the physiological mechanisms associated with dystocia with a focus on metabolic state and hormonal influences. Studies should include an evaluation of glycogen in uterine muscle, ewe aerobic fitness, sub-clinical hypocalcaemia, pregnancy toxemia and oxidative stress. If this proirity is not addressed through this call then the possiblity of inclusion in future levy based calls will be evaluated.

Beef Productivity	**Outcome - Reducing reproductive wastage in young bulls** – There is anecdotal evidence of unexpectedly high incidence of bulls with penis damage (acute ulcerative or pustular balanoposthitis). Affected young bulls are reluctant to serve (presumably painful) and affected bulls are predisposed to secondary issues including physical trauma and secondary infections in the damaged tissues. If infection is allowed to resolve it is not known whether scarring of connective tissues as part of the healing process of the prepuce and glans penis is correlated with poor erectile function, chronic inflammatory penis enlargement or penis deviation. All of these sequelae are observed to have negative impacts on bull service efficiency. It has been suggested that this syndrome may be related to infectious disease, but a causal link has not been established. The role and interactions of bovine herpes viruses (BHV-1 and BHV-5) and/or the bacterium *Ureaplasma diversum* are not well understood. Veterinary clinical investigations suggest that this problem is Australia-wide. Producers want progress on understanding the cause of this problem, management options to mitigate it and preferably scientific controlled studies to support the efficacy of BHV vaccines currently being used.	Propose a review of literature to identify gaps in knowledge, scope of the issue, scale of economic loss and research priorities. Investigative field research of balanoposthitis in bulls to elucidate the contribution infectious agents and investigate potential interventions (including existing BHV vaccines) that may reduce incidence and severity of balanoposithitis.	This priority is being addressed with an integrated R&D Producer Demonstration Site (PDS) project developed by the Animal Welfare and Adoption team. The details will be presented when contracting occurs.

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sustainable Feedbase Resources **Animal Wellbeing**	**Producer Outcome - Making Potentially Toxic Pastures Safer** – Many of the most productive pastures species contain toxins which affect livestock performance. Production effects are pasture species specific and range from management inconvenience, through reduced feed intake to high level mortalities. The opportunity cost of not sowing these highly productive pasture species to avoid these effects is probably the greatest cost to the sheep and cattle industries. There are a range of causative agents implicated – e.g.: endophyte toxins, mycotoxins, bacterial toxins, toxic plant alkaloids, mineral imbalances - and some are poorly understood or undefined. In general, control and outbreak response measures are limited in mitigating loss and improvements can be made. Progress in managing these issues in the last few decades has been slow and there is little ongoing coordinated research effort to overcome these problems. The exception to this has been ARGT for which is a very effective biological control agent has been developed. Unfortunately, it is no longer commercially available, whilst at the same time, ARGT toxic pastures are expanding into new untreated areas.	Form a toxic pastures taskforce (working group) comprising expert scientists and economists to: 1. Review the cause and impact of toxic pastures on grazing livestock productivity including toxic and anti-nutritional factors and mineral imbalances. 2. Prioritise and recommend a plan to address these issues based on a probability of success/industry impact/RoI model, including long term biological control. For ARGT, develop a business case for manufacture and supply of twist fungus biocontrol agent. 3. Oversee the initiation, execution and review of research work recommended by this taskforce.	There has been a slow rate of uptake of twist fungus for biocontrol of Annual Ryegrass Toxicity (ARGT), or the Safeguard ARGT-safe cultivar. Australain Wool Innovation (AWI) have attempted across many years to elicit commercial interest in the development of a vaccine. The outcome was that there wasn't enough interest for the vaccine to be developed. MLA has previously invested in the following projects in this space: • 'A coordinated approach to minimising the impact of annual ryegrass toxicity (ARGT) in agriculture' (B.AHW.0058 – final report available); • 'Development of a vaccine against annual ryegrass toxicity' (B.AHW.0160 – final report available). • 'Supplementation to reduce the impact of mycotoxins and insufficient magnesium' (B.GBP.0012 - final report available). Much has been published on toxic plants on Australian pastures. Opportunities exist to develop adoption resources such as an e-learning module and a user-friendly glovebox guide.

Sheep Productivity And Beef Productivity And Sustainable Feedbase Resources	**Virtual Fencing in farm systems evaluation** Livestock producers have a high level of awareness and are looking forward to the management opportunities that virtual fencing brings to livestock production. Virtual fencing has been raised at most forums conducted by WALRC in the past 3 years. The research into virtual fencing for livestock has reached a point where its application and evaluation on commercial properties is required. It also opens opportunities to control animals in new ways in research projects. Virtual fencing for sheep and cattle are at different stages. With cattle, the work is around proof of commercial use; with sheep, the work is more the engineering and delivery method of the technology and understanding the differences in behaviour i.e. breed, age, sex, lambing status.	Field based research and development to evaluate and quantify the capability and benefits in livestock production from virtual fencing. The uses of the technology include the following: 1. Subdivision of large paddocks into smaller management units to temporarily protect newly sown/established pastures, riparian zones, shelter shrubs or remnant vegetation. 2. Exclusion zones in large paddocks to prevent overgrazing or to graze out/control undesirable species 3. Subdivision to optimise lambing mobs size/location and to assist lambing of small mobs in single sire mating groups. 4. Modifying behaviour to enhance adaptation of rangeland cattle brought into backgrounding situations. Improve pasture utilisation efficiency whilst also maximising pasture growth and livestock production (post weaning lamb growth, wool production per hectare.	Cattle: While this priority is relevant to all Research Advisory Councils (RACs) and continues to generate interest from the livestock sector, there has been investment across Rural Research and Development Corporations (RDCs) through the Rural Research and Development for Profit (RRDfP) (round 2) program lead by Dairy Australia (Commonwealth Grant: Enhancing the profitability and productivity of livestock farming through virtual herding technology) which will end in 2020. MLA has invested levy funds to support this work with the long term intent to progress the technology for beef cattle applications. A substantial body of work has been generated by this RRDfP program in addressing a number of R&D gaps. The biggest challenge to industry adoption is individaul state legistaion for the on-farm use of virtual herding technologies. Tasmania and Queensland remain the only states in Australia where the virtual fencing technology may be used commercially. It is still limited to R&D use only in other states. Agersens are active in helping to change the regulations across Australia, but a consistent communications plan is required to promote the application to the wider livestock sector and address comments from animal wlefare agencies. An extension and communications effort is required to promote animal management/welfare benefits and provide industry with sufficient information to advocate change in state legislation and general acceptance of the technology. MLA is currently working with industry to progress an integrated PDS for virtual fencing in northern WA with potential partner sites in southern WA. This work will be managed under the current WABeefLinks program,

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
			with additonal funding through the MDC aggreement with University of WA. Sheep: In studies investigating the behavioural responses of sheep to virtual fencing, it has been demonstrated that the capacity for ewes to be successfully trained to turn away from virtual barriers is highly variable. Incidences of close to 50% of ewes still receiving shocks after a period of learning are reported. Effectiveness of virtual fencing is also highly dependent on, the attractiveness of penetrating the boundary e.g., attractive foodstuff or peers, presence of wool and presence of lambs. Given the variability between animals there are significant ethical concerns regarding the use of virtual fencing for sheep and the acceptability of animals receiving multiple aversive shocks. In addition, commercial versions of the technology are not yet available for sheep (despite significant global investment in the technology) and until device weight and cost is reduced it is unlikely to be viable in the sheep sector. Further information will be available through the MLA Donor Company project 'Spatially Resilient Grazing Systems: Measuring and optimising landscape utilisation in rangeland sheep and goats' (P.PSH.1235), due for completion in 2023.

Sheep Productivity	**Key Outcome - Selection Indices for simultaneous genetic gain in production and management traits.** Producers are not prepared to adopt genetic flystrike resistance breeding because of its negative correlations with production-based traits. Bare breech animals not emerging from breeding programs quickly enough and are not the sole simple solution to breeding flystrike resistant sheep. Furthermore the use of ASBVs singly or in combination is prone to selection of animals which do not meet the studs breeding objective (long term). The Merino industry has proven in the last 20years that correlated traits CFW - Bwt and FD-CFW can be improved at the same time using appropriately mathematically balanced selection indices which account for genetic correlation between traits and their heritability. It seems unlikely that much progress will be made in flystrike resistance in the Merino in the absence of this fundamental tool.	Development, validation and publication of selection indexes incorporating a balance of production traits and flystrike indicator traits such that positive progress can be made in all.	Priorities in genetics research have provided important outcomes for producers over the last 10 years so new research is not considered necessary at present. Breech Wrinkle Breeding Values have been available for close to 10 years, the number of breeders taking records and the number of records being submitted to sheep genetics continues to grow significantly and genetic trends for wrinkle are improving despite the unfavourable relationship to fleece weight. This information has been included in relevant indexes for a long time, the most recent version for BreedObject (software that is used to develop indexes) allows for higher feed costs to be applied to cow weight to further improve responses. Breech wrinkle is an indicator trait for flystrike resistance, and is therefore used to select plainer breech animals of lower fly susceptibility. MERINOSELECT delivers a breech wrinkle trait called Early Breech Wrinkle (EBWR), which breeders score on unmulesed sheep (generally at marking immediately prior to mulesing, unless not mulesing where it can be recorded later in life). EBWR is a trait, where a lower (more negative) value is desirable, as this indicates 'less wrinkle', or a plainer breech. A common argument for not selecting plainer animals is that plainer animals cut less wool (fleece weight) which is an important profit driver for Merino breeders. Results show that flocks are increasingly doing better at managing this unfavorable correlation between these two traits. A key driver in this is that there is more recording of, and selection using, breech wrinkle in industry. This increased interest in breech wrinkle has also led to the inclusion of this trait in selection indexes for interested flocks. MLA have been working with individual flocks to develop indexes where breech wrinkle is included, and balanced with other important profit drivers, like fleece weight. We are

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
			now looking at how we might roll these indexes out for industry to use more widely.
Sustainable Feedbase Resources	**Subsoil constraints to more productive pastures in Western Australia** – The majority of topsoils in WA (all regions with duplex soils) are quite acidic (pH<5.5), and conversely many subsoils are neutral to alkaline (pH 7-9). Subsoils with higher clay content are more alkaline than those with lateritic or weathered granite geological origins. On sites where lime is applied, CaCO3 concretions are often found in the subsoil layer. It seems paradoxical that liming, whilst ameliorating the topsoil, is making the subsoil layers less optimal for plant growth. High subsoils pH may also be altering the availability of micronutrients for animal production e.g.: selenium, copper and cobalt. Are there better soil ameliorating techniques which makes our soils more suitable for a more diverse range of pasture species?	Regionally specific to duplex soils and swWA pastures (Geraldton to Esperance), a program of field research work to examine the impact of liming on the growth of existing and marginal pasture species, particularly root development and drought resilience. Propose and test a range of alternative soil treatments which reduce alkalinity becoming worse at depth. Examine the interaction of high subsoil pH with other soil constraints such as compaction, non-wetting and plant pathogens. Test plant available nutrients across these treatments. A subsequent phase may examine to uptake of these nutrients by livestock	Research into this priority will be conducted under the Terms of Reference "Matching feed supply in a variable landscape to a changing climate". In addition there is a Producer Demonstration Site (PDS) in this space looking at gridded soil sampling. This priority also aligns with PDS priorities, so MLA encourages interested parties to apply to cover this priority in the next PDS call.

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sheep Productivity	**Understanding new opportunities to reduce Merino ewe mortality –** Managing ewe mortality has economic and welfare benefits for the enterprise, and industry more widely particularly whilst rebuilding national ewe flock. • The most recent review of priority diseases that cause mortality in mature sheep (Lane et al) highlighted lack of information and low confidence in the reliability of the mortality data for the majority of important fatal ewe diseases identified as having a high priority. • Most reports and modelling cites the Victorian Ewe Sentinel Flock Project that monitored 18 flocks to determine mortality rate and causes of death. It is not clear whether those observations apply to Mediterranean environments, and that project didn't explore management risk factors. • Unlocking the Keys to Ewe survival is an MLA project monitoring non-Merino ewe mortalities over lambing period. Whilst this project includes 8 WA farms, it is not clear how those observations and recommendations apply to Merino ewes. • Other ongoing projects that include measuring mortality either included limited age groups or limited litter size/birth types.	Overall, there is a lack of information on ewe death rates in Australian Merino sheep flocks. The main causes of ewe mortality are also not well understood, and current management recommendations relating to ewe mortality are based on limited or outdated data that may not apply to Merino ewes in Mediterranean environments: Veterinary field survey to quantify the important causes of Merino ewe mortality in Mediterranean environments to inform extension and adoption programs that will reduce ewe mortality.	Extensive pre-Lifetime Ewe Management (LTEM) participation data collection was undertaken on the rates of merino ewe mortality across the country (12M ewes) with an average rate reported of 4.1% (1.6% higher than the average rate recorded for year one maternal ewe mortality as part of the unlocking the keys to ewe survival project; L.LSM.0019). Causes of mortality were not reported.

Sheep Productivity	**Parasite resistance and scouring in sheep –** Outcome is new or modified interventions to reduce scouring and flystrike risks in Mediterranean environments. Regardless of mulesing, scouring sheep accumulate dag and the associated costs impact farm profitability, and has important impacts for meat and wool industry beyond the farm gate as well as impacts for sheep welfare. The causes of scouring in sheep in Mediterranean environments is not well understood. Scouring is common in flocks using best-practice parasite control, and "hypersensitivity scouring" in sheep with some immunity to worms is common and widespread. The relationship with genetic resistance to worms is complex, and selection for worm resistance will not reduce scouring. We currently have no answers to several critical issues: • The prediction and diagnosis of scouring is difficult once sheep acquire some worm immunity • The response to anthelmintic treatment is inconsistent, and often ineffective • We have no consistently effective recommendations for prevention Genetics and culling strategies contribute to long- term solutions to breech flystrike, however there are substantial gaps in knowledge about the underlying causes of scouring including (a) the hypersensitivity scouring syndrome (especially in 1-2 year old sheep), (b) role of nutrition and non-worm parasites, (c) impact of water quality, and (d) how genetic selection for worm resistance, dag and strike is best incorporated into indexes that include production traits.	Research to develop understanding of the causes of scouring for sheep in Mediterranean and winter rainfall environments and identify opportunities to reduce scouring risk.	Significant research funding invested against this priority, culminating in the establishment of ParaBoss. ParaBoss Summary Current projects include: • 'Designing farm specific nematode control programs for sheep' (B.AHE.0308). • 'ParaBoss for cattle parasites' (B.AHE.0314).

Beef Productivity and Sheep Productivity	**Outcome - An answer to "Are big cows and ewes more profitable than small ones?"** The advent of EBV's and the use of Breedplan Indices by the seed stock industry has resulted in an increase in growth rates but also an increase in the mature size of females. This increase in mature cow size has increased the maintenance costs of the breeding herd but there does not seem to be any evidence to quantify if the increased maintenance costs are being offset by the increased growth rates and income of sale of larger progeny or not. If you chase all the indices - you end up with a big cow. Are we simply breeding bigger animals which eat more and have no improved efficiency, such that output per hectare is not improving? Are we making genetic progress or simply genetic change without any resulting improvement in profit?	Review the literature on maintenance costs for cows and correlate it with growth rates of progeny and whether the system is developing additional profits or are we simply making genetic change and cattle are getting bigger without being any more productive per hectare or more profitable? In the absence of literature on the subject use the data available from Breedplan and develop a model to examine the costs of maintenance of a larger cow, relate that to growth rates and the profit or loss which may be incurred in such a system. Look to the future to predict what size cow we will end up with, given the current rate of genetic change.	To assist in achieving this priority, MLA has tools available for industry including BreedObject and the individual Estimated Breeding Value (EBV), along with Mature Cow Weight (MCW). The impact of utilising indexes on MCW has been addressed in the more recent version of BreedObject and will positively affect selection decisions. The tools align with both the industry Strategic Plans and the National Livestock Genetics Consortium (NLGC) priority of improving Sustainability and Welfare traits. The outcomes provide confidence to industry that producers concerns have been considered heavily within the genetics program over the last 20 years. It is a promising time where we have a better version of BreedObject available to industry as well as the technology to establish improved efficiency. The Big Cow/Big Ewe conversation offers a good case study. Industry is raising sensible points about the impact of genetic gain on farm profitability and the size of breeders promotes questions about the efficiency of productions systems. However, we know that it is already possible to address mature size in our genetic evaluations and therefore select for our desired outcome. We are using mature size as a proxy for feed costs in our breeder herd or flock. It may be a much better outcome to have a direct measure of feed cost for breeders (maybe some big cows are more efficient feed converters than some small cows?) that allows producers to select the animals that most effectively convert feed into saleable product irrespective of size. Currently we only have the ability to use net feed intake data collected in a feedlot setting for animals

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
			that are in a finishing phase. The R&D gaps in that case are along the lines of; • How do we measure feed intake in grazing conditions? (CSIRO, Ceres, Allflex have been doing work with tags and collars in this area, don't know how effective it is yet) • How do you define the right trait/s to measure? • How much genetic variation is there in the breeds we work with? • How do we collect enough data to develop genetic parameters? • How do we collect enough data to deliver reliable EBVs for people to be able to select for the trait?

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sheep Productivity	**Nematode Worm Vaccine –** Worms is third highest ranked production limiting disease in sheep. MLA recently released a review commissioned in 2018 by David Emery et al (B.AHE.0325). Their main conclusions were: • Vaccines part of an IPM approach • Optimal use will vary with region • Likely role to reduce use of long acting anthelmintics • Barbers Pole vaccine now commercialised so future work should focus on scour worms. • Expensive and long-term research effort • A permanent worm control tool, cf anthelmintics which have limited life • Global market, international effort, global investment $ available • There are a number of new antigens identified and new technologies which could be applied.	MLA initiate a taskforce comprising global scientific expertise to progress the recently completed review and establish a short list of experimental pathways to demonstrate that some vaccine candidates provide immunological protection against scour worms. Facilitate engagement of a multinational partner to further develop and commercialise.	This priority will be address through the Terms of Reference – 'A scour worm vaccine for sheep'. The recommendations from a recently competed project 'The potential for vaccines against gastrointestinal nematodes of small ruminants' (B.AHE.0325) were used as the basis of this Terms of Reference.

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sustainable Feedbase Resources	**Outcome - Address gaps in Rhizobial ecology for N fixation in a mixed farming system.** There appears to be some conflicting advice about the use of rhizobium-based products for sowing with legume crops and pastures. For example, there is advice that rhizobia can be sown in the final year of the cropping phase to build up rhizobial population for the following year. Conversely producers are advised to inoculate where there has been no legume sown in past 4 years. In addition, there are many cases of nodulation failure where all practises examined appear sound. Some of this apparent conflict may be misunderstanding and therefore an education issue. However, it is also believed that there are genuine gaps in knowledge about rhizobium ecology which if addressed would result in better performance of rhizobia and more N fixation in soils of mixed farming systems.	A review of all extension advice including information materials to assess for consistency of message. Inconsistencies in message to be debated/reviewed and determined whether a knowledge gap exists and how best to address it. Appropriate research projects established to address knowledge gaps including but not limited to the concurrent application to seed dressings of pesticides and rhizobial inoculants.	The project 'Not enough nodules: impact of herbicides, pesticides and other farm management tactics' (B.PAS.0360) was funded in the 2019-20 Investment Call. The report is due to MLA in June 2021. Following this study, there will be work on a review concerning herbicide, insecticide, fungicide use and soil management to improve legume-rhizobia symbiosis; re-inoculation strategies for existing pasture.

MLA Program Area	New Research – Outcome sought	To adequately achieve the outcome, identify R&D and/or adoption gaps or strategies?	MLA Response to Priority
Sustainable Feedbase Resources	**Outcome - Unlocking the potential of Pastures from Space for farm business decision making** – PfS maintains a small dedicated subscriber base who recognise the value it provides to their grazing business. Active subscribers use it for: 1. Monitoring and planning paddock use to match DM intake demand of lactating and growing livestock 2. Supplementary feeding decisions 3. Early recognition of poor seasonal growth patterns and triggering contingency plans to mitigate loss 4. Farm purchase/leasing based on relative FOO. DPIRD have done an excellent job with limited resources to keep PfS service available and the vision alive of its role in farm decision making. However, PfS has problems which producers would like to be addressed. Resolution of these issues are required for further adoption and better decision making by producers.	This priority is about better tool development and delivery mechanisms. Therefore, we seek redevelopment of PfS to make it: 1. More interactive and user friendly for producers 2. Develop training packages suitable for inclusion in business modules of MLA adoption programs, university undergraduate course units. 3. Develop interfaces to enable data transfer from PfS to enterprise modelling. 4. Develop a business model to transition PfS from a free service to user pays.	The opportunity here is to develop adoption tools to support the utilisation of pastures from space. MLA plans to work with the Department of Primary Industries and Regional Development (DPIRD) to progress either a Profitable Grazing Systems (PGS) package or an integrated Producer Demonstrated Site (PDS) activity that is co-funded through the MLA Donor Company (MDC). Once progressed, this will be linked with the ToR "Matching feed supply in a variable landscape to a changing climate" not just pasture growth and the information used (past to present) to inform land management.

Table 2: Identify ongoing research, development or adoption priorities that remain a priority from previous investment calls:

MLA Program Area	Ongoing Research – Outcome sought	To adequately achieve the outcome, is the gap in R&D or adoption?	MLA Response to Priority
Sustainable Feedbase Resources	**Building improved feedbase for the Mediterranean Zone.** **Producers want options to address the autumn/winter nutrient gap as this allows them to increase overall stocking rates, reduce risk and improve profitability.**	Producers want options to broaden feed supply and address the autumn/winter nutrient gap as this allows them to increase overall stocking rates, reduce risk and improve profitability. Priorities for research include: • A systems-based approach to understanding the existing feedbase and identify targets for improvement, • Better varieties or novel mixtures for a range of soil types, which deliver higher DM production of high quality without downside risks such as toxicities. • Better perennial species for out of season production and buffering risk associated with poor seasons. Within the mixed crop/livestock zones, perennials have lowest opportunity cost on soils that are marginal for cropping. • Better forage crop systems. • Options to deliver ryegrass pastures that are ARGT safe and not a weed risk for cereal crops.	Current work in this area includes: • 'New Powdery Mildew Resistant and Spineless Barrel Medics' (P.PSH.0749). • 'Rural Research and Development for Profit - Novel Pasture Legumes in Dry Areas' (P.PSH.1136). • 'Agronomy package for Tedera' (B.CCH.6621). • 'What is the value of modern crop stubbles?' (L.LSM.0016). • 'No more gaps with superior shrub systems' (L.LSM.0018). Opportunity: • Delivery of former Grain & Graze materials (G&G 1-3). • Delivery of former EverGraze materials. • This priority also aligns with Producer Demonstrated Site priorities, MLA encourages this to be raised as a Producer Demonstration Site (PDS) priority and applications be submitted via PDS Annual Call program. • "Pasture Paramedic" will be extended to cover Mediterranean zones.

MLA Program Area	Ongoing Research – Outcome sought	To adequately achieve the outcome, is the gap in R&D or adoption?	MLA Response to Priority
Sustainability and CN30	**Key Outcome is a Carbon Audit** – In the rangelands - we have very differing situations in performance of grazed versus un-grazed versus unmanaged regions in terms of the methane emissions that are generated. For example, termites generate methane however this may not be accounted for. There is a lot of information about the amount of methane ruminant animals emit, yet our farms grow 4-5000 t of dry matter/ha per year that is renewable. The producer wants to know how much offset I get from choosing to grow 4000t of dm pasture per year." In the end we must show a balance that gives us the social license in 2030 that we are carbon neutral and in fact we could be entitled to payments for offset. Determine the carbon footprint of stock grazing in the rangelands (and also agricultural areas) as separate mass balance investigations.	This project should prepare a detailed audit procedure to determine a fair and equitable process to inform producers of their carbon footprint. It should concentrate on standardising methodologies, identifying gaps in knowledge and coordinating appropriate research projects to satisfy unknowns.	This priority will be addressed in the 'NRM in a Changing Climate' project the RMP has recommended for contracting in the 2020-21 FY.

MLA Program Area	Ongoing Research – Outcome sought	To adequately achieve the outcome, is the gap in R&D or adoption?	MLA Response to Priority
Sustainability and CN30	**The Carbon footprint of our business** - To most livestock producers, the gross and nett carbon emissions of their livestock business is a theoretical number. As we move towards an industry goal of carbon neutrality by 2030, we must improve the practical understanding of levy payers about carbon emissions.	An adoption program in whole or part which has four main outcomes: 1. Trains producers about the sources of carbon emissions and sequestration. 2. Has producers perform a carbon account for their pastoral businesses. 3. Provides on-farm options to mitigation of nett emission of carbon i.e.: how many hectares of eligible vegetation and what is the renewal timeline 4. Creates Tools and calculators that deal with mixed farms. We note that this raises the need to re- examine what improvements can be done to a carbon audit over time to better capture true emissions status.	This priority will be addressed in the 'NRM in a Changing Climate' project the RMP has recommended for contracting in the 2020-21 FY.

MLA Program Area	Ongoing Research – Outcome sought	To adequately achieve the outcome, is the gap in R&D or adoption?	MLA Response to Priority
Sheep Productivity	Lamb Survival – What are the big hitters? About 30% of all lambs born (or 15 million lambs) die within 3 days of birth (perinatal mortality). The largest contributor to these deaths are a consequence of the starvation/mismothering/exposure complex continuum further overlaid with variable effects of dystocia. Provision of shelter is known to reduce perinatal lamb loss by up to 50% via a reduced chill index. In the broader mixed farming context, the previous research can inform effort to update and optimise new ways to provide such shelter. This is an emerging animal welfare issue over which the industry does not have scientific control. A recent review of national sheep reproduction rates and lamb survival undertaken for Sheep Producers Australia indicated that reducing current level of losses by half would result in an annual return of $750 million. Current and recent research outcomes have progressed in only small increments (1 and 2%ers) for producers that are otherwise already adopting 'best practice' recommendations, leaving the largest sources of lamb loss accounted for in "cause of loss" statistics but not recoverable with existing knowledge or technologies.	A multidisciplinary research effort required to identify source drivers of lamb loss by region and production system, then understand underlying physiology/pathological processes such that possible solutions can be developed and tested at field level. This is a long-term multidisciplinary R&D program. Applied research in the modern mixed farming context to optimise the provision of shelter to reduce perinatal loss in lambs.	MLA has many investments underway in this space including investments due to commence following endorsement from the latest round of projects. These include: • Accelerating sheep reproduction best practice. • The Sheep Reproduction Strategic Partnership (MLA Donor Company call). • 'Increasing lambing percentages through better use of pregnancy scanning' (L.LSM.0021). • 'Unlocking the keys to ewe survival' (L.LSM.0019). • 'Managing fecund flocks to improve survival of triplet dams and their lambs' (L.LSM.0013). These, along with previous investments, have delivered a highly comprehensive understanding of the timing and causes of loss as well as the development of proven interventions to affect causes of mortality. MLA has acknowledged this remains a high priority and will continue to address this through existing projects and the ongoing development of the strategic partnership.

MLA Program Area	Ongoing Research – Outcome sought	To adequately achieve the outcome, is the gap in R&D or adoption?	MLA Response to Priority
Animal Wellbeing	**Outcome – Revitalise Paraboss** Paraboss is currently the main extension pathway for parasite management (internal and external parasites). Paraboss is the only independent source of industry information remaining relating to treatment and control of worms, blowflies and lice in sheep. It is highly regarded by sheep producers Australia wide as an independent quality source of information for their business.	<u>Adoption/Extension gap</u> Support ongoing development of the Paraboss web-based materials and extension activities to provide updated and unbiased advice for producers and animal health advisors.	MLA and AWI have recently varied the existing ParaBoss project with University of New England to extend the project until June 2021. The variation will see the continued maintenance and updating of the ParaBoss suite of sheep and goat websites and ongoing development of an online training certificate program for trusted advisors (including rural merchandisers). Animal Health Australia (AHA) have been engaged for the same period to delivery ongoing communication activities on behalf of ParaBoss (including Newsletters, Feature Articles, Outlooks, managing Facebook content etc.). In addition to ongoing support, the current project partners will work together to develop a long-term strategy/proposal for funding of Phase III for ParaBoss which will include the inclusion of cattle following completion of the TickBoss for cattle in early 2021.