

## Science and Innovation Briefing: Genomics Research in the Agricultural Sector

Date:	14 October 2013	Priority:	Urgent
Security Classification:	Commercial In Confidence	Briefing no:	0700 13-14

ACTION SOUGHT		
	Action sought	Deadline
Hon Steven Joyce Minister of Science and Innovation	Note the information provided on AgResearch's Genomics team and other capability in the Animal Productivity Science Group	15 October 2013

CONTACT FOR TELEPHONE DISCUSSION (IF REQUIRED)				
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THE FOLLOWING DEPARTMENTS/AGENCIES HAVE SEEN THIS REPORT					
<input type="checkbox"/> MSD	<input checked="" type="checkbox"/> NZTE	<input type="checkbox"/> Treasury	<input type="checkbox"/> COMU	<input type="checkbox"/> TEC	<input type="checkbox"/> MoE
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Please specify: AgResearch

Minister's Office to Complete:

<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn

Comments:



## Recommendations

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We recommend that you:

a.	Note the information provided on AgResearch's Genomics team and other capability in the Animal Productivity Science Group	
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Eileen Basher  
Manager, Institutional Performance  
Science, Skills and Innovation Group

9(2)(e)

14/10/13

\_\_\_\_\_  
Date

Hon Steven Joyce  
Minister of Science and Innovation

\_\_\_\_\_  
Date

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## Purpose

1. You have requested additional information on AgResearch's capability in genomics, specifically the team that is currently based in Invermay.
2. The briefing also describes teams in the fields of Animal Genomics, GenomNZ, Reproductive and Developmental Biology and Reproductive Technologies. Collectively, these teams form the Animal Productivity Science Group.
3. The Future Footprint will co-locate the majority of these teams in Lincoln at the Productive Land Hub.

## Background

4. There are four teams that make up AgResearch's Animal Productivity Science Group. The teams in the Animal Productivity Group were reviewed in the Animal Sciences Roadmap during 2012. As a result, a number of change initiatives were undertaken to realign groups, recruit new capabilities (nutrition, quantitative genetics, and animal physiology) and reduce some capability in lactation, growth and reproduction.
5. The following table shows the current and proposed locations of the teams in the Animal Productivity Science Group:

Team	Ruakura		Grasslands		Lincoln		Invermay	
	Current	26 Sept Plan	Current	26 Sept Plan	Current	26 Sept Plan	Current	26 Sept Plan
Reproductive Technologies	15	9(2)(b)	9(2)(b)	9(2)(b)	9(2)(b)(ii)	9(2)(b)(ii)	9(2)(b)(ii)	9(2)(b)(ii)
Reproductive & Developmental Biology	4						6	
Genomnz							13	
Animal Genomics	4				9(2)(a)		19	
Science Group Leader & Support	9(2)(a)		9(2)(a)				9(2)(a)	

6. Under the Future Footprint, most teams are planned to be co-located at Lincoln. The transgenics part of Reproductive Technologies will remain at Ruakura while the review of transgenics capability with the University of Auckland takes place.
7. Of the 101 permanent AgResearch staff at Invermay, 40 are in the Animal Productivity Science Group. The remaining 63 staff at Invermay are involved in farm systems (13), environmental research (16), and support and management (34). A further 5 staff are based in Southland (Farms and Land Environment staff).
8. The Future Footprint staffing for Invermay (including Southland) will consist of 28 staff:
  - Innovative Farm Systems focussed research on predominantly sheep, deer and beef farming.
  - Land and Environment largely focused on water quality and nutrient runoff.
  - Support and Farm Staff 9(2)(b)(iii)
  - In addition 9(2)(b)(iii) staff will continue to be based in Southland.

9. Recruitment opportunities exist in Invermay in applied animal nutrition, applied agronomy and farm systems. These will focus on regional requirements.
10. An overview of the teams in the Animal Productivity Science Group is provided as Annex One. This includes detail of the key scientists and equipment.

**Animal Genomics research**

11. Genomics is a discipline within the science of genetics that applies DNA sequencing methods, and bioinformatics to analyze the complete set of DNA within a single cell of an organism.
12. Within AgResearch, animal genomics is undertaken by the Animal Genomics Team, which focus on sheep, deer, beef and dairy in that order. The team is part of the Animal Productivity Science Group.
13. The primary goal of the Animal Genomics Team is to work with industry to develop tools that accelerate genetic gain in farmed animals, and improve the productivity of farms. Research to date has resulted in uptake of several genetic testing products by the sheep, cattle and deer sectors in NZ.
14. There are 9(2)(b)(ii) scientists in the team. 9(2)(b)(ii) As succession planning, a newly recruited scientist from Canada will arrive late in November 2013. AgResearch reports that 9(2)(b)(ii)
15. For the Animal Genomics team, the most important scientific collaborations are international. This is because, at least for science capabilities in sheep, beef and deer genomics/genetics, AgResearch holds a significant proportion of New Zealand's capacity. International collaborations are an important vehicle for new ideas and intellectual property to come into New Zealand partnerships.
16. Key linkages are:
  - International 9(2)(b)(ii)
  - Domestic research 9(2)(b)(ii)
  - Domestic customers - 9(2)(b)(ii)

Internal collaboration – Animal Nutrition & Health (greenhouse gases, animal health, feed efficiency), Food & Bio-Based Products (meat quality) and Forage Improvement (leveraging common technology platforms) [mix of Lincoln and Palmerston North].
17. The Animal Genomics team are also a major customer of 9(2)(b)(ii) utilising their commercial sequencing capability for animal genomics research.

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## Animal Genomics and AbacusBio

18. AbacusBio is an Australasian-focused agribusiness consulting and business development organisation. They have expertise in agricultural technology and biotechnology backed by specialised economic modelling, financial analysis and business management capabilities. Their focus areas and key customers are:

- Advanced breeding programmes 9(2)(b)(ii)
- Animal performance and productivity 9(2)(b)(ii)
- Data mining and analysis 9(2)(b)(ii)
- Environmental strategies 9(2)(b)(ii)
- Export and importation 9(2)(b)(ii)
- Food science 9(2)(b)(ii)
- Genetics and breeding strategies ( 9(2)(b)(ii)
- Imaging technologies 9(2)(b)(ii)
- Reproductive technologies 9(2)(b)(ii)

19. AgResearch's revenues from AbacusBio fluctuate from 9(2)(b)(ii) Most of this relates to statistical quantitative genetics that is subcontracted from AbacusBio's work for 9(2)(b)(ii)

20. AgResearch subcontracts genetic analysis to AbacusBio, including work for 9(2)(b)(ii)

21. 9(2)(b)(ii) contract AbacusBio and AgResearch separately for work relating to the 9(2)(b)(ii) contracts AbacusBio and AgResearch separately to 9(2)(b)(ii)

22. Both AgResearch and AbacusBio have been involved in advancing sheep and deer genetics via various projects over the last few years. It is envisaged that the work on sheep and beef genetics will continue 9(2)(b)(ii)

## GenomNZ

23. GenomNZ™ is predominantly a commercial DNA testing laboratory, which develops and commercialises Parentage Tests, and various gene tests to the agriculture, plant and aquaculture industries. They are a leading agricultural DNA testing laboratory providing the most comprehensive service for farmed species in New Zealand. Their services are available globally and utilised by farmers and producers worldwide and they can operate from any location provided they have the necessary equipment.

24. Specialising in sheep, deer, dairy cattle, alpaca, goats, various finfish and shellfish species and plants, GenomNZ™ processes thousands of samples every year on tests covering sequencing, single gene tests, microsatellite and single nucleotide polymorphism (SNP) based parentage panels, and high density SNP chips.

25. GenomNZ™ is accredited by International Accreditation New Zealand to ISO 17025 standards. Its external proficiency testing includes the ISAG programme, inter-laboratory programmes, and the Illumina CPro certification programmes.

26. GenomNZ™ has a highly skilled team of technicians and scientists that are experienced in DNA extraction techniques from a variety of sample types, use of state-of-the-art robotics, a variety of genotyping platforms, and use of sophisticated proprietary software and customised databases which allow for precise parentage analysis and data recording.

27. They are a team of 13, located at Invermay.

28. Key Linkages are:

- International: Customers in the sheep, cattle, dairy and aquaculture industries. These include links with (b)(6)(b)(7)(C)
- Domestic: Customers include (b)(6)(b)(7)(C)

### Reproductive Science research

29. Reproductive sciences in AgResearch have been focused on sheep and dairy. The research has been in two broad areas; advanced reproductive technologies like cloning and animal transgenics (carried out by the Reproductive Technologies team) and reproductive biology like ovulation rates and embryo survival (carried out by the Reproductive and Developmental Biology team). These two teams are quite distinct from the Animal Genomics team.

30. The Reproductive and Developmental Biology team was previously largely at Wallaceville, Upper Hutt although some of the team have also been based at Ruakura in the past. (b)(6)(b)(7)(C) staff from that team who were at Wallaceville were relocated to Dunedin in 2008. The (b)(6)(b)(7)(C) staff who remain from this team and are now at Invermay (b)(6)(b)(7)(C)

31. The Reproductive Technologies team are currently (and historically) located in Hamilton. (b)(6)(b)(7)(C) team will move to Lincoln under the Future Footprint project (b)(6)(b)(7)(C) remain in Hamilton. (b)(6)(b)(7)(C)

32. Key linkages are:

- International collaboration (b)(6)(b)(7)(C)
- Domestic collaboration (b)(6)(b)(7)(C)

### The Argument for Change

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33. The major challenges facing NZ farming are:

- Farming within limits – sustainable productivity and profitability gains within acceptable social and environmental limits.
- Continued guarantee of quality, safety and assurance in the markets we export to, where "wealthy" consumers are more discerning and social media means instant communication of issues, risks and problems.

- The growing need to "add value". A reliance solely on increasing production and the "risk" of diminishing gains that may occur as a consequence of farming within limits, means an urgent need to add and capture more value from the agri-food and beverages we export.
  - The problems and issues the agricultural sector is facing are bigger, more multi-faceted and complex than ever, and heavily driven around our farm systems.
34. It is the goal of AgResearch and its partners in the Lincoln and Massey hubs to address these challenges. The hubs will bring together public research organisations, private sector players, farmers and producers. We believe that these improved linkages can deliver high quality collaborative research, innovative solutions and a step-change in knowledge- and tech-transfer.

#### **Drivers for change**

35. The major drivers for the move to Lincoln are:
- Integration of animal sciences, including genetics/genomics with plant genetics/genomics and farm systems.
  - Co-location with the technology platforms needed to support future advances in animal and plant genomics/genetics
  - Co-location and integration within a hub which includes an agriculturally-focussed university (attracting and growing talent).
  - Improve adoption and practice change by co-location and integration with farm systems and in an on-farm agriculturally focussed hub
  - exploiting the synergies between plant and animal breeding – stronger and more likely to create impacts to the agricultural sector than those that exist between the animal (AgResearch) and the human genetics work based at the University of Otago.
36. There are a number of other significant factors specific to driving genetic gain in animal herds. These address challenges such as improving reproductive performance in dairy (falling as a result of improvements in lactation) and improving lamb survival (multi-lamb ewes struggling to raise all their lambs).
37. To meet these challenges, there needs to be a multi-disciplinary multi-team approach and a single 'omics' platform to improve AgResearch depth of understanding. There also needs to be better linkages to farm systems research (sustainability and productivity) and knowledge- and tech-transfer agencies.

#### **Drivers for the status quo**

38. The major drivers for maintaining the status quo or increasing capability at Invermay are:
- In the short term at least, it reduces the risks from loss of key staff and disruption to research delivery. This is only a short term benefit as several key staff are either at, or approaching retirement age.
  - Growing stronger collaborations with regional stakeholders in land-use and environmental-based research relevant to regional on-farm issues. With the growth in dairying in this region, this is particularly relevant. AgResearch's current capabilities are planned to remain at Invermay, but an increase in capabilities in farm systems research will also be required.



## Basis for Conclusions

39. The major arguments for co-locating the Invermay teams to Lincoln as outlined in the current Future Footprint plan are:
- Integration of animal sciences from Invermay in the national land productivity innovation hub will promote and accelerate improved animal performance within the broader context of environmentally sustainable farm systems. This will include the key technologies, farm-systems capabilities, stakeholders focused on adoption and practice change, and an agriculturally-focused university.
  - Co-location of plant and animal genetics/genomics capability in the national land productivity innovation hub will facilitate accelerated genetic gain in forage species important to agriculture, and will enable greater synergies for both from future advances in selection methodologies and technology.
  - Reduces long term risk of maintaining nationally important capabilities by co-location in an innovation hub with an agriculturally-focused University (attracting and growing talent) and dedicated modern fit-for-purpose infrastructure that will support genetics, genomics and reproduction research, and the technology platform the science relies on.
40. These assumptions were challenged in the staff consultation process. AgResearch remains confident that aggregation of capability in Lincoln represents the best long-term strategy for New Zealand and that the implementation hurdles are not prohibitive. However one change relating to these teams was made - the <sup>52</sup> staff based at Ruakura will not move <sup>9(2)(b)(ii)</sup>
41. For your information, a copy of the staff consultation findings is provided as Annex Two. The report was collected by the Change Management Team, a group comprising of 5 members nominated by affected staff, 4 management representatives, a PSA staff delegate, a Project Manager and an HR Advisor.

## List of Annexes

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Annex One: Animal Productivity Science Group

Annex Two: Consultation and the Change Management Team

- Easier to maintain collaborations with other research providers like Otago University and AbacusBio, and given that the current base is low, there is the potential to grow these collaborations.

## Overview of Options

### SWOT ANALYSIS – For Animal Productivity If teams move to Lincoln

<b>S</b> <b>Strengths</b> <ul style="list-style-type: none"> <li>• Co-location and integration of animal and plant genetics</li> <li>• Address simple value-chain by co-locating LRD farm systems adjacent to milk parlors</li> <li>• Right to the field, to assess breeding or control breeding</li> </ul>	<b>W</b> <b>Weaknesses</b> <ul style="list-style-type: none"> <li>• Distance from some existing stakeholders</li> <li>• Disruption to science research</li> <li>• Distance from some commercial farms used for research</li> </ul>
<b>O</b> <b>Opportunities</b> <ul style="list-style-type: none"> <li>• Synergies with plant genetics</li> <li>• Catalysing university capability in animal science through increased opportunities for post graduates</li> <li>• Growing links with core stakeholders</li> <li>• Linkages with other hubs/centres</li> </ul>	<b>T</b> <b>Threats</b> <ul style="list-style-type: none"> <li>• Loss of capability through key staff leaving</li> <li>• Potentially reduced interaction with Otago University</li> <li>• Distance from collaborator AbacusBio</li> </ul>

### SWOT ANALYSIS – For Animal Productivity If teams remained at Invermay

<b>S</b> <b>Strengths</b> <ul style="list-style-type: none"> <li>• Close to some end users</li> <li>• Existing infrastructure doesn't need to be moved</li> <li>• Good proximity to plant and research providers</li> </ul>	<b>W</b> <b>Weaknesses</b> <ul style="list-style-type: none"> <li>• Not co-located with other animal science teams</li> <li>• Not co-located with plant genetics</li> <li>• Not co-located with capabilities in farm systems</li> <li>• Continued focus on selecting the animal removed from systems they're farmed in.</li> </ul>
<b>O</b> <b>Opportunities</b> <ul style="list-style-type: none"> <li>• Grow links with AbacusBio</li> <li>• Develop collaborative projects with Otago University in animal genetics</li> <li>• Grow stronger links with regional stakeholders</li> </ul>	<b>T</b> <b>Threats</b> <ul style="list-style-type: none"> <li>• Remote from agriculturally-based Universities</li> <li>• AgResearch loses opportunity to leverage animal genetics in the broader context of environmentally sustainable farm systems</li> <li>• Remote from Land Productivity hub partners</li> </ul>

**Annex One: Animal Productivity Science Group (provided by AgResearch)**

Animal Productivity Team	Key Activities	Key facilities and equipment	History of team, age demographics, location and key individuals	Future Footprint changes
<p><b>Animal Genomics</b></p> <p>The primary goal of the Animal Genomics Team is to work with industry to develop tools that accelerate genetic gain in farmed animals, and improve the productivity of NZ farms. Research to date has resulted in uptake of several genotyping products by the sheep, cattle and deer sectors in NZ.</p> <p>The work involves liaising with industry experts, economic evaluation, experimental design, flock management, QTL mapping, interfacing with end-users to procure industry data, phasing using a variety of methods, genotyping using high density Single Nucleotide Polymorphism (SNP) markers, data analysis (derivation of prediction equations and molecular breeding values) and product development.</p>	<p><b>Genomics, genetics, molecular biology</b></p> <p>GenomNZ is predominantly a commercial DNA testing laboratory, which develops and commercialises Parentage Tests, and various gene tests to the agriculture, plant and aquaculture industries</p>	<ul style="list-style-type: none"> <li>Shares technology platform with GenomNZ</li> <li>At Invermay, shares sheep/deer research flocks/herds and farms and research facilities with Reproductive and Developmental Biology and Farm Systems Research Group teams based at that campus</li> </ul>	<p>Historically this team has been centred in Dunedin and has had staff located in Hamilton.</p> <p>For succession planning a newly recruited scientist from Canada will arrive late November 2013.</p>	<p>Current staff = 28</p> <p>Future Footprint changes</p>
<p><b>GenomNZ</b></p>	<p><b>Genotyping services</b></p> <p>GenomNZ is predominantly a commercial DNA testing laboratory, which develops and commercialises Parentage Tests, and various gene tests to the agriculture, plant and aquaculture industries</p>	<ul style="list-style-type: none"> <li>Three different genotyping platforms, and extensive use of robotics</li> </ul>	<p>This team has always been located in Dunedin.</p>	<p>Current staff = 13</p> <p>Future Footprint changes</p>
<p><b>Reproductive and Developmental Biology</b></p>	<p><b>Reproductive physiology, embryology, molecular biology</b></p> <p>Work is focussed in the area of improved reproductive efficiency in sheep and cattle.</p> <p>Improving embryo survival in dairy cattle is also one of the dairy industry's main impact areas.</p> <p>One major research focus of the group is to improve pregnancy rates by decreasing early embryo losses in dairy cattle, with current projects aiming to increase the understanding of the specific reproductive processes occurring at this critical time of early gestation. Future research will include developing selection markers associated with pregnancy maintenance and embryo survival in dairy cows, for improved genetic gain in the national herd.</p>	<ul style="list-style-type: none"> <li>Cattle animal handling facilities for on-farm trials investigating the relationship between reproductive traits and other parameters (e.g. lactation, nutrition)</li> <li>Sheep research flocks and farms with appropriate facilities co-located with researchers at Invermay</li> <li>Access to a Research Dairy Farm in the South Island</li> <li>Small animal colony with Genetic Modification facility</li> <li>Laboratory facilities (Molecular biology, IVF, Cell culture, Endocrinology, histology laboratories, Protein production and purification facilities)</li> </ul>	<p>3 of the current staff in Dunedin were previously located at Wallaceville, Upper Hutt before being moved to Dunedin in 2008.</p> <p>This team has recently undergone a restructure to align capability to future sector needs.</p> <p>Currently advertising for an additional science technician leader in reproduction.</p>	<p>Current staff = 10</p> <p>Future Footprint changes</p>
<p><b>Reproductive Technologies</b></p>	<p><b>Assisted reproductive technologies, transgenics, stem cells, cloning</b></p> <p>Focus on the fertility and reproductive health of dairy cows; shortening the interval between calving and conception; the development of semen diluents and embryo media; as well as accelerated (e.g. cloning) animal breeding. This team is also responsible for animal transgenics research including genetically-modified cattle models of milk volume and <math>\beta</math>-lactoglobulin protein suppression that can be utilized to identify important genetic loci, or test the potential for reducing the allergenicity of bovine milk.</p>	<ul style="list-style-type: none"> <li>For research on cow fertility and reproductive technologies requires access to a dairy farm.</li> <li>Large and small animal containment facilities as well as laboratory containment facilities for molecular, microbial and cell culture work are essential for work on Genetic Engineering.</li> <li>Bioinformatics and statistical support.</li> </ul>	<p>This team have always been located in Hamilton.</p>	<p>Current staff = 15 in Hamilton</p> <p>Future Footprint changes</p>

## **Annex Two: Consultation and the Change Management Team**

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1. The Change Management Team (CMT) is a mechanism AgResearch has used for a number of years for any large staff consultation process. The Change Management Team was a group brought together specifically through the staff consultation period to review and consider all staff feedback received on the Future Footprint Proposal, summarise it, and provide recommendations to the AgResearch Executive for their consideration. It was then disbanded.
2. Its membership comprised; five members nominated by affected staff, four management representatives, a PSA staff delegate, a Project Manager and an HR Adviser.
3. The CMT reviewed 245 staff submissions about the proposal. All submissions were read by the CMT, then themed against the FFP proposal. As a result of their process, the CMT prepared a report to the Executive Team, making 28 recommendations on the proposal and five on implementation of the proposal. Of these, 10 agreed with the proposed changes, 18 disagreed with the proposed changes and 5 related specifically to implementation issues. If the CMT did not get a staff submission about some aspect of the Future Footprint Proposal, then the CMT did not comment on that aspect of the proposal.
4. The Executive Team then reviewed and provided a response to each recommendation. Of the 28 proposal recommendations, the Executive team supported 17 of the CMT recommendations, it did not support 7 of the recommendations and partially supported a further 4 recommendations.
5. The recommendations within the scope of this briefing are CMT recommendations 6 and 7:

### **'CMT Recommendation 6 (Change to proposal)**

Animal Genomics and Genomix teams to be co-located at Invermay.

Condition: Consideration is given as to whether Animal Genomics capability at Ruakura is required to address North Island regional issues, specifically selection for Facial Eczema resistance in sheep and cattle.

### **CMT Recommendation 7 (Change to proposal)**

The majority of the Reproductive Technologies team to be co-located with other Animal Productivity capability at Invermay.

Condition: That confirmation of an alternative satisfactory approach to obtaining sufficient ovaries for reproductive research is able to be developed prior to co-location.

### **Executive Team Response:**

We agree with the CMT that the co-location of the teams in Animal Productivity and the deer research capability is paramount. Furthermore, for all of these teams/capability, co-location with agricultural and farm systems capability in the land-based hub at Lincoln creates the opportunity for an integrated approach (through the value-chain) to on-farm science challenges, providing a greater premium than being co-located at Invermay. This premium outweighs the various counter arguments to either retain the current distribution of staff or move these teams/capabilities to Invermay.

We acknowledge that as we work through implementation of our current plans we will need to ensure staff have access to the appropriate mix of deer, dairy, sheep and beef facilities and farms.