Evaluation of the Economic Impacts from Waterfowl Damage

Final Report

Identification and Quantification of Economic Losses and Compensation Options

Prepared for

BC Agricultural Council
Agriculture Environment Initiatives

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Executive Summary

Partial compensation for forage damages caused by waterfowl is currently provided in Delta and the Comox Valley out of provincial contributions under the federal-provincial Safety Net Program. However, forage producers are dissatisfied with the level of compensation provided by program and are concerned that economic losses will rise as waterfowl populations increase.

This report uses existing yield, damage, pricing and farming practices information to quantify the economic impacts of waterfowl damages in the two regions. The investigation identifies the economic gap facing producers in the current program and makes recommendations for bridging the shortfall in BC.

Waterfowl impacts have been calculated for four forage cropping scenarios. These are irrigated silage, dryland silage, irrigated hay and dryland hay. The impacts have been calibrated for three damage levels used in the existing program: 1) recoverable damage; 2) damage requiring overseeding; and 3) damage requiring reseeding. Based on consultations with producers respecting farming practices, the per acre economic impact of waterfowl damage to forage fields has been estimated.

Several factors that have been considered in the economic impact calculation:

- the expected yields for each of the cropping scenarios
- the extent of yield damage, based on producer testimonial and program experience
- the value of the lost production
- changes in protein content
- the cost of replacing lost yield
- the cost of extra and/or less efficient operations
- the opportunity costs associated with foregone revenue streams
- the net impact of current mitigation measures
- deterioration in fixed farm assets due to waterfowl damage (laser leveled land, subsurface drainage).

The findings of the study indicate that the current compensation program leaves an economic shortfall to the producer (based on the lost production value- LPV) that ranges between $98 and $630 per acre, depending on the severity of loss. However, the production value of the yield loss only represents between 60% and 86% of the total economic impact on producers. As such, the current compensation program, based on LPV) is estimated to compensate for 27% to 40% of the economic loss sustained by forage producers, depending on the severity of loss, or leaving a “gap” of 60% to 73% of total economic loss.

When the replacement cost of the lost feed is factored into the analysis, the current compensation program leaves an economic shortfall to the producer (based on feed replacement value - FRV) that ranges between $257 and $1,113 per acre, depending on the severity of loss. The feed replacement value of the yield loss represents between 73% and 91% of the total economic impact on producers. As such, the current compensation program, based on FRV, is estimated to compensate for 11% to 26% of the economic loss sustained by forage producers, depending on the severity of loss, or leaving a “gap” of 74% to 89% of total economic loss.

This study recommends that:

- a federal-provincial waterfowl damage compensation program (WDCP) be set up immediately in BC, modeled on effective programs operating in the Prairie provinces and utilizing the 60-40 federal-provincial cost sharing formula;
- existing yield information and damage information is sufficient to get started, but should be augmented by the pursuit of more systematic and accurate waterfowl impact assessment techniques;
- a number of information gaps should be filled by targeted investigation;
- the provincial government treat waterfowl damages as “catastrophic” or in the “no premium” category and top-up the WDCP so as to provide forage producers with 100% compensation of lost production value;
- the current AEPI program stay focused on developing and testing mitigation measures that would lessen the severity of waterfowl damages on forage fields, such as lure cropping, new techniques and hunting to change waterfowl behaviour, and non-forage field strategies;
- wildlife agencies be made fully aware that it is in their collective interests to participate responsibly when wildlife management strategies create unsustainable impacts on forage producers, or risk having the land convert to crops that do not provide waterfowl food resources and habitat.

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1.0 Report Objectives

The scope of this work is to investigate the following:

- The direct impacts and losses incurred by perennial forage producers in Delta and the Comox Valley from waterfowl damage,
- The indirect impacts and losses associated with management to rehabilitate and mitigate waterfowl impacts,
- The economic gap between the estimated economic losses and the current "compensation" programs
- Possible solutions to addressing the economic gap not being filled by current programs.

2.0 The Waterfowl Depredation Issue

2.1 Use of Forage Fields by Waterfowl

The BC south coastal area is an important staging and over-wintering area for migratory waterfowl. In particular, the Fraser River delta provides critical habitat resources for a minimum of 1.4 million migratory birds annually. In fact, some biologists believe that there may be as many as 5 million. It is estimated that between 200,000 and 300,000 of these are ducks, geese, and swans that spend some time feeding on upland farm fields, particularly during winter. The Comox Valley provides similar winter resources to over 3,000 wintering trumpeter swans as well as a widgeon population. Winter populations of Trumpeter Swans and Snow Geese on the lower coast of BC have been increasing since the 1970's and 1980's, respectively, but the American Wigeon population along the west coast appears to be stable. Although the overall population size has changed little for Wigeon, their distribution has changed as habitat alterations have occurred. There is the potential that waterfowl damage to perennial forage crops may increase under the current conditions of population redistribution and habitat alteration.

Perennial forage fields are typically used by waterfowl during winter between October and April. The presence of damage and its severity varies from year to year and from field to field, depending on a number of known and unknown factors including, but likely not limited to, the following:

- weather,
- field drainage, field contours, and presence of surface water,
- height of over wintering forage stand,
- variety of forage grasses grown,
- age of field,
- abundance and proximity of alternative feeding areas including vegetable crop residue, unharvested crops and winter cover crops,
- proximity of waterfowl roosting areas (Boundary Bay in Delta),
- use of scare devices,
- historical pattern of waterfowl use,
- type of waterfowl, and
- unexplained bird behaviour.

In the 5 years (2001/02 – 2005/06) of reports of the Delta Forage Compensation/Mitigation Pilot Project, between 16% and 40% of the forage acreage has been damaged by migratory waterfowl in any given year. In 2005-2006, about 58% of the enrolled forage acreage in the Comox Valley received payments for damage. This damage may occur at any time within the over wintering period and it is not uncommon for crops spared damage in December to be grazed extensively the following March. Spring weather patterns also influence the length of time migratory birds may stay in the south coastal areas before returning to northern breeding grounds.

2.2 Compensation Provided by the Forage Compensation Program

The Delta Forage Compensation/Mitigation/ Monitoring Project has been in existence since 2001. The program was created to address known impacts of waterfowl on perennial forage production in the municipality of Delta and the Mud Bay area of Surrey. The program is limited to commercial farmers and minimum enrolment must be at least 10 acres, Funded components of the program consist of evaluation of mitigation procedures and practices, monitoring damage, and compensation. The initiative was created out of a proposal of the Delta Farmers' Institute (DFI) to the British Columbia Agriculture Council (BCAC) to access funding through the Agriculture Environmental Partnership Initiative (AEPI). Funding for the compensation component is accessed by contract with the BC Ministry of Agriculture and Lands (BCMAL).

The Forage Compensation Program does not operate in isolation in Delta but it is the only program that partially compensates for waterfowl damage. The compensation component of the program is funded out of the provincial contributions under the federal-provincial Safety Net Program. The Forage Compensation program was started up with an initial commitment of a maximum of $240,000 available for compensation each year of the 3 year pilot.

Funding levels and requests of the Forage Program from the AEPI are notional, meaning that priorities and/or commitments to the program may change depending on other wildlife compensation projects in BC and availability of funds. In March 2004, a further $3 million was allocated by Agriculture and Agri-Food Canada (AAFC) to agriculture-wildlife conflicts in BC to March, 2008, while the Forage Compensation program was expanded to include waterfowl damage compensation in the Comox Valley, with continued monitoring and mitigation trials.

Other agencies have contributed towards mitigation and monitoring requirements, however, contributions by some agencies have declined over the program's duration. The delivery structure has included representation from the Ducks Unlimited, BCMAL, Delta Farmers' Institute, Canadian Wildlife Service, Corporation of Delta, BC Ministry of Water, Air and Land Protection, and the Delta Farmland and Wildlife Trust (DFWT). The DFWT is a non-profit Society that has been actively promoting land stewardship programs in Delta since 1993. These programs provide research, extension and financial incentives to area farmers to help implement stewardship projects that benefit both agriculture and wildlife. The projects include cover cropping, land leveling, grassland set-asides, and field margin management. Some of these measures also help to reduce and/or mitigate the impact of waterfowl.

The Business Risk Management Branch of the BC Ministry of Agriculture and Lands administers the compensation funds provided by the program and ensures that claims comply with reporting and assessment requirements and that standards of verification are satisfied. One of the crop insurance principles adopted in the payout structure is the 80% maximum payout on verified losses to discourage farmers from “farming” the program and to recognize that the measurement of losses is itself subject to inaccuracy.

The Delta Forage Compensation Program has paid out about $413,000 in compensation in 5 years of operation (see Table 1). The Comox Valley Forage Compensation Program paid out $155,000 in 2005-6 (see Table 2). While the number of acres enrolled in the Delta program has increased and the percentage of acres damaged has declined, there is no evidence pointing to a correlation between the two variables.

Table 1: Summary of Compensation Paid in the Delta Forage Compensation Program, 2001-2 to 2005-6

Annual Report Year	Total Acres Enrolled	Acres Damaged	Acres Over-seeded	Acres Reseeded	Not Damaged	Total	Percent Damaged
2001-2002	2,372.0	893.0	0.0	73.0	1,406.0	2,372	40.7%
2002-2003	2,477.0	685.0	0.0	162.0	1,630.0	2,477	34.2%
2003-2004	2,594.0	350.0	411.5	99.6	1,732.9	2,594	33.2%
2004-2005	2,485.0	236.7	143.2	26.0	2,079.1	2,485	16.3%
2005-2006	2,818.0	559.1	242.7	64.0	1,952.2	2,818	30.7%
Average	2,549	545	159	85	1,760	2,549	
Percent	100.0%	21.4%	6.3%	3.3%	69.0%		31.0%
Payout 2001-2002		$38,975	n/a	$22,265		$61,240	
Payout 2002-2003		$30,747	n/a	$49,410		$80,157	
Payout 2003-2004		$22,763	$61,718	$30,393		$114,874	
Payout 2004-2005		$15,386	$21,480	$7,930		$44,796	
Payout 2005-2006		$55,921	$36,420	$19,520		$111,861	
	Average	**$32,758**	**$23,924**	**$25,904**		**$82,585**	
					Total	$412,927	
Compensation ($/acre paid)							
2001-2		$45.00	n/a	$305.00			
2002-3		$45.00	n/a	$305.00			
2003-4		$65.00	$150.00	$305.00			
2004-5		$65.00	$150.00	$305.00			
2005-6		$100.00	$150.00	$305.00			

Table 2: Summary of Acres Enrolled and Compensation Paid in the Comox Valley Forage Compensation Program, 2005-2006.

2005-2006	Total Acres Enrolled	Acres Damaged	Acres Over seeded	Acres Reseeded	Not Damaged	Total
	4,231.5	1,436.0	25.5	48.0	2,722	4,231.5
Average	4,231.5	1,436	26	48	2,722	4,231.5
Percent	100.0%	33.9%	0.6%	1.1%	64.3%	
Payout 2005-2006		$136,430	$3,825	$14,640		$154,895
Compensation ($/acre paid)						
2005-6		$95.00	$150.00	$305.00		

Source: Comox Valley Farmers' Institute. 2007. Comox Valley Waterfowl Compensation and Mitigation Project: Year 1 Annual Report, September 01, 2005 to October 31, 2006.

While the size of payouts for some damages under the program has changed, compensation is paid for three categories of impacts under the following rationale:

1. **Forage damage** – or reduced yields in standing crops. In the first year of the program, the compensation rate was set at a flat rate of $45.00 per acre for a damaged field. The extent and intensity of damage at this level is not severe enough to warrant overseeding or reseeding and the field capable of recovering. The compensation rate was not an actual field-specific yield loss assessment, but was arbitrarily set until more robust data on forage loss could be gathered.

   In year 3 of the program, the compensation level was adjusted upwards to $65.00 per acre to better reflect known crop losses, although the payment was not calibrated to the price of forage in the year of loss. Currently, producers are paid $100 per damaged acre in fields where damage has been substantiated. These payments have been increased over time in an attempt to relate the compensation rate to a low estimate of the replacement cost of local forage in an average damage situation. Yield losses in specific fields are not adjusted.

2. **Over-seeding** - was not a component of the program at its outset. However, some fields did have damage exceeding the forage damage level, but not requiring full reseeding. The compensation value was established at $150.00 per acre, based in part, on the estimate of over seeding compensation the field and compensation for the reduced forage yield the following harvest season. Some Delta farmers indicate that the current rate is no longer adequate.

3. **Reseeding** – the reseeding compensation is paid at a rate of $305 per acre, and was initially intended to compensate for 80% of the cost of reseeding. Some Delta farmers indicate that the current rate is no longer adequate. Comox Valley farmers claim that reseeding is ineffective as the waterfowl will harvest the crop in the subsequent year before it can reach maturity.

3.0 Forage Production and Waterfowl Impact Characteristics

3.1. Analytical Considerations

Feed composition is an important consideration in estimating nutritional value for hay or dairy production, and nutritional value is generally correlated with economic value. The components that comprise forage value include carbohydrates, fats and oils, lignin, proteins, minerals and vitamins The various analyses include dry matter (%DM), acid detergent fibre (%ADF), acid detergent insoluble nitrogen (ADIN), total digestible nutrients (TDN), ash mineral analysis and crude protein (%CP), of which protein and carbohydrates are most often measured to determine economic value.

Plant proteins contain nitrogen and legume forages contain higher levels of nitrogen than the grasses. Protein content is estimated from nitrogen content based on the knowledge that protein contains about 16% nitrogen on average (meaning the amount of protein is 6.25 times the nitrogen content of forage). However, not all of the nitrogen is in protein form and not all of the protein is digestible.

Carbohydrate content, or the energy in plants, is commonly measured in terms of dry matter content (%DM). The amount of moisture in feed can vary widely; hay and grain usually contain about 10% moisture, silage may contain 50 to 75%, and green plants are 80 to 85% water. Table 3 presents the dry matter (DM) conversions.

Table 3: Conversion Relationship Between Grass Silage and Hay Yields, Based on BC Forage Council Trials, Yield Averages, Selected Years, 1980 to 2006[1]

	Average %DM	Average Yield/ac	Average Crude Protein
Non-irrigated (Dryland) Grass			
Grass Hay (T/ac)	88.4%	4.83	18.0%
Grass Silage (T/ac)	35.1%	12.14	16.0%
Irrigated Grass (assuming 35% yield increase over dryland)			
Grass Hay (T/ac)	88.4%	6.52	18.0%
Grass Silage (T/ac)	35.1%	16.39	16.0%

The use of dry matter content eliminates moisture as a variable in the comparison of various feeds. Dry matter is generally expressed as the ratio of dry to wet (green) weight after drying at 70 to 80 degrees Celsius.

Feed quality is essentially determined by its energy content, which is directly related to the stage of maturity of the crop at harvest. The optimum time for harvest is a compromise between quality and quantity, where the target is maximum nutrient yield per unit of area. The harvest of younger plants results in lower dry matter yield and

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[1] Protein values are based on target yields for the Fraser Valley and the Comox Valley in Appendix Tables 7 and 8. Also see BCMAF. 2002. Forage Quality in the South Coastal Region in 2001. Forage Factsheet. http://www.al.gov.bc.ca/forage/publications/ForQual2001.pdf

elevated protein content. Harvest of older plants results in higher dry matter yield and lower protein content. The relationship is portrayed in Appendix Figure 1 and the trade-off is similar for all the cuts during the growing season.

Dairy producers prefer silage from younger plants because of the increased protein content. Forage growers of hay bales for sale prefer higher biomass yields, especially if the bales are sold to the horse industry, where protein content is not a major consideration.

Forage producers in the south coastal area produce forage on their farms either to feed to their beef and dairy herds or to market locally, mostly to the horse industry. This means there are two distinct forage harvesting patterns.

Much of the Delta area uses irrigation and therefore, drought does not have an impact on production. Producers in the Comox Valley have a higher proportion of dryland fields. Under normal growing and harvesting conditions, producers in the Lower Mainland and Comox Valley achieve an average of 5 cuts of silage forage each season. Varieties grown and yields achieved in the two areas are comparable.

The yield of hay and silage, from a biomass perspective, is comparable. Dairy operators will harvest up to 5 cuts over the season, in the form of silage and with the objective of optimizing the yield/protein production. Hay producers tend to let their crops mature longer and will harvest 3 times over the course of the growing season, in the form of bales. Hay producers for the horse industry will pursue biomass at the expense of protein, while some dairy producers will harvest grass for silage and baled hay.

Production practices for irrigated and dryland forage crops do not vary significantly, although lower yields for dryland production are to be anticipated. For the purpose of analysis and based on producer information, we have estimated that irrigated yields may be about 35% higher than non-irrigated forage yields. While in dry years, the dryland harvest may also comprise one less cut, this outcome has not been taken into consideration in this analysis.

Producers use several varieties of grasses. Dairy operations prefer orchard grass and ryegrass because of preference by livestock, ease of handling, protein content and yield. However, waterfowl of all species have a distinct preference for orchard grass as compared to tall fescue forage. As a result, producers have switched to species that are less attractive to waterfowl and about 90% of all forage grown in Delta now contains tall fescue as the dominant species in the grass mix. Producers in the Comox Valley still use a significant proportion of orchard grass in their forage mix.

Implications of using tall fescue in grass mixes include:

- reduced waterfowl depredation,
- reduced palatability to livestock,
- lower protein content,
- slower establishment,
- higher proportion of the yield in the first cut
- more difficult to cut and harvest.

Hay producers tend to use timothy as their grass, a preferred variety for the equine feed market. This species is also susceptible to waterfowl use, but in addition does not recover as well from waterfowl grazing.

3.2 Yield Loss Scenarios

3.2.1 Yield Expectations

Forage fields are a feedstock for waterfowl. Starting in November, the plants are consumed through the winter. In the spring, most of these birds stock up before going to breeding grounds farther north. Damage may occur in the fall, in the winter and/or in the spring.

The most apparent impact of winter waterfowl depredation of perennial forage crops is substantial reduction in the biomass of the first cut. This is offset to a minor degree in the residual forage by higher protein content of the damaged cut.

With the extremely high cost of farmland in the project areas, it is reasonable to assume that commercial farmers use good management practices to attain target yields. These yields are typically affected by the presence or absence of moisture in two significant ways: 1) excess water and/or 2) drought. Through the course of a crop year, it is not uncommon for a crop to be affected by both factors.

Improved Drainage Yield Impacts
Farmers have responded to these conditions in two significant ways. The first is the installation of improved drainage. Laser leveling and subsurface drain tile installation are relatively common practices for most forage, grain and vegetable producers in Delta. On average, 40-55% of the acreage enrolled in the forage compensation program for the Delta/Surrey area has been leveled and 52-57% has subsurface drain tiles.[2] Both practices reduce the potential for surface water ponding, a condition that can to attract waterfowl to fields in the first place. Producers in the Comox Valley also take steps, where possible due to the more variable terrain and soil conditions, to eliminate surface water ponding on forage fields.

Data collected on the impact of drainage and sub-irrigation from the Boundary Bay Water Control Project in Delta (1982 – 1991) is presented in the BC Agricultural Drainage Manual.[3] The findings indicate that forage yield increases in response to drainage and sub-irrigation (see Table 4). The forage grass quality measurements also indicate that drainage improved protein content by about 3% and acid detergent fibre (ADF) by about 10% in relation to the undrained crop.

Table 4 indicates that the reported yield response of forage grass to drainage of about 31% and to sub-irrigation, 2.3%. The yield response of silage corm to drainage is 90%

[2] Merkens, M. 2007. Personal communication.
[3] Lalonde, V. and G. Hughes-Games. 1997. BC Agricultural Drainage Manual. BC Ministry of Agriculture, Fisheries and Food.

and to sub-irrigation, 4%. On average, dry matter yield of tame species increases by 2 t/ha (0.89 ton/ac) and dry matter digestibility by about 20%.[4]

Table 4: Yield Response to Drainage and Sub-Irrigation, Boundary Bay Water Control Project (a)

Crop	Drained	Undrained	Sub-irrigated (b)	Years of Data
	Tonnes/ha DM (Tons/Ac)			
Forage grass (perennial ryegrass or orchard grass hay)	8.9 (3.97)	6.8 (3.03)	9.1 (4.06)	7
Corn silage	17.5 (7.81)	9.2 (4.10)	18.2 (8.12)	4

(a) Source: Lalonde, V. and G. Hughes-Games. 1997. BC Agricultural Drainage Manual. BC Ministry of Agriculture, Fisheries and Food. P. 89.
(b) Note: The drain spacing for the sub-irrigated site was 7m, as opposed to the 14m spacing for the drained site.

Irrigation Yield Impacts

The second management response has been to drought in the hot summer months. Many forage producers utilize irrigation to improve yields, although the extent of this practice in the waterfowl compensation project area has not been documented.

Tame forages are particularly responsive to irrigation in water deficit areas. Annual crop water requirements range from 6 to 12 inches (15 – 30 cm) in the Fraser Valley to 12 to 18 inches (30 - 45 cm) in the Comox Valley.[5]

Table 5 and Figure 1 shows dryland forage trial yields by cut, averaged across various locations in the south coast. Details are presented in Appendix Tables 3, 4, and 5. For the purposes of further analysis, it has been assumed that irrigated yield is 135% of dryland, or that the average yield across the grass species is 6.52 tonnes DM per acre for the entire growing season.[6] With a silage moisture content of 25% DM, silage yield is estimated at about 23 tonnes/acres.

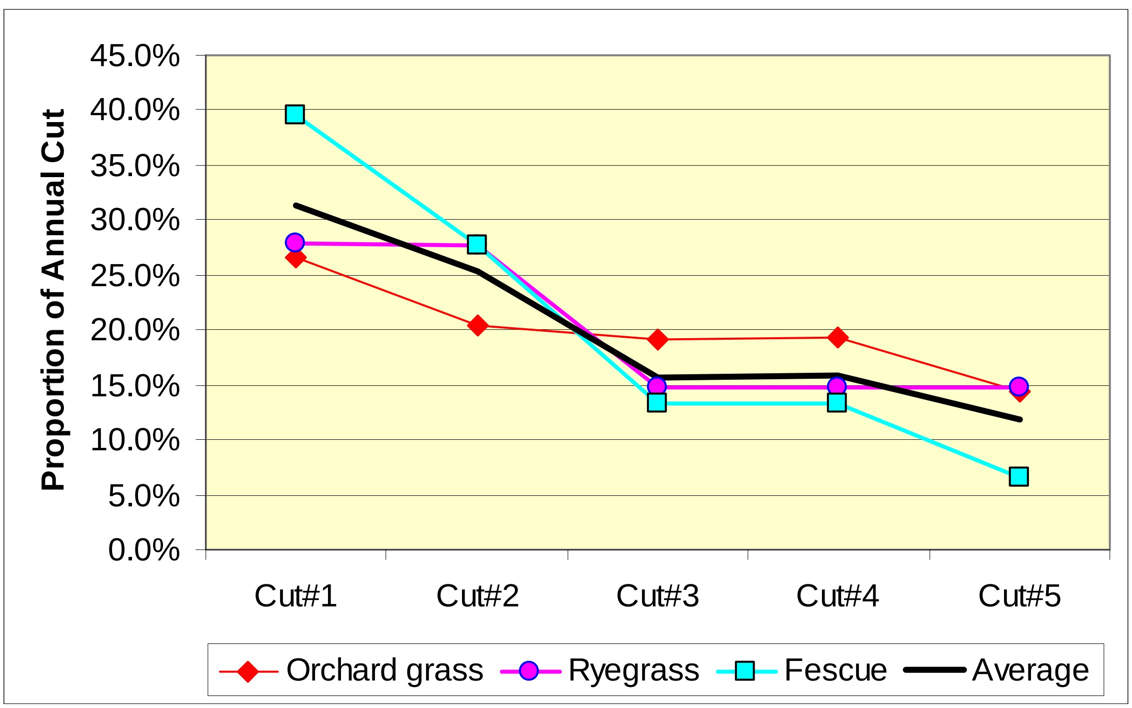
[4] Ibid. P. 87.
[5] Canada – BC Environmental Farm Plan Program. Irrigation System Assessment Guide. Based on an Average Maximum Soil Water Deficit of 7.5cm (3”).
[6] Although specific data for the project area is not available, this value is considered conservative. The 2002 census of agriculture examined irrigated vs. non-irrigated tame hay yields throughout the US and founds an average differential in favour of irrigated of 37%. See http://www.nass.usda.gov/census/census02/volume1/us/st99_1_033_033.pdf . A Saskatchewan Hay Report indicates yield differentials between irrigated and non-irrigated hay production ranging from 24% to 69%, depending on variety. http://www.saskforage.ca/publications/2004_Hay_Report_September.pdf

Table 5: Average Dryland and Estimated Irrigated Yields of BC Forage Trials, South Coast, Selected Years 1980 to 2006 (a)

BC Forage Council Trials	Cut#1	Cut#2	Cut#3	Cut#4	Cut#5	Total Yield (T/ac)
			Percent of Total			
Orchard grass	26.6%	20.5%	19.2%	19.3%	14.5%	5.33
Ryegrass	27.9%	27.8%	14.8%	14.8%	14.8%	4.68
Fescue	39.6%	27.8%	13.3%	13.4%	6.6%	4.45
Average	31.4%	25.3%	15.7%	15.8%	11.9%	
Average non-irrigated Yield (DM)	1.51	1.22	0.76	0.76	0.58	4.82
Calculated Adjustments						
Non-irrigated Yield (T wet weight/ac)	5.34	4.31	2.68	2.70	2.03	17.06
Irrigation Adjustment (1.35)	2.04	1.65	1.02	1.03	0.78	6.52
Irrigated Yield (T wet weight/ac)	7.22	5.83	3.62	3.64	2.75	23.06

Notes: DM yield based on 88% dry matter; wet weight of silage is calculated using a conversion of 25% DM.
(a) Source: http://www.farmwest.com/index.cfm?method=pages.showPage&pageid=331 and forage trial file records archived at BCMAL, Abbotsford.

Figure 1: Distribution of Forage Yield, South Coast, Selected Years, 1980 to 2006 (Appendix Tables 3, 4, and 5)



Based on the pattern of BC Forage Council trial yields (see Appendix Tables 3, 4 and 5 for details), research of the Delta Forage Compensation Pilot Program, and farmer estimates of the impact of various levels of waterfowl depredation, various schedules of silage and hay production by harvesting period under various impact scenarios have been constructed. The Delta waterfowl compensation program has 5 years of experience, Comox Valley has just one year.

3.2.2 Irrigated Silage Yield Impact

Yield Loss Associated with Recoverable Damage

The most prevalent type of waterfowl damage to forage crops is "recoverable damage", defined here as damage which may be extensive but limited to the grazing of the above-ground vegetation. This crop will recover after the 1st cut without the need for over-seeding or tillage and reseeding.

Generally, any significant damage to a forage field, that does not require overseeding or reseeding, leads to delayed harvesting of the first cut. This delay is generally 3-4 weeks and results in a 70% loss of first cut yield[7], compared to what would be expected in the absence of waterfowl damage (Table 6). In these situations, the reduced production occurs in the first cut with minimal to no production loss in subsequent cuts. However, because of the delay of production early in the year a 5th cut is usually not expected.

The yield shortfall associated with recoverable damage to fields that do not require over-seeding or reseeding in comparison to silage yields on an established forage field is estimated at 7.80 wet tonnes per acre, per season.

Table 6: Irrigated Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Recoverable Damage Level (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Wet Tonnes per Acre					
Average Wet Yield (T)	7.22	5.83	3.62	3.64	2.75	23.06
Yield Damage (%)	70%**	0%*	0%*	0%*	No cut*	
Realized Yield (T)	2.17	5.83	3.62	3.64	0.00	18.15
Yield Shortfall (T)	(5.05)	---	---	---	(2.75)	**(7.80)**

Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.

Yield Loss Associated with Damage Requiring Over Seeding

When waterfowl damage occurs to an extent that requires over-seeding, there is generally a complete loss of 1st cut compared to forage crops without waterfowl damage. In addition, forage yields remain lower than normal for the 2nd and 3rd cuts. Note that the reduction in yield is expressed in relation to the yield of an established forage crop.

An over-seeded field is managed similar to a reseeded field, except that an over-seeded yield may be somewhat more depressed because a reseeding involves tillage, which prepares a superior seedbed compared to overseeding. A maximum of 3 cuts will be

[7] Delta Farmers' Institute. 2006. Delta Forage Compensation Program. Year 5 Annual Report (July 2005 – July 2006). This estimate is based on research conducted in Delta in 2005-6.

achieved in the year of over seeding with relatively depressed yields, as indicated in Table 7. Over seeded tall fescue will permit only 2 cuts in the establishment year.

The yield shortfall associated with overseeding in comparison to silage yields on an established forage field is estimated at 20.38 wet tonnes per acre, annually.

Table 7: Irrigated Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Over Seeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Wet Tonnes per Acre					
Average Wet Yield (T)	7.22	5.83	3.62	3.64	2.75	23.06
Yield Damage (%)	100%**	85%*	50%*	No cut*	No cut*	
Realized Yield (T)	0.00	0.87	1.81	0.00	0.00	2.68
Yield Shortfall (T)	(7.22)	(4.96)	(1.81)	(3.64)	(2.75)	**(20.38)**

Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.

Yield Loss Associated with Damage Requiring Reseeding

Where reseeding of a forage field used for silage production is required due to waterfowl damage, expected yield reduction (compared to established crop production in the absence of waterfowl damage) by cut throughout the growing cycle follows a pattern as portrayed in Table 8. Note that the reduction in yield is expressed in relation to the yield of an established forage crop. Since reseeding is the first year of establishing a forage crop, the number of cuts is restricted to 3 in the season and a healthy stand of grass is maintained into the winter so as to discourage waterfowl. Reseeded tall fescue will permit only 2 cuts in the establishment year.

The yield shortfall for reseeded forage, compared to silage yields on an established forage field, is estimated at 19.79 wet tonnes per acre, annually (see Table 8).

No allowance has been made in the calculations for situations where a field may require reseeding because of waterfowl damage but the farmer may wish to rotate the field into another crop. It is possible for a field to deteriorate after extended mature forage production, in which the lower yield during re-establishment of the crop would be a normal farming expense. Farmer testimony indicates that forage fields are normally maintained without reseeding for several years.[8]

[8] Merkens, M. 2007. Personal communication. Most dairy farmers in Delta re-establish forage crops every 5-7 years, and those that have mixed farms may re-establish more frequently than that (3-4 years). Hay producers likely have longer term stands.

Table 8: Irrigated Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Reseeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Wet Tonnes per Acre					
Average Wet Yield (T)	7.22	5.83	3.62	3.64	2.75	23.06
Yield Damage (%)	100%**	75%*	50%*	No cut*	No cut*	
Realized Yield (T)	0.00	1.46	1.81	0.00	0.00	3.27
Yield Shortfall (T)	(7.22)	(4.37)	(1.81)	(3.64)	(2.75)	**(19.79)**

Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.

3.2.3 Irrigated Hay Yield Impact

Based on the pattern of forage trial yields and farmer estimates of the impact of various levels of waterfowl depredation, a schedule of yield impacts on hay production has been constructed. As with silage, waterfowl damage in hay stands can be significant enough to warrant over-seeding or tillage and reseeding. In other instances, grass species are not significantly uprooted and the hay stand will come back on its own but with reduced yield.

Yield Loss Associated with Recoverable Damage

The impact of any significant waterfowl damage to hay stands that can rebound on their own without over-seeding or reseeding applications, still leads to delayed growth and harvesting of first cut. This delay is generally 3-4 weeks and results in a loss of first cut yield in the range of 70%.[9] Impact on the biomass yield of the second cut for hay is about 30%, as shown in Table 9. Hay (passively) managed fields tend to recover one cut more slowly from the impacts of grazing than silage (intensively) fields.[10]

The yield shortfall associated with damage not requiring over-seeding or reseeding in comparison to hay yields on an established forage field is estimated at 2.77 tonnes DM per acre, annually.

[9] Delta Farmers' Institute. 2006. Delta Forage Compensation Program. Year 5 Annual Report (July 2005 – July 2006)

[10] Delta Farmers' Institute. 2006. Delta Forage Compensation Program. Year 5 Annual Report (July 2005 – July 2006). This observation is based on field research conducted in 2005-6.

Table 9: Irrigated Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Recoverable Damage Level (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Dry Tonnes per Acre					
Average DM Yield (T)	3.25	1.63	1.63	No cut	No cut	6.51
Yield Damage (%)	70%**	30%**	0%*			
Realized Yield (T)	0.98	1.14	1.63			3.74
Yield Shortfall (T)	(2.28)	(0.49)	---			**(2.77)**
Note: (a) Yield damage (%) is based on producer estimates and research carried out under the Delta Forage Compensation Pilot Program.						

Yield Loss Associated with Damage Requiring Over-Seeding
Waterfowl damage to a hay stands that requires over-seeding an area of the field generally results in the loss of the entire first cut, followed by significant yield reduction in 2nd and 3rd cuts. Note that the reduction in yield is expressed in relation to the yield of an established forage crop. Essentially, an over-seeded field is managed similar to a reseeded field, except that yield may be somewhat more depressed because a reseeding involves tillage, which prepares a superior seedbed compared to over-seeding. A maximum of 2 cuts will be achieved in the year of over-seeding with relatively depressed yields, as indicated in Table 10.

The yield shortfall associated with overseeding in comparison to hay yields on an established forage field is estimated at 5.45 tonnes DM per acre, annually.

Table 10: Irrigated Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Over-seeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Dry Tonnes per Acre					
Average DM Yield (T)	3.25	1.63	1.63	No cut	No cut	6.51
Yield Damage (%)	100%**	85%*	50%*			
Realized Yield (T)	0.00	0.24	0.81			1.06
Yield Shortfall (T)	(3.25)	(1.39)	(0.82)			**(5.45)**
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

Yield Loss Associated with Damage Requiring Reseeding
Table 11 indicates the pattern of yield related to a reseeded forage field for hay production in comparison to established field in the absence of waterfowl damage. Note that the reduction in yield is expressed in relation to the yield of an established forage crop. Reseeding is the first year of re-establishing a field. The number of cuts is restricted to 2 in the season, after a missed first cut. A healthy stand of grass is maintained into the winter so as to discourage waterfowl.

The yield shortfall associated with reseeding in comparison to hay yields on an established forage field is estimated at 4.29 tonnes DM per acre, annually.

No allowance has been made in the calculations for situations where a field may require reseeding because of waterfowl damage but the farmer may wish to rotate the field into another crop. It is possible for a field to deteriorate after extended mature forage production, in which the lower yield during re-establishment of the crop would be a normal farming expense. Farmer testimony indicates that forage fields for hay production are normally maintained without reseeding for extended periods exceeding 10 years.

Table 11: Irrigated Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Reseeded Field (a)

Forage – Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Dry Tonnes per Acre					
Average DM Yield (T)	3.25	1.63	1.63	No cut	No cut	6.51
Yield Damage (%)	100%**	75%*	50%*			
Realized Yield (T)	0.00	0.41	0.81			1.22
Yield Shortfall (T)	(3.25)	(1.22)	(0.82)			**(5.29)**
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

Table 12 summarizes the impacts of waterfowl damage to irrigated silage and irrigated hay stands in terms of residual yields by cut. The last column indicates the percentage shortfall in seasonal yield compared to established, non-damaged crops.

Table 12: Summary of Estimated Yield Impacts from Waterfowl Depredation of Irrigated Forage Fields, South Coast

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Yield	**Shortfall**
	Yield - Wet Tonnes per Acre						**Percent**
Silage – No Damage (25% DM)	7.22	5.83	3.62	3.64	2.75	23.06	
Silage – Recoverable damage	2.17	5.83	3.62	3.64	0.00	18.15	**(34%)**
Silage – Over-seeded	0.00	0.87	1.81	0.00	0.00	2.68	**(88%)**
Silage – Reseeded	0.00	1.46	1.81	0.00	0.00	3.27	**(86%)**
	Yield - Dry Tonnes per Acre						
Hay – No Damage (88% DM)	3.25	1.63	1.63	No cut	No cut	6.51	
Hay – Recoverable damage	0.98	1.14	1.63			3.74	**(43%)**
Hay – Over-seeded	0.00	0.24	0.81			1.06	**(84%)**
Hay – Reseeded	0.00	0.41	0.81			1.22	**(81%)**

3.2.4 Dryland Silage Yield Impact

Dryland silage and hay production shortfalls have been estimated using the same methodology as for irrigated forage, above, based on the pattern of BC Forage Council forage trial yields, research by the Delta Forage Compensation Project,[11] and farmer estimates of the impact of various levels of waterfowl depredation.

Generally, the schedules reflect similar patterns of yield shortfall as for irrigated but with somewhat lower target yields for established undamaged crops. Tables 13, 14 and 15 estimate the annual production shortfall for recovering, over-seeded and reseeded dryland silage crops to be 5.78, 15.09 and 14.66 wet tonnes, respectively.

Table 13: Dryland Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Recoverable Damage Level (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Wet Tonnes per Acre					
Average Wet Yield (T)	5.35	4.32	2.68	2.70	2.03	17.08
Yield Damage (%)	70%**	0%*	0%*	0%*	No cut*	
Realized Yield (T)	1.60	4.32	2.68	2.70	0.00	11.30
Yield Shortfall (T)	(3.75)	---	---	---	(2.03)	(5.78)
Note: (a) Yield damage (%) is based on producer estimates and research carried out under the Delta Forage Compensation Pilot Program.						

Table 14: Dryland Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Over-seeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Wet Tonnes per Acre					
Average Wet Yield (T)	5.35	4.32	2.68	2.70	2.03	17.08
Yield Damage (%)	100%**	85%*	50%*	No cut*	No cut*	
Realized Yield (T)	0.00	0.65	1.34	0.00	0.00	1.99
Yield Shortfall (T)	(5.35)	(3.67)	(1.34)	(2.70)	(2.03)	(15.09)
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

Table 15: Dryland Silage Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Reseeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Wet Tonnes per Acre					
Average Wet Yield (T)	5.35	4.32	2.68	2.70	2.03	17.08
Yield Damage (%)	100%**	75%*	50%*	No cut*	No cut*	
Realized Yield (T)	0.00	1.08	1.34	0.00	0.00	2.42
Yield Shortfall (T)	(5.35)	(3.24)	(1.34)	(2.70)	(2.03)	(14.66)
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

[11] Delta Farmers' Institute. 2006. Delta Forage Compensation Program. Year 5 Annual Report (July 2005 – July 2006)

3.2.5 Dryland Hay Yield Impact

The percentage estimates of production shortfall for dryland silage and dryland hay mirror those of the irrigated crop counterparts. Tables 16, 17 and 18 estimate the annual production shortfall for recovering, over-seeded and reseeded dryland silage crops to be 2.06, 4.04 and 3.92 tonnes of DM, respectively.

Table 16: Dryland Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Recoverable Damage Level (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Tonnes
	Dry Tonnes per Acre					
Average DM Yield (T)	2.41	1.21	1.21	No cut	No cut	4.82
Yield Damage (%)	70%**	30%**	0%*			
Realized Yield (T)	0.72	0.84	1.21			2.76
Yield Shortfall (T)	(1.69)	(0.37)	---			(2.06)
Note: (a) Yield damage (%) is based on producer estimates and research carried out under the Delta Forage Compensation Pilot Program.						

Table 17: Dryland Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Over-seeded Field (a)

Forage - Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Dry Tonnes per Acre					
Average DM Yield (T)	2.41	1.21	1.21	No cut	No cut	4.82
Yield Damage (%)	100%**	85%*	50%*			
Realized Yield (T)	0.00	0.18	0.60			0.78
Yield Shortfall (T)	(2.41)	(1.03)	(0.61)			(4.04)
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

Table 18: Dryland Hay Yield Impact of Waterfowl on an Established Field over the Growing Season, South Coast, Reseeded Field (a)

Forage – Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total DM
	Dry Tonnes per Acre					
Average DM Yield (T)	2.41	1.21	1.21	No cut	No cut	4.82
Yield Damage (%)	100%**	75%*	50%*			
Realized Yield (T)	0.00	0.30	0.60			0.90
Yield Shortfall (T)	(2.41)	(0.91)	(0.61)			(3.92)
Note: (a) Yield damage (%) is based on producer estimates* and field research carried out under the Delta Forage Compensation Pilot Program**.						

Table 19 summarizes the impacts of waterfowl damage to irrigated silage and irrigated hay stands in terms of residual yields by cut. The last column indicates the percentage shortfall in seasonal yield compared to established, non-damaged crops.

Essentially, the yield shortfalls between irrigated and dryland production are indicated to be identical because both forage systems are assumed to undertake the same number of cuts per season and the seasonal proportion of yield per cut is unchanged (compare Tables 12 and 19). If these parameters were to change, differentials between irrigated and dryland shortfalls would be anticipated to emerge.

Table 19: Summary of Estimated Yield Impacts from Waterfowl Depredation of Dryland Forage Fields, South Coast

Forage – Non-Irrigated	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total Yield	Shortfall
	Yield - Wet Tonnes per Acre						Percent
Silage – No Damage (25% DM)	5.34	4.31	2.68	2.70	2.03	17.08	
Silage – Damaged field	1.60	4.32	2.68	2.70	0.00	11.30	**(34%)**
Silage – Over-seeded field	0.00	0.65	1.34	0.00	0.00	1.99	**(88%)**
Silage – Reseeded field	0.00	1.08	1.34	0.00	0.00	2.42	**(86%)**
	Yield - Dry Tonnes per Acre						
Hay – No Damage (88% DM)	2.41	1.21	1.21	No cut	No cut	4.82	
Hay – Damaged field	0.72	0.84	1.21			2.76	**(43%)**
Hay – Over-seeded field	0.00	0.18	0.60			0.78	**(84%)**
Hay – Reseeded field	0.00	0.30	0.60			0.90	**(81%)**

4.0 Types of Economic Losses Caused by Waterfowl

Losses caused by waterfowl fall into the following main categories:

- Forage yield loss
- Extra and/or more inefficient operations
- Deterioration of fixed assets, such as land improvements
- Lost gross margin to reinvest
- Cost of mitigation measures

4.1 Economic Cost of Yield Shortfall in Forage Production

Protocols for producing forage in the Lower Mainland (LM) and the Comox Valley, Vancouver Island (CV) vary between regions and by farm. Nonetheless, practices followed by producers result in the economical production of forage that is either sold in the local hay market or used in the livestock enterprise on the farm.

In 1994, irrigated grass forage in the Fraser Valley[12] under good management practices was estimated to yield 6.1 tonnes DM per acre per year. Non-irrigated grass forage in the Comox Valley[13] yielded 3.5 tonnes DM per acre per year.

In 1994, the direct cost of forage production was about $51 per tonne for irrigated production and $58.75 for dryland production in the South Coast area. In addition, the contribution margin[14] was about $85 per irrigated tonne for the Fraser Valley, while the Comox Valley contribution margin on dryland forage production was $63/tonne. Total estimated production values associated with irrigated and dryland forage production are $135.97/tonne and $121.74/tonne, respectively (see Table 20).

Table 20: Direct Expenses and Contribution Margins Associated with Established Irrigated and Dryland Forage Production, South Coast

Established Field	Fraser Valley (irrigated)	Comox Valley (not irrigated)
Yield (tonnes DM)	6.1	3.5
	$/tonne DM	
Direct Expenses	$50.84	$58.72
Contribution Margin	$85.13	$63.02
Production Value	$135.97	$121.74

The per tonne production value in Table 20 is considered a reasonable indicator of the value or commodity price for these crops in the field. Compensation for wildlife damage in Canada is generally based on the value of the commodity lost in the field.

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[12] BC Ministry of Agriculture, Fisheries and Food. 1994. Grass Forage (established). Fraser Valley. Spring, 1994. Farming For Profit enterprise budget.

[13] BC Ministry of Agriculture, Fisheries and Food. 1994. Dryland Grass Forage (established). Comox Valley. Summer, 1994. Farming For Profit enterprise budget.

[14] Contribution margin is defined as the excess of revenue over cost of goods sold and represents the gross profit before fixed costs and return to management are incorporated.

Contribution margins reflect the gross profit associated with producing the forage either for the local hay market or for the on-farm livestock enterprise, in addition to the cost of production. In the case, of forage crops (particularly silage), publicly traded markets are not available as they are with primary cereal crops. Consequently, production cost plus a contribution margin provides a notion of the price of the commodity and thereby the value of the commodity delivered to market. A percentage of this (e.g. 90%) may be the best indication of the "value of the commodity" damaged in the field. Production values shown in Table 20 indicate that at a price of $220/tonne for purchased alfalfa, it is significantly more economical to grow forage for livestock operations than to purchase it.

It has been estimated that target irrigated yields in 2006 may have been 6.52 tonnes DM/ac (23.06 tonnes wet weight/acre) and that dryland yield may have been 4.83 tonnes DM/acre (17.08 tonnes wet weight/acre). These yields are somewhat higher than those used in the 1994 Farming For Profit enterprise budgets, but better reflect the dryland yields attained in BC Forage Council trials (see Appendix Tables 3, 4 and 5) and the conventional consensus regarding the yield benefits of irrigation (i.e., 35% increase in yields above dryland production).

Most importantly, the cost to replace farm hay with purchased alfalfa in a dairy operation is significantly higher and indicates that even a production cost-based recovery model would compensate for less than 60% of the total economic impact due to yield loss, even assuming contribution margins existing in 1994.

Given the previous explanation there are four distinctly different crops to consider: These crops are irrigated silage, irrigated hay, dryland silage, and dryland hay, and each crop is may be grown in each of the 2 different regions. However, the enterprise budgets provide economic information on only two of the cropping systems. For the purposes of further analysis, we have assumed that production practices and values for irrigated hay and silage in Delta and the Comox Valley would be equivalent and that the dryland forage values in the 2 regions would be equivalent.

4.1.1 Economic Cost of Irrigated Silage Yield Shortfalls

Based on the foregoing yield loss analysis, Table 21 compares the average estimated economic shortfall from benefits received through existing waterfowl compensation programs. In Delta, Table 21 suggests that compensation payments have averaged about 23% of production value but only 14.5% of the cost of replacing feed through purchases.

Table 22 compares the estimated economic shortfall from the programs of having to replace own forage with purchased forage in the Comox Valley on irrigated acreage using south coastal average yields. The Table suggests that program payouts have paid about 32% of value of lost production value in 2005-6 but only 20% of the cost of replacement feed. However, it should be noted that most forage producers in the Comox Valley elected to take a damage payment rather than an over-seeding payment because of difficulties in fitting the program to their management. As a result, the payout record may be disguising a more severe loss situation.

Table 21: Estimated Irrigated Silage Losses in Relation to Compensation Levels in the Delta Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
Average, 2001-2 to 2005-6	545	159	85	1,760	2,549	
Average Percent	21.4%	6.3%	3.3%	69.0%	100.0%	
Estimated yield loss production value (1)	$162,244	$124,452	$64,392		$351,088	
Estimated yield loss replacement cost (2)	$262,525	$201,374	$104,192		$568,091	
Average program payout, 2001-2 to 2005-6	$32,758	$23,924	$25,904		$82,585	
Average yield loss production value shortfall (3)	$129,486	$100,528	$38,488		$268,502	76.5%
Average yield loss replacement cost shortfall (4)	$229,767	$177,450	$78,288		$485,505	85.5%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/irrigated tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 6.5 tonnes DM/acre or 23 tonnes wet weight/acre, contribution margin of $85/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 11.

Table 22: Estimated Irrigated Silage Losses in Relation to Compensation Levels in the Comox Valley Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
2005-2006	1,436.0	25.5	48.0	2,722	4,231.5	
Average Percent	33.9%	0.6%	1.1%	64.3%	100.0%	
Estimated yield loss production value (1)	$427,679	$19,899	$36,397		$483,975	
Estimated yield loss replacement cost (2)	$692,023	$32,199	$58,893		$783,114	
Actual program payout, 2005-6	$136,430	$3,825	$14,640		$154,895	
Average yield loss production value shortfall (3)	$291,250	$16,074	$21,757		$329,081	68.0%
Average yield loss replacement cost shortfall (4)	$555,593	$28,374	$44,253		$628,220	80.2%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 6.5 tonnes DM/acre or 23 tonnes wet weight/acre, contribution margin of $85/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 11.

4.1.2 Economic Cost of Irrigated Hay Yield Shortfalls

Some producers grow irrigated hay for use on their farms and/or for sale into the local equine market. Table 23 suggests that the payout from the Delta program amounts to about 21% of the production value of the hay and only 13% of the cost of replacement feed, if hay is required to replace lost feedstock on these farms.

Table 23: Estimated Irrigated Hay Losses in Relation to Compensation Levels in the Delta Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
Average, 2001-2 to 2005-6	545	159	85	1,760	2,549	
Average Percent	21.4%	6.3%	3.3%	69.0%	100.0%	
Estimated yield loss production value (1)	$204,611	$118,109	$61,015		$383,735	
Estimated yield loss replacement cost (2)	$331,078	$191,111	$98,727		$620,916	
Average program payout, 2001-2 to 2005-6	$32,758	$23,924	$25,904		$82,585	
Average yield loss production value shortfall (3)	$171,852	$94,186	$35,111		$301,149	78.5%
Average yield loss replacement cost shortfall (4)	$298,320	$167,188	$72,823		$538,331	86.7%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/irrigated tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 6.5 tonnes DM/acre or 23 tonnes wet weight/acre, contribution margin of $85/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 11.

Table 24: Estimated Irrigated Hay Losses in Relation to Compensation Levels in the Comox Valley Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
2005-2006	1,436.0	25.5	48.0	2,722	4,231.5	
Average Percent	33.9%	0.6%	1.1%	64.3%	100.0%	
Estimated yield loss production value (1)	$539,358	$18,885	$34,488		$592,731	
Estimated yield loss replacement cost (2)	$872,729	$30,558	$55,804		$959,091	
Actual program payout, 2005-6	$136,430	$3,825	$14,640		$154,895	
Average yield loss production value shortfall (3)	$402,929	$15,060	$19,848		$437,837	73.9%
Average yield loss replacement cost shortfall (4)	$736,300	$26,733	$41,164		$804,196	83.8%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/irrigated tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 6.5 tonnes DM/acre or 23 tonnes wet weight/acre, contribution margin of $85/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 11.

Table 24 presents a similar assessment for the Comox Valley waterfowl damage compensation program. The program currently covers about 26% of the value of forage production and 16% of the cost of replacement feed.

4.1.3 Economic Cost of Dryland Silage Yield Shortfalls

A similar analysis has been undertaken to model economic impacts of yield loss from waterfowl on dryland forage production and compared to current payouts. The assumed yield is 4.83 tonnes DM/acre, contribution margin of $63/tonne. Although it is readily recognized that the vast majority of silage acres in Delta are not dryland managed, it is interesting to observe the extent to which the current program compensates lost production value in this scenario.

Table 25 suggests that the current Delta program covers in the range of 35% of the value of dryland forage crop production but only 20% of the cost of replacement feed. Table 26 indicates that compensation for waterfowl damages on dryland silage yields in the Comox Valley has a 52% shortfall over the value of production losses, but a 73% shortfall over the cost of replacement feed. However, a significant proportion of Comox Valley producers opted to take damage compensation rather than overseeding compensation, so damages may be understated.

Table 25: Estimated Dryland Silage Losses in Relation to Compensation Levels in the Delta Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
Average, 2001-2 to 2005-6	545	159	85	1,760	2,549	
Average Percent	21.4%	6.3%	3.3%	69.0%	100.0%	
Estimated yield loss production value (1)	$107,711	$82,663	$42,754		$233,128	
Estimated yield loss replacement cost (2)	$194,649	$149,385	$77,263		$421,297	
Average program payout, 2001-2 to 2005-6	$32,758	$23,924	$25,904		$82,585	
Average yield loss production value shortfall (3)	$74,953	$58,740	$16,851		$150,543	64.6%
Average yield loss replacement cost shortfall (4)	$161,891	$125,461	$51,360		$338,712	80.4%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 4.83 tonnes DM/acre or 17 tonnes wet weight/acre, contribution margin of $63/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 18.

Table 26: Estimated Dryland Silage Losses in Relation to Compensation Levels in the Comox Valley Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
2005-2006	1,436.0	25.5	48.0	2,722	4,231.5	
Average Percent	33.9%	0.6%	1.1%	64.3%	100.0%	
Estimated yield loss production value (1)	$283,928	$13,217	$24,166		$321,312	
Estimated yield loss replacement cost (2)	$513,100	$23,886	$43,672		$580,658	
Actual program payout, 2005-6	$136,430	$3,825	$14,640		$154,895	
Average yield loss production value shortfall (3)	$147,499	$9,392	$9,526		$166,417	51.8%
Average yield loss replacement cost shortfall (4)	$376,671	$20,061	$29,032		$425,764	73.3%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 4.83 tonnes DM/acre or 17 tonnes wet weight/acre, contribution margin of $63/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 18.

4.1.4 Economic Cost of Dryland Hay Yield Shortfalls

Table 27 indicates that compensation for loss of dryland hay production in Delta due to waterfowl probably covers about 32% of the value of lost production. Compensation currently covers 18% of the cost of replacement feed, where livestock is integrated into the hay operation.

Table 27: Estimated Dryland Hay Losses in Relation to Compensation Levels in the Delta Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
Average, 2001-2 to 2005-6	545	159	85	1,760	2,549	
Average Percent	21.4%	6.3%	3.3%	69.0%	100.0%	
Estimated yield loss production value (1)	$135,853	$78,373	$40,486		$254,713	
Estimated yield loss replacement cost (2)	$245,507	$141,632	$73,165		$460,304	
Average program payout, 2001-2 to 2005-6	$32,758	$23,924	$25,904		$82,585	
Average yield loss production value shortfall (3)	$103,095	$54,450	$14,583		$172,127	67.6%
Average yield loss replacement cost shortfall (4)	$212,749	$117,708	$47,261		$377,718	82.1%

Notes: (1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/irrigated tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 4.83 tonnes DM/acre or 17 tonnes wet weight/acre, contribution margin of $63/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 18.

Table 28 presents similar information on dryland hay production for the Comox Valley and indicates a shortfall of 61% in compensation for the value of production and a 78% shortfall in terms of the cost of purchasing feed.

Table 28: Estimated Dryland Hay Losses in Relation to Compensation Levels in the Comox Valley Waterfowl Damage Forage Compensation Program (a)

	Acres Recoverable Damage	Acres Over-seeded	Acres Reseeded	Acres Not Damaged	Total Acres Enrolled	Shortfall Percent
2005-2006	1,436.0	25.5	48.0	2,722	4,231.5	
Average Percent	33.9%	0.6%	1.1%	64.3%	100.0%	
Estimated yield loss production value (1)	$358,112	$12,531	$22,884		$393,528	
Estimated yield loss replacement cost (2)	$647,162	$22,646	$41,356		$711,164	
Actual program payout, 2005-6	$136,430	$3,825	$14,640		$154,895	
Average yield loss production value shortfall (3)	$221,683	$8,706	$8,244		$238,634	60.6%
Average yield loss replacement cost shortfall (4)	$510,733	$18,821	$26,716		$556,269	78.2%

Notes:
(1) Yield loss production value = (# acres damaged)*(# tonnes lost/acre) *(production value/irrigated tonne)
(2) Yield loss replacement value = (# acres damaged)*(# tonnes lost/acre) *($220/tonne alfalfa)
(3) Production value shortfall = (production value - program payout)
(4) Replacement value shortfall = (replacement value - program payout)

Note: (a) Values based on yield of 4.83 tonnes DM/acre or 17 tonnes wet weight/acre, contribution margin of $63/tonne, replacement feed cost of $220/tonne delivered, and yield loss schedule as presented in Table 18.

4.1.5 Protein Loss

Most Delta forage producers have made the switch to forage varieties that produce less protein than traditional varieties such as orchard grass. Comox Valley producers still grow a substantial proportion of orchard grass but this practice is changing in view of rapidly escalating waterfowl impacts in the area.

Delta producers have reported that tall fescue protein content under normal growing conditions is about 4 percentage points or 20% lower than found in orchard grass.[15] In view of the fact that forage producers in Delta are now growing about 90% tall fescue, mitigation measures have caused at least 18% reduction in protein content in their forage feedstock (see Table 29).

[15] Research supporting this table has been undertaken on the economic impact of variety changes. See Delta Forage Compensation Program. Year 3 Annual Report (July 2003 – July 2004).

Table 29: Comparison of Protein Content in Orchard Grass and Fescue Forage, Delta Producer Testimonials

Cut	Orchard grass	Fescue	Timothy
	% Crude Protein		
Cut #1	15%	11%	
Cut #2	18%	13.5%	15%
Cut #3	20%	16%	
Cut #4	20%	16%	
Cut #5	20%	16%	

Loss of biomass from waterfowl damage is correlated with loss of protein in forage. However, while reduced biomass yields also result in an absolute reduction in protein yields, the impact of waterfowl damage is to increase the relative protein content in damaged cuts. Research undertaken in 2005-6[16] indicates that damaged fields suffering a 70% decrease in biomass production may have a 20% increase in protein levels.

If protein is considered interchangeable with biomass yield, then the decrease in biomass in the first cut is mitigated by the increased protein. A simple calculation would suggest that 6% (i.e., 20% increase of 30% yield) of the 70% biomass loss would be recovered by the increased protein content, resulting in a net yield loss in the 1st cut of 64%. Or from another perspective, for damaged yield of 0.61 tonnes for irrigated silage in the 1st cut, the imputed protein increase would represent an adjustment of only about 0.12 tonne/ac based on the assumptions in this paragraph. This gross benefit would also be offset by the need to add other fibre to the herd diet to make up the decrease in roughage.

4.1.6 Summary

None of the forage operations in the regions affected by waterfowl are receiving anywhere close to the actual costs of waterfowl damage by way of compensation for losses. The largest magnitudes of loss are associated with reseeded and over-seeded fields because they do not reach a mature stage of production in the year of seeding. Chronic waterfowl depredation can lead to fields that never reach mature production, although receiving the inputs associated with establishment of perennial forage production. The economic shortfall increases from lowest with damaged fields to highest with fields requiring over-seeding. The compensation shortfall is highest for over-seeded fields, where the grass crop requires reseeding management but the compensation is substantially lower.

Hay crops sustain relatively more yield damage than do silage crops from similar levels of waterfowl depredation because a larger proportion of the total hay yield is taken in the first cut. Irrigated crops would be expected to be more resilient than dryland crops to levels of damage not requiring reseeding or overseeding (see Table 30).

[16] Delta Forage Compensation Program. Year 5 Annual Report (September 01, 2005 – August 31, 2006)

Table 30: Estimated Economic Shortfall from Compensation on a Per Acre Basis

Type of Forage Production and Impact Level	Production Value Compensation Shortfall/ac	Feed Replacement Compensation Shortfall/ac	Production Value Compensation Shortfall/ac	Feed Replacement Compensation Shortfall/ac
	Delta		Comox Valley	
Irrigated Silage				
- recoverable damage	237.69	421.78	202.82	386.90
- over-seeded	630.35	1,112.68	630.36	1,112.69
- reseeded	453.23	921.90	453.27	921.94
Weighted Average	340.24	615.22	218.01	416.18
Irrigated hay				
- recoverable damage	315.46	547.62	280.59	512.74
- over-seeded	590.58	1,048.33	590.58	1,048.33
- reseeded	413.50	857.59	413.50	857.59
Weighted Average	381.61	682.16	290.05	532.76
Dryland Silage				
- recoverable damage	137.59	297.18	102.71	262.31
- over seeded	368.32	786.69	368.33	786.76
- reseeded	198.43	604.80	198.47	604.84
Weighted Average	190.76	429.21	110.25	282.06
Dryland Hay				
- recoverable damage	189.25	390.54	154.38	355.66
- over-seeded	341.42	738.08	341.43	738.08
- reseeded	171.72	556.54	171.76	556.58
Weighted Average	218.11	478.63	158.09	368.51

The effect of waterfowl on protein content in silage harvested from damage fields is restricted to situations where yield is depressed but plants are not destroyed. The magnitude of this impact would be related to the potential for protein increase in the residual yield of the first silage cut. The economic impact on haying operations would be minimal since elevated protein content is not a quality factor in the equine sector.

Combinations of over-seeding and surviving plants may also have some increased protein benefits, but the residual yield is usually extremely low so as not to amount to an economically significant increase in protein.

4.2 Extra and/or Less Efficient Operations

4.2.1 Normal Forage Production Practices

Under good farm management practices, a forage field has longevity of 10 to 12 years before needing to be rotated or reseeded into a new forage crop. Although the varietal mix may change over this period, a healthy stand generally controls the emergence of weeds while, in the case of dairy, also providing a destination for manure generated by livestock.

In the first year of forage crop establishment, producers control unwanted growth with Roundup herbicide, then seed into a plowed and tilled seed bed. After crop emergence, an herbicide may be applied to control volunteer weeds. Thereafter, crop growth and multiple harvesting generally prevents weed establishment. Typically, 2 (hay) to 3 (silage) cuts are taken in the establishment year.

In the second year, forage production attains mature yields and maintains those yields thereafter. Typically, silage producers will apply manure 3 times per season (before first cut and after 3rd and 5th cuts) as well as supplement once with lime and 3 to 4 times with synthetic fertilizer (see Appendix Table 1). Five cuts of silage are harvested over the course of the season, attempting to optimize biomass for targeted protein content levels.

Producers of hay for sale generally do not apply manure but rely on the application of synthetic fertilizers for nutrients before each cut. Typically, 3 cuts of hay will be harvested over the course of the season. Biomass production is emphasized more than protein content in hay production, thus hay cuts take place after longer intervals than silage cuts (see Appendix Table 2).

4.2.2 Management Inefficiencies Created on Damaged Forage Fields

Recoverable Damage Impacts

Under damage scenarios where the forage plants survive and the crop recovers after first cut to meet yield potential, there may not be significant additional operations required to weather the impact of waterfowl. However on average, Delta producers indicate that on damaged fields the first cut of silage may be reduced by 70% and one cut of silage forage may be lost per season.

Thus, the first cut is harvested with machinery over-sized for crop conditions and the total investment in forage equipment is excessive based on realized yield. In Delta, recoverable damage impacts from waterfowl averaged 14% of the enrolled acreage in the 2003/4-2005/6 period. In the Comox Valley in 2005/6, 55% of the enrolled acreage was damaged to a recoverable level.

Seasonal silage yield loss from recoverable waterfowl damage has been estimated at about 34% of established forage yield. The corresponding value for hay production is 42.5% reduction in yield.

Table 31 suggests that management inefficiency costs induced by having to manage recoverable damage forage fields may be $48 to $73 per acre.

Table 31: Estimated Inefficiency Costs Associated with Recoverable Damage Impacts

Operation	Custom Machinery Cost Per Acre	Inputs Cost Per Acre	Imputed Additional Cost Per Acre
Extra herbicide application	$4.00	$20.00	$24.00
Silage harvesting –34% reduction in yield	$70.12 (4 cuts)		$23.84
Hay harvesting - 42.5% reduction in yield	$114.66 (3 cuts)		$48.73
		Total Estimate	$48-$73

Note: Custom rates are based on Alberta 2007 farm machinery costs, Roddick Farm Supply personal communication, and producer information. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/inf11015

Removal of the majority of over-wintering growth from a field prior to the spring growing period makes the field susceptible to weed growth. As well, waterfowl excrement appears to contain significant numbers of weed seeds present in biomass harvested elsewhere by the birds.[17] This may entail the need for an herbicide application to control weeds, which in Delta is done on a custom basis for $16/ac plus the cost of herbicide ($20/ac).

Damage Impacts Requiring Overseeding
Over-seeding is intended to re-invigorate areas that have lost a significant proportion of the plants comprising a forage stand. Contacted producers indicated that plant loss exceeding 50% was severe enough to require re-seeding, so it may be assumed that some level of plant loss in the range of 25%-50% would lead to over-seeding.

The overseeding operation seeds into an existing forage stand and is accomplished with a special press drill that does not disturb the soil significantly. However, the seed bed is not as optimal as fields prepared for reseeding and Delta farmers have experienced lower yields on over-seeded fields than on reseeded fields. Per acre over-seed costs will depend on the amount of plant loss, but range between $45.00 and $120 per acre.[18] Custom seeding rates are in the range of $20.00/ac.

Typically, over-seeded areas will not comprise the majority of a damaged field. Harvesting (1st cut) of the less damaged portions of the field will generally be carried out around the over-seeded area rather than through it, as traffic of heavy or loaded equipment on emerging plants is not desired. However, maneuvering around over-seeded areas creates harvesting inefficiency and causes rutting in turning areas. Producers plan to harvest 3 cuts of forage from over-seeded areas, but at significantly reduced yields compared to established stands. Areas over-seeded with tall fescue take longer to establish than other grass varieties and may not generate yield in the 2nd cut.

Silage producers have noted a reduction in the ability to spread manure on over-seeded fields. In a normal forage season, producers will plan to make 3 applications of liquid manure at a rate for each application of 4,000 gallons per acre. With over-seeding, the total volume of application per acre is essentially halved, since the young crop cannot beneficially use nutrients at the higher rate, and the producer must run his equipment in two passes at rates of 2,000 and 4,000 gallons per acre. This situation not only creates inefficiency in manure application but requires application over a larger area, which could be problematic if the area of forage fields is closely matched to herd size. This management problem could be exacerbated if the severity of waterfowl damage escalates and more forage crops do not become established from year to year.

Table 32 suggests that management inefficiency costs induced by having to over-seed forage fields may be $106 to $124 per acre.

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[17] Producer comments at a producer workshop related to this study.
[18] Noel Roddick. 2007. Personal communication. Seed costs average $3.00 per lb., over-seeding rates may vary from 15 to 40 lbs per acre.

Table 32: Estimated Inefficiency Costs Associated with Damage Impacts Requiring Over-seeding

Operation	Custom Machinery Cost Per Acre	Inputs Cost Per Acre	Imputed Additional Cost Per Acre
Overseeding	$10.00	$82.50	$36.00
Additional herbicide application	$4.00	$20.00	$24.00
Silage Harvesting –88% reduction in yield	$52.59 (3 cuts)		$46.28
Hay Harvesting - 84% reduction in yield	$76.44 (2 cuts)		$64.20
Lost ability to apply manure	(a)		(a)
		Total Estimate	$106-$124
(a) This cost is will be different for every farm operation			

Note: Custom rates are based on Alberta 2007 farm machinery costs, Roddick Farm Supply personal communication, and producer information. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/inf11015

Removal of forage plants leaves the ground susceptible to weed introduction and proliferation. Rampant weed growth is encouraged by the removal of entire grass plants by waterfowl. Waterfowl excrement also is a vector in introducing invasions of weeds that may not have been found on the field prior to damage. This weed intrusion is significant and may require herbicide application to control, provided the weeds present can be controlled with broad-leafed herbicides

Damage Impacts Requiring Reseeding

Reseeding is intended to remediate areas that have lost the majority of the plants comprising a forage stand. Contacted producers indicated that plant loss exceeding 50% was severe enough to require re-seeding, so it may be assumed that some level of plant loss in excess of 50% would lead to reseeding.

The reseeding operation requires vegetation control prior to cultivation, seed bed preparation, seeding, land rolling and an herbicide application to control weeds after crop emergence. The custom seeding rate in Delta is about $17.75/acre in 2007.[19] Delta farmers have experienced lower yields on over-seeded fields than on reseeded fields. Per acre seed costs will depend on the amount of plant loss, but range between $45.00 and $120 per acre.[20]

With reseeding, producers are able to apply a significant volume of manure prior to seedbed preparation so that application constraints are not immediately apparent, although the timing of manure application would change. The reduction in ability to spread manure on reseeded fields during the growing season is essentially identical to over-seeded fields.

[19] Roddick, Noel. 2007. Personal communication.
[20] Roddick, Noel. 2007. Personal communication. Seed costs average $3.00 per lb., over-seeding rates may vary from 15 to 40 lbs per acre.

Table 33 suggests that management inefficiency costs induced by having to reseed forage fields may be $287 to $304 per acre.

Table 33: Estimated Inefficiency Costs Associated with Damage Impacts Requiring Reseeding

Operation	Custom Machinery Cost Per Acre	Inputs Cost Per Acre	Imputed Additional Cost Per Acre
Additional herbicide application	$4.00	$20.00	$24.00
Plowing	$10.00		$10.00
Tillage (3 times)	$21.00		$21.00
Reseeding	$17.75	$140.00	$157.75
Land rolling	$5.50		$5.50
Additional herbicide application	$4.00	$20.00	$24.00
Silage Harvesting –86% reduction in yield	$52.59 (3 cuts)		$45.23
Hay Harvesting - 81% reduction in yield	$76.44 (2 cuts)		$61.92
		Total Estimate	$287-$304

Note: Custom rates are based on Alberta 2007 farm machinery costs, Roddick Farm Supply personal communication, and producer information. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/inf11015

Typically, reseeded areas will not comprise the majority of a damaged field. Harvesting (1^{st} cut) of the less damaged portions of the field will be avoid the reseeded area, as traffic of heavy or loaded equipment on emerging plants is not desired. However, maneuvering around reseeded areas creates harvesting inefficiency and causes rutting in turning areas. Producers plan to harvest 3 cuts of forage from reseeded areas, but at significantly reduced yields compared to established stands. Areas reseeded with tall fescue take longer to establish than other grass varieties and may not generate yield in the 2^{nd} cut.

4.3 Cost of Rehabilitating Deteriorated Farm Assets

Use by waterfowl can reduce the capability of the fields to attain subsequent target yield expectations due to the deterioration of previously improved field conditions and management.

Waterfowl tend to be attracted to ponding, which has lead many farmers and the Delta Farmland and Wildlife Trust to advocate land leveling as a tactic to reduce field susceptibility. Similarly, subsurface drainage is used by many farmers as a land improvement to assist in draining water quickly from fields, improve growing conditions for heavier stands of forage less susceptible to reduced yield impacts, and to provide conditions for irrigated cropping. Nevertheless, some farmers claim that the attractiveness of fields to waterfowl use also can be random.

Even where observable ponding does not initially exist, grazing, root feeding and simply the congregating of waterfowl can quickly lead to the creation of depressions in otherwise well-drained fields. Waterfowl use has been reported to have two immediate effects on land-leveled and tiled drained farmland: 1) re-contouring of fields due to waterfowl activity, and 2) sealing of the top soil layer and subsoil compaction leading to impaired drainage. The fixed costs of land leveling and tile drainage are substantial and intended to provide benefits over a design lifetime exceeding 15 years. Waterfowl use can lead to substantial deterioration of these assets before their design life is over.

Land leveling can cost from $350-$400 per acre, depending on soil type, the amount of soil to be moved, and the location of fill in relation to the area needing leveling. Installation of closer spaced tile drainage to improve subsoil drainage beyond crop requirements to discourage waterfowl use can cost in the range of $250 per acre. Reseeding options with field operations consisting of plowing and tillage also counteract soil compaction. Custom rates for plowing, tillage and roller operations may be in the range of $10.00, $7.00 and $5.50 per acre, respectively.[21] In addition to a seeder pass, reseeding commonly employs one plowing operation, three tillage operations, and one roller operation.

Comox Valley farmers are using an aerator to remediate fields compacted by waterfowl puddling behaviour. Other farmers will pull chain harrows to try to break up surface sealing in an established grass field. These operations are not completely effective in restoring yield capability and growers may be forced to consider plowing and tillage to restore sub-surface drainage. However, recent experience with waterfowl depredation in the area suggests that over-seeded or reseeded fields may never re-establish with the chronic re-occurring nature of the waterfowl impact and heavy intensity of current waterfowl use.

4.4 Opportunity Cost of Lost Gross Margin for Investment in Other Aspects of the Business

The definition of production value used to quantify yield loss value (see Table 20, above) includes direct costs of production and the gross margin in the calculation. This is considered a reasonable measure of the value of the forage in the field. As such, there is not an opportunity cost associated with lost gross margin, as it is embedded in the calculation.

However, there is an opportunity cost related to lost interest that could have been earned on that gross margin had it been generated through the production of forage. Instead, any compensation based on production value would be used to purchase replacement feed.

The definition of opportunity cost is the income foregone by not being able to use the resource in its next best alternative. In this instance, the opportunity cost[22] is the

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[21] Custom rates for Alberta, 2007

[22] The opportunity cost of forage depredation by waterfowl is the economic cost of the opportunity foregone or the expected benefits not received from crops lost to waterfowl, in this case as livestock feed or as a saleable commodity. Alternatively, the opportunity cost may be viewed as the opportunity foregone by having to invest in replacing feed rather than other aspects of the farming business. For the purposes of analysis, a low risk investment at the average prime bank rate of 3.7% has been assumed, based on the 2000 to 2006 period.

revenue stream that would have been generated from being able to invest the gross margin.

For some producers, chronic severe waterfowl damage is considered to have constrained their ability to generate the capital needed to expand and modernize their farms. That is, chronic waterfowl predation leading to the elimination of gross margin from forage production has meant that other revenue streams in the farming operation have had to financially make up the shortfall in forage returns.

The contribution margins of $85.00 per tonne for irrigated production and $63.00 per tonne for dryland production are estimates of the gross profit associated with forage production. This profit would have been invested in the ongoing farming operation. The lost contribution margins and associated lost opportunity costs are estimated by damage category in the Table 34.

Table 34: Opportunity Costs Associated with Foregone Forage Benefits

Type of Crop	Lost Yield (T/ac)	Contribution Margin ($/T)	Lost Contribution Margin ($/ac)	Opportunity Cost ($/ac)
Irrigated Silage				
recovered damage	2.19	$85.13	$186.43	$6.90
over seeded	5.75	$85.13	$489.48	$18.11
reseeded	5.58	$85.13	$475.01	$17.58
Irrigated Hay				
recovered damage	2.77	$85.13	$235.80	$8.72
over seeded	5.45	$85.13	$463.95	$17.17
reseeded	5.29	$85.13	$450.33	$16.66
Dryland Silage				
recovered damage	1.62	$63.02	$102.09	$3.78
over seeded	4.26	$63.02	$268.47	$9.93
reseeded	4.14	$63.02	$260.91	$9.65
Dryland Hay				
recovered damage	2.05	$63.02	$129.19	$4.78
over seeded	4.04	$63.02	$254.60	$9.42
reseeded	3.92	$63.02	$247.04	$9.14

Lost opportunity costs, represented as interest derived from the contribution margins associated with silage and hay production (see Appendix Tables 7 and 8) are largest where damage is most severe, i.e., for over-seeded and reseeded areas. Based on contribution margins estimated in 1994 and average bank rate for 2000 to 2006, lost opportunity costs of foregone investment of the contribution margin are estimated to range as follows:

- From $6.90 to $8.72 per acre on irrigated forage subjected to recoverable waterfowl damage
- From $17.17 to $18.11 on irrigated forage subjected to damage requiring overseeding
- From $16.66 to $17.58 on irrigated forage subjected to damage requiring reseeding
- From $3.78 to $4.78 per acre on dryland forage subjected to recoverable waterfowl damage

- From $9.42 to $9.93 on dryland forage subjected to damage requiring overseeding
- From $9.14 to $9.65 on dryland forage subjected to damage requiring reseeding.

4.5 Net Economic Impact of Mitigation Measures

Delta forage producers already undertake a number of measures that are intended to mitigate the impact of waterfowl depredation of forage fields. Some of these practices are employed by farmers as standard practices with benefits beyond mitigation of waterfowl damage to perennial forage crops. These measures include:

1. Laser leveling of fields
2. Tile drainage
3. Winter cereal crop cover cropping and relay/lure cropping
4. Selection of forage varieties not as attractive to waterfowl
5. Scare tapes and devices

The first 2 of these practices are promoted under programs and rationale separate from the Forage Compensation project and will not be dealt with further.

In addition, waterfowl will harvest residue in vegetable fields when available (e.g., cabbage, carrots, potatoes, turnips, beets) during the over-wintering period and this has the potential to help alleviate forage use to some extent. However, several crops (e.g., winter cauliflower, vegetables for seed) cannot be grown in the Delta because of waterfowl depredation and existing programs provide no compensation or incentives to promote the provision of these crops as feeding habitat instead of forage fields. Cull potatoes are very attractive to waterfowl in Delta and the Comox Valley. Turf farmers in Delta, with young succulent turf grass, have also experienced grazing losses from over-wintering waterfowl.

While Comox Valley forage producers are only into the second year of their Forage Compensation Program, Canadian Wildlife Service and Ducks Unlimited Canada have operated cover crop, hazing, monitoring and communication programs in the area since 1991. This area is also much more heterogeneous in terms of soil type and topography, suggesting that measures used in Delta (such as items 1 and 2, above) may not be appropriate in the region.

The last three practices have been examined by the mitigation component of the Delta Forage Compensation Project in Delta and have benefited from the assistance of agencies such as DU, CWS and DFWT.

4.5.1 Changing Forage Varieties

Conversion of forage fields to tall fescue, a less palatable grass to waterfowl, has being occurring. In 2005/2006, 55% of the forage crop area enrolled in the program contained orchard grass as a component in the mix and 44% of the area contained fescue in the mix.[23]

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[23] Merkens, M. 2007. Personal communication.

While Comox Valley forage fields are still predominantly orchard grass, many producers have also switched to tall fescue. Although Comox Valley producers use relatively more mixed species for their forage stands, fescue is becoming dominant mainly because other forage species are more heavily used by waterfowl over the winter, causing the species mix to change.

Regardless of whether fescue survives the winter waterfowl depredation, the surviving stand is lower quality and often infested with invading weeds or weeds brought into the fields in the waterfowl droppings. The effectiveness of the measure in relation to the heavy and increasing need for waterfowl feedstock needs to be assessed. Research is also needed to determine if taller fall forage crops might reduce depredation.

4.5.2 Winter Cover Cropping/Lure Cropping

Relay cropping is the practice of interplanting annual corn crops with Italian ryegrass or wheat. The program is regarded simply a cover crop program that has a different seeding date than cover crops planted into annual crop fields. After the corn is harvested, the relay crop provides additional winter cover crop habitat for waterfowl and has the potential to lure waterfowl away from perennial forage fields. If not all consumed or severely damaged by waterfowl, the residual yield is harvested as silage by producers.

While relay crops have been used by waterfowl, the fields have not been completely successful in luring the birds away from forage fields. The attractiveness of lure crops to waterfowl is affected by the maturity of the crop at the time waterfowl arrive and the species of waterfowl that have historically used the field for winter foraging.

Some silage corn producers in Delta have participated in a relay cropping program, operated as a mitigation/compensation strategy to lure waterfowl away from forage fields or provide a secondary early season forage crop. Italian ryegrass is under seeded into corn fields to serve as food source. Although relay cropping has only been used in Delta for the last 4 years, the mitigation/compensation strategy appears to be effective. Relay crops planted close to waterfowl roosting areas are used extensively and intensively as alternative feeding areas by waterfowl and those further from open water typically can be harvested as an early season silage crop. In one area, the relay crops effectively lure Trumpeter Swans in and although they are heavily used by swans throughout the winter, they still provide substantial silage for harvest.

Other alternative feeding areas for waterfowl include conventional winter cover crops and/or vegetable crop residue.

Relay cropping has been conducted in Delta for 4 years and in the Comox valley for 2 years. In 2005-6, there were about 100 acres of ryegrass relay crops and 65 acres of relay cropped wheat in Delta. The Comox Valley Waterfowl Project has been providing producers with compensation of $25/acre to plant cover crops since 1991. The area has ranged from 300-500 acres. In 2005, the compensation program raised the amount to $50/acre and 700 acres of cover crops were planted in the winter of 2006-7.

The extra cost of relay cropping consists of seed purchase, seeding, and the extra cultivation to prepare the field the following year. In addition, spring weather conditions during harvest could complicate seeding opportunities.

The benefits of relay cropping are threefold: 1) the forage value of the residual of the over-wintered crop, 2) alternatively, the value of incorporating the residual biomass into the soil and 3) the effectiveness of luring waterfowl from nearby perennial forage fields. Relay cropped Italian ryegrass is generally interplanted in mid-June and harvested the following April. Italian ryegrass stands left undamaged or only slightly damaged by waterfowl can yield about 3.6 tonnes per acre.[24]

Value of the over-wintered forage will depend on the quality of the harvest, including protein content. For the purposes of analysis, a production value of $135 per tonne has been assumed[25], resulting in a potential revenue stream of about $486 per acre (see Table 35).

In 2005-6, DFWT funded a total of 2,470 acres of winter cover crops including 101 acres of relay crops. Under their program, DFWT provides producers with $45 per acre as a cost share. Monitoring of the winter cover crops during 2005/06 indicated that by the end of winter, 82% of total cover crop area showed evidence of grazing and 51% was heavily grazed. With respect to relay crops, 70% of the area planted showed evidence of grazing and 54% were heavily or completely grazed by the end of winter.[26]

In the same year, 31% (866 out of 2818 acres) of the area of perennial forage crops were damaged and over half of this (441 acres) was in the Surrey Mud Bay area where winter cover crops (including relay crops) are not grown. These data show that winter cover crops were effective in luring waterfowl from perennial forage fields in 2005-6. More years of observation are needed to confirm whether the 2005-6 experience reflects a reliable and effective waterfowl lure strategy.

A breakeven yield of about 0.5 tonne/ac would be required to cover the estimated direct costs associated with relay crop production, but would provide no incentive to relay crop if a silage crop was the only expected benefit of the program. In fields that sustain moderate to minimal grazing or those experiencing extensive but not intensive grazing, the 0.5 tonne/ac break even point is exceeded.

Where cover crops are intensively cropped by waterfowl, the benefit of luring waterfowl away from perennial forage crops may be of more value than the cost of lost cover crop silage at the end of winter. Table 35 indicates the direct cost of producing cover crops (less harvest cost) is about $64/tonne or $224 per acre. More research is required to establish and quantify the linkage between the uses of winter cover and lure crops and the decreased predation of perennial forage crops.

As well, the opportunity cost associated with the foregone gross margin benefit could represent an additional $2.25 to $8.13 per acre, depending on extent of waterfowl use.

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[24] Delta producers workshop. February, 2007.
[25] The value of $135 per tonne is the value of forage in the Farming For Profit factsheet (see Table 20).
[26] Merkens, M. 2007 Personal communication. Unpublished data.

Table 35: Estimated Costs and Financial Benefits Associated with Relay Lure Cropping of Italian Ryegrass

	Yield		$ Per Acre	$/Tonne
Target Revenue	3.6 tonnes		$486	$135
Direct Costs				
Operation	Custom Machinery Cost Per Acre	Inputs Cost Per Acre	Cost Per Acre	Cost Per Tonne
Seeding (1)	$30.00	$140.00	$170.00	$47.22
Fertilizer application		$ 45.00	$62.75	$17.43
Silage Harvesting	$17.53		$17.53	$ 4.87
Hay Harvesting	$38.22		$38.22	$10.62
Tillage (2 times)	$ 14.00		$14.00	$ 3.89
	Total Direct Costs		$286	$69-$74
	Estimated Gross Margin		$200	$61-$66
	Relay Seeding Payment		$45	

Note: Custom rates are based on Alberta 2007 farm machinery costs, Roddick Farm Supply personal communication, and producer information. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/inf11015
(1) This operation is performed by a special seeder that cultivates, seeds, and bands in one operation.

4.5.3 Scare Devices

Scare tape and laser powered scare devices have been tested in Delta with mixed results. Snow fencing appears to reduce attractiveness of small fields. These measures have not been adopted as part of forage management protocol and do not pose additional economic costs for producers at this time.

The Comox Valley also has a history of experimentation with scare devices to mitigate forage depredation. Various hazing techniques to decrease swan and snow goose depredation have been tried including dogs, electronic avian deterrents, banger and cracker shells, flash tape, pennant flags, black flags, barrels, decoys top lure birds to cover crops, and air horns.[27] Some of these techniques have been effective in keeping waterfowl away from forage fields for various periods of time until they become familiarized with the hazing or until feed resources in unprotected areas are depleted. Some techniques have been found to be effective only for small areas, prohibitively expensive for larger areas, or requiring a lot of maintenance or operator time.

In general, the most effective mitigation is a combination of hazing techniques used repeatedly on smaller fields. However, waterfowl use forage fields for feed and deterrents are less effective when non-hazed crops are not available and when standing water is present. Once fields are used by waterfowl, they become more susceptible to predation regardless of the level of hazing.

[27] Buffet, D. 2004. Comox Valley Waterfowl Management Project: 1991-2002 Evaluation. Prepared for Canadian Wildlife Service (Pacific and Yukon Region) and Ducks Unlimited Canada (BC Coastal Office). June.

5.0 Current Compensation Levels and Economic Gaps

The following Tables summarize the calculations contained in Section 4. The estimated economic losses are compared to the current levels of compensation in the Forage Compensation Program for the three categories of waterfowl damage. Generally, the largest shortfalls in compensation are found in the over-seeding and reseeding categories. Waterfowl-related economic losses in silage-managed forage crops are estimated to be slightly larger than in hay-managed forage crops. Waterfowl-related economic losses in irrigated forage crops are higher than in dryland crops.

5.1 Economic Impacts of Waterfowl on Irrigated Forage for Silage

Table 36 presents summary estimates of the magnitude of economic losses incurred on irrigated silage because of waterfowl and the shortfalls that characterize the current compensation program. Based on the cost components indicated, the quantifiable production value shortfall varies from $253/ac for recoverable damage to $758/ac for re-seeded acres. The economic shortfall based on the cost of replacing feed consumed by waterfowl ranges from $437/ac for recoverable damage to $1,227/ac for acres requiring over-seeding.

Table 36: Comparison of Compensation with Economic Impacts from Waterfowl Depredation, Irrigated Silage, Delta and Comox Valley

Current Level of Compensation	Severity of Waterfowl Damage		
	Recoverable	Over seeding	Reseeding
	$100/ac	$150/ac	$305/ac
PRODUCTION VALUE CALCULATION			
Cost component	Economic Cost Per Acre		
Production value of lost yield	$298	$780	$758
Extra/less efficient operations	$48	$106	$287
Opportunity cost – lost gross margin and investment	$7	$18	$18
Total Quantifiable Cost (Production Value Estimate)	**$353**	**$904**	**$1,063**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$253**	**$754**	**$758**
REPLACEMENT COST CALCULATION			
Feed replacement cost of lost yield	$482	$1,263	$1,227
Extra/less efficient operations	$48	$106	$287
Opportunity cost – lost investment of gross margin	$7	$18	$18
Total Quantifiable Cost (Feed Replacement Value)	**$537**	**$1,387**	**$1,532**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$437**	**$1,237**	**$1,227**

5.2 Economic Impacts of Waterfowl on Irrigated Forage for Hay

Table 37 presents summary estimates of the magnitude of economic losses incurred on irrigated hay because of waterfowl and the shortfalls that characterize the current compensation program. Based on the cost components indicated, the quantifiable production value shortfall varies from $458/ac for recoverable damage to $1,040/ac for reseeding. The economic shortfall based on the cost of replacing feed consumed by waterfowl ranges from $590/ac for recoverable damage to $1,180/ac for acres requiring over-seeding.

Table 37: Comparison of Compensation with Economic Impacts from Waterfowl Depredation, Irrigated Hay, Delta and Comox Valley

Current Level of Compensation	Severity of Waterfowl Damage		
	Recoverable	Over seeding	Reseeding
	$100/ac	$150/ac	$305/ac
PRODUCTION VALUE CALCULATION			
Cost component	Economic Cost Per Acre		
Production value of lost yield	$376	$741	$719
Extra/less efficient operations	$73	$124	$304
Opportunity cost – lost gross margin and investment	$9	$17	$17
Total Quantifiable Cost (Production Value Estimate)	**$458**	**$882**	**$1,040**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$358**	**$732**	**$735**
REPLACEMENT COST CALCULATION			
Feed replacement cost of lost yield	$608	$1,198	$1,163
Extra/less efficient operations	$73	$124	$304
Opportunity cost – lost investment of gross margin	$9	$17	$17
Total Quantifiable Cost (Feed Replacement Value)	**$690**	**$1,339**	**$1,485**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$590**	**$1,189**	**$1,180**

5.3 Economic Impacts of Waterfowl on Dryland Forage for Silage

Table 38 presents summary estimates of the magnitude of economic losses incurred on dryland silage because of waterfowl and the shortfalls that characterize the current compensation program. Based on the cost components indicated, the quantifiable production value shortfall varies from $150/ac for recoverable damage to $495/ac for reseeded acres. The economic shortfall based on the cost of replacing feed consumed by waterfowl ranges from $309/ac for recoverable damage to $902/ac for acres requiring over-seeding.

Table 38: Comparison of Compensation with Economic Impacts from Waterfowl Depredation, Dryland Silage, Delta and Comox Valley

Current Level of Compensation	Severity of Waterfowl Damage		
	Recoverable	Overseeding	Reseeding
	$100/ac	$150/ac	$305/ac
PRODUCTION VALUE CALCULATION			
Cost component	Economic Cost Per Acre		
Production value of lost yield	$198	$518	$503
Extra/less efficient operations	$48	$106	$287
Opportunity cost – lost gross margin and investment	$4	$10	$10
Total Quantifiable Cost (Production Value Estimate)	**$250**	**$634**	**$800**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$150**	**$484**	**$495**
REPLACEMENT COST CALCULATION			
Feed replacement cost of lost yield	$357	$937	$910
Extra/less efficient operations	$48	$106	$287
Opportunity cost – lost investment of gross margin	$4	$10	$10
Total Quantifiable Cost (Feed Replacement Value)	**$409**	**$1,053**	**$1,207**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$309**	**$903**	**$902**

5.4 Economic Impacts of Waterfowl on Dryland Forage for Hay

Table 39 presents summary estimates of the magnitude of economic losses incurred on dryland silage because of waterfowl and the shortfalls that characterize the current compensation program. Based on the cost components indicated, the quantifiable production value shortfall varies from $227/ac for recoverable damage to $485/ac for reseeded acres. The economic shortfall based on the cost of replacing feed consumed by waterfowl ranges from $429/ac for recoverable damage to $870/ac for acres requiring over-seeding.

Table 39: Comparison of Compensation with Economic Impacts from Waterfowl Depredation, Dryland Hay, Delta and Comox Valley

Current Level of Compensation	Severity of Waterfowl Damage		
	Recoverable	Overseeding	Reseeding
	$100/ac	$150/ac	$305/ac
PRODUCTION VALUE CALCULATION			
Cost component	Economic Cost Per Acre		
Production value of lost yield	$249	$491	$477
Extra/less efficient operations	$73	$124	$304
Opportunity cost – lost gross margin and investment	$5	$9	$9
Total Quantifiable Cost (Production Value Estimate)	**$327**	**$624**	**$790**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$227**	**$474**	**$485**
REPLACEMENT COST CALCULATION			
Feed replacement cost of lost yield	$451	$888	$862
Extra/less efficient operations	$73	$124	$304
Opportunity cost – lost investment of gross margin	$5	$9	$9
Total Quantifiable Cost (Feed Replacement Value)	**$529**	**$1,021**	**$1,175**
Economic Gap (Total Quantifiable Costs – Current Level of Compensation)	**$429**	**$871**	**$870**

5.5 Economic Impacts of Waterfowl on Winter Cover Crops and Relay Cropped Ryegrass

Winter cover cropping and relay cropping both have the expectation that benefits will be obtained from 1) luring waterfowl off perennial forage fields, and 2) the harvest, often to partially offset damage to established forage fields. While winter cover cropping usually consists of crops that will not over winter and thus add organic matter to the soil, residual spring harvests are more commonly associated with relay cropping.

The production value of this crop has been estimated at $135/tonne ($486/ac.). The direct cost of producing and harvesting this crop has been estimated at $286 per acre. The direct cost of producing the crop (less harvesting cost) is estimated at $224 per acre.

Currently, farmers are assisted by DFWT in establishing winter cover and relay crops. This benefit is $45/ac.

In the event of use of relay crops by waterfowl, the potential economic shortfall on the relay crop could vary from $0 to $441 based on production value and from $0 to $747/ac, based on feed replacement cost. This shortfall is offset to some extent by the benefit of luring some waterfowl away from perennial forage fields. Although the logic appears solid, there is no research or data that has attempted to value this benefit.

5.6 Potential for Other Economic Impacts

Waterfowl damage causing degradation of land improvements is of particular concern in Delta and the Comox Valley. Trumpeter swans exhibit root feeding behaviour that causes significant depressions in the ground, which are hazards for equipment.

Waterfowl may create depressed areas that pond further, attracting even more waterfowl. Puddling behaviour can lead to sealing of the soil surface layer and compaction creating ineffective subsurface drainage. As Table 40 indicates, these impacts can be expensive to remediate.

Table 40: Other Economic Impacts Related to Waterfowl Depredation of Forage Crops

Factor	Economic Cost Per acre
Restore land leveling	$350-$400
Restore subsurface drainage	$250

6.0 Bridging the Economic Gap

6.1 The Gap

Based on the preceding analysis, Table 41 summarizes the shortfalls of the program in relation to the different economic calculations and current compensation levels. The economic loss calculations of perennial forage damage that are considered relevant for determining compensation levels in the context of a compensation program have been broken out in the following manner:

- **The lost production value (LPV)**, as represented by the field value of the lost perennial forage production.
- **The feed replacement value (FRV),** as represented by the feed replacement value of the forage lost to waterfowl.
- **Lost production value, remediation, and loss opportunity cost, (LPV Plus)** as represented by the field value of the lost production, the cost of extra/less efficient operations to rehabilitate the field, and the value of the lost opportunity to realize the investment value of the foregone gross margin.
- **Feed replacement value, remediation, and loss opportunity cost, (FRV Plus)** as represented by the feed replacement value of the forage lost to waterfowl, the cost of extra/less efficient operations to rehabilitate the field, and the value of the lost opportunity to realize the interest from investment of the foregone gross margin.

Loss values associated with winter cover cropping and lure cropping are not directly related to the perennial forage damage issue, and are likely partially offset by the benefit of attracting waterfowl away from perennial forage fields. As such, treatment of loss issues would appear to be best dealt with under separate arrangement and not as a compensation issue since it is intended that the crop be utilized by waterfowl.

Damage to fixed assets, such as subsurface drainage and land leveling, should be recognized as impacts associated with waterfowl use of perennial forage fields in some cases and unleveled and/or ponded fields can attract waterfowl. However, impacts on field improvements are not yield compensation issues directly and it is suggested that they should be dealt with under initiatives that encourage adoption of mitigation measures.

Based on the LPV Plus calculation, the compensation gap ranges from $150 to $758 per acre, depending on severity of damage experienced. Based on the FRV Plus calculation, the compensation gap ranges from $309 to $1,237 per acre, depending on severity of damage experienced.

Table 41: Summary of Different Components of the Economic Shortfall

Forage Category	Recoverable Damage	Over seeding Required	Re-seeding Required
	Shortfall ($/ac)		
Irrigated Silage			
LPV	198	630	453
LPV Plus	253	754	758
FRV	382	1,113	922
FRV Plus	437	1,237	1,227
Irrigated Hay			
LPV	276	591	414
LPV Plus	358	732	735
FRV	508	1,048	858
FRV Plus	590	1,189	1,180
Dryland Silage			
LPV	98	368	198
LPV Plus	150	484	495
FRV	257	787	605
FRV Plus	309	903	902
Dryland Hay			
LPV	149	341	172
LPV Plus	227	474	485
FRV	351	738	557
FRV Plus	429	871	870

Section 5.0 has also indicated that the economic costs of perennial forage damage from waterfowl exceed current program payouts to offset these damages by a significant amount. The amount is estimated to vary between two values: the LPV Plus and the FRV Plus. An investigation into the feed value of local perennial forage in relation to the value of imported feed would be required to determine actual value.

Table 42: The "Gap" between Economic Costs and Current Compensation Levels for Perennial Forage Losses

Calculation	Forage Category	Recoverable	Over-seeding	Re-seeding
LPV Plus		Compensation Shortfall as a % of Total Economic Cost (Gap)		
	Irrigated silage	71.7%	83.4%	71.3%
	Irrigated hay	78.2%	83.0%	70.7%
	Dryland silage	60.0%	76.3%	61.9%
	Dryland hay	69.4%	76.0%	61.4%
FRV Plus				
	Irrigated silage	81.4%	89.2%	80.1%
	Irrigated hay	85.5%	88.8%	79.5%
	Dryland silage	75.6%	85.8%	74.7%
	Dryland hay	81.1%	85.3%	74.0%

As Table 42 indicates, the gap between estimated economic costs of waterfowl damage and current payouts ranges between 60% and 89%, depending on severity of damage.

The method of valuing the forage is a key determinant in how well the yield compensation mechanism will compensate for losses. In the Lower Mainland, the market for local hay is thin and the market for local protein tested forage is virtually non-existent.

As Table 43 shows, the two methods used to value perennial forage production have implications for the level of compensation at the various damage levels. First, in high crop value and high yield options (e.g., irrigated silage and irrigated hay), crop value may represent 90% of total economic loss (TEL). Second, in low crop value and low yield options, crop value represents about 80% of TEL.

Third, crop value as portion of TEL for re-seeding is the lowest because of the relatively greater number of equipment operations that must be carried out. Crop value in these situations can represent as little as 60% of the total economic loss based on lost production value (LPV) (see row 16, Table 43). Even at feed replacement value, crop value can represent as low as 73% of total economic loss.

Table 43: Lost Crop Value as a Proportion of Estimated Total Economic Loss

Crop Category	**Based on LPV Plus**			**Based on FRV Plus**		
	Recover-able	Over seeded	Re-seeded	Recover-able	Over-seeded	Re-seeded
1. Irrigated Silage						
2. Total Economic Loss (TEL)	$353	$904	$1,063	$537	$1,387	$1,532
3. Lost Crop Value	$298	$780	$758	$482	$1,263	$1,227
4. Lost Crop Value (% of TEL)	84%	86%	71%	90%	91%	80%
5. Irrigated Hay						
6. Total Economic Loss (TEL)	$458	$882	$1,040	$690	$1,339	$1,485
7. Lost Crop Value	$376	$741	$719	$608	$1,198	$1,163
8. Lost Crop Value (% of TEL)	82%	84%	69%	88%	90%	78%
9. Dryland Silage						
10. Total Economic Loss (TEL)	$250	$634	$800	$409	$1,053	$1,207
11. Lost Crop Value	$198	$518	$503	$357	$937	$910
12. Lost Crop Value (% of TEL)	79%	82%	63%	87%	89%	75%
13. Dryland Hay						
14. Total Economic Loss (TEL)	$327	$624	$790	$529	$1,021	$1,175
15. Lost Crop Value	$249	$491	$477	$451	$888	$862
16. Lost Crop Value (% of TEL)	76%	79%	60%	85%	87%	73%

6.2 Waterfowl Damage Compensation Programs in Other Jurisdictions

There are numerous wildlife damage compensation programs in North America, reflecting the fact that large populations of wildlife live in proximity to agriculture. Canadian waterfowl damage compensation schemes are the most comprehensive waterfowl damage compensation programs in the world.

Federal - Provincial Agreements for the purposes of implementing the Agricultural Policy Framework (APF) allow compensation for damage caused by wildlife, including waterfowl, within the Production Insurance (PI) portion of the framework agreement in any province without cost to the producer except for administration fees and without requiring the producers' enrollment in any other government programs.[28] In this way, compensation for wildlife damage to crops is treated in a similar fashion under PI with respect to farmer premium as to "catastrophic benefits" for risks that are considered so infrequent that producers may not purchase the insurance protection if it were offered. Catastrophic losses are defined in the PI section of the framework as a loss frequency less than 93% of occurrence based on an actuarial assessment. Wildlife damage losses within defined tolerances are in this "no premium" category, not because they are considered infrequent, but rather because producers have limited ability to mitigate these losses due to "property rights" since wildlife is "owned" and protected/managed by the Crown (provincial or federal governments).

The Prairie Provinces (Alberta, Saskatchewan and Manitoba) incorporate wildlife compensation into their respective federal-provincial Implementation Agreements. In these provinces, producers who incur wildlife damage to crops or livestock are eligible for pre-defined levels of compensation. Eligible crops and livestock may vary to some degree but the compensation programs in the three provinces follow standard principles and designs are similar.

Compensation is categorized according to the crop situations it is intended to address (may vary by province) including:

- ***unharvested crops*** damaged by waterfowl (primarily ducks, geese and sand hill cranes) ungulates, upland game birds, bears and in some jurisdictions gophers. The damaged crops are either standing or in swaths and the damaged portion of the field must remain unharvested until verified by a qualified loss adjuster
- ***stacked or stored hay*** damaged or eaten by ungulates
- ***livestock*** injured or killed by predators such as wolves, bears, cougars, eagles, etc. The livestock species eligible for compensation may vary among provinces and the compensation level can vary depending on the whether livestock is

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[28] For example, a section on Wildlife Compensation is contained in 19.1.22 of the Canada-Alberta Implementation Agreement. Compensation is provided when: producers are restricted, without permission, from taking direct action against the wildlife as a result of government regulation; there are effective mitigation and prevention measures in place to reduce damage; there are requirements in place with respect to the minimum level of damage that must be incurred before any payment may be made; and payments do not exceed 80% of the value of the loss (restriction for federal cost-sharing).

injured or killed and whether the loss is due to a “confirmed” predator attack or a “probable” predator attack, and

- ***honey bee and leaf cutter bee colonies*** that sustain losses to honey production, brood, beehives and/or equipment.

Ineligible crops usually include:

- grazing land and native pasture
- crops seeded on land not suitable for production
- crops seeded too late to produce a normal yield
- volunteer crop
- swath grazing, or
- crops left exposed to wildlife damage due to management practices.

Wildlife compensation in the Prairie Provinces is administered by the respective provincial Crown Corporations that manage the production insurance (formerly crop insurance) programs. These provincial Corporations work in close cooperation with their provincial counterparts who manage the wildlife resources and provide advice and assistance to producers sustaining wildlife damage. Farmers pay no premium for wildlife damage compensation and do not have to be enrolled in the production (crop) insurance program to be eligible. Governments' cost-share claims on a 60% federal/40% provincial basis for crop losses. In Manitoba and Saskatchewan compensation is equal to 80 percent of the value (yield and grade) of the crop damaged and determined by:

- 80 percent of (the percent of loss ***times*** the estimated yield prior to damage ***times*** the acres damaged ***times*** the commercial value of the crop).

In Alberta, compensation is paid at 100 percent of the value (yield and grade) of the crop damage and the province pays the additional 20% of the claim on their own above what is cost-shared 60 %federal/40% provincial as in Saskatchewan and Manitoba.

The crop value is determined by the high price option for the designated crop grade under the provincial production (crop) insurance program factored for the grade of crop lost at the time of harvest. For example, a compensation payment in Alberta for a 50 percent loss on 10 acres of spring wheat would be determined as in Table 44. In this example, the grade of the harvested crop is Canada Feed which is worth 0.485 of the value of the designated grade of wheat insured under the production (crop) insurance program. The annual price options and their respective grade values are determined on an annual basis.[29]

[29] In Alberta, a “variable price option”, offered under the basic production (crop) insurance program, applies to wildlife damage claims as well. The variable price option, built into each insurance policy, compensates the producer when there is a production loss AND the crop price during the year increases by at least 10 percent from the high price option set in the spring. In these situations, production losses under production (crop) insurance and wildlife compensation are paid at the higher crop market price. No adjustments for declining prices are made to the high price option.

Table 44: Compensation Payment Example for Wildlife Damage on Spring Wheat in Alberta.

Basic Information	Compensation Payment
Yield prior to damage 30 bus/acre Grade of harvested crop Canada Feed Harvested grade factor 0.485 Price of designated wheat grade $4.35	%damage x crop value x acres damaged = 50% x (30 bus/acre x 0.485 x $4.35) x 10 acres = 50% x $63.29 x 10 = **$316.45** Producers in Manitoba and Saskatchewan would receive 80% of this example amount.

Waterfowl (a national resource under the North American Waterfowl Management Plan) and wildlife (generally considered a provincial resource) compensation claims are treated the same way with regards to federal and provincial funding. In Alberta, livestock compensation for a "confirmed predator kill" is paid at 85% of the average commercial market value for an animal of the same type and class as the one killed in the predator attack. Claims for "probable predator kills" are paid at a rate of 50% of the commercial market animal for the animal. A probable kill occurs when there is insufficient evidence to confirm a predator kill but where there is some evidence of predators and a confirmed predator kill has occurred within 90 days and 10 km. of the incident being investigated.

In each province, minimum claim amounts apply and producers are expected to manage their crops and livestock in a way to mitigate losses as practically possible. Repeat claims can be reduced or denied if the producer has not undertaken mitigation strategies recommended by qualified "environment" personnel particularly for losses to stored and stacked hay by ungulates. Producers must file compensation claims within specified time limits and cannot harvest damaged acres or disturb a predator site until a qualified loss adjuster has made a damage assessment. The same appeal processes governing production (crop) insurance claim assessments apply to wildlife damage compensation for producers who are unsatisfied with a claims settlement.

Payments for wildlife damage claims based on individual loss assessment are deducted from any forthcoming production (crop) insurance claims for the same crop to avoid double indemnification.

6.3 A Canada-BC Waterfowl Damages Compensation Program (WDCP)

It is essential that a Canada-BC waterfowl damages compensation program be pursued as a highest priority pillar of the overall compensation strategy. The rationale for pursuing the WDCP includes the following:

- The WDCP program is operating effectively elsewhere.
- Waterfowl damage compensation responsibilities are recognized in the WDCP
- Elements of the program, e.g., 100% compensation for the value of expected yield and no premiums, are particularly germane to the chronic and substantial losses experienced by Delta and Comox Valley forage producers

- Since BC producers compete with producers in other provinces in the production of agricultural commodities, it is clear that the absence of a WDCP places BC producers at an unfair economic disadvantage.
- A WDCP is capable of handing the largest slice of the compensation gap.

The potential contribution of a WDCP based on current federal provincial agreements would comprise 80% of the value of the crop lost. From Table 41, this value would be between lost production value (LPV) and feed replacement value (FRV) and would represent the commercial value of the perennial forage locally. Under wildlife damage compensation initiatives the federal government can pay their share (60%) of 80% of the value of the crop destroyed by wildlife. There are no strict rules for determining the value of the commodity so either a cost of production (COP) or value of commodity approach is possible. The value of the commodity is the preferred option provided the value represents a normal market replacement cost rather than one that represents extreme feed shortage situations. COP formulas that result in figures less than a value of the commodity are readily accepted as “value indicators” for wildlife damage compensation. However, the gross margins of Delta and Comox Valley perennial forage producers suggests that they are extremely efficient producers of forage and that COP represents less than 50% of the production value of the crop.

In the other provinces, government is willing to pay compensation for waterfowl damages in a formalized manner with compensation based on the value of loss. In federal-provincial crop insurance schemes, program developers have used rationalized the 80% compensation level to eliminate small nuisance claims, to reduce the potential for moral hazard, and to lessen the potential for adverse selection.[30] The 20% deductible under crop insurance also acknowledges the principle that farmers have some responsibility to undertake mitigation measures to protect themselves from wildlife impacts. In general, a deductible is intended to ensure the producer feels some hurt from the loss and does things to mitigate the cause of the loss (just as in automobile insurance; deductible and higher premiums for accidents etc.).

The rationale for farmers not having to pay premiums for waterfowl damage compensation coverage and 100% coverage appears to be related to the concept that producers should not incur any financial loss – based on the value of the crop – for wildlife damages.

In some cases, if a crop is designated by wildlife officials as being important for habitat or as a lure crop to keep waterfowl/wildlife from going into other crops, the losses are paid at 100%. That becomes part of an acceptable mitigation strategy and may be acceptable to the federal government if introduced that way.

The potential impact of this compensation mechanism on total economic loss is estimated in Table 45. Compensation has been calculated based on Lost Production Value (LPV) and Feed Replacement Value (FRV) for the various damage levels. The 80% compensation rule covers the highest proportion of total economic losses (TEL) for over

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[30] Adverse selection is the term for attracting the type of program participants that make themselves more susceptible to the perils being insured against.

Table 45: Estimated Proportion of Total Economic Loss that Could be Compensated under a Waterfowl Damage Compensation Program

Crop Category	Based on LPV Plus			Based on FRV Plus		
	Recoverable	Over seeded	Reseeded	Recoverable	Over seeded	Reseeded
1. Irrigated Silage						
2. Total Economic Loss (TEL)	$353	$904	$1,063	$537	$1,387	$1,532
3. Lost Crop Value	$298	$780	$758	$482	$1,263	$1,227
4. WDCP 80% of crop value (% of TEL)	$238 (68%)	$624 (69%)	$606 (57%)	$386 (72%)	$1,010 (73%)	$982 (64%)
5. Irrigated Hay						
6. Total Economic Loss (TEL)	$458	$882	$1,040	$690	$1,339	$1,485
7. Lost Crop Value	$376	$741	$719	$608	$1,198	$1,163
8. WDCP 80% of crop value (% of TEL)	$301 (66%)	$593 (67%)	$575 (55%)	$486 (71%)	$958 (72%)	$930 (63%)
9. Dryland Silage						
10. Total Economic Loss (TEL)	$250	$634	$800	$409	$1,053	$1,207
11. Lost Crop Value	$198	$518	$503	$357	$937	$910
12. WDCP 80% of crop value (% of TEL)	$158 (63%)	$414 (65%)	$402 (50%)	$286 (70%)	$750 (71%)	$728 (60%)
13. Dryland Hay						
14. Total Economic Loss (TEL)	$327	$624	$790	$529	$1,021	$1,175
15. Lost Crop Value	$249	$491	$477	$451	$888	$862
16. WDCP 80% of crop value (% of TEL)	$199 (61%)	$393 (63%)	$382 (48%)	$361 (68%)	$710 (70%)	$690 (59%)

seeded and recoverable damage impacts. This is because a higher portion of the TEL is comprised of field rehabilitation rather than yield loss, per se.

For example, reseeded dryland compensation under an 80% compensation level would recover only 48% to 59% of the TEL (see rows 12 and 16 of Table 45), based on LPV and FRV, respectively.

This observation highlights that the damage costs incurred by perennial forage producers in field rehabilitation and preparation are substantial and should be part of the compensation package offered in these areas. However, the waterfowl compensation programs in other provinces do not address losses beyond yield value and recovery of these costs from a BC compensation program would entail looking beyond the scope of current compensation approaches. Beyond yield, uncompensated extra and inefficient operations have the effect of further eroding the competitive advantage of associated dairy operations and making the operation costs for commercial hay producers unsustainable.

6.4 Provincial Top Up of WDCP

It was noted in Section 6.2 that Alberta tops up its waterfowl damage compensation program coverage by 20% to 100% of crop value (yield and grade), beyond the terms of the federal – provincial agreement. Given the magnitude and chronic nature of damages being sustained by producers in these areas, a similar approach could be considered in BC.

In BC, Table 46 shows that the current contribution from the Forage Compensation Program exceeds 20% of the crop value based on lost production value (LPV) in almost all damage categories and crop categories. Forage Compensation Program expenditures in relation to feed replacement value (FRV) is very close to the 20% proportion for recoverable and reseeding yield loss impacts and somewhat below 20% for overseeding damage impacts.

One strategy in pursuing top-up funds for a WDCP from the province is to articulate the economic impacts perennial forage producers face and the lack of options for avoiding these impacts. The catastrophic nature of waterfowl damage impacts on many individual farms and farming operations may be sufficient rationale for BC to follow Alberta’s example. The costs for this “top-up” to 100% compensation would not exceed what is currently being spent in the existing Forage Compensation Program.

A rationale for making the 100% coverage argument is that there are restrictions on how producers can mitigate the damage. In other words, the waterfowl can’t be controlled by shooting or poisoning but other segments of society are creating habitat and encouraging the increase in waterfowl populations. If the producer is facing chronic damage exceeding 20% of the value of the crop on an annual basis, then there would also appear to be a case for higher compensation. The cumulative impact of losses and has been recognized by some producers in highly impacted areas to have affected the economic livelihood of their operations.

Table 46: Estimated Proportion of Total Economic Loss that Could be Compensated for under a Top – Up of a WDCP or Contribution of the Existing Forage Compensation Program

Crop Category	Based on LPV Plus			Based on FRV Plus		
	Recoverable	Over seeded	Reseeded	Recoverable	Over seeded	Reseeded
1. Irrigated Silage						
2. Total Economic Loss (TEL)	$353	$904	$1,063	$537	$1,387	$1,532
3. Crop Value (CV)	$298	$780	$758	$482	$1,263	$1,227
4. 20% of TEL	$71	$156	$152	$96	$252	$245
5. 20% of Crop Value	$60	$156	$152	$96	$253	$245
6. Current Program Payout (% of TEL)	$100 (28%)	$150 (17%)	$305 (29%)	$100 (19%)	$150 (11%)	$305 (20%)
7. Current Program Payout as % of CV	33.6%	19.2%	40.2%	20.7%	11.9%	24.9%
8. Irrigated Hay						
9. Total Economic Loss (TEL)	$458	$882	$1,040	$690	$1,339	$1,485
10. Crop Value (CV)	$376	$741	$719	$608	$1,198	$1,163
11. 20% of TEL	$92	$176	$208	$138	$268	$297
12. 20% of Crop Value	$75	$148	$144	$122	$240	$233
13. Current Program Payout (% of TEL)	$100 (22%)	$150 (17%)	$305 (29%)	$100 (15%)	$150 (11%)	$305 (21%)
14. Current Program Payout as % of CV	26.6%	20.2%	42.4%	16.4%	12.5%	26.2%
15. Dryland Silage						
16. Total Economic Loss (TEL)	$250	$634	$800	$409	$1,053	$1,207
17. Crop Value (CV)	$198	$518	$503	$357	$937	$910
18. 20% of TEL	$50	$127	$160	$82	$211	$241
19. 20% of Crop Value	$40	$104	$101	$71	$187	$182
20. Current Program Payout (% of TEL)	$100 (40%)	$150 (24%)	$305 (38%)	$100 (24%)	$150 (14%)	$305 (25%)
21. Current Program Payout as % of CV	50.5%	29.0%	60.6%	28.0%	16.0%	33.5%
22. Dryland Hay						
23. Total Economic Loss (TEL)	$327	$624	$790	$529	$1,021	$1,175
24. Crop Value (CV)	$249	$491	$477	$451	$888	$862
25. 20% of TEL	$65	$125	$158	$106	$204	$235
26. 20% of Crop Value	$50	$98	$95	$90	$178	$172
27. Current Program Payout (% of TEL)	$100 (31%)	$150 (24%)	$305 (39%)	$100 (19%)	$150 (15%)	$305 (26%)
28. Current Program Payout as % of CV	40.2%	30.5%	63.9%	22.2%	16.9%	35.4%

6.5 Re-Focused Role for the Existing Forage Compensation Program

The partnership that farmers have developed with various wildlife agencies through the administration of the Forage Compensation Programs should not be lost in a re-juggling of responsibilities under a new federal-provincial waterfowl damages compensation program. Rather, with the evolution of program and funding responsibilities to Risk Management Branch (where yield compensation should really be anyway), there should be opportunity for the program to focus in several key areas:

- Coordinate new and improved mitigation strategies on farmers' fields. This initiative can be envisioned as seeking ways to further reduce the impact of waterfowl on perennial forage fields and has compensation program implications in terms of addressing the potential moral hazard question with respect to farming practices eligibility for the WDCP. In addition, the increased use of hunting as a waterfowl damage mitigation technique should be re-considered. The promotion of lure cropping strategies on non-forage fields has the potential to both increase the feeding areas available to waterfowl and reduce the field-specific severity of wildlife depredation on agricultural lands.
- Work with farmers and wildlife agencies to develop effective and efficient methods of measuring the full yield impact of waterfowl on perennial forage fields. Fields could be segmented to identify damaged versus non-damaged areas and crop enclosures set up to measure the relative intra-and inter- year yield differences. Enclosures could be clipped throughout the season and the forage crop dry matter compared between damaged and non-damaged sites. In addition, satellite technology could be used to measure the growth (biomass) of forage in both damaged and un-damaged areas. If crop enclosure sites could be constructed to ensure that a full satellite-image (5 to 10 square meters) is contained within the enclosure, the clippings could be used to calibrate satellite readings of the "normalized difference vegetative index" (NDVI) to identify crop harvest and waterfowl damaged areas. In future, satellite-imagery might be a means to access the damage caused by waterfowl and make payments to producers. At present, crop enclosure areas in producing fields are the best indicators of expected yields or relative yields in any given year between damaged and non-damaged crops. The enclosure areas need to allow consistent management of the crop (fertilizer application, chemical application, irrigation, etc.) as in open areas to allow a proper measurement of production loss overtime between damage and non-damaged fields.
- Developing a forage supply strategy in the area which would reduce the cost of replacement feed supplies. With a WDCP, it may be reasonable to expect that farmers will more aggressively source forages locally, and look for feedstock rations that are more economical.
- As the other components of the compensation program fall into place, work with wildlife agencies to consider providing incentives to have forage and non-forage farmers adopt mitigation measures that are known to reduce exposure to waterfowl depredation.

6.6 Controlling Moral/Morale Hazard and Adverse Selection within WDCP

WDCP is essentially insurance with no direct premium cost to the producer. Production losses need to be attributed to named wildlife species, trigger a production shortfall that can be identified by a qualified loss adjuster and result in a pre-defined level of compensation relative to the value of the lost production. At the same time, moral hazard, morale hazard and adverse selection situations need to be addressed in a cost effective framework to ensure that compensation paid for by tax payers is only made in appropriate situations.

Moral hazard exists when the insured person deliberately takes action to cause a loss to occur. Morale hazard represents the inclination of an insured person to minimize their care of a crop/livestock once a loss situation has begun. Adverse selection occurs when participants attracted to the insurance program feel they can predict program loss outcomes or that premium rates charged for the insurance program underestimate their own risk exposure. While usually minimal, insurance policies and operating procedures should include provisions and procedures to reduce the occurrence of these negative impacts that, if left unabated, can result in higher losses and increased premium costs to all participants.

Adverse selection is not usually a concern with compensation programs since they are freely available to all producers at no cost. However, continuously reoccurring loss situations can be a concern if the producer is not adopting recommended practices to mitigate the potential for wildlife damage. In most programs, insurance agencies that administer production insurance and WDCP programs work closely with their respective environment departments to provide advice and risk aversion strategies to the producer. If these are not followed, repetitive claims can be either reduced or denied.

Moral/morale hazard is also of limited concern in wildlife compensation situations particularly if the full cost of the loss is not paid for in the compensation program. With severe waterfowl losses by waterfowl in the forage crops under this study, there are significant costs to producers for which there would be no compensation (e.g. inefficient field operations, asset restoration (land leveling), ineffective use of equipment and the time and effort to purchase replacement forage. These additional costs mean that producers who receive compensation are generally not as well off as they are in the absence of compensation and therefore are inclined to mitigate or at least not directly engage in creating production losses by wildlife. Experienced loss adjusters and environment personnel should be used to assess that losses are not due to management practices.

6.7 Engaging the Ministry of Environment (MOE) and Environment Canada in the Initiative

There are no instances of wildlife agencies involved in compensating farmers for lost or damaged crops in other jurisdictions. Other agencies, environment Ministries, DU, etc. maintain it is their role to protect and develop habitat for society and their financial expenditures to do that keep costs in this area down for government. Governments are then considered responsible to compensate farmers for the damage that wildlife cause.

Presumably, the logic here is that society has two minds: 1) wants wildlife and wildlife habitat, and 2) doesn't want farmers to suffer adversely for loses caused by the wildlife.

Even with the various roles suggested above, there is a significant gap that needs to be filled by wildlife agencies. With their knowledge of waterfowl behaviour and habitat requirements, one obvious area where these agencies need to be encouraged to participate is the devising, research, testing, monitoring and implementation of mitigation measures to reduce the potential for waterfowl forage damage.

One point to be made is that potential conversion to non-forage acres in Delta would reduce over-wintering carrying capacity and increase the severity of damage on the remaining perennial forage acres before they too are converted. That is, wildlife agencies need to tackle the challenge they face of having to compete with the economic opportunities presented by other farm crops. If these agencies wish to ensure that perennial forages continue to be planted and harvested on these waterfowl susceptible private lands, they will have to reduce the damage impact to economically sustainable levels for the farming enterprises that produce the crops they prefer. In the Comox Valley, some fields are so damaged that they will soon be converting to alternative crops that will not provide over-wintering areas for waterfowl. Based on the cover crop damage calculations in Section 4.5.3, there is significant opportunity to ensure that farmers do not reduce cover cropping, especially if the mitigation proves to be effective and efficient in alleviating damage to perennial forage fields.

Wildlife agencies are sensitized to the perception that waterfowl carrying capacities in affected areas may be exceeded. There would be a lot of agricultural support of initiatives to answer that question. Alternatively, wildlife agencies should be undertaking strategic planning to determine whether it is more cost-effective to support existing farm managers of natural resources in areas used extensively by waterfowl or to risk losing some of that habitat in the event that the perennial forage producers find the damages to be unsustainable.

6.8 Putting The Pieces Together

It would appear that financial mechanisms to mitigate the waterfowl damages exist in other Canadian provinces or are being used to some degree in BC already. The Prairie Provinces have effective and well-run waterfowl damage compensation programs that recognize the vulnerability of farmers to migratory waterfowl. Alberta has a further top-up to the federal-provincial program that effectively eliminated the deductible and offers coverage to 100% of crop value (yield and quality). Even in Alberta, producers often experience financial losses in excess of compensation paid that can be attributed to inefficiency at harvest, administration costs associated with claims (a per quarter section processing fee to discourage nuisance claims) and the cost of mitigation strategies and/or arranging for replacement feed. Nonetheless producers generally appreciate wildlife populations and often like to see them on the farm provided production losses are not excessive.

Table 47 presents the roll-up of how economic gaps resulting from waterfowl damages on perennial forage crops could be addressed by each of the components. Clearly, a WDCP modeled on the Alberta program would have significant benefits for BC

Table 47: Summary of How Economic Gaps Related to Perennial Forage Production Might Potentially be Filled in BC

Crop Category	Based on LPV Plus			Based on FRV Plus		
	Recoverable	Over seeded	Reseeded	Recoverable	Over seeded	Reseeded
1. Irrigated Silage						
2. Total Economic Loss (TEL)	$353	$904	$1,063	$537	$1,387	$1,532
3. WDCP Program (80%)	$238 (68%)	$624 (69%)	$606 (57%)	$386 (72%)	$1,010 (73%)	$982 (64%)
4. Provincial top-up (20%)	$60 (17%)	$156 (17%)	$152 (14%)	$96 (18%)	$253 (18%)	$245 (16%)
5. Residual gap	15%	14%	29%	10%	9%	20%
6. Irrigated Hay						
7. Total Economic Loss (TEL)	$458	$882	$1,040	$690	$1,339	$1,485
8. WDCP Program (80%)	$301 (66%)	$593 (67%)	$575 (55%)	$486 (71%)	$958 (72%)	$930 (63%)
9. Provincial top-up (20%)	$75 (16%)	$148 (17%)	$144 (14%)	$122 (18%)	$240 (18%)	$233 (16%)
10. Residual gap	18%	16%	31%	11%	10%	21%
11. Dryland Silage						
12. Total Economic Loss (TEL)	$250	$634	$800	$409	$1,053	$1,207
13. WDCP Program (80%)	$158 (63%)	$414 (65%)	$402 (50%)	$286 (70%)	$750 (71%)	$728 (60%)
14. Provincial top-up (20%)	$40 (16%)	$104 (16%)	$101 (13%)	$71 (18%)	$187 (18%)	$182 (15%)
15. Residual gap	21%	19%	37%	12%	11%	25%
16. Dryland Hay						
17. Total Economic Loss (TEL)	$327	$624	$790	$529	$1,021	$1,175
18. WDCP Program (80%)	$199 (61%)	$393 (63%)	$382 (48%)	$361 (68%)	$710 (70%)	$690 (59%)
19. Provincial top-up (20%)	$50 (15%)	$98 (16%)	$95 (12%)	$90 (17%)	$178 (17%)	$172 (15%)
20. Residual gap	24%	21%	40%	15%	13%	26%

producers. Based on either forage valuation, the compensation based on 80% damage coverage could address as little as 48% but as high as 73% of the total economic loss (TEL) estimated in this study.

In addition, the catastrophic nature of waterfowl depredation in over wintering areas would seem to boost the rationale for a provincial top up of the 20% deductible in order to alleviate what appears to be the excessive economic hardship on perennial forage producers in these areas, over which they have no control or effective options to mitigate. This top-up would represent a further 12% to 18% of TEL depending on damage category and forage valuation formula, for total compensation program coverage between 60% and 90% of TEL.

Finally, as the existing program reduces in scope and becomes more oriented toward mitigation strategies, wildlife agencies should be encouraged to continue the momentum generated in these areas. One of the strongest arguments has to be that these agencies should not cause spillover or external impacts from their wildlife management strategies.

7.0 Recommendations

7.1 Implement a Waterfowl Damages Compensation Program (WDCP)

It is recommended that BC and Canada enter into negotiations to establish a BC-Canada Waterfowl Damages Compensation Program (WDCP). It is anticipated that the program should be province-wide and that the programs in the Prairie Provinces should be examined closely to get the BC program up to speed quickly.

Forage producers in other provinces with waterfowl predation issues have waterfowl compensation programs based on the value of crop production standing in the field. Setting up this program requires a 60%-40% federal-provincial commitment and can pay producers up to 80% of adjudicated loss. It is also suggested, in light of the chronic nature of the damage, potentially devastating impacts from year to year, and the inability of perennial forage producers to protect themselves, that the provincial government contribute the additional 20% of insurance coverage toward the program (i.e., the deductible in the program), in recognition of the severe impact of caused by these congregated waterfowl populations.

It is recommended that farmers be required to be cross-compliant by adopting effective mitigation measures in order to qualify for compensation coverage. This action will reduce the potential for wildlife impacts on perennial forage fields to the greatest extent while addressing the concerns of program administrators that producers might be inclined to moral hazard by attempting to use the program to “market” their forage to the program rather than using best available practices to mitigate damage from waterfowl.

Producers should also be required to report management practices to the program, so that administrators can use management to assist in determining expected yields on each field prior to waterfowl damages. One key management input to be monitored would be fertilizer use, another factor is irrigation. Low input management practices would be anticipated to result in lower target yields, hence lower compensation levels from waterfowl damage because expected yields would also be lower.

7.2 Use Existing Yield, Drainage and Irrigation Information

At the startup of the WDCP, it is recommended that area-average forage yields be used to establish initial target yields. These area-average yields consist of BC Forage Council trials, which should be adjusted by an irrigation factor on those fields receiving irrigation. Individual producers should be encouraged to keep farm records of management practices, for the purpose of moving to individual crop coverage in the future. The WCTP would continue to monitor and assess waterfowl damage and this information would be fed into a database for calculating waterfowl damage.

Measures of yield at the farm level could be accomplished by weighing silage wagon loads and bales of hay. Protein adjustments may be considered later but are probably more expensive to monitor than the value of the potential adjustment.

7.3 Consider a Satellite-Based Production Monitoring System

Experience elsewhere in North America suggests that satellite imagery techniques to detect crop conditions may be an effective and efficient method to monitor production losses in the field. Using suitably sized plots, research could begin to assess the ability to measure yields in undamaged and waterfowl damaged areas. In this regard, B.C. could consider a pilot project to combine field enclosure test sites of damaged sand non-damaged forage with satellite-based imagery to determine if relative production values and recovery periods can be recognized.

7.5 Train Qualified Adjusters

Timeliness of crop adjustment is a critical operational factor for a cropping system that produces 5 cuts per season. Qualified loss adjusters are the best in-field method to ensure moral hazard/morale hazard situations are kept in check. Training of qualified loss adjusters should incorporate liaison with environment and wildlife agency personnel to define mitigation procedures for producers to reduce the potential for continuous production losses. Failure by a producer to adopt practical mitigation strategies clearly identified by environment/wildlife agency personnel could reduce or make wildlife claims ineligible in extreme and repeated situations.

7.6 Fill Information Gaps

The preceding sections have indicated areas where better information may be required to implement a more accurate compensation program.

7.6.1 Determine Perennial Forage Target Yields in the Affected Areas

Outside of trials that were completed in the Boundary Bay area in 1980 to 1991, there is no information that has updated Delta’s perennial forage yields. Comox Valley perennial forage trials were last carried out in 1985. Silage and hay yields should be measured in relation to management practices for both dryland and irrigated systems. Field enclosures that monitor the relative production from damaged and non-damaged sites production over time could provide valuable information to refine compensation programs that are established on a current production information baseline. Area-wide production results could be used with an "individualization" of producers' yield expectations over time through enhanced coverage based on documented and beneficial management practices.

7.6.2 Estimate Production Value

The most recent estimates of the cost of producing silage and hay and the value of the product in the field, were made in 1994 by the BC Ministry of Agriculture and Lands. These values may be expected to be higher in 2007. Some means should be developed to reasonably track costs of production overtime and equate these costs to a known value for the commodity either in local or regional hay prices.

7.6.3 Compare Local Perennial Forage with Imported Replacement Feed Costs

Generally, imported alfalfa has superior feed quality characteristics compared to local hay because it is comprised of alfalfa, with higher protein content. Therefore, reduced quantities of imported replacement feed may be required to replace local forage damaged by waterfowl. However, the balance of protein and roughage in feed rations is complex and the trade-offs between the two feed sources are not clear. In the case of commercial hay producers, imported feed cost is not a realistic indicator of local hay value.

7.6.4 Verify Waterfowl Damage Impacts

In the last two years of the program, research has been conducted to measure the impact of waterfowl predation (regarding recoverable damage) on 1st cut yield of perennial forage. The pattern of impacts on subsequent cuts has been described by area producers but needs to be verified. Again, field enclosures in combination with satellite-based imagery may be a useful tool to track the relative productivity in damaged and undamaged fields overtime. Enclosure sites need to be treated like open field situations with respect to management and harvesting timelines that coincide with normal hay harvest. Perennial crop production can be monitored with continuous management of enclosure sites over the course of a three year study to determine the perennial nature of waterfowl production losses.

7.6.5 Develop Protocols to Measure Loss Due to Waterfowl

In any given year, target yields are a function of management, weather and waterfowl. One challenge is to separate out the impacts of each of these variables, so that any compensation program would compensate for waterfowl impacts and not other yield reducing factors. First, producers would need to substantiate their production practices to obtain specific target yields relative to known and documented production enhancing management (this "individualization" of forage yield may have to be factored into the program design overtime). Second, patterns in non-damaged fields within the area (through enclosure clippings, satellite-based imagery and rainfall/temperature monitoring) may provide an indication of expected production results in an area. Third, the explanation of the residual shortfall of realized yield in comparison to the target yield may be useful in corroborating waterfowl impact in combination with in-field loss adjusting.

7.6.6 Develop On–Farm Yield Verification Methodology

Measurement of on-farm yields is vital for determining yield loss. This requires protocols for measuring harvested production in either silage or hay bales as well as assessing in-field production losses in standing crops. Enclosures in combination with satellite-based imagery may be useful in this regard.

7.6.7 Determine Net Effect of Mitigation Measures

Producers are using mitigation measures to scare waterfowl away from perennial forage and to lure waterfowl away from perennial forage. The impacts of these activities need to be evaluated so that reasonable cross-compliance measures can be identified and adopted to minimize the level of overall exposure of program participants.

7.6.8 Identify More Effective Mitigation Measures in Non-Forage Areas

The Comox valley has found that leaving cull potatoes in the field or feeding cull potatoes is effective in rerouting swans to less susceptible areas. There is potential to include vegetable and other annual crops (e.g. corn) producers in the mitigation strategy by enlisting them to establish over-wintering areas for waterfowl.

7.6.9 Identify Cross-Compliance Strategies

Winter cover crops are used extensively by over-wintering waterfowl. There appears to be strong evidence that this use may be diverting some waterfowl away from perennial forage fields. This mitigation measure, and others yet to be identified, may be the basis of compliance measures that forage producers should be required to adopt to reduce exposure to waterfowl impacts.

8.0 Next Steps

8.1 Approach the Province

This document should be used as the starting basis of discussions with the province about developing a federal-provincial Waterfowl Damage Compensation Program (WDCP) for perennial forages in BC. Delta and the Comox Valley could be proposed as initial pilot areas. Within the production insurance framework, the federal government usually allows the province to take the lead in suggesting designs and implementation strategies for crop insurance and wildlife damage compensation. Without a commitment from the province, federal funding for wildlife damage compensation which has been forthcoming to other Provinces, cannot be accessed for B.C producers.

8.2 Start Negotiations with the Federal Government

Provincial crop insurance representatives should be persuaded to sit down with the federal counterpart to review this paper to determine the type of program that could be constructed. This would also start a process to get an indication from the federal counterpart about what they would require as additional information in order to participate in a waterfowl compensation program for forage in BC.

8.3 Approach the BC Agriculture Council (BCAC) to Continue the Forage Loss Mitigation Program

A federal-provincial WDCP would compensate for about 55% of the estimated economic loss related to waterfowl damage of perennial forage and replacement of the lost feed. With a provincial “top up” to 100% of forage value, the percentage of losses covered by a topped up WDCP is in the range of 75%. As such, a key component of more equitable treatment of affected forage producers will continue to be the existing Forage Compensation Program, but perhaps with a re-orientation towards reducing the exposure of perennial forage to waterfowl damages.

As such, all areas that may be eligible for a new provincial waterfowl damages compensation program should be encouraged to access BCAC to pursue or develop new and promising mitigation strategies to make the program as cost-effective as possible.

One area where substantial opportunity exists is in conducting field trials to identify lure crops to increase the feeding area for waterfowl while reducing the severity of impacts on forage fields. As well, there is significant potential to develop mitigation strategies that may create feeding opportunities on non-forage fields in impact areas less expensively than through compensation of forage losses, while creating environmental and agricultural benefits on a larger land base.

A key rationale for continuation of the program may be the prospect of the program not being required to as great an extent in the future. A significant portion of the economic gap is created by the disparity in imported forage prices relative to the production value of local forage. Presumably, with more compensation available and continued need for replacement feed, a market may develop for local forage at more reasonable prices that would decrease the financial obligation of the program in the future.

8.4 Approach Wildlife Agencies and Ministry of Environment with Cost Sharing Initiatives

Wildlife agencies and MOE should be approached to sponsor initiatives more aligned with their mandates, e.g., to investigate waterfowl behaviour, research and test mitigation measures, encourage sustainable practices, and assess the nature of waterfowl damage. With a more prominent role for agricultural agencies in compensating yield loss through WDCP, there may be added incentive for wildlife agencies to add financial support to initiatives to reduce the impact of waterfowl on perennial forage fields.

From a waterfowl perspective, there is little doubt that keeping perennial forage producers in business is preferable to seeing the acres convert to less susceptible crops such as blueberries or vegetables. These crops would provide considerably less over-wintering habitat for migratory waterfowl.

Appendix

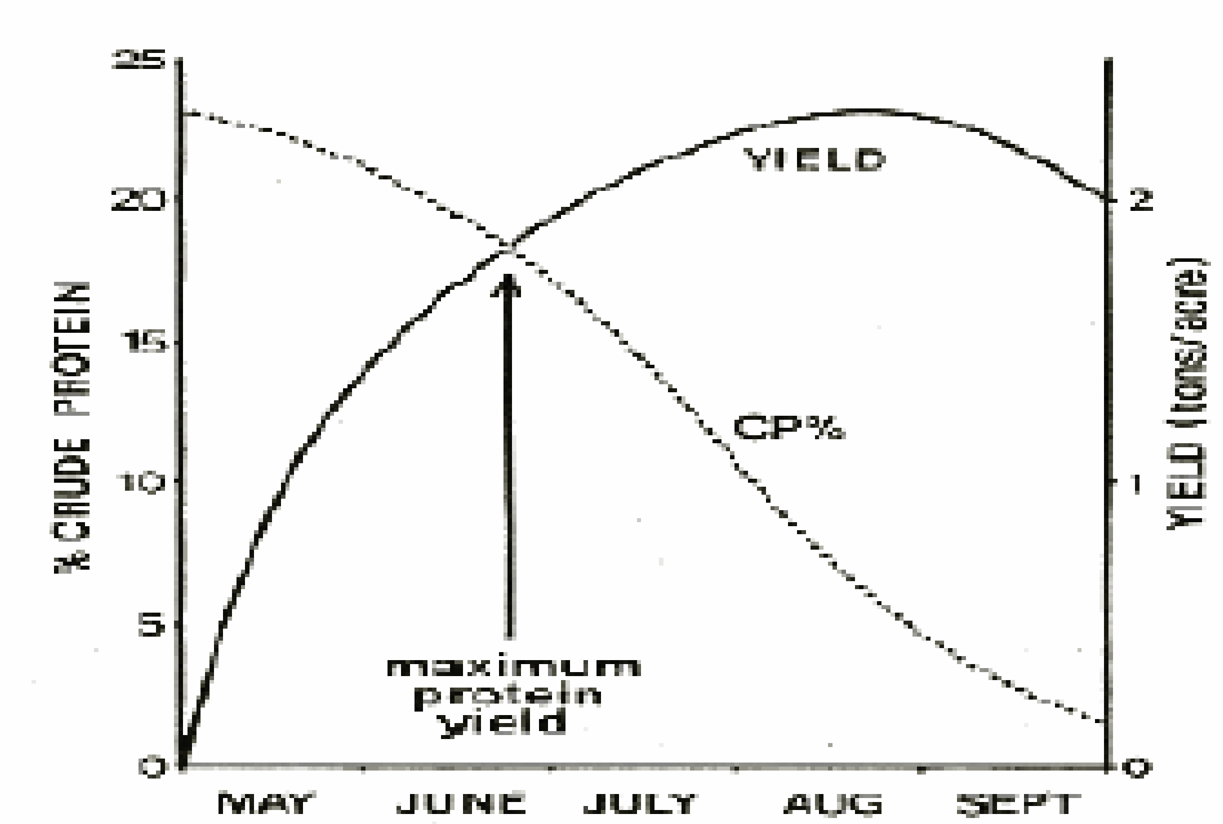
Appendix Table 1: Silage Production Practices on Established Forage Fields under Various Waterfowl Impact Conditions

Farm Practices	Conditions			
	No waterfowl damage	**Recoverable waterfowl damage**	**Overseeding due to waterfowl**	**Reseeding due to waterfowl**
Herbicide application				Roundup
Manure application	4,000 gal/ac	4,000 gal/ac		8,000 gal/ac
Fertilizer application			100 lbs/ac phosphate	300 lbs/ac 19-19-19
Field tillage		Harrow	Harrow Oversee	Plough Till 3x Seed Roll/pack
Cut #1	**100% of established**	**30% of established**	**0% of established**	**0% of established**
Herbicide application			MCPA	MCPA
Fertilizer application	300 lbs/ac 19-19-19	300 lbs/ac 19-19-19		150 lbs/ac 46-0-0
Manure application			2,000 gal/ac	2,000 gal/ac
Cut #2	**100% of established**	**100% of established**	**0% - 30% of established**	**0 % - 50% of established**
Fertilizer application			150 lbs/ac 46-0-0	150 lbs/ac 46-0-0
Manure application	4,000 gal/ac manure	4,000 gal/ac manure		
Cut #3	**100% of established**	**100% of established**	**50% of established**	**50% of established**
Fertilizer application	150 lbs/ac 46-0-0	150 lbs/ac 46-0-0		
Manure application			4,000 gal/ac	4,000 gal/ac
Cut #4	**100% of established**	**100% of established**	**No Cut**	**No Cut**
Fertilizer application	150 lbs/ac 46-0-0			
Manure application		4,000 gal/ac manure		
Cut #5	**100% of established**	**No Cut**	**No Cut**	**No Cut**
Manure application	4,000 gal/ac			

Appendix Table 2: Hay Production Practices on Established Forage Fields under Various Waterfowl Impact Conditions

Farm Practices	Conditions			
	No waterfowl damage	**Recoverable waterfowl damage**	**Overseeding due to waterfowl**	**Reseeding due to waterfowl**
Herbicide application				Roundup
Manure application	4,000 gal/ac	4,000 gal/ac		8,000 gal/ac
Fertilizer application			100 lbs/ac phosphate	300 lbs/ac 19-19-19
Field tillage		Harrow	Harrow Over seed	Plough Till 3x Seed Roll/pack
Cut #1	**100% of established**	**30% of established**	**0% of established**	**0% of established**
Herbicide application			MCPA	MCPA
Fertilizer application	300 lbs/ac 19-19-19	300 lbs/ac 19-19-19		150 lbs/ac 46-0-0
Manure application			2,000 gal/ac	2,000 gal/ac
Cut #2	**100% of established**	**70% of established**	**0% - 30% of established**	**0 % - 50% of established**
Fertilizer application	150 lbs/ac 46-0-0	150 lbs/ac 46-0-0	150 lbs/ac 46-0-0	150 lbs/ac 46-0-0
Manure application	4,000 gal/ac manure	4,000 gal/ac manure		
Cut #3	**100% of established**	**100% of established**	**50% of established**	**50% of established**
Fertilizer application				
Manure application	4,000 gal/ac manure	4,000 gal/ac manure	4,000 gal/ac	4,000 gal/ac

Appendix Figure 1: The Effect of Maturity on Forage Yield and Quality
(Source: BC Ministry of Agriculture and Lands. 1985. Nutrition Guide for BC Sheep Producers.
http://www.agf.gov.bc.ca/sheep/publications/documents/nutrition/smaller_sectiona.pdf)



Estimates of expected or target forage yields have been obtained from field trials conducted over the years on Vancouver Island and in the Lower Mainland of BC. These yields have been summarized in the Tables below.

Appendix Table 3: Ryegrass Yields, BC Forage Council Forage Cultivar Trials, Selected Years 1980 to 2006

				Tonnes per Ha			# Years
	Cut #1	**Cut #2**	**Cut #3**	**Cut #4**	**Cut #5**	**Total**	**of Trials**
Agassiz	3.46	2.87	1.83	1.45	1.19	10.95	5
Sumas	3.99	2.78	2.03	1.78	1.66	11.74	9
Ladner	4.73	3.16	2.64	1.84		12.38	3
Sidney	2.39	2.86	1.59	3.01	1.97	11.81	1
Comox	2.37	3.79	0.91	0.91	1.30	9.28	1
Saanichton	2.30	4.08	0.62	1.53	1.73	10.25	1
Chilliwack	4.10	3.91	1.63	1.45	2.88	11.64	3
Fraser Valley	4.02	2.80	2.45	1.88	0.41	11.56	
Lower Mainland	3.23	3.21	1.71	1.71	1.71	11.56	

				Tonnes per Acre			# Years
	Cut #1	**Cut #2**	**Cut #3**	**Cut #4**	**Cut #5**	**Total**	**of Trials**
Agassiz	1.40	1.16	0.74	0.59	0.48	4.43	5
Sumas	1.61	1.12	0.82	0.72	0.67	4.75	9
Ladner	1.92	1.28	1.07	0.75	0.00	5.01	3
Sidney	0.97	1.16	0.64	1.22	0.80	4.78	1
Comox	0.96	1.54	0.37	0.37	0.53	3.76	1
Saanichton	0.93	1.65	0.25	0.62	0.70	4.15	1
Chilliwack	1.66	1.58	0.66	0.59	1.16	4.71	3
Fraser Valley	1.63	1.14	0.99	0.76	0.17	4.68	
Lower Mainland	1.31	1.30	0.69	0.69	0.69	4.68	
% per Cut	**27.9%**	**27.8%**	**14.8%**	**14.8%**	**14.8%**	**100.0%**	

Appendix Table 4: Orchard Grass Yields, BC Forage Council Forage Cultivar Trials, Selected Years 1980 to 2006

				Tonnes per Ha			# Years
	Cut #1	**Cut #2**	**Cut #3**	**Cut #4**	**Cut #5**	**Total**	**of Trials**
Agassiz	3.78	2.75	2.47	2.12	1.27	12.55	6
Sumas	3.78	3.00	2.76	2.41	1.92	13.05	9
Ladner	4.39	3.23	3.35	1.70		12.67	3
Sidney	3.17	3.01	2.97	3.77	2.22	15.13	1
Comox	4.07	3.02	1.73	1.98	1.49	12.29	1
Saanichton	3.37	3.27	2.29	2.78	1.90	13.60	1
Chilliwack	3.83	3.32	1.67	2.24	0.90	11.96	3
Fraser Valley	3.79	2.81	3.15	1.98	0.40	12.14	
Lower Mainland	3.51	2.69	2.52	2.54	1.90	13.17	

				Tonnes per Acre			# Years
	Cut #1	**Cut #2**	**Cut #3**	**Cut #4**	**Cut #5**	**Total**	**of Trials**
Agassiz	1.53	1.11	1.00	0.86	0.52	5.08	6
Sumas	1.53	1.21	1.12	0.98	0.78	5.28	9
Ladner	1.78	1.31	1.36	0.69	0.00	5.13	3
Sidney	1.28	1.22	1.20	1.53	0.90	6.12	1
Comox	1.65	1.22	0.70	0.80	0.60	4.97	1
Saanichton	1.36	1.32	0.93	1.13	0.77	5.51	1
Chilliwack	1.55	1.34	0.68	0.90	0.37	4.84	3
Fraser Valley	1.54	1.14	1.28	0.80	0.16	4.91	
Lower Mainland	1.42	1.09	1.02	1.03	0.77	5.33	
% per Cut (LM)	**26.6%**	**20.5%**	**19.2%**	**19.3%**	**14.5%**	**100.0%**	

Appendix Table 5: Fescue Yields, BC Forage Council Forage Cultivar Trials, Selected Years 1980 to 2006

				Tonnes per Ha			# Years
	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total	of Trials
Agassiz	4.56	2.40	1.19	1.57	0.53	9.97	2
Sumas	4.68	3.25	1.45	1.70	1.69	11.49	4
Ladner							
Sidney	3.89	3.05	1.58	3.72	2.34	11.28	3
Comox							
Saanichton							
Chilliwack	4.31	3.53	1.62	1.59	2.43	11.25	4
Fraser Valley							
Lower Mainland							
Average	**4.36**	**3.05**	**1.46**	**2.14**	**1.74**	**11.00**	

				Tonnes per Acre			# Years
	Cut #1	Cut #2	Cut #3	Cut #4	Cut #5	Total	of Trials
Agassiz	1.84	0.97	0.48	0.64	0.21	4.04	2
Sumas	1.89	1.31	0.59	0.69	0.68	4.65	4
Ladner							
Sidney	1.57	1.23	0.64	1.50	0.95	4.57	3
Comox							
Saanichton							
Chilliwack	1.74	1.43	0.65	0.64	0.98	4.55	4
Fraser Valley							
Lower Mainland							
Average	**1.76**	**1.24**	**0.59**	**0.87**	**0.71**	**4.45**	
% per Cut	**39.6%**	**27.8%**	**13.3%**	**19.5%**	**15.9%**	**100.0%**	

Appendix Table 6: A Summary of Feed Analyses Performed at the BC Soil and Feed Test Laboratory, 1969 to 1984

(Source: BC Ministry of Agriculture and Lands. 1985. Nutrition Guide for BC Sheep Producers.
http://www.agf.gov.bc.ca/sheep/publications/documents/nutrition/smaller_appendix.pdf)

Feed Type		DM	TDN	CP	Ca	P	K	Mg	Fe	Mn	Zn	Cu	Mo
		NUTRIENT											
		%							ug/g				
Grass Hay	High	94.4	64.4	15.2	0.71	0.34	2.75	0.35	281	211	50	11.4	6.1
	Average	88.4	55.9	10.3	0.47	0.23	1.81	0.20	147	113	26	7.0	3.5
	Low	81.9	47.4	5.4	0.23	0.12	0.87	0.15	13	15	2	2.6	< 1.0
Grass Legume Hay	High	95.0	60.8	16.1	1.43	0.29	2.94	0.39	247	108	41	14.2	5.6
	Average	87.3	54.2	11.8	0.87	0.22	2.06	0.24	133	59	24	8.7	3.1
	Low	79.6	47.7	7.5	0.31	0.15	1.18	0.09	19	9	7	3.2	< 1.0
Alfalfa Hay	High	95.9	64.9	19.4	1.93	0.37	3.21	0.43	446	58	38	15.1	4.3
	Average	88.7	57.0	16.4	1.33	0.27	2.47	0.28	251	35	23	9.7	2.6
	Low	81.5	49.2	13.4	0.73	0.17	1.73	0.13	56	13	9	4.2	< 1.0
Cereal Hay	High	95.2	64.9	14.0	0.57	0.37	3.04	0.33	360	100	40	14.6	4.1
	Average	86.4	60.9	9.3	0.37	0.26	1.95	0.18	194	55	26	7.8	2.4
	Low	77.6	56.9	4.6	0.17	0.17	0.86	0.03	28	10	12	1.0	< 1.0
Barley Grain	High	92.6	84.6	13.2	0.19	0.46	0.63	0.17	19	36	59	17.8	2.3
	Average	88.6	81.4	11.2	0.11	0.38	0.53	0.15	119	22	45	11.0	1.7
	Low	84.5	78.2	9.3	0.03	0.30	0.43	0.13	219	8	32	4.2	< 1.0
Oats Grain	High	90.8	80.6	12.8	0.18	0.40	0.78	0.15	121	70	45	14.6	3.8
	Average	87.7	76.9	10.9	0.10	0.34	0.70	0.13	79	48	37	7.8	2.4
	Low	84.5	73.2	9.0	0.02	0.28	0.62	0.11	38	26	28	1.0	< 1.0
Grass Silage	High	47.5	59.7	16.0	0.82	0.60	3.43	0.42	570	198	55	15.8	4.4
	Average	35.1	53.3	12.6	0.57	0.40	2.47	0.30	352	124	35	9.1	2.6
	Low	22.7	47.0	9.3	0.32	0.20	1.51	0.18	134	50	15	2.4	0.8
Grass Legume Silage	High	46.6	58.1	18.7	1.33	0.34	2.98	0.38	509	122	51	13.9	5.6
	Average	34.4	53.3	15.5	0.93	0.26	2.28	0.25	287	76	31	8.7	3.2
	Low	22.2	48.5	12.2	0.53	0.18	1.58	0.12	65	30	11	3.5	0.7
Corn Silage	High	37.6	71.8	10.8	0.60	0.30	1.63	0.32	360	80	47	11.2	2.4
	Average	29.6	63.9	8.8	0.36	0.24	1.29	0.20	213	47	29	7.0	1.7
	Low	21.6	56.0	6.8	0.12	0.18	0.95	0.08	66	14	11	2.8	1.0
Cereal Silage	High	53.4	77.9	11.6	0.60	0.40	2.38	0.27	498	113	48	13.1	3.9
	Average	38.2	63.4	9.1	0.39	0.28	1.61	0.19	283	66	32	7.1	2.5
	Low	22.9	48.9	6.7	0.18	0.16	0.84	0.11	68	18	16	1.1	1.1

Appendix Table 7: Established Forage Enterprise Budget, Fraser Valley

PLANNING FOR PROFIT

Province of British Columbia
Ministry of Agriculture, Fisheries and Food

Agdex 120 - 810

Grass Forage (Established)
Fraser Valley
Spring 1994

Introduction

The planning process provides producers with the opportunity to look at their operation as a group of distinct enterprises. Alternative enterprises should be evaluated on the basis of **Contribution Margin,** taking into consideration resource constraints, market opportunity, risk and uncertainty.

The **Contribution Margin** must provide funds for interest, overhead and other indirect expenses as well as a return for living expenses, loan repayment and investment. These items should be included in the overall farm plan which will include a **Projected Income Statement** and **Projected Cash Flow Budget**.

Key Factors Affecting Profit

	Target
Quality - Hay	Min 65% T.D.N.
	Min. 18% Crude Protein
- Silage	Min 60% T.D.N.
	Min. 16% Crude Protein

Forage yields are affected primarily by species and variety selection, supply of nutrients and availability of moisture to the crop. Efficient use of nutrients from manure and/or fertilizer will result in optimum yields. Forage quality is affected most by stage of maturity at harvest. Proper handling and storage facilities will maintain good feed quality. Additional costs may be incurred for weed control. To assess the full impact of forage production, a contribution margin analysis should also be carried out for the establishment of the forage crop.

Marketing Alternatives

A limited opportunity exists to market grass silage. The majority of the crop is produced for consumption on the farm. Livestock operations would realize the cash income when forage is transferred to the livestock enterprise. Hay can be marketed locally to individuals with small livestock holdings on limited acreages.

Cash Flow Timing

	J	F	M	A	M	J	J	A	S	O	N	D
%Inc	10	10	10	10	10	10	10	10			10	10
%Exp				15	20	20	20	20	5			

The above information indicates the timing of monthly flow of funds included in the contribution margin only. A complete **Projected Cash Flow** should include indirect expenses, capital sales and purchases, loans and personal expenses.

Rules of Thumb

Machinery Investment	$3,000/acre
Direct Expenses % of Income	30 - 40%

The above indicators are provided for comparison purposes. They are set out as potential targets for grass forage production.

Contact: DON BATES, P.Ag.
Field Crop Specialist
Chilliwack
BOB CHEATLEY, P.Ag.
Farm Management Branch
Abbotsford

Spring 1994

ESTABLISHED GRASS FORAGE
Target Yield - 6 Tons D.M./acre

Contribution Margin 1 Acre of Grass Forage Fraser Valley

Income

	Yield	Price	Unit	Income
Grass Silage (35 - 40% D.M.)	10	$50.00	ton	$500
Grass Hay (85 - 90% D.M.)	2.75	120.00	ton	330
Total Income				**$830**

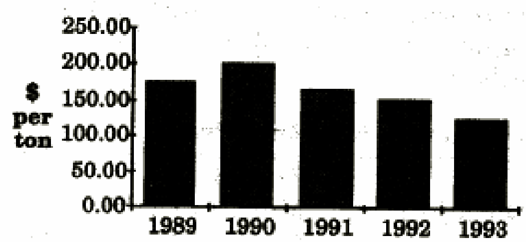
Direct Expenses

	Quantity	Price	Unit	Expense
<u>Fertilizer</u>				
Manure	10	$0.00	ton	$0
Lime	.5	45.00	MT	22
0 - 0 - 60	420	.15	lb.	63
11 - 52 - 0	110	.23	lb.	25
46 - 0 - 0	600	.15	lb.	90
<u>Crop Supplies and Service</u>				
Silage Additive	10	3.50	ton	35
Silo Cover	10	.15	ton	2
Twine	.175	28.74	roll	5
Fuel, Oil & Lube				38
Equipment Repair & Maintenance				30
Total Direct Expenses				**$310**
Contribution Margin				**$520**

Buildings & Machinery Replacement Cost Total Farm Size - 90 Acres

Machinery Shed	$15,000
Bunker Silo	35,000
Hay Storage	15,000
Power Machinery	33,000
Field Machinery	55,500
Harvest Equipment	12,000
Vehicles	<u>104,500</u>
Total	$270,000

Fraser Valley Alfalfa Hay



Contribution Margin - Sensitivity Analysis

The table below lists the changes to contribution margin as yield of hay changes and price received varies.

Price	Hay Yield Tons per Acre			
$/ton	1.75	2.25	2.75	3.25
80.00	330	370	410	450
100.00	365	415	465	515
120.00	400	460	520	580
140.00	435	505	575	645

This information is provided as a guideline only. Target yield indicates above average production. An individual crop plan should be developed by each producer. Planning forms may be obtained from your local office of the B. C. Ministry of Agriculture, Fisheries and Food.

Appendix Table 8: Established Forage Enterprise Budget, Comox Valley

PLANNING FOR PROFIT

Province of British Columbia
Ministry of Agriculture, Fisheries and Food

Dryland Grass Forage
(Established)
Comox Valley
Summer 1994

Agdex 120 - 810

Introduction

The planning process provides producers with the opportunity to look at their operation as a group of distinct enterprises. Alternative enterprises should be evaluated on the basis of **Contribution Margin,** taking into consideration resource constraints, market opportunity, risk and uncertainty.

The **Contribution Margin** must provide funds for interest, overhead and other indirect expenses as well as a return for living expenses, loan repayment and investment. These items should be included in the overall farm plan which will include a **Projected Income Statement** and **Projected Cash Flow Budget.**

Key Factors Affecting Profit

	Target
Quality - Hay	Min 65% T.D.N.
	Min 18% Crude Protein
- Silage	35% Dry Matter
	Min 16% Crude Protein

Forage yields are affected primarily by the supply of nutrients and the availability of moisture to the crop. Efficient use of nutrients from fertilizer and or manure will result in optimum yields without any harmfull effects such as high nitrate levels. Forage quality is affected most by stage of maturity at harvest. Proper handling and storage facilities will maintain good feed quality. Irrigation will enhance yields. To assess the full impact of forage production, a contribution margin analysis should also be carried out for the establishment of the forage crop.

Marketing Alternatives

A limited opportunity exists to market grass silage. The majority of the crop is produced for consumption on the farm. Farm operations would realize income when forage is transferred to a livestock enterprise. Hay can be marketed locally to individuals with small livestock holdings on limited acreages.

Cash Flow Timing

	J	F	M	A	M	J	J	A	S	O	N	D
%Inc	10	10	10	10	10	10	10	10			10	10
%Exp				15	20	20	20	20	5			

The above information indicates the timing of monthly flow of funds included in the contribution margin only. A complete **Projected Cash Flow** should include indirect expenses, capital sales and purchases, loans and personal expenses.

Labour Times

Fertilizing	40 - 45 min./acre
Harvesting	3 - 3 1/2 hours/acre

The above indicators are based on the actual field time with the equipment complement used in this budget, which is assumed to be in top operating condition. Individual operators may vary from this depending on equipment size, land and operator expertise.

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District Agriculturist
Courtenay
ROGER KEAY, P.Ag.
Farm Management Branch
Kamloops
Prepared By: ANDREA GUNNER, P.Ag.

ESTABLISHED GRASS FORAGE
Target Yield - 3.5 Tons D.M./acre

Contribution Margin 1 Acre of Grass Forage Comox Valley

Income

	Yield	Price	Unit	Income
Grass Silage	7.5	$40.00	ton	$300.00
Grass Hay	1.0	140.00	ton	140.00
Total Income				**$440.00**

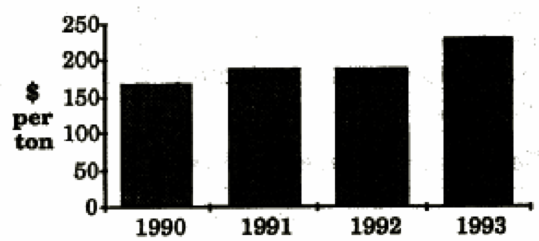
Direct Expenses

	Quantity	Price	Unit	Expense
Fertilizer				
0 - 0 - 60	150	$.15	lb.	$22.50
11 - 52 - 0	130	.23	lb.	29.55
46 - 0 - 0	285	.15	lb.	42.75
Lime	.5	60.00	ton	30.00
Manure	10	0	ton	0.00
Machinery Costs				
Land Preparation				1.65
Fertilizing				6.50
Harvesting				41.70
Trucking				7.35
Crop Supplies and Service				
Silage Additive	7.5	3.50	ton	26.25
Silo Cover	7.5	.15	ton	1.15
Twine	1	2.50	ton	2.50
Total Direct Expenses				**$211.90**
Contribution Margin				**$228.10**

Buildings & Machinery Replacement Cost Total Farm Size - 90 Acres

Buildings	$65,000
Power Machinery	33,000
Field Equipment	58,200
Harvest Equipment	92,300
Vehicles (incl. used dump truck)	58,000
Total	$306,500

Comox Valley Alfalfa Hay



Contribution Margin - Sensitivity Analysis

The table below lists the changes to contribution margin as yield of hay changes and price received varies.

Price $/ton	Hay Yield Tons per Acre .8	.9	1.0	1.1
100.00	169	178	188	198
120.00	185	196	208	220
140.00	201	214	228	242
160.00	217	232	248	264

This information is provided as a guideline only. Target yield indicates above average production. An individual crop plan should be developed by each producer. Planning forms may be obtained from your local office of the B. C. Ministry of Agriculture, Fisheries and Food.