

**Assessment Schedule – 2013****Agricultural and Horticultural Science: Analyse a New Zealand primary production environmental issue (91532)****Assessment criteria**

<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
<p><i>Analyse</i> involves:</p> <ul style="list-style-type: none"> <li>explaining the environmental issue arising from the primary production management practices</li> <li>explaining potential courses of action to mitigate the negative impacts of the management practices</li> <li>recommending sustainable management practices.</li> </ul>	<p><i>Critically analyse</i> involves:</p> <ul style="list-style-type: none"> <li>explaining, in detail, the issue arising from the primary production management practices</li> <li>evaluating potential courses of action to mitigate the negative impacts of the production management practices</li> <li>recommending sustainable production management practices that best address the issue.</li> </ul>	<p><i>Comprehensively analyse</i> involves:</p> <ul style="list-style-type: none"> <li>evaluating the environmental issue arising from the primary production management practices</li> <li>justifying potential courses of action to mitigate the negative impacts of the management practices</li> <li>recommending sustainable production management practices that best address the issue and are economically viable.</li> </ul>

N0	No response; no relevant evidence.
N1	Describes a farming management practice that causes the issue, correctly identifies ONE implication, and gives a partial description of a course of action.
N2	Describes a farming management practice that causes the issue, correctly identifies TWO implications, and gives a partial description of a course of action that would mitigate the negative environmental implications.
A3	Describes a farming management practice that causes the issue, identifies and explains in general terms THREE implications (TWO environmental implications and ONE social or economic or political implication), and explains ONE potential course of action that would mitigate the negative environmental implications.
A4	Explains a farming management practice that causes the issue, correctly identifies and explains in general terms THREE implications, and explains TWO potential courses of action that could mitigate the negative environmental implications.
M5	Explains in detail a farming management practice that causes the issue, explains TWO implications (ONE environmental implication and ONE social or economic or political implication) in detail, and evaluates (relative strengths and weaknesses) ONE potential course of action that could mitigate the negative environmental implications.
M6	Explains in detail a farming management practice that causes the issue, explains THREE implications (TWO environmental implications and ONE social or economic or political implication) in detail, evaluates ONE potential course of action that would mitigate the negative environmental implications, and gives partial evaluation of a second course of action.
E7	Explains in detail a farming management practice that causes the issue, explains THREE implications (TWO environmental implications and ONE social or economic or political implication) in detail, evaluates ONE potential course of action that would mitigate the negative environmental implications, gives partial evaluation of a second course of action <i>AND</i> gives a partial justification of a selected course of action that is economically viable.

E8	Explains in detail a farming management practice that causes the issue, explains THREE implications (TWO environmental implications and ONE social or economic or political implication) in detail, evaluates ONE potential course of action that would mitigate the negative environmental implications, gives partial evaluation of a second course of action <i>AND</i> gives a comprehensive evaluation of a selected course of action that is economically viable, which involves consideration of at least two of the social and/or economic and/or political implications.
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## Appendix: Examples of possible answers

### Selected option: Water quality and/or quantity

#### Part (a) Description of environmental issues, and explanation of environmental, economic, and social impacts

Water quality – downstream water is polluted by sediment caused by cultivation of farmland, nutrients carried by animal effluent run-off and leaching of fertiliser or by run-off water carrying pathogens in animal effluent.

Water quantity – water levels in streams and rivers are decreased because of irrigation on farms, and for horticultural crops.

#### Negative environmental impacts

- Water pollution, due to leaching of nutrients into waterways or underground aquifers. The leaching of nutrients into waterways and aquifers is a particular risk for agricultural fertilisers and effluent. These have the greatest potential to be applied in quantities that risk leaching – causing increased nutrient levels in the water, accelerated growth of algae, and loss of habitat for living organisms.
- Pathogen contamination of water, due to *E.Coli* and other bacteria in effluent. Many chemicals applied to crops do not break down in the soil. Over time, their concentration in the soil builds up to levels that may be toxic to plants and animals. Another danger is the chemicals re-entering the food chain and negatively impacting on plant and/or animal life.
- Sediment gradually fills streams and waterways, the ability of the stream to handle flood volumes becomes an issue. As streams begin to run shallower, the water temperatures will increase, impacting negatively on aquatic life.

#### Negative economic impact

- Cost of fertilisers – the farmer has a financial cost of the fertilisers at around \$600/tonne.
- Cost of effluent treatment.
- The set-up costs of treatment and storage ponds, etc.

#### Social impact

- Human health risks – pathogens in effluent make waterways unsafe for swimming.
- Eutrophication of waterways – growth of algae and side effects of eutrophication take away use of waterways from the public for activities like fishing and swimming.

#### Part (b) Courses of action that New Zealand producers could implement

##### Reduce the usage of nitrogenous fertilisers in farming systems

If less fertiliser is applied, the level of nitrogenous compounds entering the land/water is reduced. This would reduce eutrophication in waterways and have positive benefits for plant and animal life.

#### Plant riparian margins alongside waterways

These intercept a proportion of the nutrients that are moving from the soil system to the waterway, via surface run-off or shallow groundwater. Animals are kept out of the streams, preventing direct contamination from urination and faeces. There are other benefits to water quality in addition to reducing nutrients, eg lower water temperatures and improved bank stability.

#### Select slow-release, organic, or RPR/PAPR fertilisers

Nutrients are released slowly and at a rate at which the plants are able to take up a much larger proportion. These are less soluble, and hence release their nutrients slowly over a longer period of time. As a result, the potential for leaching and loss of N-nutrients from the root zone of the plant is reduced. With fewer nutrients leaching beyond the root zone, waterways will have less eutrophication.

#### Management of effluent application over land

The application of treated animal effluent over farmland is regulated by many councils (eg no more than 20mm per 24 hours) to avoid leaching beyond the root zone. Farmers need to have storage ponds large enough to hold x days effluent, so that this limit is not over-applied during the winter months, when soils are near field capacity. Keeping the nutrients within the root zone allows plants to uptake the nutrients, preventing them from leaching into waterways and underground water.

#### Installation of water storage ponds

Farmers/growers building their own ponds to collect and store water during the winter months to use for irrigation during summer. This will reduce the take from underground water and streams, keeping water levels higher. Water temperatures will remain lower, and nutrient and pathogen levels will be more diluted.

#### Limit water take for irrigation use.

Regional councils already use the RMA to limit how much water can be used for crop and pasture irrigation during summer months. Balancing the needs of many farmers with a shared quota of water will keep stream flow above a minimum level, maintaining enough flow for aquatic life and recreational use.

### **Part (c) Discussion on New Zealand producers' consideration of implications when mitigating the selected issue**

#### *Example: Resource A*

There are many stakeholders in the use of water in the streams and rivers of New Zealand. New Zealand is built on the backbone of the Ag/Hort industry, and our ability to produce quality primary sector goods from the land at a time that is off-season in the Northern Hemisphere. For that reason, the economic importance of primary production in New Zealand is significant.

Without access to water for animals, or crop and pasture growth, the impacts on New Zealand's GDP would be substantial. In 2012/13 the net contribution of irrigation to GDP at the farm gate was estimated by MAF (then, MPI now) to be in the order of \$920 million. Irrigation contributed approximately 12% of farm gate GDP in that year from almost 500 000 ha of land, which is about 3.9% of the 12.1 million hectares farmed in NZ. Assuming the extra production was exported, the value of these exports was in the order of \$1.7 billion (12% of total agricultural and horticultural exports). Irrigated land also employed in the order of 5 000 full-time equivalents on farms and horticulture properties. Since that report, the area of irrigated land in New Zealand has risen to 600 000 ha.

The social cost of using that water is observable, however. Rivers and streams have lower levels. Algae and slimes are increasing. Waterways are becoming choked with weed, pathogens are becoming more concentrated, and fish and other aquatic life are struggling. In winter, hydro dams have low water levels, so people are encouraged to turn off their heaters, and in summer, water restrictions in towns put ratepayers on hand-watering and day restrictions.

The ratepayer may complain about losing the recreational value of water (fishing, swimming, etc) but is most likely benefiting from the export earnings of the Ag/Hort sector, either directly as an employee, or indirectly as an employee of a support industry.

The other consideration is New Zealand's global image. We are marketed as "clean and green", but recently there has been some bad publicity, with some of our rivers (eg Manawatu) being rated as among the most polluted in the world. This is a result of dairy effluent and low oxygen levels being recorded. This dilemma must be addressed, and it will take a long time and innovative approaches to balance the need for water to increase productivity, and to preserve the water quality for our export markets.

### **Selected option: Nutrient management**

#### **Part (a) Environmental, economic, and social impacts**

##### Negative environmental impacts

- Increased level of nutrients (especially phosphates and nitrates) in surface water. This causes an increase in the growth of nuisance weed and algae growth, affects stream life, and decreases water clarity.
- Smell of effluent when collected / dispersed onto land.
- Loss of nitrous oxide (N<sub>2</sub>O) gas from soils that have high nitrate levels.

##### Economic impacts

###### Negative:

- Dairy effluent systems cost upwards of \$20 000 to install, and require annual maintenance costing between \$2 000–\$5 000.
- Non-compliance costs / fines can be imposed by regional councils, and can be as high as \$50 000 or more.

###### Positive:

- The spreading of waste effluent back onto land / pasture recycles significant quantities of nutrient back into the soil. Savings in fertiliser costs are in the region of \$100–\$300 / ha / yr.

##### Social impacts

- Smell of effluent when collected / dispersed onto land.
- Once contaminated, water resources may take years to clean up – limiting land use options, and potentially the ability to carry out certain farming operations on areas supplied by the contaminated water.
- Other downstream users may be affected by nutrient and coliform contamination occurring upstream, eg a mussel farmer may not be able to export shellfish because bacterial / algae conditions in the growing water have become excessive due to the activities of farmers upstream.
- The use of surface water (streams and lakes) for recreational purposes (swimming, fishing, etc) is adversely affected, should it become excessively contaminated and high in nitrates and bacterial pathogens like *E.coli*.
- Human health risk from water with high levels of nutrients (nitrogen) and pathogenic bacteria.

**Part (b) Courses of action that New Zealand producers are likely to implement**

Apply animal effluent directly back onto pasture

Strengths:

- Recycling of nutrients in dung / urine means less money spent on fertilisers.
- “Organic”, and hence has appeal with many producers and consumers.
- Water content of the material can give some boost in times of low rainfall.

Weaknesses:

- Limits are imposed by regional councils on how much effluent can be applied each year.
- Cannot be applied when the soil is saturated, due to risk of runoff.
- Lag time and rainfall (or irrigation) is required before cows will graze the pasture, due to the effluent application.
- Smell is often a problem, especially with pig and poultry effluent.

Install advanced treatment systems.

Strengths:

- Able to work in all weather conditions.

Weaknesses:

- Requires regular de-sludging and upkeep if it is to operate effectively.
- Takes up valuable land that could be used for farming operations.
- Loss of nutrients from the farm system.

Install Riparian strips alongside waterways / Fence waterways

Strengths:

- Acts as a buffer between grazed pasture and the waterways, reducing the levels of contaminants running off the paddocks into the water.
- Provides a partial reduction in the leaching of nutrients into the waterways.

Weaknesses:

- Time and costs to install and maintain (spray weeds etc).
- Loss of potentially productive land.

Cap stocking rates and / or restrict specific farming types in certain areas, to limit the potential production of effluent and its impacts

Strengths:

- Puts a limit on the numbers of animals / effluent-producing operations that are allowed in a particular area.
- Allows matching of an area’s environment and its ability to handle intensive farming with the numbers of farms operating there.

Weaknesses:

- Huge economic impacts for both individual farmers and whole communities that are reliant on particular effluent-producing farming operations.
- Requires an organisation and people to enforce the restrictions – costs would be significant.

Use technologies such as the “Overseer” programme in conjunction with GPS-based fertiliser application.

Strengths:

- Results in the maximum efficiency of fertiliser use, without any significant expenditure.

Weaknesses:

- High levels of leaching and runoff in grazed systems are still likely – especially in intensive dairy systems with high volumes of urine and dung being deposited on the paddocks.

### Part (c) Discussion on New Zealand producers’ considerations of implications when mitigating selected issue

*Example: Apply animal effluent directly back onto pasture vs. use of advanced treatment systems.*

This is the best option in terms of minimising the negative environmental impacts that result from the disposal of animal effluent.

The key advantage with this option is that the nutrient content of the effluent (be it cow, pig, or poultry) is able to be utilised and recycled back into the soil – saving the farmer money due to reduced fertiliser costs, and promoting a healthy soil with earthworms, decomposing bacteria, etc. It is a relatively low-cost option (dairy systems are typically installed for around \$15 000–\$20 000) and is a viable method for pig and poultry operations, providing they have access to a nearby farming operation (sheep/dairy/arable/market gardening, etc). It has the extra advantage of being an organically approved activity.

While there are some issues with smell and the availability of suitable land (flat land, non-saturated soils, neighbours who do not like the smell), with careful management these should be able to be overcome or negated, as can issues to do with the inability to apply effluent onto wet/saturated/boggy pastures (as opposed to free-draining, sandy-textured soils) – generally in conjunction with sufficiently large storage tanks to contain the effluent until suitable soil conditions become available.

The other option – installing advanced treatment systems – has significant weaknesses. Advanced treatment systems are the traditional means of dealing with animal effluent, but at the end of the day, the treated waste still ends up in our waterways, causing elevated nitrogen and phosphorus levels, eutrophication, and increased levels of pathogens such as *E.coli*. These environmental impacts are inevitable in intensive dairy farming areas. With the high number of large dairy farms, many of which are irrigated, it makes much more sense to spread the effluent back onto the land.

### Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 2	3 – 4	5 – 6	7 – 8