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Importation of Dried Distillers Grains with Solubles – Scoping Study

Abstract

The study conducted a preliminary examination of the feasibility of the importation of Dried Distillers Grains with Solubles (DDGS) into Australia from the United States in the event of grain shortages. Examination of the American industry shows current production of 7-8 million tonnes of DDGS, with exports of over a million tonnes, and new production capacity of approximately 5.4 million tones being built. Examination of the potential utilisation of DDGS in Australia by the livestock industries indicated that there was potential to utilise 33,300 tonnes a week of DDGS in Australia during times of critical feed shortages or extreme grain pricing. Preliminary examination of the quarantine risks showed that it is likely that DDGS is pathogen free when it is produced, and that the major quarantine issues will be cross contamination in the transporting of DDGS to Australia. We recommend that the livestock industries pursue an IRA application to determine the import conditions for DDGS from the USA

1 Executive Summary

The objectives of the study were:

1) To assess the future supply of DDGS available for import, given the current development of ethanol production capacity in the USA.

2) To assess the potential usage of the product in an Eastern Australian drought situation.

3) A preliminary assessment of the quarantine risk.

Assessment of Future Supply of DDGS available for Import

Key points are:

- Estimates of current production of DDGS are approximately 7-8 million tonnes with estimates of new production coming on stream of approximately 5.4 million tonnes with the new ethanol capacity that is being built.
- Exports of DDGS in 2005 were 970,000 tonnes with a 36% increase in showing in the figures for Jan-June 2006 compared to the previous period in 2005.
- New ethanol plants are mainly designed to be able to produce DDGS, contrary to our expectations that most plants would be co-located with cattle operations.
- Our assessment is that it is unlikely that there will be a fall in DDGS production unless there is a calamitous fall in the oil price, and that it is likely there will be significant extra new capacity coming on line if oil prices remain high.

Our conclusions from this assessment are that:

- It is clear from the data that there will be significant volumes of DDGS produced from the United States over the coming years.
- It is also clear that with the United States already exporting significant volumes of DDGS, the rapid increase in production is likely to result in extra exports.
- This needs to be tempered against the fact that increased research is going into animal feeding of DDGS in the United States.
- However it is likely that the DDGS price will be linked very closely to corn prices. Therefore significant volumes are likely to be available for export at a small price premium above the local market.

Potential Usage of DDGS in Eastern Australia

Key points are:

- New research is demonstrating that quite high inclusion rates of DDGS can be used in dairy cattle, beef cattle and pigs. Poultry are less able to utilise DDGS.
- In a "normal" grain pricing situation DDGS would have to be available for diets in Australia at $190 a tonne. Given that FOB prices for DDGS in the USA are around $170

a tonne before any possible quarantine costs are attached to the handling of the product this is clearly not viable.

- In a severe drought situation DDGS could be added to diets at $270 a tonne which makes the product far more viable depending on transport costs.
- There are difficulties with adding DDGS to diets. DDGS is of a much lower bulk density than wheat which will make its costs of transport higher. In addition higher inclusion rates are reported to slow down pellet presses, and cause handling problems for feed mills.
- We have calculated various scenarios for the use of DDGS with a potential to utilise 33,300 tonnes a week in livestock diets

Our conclusions for this assessment are:

- It is clear from these possible scenarios that there is considerable scope for importation and utilisation of DDGS into Australia in the case of severe drought, especially if there is a physical shortage of feed grains for the livestock industries.
- It is clear that the importation of DDGS during normal feed pricing years will not be a viable option.
- More work needs to be done on the delivered pricing into Australia

Preliminary Quarantine Assessment

Key points:

- The milling and processing of maize in ethanol plants subjects the grain to physical, temperature, pH and alcohol conditions that are likely to make the DDGS virtually sterile as it is produced, with little likelihood of viable weed seeds, nematodes, or insects.
- There are significant differences between ethanol plants in the processes, especially as operators are trying to reduce heat inputs to reduce energy costs and produce a better quality DDGS product.
- There will still be significant quarantine issues to be overcome in the transport part of the export process with identity preservation/cleanliness of transport facilities and vessels being a major issue if there are to be no further treatments.

Our conclusions from this assessment are:

- There will be significant reductions of, and possibly complete elimination of, the quarantine risks of DDGS compared to whole maize from the USA as determined at the end of the ethanol plant process.
- The key quarantine risks are therefore more likely to be in the storage and transport processes where DDGS can become contaminated with seeds and pathogens due to common freight systems with domestic and export grain movements
- These external quarantine considerations will not be as easily overcome as some in industry may think and may impose significant restrictions in terms of locations where DDGS can be accessed, or costs of obtaining and transporting the product.
- Import applications may have to be done on a plant by plant basis

2 Conclusions and Recommendations

1) That there is considerable scope for bringing in DDGS into Australia in the case of severe drought that causes physical feed grain shortages/or high pricing. The possibility of this occurring has been increased due to:

a) Higher levels of production in the USA

b) Improvements in feed utilisation due to research across species.

c) Improvements in process technology and value awareness – an increasing sophistication is occurring with DDGS producers as they realise that they need to supply a consistent high value feed product if they are to maximise their profits in the long term

2) That the quarantine risks of bringing in DDGS over whole grain will be much lower than for the importation of whole maize (ignoring a devitalisation step for whole grain at port in Australia).

3) That there is significant variation between ethanol plant processes that will have to be taken into consideration during an IRA process, and individual applications to import.

4) Transport and freight steps are likely to pose the most difficulties in quarantine processes.

5) That it is likely that there will be an increase in the price of DDGS in the near future if ethanol production continues to increase on the basis that domestic corn prices are likely to rise as ethanol demand reduces export levels. This is a risk for future costs of imported DDGS.

6) That further work be done to assess the feed mill/farm landed price for DDGS given the difficulties of bringing product in, increases in shipping costs and the issues of low density associated with DDGS.

7) That DDGS importation should be pursued as an alternative strategy to whole grain importation but not as an exclusive strategy. This requires an IRA application to be made, and fast tracked if importation in 2007 is to occur.

Contents

Page

1 Executive Summary 3

2 Conclusions and Recommendations 5

3 Background 9

4 Project Objectives 9

5 Methodology 10

6 Possible Future Supply of DDGS 11

6.1 Background and Summary 11
6.2 Current Production Levels 11
6.3 Survey of Plants Undergoing Construction 12
6.4 Export Data for the USA 13
6.5 Possibilities for Changes to DDGS through Technical Change 17
6.6 Other Considerations 18
6.7 Conclusion 19

7 Potential Usage of DDGS in Eastern Australia ... 20

7.1 Background and Summary 20
7.2 Beef Cattle 20
7.3 Dairy 22
7.4 Pigs 22
7.5 Poultry 23
7.6 Horses 24
7.7 Other species 25
7.8 Impediments to the utilisation of imported DDGS 25
7.9 Tentative costings of DDGS 26
7.10 DDGS Utilisation Summary 32

8 Preliminary Quarantine Considerations 34

8.1 Background and Summary 34
8.2 Pathogens and Pests Associated with Maize in the USA 35
8.3 Processes Within Ethanol Plants that Reduce Quarantine Risk 38
8.4 Results of Milling and Screening 40
8.5 Results of Heating, Fermentation, Distillation and Drying.............. 42
8.6 Risks Outside the Ethanol Plant 44
8.7 Preliminary Quarantine Assessment 48

9 Conclusions and Recommendations 49

10 Appendices 50

10.1 Appendix 1 – Summary of Plants Under Construction in the USA 50

10.1.1 Pinal Energy, LLC 50
10.1.2 Pacific Ethanol, Inc 51
10.1.3 Front Range Energy 52
10.1.4 Sterling Ethanol, LLC 52
10.1.5 Illinois River Energy, LLC 53
10.1.6 Central Indiana Ethanol, LLC 53
10.1.7 AS Alliances Biofuels, LLC 54
10.1.8 Anderson Clymers Ethanol, LLC 54
10.1.9 Iroquois Bio-Energy Company 55
10.1.10 Frontier Ethanol, LLC 55
10.1.11 Green Plains Renewable Energy 56
10.1.12 Hawkeye Renewables, LLC 56
10.1.13 Lincolnway Energy 57
10.1.14 Pinnacle Energy 57
10.1.15 VeraSun Energy 58
10.1.16 US Bio Albert City 58
10.1.17 Conestoga Energy Partners LLC 59
10.1.18 Gateway Ethanol 59
10.1.19 Prairie Horizon Agri-Energy 60
10.1.20 Bluegrass Bioenergy LLC 60
10.1.21 Great Lakes Ethanol - MI 61
10.1.22 The Andersons, Inc 61
10.1.23 US Bio Woodbury 62
10.1.24 Heron Lake BioEnergy 62
10.1.25 Missouri Ethanol 63
10.1.26 Abengoa Bioenergy of Ravenna 63
10.1.27 E3 - Biofuels 64
10.1.28 Holt County Ethanol 64
10.1.29 Nedak Ethanol 65
10.1.30 E Energy Adams 65
10.1.31 Advanced BioEnergy – Nebraska 66
10.1.32 Mid American Agri-Products - NE 66
10.1.33 Siouxland Ethanol, LLC 67
10.1.34 Val-E Ethanol 67
10.1.35 Blue Flint Ethanol, LLC 68
10.1.36 Red Trail Energy 68
10.1.37 Prairie Ethanol, LLC 69
10.1.38 Redfield Energy, LLC 69
10.1.39 Millennium Ethanol 70

10.1.40 Panhandle Energies 70
10.1.41 White Energy Texas 71
10.1.42 Western Wisconsin Renewable Energy 71
10.1.43 United Ethanol LLC Milton Wisconsin 72
10.2 Appendix 2 - Suggested Testing Regimes for DDGS 73

3 Background

MLA Project FLOT.123 – 'Review options to reduce feedstuff supply variability in Australia' highlighted the need for measures to be put in place to address the increasing likelihood of grain shortages on the East Coast of Australia over coming years. Importation of alternative feedstuffs will be vital to the livestock industries to ensure sufficient feed supplies and to maintain reasonable import parity pricing for feed.

This project was a desk top exercise to conduct a preliminary assessment on the potential for importation of dried distillers grains with solubles (DDGS) from North America to meet part of this feedstuff demand, given the rapid growth of the Ethanol industry in the USA.

4 Project Objectives

To conduct a scoping study to assess the potential for the importation of dried distillers grain with solubles (DDGS), incorporating assessments of:

a) The future supply of DDGS available for import, given the current development of ethanol production capacity in the USA;

b) The potential usage of the product in an eastern-Australian drought situation, based on the latest information on maximum inclusion rates in dairy, pig, poultry and beef feedlot rations and the price competitiveness of the landed product; and,

c) A preliminary assessment of the quarantine risk associated with the import of DDGS compared to that of EDN-treated whole grain.

5 Methodology

The project consisted of three parts:

a) An assessment of the new ethanol capacity that is being built in the USA to determine which of the new plants will be producing DDGS, what their total capacity and potential output will be and their locations.

b) A literature review to determine the latest maximum inclusion rates for DDGS in dairy, pig, poultry, and beef feedlot rations under Australian conditions in order to estimate potential usage in a drought situation. The potential and practical importation levels in Australia will be calculated given Australian feed milling practices and price competitiveness of the product.

c) A preliminary assessment of the risk reduction that the production of DDGS through an ethanol plant has compared to the importation of whole grain by examining the processes involved and the risks that have been identified in the EDN grain denaturing project that is currently underway.

6 Possible Future Supply of DDGS

6.1 Background and Summary

In order to assess the possible future supply of DDGS we have examined five factors:

- The current data on production levels of DDGS in the USA
- A reconciled survey of the plants under construction in the USA and their intentions in producing DDGS or Wet Distillers Grains with Solubles (WDGS) or Modified Wet Distillers Grains with Solubles (MWDGS)[1]
- An examination of the export data for DDGS from the United States
- The possibilities for changes in DDGS production through technical change to the ethanol manufacturing process.
- Considerations on the ongoing development and viability of the corn based ethanol industry in the USA

Our assessment of this information is that it is likely that in the next 5-10 years there will be plenty of available DDGS from the USA for export even though use in the USA is likely to increase with new research on feeding options. However this is not a comment on whether the DDGS will be available at a price which is acceptable to Australian users. Price will be determined by demand as well as supply and current export demand plus the possibility that domestic corn prices could rise significantly.

6.2 Current Production Levels

It is difficult to get accurate production levels on DDGS production because the USDA does not appear to keep official figures and while there are various statements of production by various authors we have not been able to find a verifiable source. In addition quoted numbers consistently seem to mix up DDGS and WDGS.

We believe that the most authoritative source is Jerry Thurson who states that 7 million tonnes of DDGS[2] was produced in 2005 and predicts that production may reach 14 million tonnes over the next few years. When we look at the results of our plant survey (see next section) these figures may be conservative if the current construction boom continues. Lists of plants under construction are now showing that the US industry is currently building 3

[1] MWDGS is a modified version of wet distillers grains with solubles that has a lower moisture content and a shelf life of approximately 2 weeks as compared to three days for WDGS
[2] Available at http://www.ddgs.umn.edu/articles-industry/2005-Shurson-%20Energy%20from%20Ag%20Conf.pdf

billion US gallons (11.35 billion litres) of capacity. This will utilise approximately 30 million tonnes of extra corn. If this was all converted into DDGS this would produce an extra 9 million tonnes. However given that some plants are producing wet distillers grains to feed to local cattle a figure of 5.4 million tonnes is more likely (60% to DDGS 40% to WDGS). This would put 2007/2008 production levels at over 12 million tonnes of DDGS.

For the purposes of this report it is not necessary to get this number exactly right. However we can conclude that there will be significant volumes of DDGS produced and that those volumes are rapidly rising.

6.3 Survey of Plants Undergoing Construction

The data on new plants in the USA has been gathered through web searches and cross referencing lists between:

1. The Biofuels Journal (www.biofuelsjournal.com)
2. The American Coalition for Ethanol (www.ethanol.org)
3. The Renewable Fuels Association (http://www.ethanolrfa.org/)

A list of the plants that are currently under construction, their location, their size, whether they will produce DDGS, their target completion dates, and web links for further information are contained in Appendix 1.

Due to the rapid nature of capital investment in the industry in the USA new proposals and investments are continually surfacing. We are confident that the data contained in this report covers the vast majority of plants under construction in the USA but cannot guarantee that every plant has been found. We have excluded plants that have announced financing but have not commenced any work. Due to the boom in ethanol plant construction timelines are being stretched for all plants and we have no confidence in announced plants that have not commenced. Even the target dates for plants that have commenced work, but are not in the full construction phase have to be treated cautiously because the demand for materials, skilled workers, and equipment is extremely high. Demand has pushed up construction costs from US$1/gallon to US$1.50 gallon over the last twelve months, which is a clear indication of the stresses in the industry. In these circumstances timelines tend not to be met.

The key points from this work are:

- That despite speculation that many of the new plants we going to be co-located with animal feeding operations to avoid the need for drying of distillers grains our research indicates that most of the new plants either plan on marketing DDGS solely or at least have the capacity to do so.
- If DDGS is required in the short-term in Australia then in combination with the industry information on the existing ethanol plants the list in appendix 1 will provide a resource to industry to contact ethanol plants for DDGS

- We concentrated on these plants due to the fact that there is already considerable information on existing plants and that the newer plants will have best technologies for producing DDGS

- With the final report we will supply a software mapping program that combines the American Coalition for Ethanol 2006 Handbook with the data that we have gathered as an easy reference for people who are looking to access information on plant locations. All of the web references that we have gathered on the new plants will be included in this program which will allow users to quickly contact most of the plants in question if they desire to do so.

6.4 Export Data for the USA

The export data for DDGS from the United States is shown in Table 1

The data shows clearly the following major points:

- That there are significant volumes of export DDGS from the United States with volumes reaching over 1 million tons in 2005[3]

- That there was a significant surge in export volumes in 2005 over the 2004 year, and that those volumes appear to have increased again in 2006.

- That if the contiguous countries of Canada and Mexico are excluded from the figures the great majority of the exported DDGS is to Western Europe. This gives greater confidence that export quarantine and quality issues can be dealt with.

These figures indicate that coupled with surging production of DDGS there will be significant volumes available for export diversion to Australia if required.

[3] A ton is approximately 0.907 tonnes. Therefore the export volumes in 2005 were approximately 970,000 tonnes

Table 1 – Export volumes and destinations for DDGS from the USA 2001-2006

	JANUARY - DECEMBER QUANTITIES					JANUARY - JUNE COMPARISONS		
	2001	2002	2003	2004	2005	2005	2006	%CHNG
AUSTRALIA(*)	0	28	0	0	0	0	0	--
BERMUDA	0	5	0	0	0	0	0	--
BAHAMAS, THE	0	30	0	0	0	0	0	--
BANGLADESH	0	0	0	0	126	0	297	--
BELIZE	0	0	0	0	169	0	0	--
CANADA	21260	30332	30898	83984	105929	47639	57120	19.9
CHINA, PEOPLES REPUB	0	0	60	54	0	0	0	--
CHILE	33	0	3652	0	3607	3607	0	--
COLOMBIA	48495	37702	10140	3849	2565	2565	1232	-51.97
COSTA RICA	0	26323	1779	6600	0	0	7946	--
CUBA	0	0	0	0	10043	0	0	--
DENMARK(*)	162543	106103	72265	0	117	0	0	--
DOMINICAN REPUBLIC	0	0	0	0	148	0	0	--
ECUADOR	0	0	0	0	0	0	2498	--
IRELAND	267265	297722	255398	185007	206222	76622	85011	10.95
EL SALVADOR	0	192	380	129	0	0	373	--
FINLAND	0	0	380	2072	3747	1878	1270	-32.37
FRANCE(*)	2679	3000	0	0	431	0	690	--
GERMANY(*)	16168	28333	580	5144	26213	26213	0	--
GUATEMALA	10070	3849	13131	3998	0	0	0	--
HONG KONG	0	0	0	0	0	0	91	--

HONDURAS	0	0	1391	8024	5039	2676	4431	65.58
INDONESIA	0	0	0	11516	46523	19210	15053	-21.64
INDIA	0	0	0	0	0	0	377	--
ISRAEL(*)	0	0	12380	6366	47935	23928	0	--
ITALY(*)	0	22032	0	0	0	0	0	--
JAPAN	26	40	15	0	2824	145	16515	11289.7
JAMAICA	0	0	0	1490	774	774	0	--
KOREA, REPUBLIC OF	14	0	70	625	4843	755	4044	435.63
MOROCCO	0	0	0	0	5499	0	14755	--
MEXICO	31319	30751	45721	66894	128271	45970	162813	254.17
MALAYSIA	0	0	0	12475	34410	10904	11849	8.67
MOZAMBIQUE	0	87	0	0	0	0	0	--
NETHERLANDS	19439	14793	16445	36536	53749	28864	182	-99.37
NICARAGUA	0	0	0	863	0	0	0	--
PANAMA	0	1247	0	1184	0	0	2648	--
PORTUGAL	67666	74209	52221	73396	57445	30658	23407	-23.65
PHILIPPINES	0	51	0	958	11758	2809	29381	945.96
SOUTH AFRICA, REPUBL	0	0	0	546	1137	0	0	--
SINGAPORE	0	0	0	163	0	0	50	--
SPAIN	39324	74677	40169	77176	110052	52233	18458	-64.66
UNITED ARAB EMIRATES	0	0	82	0	0	0	0	--
THAILAND	0	0	61	10	12802	1643	14428	778.15
TUNISIA	0	0	0	0	46	0	0	--
TURKEY	0	0	0	0	216	216	0	--
TAIWAN	0	0	0	7431	42249	16047	41113	156.2

UNITED KINGDOM	111165	86612	184742	188857	113874	7293	47655	553.43
VENEZUELA	0	4023	0	1726	10579	10579	0	--
VIETNAM	0	0	0	633	19869	1674	1721	2.81
LEEWARD-WINDWARD ISL(*)	0	0	0	0	0	0	191	--
TOTAL	797466	842141	741960	787706	1069211	414902	565599	36.32
Data Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics								
(*) denotes a country that is a summarization of its component countries.								

6.5 Possibilities for Changes to DDGS through Technical Change

There has been some discussion in the ethanol industry in the USA and in the livestock press in Australia regarding new processes to separate parts of the maize grain before it enters the ethanol production process.

At the Ethanol 2006 conference in Brisbane in May 2006 Bib Swain from Delta T Corporation described technologies that could be retrofitted to existing ethanol plants, and could be designed into new plants.

These technologies were focused on taking out high-value components of the grain that were not required for the ethanol fermentation process, such as the germ or corn oil.

There is some danger that this may start to occur in the industry in the USA but there was no indication in any of the web searches that we conducted of significant numbers of plants announcing adoption of this technology.[4]

Some of the changes may be beneficial to the feed by products that are produced from plants fitted with such equipment but others will not be and may improve the by products for some species while reducing value for others.

It is our view that:

- There is not a lot of adoption of this technology occurring at this point in time due to the fact that there is so much effort going into getting standard plants up and into operation while the profits are high.
- That even the most optimistic people in the industry are saying that it will take 5 years to get any significant adoption (Bib Swain pers com)
- That the livestock industries need to keep an eye on developments that are occurring in the USA on this issue (among others).

[4] The 2004 USDA/NASS Survey on Distillers Grains reported that 5% of the plants that responded had germ removal as part of their operations.

6.6 Other Considerations

In 2006 it is expected there will be up to 8 million tonnes of DDGS available for livestock feeding in the USA with projections up to 14 million tonnes per year in the future. The ongoing actual volumes that are available, and their usefulness will be determined primarily by three factors:

- The price of oil

  The present capital investment in the ethanol industry in the USA is being driven by the price of oil. With oil prices at U$60-75 a barrel in West Texas Intermediate terms then ethanol is an extremely viable alternative fuel. With corn prices at A$100 a tonne[5] US plants can produce ethanol at US$1.00 per US gallon or A 35.23 cents per litre at a 0.75 exchange rate. Even if corn prices were double this level[6] and there was no corresponding increase in the offsetting value of DDGS (which is unlikely) then the ethanol would still be US 170 cents a US gallon which makes it competitive at US$2.54 a gallon due to the fact that ethanol is only 67% the energy of petrol and has no current excise in the USA[7]. Therefore if oil prices remain high increasing levels of ethanol production are likely.

- Continued levels of support for corn based ethanol in the USA.

  There are considerable support programs for US based corn ethanol including subsidies, State based mandating programs, excise relief, and import tariffs. If these support programs remain in place then it is likely that production will continue to increase.

- Co –location of plants with cattle operations

  As energy costs rise the cost of drying and transporting distillers grains has risen. This has made co-locating ethanol plants and cattle feeding (either dairy or feed lot operations) more attractive and this may limit DDGS production in the future.

It is not possible to predict the complex interaction of all of these factors. However it is possible to make the following statements:

- The decision to continue operating a grain based ethanol plant is a different to the investment decision to build a plant. The costs of production outlined above include capital costs. Once the plant is built these costs will be incurred whether the plant is

[5] 1 tonne = 2204 pounds. 1 bushel = 56 pounds. Therefore there are 39.37 bushels to a tonne. Therefore A$100 a tonne = A$2.52 per bushel or US$1.89 per bushel at an exchange rate of US 75 cents to the Australian dollar

[6] At the time of writing this report the CBOT futures for corn were Sep 06 US$2.33, Dec 06 US$2.49, and July 07 US$2.81

[7] Retail prices in August 2006 reached a record average of US$2.55 a US gallon according to the US Today: http://www.usatoday.com/money/industries/energy/2005-08-14-gas-prices_x.htm

operating or not. Therefore the investment return required to keep a plant operating will be below the real cost of operation. This means that most of the plants that are currently operating or are being built are likely to remain operating unless there is a calamitous fall in the oil price.

- Even if there was a calamitous fall in the price of oil it is likely that the US government would step in to support the existing plants for political and energy security reasons.

- Therefore we can have a reasonable level of confidence that the DDGS production numbers contained in this report will be maintained. We are less confident about bullish predictions of increasing production, although they are plausible possible scenarios.

6.7 Conclusion

- It is clear from the data that there will be significant volumes of DDGS produced from the United States over the coming years.

- It is also clear that with the United States already exporting significant volumes of DDGS the rapid increase in production is likely to result in extra exports.

- This needs to be tempered against the fact that increased research is going into animal feeding of DDGS in the United States.

- However it is likely that the DDGS price will be linked very closely to corn prices. Therefore significant volumes are likely to be available for export at a small price premium above the local market.

7 Potential Usage of DDGS in Eastern Australia

7.1 Background and Summary

DDGS has become a major feed resource as a consequence of the expansion of the grain-based fuel ethanol industry, primarily in the USA. Corn is the primary grain used in the USA for ethanol production and when corn is fermented in these operations approximately 36% of the grain is recovered as ethanol, 32% as carbon dioxide and 32 % as DDGS. Consequently the composition of DDGS is approximately 3 times the non-fermentable components of the original grain e.g. protein, fibre, minerals (Shurson and Noll, 2005).

Traditionally feed millers have held very conservative views on the feed value of DDGS due to variability in its nutrient content, high fibre, apparent low energy content, and low amino acid availability from the protein. However recent research with products from the “new generation” ethanol plants has revealed that feeding values are considerably higher than previously accepted.

Due to their relatively high fibre content distillers by-products have traditionally been channelled into ruminant diets but recent research indicates they have much wider application.

The aim of this study is to explore the potential limits to the utilisation of imported DDGS in the Australian feed industry in terms of need and the likely volumes that may be utilised.

The protocol that has been adopted is to examine the application of DDGS within each species and then to generate cumulative potential use based on livestock numbers. There will however be handling constraints both in terms of feed milling and also geographic relocation around the country which will need to be considered in these estimates.

7.2 Beef Cattle

In terms of appropriateness for beef cattle diets DDGS fits very well. Although most of the readily fermentable carbohydrates have been removed the residual structural carbohydrates are accessible to rumen microbial fermentation, and the protein/fat mineral components have been concentrated. The net result is that DDGS has an energy value at least equal to grain, and due to its low starch content has the ability to dilute the risk of acidosis in grain based diets. As such it has the potential to improve the utilization of the supplementary grain by maintaining rumen stability.

Most authorities concur from trials conducted that up to 40% of the diet can be supplied from DDGS with no compromise to performance.[8]

[8] This includes marbling scores, despite recent media reports that levels above 30% could impact on marbling scores.

So in terms of meeting the beef feedlot requirements as well as the growing beef cattle supplementary feeding requirements in terms of severe feed shortage the realistic potential usage of DDGS could be calculated as follows.

Based on cattle feed lot grain requirements of 2.73 million tonnes[9] this means that the maximum possible inclusion rate for DDGS would be 2,992 tonnes per day assuming that every feed lot used the maximum inclusion rate. This is clearly not possible.

There are many ways to calculate what might realistically occur. An assumption that half the feed lot cattle would be fed on a 30% inclusion rate gives a daily inclusion of 1,121 tonnes day assuming that cattle on feed remained the same.[10]

We have assumed three possible scenarios for our summary table at the end of this section:

- High: 1,000,000 cattle consuming 9 kg grain per day with 50% of them having 40% of that grain replaced by DDGS
- Medium: 850,000 cattle consuming 8Kg grain per day with 50% of them having 30% of that grain replaced by DDGS
- Low: 750,000 cattle consuming 8Kg grain per day with 30% of them having 30% of that grain replaced by DDGS.

On top of the feed lot requirements in a severe drought there would also be a requirement to supplementary feed beef breeding cattle Assuming about 29 million breeders in the country and assuming say 10% will be supplementary fed at 5 kg/day and 10% of that feed could be DDGS the resultant tonnage would be 1450 tonne/day.

We have assumed the following scenarios for our summary table at the end of this section:

- High: 29 million breeders with 10% supplementary fed at 5kg/day and 10% of the DDGS
- Medium: 27.5 million breeders with 7.5% supplementary fed at5kg/day with 10% of that DDGS
- Low: 25 million breeders with 5% supplementary fed 5kg a day with 10% of that DDGS

[9] MLA FLOT.123 - Review Options to Reduce Feedstuff Variability in Australia - Volume 2 Statistical Compendium and Supplementary Reports - Review of Feed Grain Requirements for Feedlots p28
[10] Many scenarios of reduced cattle numbers, or high usage rates would be created but in our view do not add much value to the key issue of whether there would be sufficient volumes to justify importation.

7.3 Dairy

When DDGS has been used as a partial (20%) replacement in dairy diets based on corn/soy there has been significant improvements in productivity, in terms of total milk, fat and protein yield.

DDGS is a particularly useful feedstuff for dairy cows. It has an energy value higher than corn, a high bypass protein value and has high phosphorus content.

Its only downside is its Neutral Digestible Fibre content which limits its inclusion. If fed beyond 20% of the total diet the NDF input may begin to reduce overall intake depending on the NDF of other components.

Based on 2.05 million dairy cows[11] eating approximately 1.1 tonne of supplement/head/year[12] and allowing up to 50% inclusion, the potential DDGS usage is 1.13 million tonne/year. But in more realistic terms access to DDGS might be restricted at the high end to 30% of cows, and perhaps 30% inclusion leads to 203,000 tonnes of DDGS a year or 556 tonnes day on average, understanding that there will be seasonable variations. This is our high case scenario.

- Medium: 2.05 million cows with 25% of them eating supplementary feed with 20% DDGS
- Low: 2.0 million cows with 15% of them eating supplementary feed with 20% DDGS

The bypass protein value of DDGS needs to be kept in perspective. The key amino acids for milk synthesis are lysine and methionine. The lysine content of DDGS is low (e.g. soybean meal protein contains 6.3% lysine per unit of protein while DDGS has only 2.8%). (O'Mara et al, 1997)

7.4 Pigs

DDGS has not been utilized traditionally in pig diets due to variability in quality, poor amino acid availability, high fibre content and price competitiveness with other potential feedstuffs.

When diets are formulated on an available amino acid basis and available phosphorus basis, trials at the University of Minnesota have indicated that the levels of DDGS in

Table 2 can be incorporated into pig diets without any negative effects on performance.

[11] ABARE 2005 commodity Statistics
[12] [12] MLA FLOT.123 - Review Options to Reduce Feedstuff Variability in Australia - Volume 2 Statistical Compendium and Supplementary Reports - Feed Grains and the Dairy Industry P55.

Table 2– Maximum Levels of DDGS in pig diets

Type of Pig	% Inclusion of DDGS
Weaning pig	**25**
Grower/Finisher pig	20[13]
Gestating sows	**50**
Lactating sows	**20**

Assuming a total annual feed usage in the Australian pig industry of 1.8 million tonnes (300,000 sows x 6 tonne/year) and applying the maximum inclusion rates nominated the potential use of DDGS could be calculated as;

	% Total Consumption	Tonnes Feed	Maximum Inclusion %	Potential Tonnes DDGS
Weaners	12	216,000	25	54,000
Gro/Fin	67	1,206000	20	241,000
Gest Sows	12	216,000	50	108,000
Lact Sows	9	162,000	20	32,000
	100	1.8 million		435,000

Realistically the inclusion rates will be limited far more than this and may also be limited by feed press operations in some farms (see later notes in this section)[14]. In our summary table we have made the following assumptions:

- High – 50% of the pigs access DDGS at the levels above
- Medium: 35% of the pigs access DDGS at the levels above
- Low: 25% of the pigs access DDGS at 75% of the above levels

7.5 Poultry

[13] Inclusion limited due to the contribution of polyunsaturated fatty acids leading to soft fat in slaughter pigs. On a simply growth performance basis up to 30% DDGS can be employed (Shurson and Spiehs, 2002).

[14] However it is likely that in a serious drought situation that a significant number of farms would feed their sows on mash feeds rather than pellets in order to access DDGS at these levels without inhibiting feed presses. This would then free up press capacity for the other feeds.

The high fibre and protein content of DDGS yield low ME values for poultry. This is partially offset by the higher oil content in the new generation DDGS products but the energy level is still only quoted as 2750 kcals ME/kg (or 11.5 MJ ME/kg) (Noll, 2005). Coupled with the relatively poor protein quality and low amino acid availability the overall feeding value of DDGS for poultry is limited.

The University of Minnesota nominates maximum inclusion levels as Broilers 10%, Turkeys (grow/finish) 15%, and layers 15% but warns careful attention is needed to balance available amino acids and energy levels if productive efficiency is to be maintained.

DDGS has some value as a source of phosphorus and xanthophylls but these are very secondary to energy and amino acids.

Given the proximity of much of the poultry industry to metropolitan mills/ports the feasibility of using DDGS is quite good. Assuming a total feed tonnage used in the broiler industry is around 2.0 million tonne/year, then at 10% inclusion this could account for 200,000 tonne/year.

- High : 65% of poultry at 10%
- Medium : 40% of poultry at 10%
- Low: 25% of poultry at 10%

Of course if DDGS was not significantly lower than imported grain then the poultry industry would take advantage of their portside locations and use grain instead of DDGS as they have done previously.

7.6 Horses

The high fibre nature of DDGS is quite suited to horses, and in fact feeding DDGS has been shown to stimulate both cellulose and protein digestion. The high oil content is also considered as a useful energy substrate for performance horses.

The only concern with DDGS for horses is palatability particularly the dark or burnt flavoured material. Trials with up to 20% DDGS in total horse mixes have been quite successful (Leonard et al 1975, Pagan 1991).
There are over 1 million horses in Australia but the level of hand feeding as distinct from grazing or hay supplementation is difficult to quantify.

For this reason we have ignored the horse population for practical purposes with the caveat that some DDGS may move into this area, assisting in the grain demand and supply situation

7.7 Other species

DDGS has been used in feed for rabbits, dogs, cats, and some aqua species (e.g. trout) at up to 25% of the diet with reasonable success. The potential tonnage of product that could be diverted to these channels is however quite small.

7.8 Impediments to the utilisation of imported DDGS

1. Traditional prejudice

To date DDGS has been viewed as a variable by-product of limited feeding value. Even if the composition of the new generation DDGS ex the USA can be shown to be superior to previous examples, there is likely to be a lot of conservative scepticism about its use in monogastric diets, and performance orientated ruminant diets. Consequently the potential usage rates nominated are unlikely to be approached unless the grain supply under drought conditions becomes extremely serious.

2. Handling concerns

Limited experience with local examples of DDGS has involved some issues of handling. Variable particle size from powder to large balls has caused difficulties with flowability, bridging in silos and separation. When used in pelleted feeds above 10% inclusion there appears to be a reduction in press output. One operator calculates that there is a 1 t/h reduction in output for each 1% of DDGS above 10% for a 35 tonne/hour press. In this instance modest savings in raw material cost could be quickly overtaken with increased manufacturing costs if throughput rate is halved.

3. Storage stability

With oil content in DDGS of around 9%, and being unsaturated, the potential for oxidative rancidity is high particularly in warm weather. This could reduce the palatability of the product and have detrimental effects on the fat composition of milk in dairy cows and lactating sows. Consequently there should be a focus on rapid turnover rather than prolonged storage and an antioxidant may need to be added. In one instance in Queensland it has been known to spontaneously combust in a silo.

4. Geographic dislocation of end users and freight costs

With high fuel prices the cost of freight will significantly impact on what radius of territory can be serviced from a receiving port. The relatively low bulk density of the DDGS product means that it cannot afford to carry a great deal of freight cost before it becomes an unattractive option. DDGS has a density of 42-58 Kg/hl compared to wheat at 75-80Kg/hl. The potential of higher tonne rates for cartage need to be taken into consideration when looking at importing DDGS.

5. Mycotoxins

Mycotoxins are of little concern in ethanol production but remain an issue for DDGS users. Mycotoxins on the grain are not denatured during fermentation and hence are concentrated three fold into the DDGS fraction (Thaler, 2002). As zearalenone and vomitoxin (DON) are common contaminants of corn and a major concern in pigs and horses, constant vigilance is required to ensure that these don't represent a problem in DDGS. We have attached a testing regime that has been proposed by Jerry Thurson of the University of Minnesota. While this comments on matters beyond mycotoxins three key points on mycotoxins should be noted:

- That ethanol plants have ELISA tests available to them to test incoming grain for mycotoxins. It is our view that this should be a minimal requirement for a QA system for plants that are considered for importation.

- That testing of DDGS for mycotoxins is problematic due to possible problems with salts and oxidisers with the tests.

- However testing is available for two mycotoxins via ELISA.

7.9 Tentative costings of DDGS

Tony Edwards has run a series of parametrics on a range of selected diets using 2 cost sets as shown in **Table 3**.

- A = "normal" raw material prices

- B = "drought situation" raw material prices

These indicate that DDGS would need to arrive on farm at less than A$190/tonne to be competitive in the "normal" situation. This is very clearly not going to be viable.

In a severe drought situation the maximum competitive price has been estimated at $270/tonne delivered to the feed lot, farm or mill. This price is more likely to be achievable depending on freight costs. The capacity to bring in large volumes may be just as important as the price in the case of high local grain prices or, actual physical shortages.

Table 3 – Break Even Costs of DDGS in Normal and Drought Situations

Breakeven costs of DDGS (A$/tonne)				
Species	**Feed**	**Normal prices**		**Drought situation**
Pig	Grower	230		340
	Finisher	230		317
	Dry Sow	200		296
Broiler		308		352
Layer		205		275
Feedlot Finisher		140 (25%)		195 (30%)
		270 (16%)		270 (20%)
				360 (15%)
Dairy-15 Supplement		180 (30%)		295 (30%)
		190 (15%)		305 (12%)
Overall max competitive price of DDGS		190		270
Raw material price assumptions (A$/tonne)				
	Normal	**Drought**		
Wheat	180	300		
Barley	160	280		
Sorghum	170	290		
Lupins	220	350		
Peas	230	360		
Millmix	140	240		
Soya - 48	420	500		
Canola	280	350		

In the “drought” situation the indicative price is extended to A$270/tonne, but still may be tight once the freight and margin factors are considered.

Prices would certainly need to come down to these levels or less if any significant volume is to be consumed.

As an indication of pricing the US Grain Council Grain perspectives newsletter[15] June 23 2006 and August 11 2006 had the following pricing for DDGS and ocean freight rates.

Table 4 – DDGS Pricing as of June 23 2006

DDGS	USD/MT			
Delivery Point	July	August	September	October.
FOB Vessel GULF 33 % Profat	130	130	130	No Quotes
FOB Vessel GULF 36 % Profat	130	130	130	" "
Mid-Bridge Brownsville, TX 33 % Profat	142	142	142	" "
Mid-Bridge Brownsville, TX 36 % Profat	142	142	142	" "
40 ft. Containers to South Korea (Busan)	161	161	161	" "
40 ft. Containers to Taiwan (Kaohsiung)	158	158	158	" "
40 ft. Containers to Indonesia (Jakarta)	160	162	165	" "

Table 5 – DDGS Pricing as of August 11 2006

DDGS	USD/MT			
Delivery Point	August	September	October	November.
FOB Vessel GULF 33 % Profat	127	127	127	No Quotes
FOB Vessel GULF 36 % Profat	130	130	130	" "
Mid-Bridge Laredo, TX 33 % Profat	140	140	140	" "
Mid-Bridge Laredo, TX 36 % Profat	141	141	141	" "
40 ft. Containers to South Korea (Busan)	155	155	156	" "
40 ft. Containers to Taiwan (Kaohsiung)	151	151	151	" "
40 ft. Containers to Indonesia (Jakarta)	155	155	155	" "

[15] Available at http://www.grains.org/page.ww?section=Market+Perspectives&name=Market+Perspectives

Table 6 – Ocean Freight Costs June 23 2006

OCEAN FREIGHT MARKETS and SPREADS			
Dry Bulk Freight Indices for HSS - Heavy Grain, Sorghum and Soybeans.			
Route and Vessel Size			
55,000 U.S. Gulf-Japan	37	Unchanged	
55,000 PNW- Japan	29	Unchanged	
55,000 U.S. Gulf - China	36	Unchanged	North or South China
25,000 U.S. Gulf- Veracruz,	15		3,000 daily discharge
Mexico			rate
35-40,000 U.S. Gulf-	11		Deep draft and 8,000 per
Veracruz, Mexico			day discharge rate.
25/30,000 U.S. Gulf- East	20		
Coast Colombia			
25,000 U.S. Gulf - Algeria	33		
55,000 U.S. Gulf -Egypt	29		
60-70,000 U.S. Gulf - Europe	19.5		
55-60,000 Brazil -China	37		Panama Canal Delays
St. Lawrence – Persian Gulf	42		
55,000 U.S. Gulf to Iraq	$54.00- $55.00		
25,000 U.S. Gulf to Morocco	30		One port discharge.

Table 7 – Ocean Freight Rates August 11 2006

Route and Vessel Size	Current Week USD / MT	Change from previous week	Remarks
55,000 U.S. Gulf-Japan	44.5	Up $1.50	
55,000 PNW- Japan	33	Up $1.00	
55,000 U.S. Gulf - China	44.5	Up $1.00	North or South China
25,000 U.S. Gulf- Veracruz,	18	Up $.50	3,000 ton daily discharge
Mexico			rate
35-40,000 U.S. Gulf- Veracruz,	13.5		Deep draft and 8,000 mt per
Mexico			day discharge rate.
30 / 35,000 U.S. Gulf- East Coast	19.5	Up $.50	
Colombia			
25,000 U.S. Gulf - Algeria	36		
55,000 U.S. Gulf -Egypt	31		
60-70,000 U.S. Gulf - Europe	24		
55-60,000 Brazil -China	45.5		Panama Canal Delays
St. Lawrence – Persian Gulf	48.5		
55,000 U.S. Gulf to Iraq	59		
25,000 U.S. Gulf to Morocco	34		One port discharge.

It is extremely important to note the freight differences in this relatively short time frame. The freight rates in the August 2006 newsletter were accompanied by the following commentary: :

***"Ocean Freight comments –** Ocean freight rates have staged an impressive, and for some painful, rally. Rates are currently at 2006 calendar year highs. Rates on the major long distance overseas routes were up $1.25 to $1.50/mt over the past week and are up a total of $12.00/tonne for the year on rates from the US Gulf to Asia. PNW rates on the same routes are up $9.92/tonne for 2006.Vessel owners are attributing the higher rates to the growing Chinese economy and its demand for Iron Ore and Steel as well as slower turn times and higher fuel costs for vessels. The rally started with the big Cape size*

vessels and spilled over to the Panamax market when charters realized the economic value of buying two Panamax vessels in place of one Cape size vessel. The rally has actually been a surprise to everyone, including the vessel owners. And everyone is

wondering how much farther things can go. Looking back at a three year history we find that vessel rates reached an all time high of $74-75.00/tonne on the US Gulf to Japan route in March of 2004. PNW rates reached their historical high of $49.90/tonne, Gulf to Japan, in December of 2004.The three year low of $32.73/tonne for the Gulf to Japan route was attained in March of 2005. The Mid-point value for this freight over the last three years is $53.36. In that US Gulf to Japan values are currently at $44.32/tonne, we can at least say that we are still below the three year Mid-point cost. It is difficult, if not impossible to predict just where things will go from here. I was of the opinion that rates were too high one month ago and now they are even higher. All markets move up and down and I believe that rates will soften in time. As with all things, Timing is everything. The yearly lows for the years of 2003 and 2005 were achieved in the months of August and September. Obviously we will not set the 2006 low values in August or September, we likely did that in the beginning of this year, but maybe there is hope for some beneficial adjustment?"

It is not our area of expertise to cost freight rates and associated costs but with DDGS FOB at US$127 a tonne this equates to A$169.33 per tonne which does not leave a lot of room for shipping, unloading and freighting to feed mills/farms if the price needs to stay below A$270 a tonne to be competitive. It will be interesting to see what the pricing for DDGS does with the increased volumes coming on to the market in the USA but with increasing research into higher feeding levels it is likely to be linked to the corn price rather than a price crash occurring.

7.10 DDGS Utilisation Summary

Table 10 Shows the summary of our scenarios for the utilisation of DDGS in Australia.

It is clear from these possible scenarios that there is considerable scope for importation and utilisation of DDGS into Australia in the case of severe drought, especially if there is a physical shortage of feed grains for the livestock industries.

More work needs to be done on the delivered pricing into Australian farms or feed mills.

Table 8– Potential DDGS Daily Utilisation Scenarios (tonnes)

	High	Medium	Low
Feed Lots	1800	1020	540
Beef Breeder Cattle	1450	1031	625
Dairy	556	308	180
Pigs	595	417	223
Poultry	356	219	136
Total Daily	4758	2996	1706
Total Weekly	33,300	20,980	11,940

References

Cromwell, G.L, Herkleman, K.L. and Stahly, T.S. (1993)
Physical chemical and nutritional characteristics of distillers dried grains with solubles for chickens and pigs. J. Animal Science 71: 679-686.

Leonard, T.M., Baker, J.P. and Willard, J. (1975)
Influence of distillers feed on digestion in the equine. J. Animal Science. 40: 1086 – 1092.

Noll, S (2005)
Corn distillers dried grains with solubles for poultry.
http://www.ddgs.umn.edu/feeding poultry

O'Mara, F.P. Murphy, J.J., and Rath, M. (1997)
The amino acid composition of protein feedstuffs before and after ruminal incubation and after subsequent passage through the intestines of dairy cows.
J. Animal Science. 75: 1941-1949.

Pagan, J. D. (1991)
Distillers dried grains as an ingredient for horse feeds. Palatability and digestibility study.
U.S. Distillers Feed Conference. 46:83-86.

Shurson, G.C. (2005)
Issues and opportunities related to the production and marketing of ethanol by-products.
USDA Agricultural Outlook Forum, 2005.
Washington D.C.

Shurson, G.C., Noll, S. (2005)
Feed and alternative uses for DDGS.
http://www.ddgs.umn.edu/info-industry.htm

Shurson, G.C. and Spiehs, M.J. (2002).
Feeding recommendations and example diets containing Minnesota – South Dakota produced DDGS for swine.
http://www.ddgs.umn.edu/feeding/swine/exampleswinediets

Shurson, G.C., Whitney, M.H., Spiehs, M.J., Baidoo, S.K. and Benteria, A. (2000)
The value of distillers dried grains with solubles in pig diets, pp47-62. In "Concepts in Pig Science". Eds. T.P. Lyons and D.J.A. Cole.
Nottingham University Press, Nottingham.

Thaler, R. (2002)
Use of distillers dried grains with solubles (DDGS) in swine diets.
http://www.agbiopubs.sdstate.edu/articles/exex2035

8 Preliminary Quarantine Considerations

8.1 Background and Summary

The preliminary quarantine assessment in this report is based on the assumption that DDGS in Australia would be transported from port to inland facilities. At those facilities the DDGS would either be included in feed stock for pelleting processes or would be fed in a mix without further processing. Therefore it is assumed that any quarantine steps that reduce import risk levels to the appropriate level for Australia must occur prior to off loading at the port.

We have divided our preliminary assessment into two areas:

- The processes within ethanol plants that may reduce the quarantine risk compared to the importation of bulk maize.
- The risks of maize outside the ethanol plant which will be mainly related transporting DDGS from ethanol plant to Australia. It is reasonable to assume that these risks will be similar to that of transport of whole maize and therefore have been dealt with during the IRA Import Risk Analysis for the Importation of bulk maize from the USA which was released in October 2002[16]. It is beyond the scope of this report and our expertise to make detailed recommendations on this area but we have included the import conditions for bulk maize and made some preliminary comments on their relationship to DDGS imports.

[16] Available at http://www.affa.gov.au/corporate_docs/publications/pdf/market_access/biosecurity/plant/final_maize.pdf

8.2 Pathogens and Pests Associated with Maize in the USA

The Import Risk Assessment for Maize found that there at least 428 pathogens associated with maize but that:

- 55 were excluded as they had not been recorded in the USA
- 202 were excluded because they either occur in Australia, or were unlikely to enter Australia in bulk maize.
- 106 were not examined due to lack of available data, and it was concluded that there was no information to indicate that these pests would meet the criteria for a quarantine pest.

Of the 65 remaining pathogens and nematodes 48 were excluded as they were not reported to cause significant economic losses. The remaining 17 pathogens are shown in

Table 9 - Qualitative analysis of the relative risk to Australia of 17 quarantine pathogens associated with maize grain from the USA

Pathogen (hosts)	Disease Introduction Risks	Economic Damage Risks	Disease Management costs	Overall Risk
Peronosclerospora sorghi (downy mildew of maize, sorghum)	High	High	High	High
Maize dwarf mosaic potyvirus (maize)	High	Medium	Medium to high	Medium to high
High Plains tenuivirus (maize, wheat)	Medium	High	Low to medium	Medium to high
Wheat streak mosaic rymovirus (maize, wheat)	Medium	High	Low to medium	Medium to high
Sclerospora graminicola (maize, sorghum, pearl millet and many grasses)	Medium	High	Medium	Medium to high
Phymatotrichospsis omnivora (Texas root rot of cotton and other dicotyledonous plants)	Medium	High	Medium	Medium
Maize chlorotic mottle machlomovirus (maize)	Very high	Low to medium	Low	Medium
Cercospora zeae-maydis (grey leaf spot maize)	High	Low to medium	Low to medium	Medium
Pantoea stewartii subsp. stewartii (Stewart's wilt sweetcorn)	Low to medium	Medium	Low to medium	Medium
Clavibacter michiganensis subsp. nebraskensis (Goss's bacterial wilt of maize)	Medium	Low	Low to medium	Medium
Heterodera zeae (maize cyst nematode)	Low to medium	Low	Low	Low
Ustilaginoidea virens (false smut of maize)	Low to medium	Low	Low	Low
Dolichodorus heterocephalus (Awl nematode)	Low	Low	Low	Low
Hoplolaimus columbus (lance nematode)	Low	Low	Low	Low
Longidorus breviannulatus (needle nematode)	Low	Low	Low	Low
Pratylenchus scribneri (root lesion nematode)	Low	Low	Low	Low
Meloidogyne chitwoodi (root knot nematode	Low	Low	Low	Low

along with the qualitative risk analysis from the IRA for bulk maize.

The IRA identified a number of arthropod pests associated with stored maize in the USA. Due to common handling of grain from the USA, Canada, and Mexico the IRA included all likely arthropods from North America as a whole, and also included common pests of possible admixture. It is likely that DDGS will be transported using similar facilities. They key difference from a quarantine perspective will be to determine if these pests are capable of surviving in DDGS as opposed to whole corn given the compositional differences. These pests are shown in Table 10.

We have included this information so that the reader has a clear understanding that the importation of DDGS from the USA will not be a simple process, and so that all the information was available in this report rather than readers having to go and source the maize IRA.

Table 9 - Qualitative analysis of the relative risk to Australia of 17 quarantine pathogens associated with maize grain from the USA

Pathogen (hosts)	Disease Introduction Risks	Economic Damage Risks	Disease Management costs	Overall Risk
Peronosclerospora sorghi (downy mildew of maize, sorghum)	High	High	High	High
Maize dwarf mosaic potyvirus (maize)	High	Medium	Medium to high	Medium to high
High Plains tenuivirus (maize, wheat)	Medium	High	Low to medium	Medium to high
Wheat streak mosaic rymovirus (maize, wheat)	Medium	High	Low to medium	Medium to high
Sclerospora graminicola (maize, sorghum, pearl millet and many grasses)	Medium	High	Medium	Medium to high
Phymatotrichospsis omnivora (Texas root rot of cotton and other dicotyledonous plants)	Medium	High	Medium	Medium
Maize chlorotic mottle machlomovirus (maize)	Very high	Low to medium	Low	Medium
Cercospora zeae-maydis (grey leaf spot maize)	High	Low to medium	Low to medium	Medium
Pantoea stewartii subsp. stewartii (Stewart's wilt sweetcorn)	Low to medium	Medium	Low to medium	Medium
Clavibacter michiganensis subsp. nebraskensis (Goss's bacterial wilt of maize)	Medium	Low	Low to medium	Medium
Heterodera zeae (maize cyst nematode)	Low to medium	Low	Low	Low
Ustilaginoidea virens (false smut of maize)	Low to medium	Low	Low	Low
Dolichodorus heterocephalus (Awl nematode)	Low	Low	Low	Low
Hoplolaimus columbus (lance nematode)	Low	Low	Low	Low
Longidorus breviannulatus (needle nematode)	Low	Low	Low	Low
Pratylenchus scribneri (root lesion nematode)	Low	Low	Low	Low
Meloidogyne chitwoodi (root knot nematode	Low	Low	Low	Low

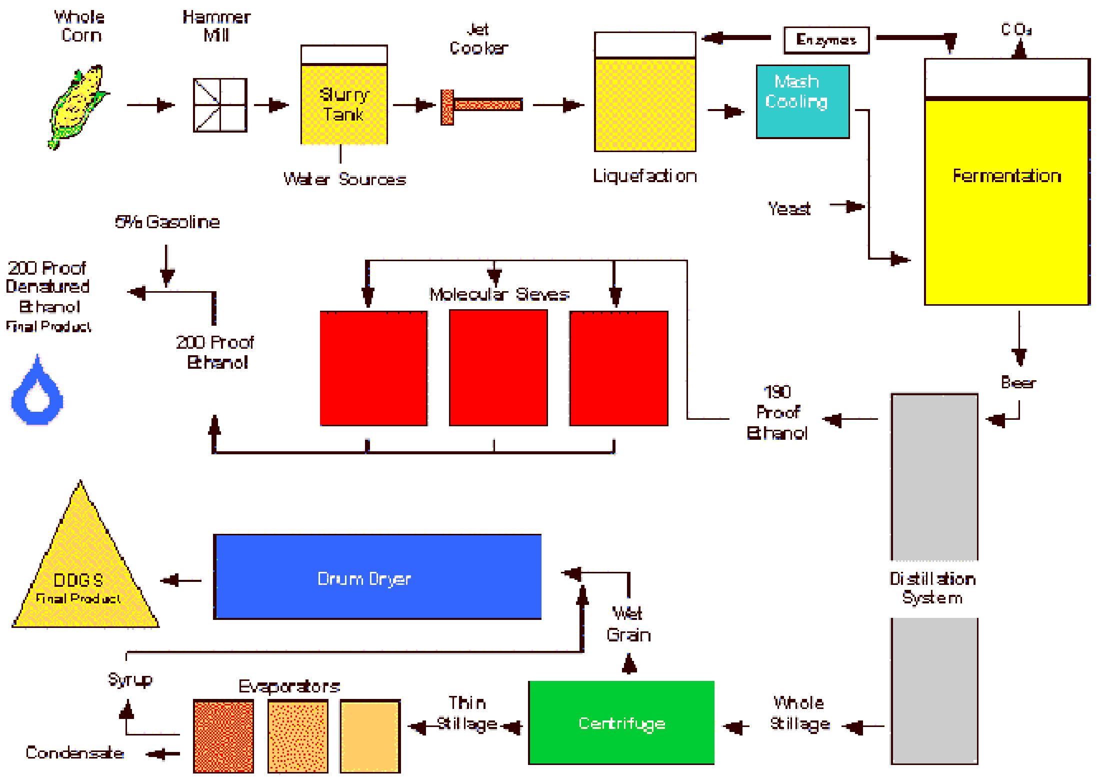
Table 10 – Quarantine pests for Australia with a significant risk of being associated withy bulk maize grain from the USA

Scientific name	Common name
a: Pests that are capable of breeding in stored grain	
Cathartus quadricollis (Guérin-Méneville, 1829) [Coleoptera: Silvanidae]	Tropical warehouse moth
Caulophilus oryzae (Gyllenhal, 1838) [Coleoptera: Curculionidae]	Broad nosed grain weevil
Cryptolestes turcicus (Grouvelle, 1876) [Coleoptera: Laemophloeidae]	Flat grain beetle
Cynaeus angustus (Le Conte, 1852) [Coleoptera: Tenebrionidae]	Large black flour beetle
Pharaxanotha kirschi Reitter, 1875 [Coleoptera: Languriidae]	Mexican grain weevil
Prostephanus truncatus (Horn, 1878) [Coleoptera: Bostrichidae]	Larger grain borer
Tribolium audax Halstead, 1969 [Coleoptera: Tenebrionidae]	American black flour beetle
Tribolium brevicornis (LeConte, 1859) [Coleoptera: Tenebrionidae]	Flour beetle
Tribolium destructor Uyttenboogaart, 1933 [Coleoptera: Tenebrionidae]	Large flour beetle
Tribolium madens (Charpentier, 1825) [Coleoptera: Tenebrionidae]	Black flour beetle
Trogoderma glabrum (Herbst, 1783) [Coleoptera: Dermestidae]	Glabrous cabinet beetle
Trogoderma inclusum LeConte, 1854 [Coleoptera: Dermestidae]	Large cabinet beetle
Trogoderma ornatum (Say, 1825) [Coleoptera: Dermestidae]	Ornate cabinet beetle
Trogoderma variabile Ballion 1878 [Coleoptera: Dermestidae]	Warehouse beetle
b: Pests associated with damp maize grain	
Glischrochilus fasciatus (Olivier, 1790) [Coleoptera: Nitidulidae]	Picnic beetle
Glischrochilus quadrisignatus (Say, 1835) [Coleoptera: Nitidulidae]	Four-spotted sap beetle
c: Pests associated with infestable pulses	
Callosobruchus chinensis (Linnaeus 1758) [Coleoptera: Bruchidae]	Cowpea weevil
Zabrotes subfasciatus (Boheman 1833) [Coleoptera: Bruchidae]	Mexican bean beetle
d: Additional pests of quarantine concern to Australia	
Trogoderma granarium Everts, 1898 [Coleoptera: Dermestidae]	Khapra beetle

8.3 Processes Within Ethanol Plants that Reduce Quarantine Risk

The vast majority of modern ethanol processing plants are dry milling plants as shown in Figure 1

Figure 1 – Modern Ethanol Plant Process



Source: http://www.distillersgrains.com/drymillprocess.htm

There are several steps in the process where a reduction in quarantine risk can occur:

1. Milling of the maize to remove whole grains

2. Cooking – This step is being removed/reduced in some plants to reduce energy use and involves the process of raw starch hydrolysis and therefore cannot be relied upon in all cases.

3. Fermentation involves pH changes and increasing alcohol concentrations

4. Distillation involves high temperatures to distil the ethanol from the beer that comes from the fermentation tank

5. Drying again involves high temperatures and reductions in moisture content

6. Storage/Transport involves time at low moisture contents.[17]

In the next sections we examine each of these steps in more detail to complete our preliminary assessment of quarantine risks.

[17] Although storage and transport are also a major source of recontamination

8.4 Results of Milling and Screening

Milling and screening is intended to create a flour like material so that the starch can be exposed to gelatinisation, enzyme, and fermentation processes designed to maximise the yield of ethanol. Due to the differences in processes in different plants there are considerable differences between the DDGS products that are produced from various plants in the USA as shown in Figure 2.

Figure 2 – Various DDGS Sources

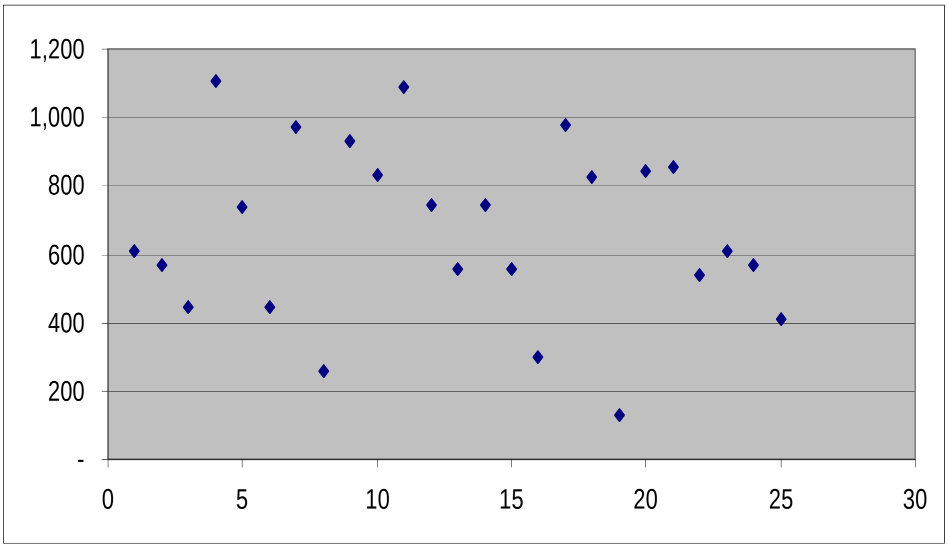
Source: Knowledge and Challenges of DDGS use in the Swine Industry by Dr Jerry Thurson

There is also considerable variation in the particle size from these plants as shown in Figure 3 which indicates considerable differences in the milling and screening processes across plants. This can be compared to the results from samples of soybean meal plants in the US in Figure 4.

This information needs to be compared to the weed seeds of concern for importation of maize from the US to assess if the weed seeds damaged sufficiently in the milling process to eliminate the quarantine risk.

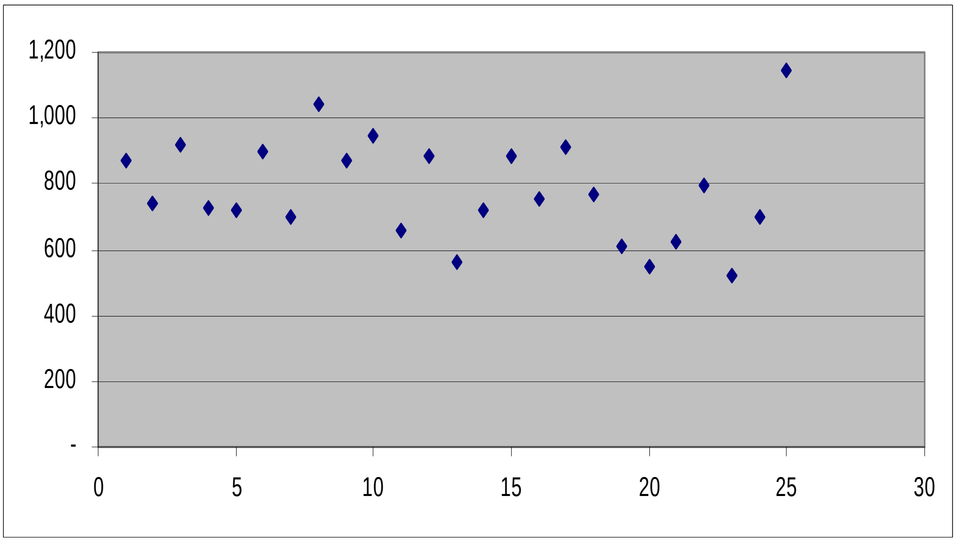
This analysis may result in plant by plant requirements for quarantine purposes.

Figure 3 – Variation in particle size (microns) among DDGS Samples Representing 25 US Ethanol Plants



Source: Knowledge and Challenges of DDGS use in the Swine Industry by Dr Jerry Thurson

Figure 4 – Variation in Particle Size (microns) among Soybean Meal Samples Representing 6 US plants



Source: Knowledge and Challenges of DDGS use in the Swine Industry by Dr Jerry Thurson[18]

[18] Available at http://www.ddgs.umn.edu/ppt-swine.htm

8.5 Results of Heating, Fermentation, Distillation and Drying

In the process of cooking, fermenting, distillation, and drying processes that occur in a modern ethanol plant the ground maize undergoes a number of temperature treatments, pH changes, and exposure to alcohol concentrations. Information from a number of sources [19] on these changes is summarised in Table 11.

Table 11 – Conditions in various steps of the ethanol plant process

	Temperature (Celsuis)	pH	Alcohol %
Slurry Tank	85 (Ave)	5.8 (Ave)	N/A
Cook	107 (Ave)	5.7 (Ave)	N/A
Mash	85 (Ave)	5.7 (Ave)	N/A
Fermenter	35-41	3.59-4.60	12-16
Distillation	93 (Ave)	N/A	N/A
Drying	62-99	4	N/A

It appears that not much work has occurred on the effects of these changes on viability of weed seeds, or other pathogens as the main concern has been recontamination of the mash before fermentation. This is due to the fact that the fermentation processes provide ideal conditions for bacterial growth that can harm ethanol production.

All indications are that the DDGS that is produced from a modern ethanol plant is essentially sterile with no viable weed seeds or pathogens (pers com Charles H Staff, Executive Director Distillers Grains Technology Council; pers com Gerald Thurson, University of Minnesota).

However these comments and the figures need to be interpreted with caution due to the fact that:

- In some plants the cooking processes are being reduced or eliminated in a process called raw starch hydrolysis. This technique has been developed to reduce costs in the face of high energy costs.

- There is significant variation between plants in their processes.

[19] **James Taylor - National Corn Ethanol Research Centre, and their website (http://www.ethanolresearch.com/research/), Charles H Staff (Distillers Grains Technology Council), Gerald Thurson (Department of Animal Science, University of Minnesota), CW Hastad et al - Swine research 2005 – Adding Dried Distillers Grains to Swine diets affects feed preferences**

- Some plants are using lower temperature drying processes in order to improve the quality of protein in their final product. This has resulted in significant variation in dryer temperatures between 127-621^{o}C [20] [21].

- There is significant risk of cross contamination between incoming maize supplies and outgoing DDGS supplies, particular from airborne bacteria or fungal spores

Despite these caveats it is clear that the processing of maize into DDGS at ethanol plants significantly reduces quarantine risks.

[20] Shurson and Noll - Feed and alternative uses for DDGS Available at http://www.ddgs.umn.edu/articles-industry/2005-Shurson-%20Energy%20from%20Ag%20Conf.pdf#search=%22DDGS%20drying%20temperatures%22

[21] Please note that this is the dryer temperature – not the temperature that the DDGS reaches.

8.6 Risks Outside the Ethanol Plant

As we have stated previously it is beyond the scope of this report, and our expertise to make specific recommendations on quarantine processes. This would be the province of a full IRA application and process. However a lot of this work has already been done in the maize IRA. Therefore we have copied the recommendations from the report on conditions for import and have made comments where appropriate.

Sourcing

To minimise the chance of post-treatment contamination, infection or infestation, the commodity should be sourced from the northern USA States in the maize growing areas, where the incidence of several of the more significant maize diseases is lower than in the southern States and from where Karnal bunt has not been detected in surveys of wheat crops. The northern States also have the advantage of a lower incidence of arthropod pests of concern compared to the southern States, and the weed, Striga asiatica, is not present. Note: This requirement may be varied depending on the demonstrated treatment efficacy and the ability to maintain the integrity of the grain after treatment.

Emergent Futures: If cross contamination of DDGS at the plant or in subsequent transport steps is considered a significant risk then location of plants and their maize sourcing arrangements may become a significant issue.

Grade

The permitted maize grade standard should be US No. 2 Grade or better.

Note: *Given the earlier conclusion that grain would need to be rendered sterile and disinfected at the port of export in the USA, the likelihood of achieving this outcome is greater if a higher grade of corn is used, since a cleaner starting product provides more latitude in the application of the treatment. It is noted however that if the process used to treat the grain can be shown to be equally effective on other grades of corn then lower grades may be an acceptable alternative.*

Emergent Futures: This is unlikely to be an issue due to the quality requirements of ethanol plants in receiving grain and their screening processes.

Transportation

The selected maize should be transported, for subsequent shipment, to a port on the Pacific Northwest in a manner that preserve s its identity.

Note: *The USDA stated that grain transport arrangements in the USA are not suited to identity preservation. The RAP therefore considers that certification of source and transport* *arrangements may be adequate for grain being handled before treatment but would not be sufficient for dealing with grain that was being sourced from specific areas on the basis of area freedom or low prevalence as an alternative to treatment.*

Emergent Futures: This is a critical issue for the importation of DDGS if treatment at port (either in the USA or Australia) is to be avoided. It is also likely to be the most difficult step in the process.

Treatment

The maize should be treated in a facility at the export port to provide a high degree of confidence that all seeds present (i.e. maize, other crop seed admixture and weed seeds) are rendered non-viable and all plant pathogens and arthropod pests present in the grain are killed.

Emergent Futures: As much of these risks will have been eliminated it should be possible to eliminate this process although this is no certainty. Cross contamination at plant and in transport will become the key issue if this is to occur.

Post-Treatment Conditioning

The treated maize should be conditioned immediately after treatment in a well cleaned plant to ensure that it is cooled to near ambient temperature and that its inherent moisture content is not more than 14% (wet basis).

Note: *The requirement to condition grain to a moisture content of not more than 14% is primarily to maintain quality but does fall within sanitary and phytosanitary regulatory considerations, as it is essential to minimise heating of the grain to prevent the development of mycotoxin producing fungi in the maize, and to reduce the risk of re-infestation or re-infection.*

Emergent Futures: This is dependent on whether treatment is required or not.

Verification of Treatment Process

Samples of the treated maize should be collected by either FGIS authorised/licensed personnel or APHIS personnel and forwarded by secure express airfreight to AQIS for analysis to determine the efficacy of treatment. AQIS should also require documentary evidence of the treatment process such as records showing exposure period/temperature details for audit purposes.

Note: *The tests for treatment efficacy could be carried out in the USA under FGIS or APHIS supervision subject to agreement with AQIS on conditions for carrying out and reporting these tests.*

Emergent Futures: This is dependent on whether treatment is required or not. Verification may be required at the end of the ethanol plant.

Storage Prior to Shipment

The treated and conditioned maize stocks should be stored in a well-cleaned, segregated facility to prevent any contact with untreated grain stocks or confusion as to the special status of the treated maize.

Emergent Futures: Applies equally to DDGS

Loading Path to Export Vessel

The grain-loading path from the storage location to the ship must be thoroughly clean and free from residues from previous grain handling operations.

Emergent Futures: Applies equally to DDGS

Phytosanitary Certification

AQIS would require a phytosanitary certificate issued by APHIS including the treatment details for the maize and certifying that no object of quarantine was detected in representative samples inspected during loading of the vessel. Alternatively, AQIS staff may pre-clear vessels.

Emergent Futures: Applies equally to DDGS

Ship Hygiene

The ship to be loaded would require pre-inspection and certification by FGIS grain inspection staff that stowage space is free from previous cargo residues and live insects, in accordance with AQIS standards for inspection of export grain vessels.

Note: *Standard stowage examination procedures are used by FGIS to certify all stowage space examined and result in the issuance of a certificate stating that: "Stowage space examined on the above date and found to be substantially clean, dry, free of insect infestation, and suitable to store or carry grain."*

Emergent Futures: Applies equally to DDGS

On-arrival Inspection

On arrival of the ship in Australia, the treated maize cargo would be inspected by AQIS prior to and during discharge of the cargo, to verify that the condition of the cargo is consistent with the analysis conducted on pre-shipment samples and that the treated maize has not been infested or in any other way contaminated in post-treatment storage or from the ship. Following successful AQIS inspection and any other testing or analysis deemed *necessary, the cargo would be released from quarantine for unrestricted movement.*

Emergent Futures: Applies equally to DDGS

8.7 Preliminary Quarantine Assessment

Our preliminary assessment is that:

- There will be significant reductions of, and possibly complete elimination of the quarantine risks of DDGS versus whole maize from the USA to the end of the dry milling plant process.
- The key quarantine risks are therefore more likely to be in the storage and transport processes where DDGS can become contaminated with grains, seeds and pathogens due to common freight systems with domestic and export grain movements
- These external quarantine considerations will not be as easily overcome as some in industry may think and may impose significant restrictions in terms of locations where DDGS can be accessed, or costs of obtaining and transporting the product.
- Import applications may have to be done on a plant by plant basis

9 Conclusions and Recommendations

1) That there is considerable scope for bringing in DDGS into Australia in the case of severe drought that causes physical feed grain shortages and/or high pricing. The possibility of this occurring has been increased due to:

   a) Higher levels of production in the USA

   b) Improvements in feed utilisation due to research across species.

   c) Improvements in process technology and value awareness – an increasing sophistication is occurring with DDGS producers as they realise that they need to supply a consistent high value feed product if they are to maximise their profits in the long term

2) That the quarantine risks of bringing in DDGS over whole grain will be much lower than for the importation of whole maize (ignoring a devitalisation step for whole grain at port in Australia).

3) That there is significant variation between ethanol plant processes that will have to be taken into consideration during an IRA process, and individual applications to import.

4) Transport and freight steps are likely to pose the most difficulties in quarantine processes.

5) That it is likely that there will be an increase in the price of DDGS in the near future if ethanol production continues to increase on the basis that domestic corn prices are likely to rise as ethanol demand reduces export levels. This is a risk for future costs of imported DDGS.

6) That further work be done to assess the feed mill/farm landed price for DDGS given the difficulties of bringing product in, increases in shipping costs and the issues of low density associated with DDGS.

7) That DDGS importation should be pursued as an alternative strategy to whole grain importation but not as an exclusive strategy. This requires an IRA application to be made, and fast tracked if importation in 2007 is to occur.

10 Appendices

10.1 Appendix 1 – Summary of Plants Under Construction in the USA

10.1.1 Pinal Energy, LLC

Pinal Energy	Maricopa	AZ	Arizona

1. Size (Ethanol Produced): 55 million US gallons (208 million litres)
2. Completion date : Ethanol production will begin the first quarter of 2007
3. Grain used: Corn
4. The plant will be producing mostly distillers wet grains that will service the neighboring feedlot by conveyor belts. The plant will have the capacity to produce dried distillers grains

Web Links

http://www.commerce.state.az.us/webapps/press/current_release.asp?sID=433

http://www.ethanolproducer.com/article.jsp?article_id=1861

10.1.2 Pacific Ethanol, Inc

Pacific Ethanol	Madera	CA	California

1. Size (Ethanol Produced): 35 million US gallons (132.5 million litres)
2. Completion date: Nov 2006
3. Grain used: corn
4. The plant will only be producing wet distillers grain. This will be shipped to the 500,000 dairy cattle that live within a 50 mile radius.

Web Links

http://www.pacificethanol.net/pei_plantupdate/slideshow_flash.html

http://www.pacificethanol.net/

http://www.pacificethanol.net/_content/about_products.php?nav=main&a=About&b=Products+and+Services&c=WDG#wdg

10.1.3 Front Range Energy

Front Range Energy	Windsor	CO	Colorado

1. Size (Ethanol Produced): 40 million US gallons (151.5 million litres)
2. Completion date : Commenced production May 2006
3. Grain used : corn
4. The plant will only be producing wet distillers grain for area feed lots and dairies.

Web Links

http://www.grainnet.com/info/articles.html?type=bn&ID=34113

http://www.trainorders.com/discussion/read.php?1,1172438,nodelay=1

10.1.4 Sterling Ethanol, LLC

Sterling Ethanol	Yuma	CO	Colorado

1. Size (Ethanol Produced): 45 million US gallons (170 million litres)
2. Completion date : March 2007
3. Grain used : corn
4. The plant will only be producing wet distillers grain for area feed lots and dairies.

Web Links
http://www.state.co.us/oemc/media/060224.htm

10.1.5 Illinois River Energy, LLC

Illinois River Energy	Rochelle	IL	Illinois

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : Dec 06
3. Grain used : corn
4. The plant will produce 136,000 tonnes of DDGS

Web Links

http://www.cargill.com/news/news_releases/2005/051003_ethanolplant.htm

http://www.illinoisriverenergy.com/

10.1.6 Central Indiana Ethanol, LLC

Central Indiana Ethanol	Marion	IN	Indiana

1. Size (Ethanol Produced): 40 million US gallons (151.5 million litres)
2. Completion date : June of 2007
3. Grain used: corn
4. The plant has the capacity to produce 130,000 tonnes of DDGS

Web Links

http://www.centralindianaethanol.com/products.html

http://www.centralindianaethanol.com/ground.html

10.1.7 AS Alliances Biofuels, LLC

AS Alliances Biofuels	Linden	IN	Indiana

1. Size (Ethanol Produced): 100 US Gallons (378.5 million litres)
2. Completion date : July 2007
3. Grain used: corn
4. The plant will produce 286,000 tonnes of dry distillers grain (DDGS) annually

Web Links

http://www.allbusiness.com/periodicals/article/861383-1.html

10.1.8 Anderson Clymers Ethanol, LLC

Andersons Clymers	Clymer	IN	Indiana

1. Size (Ethanol Produced): 110 million US gallons (416 million litres)
2. Completion date : March 2007
3. Grain used: corn
4. The plant has the capacity to produce 317,000 tonnes of DDGS

Web Links
http://www.andersonsethanol.com/clymers.asp

10.1.9 Iroquois Bio-Energy Company

Iroquois Bio-Energy Company	Rensselaer	IN	Indiana

1. Size (Ethanol Produced): 40 million US gallons (151.5 million litres)

2. Completion date: broke ground September 1st, 2005 - Construction time is expected to take 12-14 months. Therefore should be completed Sept 06-Dec 06

3. Grain used: corn

4. The plant has the capacity to produce DDGS but will also market wet distillers grains. At full drying capacity it would produce approximately 120,000 tonnes of DDGS

Web Links

http://www.ibecethanol.com/

http://www.indianaeconomicdigest.net/main.asp?SectionID=31&subsectionID=68&articleID=27975

10.1.10 Frontier Ethanol, LLC

Frontier Ethanol, LLC	Gowrie	IA	Iowa

1. Size (Ethanol Produced): 60 million US gallons (227 million litres)

2. Completion date : started production May 25 2006

3. Grain used: corn

4. The plant has the capacity to produce 161.5 thousand tonnes of DDGS annually and will be marketing under the Dakota Gold brand

Web Links

http://www.grainnet.com/info/articles.html?type=bn&ID=34066

http://www.frontierethanol.com/

10.1.11 Green Plains Renewable Energy

Green Plains Renewable Energy	Superior	IA	Iowa

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : June 30, 2007 – Sept 30 2007
3. Grain used: corn
4. The plant will have the capacity to produce DDGS but is also looking to market wet distillers grains. At full capacity the plant would produce approximately 140,000 tonnes of DDGS

Web Links
http://www.gpreethanol.com/

10.1.12 Hawkeye Renewables, LLC

Hawkeye Renewables	Fairbank	IA	Iowa

1. Size (Ethanol Produced): 100 million US gallons (379 million litres)
2. Completion date : May 2006
3. Grain used: corn
4. The company markets DDGS and modified wet distillers grains with solubles (MWDGS) which is a lower moisture wet distillers grains. The plant has the capacity to produce 280,000 tonnes of DDGS

Web Links
http://www.hawkrenew.com/our_history.asp

For daily prices of Distillers Grains at the plant
http://www.hawkrenew.com/userdocs/corn_bids.asp

10.1.13 Lincolnway Energy

Lincolnway Energy	Nevada	IA	Iowa

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : June 2006
3. What grain it will be using: corn
4. The plant will produce DDGS. Maximum capacity is approximately 140,000 tonnes

Web Links
http://www.lincolnwayenergy.com/

10.1.14 Pinnacle Energy

Pinnacle Energy	Corning	IA	Iowa

1. Size (Ethanol Produced): 60 Million US Gallons (227 million litres)
2. Completion date : August 2007 (estimate as no target date released)
3. Grain used: corn
4. The plant will produce 161,000 tonnes of DDGS marketed under the Dakota Gold Brand

Web Links
http://www.grainnet.com/articles/Pinnacle%20Ethanol%20Breaks%20Ground%20Near%20Corning,%20IA%20%20-32911.html

10.1.15 VeraSun Energy

VeraSun Energy	Charles City	IA	Iowa

1. Size (Ethanol Produced): 110 Million US Gallons (416 million litres)
2. Completion date : August 2007
3. Grain used: corn
4. The plant will produce 310,000 tonnes of DDGS

Web Links

http://www.verasun.com/facilities/charlescity_info.htm

http://www.verasun.com/press/releases_05-05-06.htm

10.1.16 US Bio Albert City

US BioEnergy Corp.	Albert City	IA	Iowa

1. Size (Ethanol Produced): 110.00 million US gallons (416 million litres)
2. Completion date : November 2006
3. Grain used: corn
4. The plant will produce 320,000 tons of dried distiller's grain per year.

Web Links
http://www.usbioenergy.net/albert.htm

10.1.17 Conestoga Energy Partners LLC

Conestoga Energy Partners	Garden City	KS	

1. Size (Ethanol Produced): 55 million US gallons (208 million litres)
2. Completion date: August 2007
3. Grain used: corn and sorghum
4. The plant will supply wet distillers grain to local beef feedlots.

Web Links
http://www.ksgrains.com/kcc/

http://www.conestogaenergy.com/

10.1.18 Gateway Ethanol

Gateway Ethanol	Pratt	KS	

1. Size (Ethanol Produced): 55 million US gallons (208 million litres)
2. Completion date: May 2007
3. Grain used: corn and sorghum
4. The plant will produce wet distillers grains

Web Links
http://www.ethanol-producer.com/article.jsp?article_id=2134

http://news.moneycentral.msn.com/category/topicarticle.asp?feed=BW&Date=20060829&ID=5978819&topic=TOPIC_IPO&iSub=2

10.1.19 Prairie Horizon Agri-Energy

Prairie Horizon Agri-Energy	Phillipsburg	KS	Kansas

1. Size (Ethanol Produced): 40 million US gallons (151.5 million litres)
2. Completion date: Construction commenced September 2005 and was supposed to be complete in July 2006. We have been unable to confirm completion of the plant.
3. Grain used: corn
4. The plant will produce 125,000 tonnes of DDGS per year

Web Links
http://www.prairiehorizon.com/

10.1.20 Bluegrass Bioenergy LLC

Bluegrass Bioenergy	Fulton	KY	Kentucky

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date: May 2007
3. Grain used: corn and sorghum
4. The plant will the capacity to produce DDGS but also plans to market Wet distillers grain and MWDGS. If it produced solely DDGS it would produce 149,000 tonnes.

Web Links
http://www.wpsdtv.com/articles/stories/public/200607/08/0yya_local_news.html
http://www.air.ky.gov/NR/rdonlyres/C63BC10E-8D16-4507-9BE8-8D260A5B5D3B/0/F06033Basis71306.pdf#search=%22Bluegrass%20Bioenergy%20Distillers%20grains%22

10.1.21 Great Lakes Ethanol - MI

Great Lakes Ethanol	Riga	MI	

1. Size (Ethanol Produced) – 50 million US gallons (189 million litres)
2. Completion date : production expected to begin by November 06
3. Grain used: corn
4. The pant will produce 140,000 tonnes of dried distillers grains (DDGS),

Web Links
http://www.greatlakesethanol.com/

http://www.michigan.gov/documents/ECOMfall2005_156071_7.pdf

10.1.22 The Andersons, Inc

Andersons Inc	Albion	MI	Michigan

1. Size (Ethanol Produced) – 55 million US gallons (208 million litres)
2. Completion date : production expected to begin by September 06
3. Grain used: corn
4. The plant will produce 154,000 tonnes of dried distillers grains (DDGS),

Web Links
http://www.andersonsinc.com/ag/index.htm

http://www.grainnet.com/articles/Dedication_for_New_Andersons__Inc__Ethanol_Plant_in_Albion__MI_Set_for_August_5-36157.html

10.1.23 US Bio Woodbury

US Bio Woodbury	Lake Odessa	MI	Michigan

1. Size (Ethanol Produced) – 40 million US gallons (151.5 million litres)
2. Completion date : production expected to begin by September 06
3. Grain used: corn
4. The plant will produce 112,000 tonnes of dried distillers grains (DDGS)

Web Links
http://www.usbioenergy.net/Superior_Corn_Products.htm

http://www.usbioenergy.net/index.htm

10.1.24 Heron Lake BioEnergy

Heron Lake BioEnergy	Heron Lake	MN	Minnesota

1. Size (Ethanol Produced): 50.00 million US gallons (189 million litres)
2. Completion date: March 2007 (however they are having some legal problems with their permits so this date could be set back).
3. Grain used: corn
4. The plant will produce 140,000 tonnes of (DDGS)

Web Links
http://www.heronlakebioenergy.com/

http://www.rurdev.usda.gov/rbs/pub/mar06/ethanol.htm

10.1.25 Missouri Ethanol

Missouri Ethanol	Laddonia	MO	Missouri

1. Size (Ethanol Produced): 45 million US gallons (170 million litres)
2. Completion date : November 2006
3. Grain used: Corn
4. The plant will produce 121,500 tonnes of DDGS that will marketed under the Dakota Gold brand

Web Links

http://www.ethanol.org/PressRelease11.4.05.htm

http://www.biofuelsjournal.com/articles/Broin_Companies_Announce_Plans_for_Development_of_an_Ethanol_Plant_near_Laddonia__MO-28564.html

10.1.26 Abengoa Bioenergy of Ravenna

Abengoa Bioenergy	Ravenna	NE	Nebraska

1. Size (Ethanol Produced): 88.00 million US gallons (333 million litres)
2. Completion date : completed in early 2007
3. Grain used: corn
4. The plant will produce 136,000 tonnes of DDGS and 317,000 tonnes WDGS

Web Links
http://www.abengoabioenergy.com/about/index.cfm?page=5&lang=1&headline=31

http://www.ethanolrfa.org/media/press/member/2005/view.php?id=475

http://www.allbusiness.com/periodicals/article/155070-1.html

10.1.27 E3 - Biofuels

E3 Biofuels	Mead	NE	Nebraska

1. Size (Ethanol Produced): 24 million US gallons (91 million litres)
2. Completion date : August 2006
3. Grain used: corn
4. The plant will only produce WDGS which will be fed to a cattle feed lot

Web Links
http://www.e3biofuels.com/index2.html

10.1.28 Holt County Ethanol

Holt County Ethanol	O'Neill	NE	Nebraska

1. Size (Ethanol Produced): 100 million US gallons (378.5 million litres)
2. Completion date : No target date is given. We have contacted the company for a date.
3. Grain used: corn
4. The plant will produce 317,500 tonnes of DDGS

Web Links
http://www.grainnet.com/articles/RFA_Congratulates_Holt_County_Ethanol_and_Midwest_Ethanol_for_Breaking_Ground_on_a_100_Million_Gallon_Per_Year_Facility_in_Nebraska-35972.html

http://www.midwestethanol.com/

10.1.29 Nedak Ethanol

Nedak Ethanol	Atkinson	NE	Nebraska

1. Size (Ethanol Produced): 44 million US gallons (166.5 million litres)
2. Completion date : Dec 2007
3. Grain used: corn
4. The plant is producing wet distillers grain for cattle

Web Links
http://www.nedakethanol.com/

10.1.30 E Energy Adams

E Energy Adams	Adams	NE	Nebraska

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : Dec 2007
3. Grain used: corn
4. The plant will produce 150,000 tonnes of DDGS

Web Links
http://www.eenergyadams.com/

http://domesticfuel.com/?p=566

10.1.31 Advanced BioEnergy – Nebraska

Advanced Bioenergy	Fairmont	NE	Nebraska

1. Size (Ethanol Produced): 100 million US gallons (378.5 million litres)
2. Completion date : June 2007
3. Grain used: corn
4. The plant will produce 292,000 tonnes of DDGS

Web Links
http://www.perennialpower.com/fairmont_ethanol_plant.htm

http://www.grainnet.com/articles/Groundbreaking%20Ceremony%20for%20Fairmont,%20NE%20Ethanol%20Plant%20Slated%20for%20Dec.%202-29721.html

http://biz.yahoo.com/e/060214/132574010qsb.html

10.1.32 Mid American Agri-Products - NE

Mid American Agri-Products	Cambridge	NE	Nebraska

1. Size (Ethanol Produced): 44 million US gallons (166.5 million litres)[22]
2. The plant is expected to be on line by June 2007.
3. Grain used: corn
4. The plant will produce 362,000 tonnes of wet distiller grains.[23]

Web Links
http://www.ne-ethanol.org/news/news.htm

http://www.mccookgazette.com/story/1150039.html

[22] The plant also has a second stage where a further 166.5 million litres of capacity
[23] In the second stage of the plant development the capacity to produce 136,000 tonnes of DDGS will be added.

10.1.33 Siouxland Ethanol, LLC

Siouxland Ethanol	Jackson	NE	Nebraska

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : operational in early 2007
3. Grain used: corn
4. The plant will produce 140,000 tonnes of DDGS on an annual basis.

Web Links
http://www.siouxlandethanol.com/

http://www.admworld.com/naen/pressroom/newspopup.asp?id=385&name=New_Ethanol_Marketing_Agreement

10.1.34 Val-E Ethanol

Val-E Ethanol	Ord	NE	Nebraska

1. Size (Ethanol Produced): 45 million Us gallons (170 million litres)
2. Completion date : August 2007
3. Grain used: corn
4. The plant will produce 88,000 tons of DDGS and 86,000 tons of WDGS.

Web Links
http://www.ordneusa.com/Groundbreaking.pdf

http://www.usbioenergy.net/Val-E_press_release_4_10_06.htm

10.1.35 Blue Flint Ethanol, LLC

Blue Flint Ethanol	Underwood	ND	North Dakota

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date : March 2007
3. Grain used : corn
4. The plant will produce 140,000 tonnes of DDGS

Web Links
http://www.blueflintethanol.com/index.asp

http://www.blueflintethanol.com/contact/

http://www.greatriverenergy.com/press/news/301706_blueflint_announcement.html

10.1.36 Red Trail Energy

Prairie Ethanol	Loomis	SD	South Dakota

1. Size (Ethanol Produced): 50 million US Gallons (189 million litres)
2. Completion date: November 2006.
3. Grain used: corn
4. The plant will produce 140,000 tonnes of DDGS

Web Links
http://www.redtrailenergyllc.com/

http://www.ethanolrfa.org/media/press/rfa/2005/view.php?id=237

10.1.37 Prairie Ethanol, LLC

Prairie Ethanol	Loomis	SD	South Dakota

1. Size (Ethanol Produced): 60 million US gallons (227 million litres)
2. Completion date: Dec 2006
3. Grain used: corn
4. Whether it is to produce dried distillers grains or not : 168,000 tonnes of DDGS under the Dakota Gold Brand

Web Links
http://www.renewableenergyaccess.com/rea/news/story?id=37975

http://www.allbusiness.com/periodicals/article/598234-1.html

http://www.biofuelsjournal.com/articles/Prairie_Ethanol__LLC_Schedules_Ground_Breaking_Ceremony_in_Letcher__SD_-28467.html

10.1.38 Redfield Energy, LLC

Redfield Energy, LLC	Redfield	SD	South Dakota

1. Size (Ethanol Produced): 50 million US gallons (189 million litres)
2. Completion date: Dec 2006 (may be earlier due to favourable weather conditions
3. Grain used:–corn
4. The plant will produce both MWDG and DDGS

Web Links
http://www.redfieldenergy.com/

http://www.redfieldenergy.com/about_update.htm

10.1.39 Millennium Ethanol

Millennium Ethanol	Marion	SD	South Dakota

1. Size (Ethanol Produced): 50 million US gallons (379 million litres)
2. Completion date: Dec 2007 (may be earlier due to favourable weather conditions)
3. Grain used:–corn
4. The plant will produce 290,000 tonnes of DDGS

Web Links
http://www.tristateneighbor.com/articles/2006/07/06/tri_state_news/top_stories/news15.txt

10.1.40 Panhandle Energies

Panhandle Energies	Dumas	TX	Texas

1. Size (Ethanol Produced): 30 million US gallons (113.5 million litres)
2. Completion date : November 2007
3. Grain Used: corn
4. The plant will produce wet distillers grains for local cattle producers in a 100 mile radius

Web Links
http://www.txfb.org/texasagriculture/2004/120304/120304ethanol.htm

http://www.allbusiness.com/periodicals/article/261889-1.html

10.1.41 White Energy Texas

White Energy	Hereford	TX	Texas

1. Size (Ethanol Produced): 100 million US gallons (379 million litres)
2. Completion date : June 2007
3. Grain Used: corn
4. The plant will produce wet distillers grains for local beef feed lot and dairy producers

Web Links
http://www.white-energy.com/hereford.html

10.1.42 Western Wisconsin Renewable Energy

Western Wisconsin Renewable Energy	Boyceville	WN	Wisconsin

1. Size (Ethanol Produced): 40 Million US Gallons (151.5 million litres)
2. Completion date: commenced trial operations September 2006
3. Grain used: corn
4. The plant will produce approximately 119,000 tonnes of DDGS

Web Links
http://www.westernwisconsinenergy.com/

http://www.wisconsinagconnection.com/story-state.cfm?Id=1046&yr=2006

10.1.43 United Ethanol LLC Milton Wisconsin

United Ethanol	**Milton**	**WN**	

1. Size (Ethanol Produced): 42 Million US Gallons (159 million litres)
2. Completion date : Dec 2007 (there is some confusion on this due to some legal and community battles)
3. Grain used: corn
4. The plant will produce approximately 125,000 tonnes of DDGS

Web Links
http://homepage.mac.com/oscura/ctd/wisplants.html#unieth

10.2 Appendix 2 - Suggested Testing Regimes for DDGS

Proposed Recommended Laboratory Testing Procedures for Distiller's Grains By-Products
Prepared by Dr. Jerry Shurson
8/4/05

Available at http://www.ddgs.umn.edu/analytical_procedures.htm

Most commercial laboratories use scientifically approved and validated analytical procedures(AOAC and others) to determine the nutrient content of feed ingredients. However, for many nutrients, there are several approved methods that can be used. As a result, depending on the analysis procedure used, different analytical results are commonly obtained, and can vary substantially. Since this is such an important issue in the marketing of Distiller's Dried Grains with Solubles (DDGS) and associated by-products, it is essential that the ethanol and feed industry recognize and adopt standardized laboratory testing procedures to minimize disputes related to DDGS not meeting minimum guarantees, and to allow potential DDGS customers to more accurately compare nutrient profiles of DDGS among ethanol plants.

To address this important ethanol industry issue, an ad hoc committee called the DDGS Production and Marketing Issues Working Group was formed to discuss and make recommendations for the ethanol industry to consider. This committee was comprised of technical experts in DDGS marketing, analytical chemistry, ethanol plant operation, animal nutrition and the feed industry, and university DDGS researchers. This group met recently to discuss and make recommendations for standardized testing procedures for distiller's grains byproducts to the ethanol, feed, and livestock industry in the U.S., and internationally. This committee is interested in receiving comments and input on these recommended standards from current and prospective DDGS producers and users. Please contact Dr. Jerry Shurson, Committee Chair, by email shurs001@umn.edu with comments on these new proposed standards.

The group agreed that the following AOAC® methods would be the most accurate methods for determining various nutrient compounds typically evaluated in the DDGS market, and recommend that these methods be adopted by the ethanol industry as industry-wide testing standard methods:

Moisture AOAC®Official Method 930.15 (135° C for 2 hours)
Crude Fat AOAC® Official Method 920.39 (petroleum ether extract)
Crude Protein AOAC® Official Method 990.03 (combustion method)
Crude Fiber AOAC® Official Method 962.09 (ceramic fiber filter method)
Ash AOAC® Official Method 942.05 (600° C for 2 hours)
Antibiotic Residues
Antibiotics such as Penicillin G, Penicillin V, and Virginiamycin are used in very small quantities to control bacterial infections in fermenters during the ethanol production process. However, there are no antibiotic residues in distiller's grains by-products because these

antibiotics are destroyed at a temperature of 200° F in the distillation towers. Ethanol plants are encouraged to work with their antibiotic vendors to obtain an annual certified test, and keep the certification on file, demonstrating that no detectable levels of antibiotics are present in distiller's grains by-products.

Mycotoxins

Aflatoxin, Vomitoxin, Fumonisin, Zearalenone and T2 Toxin are mycotoxins that can be present in distiller's grains by-products if the grain delivered to the ethanol plant is contaminated. Mycotoxins are not destroyed during the ethanol production process and are not destroyed during the drying process to produce distiller's grains by-products. However, the risk of mycotoxin contamination in distiller's grains by-products is very low because most ethanol plants monitor in-coming grain quality with approved ELISA test kits and reject sources that may be contaminated.

If ELISA tests kits are used on distiller's by-products, false positive determinations often occur and are invalid. It is suspected that distiller's grains by-products contain certain salts and oxidizers that affect detection. Currently ELISA test kits for Vomitoxin (Deoxynivalenol) and Fumonisin have been validated against standard methods for DDGS by Neogen Corporation and found acceptable for use.

When samples of distiller's by-products are tested, only High Performance Liquid Chromatography (HPLC) and Thin Layer Chromatography (TLC) methods are acceptable for most mycotoxins.

References:

Official Methods of Analysis of the Association of Official Analytical Chemists International www.aoac.org.

Neogen Corporation, Lansing, Michigan www.neogen.com.