An Approach to Technology Transfer within the Canada-Ontario Green Plan

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Executive Summary

The objectives of this study were:

- to compile a list of all of the projects undertaken as part of one of the components of Green Plan in Ontario, since the conclusion of SWEEP.
- to recommend improvements to the system of technology transfer in Ontario to promote the transfer and adoption of the information generated from these projects.

The titles, principal researchers, objectives and results achieved or expected of 177 individual projects within eleven programs or sub-programs were compiled into lists. These projects covered a wide range of activities including: literature reviews, surveys of farmers' attitudes or farming practices, scientific studies, computer software development and on-farm demonstrations. Within the listings, projects were grouped according one issue that provided the main focus for the project. These areas were patterned after those used within the Environmental Farm Plan Workbook.

In anticipation of recommending changes to the system of technology transfer in Ontario, the Technology Transfer Committee recommended that the development of a revised system of technology transfer for be used as a pilot project. Accordingly, the issues raised by manure management were considered in some detail. Manure management may represent the ultimate challenge in transferring sustainable technology, since it presents the difficulty of designing an **affordable** system for collecting, storing, transporting and applying manure which **minimizes the risk of contamination of air, surface water and groundwater,** at all stages in the system, **without significant agronomic or operational problems**. Current recommendations offer few guidelines in dealing with this complexity to farmers, who seem faced with an impossible set of demands. It is essential that a harmonized set of environmental targets be established for contaminants from manure, along with a process by which farmers can design practical and affordable systems to achieve them.

Within Ontario, the Ontario Agricultural Services Coordinating Committee (OASCC), the eight Research and Services Committee which report to it, exist to provide coordination of agricultural research and the formulation and delivery of recommendations. Since OASCC was formed changes have occurred in Ontario relative to discovery, development and transfer of technology, such that much the information being generated in the province is not reported through OASCC nor integrated into recommendations:

Much research, even at public institutions, is now funded by sources other than OMAFRA or AGRICULTURE AND AGRI-FOOD CANADA, each with its own reporting mechanism.

A substantial amount of research that affects agriculture is done within institutions, farms, businesses or organizations outside the OASCC system.

Technology transfer in Ontario has tended to follow the traditional extension model, in which information is perceived to flow in steps from researchers/developers through a recommending body, to public sector extension personnel or private sector sales representatives and then to farmers. In the past, the level of information available and the

system that delivered it, suited the times and technology was transferred very effectively. However, because technology is being developed or adapted at almost all levels of the system (i.e. researcher, extension, private sector and farm) and at a multitude of sources external to it, information flow is becoming increasingly multi-directional and less coordinated. It is doubtful if the system, as it is currently structured, will be adequate in the future:

In transferring detailed information, Ontario remains highly dependent upon personal contact, the preferred method of learning of many farmers. Farmers, however, have become very diverse in their abilities to obtain, assimilate and apply information, and will be more selective about the format in which they will accept information.

Farms have become so diverse and so specialized, that each farmer's informational needs are almost unique, in respect to both the questions to be answered and the level of detail sought. Some farmers are looking for the specific information they need to implement a technology, while others still require general materials to raise awareness and promote experimentation.

Even to experiment with a new technology can necessitate a large capital investment for a farmer and thus pose a large risk for him or her. Increasingly, farmers will require a package of information complete enough for them to visualize how the entire system can be made to work, profitably, on their farm before they will try it.

The amount of information now available and the level of detail being requested are beginning to seriously tax the system for extending information in Ontario, especially in an era when the number of personnel is being reduced at all levels within the system.

It does not appear feasible to attempt to transfer "packaged" systems, at this time, given the diversity and complexity of most farm operations, but clients should be able to obtain information on all components of the system they are assembling.

The extension system has generally served Ontario agriculture well, and continues to do so despite the limitations noted above. However, these limitations must soon be addressed, since their effects will likely become more significant in the future.

The current system for technology transfer in Ontario does represent a solid base upon which to make improvements. Much of the information required by our clients can be transferred using existing agencies, organizations and communications technology, with appropriate modification and supplementation.

Recommended Goals:

1) Information must presented in ways that will allow potential users to assess the impact of a change in technology on their production system and the environment.

2) An effective alternative to direct contact with experts must be developed to transfer detailed information to clients.

3) The technology transfer system must ensure that the best available information is widely accessible in formats that will facilitate widespread usage.

Recommended Objectives:

1) For each issue area, an individual, or group, should be assigned the task, and held accountable, to ensure that, as information becomes available, it is:
   - assembled at a central location, preferably in both printed and electronic formats.
   - reviewed and integrated with previous information, noting whether they support current recommendations or necessitate change.
   - summarized with previous information.
   - presented, with draft recommendations, to the appropriate OASCC committee for review.
   - available to extension personnel and private sector sales staff, in a readily usable form.

2) To ensure that the summarization of data in this manner will occur, it is likely that funding will have to be provided specifically for this task.

3) Design of projects on related topics should be coordinated to facilitate integration of their results. Collection of a standard dataset should be encouraged, as appropriate.

4) Information from on-farm demonstrations and experiments should be integrated into the reviews outlined above. Use of a standard design for on-farm plots and collection of a standard dataset should be encouraged, especially where the work is conducted with public sector input (e.g. OSCIA and Rural Conservation Clubs).

5) Extension materials should be designed to meet the needs of specific client groups, with regard to the level of detail and format. In such materials, either printed or electronic, the pathway by which a user can obtain more information must be clear.

6) All extension materials related to a particular topic should be available, or accessible, through the same location.

7) Production recommendations and related information should be organized and presented in ways that facilitate use of a systems-approach in considering and applying new technology.
8) Extension material should outline the potential impact of a technology on both other parts of the farm system and the environment or indicate where such information can be obtained. Prerequisites for implementing the technology on a farm should also be identified.

9) Materials should be developed to assist farmers in comparing the costs and benefits of alternate technologies, objectively, relative to both farm and environmental goals. Through such an approach, farmers should be able to arrive at a least-cost, practical system.

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Introduction

Canada's Green Plan lists three objectives vital to achieving sustainable agri-food systems:

- to conserve and enhance the natural resources that agriculture uses and shares.
- to be compatible with other environmental resources that are affected by agriculture.
- to be proactive in protecting the agri-food sector from the environmental impacts caused by other sectors and factors, external to agriculture.

Over the past decade, Green Plan has provided funding for many research, development or demonstrations projects aimed at furthering these goals, and much useful information has been collected. The success of program, however, cannot be measured only in terms of the amount of information produced. The program can be considered successful only if the information and resulting recommendations are disseminated to the agri-food sector, and to the public in general, in ways that result in their application towards attainment of the Green Plan objectives. It was towards this end that the Green Plan Technology Transfer Committee contracted for this project.

Objectives

1) To compile a list of all of the projects undertaken as part of one of the components of Green Plan in Ontario, since the conclusion of SWEEP.

2) To recommend improvements to the system of technology transfer in Ontario to promote the transfer and adoption of the information generated from these projects.

Compilation of Canada-Ontario Green Plan Projects

Before beginning to develop a technology transfer strategy for information generated within Green Plan, it was necessary to assemble a list of the research and demonstrations projects conducted as part of the Canada-Ontario Agriculture Green Plan. (The contacts and sources from which the lists were compiled are shown in Appendix A.) The following programs were included in this compilation:

Program Title	Dates	Abbrev.
Previous Programs:		
Ontario Land Stewardship Program	(1987-1990)	(LS)
Soil Quality Evaluation Program	(1989-1994)	(SQEP)
National Soil Conservation Program	(1989-1993)	(NSCP)
Great Lakes Water Quality Program	(1989-1994)	(GLWQP)
Ontario Land Stewardship II Program	(1990-1993)	(LSII)
Environmental Sustainability Initiative	(1992-)	(ESI)
Land Management Assistance Program	(1992-1994)	(LMAP)
Current Programs:	(1993-1997)	
Rural Conservation Club Program		(RCC)
Manure/nutrient Management and Closed Loop Recycling		(MA)
On-Farm Research		(RF)

Development of Integrated Resource Monitoring Capability (MO)

A total of 177 individual projects within these programs were included in this summary. These projects covered a wide range of activities including: literature reviews, surveys of farmers' attitudes or farming practices, scientific studies, computer software development and on-farm demonstrations. Some of the latter provided only notes on the co-operators' observations, but add to the useful knowledge, nonetheless.

To provide some structure to the listings, categories identifying one main environmental or agronomic issue were established, so that projects could be sorted according to their primary focus (Table 1). These categories were patterned roughly after those used to define the modules of the Environmental Farm Plan (Appendix B), with some modification. Some projects did not fit an EFP module topic and so many projects dealt with certain facets of some modules (e.g. manure application), that it was useful to sub-divide the categories.

Appendix C contains a list of the titles of the projects under each of the above programs, along with the principal researcher or contact, the lead agency for the project and codes by which the project is identified throughout this report.

Appendix D lists the titles of projects within each issue area, the principal researcher or contact, the lead agency for the project and codes by which the project is identified throughout this report. The distribution of projects by issue area in tabular form and the year in which each project is to be completed are illustrated in Table 2. (Many projects will also provide useful information on issues other than those which represent their main focus. The lists should be cross-referenced between issue areas, but this has not been done to date.)

Appendix E contains a brief summary of lists the projects within each issue area, outlining their objectives and results achieved or expected. (Because of time constraints, summaries for projects in SQEP and GLWQP are not yet included. Summary reports of both of these programs have been published and are available through Agriculture and Agri-Food Canada.)

Table 1: Issue areas used to sort Green Plan research and demonstration projects

Code*	Issue Area
1A:	Development of Methodologies to Evaluate Soil Quality
1B:	Soil Erosion Measurement and Prediction
1C:	Development of Methods to Monitor and Map Soil Resources
2A:	Agriculture and Water Quality
2B:	Drinking Water
2C:	Agricultural Chemicals and Water Quality
2D:	Alternate Water Supply for Livestock
16:	Nutrient Management
11:	Treatment of Milkhouse Washwater and other Contaminated Water
17A:	Manure/Nutrient Management - General
17B:	Nitrogen and Carbon Transformations in Manure During Storage and Handling or in Soil
17C:	Effect on Water Quality of Manure Source and the Rate, Method and Time of Application
17D:	Use of Urban Organic Wastes on Farmland
18A:	Horticultural Crops: Soil Management
18B:	Horticultural Crops: Greenhouse Management
19A:	Conservation Cropping Systems - General
19B:	Cropping Systems and Water Quality
19C:	Cropping Systems and Soil Properties
19D:	Conservation Cropping System Demonstrations
20A:	Pest Management: Field Crops
20B:	Pest Management: Horticultural Crops
21:	Wetlands and Streambanks
23:	Woodlots and Wildlife
24:	Other

* Issue code numbers are patterned after those used in the Environmental Farm Plan.

Issue Area Summaries

The following are brief summaries of the types of activities undertaken in the projects included in the various categories.

1A: Development of Methodologies to Evaluate Soil Quality

- evaluate methods to measure spatial and temporal variations in soil biomass;
- assess the suitability of soil organisms and/or soil biological activity as bio-indicators of soil quality;
- assess changes in soil physical quality, and their effect on crop productivity.

1B: Soil Erosion Measurement and Prediction

- evaluate methods to measure or predict the amount and distribution of soil erosion.
- survey soil Cesium-137 contents across the province to provide a baseline against which to compare future estimates of soil loss.

1C: Development of Methodologies to Monitor and Map Soil Resources

- evaluate methods to upgrade resource maps and databases used to define, illustrate or report the quality, extent or sustainability of agricultural resources.
- compare the suitability of methods used to present such information as a basis for decision- or policy-making.
- develop a computerized database with a standardized format for recording and summarizing the results of agricultural resource monitoring projects.

2A: Agriculture and Water Quality

- determine the mechanisms of contaminant movement from agricultural land into surface or ground waters, including macropore flow.
- estimate the potential impacts of agriculture on water quality, on a regional basis.

2B: Drinking Water

- survey the quality of water from farm wells across Ontario.
- develop and demonstrate methods to protect or improve farm wells and the quality of their water.

2C: Agricultural Chemicals and Water Quality

- develop criteria for determining the threat to water quality posed by various classes of pesticides.
- determine the relative importance of the mechanisms by which agricultural chemicals degrade water quality.
- estimate loading of agricultural chemicals into Great Lakes from non-point sources.
- develop biomonitoring systems to assess the impact of agricultural chemicals on stream sediments.
- investigate the atmospheric deposition of agricultural chemicals.

2D: Alternate Water Supply for Livestock

- demonstrations of ways to supply water to livestock, denied access to streams.

Table 2: Issues Addressed by Canada-Ontario Green Plan Projects and Completion Times

Issue Area	Completed Projects	Projects Ending in: 1995	1996	1997	#
Development of Methods to Evaluate Soil Quality	LS 7016; SQEP 4,7,9 ESI - 1; NSCP 1,2	MA 11, MO 01	MO 02	MA 07, MO 03 RCC 73	13
Soil Erosion Measurement	SQEP 6; NSCP 10		MO 08		3
Monitoring and Mapping Soil Resources	SQEP 1,2,3,12 MO 04	MO 05, MO 06 MO 07	MO 09, MO 11		10
Agric. and Water Quality	NSCP 3,4 GLWQP X?,14			MO 10	5
Drinking Water Quality	ESI 2; LMAP 1,2			RCC 56,79	5
Pesticides & Water Qual.	SQEP 10 GLWQP 1,2,3,5,6,7,8,11,13				12
Livestock Water Supply	LSII 32,48,107		RCC 88		4
Waste Water Treatment	LSII 28			RCC 15,33,90, 98,102,104	7
Nutrient Management	LS 7017,7020,7018; NSCP 5 LSII 26,29e,59,89,100 LMAP 15/94; GLWQP 09			RF 05 RCC 115,125	14
Manure: General	MA 01			MA 10	2
Manure: N & C Dynamics	NSCP 6; LSII 74 LMAP 13/94			MA 02, MA 03, MA 04	6
Manure Management and Water Quality	LSII 40,66,99,113 NSCP 7; GLWQP 10			MA 05; RF 02 RCC 29,72	10
Urban Wastes on Farmland	LSII 43; SQEP 11			MA 06 RCC 96,99	5
Hort. Crops: Soil Mgt.	LS 7005,7019,7009 LSII 60,87,102			RF 07 RCC 59	8
Greenhouse Management	LSII 72,91				2
Cropping Systems: General	LS 7008; LSII 71; RCC 45			RCC 78	7
Cropping Systems: Effect on Water Quality	NSCP 8 LMAP 16/94			RF 03, RF 06 MA 08, RCC 17	6
Cropping Systems: Effect on Soil Properties	LS 7002,7006,7007,7015, 7004,7011,7012,7013 NSCP 9,11			RF 04	9
Cropping Systems: Demonstrations	LSII 7,22a,b,29a,d,35,58, 61,65,80,81,105,106,115 RCC 110a,110b,122	RCC 34,97		RCC 09,42,67 68,84	23
Pest Mgt.- Field Crops	LSII 23,63,19c,70 GLWQP 4,12			RCC 8,25,75	7
Pest Mgt.- Hort. Crops		RCC 16		RCC 76,120	3
Wetland Mgt. or Construction	LS 7010; LMAP 6,7,14/94			RCC 14,77,92	7
Woodlots & Shelterbelts	LS 7000,7003,7014			RCC 117	4
Agriculture and Wildlife	LSII 87; LMAP 9,10; MA 09				4
Community Supported Agric.	RCC 48				1
On-farm Research Methods	RF 01				1

For project titles, refer to Appendix C.

16: Nutrient Management

- examine effects of tillage systems and cropping systems on soil nitrogen dynamics, losses and availability (includes conservation tillage, cover crops and crop rotations, especially involving legumes).
- evaluate and demonstrate the soil test from nitrate-nitrogen as a means of establishing nitrogen requirements for various crops (mainly corn).
- on-farm demonstration of fertilizer application methods for conservation tillage.

11: Treatment of Milkhouse Washwater and other Contaminated Water

- on-farm evaluation and demonstration of vegetated filter strips, constructed wetlands or tile beds for treatment of contaminated water.

17A: Manure/Nutrient Management - General

- literature review of the current state of knowledge on manure-nutrient management and its environmental impacts.
- investigate the effectiveness of manures in controlling soil-borne plant pathogens

17B: Nitrogen and Carbon Transformations in Manure During Storage and Handling or in Soil

- examine the transformations of carbon and nitrogen, including losses to the atmosphere or water, which occur during collection, storage, handling, treatment or spreading of manure from various types of livestock and storage systems (including composting).
- examine transformations of carbon and nitrogen occurring after spreading of manure from various types of livestock and storage systems (including composting).

17C: Effect on Water Quality of Manure Source and the Rate, Method and Time of Application

- determine the mechanisms by which nutrients and bacteria from manure, especially liquid, are transported to surface or ground water.
- monitor the impact of manure application on water quality.
- investigate methods of integrating manure application into conservation tillage systems to reduce the risk of contamination of air or water.
- survey the nutrient contents of manures from a range of farm operations and measure actual application rates and spreading patterns.

17D: Use of Urban Organic Wastes on Farmland

- assess the environmental, agronomic and economic impacts of the application of urban organic wastes on farmland.

18A: Horticultural Crops: Soil Management

- develop and demonstrate cover crops, improved crop rotations and conservation tillage systems for horticultural crops.

18B: Horticultural Crops: Greenhouse Management
- identify and promote greenhouse management practices that support environmental sustainability.

19A: Conservation Cropping Systems - General
- survey of costs associated with various cropping systems (E-Plus program).
- survey of farmer attitudes towards soil conservation.
- literature review of Ontario information on no-till (1992).

19B: Cropping Systems and Water Quality
- measure effects of cropping and tillage systems on water quality.

19C: Cropping Systems and Soil Properties
- measure the effects of various cropping systems on soil properties and crop yields.
- determine, and develop ways of overcoming, the factors limiting crop performance in conservation tillage systems on clay soils.
- literature review pertaining to buffer strips.

19D: Conservation Cropping System Demonstrations
(Land Stewardship II and Rural Conservation Club programs.)
- on-farm demonstrations and comparisons of conservation cropping systems (includes tillage, fertilizer application, variety selection, strip-cropping, cover crops).

20A: Pest Management: Field Crops
- development, demonstration or comparison of systems to reduce pesticide use in field crops (includes rootworm monitoring, band spraying, vegetation-detecting sprayers, controlled drainage).

20B: Pest Management: Horticultural Crops
- development, demonstration or comparisons of non-chemical methods of controlling Colorado potato beetle.
- evaluate systems of water and chemical management in turf.

21: Wetlands and Streambanks
- demonstrate wetland restoration and management of adjacent lands.
- develop a computer model to assist in the design and locating of ponds, artificial wetlands and infiltration systems.
- assess methods for monitoring the impact of artificial wetlands on the quality of surface and ground waters.
- evaluate the suitability of several species of trees and shrubs for streambank stabilization.

23: Woodlots and Wildlife
- develop an improved system for designing shelterbelts.

- investigate a variety of aspects of the interactions between trees and crops (e.g. intercropping, riparian strips, shelterbelts, sugarbush management)
- literature review of the impact of wildlife on agriculture, and vice versa, leading to recommendations for improved management of wildlife habitats on farms.
- demonstrate integration of wildlife habitat enhancement in farm plans.

24: Other
- community assisted agriculture
- literature review of methods to conduct and evaluate on-farm research

Manure Management - A Case Study in Complexity

In anticipation of recommending changes to the system of technology transfer in Ontario, the Technology Transfer Committee recommended that the development of a revised system of technology transfer for manure management be used as a pilot project. Accordingly, the issues raised by manure management were considered in some detail. (This report does not contain a full review of the technical and environmental issues related to manure management, because that was the focus of one of the Canada-Ontario Green Plan projects. See MA 01/94, *Literature Search on Manure/Nutrient Management*.)

Manure management may represent the ultimate challenge in transferring sustainable technology, since it represents the difficulty of designing an **affordable** system for collecting, storing, transporting and applying manure which **minimizes the risk of contamination of air, surface water and groundwater,** at all stages in the system, **without significant agronomic or operational problems**.

Figure 1 and Table 3 together illustrate this complexity, although both oversimplify the situation.

Note: The numbers used in brackets throughout this section and to label the parts of Figure 1, refer to the corresponding sections of Table 3.

Figure 1 graphically shows possible pathways of manure movement from its source to the field, and the points and processes at which contaminants (1a & 1b) can be lost into the environment. At virtually every stage, there is the potential for contamination of the air or water or both, with a variety of contaminants.

At each stage depicted in Figure 1, farmers can choose among several options for facilities or equipment (Table 3b). These can be combined in a variety of ways to produce a multitude of possible manure handling systems (although some choices limit the options available at later points in the system).

Gases produced by livestock during digestion (2a) can be expelled directly from the animals or released from the manure after excretion.

Manure produced by livestock (3) can be deposited in confined areas, such as barns or barnyards, in pasture or directly into surface water (2e) if access is not restricted. Rainfall and other water running off such areas will be contaminated with manure or its constituents (2i). Contaminated water should be directed into either a liquid manure storage area or into a separate reservoir or treatment facility for contaminated water (7). Depending on surface material and the soil type, nitrates could leach into the groundwater from yards and surrounding areas (2L).

In some cases, areas where manure is deposited also serve as the storage (6), (e.g. manure packs and liquid storages under slatted floors). Otherwise, manure must be collected and transferred to storage (5) or spread directly on the field. Ammonia, carbon dioxide or methane may be released as the manure decomposes in storage (2b). As with open yards, rainfall or other water running off the storage area will be contaminated with manure or its constituents (2i), and nitrates can leach from improperly designed or constructed storage areas (2L).

When the situation dictates, manure is removed from storage and transported to the field for spreading (8). Farmers must consider a range of soil, crop and farm management factors to determine the time, method and rate of application (4). During application contaminants may enter surface water directly through spills (2f), drift (2g) or misapplication (2h).

After application, gases are released through volatilization of previously produced gases (2c), continued decomposition (2b) or denitrification (2d). Surface water can be contaminated by runoff (2i), soil erosion (2j) or flow through soil macropores to tile drains (2k). Depending on the soil type and management practices, nitrates can leach into the groundwater (2L). (Figure 2 provides a more detailed illustration of nitrogen transformations in soil.)

From virtually every perspective, manure handling is a complex problem. Environmentally, no one system appears to reduce all of potential problems simultaneously.
Consider some examples:

1) Use of a liquid manure system generally reduces the risk of contamination of runoff from the storage (as compared to solid), but increases the likelihood of contamination by macropore flow after application and tends to cause more odours problems.

2) Irrigation reduces the risk of soil compaction, but likely increases loss of ammonia by volatilization, as compared to application by tanker. Injection of manure should reduce ammonia loss and odour problems, but appears to increase the risk of denitrification.

Table 4 lists several Best Management Practices contained in *Livestock and Poultry Waste Management*, their likely effect on contamination of air or water, and other complicating factors, related to manure application. (Each of the options available for storing and handling manure also has its own set of environmental impacts.) All of the practices listed, simultaneously improve some problems and worsen others. By comparison, conservation tillage (e.g. no-till or mulch-till), although also complex to implement, at least tends to lessen most of the environmental problems related to crop and soil management.)

Current recommendations offer farmers few guidelines in dealing with this complexity. **Farmers face a seemingly impossible set of demands, if they are asked to store and apply manure with no environmental impact - with current technology, even the best manure management system adds something undesirable into the environment, at some level.**

Figure 1: Potential Pathways for the Movement of Manure or its Components on Farms

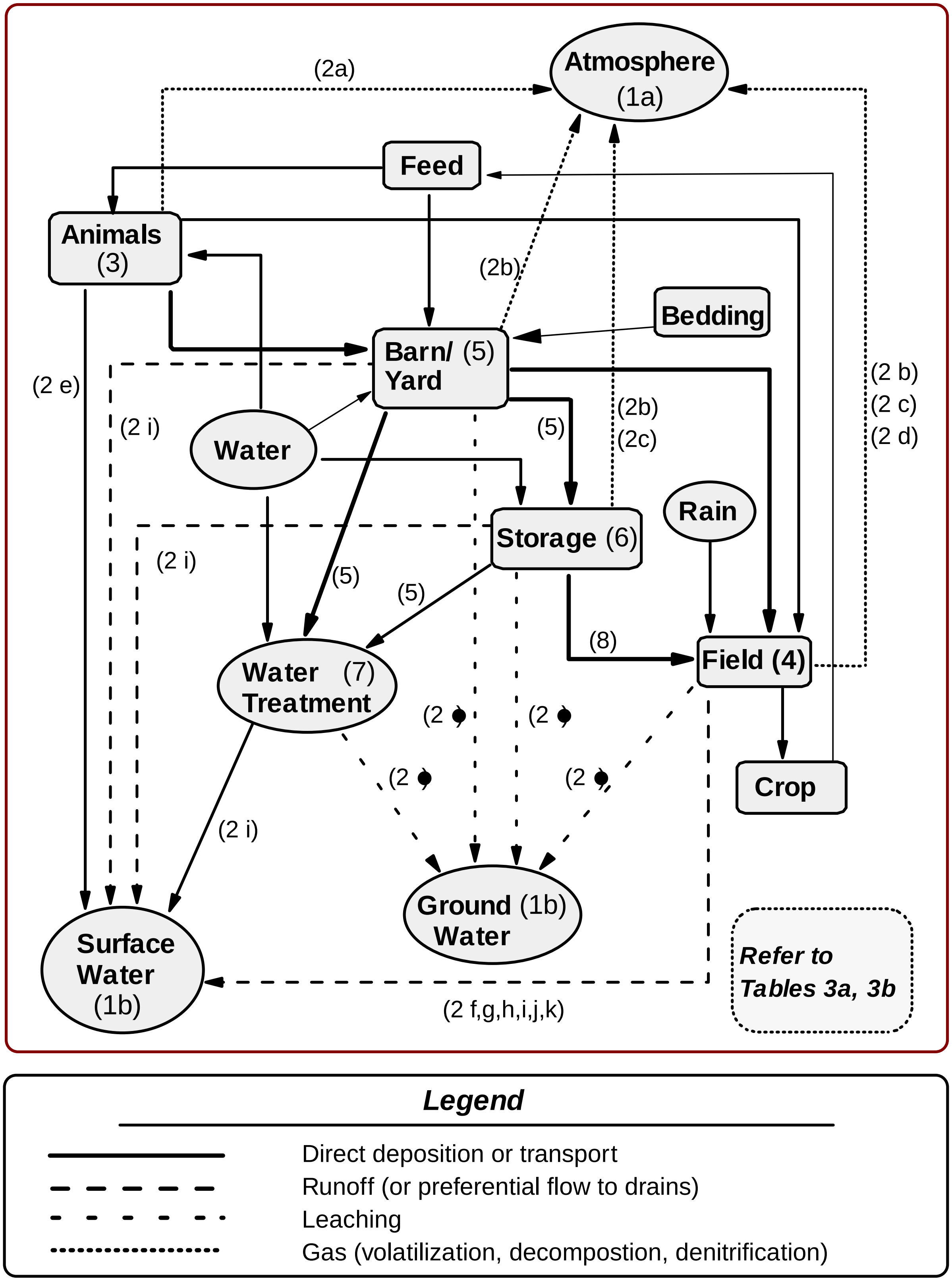


Table 3a: Environmental, Animal and Agronomic Factors Relating to Manure Use

1: Contaminants	2: Contamination Processes	3: Livestock Types	4: Management Factors
a) Air:		Dairy:	
NH_3	Air:	Milking Cows	Cost
CH_4	a) Digestion	Dairy Cows	Climate
CO_2	b) Decomposition	Heifers	Distance to:
NO_x	- Aerobic	Calves	- barn
H_2S	- Anaerobic	Beef:	- neighbours
Odours	c) Volatilization	Cow-calf	- watercourses
	d) Denitrification	Stockers	- wells
b) Water:		Feeders	- watertable
NH_3	Water:	Swine:	Soil:
NO_3	e) Direct	Farrowing	Texture
Bacteria	f) Spills	Finishing	Structure
Solids	g) Drift	Poultry:	Drainage
Phosphorus	h) Misapplication	Layers	Topography
	i) Runoff	Broilers	Fertility
	j) Erosion	Turkeys	Compaction
	k) Macropore Flow	Hatching Eggs	pH
	l) Leaching	Ducks/Geese	Crop rotation
		Sheep	Tillage system
		Goats	Pest Control
		Horses	Convenience
		Fur-bearers	Labour

Table 3b: Options in Handling, Storing and Spreading Livestock Manures

5: Collection and Transfer to Storage	6: Storage	8: Loading, Transport & Spreading Equipment
	Covered or uncovered	
Solid:		Solid or Semi-solid:
Manure pack	Composting	Front-end loader
Manual		Box spreader
Litter carrier	Solid:	Open tank spreader
Scraper	Earth	Dump truck
Gutter cleaner	Concrete	
Stacker		Liquid:
Front-end loader	Liquid:	Pumps
	Concrete	Auger
Liquid:	Steel	Elevator
Cable scraper	Earthen	Vacuum tanker
Water		Pipeline
Slatted floor	Semi-solid: Concrete	Tanker truck
Front-end loader		Spreader tank wagon
Gravity		Injector tank wagon
Pumps	7: Water Treatment	Spreader tank truck
	Liquid Storage	Irrigation
	Tank-trench system	
	Artificial Wetland	
	Vegetative Filters	
	Irrigation	

Figure 2: Transformations of Manure Nitrogen Following Application to Soil

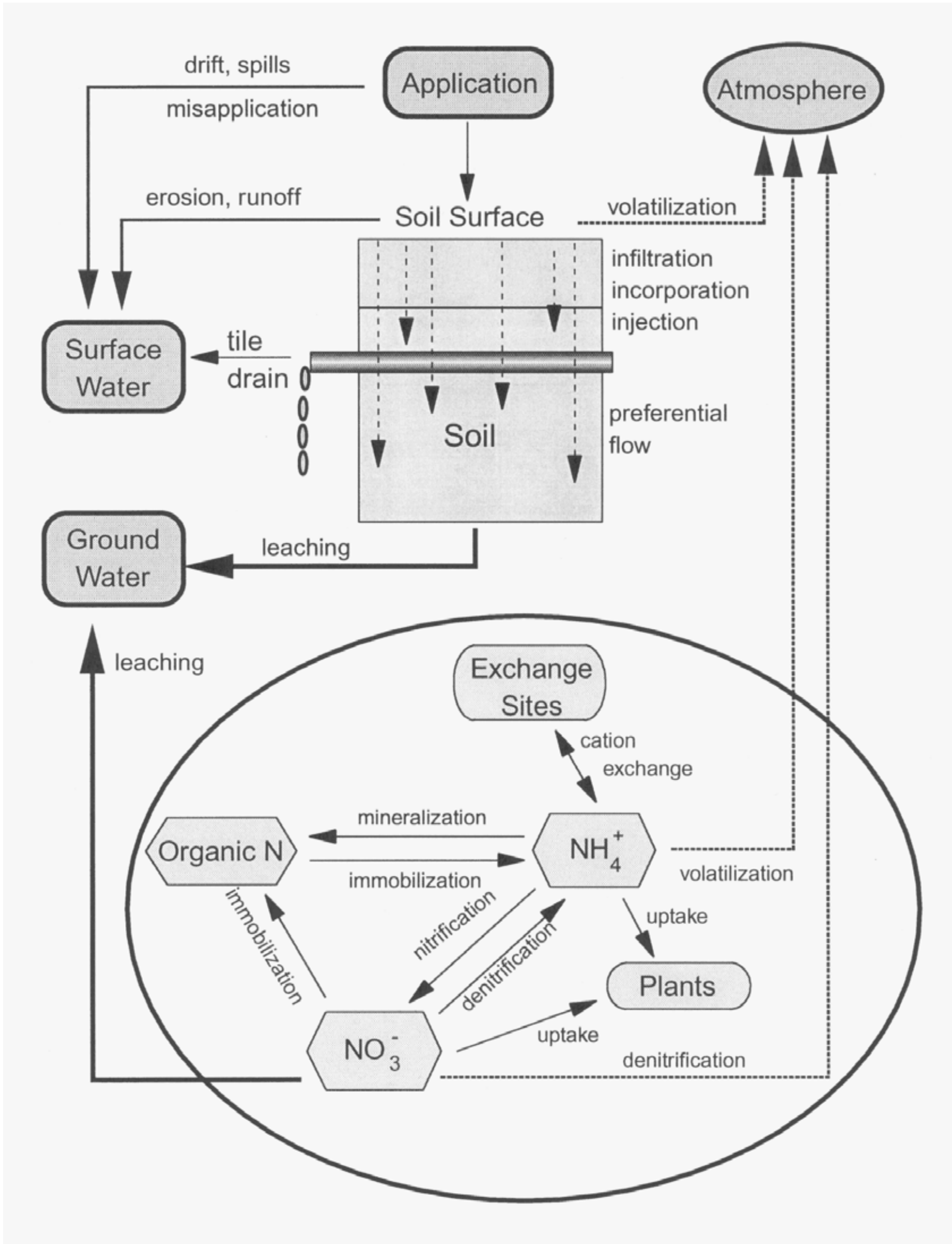


Table 4: Likely Effect of Current BMP's for Manure Application on Environmental Contamination Through Various Processes Other Complicating Factors

Concern BMP	Rnf *	Prf Flw *	Lch *	NH_3 Vol *	DeN *	N Avl *	N Eff *	Cmp	P&K Exs	Complicating Factors
Add bedding	-	-	-? *	- *	+? *	-? *	+? *	-?		Cost & availability. Nutrient content can be more variable. Can affect spreading characteristics. Increased immobilization and denitrification, if high C/N.*
Compost	-	?	- *	? *	?	-? *	? *	-		Cost. Labour. Not suitable for all types of manure.* N in stable compost slow to mineralize.
Supply 75% of N from manure	-	-	-	-	-		+		-	Could require additional land. Determining nitrogen supply in soil.* Determining ability of manure to supply nitrogen.*
Spread evenly	- *	-? *	-		-		+		-	Variable composition, especially from uneven mixing. Limitations of spreading equipment.* Effect of wind on distribution of liquid manure.*
Spread when soil is dry	- *	- *		?			+	-		Weather; wet soil when manure should be spread. Timing conflicts with other field work. Can require increased storage capacity.
Improve drainage	-?	?	+?		-		+	-		Cost. Soil Texture.
Spread on bare, unfrozen soil	-			?			+	+?		Will require increased storage capacity. Adds to work scheduling conflicts.
Match time with crop demand	? *	? *	- *		- *	+? *	+? *	+?		Timing conflicts with other field work. Soil may not be dry enough in early spring. Can require increased storage capacity.
Till soil before applying liquid manure	- *	- *					+? *	+?		Adds to work scheduling conflicts. Might not be compatible with no-till systems.* Could increase risk of recompaction of topsoil.
Incorporate within 24 hours	- *	- *		-			+			Adds to work scheduling conflicts. Not compatible with no-till systems.*
Inject liquid manure	- *	-? *	? *	-	+? *		? *			Cost. Can leave soil very rough.* Possible denitrification in manure band.
Irrigation of liquid manure	? *	? *		+			?	-		Increases odours & losses from ammonia volatilization.* Tendency to overapply.
Mulch Tillage	- *	-? *	? *	? *	?	? *	? *	?		
No Till	+ *	+? *	? *	+? *	+?	? *	? *	? *		Difficult to incorporate manure into soil.* Soil moisture contents tend to be higher.
Use cover crops			- *		-		+? *			Questionable effectiveness.* Timing of nitrogen release may not match crop needs.* Not compatible with some crop rotations. Usefulness reduced in systems using fall tillage.*
In emergencies, spread on hay/ grass in summer	?	?	?	+	?			_		Risk of runoff. High loss of nitrogen from volatilization. Can overstimulate grasses in grass-legume stands.

Title Abbreviations (in order): Runoff; Preferential flow; Leaching; Volatilization; Denitrification; Availability of nitrogen to subsequent crop; Efficiency of nitrogen utilization: Soil compaction; Excessive phosphorus or potassium levels in soil.

(-) reduction expected: (+) increase expected; (?) effect unclear or variable

* Information available or expected from Green Plan projects.

Table 5a: Environmental, Agronomic and Management Aspects of Manure Use on Land, Addressed by Green Plan Projects
(16 projects involve manure directly; 18 other related studies should also provide relevant information)

Management Area Concern	Measurement or Prediction	Nitrate-N Soil Test	Application Methods	Tillage	Cover Crops	Livestock	
						Species	Ration
Surface Runoff Water Quality (related studies)	GLWQP: 10 L MA 05/97 L RF 02/97 L (RF 03/97) (MO 10/97)		GLWQP: 10 L RF 02/97 L	MA 05/97 L RF 02/97 L RCC: 72 L			
Preferential Flow (related studies)	GLWQP: 10 L LSII: 66 L MA 05/97 L RF 02/97 L (NSCP: 3,4) (MO 10/97)		GLWQP: 10 L MA 05/97 L RF 02/97 L (NSCP: 4)	GLWQP:10 L MA 05/97 L RF 02/97 L (RCC: 72) (NSCP: 4)			
Nitrogen & Carbon Transformations	LMAP 13/94 L MA 02/97 B MA 04/97 B		MA 04/97 B		LMAP:13/94 B	MA 2/97 B	MA 2/97 B
Nitrate Leaching: Manure Studies (related studies)	MA 03/97 S MA 05/97 L	NSCP: 7 B RF 02/97 L	MA 03/97 S LMAP:13/94 L MA 05/97 L RF 02/97 L NSCP: 7 B (MA 04/97) B	LSII: 113 B NSCP: 7 B	LSII: 113 B NSCP: 7 B LMAP:13/94 B	MA 2/97 B	MA 2/97 B
Related Nitrogen Mgt. Studies	LS 7020 LS 7017 LSII: 100 GLWQP: 9,12 LMAP 15/94	LS: 7020 LSII: 26,29e LSII: 100 RF 05/97	GLWQP: 9	GLWQP:9,11 NSCP: 5 LMAP 15/94	GLWQP: 9 LS: 7017 LSII:59, 29d LSII: 100 LMAP 15/94 RF 06/97 RCC: 115		
Nutrient Content and/or Crop Response		LSII: 40 B NSCP: 7 B	NSCP: 6 S RCC: 29 S MA 03/97 S MA 05/97 L RF 02/97 L RCC: 72 L LSII: 40 B LSII: 99 B NSCP: 7 B MA 04/97 B	LSII: 113 B MA 05/97 L RF 02/97 L	LSII: 113 B LMAP:13/94 L NSCP: 7 B	LSII:113B LSII: 40B MA 3/97 S RF 2/97 L MA 4/97 B	MA 4/97 B
Plant Pathology	MA 10/97 B					MA10/97B	
Costs			MA 03/97 S RCC: 72 L GLWQP: 10 L MA 02/97 B				

None of these projects directly considers the effects of manure application on other soil properties. Results of several projects under "Development of Methodologies to Evaluate Soil Quality should be useful in this regard.

The literature review, "Current State of the Art on Manure/Nutrient Management" (MA 01/94), contains information relating to most of these concerns and lists gaps in the current information.

S: Solid Manure L: Liquid Manure B: Both Liquid and Solid

Table 5b: Projects Related to Manure Storage, Handling and Application

A: Treatment of Contaminated Water Through:

Vegetative Filters:	RCC 124 (milkhouse); RCC 102 (runoff)
Treatment Beds:	LSII 28 (milkhouse)
Constructed Wetlands:	RCC 15 (milkhouse); RCC 98 (runoff); RCC 90 (both)
Irrigation:	RCC 33 (lagoon effluent)

B: Carbon and Nitrogen Transformations

MA 02/97	effect of livestock species, ration, storage facilities, bedding & handling method on changes in manure nutrient content, notably carbon and nitrogen

C: Composting

NSCP 6 MA 03/97	comparison of methods, including costs, carbon and nitrogen transformations, and utilization
LSII 74	on-farm demonstration of passively aerated composting

D: On-farm Surveys of Manure Nutrient Contents and Application Rates

LSII 40
LSII 99

S))

Several projects currently underway, within Green Plan and elsewhere, will provide data regarding contamination of the environment from various manure handling systems, or components thereof and the effects of various management practices (Table 5a & 5b). **Currently, there is no method to compare the relative severity of the environmental impact of the various contaminants.** For example, is it worse to irrigate manure and increase the amount of ammonia released into the atmosphere or to inject it and increase the release of NO_x through denitrification?

It is equally difficult, if not impossible, to weigh the environmental cost against the farmers' costs. For example, although it is possible to almost eliminate this risk of water contamination from barnyards and manure storages, the capital costs of doing so appear prohibitive to many farmers. For some contaminants, it is probably impossible to do a cost/benefit comparison (e.g. greenhouse gases), since we cannot fully predict the environmental cost.

It is essential that a harmonized set of environmental targets be established for contaminants from manure, along with a process by which farmers can design practical and affordable systems to achieve them. To review the current recommendations and information regarding manure management, a farmer, or his advisor, may need to consult:

The Agricultural Code of Practice,
The Canada Animal Waste Management Guide,
The Agricultural Pollution Control Manual,
Ontario Field Crop Recommendations,

several of the Best Management Practices booklets,
a number of the 28 OMAFRA Factsheets that relate directly to manure and
several other OMAFRA publications related to nutrient management.

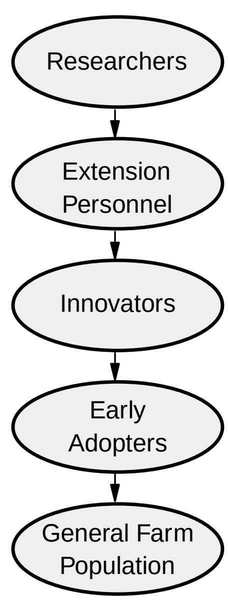
None of these sources address the complete manure management system. Faced with a set of apparently conflicting or contradictory demands and no clear way to resolve them, it is easy for farmers to ignore them all and continue to use the system they find most convenient and/or economical. Farmers generally accept that they should minimize the impact of their activities on the environment. However, with no comprehensive aid to assist farmers in integrating all of the factors into an optimum total system, how are they to chose among the available options?

A Review of Technology Transfer in Ontario
(The following analysis and comments was influenced considerably by SWEEP Report # 7 *Sources of Motivation in the Adoption of Conservation Tillage*. Otherwise, they are based upon my personal experiences, observations and perceptions, not the result of any particular research, unless specified.)

In the traditional model of technology transfer, sometimes referred to as the "Adoption-Diffusion Model", information is perceived to flow in steps from researchers/developers through a recommending body, to public sector extension personnel or private sector sales representatives and then to farmers (Figure 3). At the farm level, new technology is seen to be applied first by "innovators", followed closely by "early adopters" and then to spread gradually throughout most of the farm population. (Almost no technology will be universally employed).

S))

Figure 3: The Traditional Approach to Technology Transfer



This model was developed in an era when information probably did flow mainly in this linear fashion (e.g.

1950 - 1970). The level of information, and the system that delivered it, suited the times and technology was transferred very effectively. Ontario agriculture changed gradually, but dramatically, over the course of 20 years or so.

Many factors combined to make the new technology relatively easy to "sell".

Information was limited and few management options were available. Extension personnel delivered a standard, relatively simple package of management recommendations, on a wide range of topics, to a fairly homogeneous farm population (i.e. mainly small, mixed, family farms), through a limited number of a media (primarily print, meetings and personal contact).

Recommended changes were relatively simple to implement, tended to deal with components of the production system individually, and were adaptable to a large proportion of the farms. Once a new practice was demonstrated by innovators, it could be readily adopted by many neighbouring farmers. There was little need to target information to specific clients (except among commodity groups) because most farmers used a similar set of technologies and thus, would obtain similar results from a change. Most changes had the combined benefits of improving production and reducing the amount of physical work required, without making management of the farm system much more difficult. For the most part, the new technologies could be tried with existing equipment without disrupting the whole farming system. (For example, one could try 2,4-D on their grain or 10-10-10 on corn without worrying about what crop would be grown next.)

Farmers looked to extension personnel for advice, because they had the best information available. Furthermore, because other channels of communications were not as developed as they are today, farmers had almost no other source from which to obtain new information.

The OASCC System

Within Ontario, an elaborate system of committees and sub-committees has been established to coordinate agricultural research and the formulation and delivery of recommendations. In theory, this coordination is provided by the Ontario Agricultural Services Coordinating Committee (OASCC), the eight Research and Services Committee which report to it and their sub-committees. (See Appendix F.) In many cases, review of research results and other information, and the drafting of recommendations is done by sub-committees of these sub-committees.

It is doubtful if any of the premises that appear to underlie the OASCC system are completely valid today.

It would appear that the OASCC system presumes that:

1) *agricultural research in Ontario is funded primarily by OMAFRA and AGRICULTURE AND AGRI-FOOD CANADA.* Thus, most of the decisions as to which research projects should be undertaken and the appropriate level at which to fund them can be channelled through the OASCC system.

i) In fact, a large proportion of research in Ontario, even at public institutions, is funded by sources other than OMAFRA or AGRICULTURE AND AGRI-FOOD CANADA. Much funding comes from other ministries and the private sector, including both agri-business and farm groups. Usually, such funding is targeted to addressing specific topic or policy questions, which are not necessarily those identified as priority areas within OASCC. Because each of these sources of funding has its reporting mechanism, results of these projects often are not reported through OASCC and thus, may not be integrated into recommendations.

2) *agricultural research is conducted primarily by scientists at research facilities operated by AGRICULTURE AND AGRI-FOOD CANADA, OMAFRA or The University of Guelph.*

i) Much research is conducted by the private sector and thus is not directly available to OASCC committees, especially that dealing with products covered by proprietary rights.
ii) A substantial amount of research that affects agriculture, at least indirectly, is done within other government ministries or agencies and other universities. Little of this information is fed through OASCC.

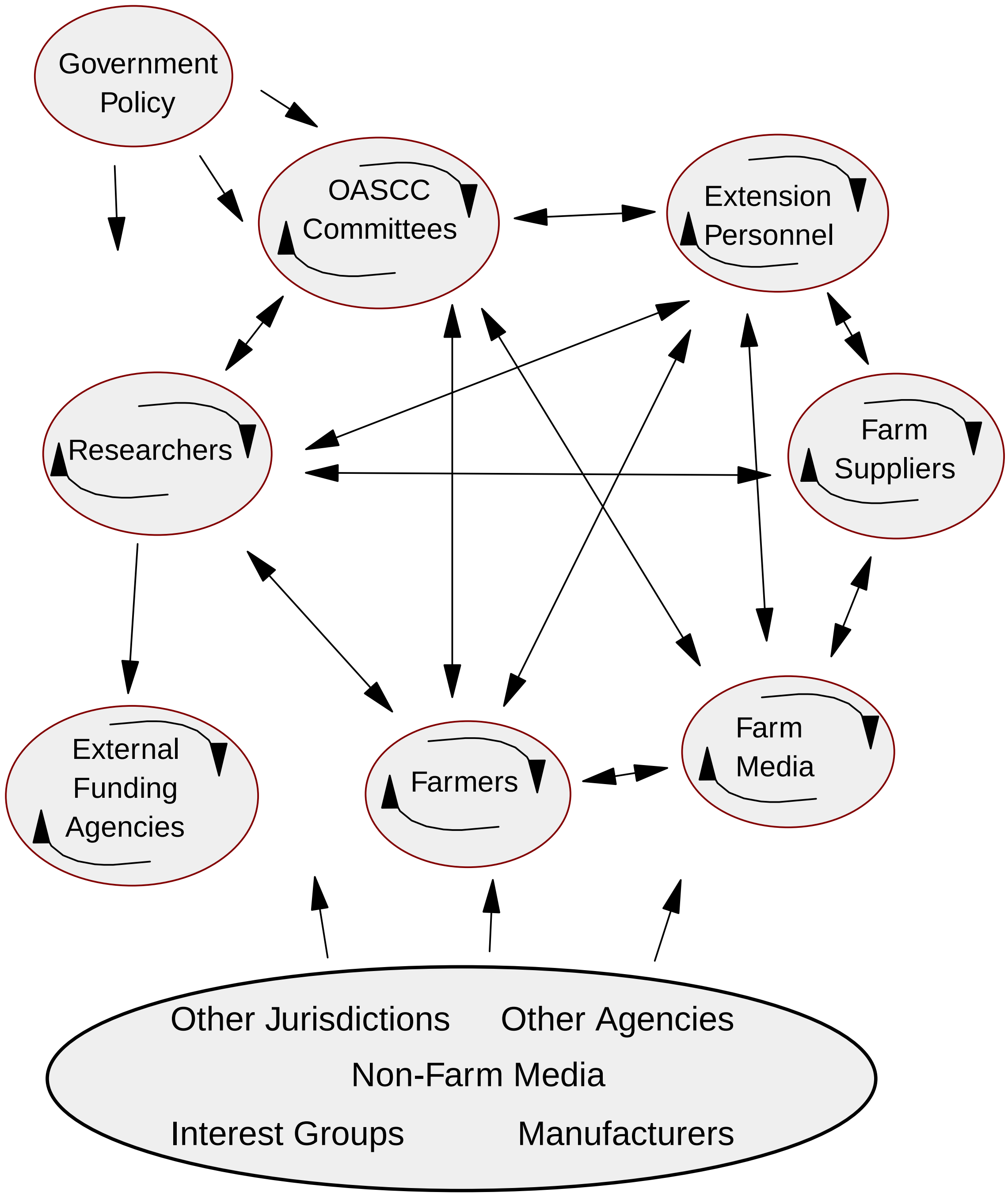
iii) Much technology development, if not invention, occurs on the farm. Often, this work addresses questions at the leading edge of environmental issues. Unfortunately, such work usually comes to the attention of OASCC committees, if at all, only as the result of questions being addressed to researchers or extension personnel by the innovators involved. Although, design of many of these experiments makes it difficult to integrate the results into the OASCC system, the information generated can be very relevant and useful. Indeed, some innovators must be recognized as our best experts on certain technologies.

3) *that research results and subsequent recommendations flow outward from OASCC committees towards farmers, more or less, according to the traditional Adoption-Diffusion model discussed above.*

i) This is progressively becoming less true, as the number of other sources of information and other communications avenues continue to increase. Because technology is being developed or adapted at almost all levels of the OASCC system (i.e. researcher, extension, private sector and farm) and at a multitude of sources external to it, information flow is increasingly multi-directional (Figure 4). Indeed, technology developed on farms would seem to flow "backwards" (ie. from farmers to researchers), if one were to attempt to apply the traditional extension model.

ii) Much information either bypasses the OASCC system or is essentially "lost", in part because of the reasons outlined above, but more particularly because no one has the assigned responsibility to collect and summarize it. Formerly, much of this was done by extension coordinators at OAC or by OMAFRA Specialists. Now, the former positions no longer exist and the latter increasingly have less time to do so.

Figure 4: Current Patterns of Information Flow



iii) Agri-business is both a significant source of information and an essential vehicle for distributing information, much of which reaches the farm without independent review. Unfortunately, technology that does not lend itself to commercialization tends to be under-extended.

iv) The farm press, including magazines and newsletters from farm associations, have become a key source of information for most farmers While the mass media are excellent for creating awareness, they are not a suitable vehicle for the level of detail required to implement technology at specific farms.

Preferred Information Sources Among Farmers

In transferring detailed information, our system remains highly dependent upon personal contact, which is the preferred method of learning of many farmers.

In Ontario, the extension system has relied heavily on printed resources and personal contact. Generally, the former have been quite effective in raising awareness about issues and the availability of new information. Because of the diversity among farms, printed resources tend to be less effective for providing detailed, farm-specific information about how to implement a new technology, especially if it is complex.

The reliance upon personal contact to transfer detailed information was confirmed by the recent Decima survey regarding Best Management Practices (as well as by SWEEP Report # 8 *Social Structure and the Choice of Cropping Technology* and the Green Plan Phase 1 Evaluation *Benchmark Survey Report*).

In the Decima Survey, farmers were asked to name the best two media sources for receiving information about: a) trying a new technique or b) implementing a new technique. They rated the following most highly:

	Try	Implement
Visiting Successful Farm Operators	42%	34%
Communications with Experts	32%	34%
Demonstration Tours	30%	27%

Only 20% of the farmers surveyed rated either seminars/workshops or Factsheets as the one of the two best media for transferring detailed information. Magazines were the most popular means of obtaining general information about a topic, but their perceived usefulness declined as the level of detailed required increased. Videos and government publications each were highly rated by only 10-15% of the respondents, depending on the question.

Challenges Faced by the Current Extension System

The extension system has generally served Ontario agriculture well, and continues to do so despite the limitations noted above. However, these limitations must soon be addressed, since their effects will likely become more significant in the future.

Farmers will continue to request more specific and more detailed information.
Ontario's farms are much more diverse today than in the past, in aspects such as:

- enterprise mix.
- production system.
- tenancy.
- intensity of operation.
- business structure.
- technology available
- scale of operation

Farms have become so diverse and so specialized, that each farmer's informational needs are almost unique, in respect to both the questions to be answered and the level of detail sought. Few areas remain for which "blanket" recommendations can provide sufficient information to allow a farmer to implement the practice on his or her farm. In many cases, even "farm level" recommendations are not specific enough. Farmers increasingly need information that will help them in varying their management "field-by-field", at the least. As technology for variable rate application develops, the area which can be managed uniquely will become ever smaller.

Farmers will be more selective about the format in which they will accept information.
Farmers have become very diverse in their abilities to obtain, assimilate and apply information. They vary widely in:

- experience.
- education (both in terms of area of emphasis and level attained).
- literacy (and first language).
- management style and emphasis.
- off-farm work or responsibilities
- information sources accessible (local, national and international).
- preferred methods of obtaining information.
- communications vehicles available.
- mobility.

For any given technology, farmers at all stages of adoption will require information appropriate for their level of interest, at any given time.
With the introduction of new technology, potential users of it go through a continuum of stages that can be described as:

awareness.
consideration.
decision.
experimentation.
adaptation.
commitment.

Thus, while some farmers will be looking for the specific information they need to implement a technology, others will still require general materials to raise awareness and promote experimentation.

Increasingly, farmers will require a package of information complete enough for them to visualize how the entire system can be made to work, profitably, on their farm before they will try it.
In the past, recommended changes tended to deal with one component of a system at a time, with minor impact on other operational aspects, and required little investment for experimentation. Today, many of the changes being recommended necessitate simultaneous changes in many facets of the farming system. This seems especially true for technologies related to environmental protection. Rather than making the production system simpler, they tend to make at least the management of it more complex. For example, adopting a new tillage system can prompt changes in planting equipment, crop rotation, fertilizer application, pest control (especially, weeds) and manure application, at least. Even to experiment with a new technology can necessitate a large capital investment for a farmer and thus pose a large risk for him or her.

The amount of information now available and the level of detail being requested are beginning to seriously tax the system for extending information in Ontario. Farmers increasingly are facing problems requiring "expert" knowledge, over a more diverse range of topics, and are looking to contact an expert directly to assist them in answering these questions. Unfortunately, one-to-one service is a very costly means of technology transfer and is becoming progressively less available. With consolidation and down-sizing in both the public and private sectors, fewer researchers, extension personnel and sales staff are available to deliver personal service. In many regions, there is not enough extension or sales staff to provide assistance in all enterprises and on all technologies. One wonders how much longer it will be before farmers become dissatisfied with the current system. There is some evidence to suggest that is beginning to happen. For example, it is not unusual for those requiring detailed information to by-pass local extension staff and contact researchers directly or to seek information from another jurisdiction.

Despite the benefits, there are several risks associated with increased direct contact between innovators and researchers.

> *Researchers could develop a skewed perspective of the level of knowledge and management ability of farmers and the appropriate level of technology to advance to the broader farm population.* The "gap" between the production systems used on the farms of innovators and those employed most commonly by other farmers appears to be widening. One wonders if the technology being developed or tested by some innovators is so different from that of the "average" farmer as to appear to the latter to not be applicable to their operations.
>
> *If the "experts" over-emphasize their contact with innovators at the expense of that with extension personnel, the latter could well become even further "behind".* It can be easy to conclude, erroneously, that because some farmers are aware of a new technology, all farmers are aware of it, and devote less effort to the preparation of project summaries and extension materials (new or revised). (Preparing reports or releases is not a highly favoured activity among either researchers or extension personnel, so it is easy to forego.) Extension and sales staff still play a key role in extending information to the broader farm population, and therefore, need to be kept up-to-date, with information that is summarized

and presented in an easily accessible format. Otherwise, the need for each extension person, and perhaps, farmer to contact an expert directly to obtain detailed information will increase, putting further stress on the system. Needless to say, this would result in a very costly and inefficient extension system.

Those who become identified as "the expert" run the risk of being kept so busy responding to requests for individual service as to limit their ability to maintain their expertise. This is of a vicious circle - as the demands for personal service increase, researchers have even less time to write and extension personnel have less time to seek out the latest information or to prepare extension releases. As a consequence, the quality of the information available locally is more like to vary among regions depending upon the interest, skills and access of the local representatives in acquiring it.

Revitalizing the System

Despite its limitations, the current system for technology transfer in Ontario does represent a solid base upon which to make improvements. Much of the information required by our clients can be transferred using existing agencies, organizations and communications technology, with appropriate modification and supplementation. Even where the decision is made to develop new channels of communications, dissemination of much-needed information must proceed in the best way possible using the current framework in the meantime. In anticipation of the changes in communications technology that are occurring, however, extension materials should be produced in forms that will be readily adaptable to communications vehicles that are likely to become widely used within the next few years. (Where several vehicles appear to be equally appropriate, preference should be given to those that will deliver information most cost-effectively.)

Some changes need to be made within the system to address the following objectives:

Recommended Goals:

1) Information must presented in ways that will allow potential users to assess the impact of a change in technology on their production system and the environment.

2) An effective alternative to direct contact with experts must be developed to transfer detailed information to clients.

3) The technology transfer system must ensure that the best available information is widely accessible in formats that will facilitate widespread usage.

Recommended Objectives:

1) For each issue area, an individual, or group, should be assigned the task, and held accountable, to ensure that, as information becomes available, it is:
   - assembled at a central location, preferably in both printed and electronic formats.
   - reviewed and integrated with previous information, noting whether they support current recommendations or necessitate change.
   - summarized with previous information.
   - presented, with draft recommendations, to the appropriate OASCC committee for review.
   - available to extension personnel and private sector sales staff, in a readily usable form.

2) To ensure that the summarization of data in this manner will occur it is likely that funding will have to be provided specifically for this task, given the state of human resources in most organizations today. One way to address this would be to dictate that this would be the final project undertaken in all programs or components thereof.

3) Design of projects on related topics should be coordinated to facilitate integration of their results. Collection of a standard dataset should be encouraged, as appropriate.

4) Information from on-farm demonstrations and experiments should be integrated into the reviews outlined above. Use of a standard design for on-farm plots and collection of a standard dataset should be encouraged, especially where the work is conducted with public sector input (e.g. OSCIA and Rural Conservation Clubs).

5) Extension materials should be designed to meet the needs of specific client groups, with regard to the level of detail and format. These could range from printed materials, for raising general awareness, to computer databases linked through hyper-text for guiding users through complex implementation problems. In such materials, either printed or electronic, the pathway by which a user can obtain more information must be clear.

6) All extension materials related to a particular topic should be available, or accessible, through the same location. (Presumably, it will be a policy decision as to which ministry or agency will be responsible for specific issues.)

7) Production recommendations and related information should be organized and presented in ways that facilitate use of a systems-approach in considering and applying new technology. It does not appear feasible to attempt to transfer "packaged" systems, at this time, given the diversity and complexity of most farm operations, but clients should be able to obtain information on all components of the system they are assembling.

8) Extension material should outline the potential impact of a technology on both other parts of the farm system and the environment or indicate where such information can be obtained. Prerequisites for implementing the technology on a farm should also be identified.

9) Materials should be developed to assist farmers in comparing the costs and benefits of alternate technologies, objectively, relative to both farm and environmental goals (e.g. something akin to full cost accounting). Through such an approach, farmers should be able to arrive at a least-cost, practical system.

Appendix A: Contacts and information sources relating to Canada-Ontario Green Plan projects.

Ontario Land Stewardship Program (1987-1990) (LS)
Summaries were prepared from information provided by:
Ken Boyd, OMAFRA, Education, Research and Laboratory Division,
P.O. Box 3650, 95 Stone Rd. W., Guelph N1H 8J7 (519) 767-6299

Soil Quality Evaluation Program (1989-1994) (SQEP)
Soil Quality Evaluation Program Summary (1994), D.F. Acton, ed., Centre for Land and Biological Research, Research Br., Agriculture & Agri-Food Canada, Ottawa, K1A 0C6

National Soil Conservation Program (1989-1993) (NSCP)
Research Component Summary Report in *National Soil Conservation Program Final Report* (1994), A. S. Hamill, ed., Agriculture and Agri-Food Canada, Research Station, Harrow, Ontario N0R 1G0 (519) 738-2251

Great Lakes Water Quality Program (1989-1994) (GLWQP)
Great Lakes Water Quality Program Summary of Achievements (1994)
G. J. Wall et al, eds., Great Lakes Advisory Committee, Agriculture and Agri-Food Canada, Pest Management Research Centre, 1391 Sandford St., London, Ontario N5V 4T3 (519) 645-5476 (London); (519) 766-9180 (Guelph)

Ontario Land Stewardship II Program (1990-1993) (LSII)
Summaries were prepared from reports and files provided by:
Doug Aspinall, Resource and Regulations Branch, OMAFRA,
P.O. Box 1030, (52 Royal Road), Guelph, N1H 1G3 (519) 767-3576

Information and summaries of the programs listed below were obtained from:
Individual Projects of the Canada-Ontario Green Plan and Related Programs
R. Guarnaccia, Agriculture and Agri-Food Canada, Market and Industry Services Branch,
174 Stone Road W., Guelph, Ontario NIG 4S9 (519) 837-9400
- Environmental Sustainability Initiative (1992-) (ESI)
- Land Management Assistance Program (1992-1994) (LMAP)
- Rural Conservation Club Program (RCC)
- Research Component of Green Plan
  - Manure/nutrient Management and Closed Loop Recycling (MA)
  - On-Farm Research (RF)
  - Development of an Integrated Resource Monitoring Capability (MO)

additional information was provided by:
Nancy Cherny, Agriculture and Agri-Food Canada, Market and Industry Services Branch,
174 Stone Road W., Guelph, Ontario NIG 4S9 (519) 837-9400

Dr. Bruce Bowman, Pest Management Research Centre, Agriculture and Agri-Food Canada,
1391 Sandford St., London, Ontario N5V 4T3 (519) 645-4452

Wetlands/Woodlots/Wildlife

Laurie Maynard, Program Manager, Canadian Wildlife Service, Ontario Region, Environment Canada, 75 Farquhar Street, Guelph, Ontario N1H 3N4 (519) 766-1593

Appendix B: Environmental Farm Plan Workbook Modules

Module	Topic
1	Soil and Site Evaluation
2	Water Wells
3	Pesticide Storage and Handling
4	Fertilizer Storage and Handling
5	Storage of Petroleum Products
6	Disposal of Farm Wastes
7	Treatment of Household Wastewater
8	Storage of Agricultural Wastes
9	Livestock Yards
10	Silage Storage
11	Milking Centre Washwater
12	Noise and Odour
13	Water Efficiency
14	Energy Efficiency
15	Soil Management
16	Nutrient Management in Growing Crops
17	Manure Use and Management
18	Horticultural Production
19	Field Crop Management
20	Pest Control
21	Stream, Ditch and Floodplain Management
22	Wetlands and Wildlife Ponds
23	Woodlands and Wildlife

Appendix C: Canada-Ontario Green Plan Research and Demonstration Projects

(Numbers in brackets refer to main issue area addressed by project; see Table 2 or end of this appendix for interpretation.)

Ontario Land Stewardship Program (LS)	Project or File No.
Agroforestry Research and Development (23) Prof. Andrew M. Gordon, OAC, Principal Researcher	LS 7000
Management of Fine Textured Poorly Drained Soils for Intensive Agriculture (19C) Dr. J.A. Stone, Harrow Research Station	LS 7002
Agroforestry Research in Ontario (23) Mr. C. Nanni, Principal Researcher, RCAT.	LS 7003
Soil Stewardship Cropping Systems for Corn & Soybean Production (19C) Dr. B.D. Kay, LRS, U.of G., Principal Researcher	LS 7004
Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil Properties in Southwestern Ontario (18A) R.W. Johnston, Ag. Chemistry Section, RCAT	LS 7005
Management of Fine Textured Poorly Drained Soils For Intensive Agriculture: Characterization of a Forage Factor which Enhances the Growth of Corn in Rotation - Parts I & II (19C) I - Dr. Ann Oaks, McMaster Univ., II - Dr. J.A. Stone, Harrow Research Stn	LS 7006 & 7007
Differences in Soil Conservation Between Operator-owned and Rented Land (19A) Dr. W. van Vuuren, Dept. of Ag. Economics and Business, U.of G.	LS 7008
A Cover Cropping Strategy for First Early Potato Production (18A) Dr. A.W. McKeown, Simcoe, Horticultural Experiment Station	LS 7009
To Investigate the Establishment, Subsequent Growth and Erosion Control Potential of Certain Tree and Shrub Species on Gully and Stream Banks (21) A. Skepasts, Head, Agronomy Section, NLCAT	LS 7010
Crop Rotation Effects on Crop Yields and Soil Properties in Southwestern Ont. (19C) D.S. Young C.K. Stevenson, C.S. Baldwin and B.R. Doidge, RCAT	LS 7011
Improving the Degraded Structure on Fine Textured Soils with Deep Tillage and Grass and Legume Crops (19C) Claude Weil, ACAFT	LS 7012
Improving the Degraded Structure of a Clay Loam Soil with Deep Tillage and Grass and Legume Crops (19C) W. Curnoe, KCAT, J. Culley, L. Heslop and N. McLaughlin, Agriculture And Agri-food Canada	LS 7013

Farm Shelterbelt Design and Demonstration (23) LS 7014
Dr. V. Chanasyk, Landscape Architecture, University of Guelph

Crop Production with a No-traffic Tillage System (19C) LS 7015
D.S. Young, RCAT

Response of the Soil Microflora and Fauna to Spring Plowing of Zerotill and
Pasture Soils (1A) V.G. Thomas, and P. Neave, LRS, U. of Guelph LS 7016

Cropping and Soil Management Effects on the Dynamics of Crop Residue Derived-N
on the Coarse-textured Soils in Southern Ontario (16) LS 7017
Dr. R. Paul Voroney, Dept. Land Resource Science, U. of Guelph

Nitrogen Research with Corn Using Conservation Tillage (16) LS 7018
C.K. Stevenson, RCAT

Impact of Soil Compaction on the Production of Processing Vegetables and LS 7019
Other Cash Crops (literature review) (18A) C.K. Stevenson, RCAT

Nitrogen Conserving Farm Systems (Soil nitrate-N test) (16) LS 7020
Dr. R. Gary Kachanoski, Land Resource Science, U. of Guelph

Soil Quality Enhancement Program (SQEP)
Soil Quality Evaluation Program Summary (1994)
D. F. Acton, ed., Centre for Land and Biological Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa, (CLBRR) Ontario K1A 0C6

A Conceptual Framework for Soil Quality Assessment and Monitoring SQEP 1
D. F. Acton and G. A. Padbury, Agriculture And Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research (CLBRR) Saskatchewan Land Resource Unit, Saskatoon, Saskatchewan

GIS-Based System to Assess Soil Quality SQEP 2
K.B. MacDonald, and F. Wang, W., Agriculture And Agri-Food Canada, CLBRR Ontario Land Resource Unit, Guelph
Fraser, G. W. Lelyk and I. Jarvis, Agriculture And Agri-Food Canada, CLBRR Manitoba Land Resource Unit, Winnipeg

A Land Use Analysis & Monitoring System for Soil Quality Assessment SQEP 3
J. C. Hiley, CLBRR Alberta Resource Unit, Edmonton, and E. C. Huffman, CLBRR, Ottawa

Benchmark Sites for Assessing Soil Quality SQEP 4
C. Wang, CLBRR, Ottawa and colleagues in CLBRR units in each province

Water Erosion Prediction and Assessment SQEP 6
G. J. Wall and E. A. Pringle, CLBRR, Guelph, and D. R. Coote, CLBRR, Ottawa

Evaluating Changes in Soil Organic Matter SQEP 7
E. G. Gregorich and C. M. Monreal, CLBRR, Ottawa; B. H. Ellert, CLBRR, Lethbridge,
D. A. Angers, CLBRR, Sainte-Foy; M.R Carter, CLBRR, Charlottetown

Assessing Change in Soil Physical Quality SQEP 9
R. A. McBride and D. W. Veenhof, Land Resource Science, Univ. of Guelph; and
G. C. Topp, Y. T Galganov and J. L. B. Culley, CLBRR, Ottawa

Prediction of Agrochemical Migration SQEP 10
W. D. Reynolds, R. de Jong, S. R. Vieira and R. S. Clemente, CLBRR, Ottawa

Industrial Organic Compounds in Selected Canadian Municipal Sludges SQEP 11
and Agricultural Soils. M. D. Webber, Wastewater Technology Centre, Burlington, ONT.

Development of Indicators of Soil Quality and Sustainable Land Management using Knowledge
and Information Obtained from Innovative Conservation Farmers SQEP 12
M. Cann, J. Dumanski and S. Gameda, CLBRR, Ottawa and
M. Brklacich, Carleton University, Geography Dep't.

SOILCROP: An Innovative Conservation Farmers' Expert System for Conservation Farm
Planning. S. Gameda and J. Dumanski, CLBRR, Ottawa SQEP 13

National Soil Conservation Program (NSCP)
National Soil Conservation Program Final Report (1994)
A. S. Hamill, ed., Agriculture and Agri-Food Canada, Research Station, Harrow, Ontario N0R
1G0 (519) 738-2251

Response of Earthworms, Soil Biota and Soil Structure to Agricultural Practices
in Corn, Soybean and Cereal Rotations. (1A) NSCP 1
Dr. A. D. Tomlin et al, London Research Centre, Agriculture and Agri-Food Canada

Methodologies for Assessing Soil Structure and for Predicting Crop Response to
Changes in Soil Quality (1A). Dr. B. D. Kay et al, University of Guelph NSCP 2

Rainfall Simulator - Grid Lysimeter System for Preferential Solute Transport
Studies Using Large, Intact Soil Blocks (2A) NSCP 3
Dr. B. T. Bowman, London Research Centre, Agriculture and Agri-Food Canada

Soil Macropore Structures and Their Effect on Solute Transport to Tile Drains (2A) NSCP 4
Dr. Gary Kachanoski, Environmental Soil Services

Influence of Soil Management System on Potentially Mineralizable Nitrogen (16) NSCP 5
Dr. Gary Kachanoski, Environmental Soil Services,

Evaluation of Three Manure Composting Methods for Nitrogen Conservation,
Environmental Impact, Crop Growth Response & Operating and (17B)

Maintenance Costs. Mr. Richard St. Jean, Ecologistics NSCP 6

Manure Management to Sustain Water Quality (17C) NSCP 7
Dr. Dr. M. J. Goss, University of Guelph

The Effect of Soil Quality on Field Scale Runoff under Conventional and NSCP 8
Conservation Tillage Systems (19B) Dr R. Walker and Dr. R. Tossel, Beak Consultants Ltd.

Crop Residue Decomposition and Organic Matter Dynamics in Alternative
Management Systems on Coarse-textured Soils. (19C)
R. Beyaert, Delhi Research Station, Agriculture and Agri-Food Canada NSCP 9

The Relationship Between Landscape Position, Tillage Practices and Soil Loss:
Model Development (1B) NSCP 10
Dr. G. Kachanoski and D. Lobb, University of Guelph

Literature Review Pertaining to Buffer Strips (19C) NSCP 11
Soil and Water Conservation Information Bureau

Great Lakes Water Quality Program (GLWQP)
Great Lakes Water Quality Program Summary of Achievements (1994)
G. J. Wall et al, eds., Great Lakes Advisory Committee, Agriculture and Agri-Food Canada, Pest Management Research Centre, 1391 Sandford St., London, Ontario N5V 4T3 (519) 645-4452 (London); (519) 766-9180 (Guelph)

?? Review of research on groundwater contamination from non-point sources in the
Great Lakes Basin. (2A) (shown on list of projects but not in above review) GLWQP ??
J.A. Millette, A.A.F.C, Ottawa, 613-995-5011

Pesticide Contamination of Surface Waters Draining Agricultural Fields:
Pesticide Contamination Classification and Abatement Measures (2C) GLWQP 01
J. Stover and A.S. Hamill, A.A.F.C., Harrow 519-738-2251

Physical Chemistry Parameters That Control Pesticide Persistence and Leaching
in Watershed Soils. (2C). D.S. Gamble, A.A.F.C, Ottawa, 613-995-5011 GLWQP 02

Transport and Dissipation Pathways of Pesticides in Upland Watersheds Employing
Conventional and Conservation Tillage in Ontario. (2C) GLWQP 03
G.J. Wall et al, A.A.F.C, Guelph 519-766-9180

Integrated Soil, Crop and Water Management Systems to Abate Herbicide and Nitrate
Contamination of the Great Lakes: Herbicides (20A) GLWQP 04
J.D. Gaynor et al, A.A.F.C., Harrow 519-738-2251

Occurrence and Fate of Selected Agricultural Pesticides in Water and Sediments
of Lake Erie Coastal Marshes. (2C) GLWQP 05

J.A. Millette et al, A.A.F.C, Ottawa, 613-995-5011

Predicting Pesticide Migration Through Soils of the Great Lakes Basin GLWQP 06
R. DeJong et al, A.A.F.C, Ottawa, 613-995-5011 (2C)

Atmospheric Transfer of Agri-chemicals. (2C) GLWQP 07
E. Pattey et al, A.A.F.C, Ottawa, 613-995-5011

Soil Persistence of Atrazine, Metolachor and Metribuzin, as Influenced by Temperature, Soil Moisture and Soil Characteristics. (2C) GLWQP 08
E. Topp and W.N. Smith, A.A.F.C, Ottawa, 613-995-5011

Integrated Soil, Crop and Water Management System to Abate Herbicide and Nitrate Contamination of the Great Lakes: Nitrate (16) GLWQP 09
C.F. Drury et al, A.A.F.C., Harrow 519-738-2251

The Effects of Livestock Manure Application and Management on Surface Water Quality. (17C). D. King et al, A.A.F.C., Guelph 519-766-9180 GLWQP 10

Fate of Agricultural Chemicals in Soil, Ground Water and Agricultural Drainage Water, Under Farm Conditions. (2C) GLWQP 11
N.K. Patni et al, A.A.F.C., Ottawa, 613-993-6002

Reduced Chemical Input Systems for Improved Water Quality. (20A) GLWQP 12
M.A. McGovern et al, A.A.F.C, Ottawa, 613-995-5011

A Protocol for Monitoring and Assessment of Water Quality in Agricultural Streams Using Benthic Invertebrates. (2C) GLWQP 13
D.R. Oliver and D.R. Barton, A.A.F.C, Ottawa, 613-995-5011

Regional Agricultural Practices and Their Potential for Land and Water Contamination. (2A) GLWQP 14
B. MacDonald, F. Wang and I. Jarvis, A.A.F.C., Guelph 519-766-9180

Ontario Land Stewardship II Program (LSII)

Conservation Technology and Practices in the Cultivation of Canola LSII 7,11
Ontario Canola Growers' Association (19D)

Soil Conditioning for No-till Systems (19D) LSII 22a
Essex Conservation Club, c/o Bill Stevens, OMAFRA, Essex

Economic Conservation Yield Monitoring Program (19D) LSII 22b
Essex Conservation Club

No-Till Demonstration Plot (20A) LSII 23
Rondeau Agricultural Conservation Corp.

Anderdon No-tillers Group, c/o Bill Stevens, OMAFRA, Essex

Yeoman's Feedlot Cleanup Project (2D) Napanee Region Conservation Authority LSII 107

Managing Cover Crops and Tillage to Conserve Nitrogen following Manure Applications (17C). Perth County Pork Producers, Cattlemen and Milk Committee with Dr. T. Vyn, Univ. of Guelph LSII 113

Evaluation of Corn Hybrids under Ridge-till, Zone-till and Conventional Tillage Systems (19D) Kent Corn Producers' Assoc. and Gordon Scheifele, RCAT LSII 115

Environmental Sustainability Imitative (ESI)
University of Guelph/Soil Research (1A) ESI 1
(soil structural changes and crop productivity models)

Ground Water Survey (Winter 1992) (2B) ESI 2
Ontario Soil and Crop Improvement Association

Land Management Assistance Program (LMAP)
Ontario Farm Groundwater Quality Survey II (Summer 1992) (2B) LMAP 1

A Study of the Seasonal Variation in Well-Water Contamination, and Survey the Health of Farm Families Drinking Water Contaminated with Nitrate or Bacteria (2B) LMAP 2
Mike Goss, Land Stewardship Chair, Land Resource Science, University of Guelph

Land Use Adjacent to Southern Ontario Wetlands (21) LMAP 6
Elizabeth Snell, Snell and Cecile Environmental Research, (519)821-5710.

COMPUTER SIMULATION OF BMP'S - A strategy to locate and manage artificial wetlands, ponds, infiltration systems and overland flow treatment systems (21) LMAP 7
Claude Weil, Alfred College

The Development Of An Ontario Goose Depredation Survey Project (23) LMAP 9
Canadian Wildlife Service
Laurie Maynard, Environmental Conservation Branch, C W S, (519)766-1593.

Wildlife Habitat Enhancement on the Farm (23) LMAP 10
Maitland Valley Conservation Authority
Phil Beard or Chris Hoskins, Maitland Valley Cons. Authority, (519)335-3557.

Transformation Rates of Inorganic Nitrogen in Animal Manure Into Plants and Soil Organic Matter and its Re-Release From Soil Organic Matter (17B) LMAP 013/94
Dr. M.J. Goss & P.S. Smith, Centre for Land & Water Stewardship, U of Guelph

A Program to Assess Surface- and Groundwater Quality At Farm Sites Selected for Artificial Wetland Construction (21) LMAP 014/94

Assoc. of Conservation Authorities of Ontario (Contact: David Hayman)

Influence of Soil Texture and Tillage Practices on the Susceptibility of
Legume-Nitrogen to Leaching (16) LMAP 015/94
Dr. B.D. Kay, and Dr. V. Rasiah, Land Resource Science, Univ. of Guelph

Maintenance Program for Three Southwestern Ontario Watersheds (19B) LMAP 16/94
Mr. David Hayman, Upper Thames Conserv. Authority, R. R. #6, London, N6A 4C1

Current Green Plan:
Individual Projects of the Canada-Ontario Green Plan and Related Programs
R. Guarnaccia, Agriculture and Agri-Food Canada, Market and Industry Services Branch, 174 Stone Road W., Guelph, Ontario NIG 4S9 (519) 837-9400

Integrated Resource Monitoring Capability (MO)
Resident Biomass and Organic Carbon (1A) RES/MON 001/95
Mr. David Charlton, Ecological Services For Planning

Resident Biomass and Organic Carbon (1A) RES/MON 002/96
Dr. Gary Kachanoski, Environmental Soil Services, Guelph, Ont

Bio-indicators and Methodologies to Quantify Soil Quality (1A) RES/MON 003/97
Dr. C. M. Monréal, Centre for Land and Biological Resources Research Agriculture Canada, Central Experimental Farm, Ottawa, ONT, K1A 0C6

A Proposal to Assess the State of Agricultural Resources:
Improving the Land Resource Database (1C) RES/MON 004/94
Mr. David Cressman, Ecologistics Limited

Proposal for the Upgrade of Soil Survey Information in Oxford County (1C) RES/MON 005/95
Mr. D. Charlton, Ecological Services For Planning, Guelph

Development and Application of Standardized Methodology for Sampling Soil
Landscape Polygons (1C). Mr. J. Hagarty, Ecolog. Services For Planning RES/MON 006/95

Development and Testing of "State of Agricultural Resources":
A Reporting and Monitoring Methodology for Ontario. (1C) RES/MON 007/95
Mr. Harold Moore, Gregory Geoscience Ltd, Kanata

Monitoring Soil Loss and Redistribution Using ^{137}Cs (1B) RES/MON 008/96
Dr. Gary Kachanoski, Environmental Soil Services

Computerized System to Manage, Use and Distribute Data Collected by Green
Plan Monitoring Research Projects (1C) RES/MON 009/96
Mr. Ken Denholm, Ont. Land Resource Unit, C.L.B.R.R., Guelph

Partitioning of Solutes from Agricultural Fields within the Hydrologic System at Two Sites in Southern Ontario and Subsequent Impact on Adjacent Aquatic Ecosystems (2A) RES/MON 010/97
Dr. David Rudolph, Waterloo Centre for Groundwater Research, Univ. of Waterloo

Improving the Land Resource Data Base - Waterloo Region (1C) RES/MON 011/96
Mr. D. Cressman, Ecologistics Limited

Manure Nutrient Management & Closed Loop Recycling (MA)

Literature Search on Manure/Nutrient Management (17A) RES/MAN 001/94
Dr. Michael Goss, Land Resource Science, University of Guelph

Nitrogen & Carbon Transformations in Conventionally-Handled Livestock Manures (17B). Dr. G. Kachanoski, Environ. Soil Services RES/MAN 002/97

Manure Composting Techniques: Understanding Nitrogen and Carbon Conservation (17B). Mr. Richard St. Jean, Ecologistics Ltd. RES/MAN 003/97

Transformations in Soil: Crop Response to Nitrogen in Manures with Widely Different Characteristics (17B). Dr. E. G. Beauchamp, J. Buchanan-Smith and M. Goss, Dept. of Land Resource Science, University of Guelph RES/MAN 004/97

Impact of Manure Application Methods on Water Quality, Focusing on Nitrogen and Bacteria Transport in Soil (17C) RES/MAN 005/97
Dr. Greg Wall, Land Resource Division, C.L.B.R.R., Guelph

Closed Loop Recycling - Composted Biodegradable Organic Urban Waste Application on Agricultural Lands (17D) RES/MAN 006/97
Mr. David Charlton, Ecological Services For Planning

Soil Organisms as Bioindicators of Agronomic Practices. (1A) RES/MAN 007/97
Dr. A. Tomlin, Pest Management Res. Centre, Agric. Canada

Effect of Controlled Drainage/Subirrigation on Tile Drainage Water Quality and Crop Yields at the Field Scale. (19B) RES/MAN 008/97
Dr. Ian van Wesenbeeck, Harrow Research Station, A.A.F.C

Literature Review on Wildlife Habitats in Agricultural Landscapes (23) RES/MAN 009/94
Mr. Lyle Friesen, Canadian Wildlife Service, Environment Canada, Hull

Assessment of the influence of manures for the control of soilborne pests including nematodes, fungi and bacteria. (17A) RES/MAN 010/97
Dr. George Lazarovits, Pest Management Research Centre, A.A.F.C. London

Measuring Soil Microbial Populations by Analysis of Their Phospholipid Signatures (1A). Dr. Ralph Chapman & Ms. Joy Kohlmaier, RES/MAN 011/95

Pest Management Research Centre, Agric. and Agri-Food Canada, London

On-farm Research (RF)

Literature Review of Methods Used to Conduct and Evaluate On-Farm Research (24) Ms. Jane Sadler-Richards, Ecologistics Ltd. RES/FARM 001/94

Investigating Methods of Integrating Liquid Manures into a Cropping System and the Effect on Soil and Water Quality (17C) RES/FARM 002/97
Mr. David Charlton, Ecolog. Services For Planning

Environmental Effects of Conservation and Conventional Cropping Systems (19B)
Jane Sadler-Richards, Ecologistics Ltd RES/FARM 003/97

Determining Factors Responsible for, and Methods to Overcome the Limitations of Conservation Cropping Systems on Clay Soils (19C) RES/FARM 004/97
Dr. Tony Vyn, Crop Science, University of Guelph, Guelph, ONT, N1G 2W1

Variable Rate Technology for Nitrogen Application (16) RES/FARM 005/97
Dr. Gary Kachanoski, Land Resource Science, U. of Guelph

Measuring the Effect of Crop Residue or Live Cover Crops in Conservation Tillage Systems on Soil and Water Quality (19B) RES/FARM 006/97
Dr. Ian Van Wesenbeeck, Harrow Research Station, Agric. Canada

Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil Properties in Southwestern Ontario (18A) RES/FARM 007/97
Mr. Ken Stevenson and R. W. Johnston, RCAT, Ridgetown ONT, N0P 2C0

Rural Conservation Club Program (RCC)

Long Term Economical & Environmental Feasibility Study of Using a Vegetation Detecting Sprayer for Weed Control in Conservation Cropping (20A) RCC 08
Rondeau Agricultural Conservation Corp., Herb Groenewegen, (519) 676-4806.

Para-Tillage: A Jump Starter for a Conservation Tillage Program (19D) RCC 09
South Lambton Conservation Tillage Club
Barry McFadden, South Lambton Conservation Tillage Club, (519) 683-6012.

Project to Evaluate and Demonstrate Wetland Restoration (21) RCC 14
Essex Region Conservation Authority, (519) 776-5209.

Constructed Wetland Treatment Facility (11) RCC 15
The Belle River Conservation Club
Paul Hermans, Region Conservation Authority, (519) 776-5209.

Alternative Methods for Colorado Potato Beetle Control (20B) RCC 16

Southwestern Ontario Potato Beetle Club,
Janice Elmhirst, Ridgetown College of Agricultural Technology, (519) 674-5456.

Upper Avon River Rural/Urban Conservation Club (19B) RCC 17
Craig Merkley, Upper Thames River Conservation Authority, (519) 451-2800.

Integrated Weed Control, Nutrient Management and Reduced Tillage in Corn and Soybeans (20A) Carleton S C I A, Rick Schouten, (613)489-3667. RCC 25

Manure Management in High Residue Applications (17C) RCC 29
Charing Cross Conservation Club, Rob Smyth, Director, (519) 436-0501.

Manure Management for Swine (11) RCC 33
Essex Manure Management Club Essex Region Conservation Authority, (519) 776-5209

Forages for Soil and Profit (19D) RCC 34
Renfrew Soil and Crop Improvement Association
Paul Sullivan, Project Advisor, c/o OMAFRA (613) 828-9167.

Wilkesport Demonstration Club (19D) RCC 42
Lambton S C I A, c/o Gabrielle Ferguson (519) 882-0180.

Farm Mapping - Management with a G.I.S. (19A) RCC 45
Agriculteurs Innovateurs de l'Est Ontarien
Pierre-Yves Gasser, Ag-Knowledge, Ottawa (613) 789-9603.

The Community Supported Agriculture Project (24) RCC 48
Chris Beeman, Co-ordinator, (613) 549-4800, or Tamsyn Rowley, (519) 822-2410.

Development and Demonstration of Approaches to Manage Drinking Water Quality on the Farm (2B) Waterloo Centre for Groundwater Research, RCC 56
David Rudolph (519)885-1211 ext 6778

Introducing No-Till Systems into Crop Rotations Based Upon Tomato Production (18A) Kent County Vegetable Growers' Association RCC 59

Comparison of Strip-cropping and Field-cropping (19D) RCC 67
Ontario Ridge Till and Strip Cropping Club; Joe Omielan, (519) 240-3769.

Pre-Tillage of Cereal Stubble in a No-Till or Minimum Tillage System (19D) RCC 68
Middlesex Pre-Till Club, Rick McCracken, (519) 289-5576.

Poultry Liquid Manure Applications in Growing Corn (17C) RCC 72
Agriculteurs Innovateurs de l'Est Ontarien,
Pierre-Yves Gasser, Ag-Knowledge, Ottawa

Soil Life Demonstration Project (1A) RCC 73
Essex Conservation Club, c/o Don Depuydt, Essex Reg. Cons. Auth. (519)776-5209

Management of Corn Rootworms on Farms by Monitoring Eggs (20A) RCC 75
Cliff Ellis, Dep't. of Envir. Biology, Univ. of Guelph, (519)824-4120 ext 3076

Non-Chemical Methods of Control of the Colorado Potato Beetle in Potatoes (20B)
Ontario Potato Pest Management Club RCC 76
Mark Sears, Dep't. of Envir. Biology, Univ. of Guelph, (519)824-4120 ext. 3567

Ontario Land Care - Extension Project Sites (21) RCC 77
Galen Driver, c/o Ducks Unlimited Canada, (705) 721-4444.

Farming for Maximum Efficiency and Environmental Sustainability (19A) RCC 78
Innovative Farmers of Ontario, c/o Stewardship Information Bureau, (519)767-5020

Well Steward Project (2B) RCC 79
Ont. Soil & Crop Improvement Assoc., Andy Graham, Program Mgr., (519) 767-3179

Variable Input Application (19D) RCC 84
Kent Precision Farming Club, Doug Smith, Project Leader, (519) 692-5240.

Solar Powered Watering Facilities (2D) RCC 88
Alternative Livestock Watering Devices Association
Terry Davidson, Rideau Valley Conservation Authority, (613) 692-3571.

Constructed Wetland Project (11) RCC 90
South Nation River Conservation Authority, Mary-Ann Wilson (613) 984-2949

South Simcoe Wetland Project (21). South Simcoe Conservation Club RCC 92

Screening of Bestialities Approved for Land Utilization in Corn (17D) RCC 96
Dundas Soil and Crop Improvement Association,
Cliff Metcalfe, c/o Eastern Crop Doctor Reg'd, (613) 774-5695.

Conservation Farming for Profit (19D) RCC 97
Peel Soil Conservation Club, Gord Armstrong, (905) 843-1795.

Constructed Wetland/Manure Management (11) Wentworth Farm Wetlands Club RCC 98

Improved Placement & Utilization of Bestialities in a Conservation Cropping System
(17D) Halton Conservation Club, Richard Sovereign, Chairman, (905) 335-9506. RCC 99

Beef Feedlot\Yard Runoff Control by Vegetative Filter Strip (11) RCC 102
Peter Doris, Ontario Cattlemen's Association, (519) 824-0334.

Conservation Tillage for Profit (19D) RCC 110a
Wellington County Conservation Club,
Elaine Williamson, c/o Willoa Associates, (519) 856-2165.

Conservation Farming (19D) RCC 110b
Wellington County Conservation Club - Martin de Groot, (519) 638-3481.

Assessing and Predicting the Effect of Cover Crops and Reduced Tillage on Nitrogen Management (16). Ontario Corn Producer's Assoc. RCC 115

Effect of Different Maple Bush Management Techniques on Tree Growth RCC 117
Assoc. des Producteurs Francophone d'Acericulture de l'Ontario (23)

Water and Chemical Management systems for the Turfgrass Industry (20B) RCC 120
Guelph Turfgrass Institute

Reduced Tillage in Spring and Winter Canola Production (19D) RCC 122
Ontario Canola Growers Association (PROJECT COMPLETED)
Murray Smeltzer, Chairman, (519) 291-4811.

Milkhouse Wash Water Control Using a Vegetative Filter (11) RCC 124
Farm Pollution Control Alternatives Assoc.

Fertilizer Placement with No-Till (16) Arcadia Cooperative Group RCC 125

Wetlands/Woodlots/Wildlife

BIGHEAD RIVER DEMONSTRATION PROJECT WWW 01
Lead Organization: Grey County Soil and Crop Improvement Association,
Ray Robertson, (519) 986-2040

CONSERVING BIODIVERSITY IN AGRICULTURAL ECOSYSTEMS OF THE CAROLINIAN LIFE ZONE WWW 02
Lead Organization: Federation of Ontario Naturalists, Kim Gavine, (416) 444-8419

COLD CREEK DEMONSTRATION PROJECT WWW 03
Lead Organization: Ontario Federation of Anglers and Hunters, Ed Reid, (705) 748-6324

LAUREL CREEK WATERSHED DEMONSTRATION PROJECT WWW 04
Lead Organization: Grand River Conservation Authority, Peter Mason, (519) 621-2761

LA CITÉ COLLÉGIALE'S WETLANDS/ WOODLANDS/ WILDLIFE PROJECT IN THE HAWKESBURY AREA WWW 05
Lead Organization: La Cite Collegiale, Jacques Bouvier, (613) 632-2483

SNAKE RIVER AND MUSKRAT BASIN DEMONSTRATION PROJECT WWW 06
Lead Organization: Ontario Federation of Anglers and Hunters, Ed Reid, (705) 748-6324

ISSUES AND OPPORTUNITIES FOR WILDLIFE HABITAT CONSERVATION IN AGRICULTURE WWW 07
Lead Organization: Lower Trent Region Cons. Authority, Barry Jones, (613) 394-4829

ENHANCEMENT OF CADDY-BOTT DRAIN IN MIDDLESEX COUNTY WWW 08
Lead Organization: Upper Thames Region Cons. Authority, Paul Fish, (519) 451-2800

MANAGING AGRICULTURAL DRAINS TO ACCOMMODATE WILDLIFE WWW 09
Lead Organization: Ontario Soil and Crop Improvement Association
Andrew Graham, (519) 767-4601

LINKING SUSTAINABLE AGRICULTURE AND WETLANDS CONSERVATION WWW 10
Lead Organization: Ducks Unlimited, Rick Wishart, (705) 721-4444

Code	**Issue Area**
1A:	Development of Methodologies to Evaluate Soil Quality
1B:	Soil Erosion Measurement and Prediction
1C:	Development of Methodologies to Monitor and Map Soil Resources
2A:	Agriculture and Water Quality (includes studies on preferential flow)
2B:	Drinking Water
2C:	Agricultural Chemicals and Water Quality
2D:	Alternate Water Supply
11:	Treatment of Milkhouse Washwater and other Contaminated Water
16:	Nutrient Management
17A:	Manure/Nutrient Management - General
17B:	N & C Transformations in Manure During Storage, Handling or in Soil
17C:	Manure Application: Sources, Rates, Methods, Timing and Water Quality
17D:	Use of Urban Organic Wastes on Farmland
18A:	Horticultural Crops: Soil Management
18B:	Horticultural Crops: Greenhouse Management
19A:	Conservation Cropping Systems - General
19B:	Cropping Systems and Water Quality
19C:	Cropping Systems and Soil Properties
19D:	Conservation Cropping System Demonstrations
20A:	Pest Management: Field Crops
20B:	Pest Management: Horticultural Crops
21:	Wetlands and Streambanks
23:	Woodlots and Wildlife
24:	Other

Appendix D: Key Issues Addressed by Canada-Ontario Green Plan Projects

<u>Legend:</u>	<u>Program Title</u>
LS	Ontario Land Stewardship Program (1987-1990)
SQEP	Soil Quality Evaluation Program (1989-)
NSCP	National Soil Conservation Program (1989-1993)
GLWQEP	Great Lakes Water Quality Program (1989-94)
LSII	Ontario Land Stewardship II Program (1990-1993)
ESI	Environmental Sustainability Imitative (1992-?)
LMAP	Land Management Assistance Program (1992-1994)
Current projects (1993-1997):	
RCC	Rural Conservation Club Program
MA	Manure/nutrient Management and Closed Loop Recycling
RF	On-Farm Research
MO	Development of an Integrated Resource Monitoring Capability
WWW	Wetlands/Woodlots/Wildlife

<u>Project Title:</u> **<u>1A: Development of Methodologies to Evaluate Soil Quality</u>**:	Program & <u>Project #</u>
Benchmark Sites for Assessing Soil Quality C. Wang, CLBRR, Ottawa and colleagues in CLBRR units in each province	SQEP 4
Evaluating Changes in Soil Organic Matter E. G. Gregorich and C. M. Monreal, CLBRR, Ottawa; B. H. Ellert, CLBRR, Lethbridge, D. A. Angers, CLBRR, Sainte-Foy; M.R Carter, CLBRR, Charlottetown	SQEP 7
Assessing Change in Soil Physical Quality R. A. McBride and D. W. Veenhof, Land Resource Science, Univ. of Guelph; and G. C. Topp, Y. T Galganov and J. L. B. Culley, CLBRR, Ottawa	SQEP 9
University of Guelph/Soil Research (soil structural changes and crop productivity models)	ESI 1
Soil Organisms as Bioindicators of Agronomic Practices. Dr. A. Tomlin, Pest Management Research Centre, A.A.F.C., London	MA 07/97
Resident Biomass and Organic Carbon Mr. David Charlton, Ecological Services For Planning	MO 01/95
Measuring Soil Microbial Populations by Analysis of Their Phospholipid Signatures. Dr. Ralph Chapman & Ms. Joy Kohlmaier, Pest Management Research Centre, Agriculture and Agri-Food Canada, London	MA 11/95
Resident Biomass and Organic Carbon. Dr. Gary Kachanoski, Environmental Soil Services, 361 Southgate Dr., Guelph, Ont N1G 3M5	MO 02/96

Bio-indicators and Methodologies to Quantify Soil Quality. MO 03/97
Dr. C. M. Monréal, Centre for Land and Biological Resources Research Agriculture Canada, Central Experimental Farm, Ottawa, ONT, K1A 0C6

Response of Earthworms, Soil Biota and Soil Structure to Agricultural Practices in Corn, Soybean and Cereal Rotations. NSCP 1
Dr. A. D. Tomlin et al, London Research Centre, AGRICULTURE AND AGRI-FOOD CANADA

Soil Life Demonstration Project (monitoring earthworm populations) RCC 73
Essex Conservation Club, Don Depuydt, Essex Reg. Cons. Authority, 519-776-5209

Response of the Soil Microflora and Fauna to Spring Plowing of Zerotill and Pasture Soils. V.G. Thomas, and P. Neave, LRS, U. of Guelph LS 7016

Methodologies for Assessing Soil Structure and for Predicting Crop Response to Changes in Soil Quality. Dr. B. D. Kay et al, University of Guelph NSCP 2

1B: Soil Erosion Measurement and Prediction

Water Erosion Prediction and Assessment SQEP 6
G. J. Wall and E. A. Pringle, CLBRR, Guelph, and D. R. Coote, CLBRR, Ottawa

The Relationship Between Landscape Position, Tillage Practices and Soil Loss: Model Development. Dr. G. Kachanoski and D. Lobb, University of Guelph NSCP 10

Monitoring Soil Loss and Redistribution Using ^{137}Cs MO 08/96
Dr. Gary Kachanoski, Environmental Soil Services

1C: Development of Methodologies to Monitor and Map Soil Resources

Computerized System to Manage, Use and Distribute Data Collected by Green Plan Monitoring Research Projects MO 09/96
Mr. Ken Denholm, Ont. Land Resource Unit, C.L.B.R.R., Guelph

Proposal for the Upgrade of Soil Survey Information in Oxford County MO 05/95
Mr. D. Charlton, Ecological Services For Planning, Guelph

State of Agricultural Resources: Improving the Land Resource Database MO O4/94
Mr. David Cressman, Ecologistics Limited

Improving the Land Resource Data Base - Waterloo Region MO 11/96
Mr. D. Cressman, Ecologistics Limited

Development and Application of Standardized Methodology for Sampling Soil Landscape Polygons. Mr. J. Hagarty, Ecological Services For Planning MO 06/96

Development and Testing of "State of Agricultural Resources": A Reporting and Monitoring Methodology for Ontario. MO 07/95
Mr. Harold Moore, Gregory Geoscience Ltd, Kanata

A Conceptual Framework for Soil Quality Assessment and Monitoring SQEP 1
D. F. Acton and G. A. Padbury, Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research (CLBRR) Saskatchewan Land Resource Unit, Saskatoon, Saskatchewan

GIS-Based System to Assess Soil Quality SQEP 2
K.B. MacDonald, and F. Wang, W., Agriculture and Agri-Food Canada, CLBRR Ontario Land Resource Unit, Guelph
Fraser, G. W. Lelyk and I. Jarvis, Agriculture and Agri-Food Canada, CLBRR Manitoba Land Resource Unit, Winnipeg

A Land Use Analysis & Monitoring System for Soil Quality Assessment SQEP 3
J. C. Hiley, CLBRR Alberta Resource Unit, Edmonton, and E. C. Huffman, CLBRR, Ottawa

Development of Indicators of Soil Quality and Sustainable Land Management using Knowledge and Information Obtained from Innovative Conservation Farmers SQEP 12
M. Cann, J. Dumanski and S. Gameda, CLBRR, Ottawa and
M. Brklacich, Carleton University, Geography Dep't.

SOILCROP: An Innovative Conservation Farmers' Expert System for Conservation Farm Planning. S. Gameda and J. Dumanski, CLBRR, Ottawa SQEP 13

<u>2A: Agriculture and Water Quality</u> (includes studies on preferential flow)

Rainfall Simulator - Grid Lysimeter System for Preferential Solute Transport Studies Using Large, Intact Soil Blocks NSCP 3
Dr. B. T. Bowman, Pest Management Research Centre, Agriculture and Agri-Food Canada

Soil Macropore Structures & Their Effect on Solute Transport to Tile Drains. NSCP 4
Dr. Gary Kachanoski, Environmental Soil Services

Review of research on groundwater contamination from non-point sources in the Great Lakes Basin. J.A. Millette, A.A.F.C, Ottawa, 613-995-5011 GLWQP ??

Regional Agricultural Practices and Their Potential for Land and Water Contamination. GLWQP 14
B. MacDonald, F. Wang and I. Jarvis, A.A.F.C., Guelph 519-766-9180

Partitioning of Solutes from Agricultural Fields within the Hydrologic System at Two Sites in Southern Ontario and Subsequent Impact on Adjacent Aquatic Ecosystems MO 10/97
Dr. David Rudolph, Waterloo Centre for Groundwater Research, Univ. of Waterloo

2B: Drinking Water

Ground Water Survey (Winter 1992). Ontario Soil and Crop Improvement Association ESI 2

Ontario Farm Groundwater Quality Survey II (Summer 1992) LMAP 1
Ontario Soil and Crop Improvement Association

A Study of the Seasonal Variation in Well-Water Contamination, and Survey the Health of Farm Families Drinking Water Contaminated with Nitrate or Bacteria LMAP 2
Mike Goss, Land Stewardship Chair, Land Resource Science, University of Guelph

Development and Demonstration of Approaches to Manage Drinking Water Quality on the Farm RCC 56
Waterloo Centre for Groundwater Research, David Rudolph, (519)885-1211 (6778)

Well Steward Project RCC 79
Ontario Soil and Crop Improvement Association; Andy Graham, (519) 767-3179

2C: Agricultural Chemicals and Water Quality

Prediction of Agrochemical Migration SQEP 10
W. D. Reynolds, R. de Jong, S. R. Vieira and R. S. Clemente, CLBRR, Ottawa

Occurrence and Fate of Selected Agricultural Pesticides in Water and Sediments of Lake Erie Coastal Marshes. J.A. Millette et al, A.A.F.C, Ottawa, ONT GLWQP 05

A Protocol for Monitoring and Assessment of Water Quality in Agricultural Streams Using Benthic Invertebrates. GLWQP 13
D.R. Oliver and D.R. Barton, A.A.F.C, Ottawa, 613-995-5011

Fate of Agricultural Chemicals in Soil, Ground Water and Agricultural Drainage Water Under Farm Conditions. N.K. Patni et al, A.A.F.C., Ottawa, ONT GLWQP 11

Pesticide Contamination of Surface Waters Draining Agricultural Fields: Pesticide Contamination Classification and Abatement Measures GLWQP 01
J. Stover and A.S. Hamill, A.A.F.C., Harrow 519-738-2251

Predicting Pesticide Migration Through Soils of the Great Lakes Basin GLWQP 06
R. DeJong et al, A.A.F.C, Ottawa, 613-995-5011

Physical Chemistry Parameters That Control Pesticide Persistence and Leaching in Watershed Soils. D.S. Gamble, A.A.F.C, Ottawa, 613-995-5011 GLWQP 02

Transport and Dissipation Pathways of Pesticides in Upland Watersheds Employing Conventional and Conservation Tillage in Ontario. GLWQP 03
G.J. Wall et al, A.A.F.C, Guelph 519-766-9180

Soil Persistence of Atrazine, Metoalchor and Metribuzin, as Influenced by

Temperature, Soil Moisture and Soil Characteristics. GLWQP 08
E. Topp and W.N. Smith, A.A.F.C, Ottawa, 613-995-5011

Atmospheric Transfer of Agri-chemicals. GLWQP 07
E. Pattey et al, A.A.F.C, Ottawa, 613-995-5011

2D: Alternate Water Supply

Grey-Dufferin Community Pasture LSII 32
Grey-Dufferin Community Pasture c/o Joan McKinlay, OMAFRA, Markdale

Alternate Water Supply. Dufferin SCIA, c/o Joan McKinlay, OMAFRA, Markdale LSII 48

Yeoman's Feedlot Cleanup Project. Napanee Region Conservation Authority LSII 107

Solar Powered Watering Facilities RCC 88
Alternative Livestock Watering Devices Association
Terry Davidson, Rideau Valley Conservation Authority, (613) 692-3571.

11: Treatment of Milkhouse Washwater and other Contaminated Water

Beef Feedlot\Yard Runoff Control by Vegetative Filter Strip RCC 102
Ontario Cattlemen's Association
Peter Doris, Ontario Cattlemen's Association, (519) 824-0334.

Milkhouse Wash Water Control Using a Vegetative Filter RCC 124
Farm Pollution Control Alternatives Assoc.

Renfrew County Environmental Demonstration Site LSII 28
Renfrew SCIA and Claude Weil, Alfred College

Constructed Wetland Treatment Facility RCC 15
The Belle River Conservation Club
Paul Hermans, Region Conservation Authority, (519) 776-5209.

Constructed Wetland Project RCC 90
South Nation River Conservation Authority
Mary-Ann Wilson, c/o South Nation River Conserv. Authority, (613) 984-2949

Constructed Wetland/Manure Management RCC 98
Wentworth Farm Wetlands Club

Manure Management for Swine. Essex Manure Management Club
Essex Region Conservation Authority, (519) 776-5209 RCC 33

16: Nutrient Management

Cropping and Soil Management Effects on the Dynamics of Crop Residue Derived-N
on the Coarse-textured Soils in Southern Ontario LS 7017

Dr. R. Paul Voroney, Dept. Land Resource Science, Univ. of Guelph

Influence of Soil Management System on Potentially Mineralizable N NSCP 5
Dr. Gary Kachanoski, Environmental Soil Services,

Use of Cover Crops for Nitrogen Management LSII 59
K. Hough, Ontario Corn Producers' Assoc., and Dr. T. J. Vyn, Univ of Guelph

Nitrogen Management for Corn Following Red Clover LSII 89
Victoria County S.C.I.A., c/o Neil Moore, OMAFRA, Lindsay

Assessing and Predicting the Effect of Cover Crops and Reduced Tillage on
Nitrogen Management. Ontario Corn Producer's Assoc. RCC 115

Influence of Soil Texture and Tillage Practices on the Susceptibility of Legume-N LMAP 15/94
to Leaching Dr. B.D. Kay, and Dr. V. Rasiah, Land Resource Science, Univ. of Guelph

Nitrogen Budget of Farms in Huron County LSII 100
Huron S.C.I.A. & Centre for Land and Water Stewardship, Univ. of Guelph

Integrated Soil, Crop and Water Management Systems to Abate Herbicide and Nitrate
Contamination of the Great Lakes: Nitrate GLWQP 09
C. F. Drury et al, A.A.F.C., Harrow 519-738-2251

Nitrogen Conserving Farm Systems (Soil nitrate-N test) LS 7020
Dr. R. Gary Kachanoski, Land Resource Science, U. of Guelph

Nitrogen Research with Corn Using Conservation Tillage LS 7018
C.K. Stevenson, RCAT

Nitrogen Test Survey LSII 29e
Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Soil Doctor. Middlesex SCIA, c/o Peter Johnson, OMAFRA, London LSII 26

Variable Rate Technology for Nitrogen Application RF 05/97
Dr. Gary Kachanoski, Land Resource Science, U. of Guelph

Fertilizer Placement with No-Till RCC 125
Arcadia Cooperative Group

17A: Manure/Nutrient Management - General
Literature Search on Manure/Nutrient Management MA 01/94
Dr. Michael Goss, Land Resource Science, University of Guelph

Assessment of the influence of manures for the control of soilborne pests including nematodes, fungi and bacteria. MA 10/97
Dr. George Lazarovits, Pest Management Research Centre, Agriculture and Agri-Food Canada, London

17B: N & C Transformations in Manure During Storage, Handling or in Soil

Nitrogen & Carbon Transformations in Conventionally-Handled Livestock Manures MA 02/97
Dr. G. Kachanoski, Environ. Soil Services

Composting Poultry Manure with a Passive Aeration Windrow System LSII 74
Niagara South S.C.I.A., with Hugh Fraser, OMAFRA and Chris Attema, Niagara Peninsula Cons. Authority.

Evaluation of Three Manure Composting Methods for Nitrogen Conservation, Environmental Impact, Crop Growth Response & Operating and Maintenance Costs NSCP 6
Mr. Richard St. Jean, Ecologistics

Manure Composting Techniques: Understanding N and C Conservation MA 03/97
Mr. Richard St. Jean, Ecologistics Ltd.

Transformation Rates of Inorganic Nitrogen in Animal Manure Into Plants and Soil Organic Matter and its Re-Release From Soil Organic Matter LMAP 13/94
Dr. M. Goss & J.S. Smith, Centre for Land & Water Stewardship, Univ. of Guelph

Transformations in Soil: Crop Response to Nitrogen in Manures with Widely Different Characteristics. Dr. E. G. Beauchamp, J. Buchanan-Smith and M. Goss, Dept. of Land Resource Science, University of Guelph MA 04/97

17C: Manure Application: Sources, Rates, Methods, Timing and Water Quality

Impact of Manure Application Methods on Water Quality, Focusing on Nitrogen and Bacteria Transport in Soil MA 05/97
Dr. Greg Wall, Land Resource Division, C.L.B.R.R., Guelph

The Effects of Livestock Manure Application and Management on Surface Water Quality. D. King et al, A.A.F.C., Guelph 519-766-9180 GLWQP 10

Investigating Methods of Integrating Liquid Manures into a Cropping System and the Effect on Soil and Water Quality RF 02/97
Mr. David Charlton, Ecolog. Services For Planning

Managing Cover Crops & Tillage to Conserve Nitrogen following Manure Applications. Perth County Pork Producers, Cattlemen and Milk Committee with Dr. T. Vyn, Univ. of Guelph LSII 113

Manure Management to Sustain Water Quality NSCP 7
Dr. Dr. M. J. Goss, University of Guelph

Field Drainage Tile Water Quality Study. Eastern Ontario Progressive
Farmers Assoc.; Pierre-Yves Gasser, Ag-Knowledge, Ottawa (613) 789-9603. LSII 66

Renfrew Manure Analysis, Sampling and Spreader Calibration Project LSII 99
Renfrew S.C.I.A., c/o Paul Sullivan, OMAFRA, Nepean

Oxford Manure Application Study LSII 40
Oxford SCIA, c/o Chris Brown, OMAFRA, Woodstock

Poultry Liquid Manure Applications in Growing Corn RCC 72
Agriculteurs Innovateurs de l'Est Ontarien, Pierre-Yves Gasser, Ag-Knowledge, Ottawa

Manure Management in High Residue Applications RCC 29
Charing Cross Conservation Club, Rob Smyth, Director, (519) 436-0501.

17D: Use of Urban Organic Wastes on Farmland

Industrial Organic Compounds in Selected Canadian Municipal Sludges and Agricultural Soils SQEP 11
M. D. Webber, Wastewater Technology Centre, Burlington, Ontario

Closed Loop Recycling - Composted Biodegradable Organic Urban Waste Application on
Agricultural Lands MA 06/97
Mr. David Charlton, Ecological Services For Planning

Soil Rehabilitation After Land Levelling LSII 43
Niagara Peninsula Fruit and Vegetable Growers' Assoc.
c/o Maribeth Fitts, OMAFRA, Vineland Station

Screening of Bestialities Approved for Land Utilization in Corn RCC 96
Dundas Soil and Crop Improvement Association,
Cliff Metcalfe, c/o Eastern Crop Doctor Reg'd, (613) 774-5695.

Improved Placement & Utilization of Bestialities in a Conservation Cropping System RCC 99
Halton Conservation Club, Richard Sovereign, Chairman, (905) 335-9506.

18A: Horticultural Crops: Soil Management

Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil
Properties in Southwestern Ontario (1)R.W. Johnston, RCAT, Ridgetown ONT LS 7005

Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil
Properties in Southwestern Ontario (2) RF 07/97
Mr. Ken Stevenson and R. W. Johnston, RCAT, Ridgetown ONT, N0P 2C0

Impact of Soil Compaction on the Production of Processing Vegetables and Other
Cash Crops (literature review). C.K. Stevenson, RCAT LS 7019

A Cover Cropping Strategy for First Early Potato Production LS 7009

Dr. A.W. McKeown, Simcoe, Horticultural Experiment Station

Introducing No-Till Systems into Crop Rotations Based Upon Tomato Production RCC 59
Kent County Vegetable Growers' Association

Cover Crop Management for Vegetable Production LSII 87
District 1 and 2, Ontario Vegetable Growers, c/o Anne Verhallen, RCAT

Feasibility of Using Permanent Grass Cover in Vineyards LSII 102
Niagara Peninsula Fruit and Vegetable Growers' Assoc.
c/o Maribeth Fitts, OMAFRA, Vineland Station

The Impact of Alternative Drainage Methods on Water Effluent Quality and Quantity of Niagara's Concord and Niagara Grapes. Grape Growers' Mkt. Bd LSII 60
and H. Fraser, OMAFRA; H. Fisher, HRIO; C. Attema, NPCA

18B: Horticultural Crops: Greenhouse Management

Management Practices Supporting Environmental Sustainability for Greenhouse Vegetable Production. Ontario Greenhouse Vegetable Producers' Marketing Board LSII 72

Management Practices Supporting Environmental Sustainability for Greenhouse Flower Production. Flowers Canada Ontario, Niagara Chapter LSII 91

19A: Conservation Cropping Systems - General

Farm Mapping - Management with a G.I.S. Agriculteurs Innovateurs de l'Est Ontarien. Pierre-Yves Gasser, Ag-Knowledge, Ottawa (613) 789-9603. RCC 45

Farming for Maximum Efficiency and Environmental Sustainability RCC 78
Innovative Farmers of Ontario, c/o Stewardship Info. Bureau, (519)767-5020

Differences in Soil Conservation Between Operator-owned and Rented Land LS 7008
Dr. W. van Vuuren, Dept. of Ag. Economics and Business, U. of Guelph

Review of No-till Information for Ontario: Corn, Soybeans, Winter Wheat LSII 71
Kent County S.C.I.A. (author: Janice Elliot, Summer Ass't, OMAFRA, Ridgetown)

19B: Cropping Systems and Water Quality

Environmental Effects of Conservation and Conventional Cropping Systems RF 03/97
Jane Sadler-Richards, Ecologistics Ltd

Maintenance Program for Three Southwestern Ontario Watersheds. LMAP 16/94
Mr. David Hayman, Upper Thames Conserv. Authority, R. R. #6, London, N6A 4C1

Upper Avon River Rural/Urban Conservation Club RCC 17
Craig Merkley, Upper Thames River Conservation Authority, (519) 451-2800.

The Effect of Soil Quality on Field Scale Runoff under Conventional and Conservation Tillage Systems. Dr R. Walker and Dr. R. Tossel, Beak Consultants Ltd. NSCP 8

Effect of Controlled Drainage/Subirrigation on Tile Drainage Water Quality and Crop Yields at the Field Scale. MA 08/97
Dr. Ian van Wesenbeeck, Harrow Research Station, Agriculture Canada

Measuring the Effect of Crop Residue or Live Cover Crops in Conservation Tillage Systems on Soil and Water Quality RF 06/97
Dr. Ian Van Wesenbeeck, Harrow Research Station, Agric. Canada

<u>19C: Cropping Systems and Soil Properties</u>

Crop Residue Decomposition and Organic Matter Dynamics in Alternative Management Systems on Coarse-textured Soils. R. Beyaert, Delhi Research Station, Agriculture and Agri-Food Canada NSCP 9

Crop Rotation Effects on Crop Yields and Soil Properties in Southwestern Ont.
D.S. Young C.K. Stevenson, C.S. Baldwin and B.R. Doidge, RCAT LS 7011

Determining the Factors Responsible for, and Methods to Overcome the Limitations of Conservation Cropping Systems on Clay Soils RF 04/97
Dr. Tony Vyn, Crop Science, University of Guelph, Guelph, ONT, N1G 2W1

Improving the Degraded Structure on Fine Textured Soils with Deep Tillage and Grass and Legune Crops. Claude Weil, ACAFT LS 7012

Improving the Degraded Structure of a Clay Loam Soil with Deep Tillage and Grass and Legume Crops LS 7013
W. Curnoe, KCAT, J. Culley, L. Heslop and N. McLaughlin, Agriculture and Agri-Food Canada

Management of Fine Textured Poorly Drained Soils for Intensive Agriculture LS 7002
Dr. J.A. Stone, Harrow Research Station

Management of Fine Textured Poorly Drained Soils For Intensive Agriculture: Characterization of a Forage Factor which Enhances the Growth of Corn in Rotation - Parts I & II LS 7006 & 7007
I - Dr. Ann Oaks, McMaster Univ., II - Dr. J.A. Stone, Harrow Research Stn

Crop Production with a No-traffic Tillage System. D.S. Young, RCAT LS 7015

Soil Stewardship Cropping Systems for Corn & Soybean Production LS 7004
Dr. B.D. Kay, LRS, U.of Guelph, Principal Researcher

Tillage Requirements for Corn and Soybeans Following Soybeans LSII 58
Dr. Tony Vyn, University of Guelph

Literature Review Pertaining to Buffer Strips NSCP 11
Soil and Water Conservation Information Bureau

<u>19D: Conservation Cropping System Demonstrations</u>

Variable Input Application RCC 84
Kent Precision Farming Club, Doug Smith, Project Leader, (519) 692-5240.

Tillage and Yield Study Group LSII 29a
Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Conservation Farming for Profit RCC 97
Peel Soil Conservation Club, Gord Armstrong, (905) 843-1795.

Comparison of Strip-Cropping and Field-Cropping RCC 67
Ontario Ridge Till and Strip Cropping, c/o Joe Omielan, (519) 240-3769.

Rye Cover Crop in Corn LSII 29d
Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Pre-Tillage of Cereal Stubble in a No-Till or Minimum Tillage System RCC 68
Middlesex Pre-Till Club, Rick McCracken, (519) 289-5576.

Para-Tillage: A Jump Starter for a Conservation Tillage Program RCC 09
South Lambton Conservation Tillage Club, Barry McFadden (519) 683-6012.

Conservation Tillage for Profit RCC 110a
Wellington County Conservation Club,
Elaine Williamson, c/o Willoa Associates, (519) 856-2165.

Conservation Farming RCC 110b
Wellington County Conservation Club - Martin de Groot, (519) 638-3481.

No-till Demonstrations and Trials. North Kent No-till Group LSII 61

Soil Conditioning for No-till Systems LSII 22a
Essex Conservation Club, c/o Bill Stevens, OMAFRA, Esssex

Economic Conservation Yield Monitoring Program LSII 22b
Essex Conservation Club

No-till Demonstrations. East Kent No-till Farmers LSII 35

Evaluation of No-till in Corn and Soybeans LSII 65
Erie Thames No-Till Innovators

On-farm Demonstrations and Trials. Electric Reduced Tillage Group LSII 80

Comparison of No-till Planting Equipment. South-west Kent No-till Group LSII 81

No-till Equipment for Brookston Clay. Townline No-tillers Group LSII 105

No-till Systems for Brookston Clay LSII 106
Anderdon No-tillers Group, c/o Bill Stevens, OMAFRA, Essex

Evaluation of Corn Hybrids under Ridge-till, Zone-till and Conventional
Tillage Systems. Kent Corn Producers' Assoc. and Gordon Scheifele, RCAT LSII 115

Conservation Technology and Practices in the Cultivation of Canola LSII 7,11
Ontario Canola Growers' Association

Reduced Tillage in Spring and Winter Canola Production RCC 122
Ontario Canola Growers Association (PROJECT COMPLETED)
Murray Smeltzer, Chairman, (519) 291-4811.

Forages for Soil and Profit. Renfrew Soil and Crop Improvement Association RCC 34
Paul Sullivan, Project Advisor, c/o OMAFRA (613) 828-9167.

Wilkesport Demonstration Club RCC 42
Lambton S C I A, c/o Gabrielle Ferguson (519) 882-0180.

20A: Pest Management: Field Crops

Reduced Chemical Input Systems for Improved Water Quality. GLWQP 12
M.A. McGovern et al, A.A.F.C, Ottawa, 613-995-5011

Integrated Soil, Crop and Water Management Systems to Abate Herbicide and
Nitrate Contamination of the Great Lakes: Herbicides GLWQP 04
J.D. Gaynor et al, A.A.F.C., Harrow 519-738-2251

Management of Corn Rootworms on Farms by Monitoring Eggs RCC 75
Cliff Ellis, Dep't. of Envir. Biology, Univ. of Guelph, (519)824-4120 ext 3076

No-Till Demonstration Plot. Rondeau Agricultural Conservation Corp. LSII 23

Band Spraying, Inter-row cultivation, and Sidedress Nitrogen Application for Corn
in Eastern Ontario. Carleton SCIA, c/o Paul Sullivan, OMAFRA, Nepean LSII 63

Band Spraying. Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia LSII 29c

Evaluation of a Vegetation Detecting Weed Sprayer LSII 70
Rondeau Agric. Conservation Corp., Jack Rigby, R. R. # 2, Blenheim, N0P 1A0

Integrated Weed Control, Nutrient Management and Reduced Tillage in Corn
and Soybeans. Carleton S C I A, Rick Schouten, (613)489-3667. RCC 25

Long Term Economical & Environmental Feasibility Study of Using a Vegetation Detecting Sprayer for Weed Control in Conservation Cropping — RCC 08
Rondeau Agricultural Conservation Corp., Herb Groenewegen, (519) 676-4806.

20B: Pest Management: Horticultural Crops

Alternative Methods for Colorado Potato Beetle Control — RCC 16
Southwestern Ontario Potato Beetle Club,
Janice Elmhirst, Ridgetown College of Agricultural Technology, (519) 674-5456.

Non-Chemical Methods of Control of the Colorado Potato Beetle in Potatoes
Ontario Potato Pest Management Club — RCC 76
Mark Sears, Dep't. of Envir. Biology, Univ. of Guelph, (519)824-4120 ext. 3567

Water and Chemical Management systems for the Turfgrass Industry — RCC 120
Guelph Turfgrass Institute

21: Wetlands and Streambanks

Project to Evaluate and Demonstrate Wetland Restoration. Essex Wetland Restoration Club. Essex Region Conservation Authority, (519) 776-5209. — RCC 14

Ontario Land Care - Extension Project Sites — RCC 77
Ducks Unlimited Canada, Galen Driver, (705) 721-4444.

South Simcoe Wetland Project. South Simcoe Conservation Club — RCC 92

Land Use Adjacent to Southern Ontario Wetlands — LMAP 6
Elizabeth Snell, Snell and Cecile Environmental Research, (519) 821-5710.

COMPUTER SIMULATION OF BMP'S - A strategy to locate and manage artificial wetlands, ponds, infiltration systems and overland flow treatment systems — LMAP 7
Claude Weil, Alfred College

A Program to Assess Surface- and Groundwater Quality At Farm Sites Selected for Artificial Wetland Construction — LMAP 14/94
Assoc. of Conservation Authorities of Ontario (Contact: David Hayman)

To Investigate the Establishment Subsequent Growth and Erosion Control Potential of Certain Tree and Shrub Species on Gully and Stream Banks — LS 7010
A. Skepasts, Head, Agronomy Section, NLCAT

23: Woodlots and Wildlife

Farm Shelterbelt Design and Demonstration — LS 7014
Dr. V. Chanasyk, Landscape Architecture, University of Guelph

Agroforestry Research in Ontario — LS 7003
Mr. C. Nanni, Principal Researcher, RCAT.

Agroforestry Research and Development — LS 7000
Prof. Andrew M. Gordon, OAC, Principal Researcher

Effect of Different Maple Bush Management Techniques on Tree Growth — RCC 117
Assoc. des Producteurs Francophone d'Acericulture de l'Ontario

Literature Review on Wildlife Habitats in Agricultural Landscapes — MA 09/94
Mr. Lyle Friesen, Canadian Wildlife Service, Environment Canada, Hull

The Development Of An Ontario Goose Depredation Survey Project — LMAP 9
Canadian Wildlife Service
Laurie Maynard, Environmental Conservation Branch, C W S, (519)766-1593.

Wildlife Habitat Enhancement on the Farm — LMAP 10
Maitland Valley Conservation Authority
Phil Beard or Chris Hoskins, Maitland Valley Cons. Authority, (519)335-3557.

<u>Wetlands/Woodlots/Wildlife</u> (21,23)

BIGHEAD RIVER DEMONSTRATION PROJECT — WWW 01
Lead Organization: Grey County Soil and Crop Improvement Association, Ray Robertson, (519) 986-2040

CONSERVING BIODIVERSITY IN AGRICULTURAL ECOSYSTEMS OF THE CAROLINIAN LIFE ZONE — WWW 02
Lead Organization: Federation of Ontario Naturalists, Kim Gavine, (416) 444-8419

COLD CREEK DEMONSTRATION PROJECT — WWW 03
Lead Organization: Ontario Federation of Anglers and Hunters, Ed Reid, (705) 748-6324

LAUREL CREEK WATERSHED DEMONSTRATION PROJECT — WWW 04
Lead Organization: Grand River Conservation Authority, Peter Mason, (519) 621-2761

LA CITÉ COLLÉGIALE'S WETLANDS/ WOODLANDS/ WILDLIFE PROJECT IN THE HAWKESBURY AREA — WWW 05
Lead Organization: La Cite Collegiale, Jacques Bouvier, (613) 632-2483

SNAKE RIVER AND MUSKRAT BASIN DEMONSTRATION PROJECT — WWW 06
Lead Organization: Ontario Federation of Anglers and Hunters, Ed Reid, (705) 748-6324

ISSUES AND OPPORTUNITIES FOR WILDLIFE HABITAT CONSERVATION IN AGRICULTURE — WWW 07
Lead Organization: Lower Trent Region Cons. Authority, Barry Jones, (613) 394-4829

ENHANCEMENT OF CADDY-BOTT DRAIN IN MIDDLESEX COUNTY — WWW 08
Lead Organization: Uppet Thames Region Cons. Authority, Paul Fish, (519) 451-2800

MANAGING AGRICULTURAL DRAINS TO ACCOMMODATE WILDLIFE WWW 09
Lead Organization: Ontario Soil and Crop Improvement Association
Andrew Graham, (519) 767-4601

LINKING SUSTAINABLE AGRICULTURE AND WETLANDS CONSERVATION WWW 10
Lead Organization: Ducks Unlimited, Rick Wishart, (705) 721-4444

24: Other

The Community Supported Agriculture Project RCC 48
Chris Beeman, Co-ordinator, (613) 549-4800, or Tamsyn Rowley, (519) 822-2410.

Literature Review of Methods Used to Conduct and Evaluate On-Farm Research RF 01/94
Ms. Jane Sadler-Richards, Ecologistics Ltd.

Appendix E: Summaries of Individual Projects Conducted Under Green Plan (Ontario) Programs

Legend:	Program Title
LS	Ontario Land Stewardship Program
SQEP	Soil Quality Evaluation Program
NSCP	National Soil Conservation Program
GLWQP	Great Lakes Water Quality Program
LS II	Ontario Land Stewardship II Program
ESI	Environmental Sustainability Imitative
LMAP	Land Management Assistance Program
Current projects:	
RCC	Rural Conservation Club Program
MA	Manure/nutrient Management and Closed Loop Recycling
RF	On-Farm Research
MO	Development of an Integrated Resource Monitoring Capability
WWW	Wetlands/Woodlots/Wildlife

1A: Development of Methodologies to Evaluate Soil Quality:

Benchmark Sites for Assessing Soil Quality SQEP 4

Contractor: C. Wang, CLBRR, Ottawa and colleagues in CLBRR units in each province

Objectives:
1) To provide a baseline data set for assessing changes in soil quality and biological productivity (i.e. yields) of representative farming systems;
2) To provide a means of testing and validating predictive models of soil degradation and from for evaluating the sustainability of land management practices;
3) To provide a network of well-documented sites at which integrated multi-disciplinary research programs can be developed.

Output: A network of 23 benchmark sites has been established across Canada, representing prevailing land use and management practices on representative soil landscapes. The sites were characterized in detail for a wide range of chemical, physical, mineralogical and morphological soil properties, along with current and historical land management practices.

Evaluating Changes in Soil Organic Matter SQEP 7

Contractor: E. G. Gregorich and C. M. Monreal, CLBRR, Ottawa; B. H. Ellert, CLBRR, Lethbridge, D. A. Angers, CLBRR, Sainte-Foy; M.R Carter, CLBRR, Charlottetown

Objectives:
1) To test a simulation model (CENTURY) for predicting changes in soil organic matter in different soils and crop rotations across Canada;
2) To develop criteria for evaluating soil organic matter quality;
3) To assess actual changes in soil organic matter associated with agricultural systems in Eastern Canada, by comparing soils under agricultural crops with those under adjacent native forests.

Results and Conclusions: The CENTURY model mimicked the soil organic matter dynamics in the Brown, Dark Brown and Black Chernozemic soils. It was not appropriate for Solonetzic soils. The model accurately predicted changes in soil organic C and N, under continuous corn in southwestern Quebec and the effects of manure applications on soils where C levels were declining because of continuous corn and high rates of erosion.

The quality and quantity of soil organic matter of agricultural and forest soils were compared at 22 sites in eastern Canada. On average, the mass of C in cultivated soils was 35% lower than in forested soils; the mass of N was 20% less in the cultivated soils. Annual fertilization tended to increase C soil levels. In a poorly drained soil, C levels were higher where tile drains had been installed.

The following biological properties were found to be useful in evaluating various aspects of soil quality: total organic C and N, light fraction, mineralizable C and N, microbial biomass, and soil enzymes.

Assessing Change in Soil Physical Quality SQEP 9

Contractor: R. A. McBride and D. W. Veenhof, Land Resource Science, Univ. of Guelph; and G. C. Topp, Y. T Galganov and J. L. B. Culley, CLBRR, Ottawa

Objectives:
1) To develop procedures to measure aspects of the physical quality of agricultural soils and the current state of these physical qualities.
2) To assess the influence of current agricultural land management practices on these physical qualities.

Results and Conclusions: Soils at 12 field sites in the Region of Haldimand-Norfolk were tested for the following: static, uniaxial compression of structurally intact soils; remoulded (slurry) consolidation; non-limiting water range (NLWR). Soils at 8 other sites were tested for infiltration and redistribution of water in the field and penetrometer resistance at selected water-potentials.

The compressive behaviour of many of the Haldimand-Norfolk soils under saturated and unsaturated conditions showed that the compression index tended to increase with increasing initial porosity, but that the degree of saturation had only a limited influence on the relative positions of compression lines. The study results also suggest that the relationship between the "normal consolidation line" and the "virgin compression line" is a more sensitive measure of the degree of soil consolidation than more traditional tests. The soils which appear to be most susceptible to a significant loss of total porosity from wheel-traffic are imperfectly or poorly drained, medium-textured soils. Fine-textured soils were frequently already so over consolidated as to resist further compaction during the corn growing or harvest season.

The NLWR concept, which incorporates and integrates a number of plant response factors, was shown to be useful when used relative to the traditional available water capacity. Long-term cultivation tended to decrease the NLWR:AWC ratio. A major factor in this decrease was an apparent increase in soil strength, limiting root growth.

University of Guelph/Soil Research ESI 1

Objectives: 1) to identify a method of measuring soil structural changes that may be related to soil management systems and that are useful in characterizing changes in soil quality;
2) to evaluate the suitability of existing crop productivity models for predicting crop response to changes in soil quality.

Soil Organisms as Bioindicators of Agronomic Practices. MA 07/97

Contractor: Dr. A. Tomlin, A.A.F.C., 1391 Sandford St., London, ONT N5V 4T3

Objectives: To measure response of selected soil bioindicators to agronomic practices in southwestern Ontario; to use the correlation between soil biotic activity and soil organic matter (OM), to classify soils by biotic content; use resin impregnated blocks for micro-fabric analysis of soil structure, OM and void space.

Expected Outputs: Development of a bioindex of soil quality through the use of resin impregnated blocks for micro-fabric analysis to provide snapshots with archival value, for comparison purposes with blocks taken later, or under different soil management. Experience should provide useful modifications, and confidence in the interpretation that can be made from this fixed record of the soil fabric, and new applications for the information therein contained. Project may lead to creation and use of soil ecosystem models, possibly at the landscape scale, for estimating resident biomass and soil carbon.

1996-97

Ending:

Development of Standard Methodologies: Resident Biomass and Organic Carbon MO 01/95

Contractor: Mr. David Charlton, Ecolog. Services For Planning, 361 Southgate Drive, Guelph, N1G 3M5

Objectives: To test the ability of current measures of resident biomass and organic carbon to relate soil fitness, crop performance and yield as indicators of agro-ecological fitness when tested over a range of physical, chemical and biological soil properties.

Expected Outputs: Measurements of spatial and temporal variation of soil biomass and carbon on the basis of landscape position, geographic location and seasonal variability sufficient to distinguish seasonal and random variations, and useful for characterizing agricultural resource fitness.

Ending: 1994-95: TO BE COMPLETED MARCH '95

Measuring Soil Microbial Populations by Analysis of Their Phospholipid Signatures MA 11/95

Contractor: Dr. Ralph Chapman & Ms. Joy Kohlmaier, Pest Management Research Centre, Agriculture and Agri-Food Canada, 1391 Sandford St, London, ONT, Canada, N5V 4T3

Objectives: 1) To establish sensitivity limits of the P-31 NMR technique using a set of pure phospholipid reagents;
2) To establish extraction protocols, minimum sample sizes, and extraction efficiencies as well as a set of phospholipid profiles for identifying the microfloral components in the soil samples using soil samples obtained from one set of the Green Plan Bioindicator sites (conventional vs. no-till vs. woodland).

Expected Outputs: 1) To make comparisons and to establish correlations between this data set and other data sets from conventional microfloral characterizations of the soil, towards the objective of associating phospholipid profiles with specific groups of microflora. If these correlations prove successful, they can be used in the development of bioindicators;
2) To develop a (bio)indicator of land use practice, based on either fatty acid or phospholipid analysis, that could be related to the underlying soil biological community, and other soil characterizations being made that relate to soil quality.

Ending: 1994-95: TO BE COMPLETED SEPT. '95

Development of Standard Methodologies: Resident Biomass and Organic Carbon MO 02/96

Contractor: Dr. Gary Kachanoski, Environmental Soil Services, 605 Arkell Rd., Arkell, Ont N0B 1C0

Objectives: To develop and test methods of measuring resident biomass and soil carbon and to relate these measurements to other soil properties directly related to soil fitness.

Expected Outputs: 150 of 200 A_p- horizon soil samples (75 landscapes x 2 tillage systems) from the TILLAGE-2000 plots will be utilized for developing and comparing methods of soil carbon analysis. Following these analysis, attention will be given to quantifying the effects of soil management on soil carbon levels, as well as the effects of other spatial and temporal functions such as soil erosion. Extensive background documentation is available to support interpretation of the current study.

1995-96:

Ending:

Bio-indicators and Methodologies to Quantify Soil Quality. MO 03/97

Contractor: Dr. C. M. Monréal, CLBRR, Agriculture Canada, Ottawa

Objectives: To develop, test and adapt methodologies to examine the use of soil enzymes, lipids and light fraction of soil organic matter (SOM) as indicators of soil fitness, current agro-ecological status and to inform the public on the impacts of management on soil resources; to characterize and separate temporal and spatial variabilities of soil enzymes, lipids and light fraction from normal and random variation with a view to establishing quantitative relationships between soil enzyme properties, lipids and light fraction with other soil attributes that relate to quality in soil agro-ecosystems.

Expected Outputs: A comprehensive database of kinetic parameters (Michaelis constant, maximum velocity and inhibition constants) on soil enzymes (dehydrogenase, glucosidase, glutaminase, urease, sulfatase, phosphatase) lipids and light fraction obtained in spatially and temporally variable situations in the A and B horizons of native and cultivated soils. Soil properties are expected to be associated with cultivation, sources of N, tillage, and physical soil properties. Statistical models used in quality control systems will be tested to quantitatively assess the potential relations of soil biochemical and chemical properties with soil fitness and quality under aggrading, sustaining and degrading conditions.

Ending: 1996-97:

Response of Earthworms, Soil Biota and Soil Structure to Agricultural Practices in Corn, Soybean and Cereal Rotations. NSCP 1

Contractor: Dr. A. D. Tomlin et al, London Research Centre, Agriculture and Agri-Food Canada

Results: Herbicide treatments reduced earthworm and some mite populations as much as machine cultivation for weed control. Continuous soybeans reduced the abundance of earthworms, mites and springtails compared to cereal or corn rotations. Most of the faunal and microfloral increases can be ascribed to increases in available soil organic matter.

Techniques developed for image analysis of soil microfabric and fine soil structure, allow measurement of differences in microfabric response to crop, tillage and weed control methods.

Soil Life Demonstration Project RCC 73

Essex Conservation Club - three year project

Earthworm population studies have not been performed or documented in Essex County to demonstrate the effect of a residue management system on earthworm populations. Commencing April 1, 1994, members of this club plan to study the population of earthworms present:

- in different tillage systems (comparison of conventional tillage, mulch tillage and no-till)
- in a field that is converted from conventional tillage to no-till, over an extended period of time
- to determine if considerations such as soil type, crop rotation or manure application effect this population

The earthworm population will be determined using two different methods:

1) counting the number of earthworm holes present. This is performed by removing the top 2.5 cm of the soil from an 1/4 m² area. The surface will then be smoothed out with a flat scraper and loose soil will be removed with a portable vacuum. A 1/4 m² frame will then be placed on the surface and holes greater than 1 mm in diameter within this frame will be counted.
2) within this same frame a weak solution of formaldehyde solution (2%) will be applied generously. This will irritate the earthworm's epidermis causing them to travel to the surface. A more reliable count will then be taken of live earthworms existing in the soil.

Don Depuydt, Essex Region Conservation Authority, (519) 776-5209.

Response of the Soil Microflora and Fauna to Spring Plowing of Zerotill and Pasture Soils LS 7016

Contractor: V.G. Thomas, and P. Neave, LRS, U. of Guelph

Objectives: 1. To examine the effect of plowing on the soil microflora and fauna in zerotilled and pasture soils.
2. To examine what differences exist between the pasture and zerotill soils (plowed and unplowed) in terms of biomass, number of organisms and their diversity.

Results: Stability is shown to be greater in the zerotill system. Return times of invertebrate communities were shorter in the zerotill system and deflection away from ground state was less in zerotill. Three conceptual models are provided to explain this result, using past history of disturbance and the successional state of the two communities. Previous disturbance "prepares" the zerotill community for the disturbance of plowing and it is able to respond quickly. The pasture community is not similarly prepared because it has not been disturbed recently and consequently takes longer to recover.

It has been recommended to farmers that it is best to no-till the soil for four to five years and then plow it up and start over again. However, the soil quality indicators of pore continuity, water infiltration rate and number of earthworms do not support this recommendation. Saturated hydraulic conductivity and dry bulk density were significantly higher in zerotill unplowed soil than in plowed soil. This indicates that there is a much higher pore continuity in the unplowed soil.

Plowing the soil decreased water infiltration in zerotill soil 100 days after plowing and earthworm numbers did not return by 142 days after plowing. It appears that plowing zerotill soil is not beneficial.

The zerotill system does not have low stability or low diversity in this study. These findings question previous recommendations about the need to increase diversity and/or stability in agroecosystems. If future studies provide evidence that agroecosystems are stable, then this whole area of agroecology may have to be rethought. It may be possible that pest outbreaks are not due to ecosystem instability, but rather single population instability.

Methodologies for Assessing Soil Structure and for Predicting Crop Response to Changes in Soil Quality NSCP 2

Contractor: Dr. B. D. Kay et al, University of Guelph

Objectives: To identify a method for measuring soil structural changes which may be related to soil management systems and which can be shown to be useful for characterizing changes in soil quality across a range of soil conditions.

To evaluate existing crop productivity models in terms of their suitability for predicting crop response to changes in soil quality.

Results: Methods to assess both structural stability and structural form were evaluated. Pedotransfer functions were developed, where possible, to describe the contribution of inherent soil properties to the magnitude of the parameters measured.

Stability parameters at the scale of aggregates and of dispersible clay appeared to be important in describing runoff volume and sediment load. A turbidmetric technique was developed to characterize dispersible clay. The dispersible clay content increased with increasing clay content, increasing water content and decreasing organic matter content.

Wet aggregate stability increased with clay, water and organic matter contents. The reduction in stability with tillage was related to the reduction in organic matter with tillage. Tensile strength increased with clay content, wet aggregate stability and decreasing organic matter content. Bulk density varied with clay and organic matter content and, for a given soil type, was about 11% higher with no-till than with conventional tillage.

Least limiting water range (LLWR) varied widely with clay and organic matter content for a given tillage treatment. Field saturated hydraulic conductivity was higher under no-till than conventional tillage, perhaps because of greater macropore continuity in no-till.

1B: Soil Erosion Measurement and Prediction

Water Erosion Prediction and Assessment SQEP 6

Contractor: G. J. Wall and E. A. Pringle, CLBRR, Guelph, and D. R. Coote, CLBRR, Ottawa

Objectives: To evaluate the effect of water erosion on soil quality and provide guidelines for the implementation of soil conservation practices by:

1) baseline monitoring of soil erosion rates on agricultural landscapes across Canada;
2) validating water erosion prediction methods;
3) using water erosion models to predict past and future changes in soil erosion losses from agricultural landscapes, and;
4) compiling a report on soil erosion risk and a handbook for estimating soil loss.

Output:

i) Samples were collected from a range of sites across Canada for analysis for Cesium 137 and estimation of soil redistribution or loss.
ii) A soil erosion model, developed in the USA, the Water Erosion Prediction Project (WEPP), was evaluated under Canadian conditions and several weaknesses identified.
iii) The Universal Soil Loss Equation (USLE) is being used, in conjunction with census data from 1981 to 1991, to highlight areas where changes in management practices have resulted in significant reductions is soil erosion.
iv) Large scale soil erosion risk maps are available for all regions of the country and should prove useful to those concerned about soil quality on a regional basis. The soil erosion manual, focused on use of the USLE for soil and water conservation planning, has been completed.

The Relationship Between Landscape Position, Tillage Practices and Soil Loss: Model Development NSCP 10

Contractor: Dr. G. Kachanoski and D. Lobb, University of Guelph

Objectives: To define the relationship between tillage erosion and landscape position using a model based on data from a Huron County study.

Results: The tillage erosion model predicted soil redistribution at one site but not at another, probably because of the limited amount of data upon which the model was based and because the simplicity of the model. The experiments did show that a tillage erosion model will be more appropriate than water erosion models for predicting soil erosion in complex landscapes.

Monitoring Soil Loss and Redistribution Using ^{137}Cs MO 08/96

Contractor: Dr. Gary Kachanoski, Environ. Soil Services, 605 Arkell Rd., Arkell, Ont N0B 1C0

Objectives: To map base-line ^{137}Cs values for an extensive part of southern Ontario to provide a future framework for classifying all present and future studies related to soil quality; and to determine the redistribution of ^{137}Cs in a selected watershed which will demonstrate deposition within the watershed, export out of the watershed and loss from the surrounding uplands which will serve as a monitoring site for soil quality measurements in the future.

Expected Outputs: A data base of ^{137}Cs values across South, West, Central and Eastern Ontario which will assist in actual measurements of soil loss. The unique character of this technology, which rests on the fallout from the testing of thermonuclear devices in the early 1950's and 1960's, is the fact that ^{137}Cs is held tightly by soil, is not taken up by plants or leached out, and only moves from a site if the soil is lost. In order to use this tool to define the state of the agricultural resource, a well defined base-line map is needed.

Ending:

1995-96:

<u>1C: Development of Methods to Monitor and Map Soil Resources</u>

Computerized System to Manage, Use and Distribute Data Collected by Green Plan Monitoring Research Projects MO 09/96

Contractor: Mr. Ken Denholm, Land Resource Unit, C.L.B.R.R., 70 Fountain St., Guelph, N1H 3N6

Objectives: To develop a data management and analysis system with the capability to correlate, interpret and document linkages between the data collected through Green Plan Monitoring Research Projects and other land resource information for Ontario; to carry out data and spatial analysis to verify the quality and content of data delivered through the Green Plan Monitoring Component; where possible to standardize and extend the area of the data analyses; to provide standardized, documented copies of data for assessment and use by other projects and agencies and for comparison with future measurements.

Expected Outputs: A conceptual framework within which data collected from Green Plan Monitoring Research activities are organized in a way capable of correlation, interpretation and linkage to other land resource information for Ontario. It is expected that data and spatial analysis will be carried out to verify the quality and content of the data being drawn from the Green Plan Monitoring projects. This analysis will have enhanced the original project results and lead to potential extension of the data to other parts of the province and to other areas of study. Not least will be provision of standardized, documented copies of data for assessment and use by other projects

Ending: and agencies and for comparison with future data.

1996-97:

Proposal for the Upgrade of Soil Survey Information in Oxford County MO 05/95

Contractor: D. Charlton, Ecolog. Services For Planning, 361 Southgate Drive, Guelph, ONT N1G 3M5

Objectives: To provide updated information on the soil resource base to allow standard capability and environmental interpretations. Study area is Oxford County, a gap in the existing data base required to address planning and environmental issues in agriculture in the Lake Erie Basin.

Expected Outputs: A compilation of existing information, a review of the status of adjacent county soil surveys with extrapolation into Oxford County, a test of a digital terrain model using 1 m contours for upgrading slope information, an appropriate sampling methodology for upgrading and verification of slope information, soil analysis of dominant soil types, and finally, an upgraded 1:50,000 soil map in digital format acceptable for the Provincial data base.

1994-95: TO BE COMPLETED MARCH '95

Ending:

A Proposal to Assess the State of Agricultural Resources: Improving the Land Resource Database MO 04/94

Contractor: **Expected Outputs**:

Objectives:

Ending: Mr. David Cressman, Ecologistics Limited, 490 Dutton Drive, Waterloo, ONT, N2L 6H7

To develop and test methods of upgrading and organizing soil survey information in selected settings in order to better understand the present condition of the agricultural land resource base and make it more useful for resource and land use planning purposes.

Consideration of two distinct types of problems and suggested approaches for dealing with each will be developed to enable work to be completed across two important target areas. The two areas are Waterloo Region and the Town of Whitchurch-Stouffville in York Region. The latter includes landscapes of both an agricultural and an open space character, the latter being portions of the Oak Ridges Moraine. Both candidate sites suffer from deficiencies in their GIS-based soil resource inventories or maps, corrections of which will be adjusted on a pilot scale to estimate the time, effort and success which might be anticipated on a larger scale.

1993-94: COMPLETED, IN REVIEW

Improving the Land Resource Data Base - Waterloo Region MO II/96

Contractor: Mr. D. Cressman, Ecologistics Limited, 490 Dutton Drive, Waterloo, ONT, N2L 6H7

Objectives: To compile and document for the complete Regional Municipality of Waterloo a soil survey map and associated database appropriate for use at a scale of 1:50,000 with linkage to the existing 1:20,000 soil survey data. The methods used to compile this information will be in accord with the procedures developed in the pilot study including the upgrade of slope classes to current CSSC standards and minor modifications of boundaries to correspond with current stream boundaries and topographic and cultural features.

Expected Outputs:

1) The final report will describe the relationship of the new map and database to the older 1:20000 Waterloo Soil Report # 44, and will include a discussion of appropriate ways of using the database;
2) The final report will include a plotted map produced at a scale of 1:50,000 showing soil polygons on an OBM base showing major cultural features (roads and urban areas), major watercourses and major land disturbances such as gravel pits and a printed legend showing soil attributes;
3) The final report will include digital data files of the map and associated database in standard ARC/Info format in a version and medium compatible with the hardware and software at the Ontario Land Resource Unit. Separate layers will be provided for the soil thematic layer, the hydrology layer, and the cultural layer. So far as possible the CanSIS conventions for naming of arc IDs will be used. The digital file record layout, format and contents will conform to the CanSIS standards as described in "CanSIS Manual 1 - CanSIS/NSDB: A general description" with the addition of a file which provides the linkage between the 1:50000 scale polygons and the 1:20000 scale polygons.

Ending: 1994-95

Development and Application of Standardized Methodology for Sampling Soil Landscape Polygons MO 06/95

Contractor: J. Hagarty, Ecolog. Services For Planning, 361 Southgate Drive, Guelph, ONT, N1G 3M5

Objectives: To develop and test a method to establish the State of the Resources to clarify the "fitness" of the agricultural resource and to provide "snapshots" of their status for public information.

Expected Outputs: A documented methodology for the collection, analysis and interpretation of soils data (organic carbon, textural class, pH and carbonates) obtained from selected soil landscape polygons identified in the Soil Landscapes of Canada, Ontario-South (1:1,000,000). Additionally, this methodology will be applied to a large portion of southern Ontario in order to characterize and update the current state of the soil that this methodology will provide a broad scale State of the Resources reporting tool.1994-95:

Ending:

TO BE COMPLETED MARCH '95

Development and Testing of "State of Agricultural Resources":
A Reporting and Monitoring Methodology for Ontario. MO 07/95

Contractor: Mr. Harold Moore, Gregory Geoscience Ltd, Kanata Square, Suite 504, 260 Hearst Way, Kanata ONT, K2C 2B5

Objectives: To develop and test a methodology to monitor the State of Agricultural Resources (STAR) in Ontario.

Expected Outputs: Definition of information requirements of a monitoring methodology; collection of data needed to supply the required information, and a definition of the resources modelling procedures required; tests of the methodology from two parts of the province (Lanark and Kent Counties); definition of implementation of methodology for Ontario.

Ending: 1994-95: TO BE COMPLETED MARCH '95

A Conceptual Framework for Soil Quality Assessment and Monitoring SQEP 1

Contractor: D. F. Acton and G. A. Padbury,Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research (CLBRR) Saskatchewan Land Resource Unit, Saskatoon, Saskatchewan

Objectives: To provide a structure for organizing knowledge of the factors that determine soil quality, so as to facilitate development of procedures for assessing and monitoring soil quality in Canada

Output:. The framework considers soil quality as the capacity of the soil to produce crops in a sustainable manner without negatively affecting the environment. Soil quality is determined largely by inherent soil properties, but land use may alter these substantially. Two general approaches to soil quality assessment and monitoring are integrated into the framework. The pathways in the framework are:

1) Determination of the objectives of the evaluation (e.g. critical soil quality functions, spatial and temporal dimensions)
2) Data collection and management.
3) Final selection of the criteria for assessment.
4) Prediction of the condition of, or the change in, soil quality.
5) Output will be a measure or predicted description of the condition of soil attributes or elements that reflect a change in, or new state of, soil quality.

GIS-Based System to Assess Soil Quality SQEP 2

Contractor: K.B. MacDonald, and F. Wang, CLBRR, Guelph
W. Fraser, G. W. Lelyk and I. Jarvis, CLBRR, Winnipeg

Objectives:

1) To develop an operational geographic information system (GIS) that integrates standard databases of soil, topography, climate and land use at appropriate scales for improved national and regional assessments of the current status of, and trends in, soil quality.
2) To demonstrate, in selected areas, the current status and potential for change to soil quality.

Output:

The concept of soil quality embodies both the capacity of the soil to carry out specific functions and its ability to maintain or improve functionality for a variety of uses.   In this sense, three aspects of soil quality were considered in this study, using existing databases and GIS systems:

- inherent soil quality (available porosity, nutrient retention, chemical rooting conditions and physical rooting conditions).
- soil quality susceptibility to change (soil thickness, slope, crop and residue cover, thickness of surface horizon, organic matter content, intensity of cultivation)
- soil quality change.

Preliminary national level assessments for Ontario and Manitoba were in agreement with subjective estimates by experienced soil researchers and surveyors.

Technically, the systems were designed to be flexible enough to:
i) incorporate additional data layers, (e.g. topography and land use.)
ii) adjust the rating criteria and algorithm for specific crops or other land uses.
iii) be used at a more detailed level (eg. regional, watershed, or farm)
iv) be combined with other analytical tools or models (e.g USLE)

A Land Use Analysis & Monitoring System for Soil Quality Assessment SQEP 3

Contractor: J. C. Hiley, CLBRR, Edmonton, and E. C. Huffman, CLBRR, Ottawa

Objectives: To develop a land use analysis and monitoring system for the agricultural regions of Canada that:
I) is applicable in all parts of the country,
ii) is oriented toward land management, farming activities and socioeconomic conditions, rather than land cover,
iii) is applicable at a variety of scales,
iv) incorporates a time dimension to facilitate monitoring, and
v) is functional within a biophysical (landscape) framework.

Output: Emphasis was on acquiring data that reflected the type and intensity of farmland use. Principal activities were developing and testing procedures for the acquisition, manipulation, analysis and presentation of land use data (e.g. Census of Agriculture) and developing expertise and technical capabilities for integrating the data with biophysical and climatic information (e.g. Soil Landscapes of Canada and Dominion Land Survey). A wide range of characteristics thought to have an effect on soil quality were included (e.g. farm type and structure, economic and financial conditions, crop type and rotations and land management features).

Development of Indicators of Soil Quality and Sustainable Land Management using Knowledge and Information Obtained from Innovative Conservation Farmers SQEP 12

Contractor: M. Cann, J. Dumanski and S. Gameda, CLBRR, Ottawa and M. Brklacich, Carleton University, Geography Dep't.

Objectives:

1) To use information collected, using a structured questionnaire, from 84 innovative conservation farmers, in Alberta, Saskatchewan and Manitoba to:
   i) identify indicators that distinguish between the kinds and severity of soil degradation;
   ii) determine losses of crop productivity caused by soil degradation;
   iii) ascertain threshold levels at which ameliorative measures should be taken.

2) To apply these observations to a framework for evaluating sustainable land management and to develop an expert system as a conservation planning and research tool.

Output: The innovative conservation farmers identified several observable indicators that can be used to assess the kind and severity of soil degradation in the field without special equipment. These indicators describe, to some extent, what is not sustainable and can assist in identifying ameliorative practices. The indicators also can be linked to changes in soil quality. The study suggests that innovative farmers can provide credible estimates of the sensitivity of yields to the degree and type of soil degradation. Innovative farmers begin control measure when soil degradation has reached the moderate level and continue to use these practices long after soil productivity has improved.

SOILCROP: An Innovative Conservation Farmers' Expert System for Conservation Farm Planning SQEP 13

Contractor: S. Gameda and J. Dumanski, CLBRR, Ottawa

Objectives: To develop a prototype soil degradation-crop productivity expert system based on the knowledge of innovative conservation farmers and on the information from scientific research.

Output:

The expert system is designed for diagnosing the type and level of degradation on a farm, along with associated yield reductions, and for identifying the ameliorative practices required and expected improvements in productivity associated with each practice. The system is intended for delivery by conservation advisors working with the farmers.

Information for the system was acquired through a survey of innovative conservation farmers in western Canada (see SQEP 12) and an extensive literature review.

SOILCROP still contains a number of limitations:
- more information from farmers, conservation advisors and researchers is required.
- location-specific data need to be included.
- research information linking qualitative indicators and quantitative soil attributes is lacking.
- SOILCROP needs to be linked with other models to enable predictions of crop performance.

<u>2A: Agriculture and Water Quality</u>

Rainfall Simulator - Grid Lysimeter System for Preferential Solute Transport Studies Using Large, Intact Soil Blocks NSCP 3

Contractor: Dr. B. T. Bowman, London Research Centre, AGRICULTURE AND AGRI-FOOD CANADA

Objectives:

To characterize macropore development under the influence of crops with different root development capabilities.
To relate macropore development to development of the subsequent crop and to solute transport.
To suggest or develop soil management systems which will curtail excessive amounts of adverse transport while retaining advantages of enhanced root development.

Results:

A technique was developed to study preferential flow of water and solutes in large blocks of intact soil, isolated at field sites and transported to the laboratory. Tracer experiments confirmed extensive preferential flow of water and solutes. The grid lysimeter system shows promise as a means to validate solute transport models, to investigate the behaviour of solute transport across soil interlayer boundaries and intermittent flow phenomena in soils.

Review of research on groundwater contamination from non-point sources in the Great Lakes Basin. J.A. Millette, A.A.F.C, Ottawa, 613-995-5011 GLWQP ?
(not included in GLWQP Summary of Achievements report, 1994)

Regional Agricultural Practices and Their Potential for Land and Water Contamination. GLWQP 14

Contractor: K. B. MacDonald, I. E. Jarvis and F. Wang, A.A.F.C., Guelph 519-766-9180

Objectives:

1) To characterize agricultural land use and management practices and land resource conditions in the Canadian Great Lakes Basin.
2) To incorporate data from a wide range of sources into one consistent spatial framework for analysis, classification and reporting of more detailed results.
3) To explore procedures to extrapolate field research to surrounding areas where conditions are similar.

Results:

Data from the following sources were assembled, and digitized, as required:

- Soil Landscapes of Canada at 1:1,000,000 scale.
- OMAFRA artificial drainage maps.
- data representing stream flow volumes and sediment loadings, from the Monitoring and Systems Branch of Environment Canada.
- 1991 Census of Agriculture
- Advanced Very High Resolution Radiometer imagery, classified according to land cover class.
- detailed soil pedon data from the Ontario Soil Names and Soil Layer files.

The GIS provided a powerful tool to manage, integrate and analyze data at various scales, for themes such as: land cover, surface texture, slope, surface shape, intensity of cropping and intensity of livestock production. Using existing databases, it was possible to develop broad scale characterizations of the biophysical, land use and management conditions in the basin and to apply models to predict the potential for contaminant loss. Detailed soils and slope data can be used to produce even better estimates of loss potential.

The potential for adsorbed and solution runoff of atrazine were estimated for the entire Mixed Wood Plain Ecozone of southern Ontario (Lakes Erie, Huron and Ontario watersheds). Potentials were based on soil erodibility, drainage class, and the half life of specific pesticides and their ability to bind to soil particles or to become dissolved, using a generalized soil-pesticide model. Almost all intensively farmed areas were rated as having a high or medium potential for loss of pesticides in the adsorbed and solute forms, although adsorbed loss potentials were lower.

Three field scale sites were characterized in detail to determine the conditions of soil, crop, management and/or manure use that may lead to contamination of water with pesticides or nitrate.

The intensive cash crop region in Essex and Kent Counties was identified as having conditions that have implications for movement of pesticides and nitrate to tile drains and ground water. Conditions in intensive livestock-based areas, such as parts of Oxford, Perth, Huron and Wellington Counties, result in high susceptibility to surface and subsurface loss of pesticides, bacteria and nitrate. In the remainder of the Mixed Wooded Plain area, the susceptibility to loss of pesticides, bacteria and nitrate decreased in proportion to the reduction in input levels.

Soil Macropore Structures and Their Effect on Solute Transport to Tile Drains. NSCP 4

Contractor: Dr. Gary Kachanoski, Environmental Soil Services, 605 Arkell Rd., Arkell, Ont N0B 1C0

Objectives: To characterize macropore transport of contaminants to tile drains.
To suggest or develop soil management systems which will curtail excessive amounts of such transport.

Results: Significant preferential flow of contaminants can occur even under unsaturated conditions. Average values of hydraulic properties for each site did not predict the observed preferential flow and transport. More information will have to be included in predictions. Tillage incorporation of tracer chemicals into the top 10 cm. of soil reduced loss of both reactive and non-reactive tracers from the root zone. Solutes applied to the soil are more likely to reach tile lines or the water table as the initial soil water content at the time of chemical application is increased. Increasing retention time of a solute in the soil matrix allowed it to reach equilibrium absorption and reduced its downward movement.

Partitioning of Solutes from Agricultural Fields within the Hydrologic System at Two Sites in Southern Ontario and the Subsequent Impact on Adjacent Aquatic Ecosystems MO 10/97

Contractor: Dr. David Rudolph (Kachanoski, van Wesenbeeck, Barton), Waterloo Centre for Groundwater Research, University of Waterloo, Waterloo, ONT N2L 3G1

Objectives: To construct a sufficient data base which will represent annual variations in the agricultural cycle by quantifying the contaminant flux distribution over the annual cycle though a hydrologic water balance focusing on water partitioning between the unsaturated zone, saturated zone, tile drainage and surface water systems; by evaluating the significance of spatial positioning within the field; by documenting subsurface geochemical conditions that control the nitrification-denitrification processes in relation to the spatial positioning; by assessing the health of the aquatic ecosystem in the surface water drains compared to systems not impacted by similar toxins and finally, to employ newly-developed mathematical models to develop predictive capabilities for agricultural land-use impact assessment**.**

Expected Outputs: Documentation of the annual variability in water flux as a result of seasonal variation and during specific hydrologic events such as large rain storms will be provided. In addition the spatial and temporal variability of nitrogen compounds including ammonia and nitrate will be tracked. Additional chemical parameters will include dissolved oxygen, dissolved organic carbon and pH. The combination of the water balance and nitrogen balance measurements will provide a fairly detailed view of contaminant flux partitioning between soil water, shallow groundwater, tile drainage, deep ground water and surface water. Non-reactive tracers will be used at both sites to provide additional information for calibration and interpretation of contaminant transport observations.

Ending: 1996-97

<u>2B: Drinking Water</u>

Ontario Ground Water Survey ESI 2

The Ontario Soil and Crop Improvement Association was responsible for the management and co-ordination of the project. Many other agencies were involved in the implementation of this survey. The survey analyzed the chemical and bacteriological quality of a agricultural wells throughout the province. Further, some two hundred multi-level test wells in agricultural fields were installed to establish correlations between agricultural practices and groundwater quality. Survey results provided a detailed and current analysis of the condition of Ontario farm wells and also a baseline for future surveys.

Ontario Farm Groundwater Quality Survey II (Summer 1992) LMAP 1

This survey investigated the same set of drinking water wells and multilevel monitoring wells that were sampled during the initial survey conducted in the winter of 1991-92 (Ontario Farm Groundwater Quality Survey 1).

Approximately 1300 domestic farm wells were re-sampled and the groundwater analyzed for nitrate-N, total and faecal coliform bacteria, and several common pesticides. Forty percent of all wells tested contained one or more of the target contaminants at concentrations above the previous provincial drinking water objectives. 32% of wells exceeded the previous maximum acceptable concentration for at least one of the coliform bacteria selected for analysis. 25% had faecal coliform bacteria. 15% exceeded the Ontario maximum acceptable concentration for nitrate (7% exceeded the acceptable concentration for both coliform bacteria and nitrate (previous objectives); 8% exceeded the acceptable concentration for nitrate alone). 12% of the wells had detectable levels of pesticides.

A Study of the Seasonal Variation in Well-Water Contamination, and Survey the Health of

Farm Families Drinking Water Contaminated with Nitrate or Bacteria LMAP 2
Dr. M. Goss, Chair, Land Stewardship, Land Resource Sci., Univ. of Guelph

The seasonal variability in the contamination of a well needs to be confirmed, and an explanation sought. Evidence of seasonality in the presence of pesticide residues needs to be addressed at the time immediately following spring runoff. The long-term trend in the level of contamination needs to be determined for nitrate, bacteria, and pesticides. Detailed epidemiological studies are needed, linked to continued monitoring of wells used to supply drinking water, to identify health risks from the levels of contamination current in groundwater.

Development and Demonstration of Approaches to Manage Drinking Water Quality on the Farm RCC 56
Waterloo Centre for Groundwater Research - four year project

The goal is to detect and eradicate contaminants in farm drinking water with a concentration on helping farmers to obtain clean water through careful well placement. Researchers will be installing test wells and developing lines of communication with participating farmers, and several options to improve water quality. The final year of the project will involve putting tracers into the water systems to study how the water flows through the shallow groundwater table. Information will then be compiled into a readable document which will be available to farmers as a guide to avoiding situations likely to cause contamination.
David Rudolph, Waterloo Centre for Groundwater Res., (519)885-1211 ext 6778

Well Steward Project RCC 79
Ontario Soil and Crop Improvement Association - four year project
100 farm families across the province will participate voluntarily in a well water monitoring and remedial action program. The focus will be on older drinking water wells with high risk of groundwater contamination. Typical remedial measures which will be put into place could include:

- establishing permanent grass buffers around the well
- ending the use of pesticides and fertilizers on the buffer
- installing a proper well cap and screening vents
- performing minor land grading to divert all surface flows away from the well head
- repairing visible cracks in the well seal at ground level
- properly capping and protecting unused wells and identifying their status and location on farm records
- extending casing height at least 30 cm above ground level
- installing anti-backflow devices on all faucets with hose connections
- installing pitless adaptors on drilled wells

Andy Graham, Program Manager, OSCIA (519) 767-3179

2C: Agricultural Chemicals and Water Quality

Prediction of Agrochemical Migration SQEP 10
Contractor: W. D. Reynolds, R. de Jong, S. R. Vieira and R. S. Clemente, CLBRR, Ottawa

Objectives: To develop the capability to quantify the soil's potential for preventing pollution of ground water by the leaching of agrochemicals.

Output: Methods were developed for characterizing and predicting the downward migration of atrazine. Spatial and temporal variability in atrazine movement is being accounted for via the combined use of a solute transport model, pedotransfer functions, geostatistical analyses and a GIS.

Conclusions: Two submodels of LEACHM (Leaching Estimation And CHEMISTRY Model) were modified for use in this study: LEACHW, which describes soil water flow, and LEACHP, which describes sorption, migration, and degradation of pesticides. These submodels were tested in both laboratory and field studies and then were used to predict atrazine leaching through soils in the Grand River watershed.

The Grand River predictions were consistent with results of a recent ground water quality survey. Both studies concluded that non-point contamination of ground water with atrazine was rare and not strongly related to soil type or land use. Although further development and testing is required, the modified submodels appear capable of simulating both laboratory and field-measured transport of water, chloride and atrazine with acceptable accuracy. Ultimately, the methodology should prove useful in the development of agricultural practices and guidelines that will maintain inputs to groundwater at acceptable levels.

Occurrence and Fate of Selected Agricultural Pesticides in Water and Sediments of Lake Erie Coastal Marshes. GLWQP 05

Contractor: J.A. Millette et al, A.A.F.C, Ottawa, 613-995-5011

Objectives:

1) To examine selected near-shore and wetland locations in the Canadian Great Lakes Basin and agricultural sources of sediments contaminated by toxic agricultural chemicals;
2) To estimate the quantity of chemicals present;
3) To evaluate their bioavailability and impact on wetland ecology; and
4) To identify the options for remedial action.

Results and Conclusions: Several bioassays to determine the toxicity of sediment samples from agricultural watersheds were developed and tested, including ones using invertebrates and rooted macrophytes.

New methods of extracting pesticides from water samples were developed and tested, and appeared to be an improvement upon traditional methods.

Microorganisms capable of completely mineralizing atrazine were discovered in sediments in Essex County, but to take maximum advantage of them, ways must be found to increase the residence time of atrazine in wetland sediments.

Field results indicate that some pesticides appear to be released from soil or sediments over several years and appear to have long-term and cumulative effects. Only trifluralin and metolachlor were detected in sediments. Contaminant levels in sediments were below those which have a significant effect on benthic invertebrates, but some toxic effect on plants, especially algae were noted. Some pesticides, especially triazines, showed low strength of binding to sediments and were present in water samples at concentrations known to have detrimental effects.

A Protocol for Monitoring and Assessment of Water Quality in Agricultural Streams Using Benthic Invertebrates. GLWQP 13

Contractor: D.R. Oliver and D.R. Barton, A.A.F.C, Ottawa, 613-995-5011

Objectives: To develop a set of techniques (i.e. a protocol) for monitoring and assessment of surface water quality in agricultural regions of southern Ontario based on benthic invertebrates, by determining:

- the best way to collect appropriate samples,
- how closely the animals need to be identified, and
- how the results can be interpreted.

Results: A protocol for invertebrate-based monitoring and assessment of surface water quality was developed and is presented in the report. This protocol can be used to identify streams subjected to significant non-point pollution and to monitor improvements in water quality, which may result from changes in land use practices, for much less cost than chemically-based surveys. Samples can be compared to the expected community from forested reference streams to identify those which are significantly impacted. Detailed inspection of the composition of the fauna usually gives an indication of the nature of the problem.

Samples were collected from more than 250 sites across southern Ontario; about 80% of the small streams surveyed appeared to be negatively affected by agriculture. The biodiversity of benthic invertebrates in small streams in agricultural areas is very high. These benthic communities respond in distinctive ways to inputs of sediments, pesticides, fertilizers and organic matter. Species which grow more actively in warmer months appear to be more sensitive to agricultural activities than those active in the winter.

Fate of Agricultural Chemicals in Soil, Ground Water and Agricultural Drainage Water, Under Farm Conditions. GLWQP 11

Contractor: N.K. Patni L. Masse, P.Y. Jui and B.S. Clegg, A.A.F.C., Ottawa, 613-993-6002

Objectives: To determine the long-term fate of metolachlor, atrazine, nitrate and phosphorus in tile-drained, loam corn fields under no tillage and conventional tillage, by measuring chemical concentrations in tile effluent, and soil, ground and surface waters.

Results: Trials were conducted at a site that has been established near Ottawa for long-term monitoring (since 1987) of field-scale transport of chemicals in soil and water under different management practices.

Tile drainage. Flow was higher under NT than CT during the spring/snowmelt but was not significantly different during the growing season or fall. Atrazine and deethylatrazine were almost always present in tile effluent, usually below the Canadian drinking water guideline. Concentrations did exceed the guidelines in rainfall-induced flows within a few weeks of application. Metolachlor was present in only a few samples, well below the drinking water guideline. Nitrate-nitrogen concentrations were above the drinking water limit in 93% of the samples and were higher under CT than NT, except in the spring. Soluble total phosphorus exceeded 30 ug/L in about 25% of the samples tested.

Groundwater Atrazine, deethylatrazine and metolachlor concentrations were well below drinking water standards. Atrazine and deethylatrazine concentrations were consistently higher under NT than CT up to 3.0 m depth. Nitrate-nitrogen concentrations decreased with depth, but still exceeded the drinking water standard in 80% of the samples at depths up to 3.0 m. Soluble phosphorus concentrations exceeded 30 ug/L in over 50% of the samples at depths up to 3.0 m.

Pesticide Contamination of Surface Waters Draining Agricultural Fields:
Pesticide Contamination Classification and Abatement Measures GLWQP 01

Contractor: J. Stover and A.S. Hamill, A.A.F.C., Harrow 519-738-2251

Objectives: To provide a background for assessments of the relative potential of pesticides to contaminate surface runoff and to outline practical abatement measures.

Output:

1) Data documenting the incidence of pesticides in surface waters of the Canadian Great Lakes Basin.
2) A guide to soil, climatic, chemical and crop production factors affecting the extent of pesticide losses in surface runoff.
3) Indices for assessing the relative potential of pesticides to contaminate surface runoff for different soil conditions, using two different approaches:
   i) SPISP (Soil/Pesticide Interaction Screening Procedure)
   ii) Kitchen Table
   (The authors express concern that the indices are highly dependent upon the soil drainage classification and note that other authors have questioned the reliability of the drainage classification system used in Ontario.)
4) A general outline of ways to reduce non-point pesticide contamination of surface water through:
   i) reducing the volume of runoff and sediment.

ii) reducing the delivery of pesticides from fields to streams.
iii) reducing the amounts of pesticides applied.

Predicting Pesticide Migration Through Soils of the Great Lakes Basin GLWQP 06
Contractor: R. de Jong, W. D. Reynolds, S. R. Vieira and R. S. Clemente, CLBRR, Ottawa

Objectives:
1) To develop a methodology for predicting, characterizing and quantifying pesticide migration rates through the soil profile;
2) To test the methodology by applying it to atrazine migration through the soil profiles of the Grand River watershed.

Output: A new methodology, which consists of solute transport modelling in combination with geostatistical analyses and GIS, was developed for predicting, characterizing and quantifying non-point source contamination of groundwater from migration of agrochemicals through the soil profile. Although the methodology is still under development, results were encouraging and compare favourably with recent groundwater survey results. When completed, the methodology should be applicable to a range of chemicals, for virtually any landscape unit, to:
- develop inventories of "pollution potential";
- evaluate agricultural practices to mitigate or control agrochemical inputs to groundwater at sustainable levels;
- predict the impact of changes in land management practices and land use.

Physical Chemistry Parameters That Control Pesticide Persistence and Leaching in Watershed Soils. GLWQP 02
Contractor: D.S. Gamble, A.A.F.C, Ottawa, 613-995-5011

Objectives:
1) To investigate the fundamental processes of the interactions of soils with contaminants;
2) To use the predictive physical Chemistry constants as input for hydrology computer models to improve the prediction of contaminant persistence and fate in the environment under field conditions;
3) To develop new analytical test methods to determine bioavailable concentrations for risk and hazard assessment, and to provide information about chemical speciation of the contaminants in the environment.

Results: Test methods and a multidisciplinary model were developed that can be used to relate standards and operational guidelines to the chemical species that influence bioavailability and toxicity hazards, instead of simply to total concentrations. Multidisciplinary computer models are more reliable for risk assessment and the control of field operations that are conventional single discipline models.

Costs estimates indicate that the technologies developed in this project should permit a more cost effective combination of bench scale laboratory tests, computer simulations and field trials, than in the past. The new technology offers the opportunity of reducing pesticide loading into the Great Lakes watershed, of cutting the costs of computer model input and of cutting crop production costs.

Transport and Dissipation Pathways of Pesticides in Upland Watersheds Employing Conventional and Conservation Tillage in Ontario. GLWQP 03
Contractor: G.J. Wall, B.T. Bowman, B.A. Grant, and D.J King, A.A.F.C, Guelph 519-766-9180

Objectives:
1) To determine the impact of tillage practices on soil temperature and moisture profiles, which in turn influence herbicide dissipation patterns in soil.
2) To describe pathways and processes for pesticide transport to surface water supplies.
3) To employ existing models for predicting pesticide transport and fate.

4) To recommend remedial measures for reducing pesticide transport to surface and groundwaters.

Results and Conclusions:

No-till (NT) soils were slightly cooler and considerably wetter just after planting than conventionally tilled (CT) soils, largely because of surface drying induced in CT soils by tillage.

Disappearance rates of atrazine and metolachlor were somewhat retarded in NT soils, relative to adjacent CT soils, during the first few weeks after application. After the fourth week, disappearance rates were similar under both tillage treatments.

The temperature and moisture monitoring systems used in this study were capable of tracking heat and water fluxes through the soil profile, and would be very useful as an aid in ground-truthing small-scale field models for water and solute transport.

The shift from CT to NT resulted in a significant increase in soil faunal activity (2X increase in population; 3X increase in biomass).

NT systems reduced erosion without requiring more herbicides than CT systems.

Banded herbicide applications reduce herbicide usage and decrease herbicide concentrations in surface runoff so that they meet water quality guidelines within several after weeks application.

Even though preferential flow did not contribute a high percentage of herbicide loss, herbicide concentrations in subsurface flow still exceeded water quality guidelines, indicating that tile drains could be a significant pathway for herbicide transport to the Great Lakes.

For soil-applied herbicides, 85-90 % of the herbicide loss near the time of application is in the aqueous phase, in both surface and sub-surface flow, and not with the sediment. Therefore, it is critical to control surface runoff, as well as sediment losses, especially soon after application. As time progresses, herbicides bind to the soil, decreasing the risk of surface transport or leaching to tile drains.

The field scale model CREAMS was calibrated and predicted annual losses of pesticides, sediments and runoff that were comparable to actual losses in simulated rainfall events. Such models can be very helpful in determining agricultural areas sensitive to soil erosion and herbicide loss and in environmental farm planning.

Soil Persistence of Atrazine, Metolachlor and Metribuzin, as Influenced by Temperature, Soil Moisture and Soil Characteristics. GLWQP 08

Contractor: E. Topp and W.N. Smith, A.A.F.C, Ottawa, 613-995-5011

Objectives: To determine the kinetics and bound residue formation of widely used pesticides in the Great Lakes area, as influenced by soil moisture, temperature and soil structure.

ii) To test laboratory-derived dissipation and bound residue formation data by comparing it to dissipation kinetics under field conditions.

iii) To provide decay rates and hydrologic transport parameters for soils in the Great Lakes Basin as input for simulation models, and to modify the pesticide fate and transport model, LEACHP, to provide improved measures of pesticide dissipation kinetics.

Output: The adsorption of atrazine and metolachlor to a variety of laboratory materials was determined. Studies indicated that soil structure does not necessarily need to be maintained during laboratory soil pesticide dissipation experiments.

Systems were designed for determining pesticide dissipation kinetics, bound residue formation kinetics and leaching with field lysimeters and in the laboratory with intact soil cores.

The pesticide transport models LEACHP and PESTFADE were enhanced by introducing new chemical subroutines for degradation and pesticide sorption. LEACHP was modified to make its prediction of dissipation more responsive to environmental conditions, and the model worked well under field conditions.

A database of half lives and bound residue formation kinetics for herbicides in the Great Lakes basin is available.

In laboratory incubations, atrazine dissipation was most rapid in clay soils, whereas metolachlor and metribuzin dissipated more quickly in sandy soils.

In field lysimeters, more leaching of atrazine and metolachlor occurred in no-tilled soil, but with either treatment (NT or CT) little herbicide reached the 20 cm depth. Tillage practice had little effect on pesticide dissipation, bound residue formation and mineralization.

Atmospheric Transfer of Agri-chemicals. GLWQP 07

Contractor: E. Pattey et al, A.A.F.C, Ottawa, 613-995-5011

Objectives:

1) To develop methods, based on the eddy-accumulation technique, to quantify the emission and surface deposition rates of agrochemicals and other toxic substances.
2) To measure the atmosphere-surface exchange of agrochemicals in the Great Lakes region using two towered-based systems having different trapping devices.
3) To measure the atmosphere-surface exchange of agrochemicals in the Great Lakes region using an aircraft-based system.

Output: Three new technologies for measuring air-surface exchange of agrochemicals were developed and tested successfully. A new thermal desorption unit was shown to simplify the analysis of agrochemicals and to improve accuracy considerably. These new technologies will provide a better knowledge of the magnitude of the exchange of chemicals between agricultural lands and the atmosphere. They will be very useful in the validation of volatilization sub-routines in various models. Measurement of the volatilization of agrochemicals under a wide range of conditions has the potential to provide management guidelines to reduce atmospheric contamination.

<u>2D: Alternate Water Supply</u>

Grey-Dufferin Community Pasture LS II 32

Contractor: Grey-Dufferin Community Pasture
c/o Joan McKinlay, OMAFRA, Markdale

Objectives: To demonstrate: 1) ditchbank protection by restricting cattle access with fencing and mid-level crossings and by reseeding;
2) alternative means of supplying water to cattle.

Results: A single strand electric fence, erected on both sides of the drain, was sufficient to prevent cattle access to the drain. Ditchbanks were reseeded with trefoil. Monitoring of revegetation of the banks continues.

Beavers plugged the culverts through the low-level crossing causing one approach to the crossing to be washed out in the spring. This type of structure was deemed to be unsatisfactory for sites where beavers may be present.

Concrete watering troughs, supplied with well water, were placed on 3 types of structures: gravel mound covered with asphalt chips; poured-concrete pad and a mound of earth. The latter was as effective as the other structures in keeping the surrounding area dry, for much less cost. A solar-powered system was installed to draw water from the drain. It worked well, even in a cloudy summer, and seems to have enough power to supply more than one trough which would make farm use of the system more economical.

Alternate Water Supply LS II 48

Contractor: Dufferin SCIA, c/o Joan McKinlay, OMAFRA, Markdale

Objectives: To evaluate different systems of supplying water to cattle on pasture.

Results: A sling pump, powered by water flow in the stream was installed. Velocity of the stream was too low without restricting the width of the channel. Unit seemed to adequate for about 30 head, but nose pumps would have been more cost-effective. A ram pump worked well, but had not been subjected to cold weather at the time the report was written. Installation costs (1993) are included.

Yeoman's Feedlot Cleanup Project LSII 107

Contractor: Napanee Region Conservation Authority

Objectives: To demonstrate exclusion fencing, mid-level stream crossings and alternate water supply, as ways of reducing contamination of streams by cattle.

Results: Approximately 2750 ft. of stream bank was fenced with electric high tensile fencing. Trees were planted in the buffer area. A culvert, protected by filter cloth was installed to provide a stream crossing. A pipe, heated by an in-line heater, was installed to supply water to pastures across the stream.

Solar Powered Watering Facilities RRCP 88

Alternative Livestock Watering Devices Association - three year project

This project involves researching and developing a design manual for farmers and extension personnel interested in installing a Solar Powered Watering Facility. The project will also establish demonstration sites of solar powered watering facilities for livestock throughout the province of Ontario. Three solar powered watering stations will be established in different counties to collect information on how these systems respond to weather conditions across the province. Also, two stream types will be examined: one with satisfactory depth to support a floating submersible pump and the other needing a stilling well.

Terry Davidson, Rideau Valley Conservation Authority, (613) 692-3571.

<u>11: Treatment of Milkhouse Washwater and Other Contaminated Water</u>

Beef Feedlot\Yard Runoff Control by Vegetative Filter Strip RCC 102

Ontario Cattlemen's Association - three year project
A project on up to 5 farms to study the effectiveness of vegetative filter strips as means of treating barnyard runoff. The strips will be level across their width and have slopes 0.5% to 4%, to evenly spread runoff across the strip to allow time for proper treatment. Grass species (e.g. reed canary, brome or orchard grass) will be planted.

Peter Doris, Ontario Cattlemen's Association, (519) 824-0334.

Milkhouse Washwater Control Using a Vegetative Filter RCC 124

Farm Pollution Control Alternatives Assoc.

Renfrew County Environmental Demonstration Site LS II 28

Contractor: Renfrew SCIA and Claude Weil, Alfred College

Objectives: To evaluate the effectiveness of a "mound treatment bed" in treating milkhouse waste water in soils with low permeability.

Results: An experimental system was designed and constructed, consisting of a modified septic tank, a pumping chamber and a peat and sand raised infiltration bed.

An interim report, "Milkhouse Wastewater Management and Treatment" was prepared, containing an extensive literature review, procedures for designing the system, description of the construction and the results of some initial infiltration tests. No information regarding leaching or leakage from the bed was presented in this report, although reference was made to another report in preparation.

A handout describing system, "Milkhouse Waste Management: Experimental Treatment System", was prepared by Claude Weil for a 1991 OMAF Dairy Extension Update.

Constructed Wetland Treatment Facility RCC 15

The Belle River Conservation Club (four year project)
Club members, with the Essex Region Conservation Authority, constructed a 3-stage wetland treatment system which will help dispose of livestock wastes from a dairy operation. Wastewater produced at the farm will be stored in a pond and released into the wetland during the summer months. The wetland, composed of cattails, bulrushes and other vegetation provides both an anaerobic and aerobic environment which will effectively remove harmful nitrates, phosphorous and bacteria from the wastewater. Trees and various shrubs will also be planted in and around the site.

Paul Hermans, Region Conservation Authority, (519) 776-5209.

Constructed Wetland Project RCC 90

South Nation River Conservation Authority - four year project

Design and development of a constructed wetland to treat runoff from a manure storage, milkhouse wastewater and a large adjacent feedlot area. The site has a high fluctuating water table, which, in the fall, was located just below the soil surface. The wetland system will be constructed above grade in addition to other measures in order to protect the groundwater quality from contamination. As a result, pumping will also be required. The wetland will consist of 3 treatment areas: a marsh, a pond and an overland filter strip.

Mary-Ann Wilson, c/o South Nation River Conserv. Auth., (613)984-2949

Constructed Wetland/Manure Management RCC 98

Wentworth Farm Wetlands Club

Essex Manure Management Club RCC 33

four year project

The members of this Club have constructed a two stage earthen lagoon in Sandwich South Township to receive liquid swine manure from a primary tank under the farrowing barn. The effluent from the 3rd stage of the manure storage will be irrigated onto a 20 acre pasture grazed by cattle. A different mixture was used in each of the four paddocks, to evaluate pasture mixtures in an irrigated rotational grazing program. The mixtures are as follows: Birdsfoot Trefoil and Creeping Red Fescue, TPR Pasture Blend/Creeping Red Fescue/Grassland White Clover/Perennial Ryegrass and Kenny Hybrid Fescue, Ryegrass/Tall Fescue/Reed Canary Grass and White Dutch Clover, Reed Canary Grass and White Clover.

Five piezometers have been installed around the project site in order to monitor groundwater quality. Background samples have been taken on a weekly basis since October. Monitoring will continue on a reduced frequency throughout the winter. Following the installation of catch basins intercepting subsurface tiles, subsurface drainage water quality will be monitored for baseline date.

Essex Region Conservation Authority, (519) 776-5209

16: Nutrient Management

Cropping and Soil Management Effects on the Dynamics of Crop Residue Derived-N on the Coarse-textured Soils in Southern Ontario **LS 7017**

Contractor: R. Paul Voroney, Dept. Land Resource Science, U. of Guelph

Objectives: To study the fate of the nitrogen in plant residue (N) and measure soil organic matter dynamics in a coarse-textured soil cropped to tobacco-fall rye, continuous corn and to wheat-soybeans using conventional and zero-till techniques.

Results: Major activities included the establishment of the treatments (cropping sequence and tillage), preparation of the ^{15}N-labelled plant materials and collection of agronomic data. Samples of the above-ground plant biomass were taken biweekly from adjacent non-labelled areas in the macroplot area and plotted against the model outputs as a sensitivity analysis. Growth curves generated by the simulation models accurately described growth rates of the crops in the macroplots. Timings of the ^{15}N-labelling pulses which were based on equal biomass accumulation between labelling periods were accurately predicted.

The simulation models for wheat, soybean and tobacco also accurately predicted total above-ground biomass accumulation during the season. However, the models for corn and fall rye under-estimated the total above-ground biomass production by 16% and 34%, respectively. Thus, the total amount of $^{15}N/^{14}N$ enrichment of the crop residues will be less than that predicted from model outputs.

Influence of Soil Management Systems on Potentially Mineralizable Nitrogen NSCP 5

Contractor: Dr. Gary Kachanoski, Environmental Soil Services, 605 Arkell Rd., Arkell, Ont N0B 1C0

Objectives: To assess effects of soil loss and tillage system on long term nitrogen mineralization potential of several Ontario soils.

Results: Potentially mineralizable nitrogen and total nitrogen supplying potential were significantly lower in eroded landscapes than in depositional sites. Conservation tillage systems increased both parameters in eroded landscapes compared to conventional tillage. Differences in mineralizable nitrogen between tillage treatments increased as the organic matter content decreased.

Conservation tillage reduced the variability in nitrogen mineralization parameters between eroded and non-eroded sites within a field.

Use of Cover Crops for Nitrogen Management LS II 59

Contractor: K. Hough, Ontario Corn Producers' Assoc., and
T. J. Vyn et al, University of Guelph

Objectives: To evaluate cover crops and management systems for their potential to absorb soil nitrogen and to release it in a manner which allows it to be used efficiently by the succeeding crop.

Results: Trials were conducted at 2 locations in 1992-93, comparing red clover, fall rye, oats and oilseed radish with different kill dates and tillage methods. When fertilizer N was applied, cover crops had no effect on yield. Red clover provided significantly more N to the corn crop than any other cover crop. Potential for groundwater contamination under red clover crops in fall or winter did not appear any higher than for bare ground. The spring time test for soil nitrate-N did not adequately predict the nitrogen that was mineralized from red clover residues later in the season. On finer-textured soils, fall tillage tended to result in spring higher nitrate levels relative to no-till.

Nitrogen Management for Corn Following Red Clover LSII 89

Contractor: Victoria County S.C.I.A., c/o Neil Moore, OMAFRA, Lindsay

Objectives: To demonstrate improved nitrogen management, where corn is grown following red clover in conservation farming systems and the soil test for nitrate-N for establishing N rates.

Results: Trials were conducted at three sites in 1992. Samples for nitrate-N were taken on 5 dates and to both 30 cm. and 6 cm. depths. Three rates of nitrogen were applied (0, N-test, "normal"). (Report does not mention what the actual rates were.) In most cases, check yields were as good as those where nitrogen was applied, especially for whole plant silage.

Soil samples were taken in 1993, but because of mix-ups in applying nitrogen, no yields were recorded. (Co-operators expected to repeat the test in 1994.)

Assessing and Predicting the Effect of Cover Crops and Reduced Tillage on Nitrogen Management RCC 115

Ontario Corn Producers' Assoc.

Influence of Soil Texture and Tillage Practices on the Susceptibility of Legume-N to Leaching LMAP 15/94

Contractor: Dr. B.D. Kay, and Dr. V. Rasiah, Dept. of Land Resource Science, Univ. of Guelph

Objectives: 1) To determine the influence of variations in soil structure, bulk density, and the volume fraction of pores (VFP) belonging to different size classes, on N-mineralization subsequent to red clover incorporation and;
2) To develop equations to predict the rates of N-mineralization on different soils.

Expected Outputs: To improve the understanding of the influence of legumes, used as winter cover crops or underseeded in row-crops, on soil N dynamics, and their place in developing sustainable crop production systems.

Ending: 1993-94: COMPLETED, IN REVIEW

Nitrogen Budget of Farms in Huron County LSII 100

Contractor: Huron S.C.I.A. & Centre for Land and Water Stewardship, Univ. of Guelph

Objectives: To demonstrate the influence of crop rotation and tillage practices on nitrogen budgets.
To strengthen the nitrogen survey which accompanied the Farm Groundwater Quality Survey.
To identify potential systems to improve the environmental impact of farming.

Results: Ten farmers participated in the study. Rainfall samples were collected and analyzed for atmospheric deposition of nitrogen. On average, 18.4 kg N/ha was received.

Soil samples were taken to 80 cm. Each 10 cm. section was analyzed for mineral nitrogen. Available phosphorus was tested in the 0-20 cm. and 30-40 cm. layers. Available phosphorus in the topsoil (0-20 cm.) exceeded 20 mg P/kg in all fields. Subsoil samples were under 10 mg P/kg on cash crop farms, but over 10 on some livestock farms. Total mineral nitrogen in the top 80 cm. ranged between 49.2 and 488.2 kg N/ha in 1992 and 37.0 and 278.3 in 1993. (Values for the N-test, i.e. 0-60 cm. are also presented.) The concentration of nitrate in the soil solution at 80 cm. varied from 0.01 mg N/L to 26.84.

A nitrogen budget was estimated for each farm. The approach used overestimated the concentration on nitrate-N in the groundwater, but could be used to identify those most at risk.

Integrated Soil, Crop and Water Management System to Abate Herbicide and Nitrate Contamination of the Great Lakes: Nitrate GLWQP 09

Contractor: C.F.Drury C.S. Tan, J.D. Gaynor, and T.W.Welacky, A.A.F.C., Harrow 519-738-2251

Objectives: To investigate the effects of the following (singly and in combinations) on nitrate-nitrogen losses from treated fields to surface or tile drainage water and crop performance (corn): controlled drainage//subirrigation, reduced tillage, banded herbicide application, and intercropping with annual ryegrass.

Results: Controlled drainage/subirrigation reduced drainage water volume by 21 % and the flow-weighted nitrate concentration in the drainage water by 25 %. The average annual nitrate loss was reduced by 41 % with controlled drainage/subirrigation, as compared to conventional tile drainage. Mouldboard tillage resulted in the lowest nitrate losses through the conventional drainage system, while the soil saver treatment resulted in the lowest losses with controlled drainage. The combination of controlled drainage/subirrigation and soil saver reduced nitrate losses by 48 %, compared to the conventional moldboard tillage system. Losses of nitrate through surface runoff were minor compared to the losses through drainage.

Nitrogen Conserving Farm Systems LS 7020

Contractor: R. Gary Kachanoski, Land Resource Science, U.of Guelph.

Objectives:

1. To determine and characterize the variability of crop response at a field scale, to applied fertilizer N under different soil and climatic conditions.
2. Determine the relation between a spring NO_3-N test and the response of the crop to N fertilizer.
3. Determine the influence of field specific nitrogen management systems on NO_3 transport out of the root zone.
4. Examine the relationship between the economic rate of fertilizer N and the maximum acceptable rate of fertilizer N with respect to nitrate contamination of groundwater.

Results: The data collected in the Partners in Nitrogen Study (PINS) project indicate a significant relationship between the amount of soil test NO_3 in 0-60 cm depth at time of planting (e.g., the N soil test) and the amount of yield obtained at a site with 0 kg N/ha fertilizer added. For most sites, once the N soil test was greater than 110 kg N/ha, there was little difference between the check yields and fertilized yields. Relationships between maximum economic rate of nitrogen MERN and the N soil test was obtained for different price ratios. The calibration equations, and N test procedure was accepted in 1991 by the Ontario Soil Management Research and Services Committee as an official soil testing procedure for Ontario. Average relationships between the soil N test for 0-30 cm and 0-60 cm samples were calculated; a shallower depth sample can be used to estimate the deeper soil N test, but a loss in some accuracy is expected. A general relationship between the soil test at time of planting and the test at sidedress was also obtained.

In 1991, 10 PINS sites had low variability and consistent enough yield response to accurately compare the N soil test prediction and the measured economic rate of fertilizer N. At these sites, the N test gave a good fertilizer N estimated on nine sites and a poor estimate on one of the sites.

Several weaknesses of the soil N test were identified:
- naturally occurring spatial variability of yield and soil test values.
- changes in yield potential at a site from year to year.
- sites with low chronically yield potentials.

Nitrogen Research with Corn Using Conservation Tillage LS 7018
Contractor: C.K. Stevenson, RCAT

Objectives: To evaluate using conservation tillage.
1. response to rates of N.
2. ammonium nitrate-urea solution, anhydrous ammonia and urea
3. various methods and times of incorporating N materials.
4. time of nitrogen application.
5. the interaction effects of the above factors.

Results: NO FINAL REPORT RECEIVED - DUE DATE WAS 12/01/91
(project has continued with funding from OCPA and Pioneer Hi-Bred)

Nitrogen Test Survey
Contractor: Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia LS II 29e

Results: Experiences of 33 co-operators were monitored over 2 years. The soil test for nitrate-nitrogen was felt to be good for rated the nitrogen level of fields into categories (low, medium, high). Co-operators generally felt comfortable with the rates recommended within about 20 kg of N/ha.
The test was less reliable where legume residues or strawy manure were present in the field.

Soil Doctor LS II 26
Contractor: Middlesex SCIA, c/o Peter Johnson, OMAFRA, London

Objectives: To evaluate if a unit designed to estimate soil nitrogen "on-the-go" during application of 28% UAN solution could be used to reduce nitrogen usage without a loss in yield.

Results: Yields obtained from 46 strip plots, over 2 years, where nitrogen was applied at rates determined by the Soil Doctor were compared against those recommended through use of the soil test for nitrate-N and a rate selected by the co-operator based on his or her experience. Results were inconclusive. There was no difference in net returns in 76% of the comparisons. In 19 trials, it was possible to estimate the most economical rate - each system came closest to predicting the most economical rate in about one third of the cases. (data are available for these sites.)

Variable Rate Technology for Nitrogen Application RF 05/97

Contractor: Dr. Gary Kachanoski, Dept. of Land Resource Science, U. of Guelph

Objectives: To develop variable rate technology for N fertilizer application by trying different methods of obtaining a field map for variable application of N; to determine the economic benefits of variable rate technology for N; and to determine the change in potential nitrate loading to the groundwater from variable field application of N fertilizer compared to constant-rate application.

Expected Outputs: Maps of field variations of crop response to applied fertilizer N, estimates of the spatial distribution of the entire N response curve, the acquisition and testing of a variable rate fertilizer applicator linked to a Global Positioning System, and mapping of the N soil test, soil texture, soil organic matter, soil water regime and landform shape are expected to meet the objectives outlined above.

Ending: 1994-95: TO BE COMPLETED MARCH '95

Fertilizer Placement with No-till RCC 125

Arcadia Cooperative Group

<u>17A: Manure/Nutrient Management: General</u>

Literature Search on Manure/Nutrient Management **MA 01/94**

Contractor: Dr. Michael Goss, Dept. of Land Resource Science, U. of Guelph, Guelph, ONT, N1G 2W1

Objectives: To establish the current state of the art of Manure/Nutrient Management in North America and Europe by summarizing the current scientific and applied literature and by identifying pertinent research projects in other jurisdictions while commenting on their relationship to the Ontario experience.

Results: A report has been printed containing a detailed literature review, bibliography and consensual information as an overview of the present state of our knowledge, helpful in identification of apparent gaps in our current knowledge.

Published as "Current State of the Art on Manure/Nutrient Management", April 1994, COESA Report No: RES/MAN-001/94

Assessment of the influence of manures for the control of soilborne pests including nematodes, fungi and bacteria. **MA 10/97**

Contractor: Dr. George Lazarovits, Pest Management Research Centre, AGRICULTURE AND AGRI-FOOD CANADA, 1391 Sandford St, London, ONT, Canada, N5V 4T3

Objectives: To assess potential of manures and related organic materials for reducing plant diseases caused by soilborne pests.

Expected Outputs:

1) To conduct an initial survey of manures from various sources and in various stages of decomposition to determine if these materials exhibit an ability to suppress Verticillium;
2) To measure the capacity of the "active" manures for reducing the survival of Verticillium and controlling diseases.
3) To monitor changes in populations of beneficial microbes in manures;
4) To identify factors which may influence disease control efficacy, (e.g. manure source, application rate, composting, soil type, etc.) Treatments found effective in the laboratory will be field tested in microplots and on farms growing potato and tomato crops. Field observation will measure pathology, soil microbiology and agronomic changes in the crop plants tested. Information as to the appropriate methods of application of manures for disease control will be generated.

1995-96:

Ending:

17B: N & C Transformations in Manure During Storage, Handling or in Soil

Nitrogen & Carbon Transformations in Conventionally-Handled Livestock Manures. MA 02/97

Contractor: Dr. G. Kachanoski, Environ. Soil Services, 605 Arkell Rd., Arkell, Ont N0B 1C0

Objectives: Document the state of our knowledge of nitrogen and carbon transformations which occur during conventional storage and handling of solid and liquid livestock and poultry manures; to investigate various manure storage and handling techniques with respect to N and C changes during storage and handling while recognizing nutrient conservation and availability for plant growth; to provide a comparative economic assessment of costs associated with manure handling, the nutrient content and value of the final product.

Expected Outputs: Nitrogen and carbon components in the feed, bedding and excrement of livestock will be tracked during handling and storage. Recognizing the changes which are certain to occur after application of the manure to the land consideration will be given to techniques which involve incubation of manure with soil. Consideration will also be given to monitoring the losses from the greenhouse gas perspective. Information obtained should enable the prediction of manure nitrogen availability for plants and losses of environmental importance.

Ending: 1996-97

Composting Poultry Manure with a Passive Aeration Windrow System LSII 74

Contractor: Niagara South S.C.I.A., with Hugh Fraser, OMAFRA and Chris Attema, Niagara Peninsula Cons. Authority.

Objectives: To evaluate the suitability of the Passively Aerated Windrow System for composting poultry manure.

Results: The system was tested on a small scale, but larger scale testing did not proceed because the system was impractical and did not produce high quality compost. Placing manure on the aeration pipes was costly and time-consuming. Poultry manure appeared to be too dry to compost properly and the pile reached very high temperatures.

Evaluation of Three Manure Composting Methods for Nitrogen Conservation, Environmental Impact, Crop Growth Response and Operating and Maintenance Costs NSCP 6

Contractor: Richard St. Jean, Ecologistics, 490 Dutton Drive, Suite A1, Waterloo, Ontario N2L 6H7

Objectives: To evaluate three methods of manure composting as a means to retain nitrogen in a non-leachable form during the fall and winter following application.
To measure the effectiveness of these approaches as a means for supplying nitrogen to a crop during the subsequent growing season.
To compare operating and maintenance costs of each system.

Results: Nitrogen losses from volatilization or from leaching did not differ significantly among treatments (passive aeration, turned pile, forced aeration, control pile).

A cover of peat moss on the passive aeration windrow showed an excellent capacity to retain nitrogen, although about one third was in the ammoniacal form.

For composting to be completed under cover, the moisture content of the manure must be maintained above 45 percent. The high evaporative capacity of composting manure suggests potential as a means to process barnyard runoffs and milkhouse washwater.

There was no significant difference in corn yields among treatments; yields were more consistent in plots receiving commercial fertilizers as compared to all other treatments.

Manure Composting Techniques: Understanding N & C Conservation MA 03/97

Contractor: Richard St. Jean, Ecologistics Ltd, 490 Dutton Drive, Suite A1, Waterloo, ONT N2L 6H7

Objectives: To evaluate composting techniques suitable for use by livestock and poultry farm operations with emphasis on carbon, nitrogen and other transformations and losses, the effect on productivity, sustainability, environmental impact, economic viability and potential for implementation in an manure management and nutrient recycling program.

Expected Outputs: Study should provide information on carbon, nitrogen and other nutrient transformations and losses; economic and physical limitations of optimizing manure C/N ratios; the evaporative potential of composting manure; relative nutrient leaching potential of manures and compost; comparison with composting techniques promoted by the Ecological Farmers of Ontario; the practicality of recycling finished compost as livestock bedding; the quantification of greenhouse gas production; and databases to establish labour, energy and capital requirements in each process.

Ending: 1996-97

Transformation Rates of Inorganic Nitrogen in Animal Manure Into Plants and Soil Organic Matter and its Re-Release From Soil Organic Matter LMAP 13/94

Contractor: Dr. M.J. Goss, and P.S. Smith, Centre for Land and Water Stewardship, Univ. of Guelph, Guelph, ONT N1G 2W1

Objectives: To study the fate of nitrogen from liquid dairy cattle and composted cattle manures in two field experiments (at the Elora Research Station, and at the Winchester research Station of Kemptville College), in which cover crops are grown to investigate the cycling of manure nitrogen between soil and crops in the fall, and to identify whether significant nitrogen is transferred from the cover crop to corn planted in the following spring.

Expected Outputs: Improved understanding of nitrogen cycling from animal manures into soils and crops, and show the role of cover crops in nitrogen transformations.

Ending: 1993-94: COMPLETED, IN REVIEW

Transformations in Soil: Crop Response to Nitrogen in Manures with Widely Different Characteristics MA 04/97

Contractor: Dr. E. G. Beauchamp, J. Buchanan-Smith and M. Goss, Dept. of Land Resource Science, University of Guelph

Objectives: Develop an understanding how the N in manures with different characteristics applied to soil in the field is immobilized or mineralized and released in synchrony with crop N requirement. Soil factors include time of application, soil texture and soil acidity. Manure characteristics include the effects of the protein levels in the dairy rations.

Expected Outputs:

- Phase 1 - Development of a yield response curve for corn with fertilizer, and comparison with manure N rates;
- Phase 2 - Comparison of the mineralization/ immobilization and availabilities of N from five different manures following fall and spring applications on one site;
- Phase 3 - A laboratory study on the influence of soil texture involving four soils ranging from loamy sand to clay loam;
- Phase 4 - A laboratory incubation study of four soils ranging in soil acidity to monitor ammonium and NO^{-}_{3} contents.

Phase 5 - Using feeding trials and characterization of the manure to develop one or more models for predicting manure N content of manures from animals given different feedstuffs.

Ending: 1996-97

<u>17C: Manure Application: Sources, Rates, Methods, Timing and Water Quality</u>

Impact of Manure Application Methods on Water Quality, Focusing on Nitrogen and Bacteria Transport in Soil. MA 05/97

Contractor: Dr. Greg Wall, Land Resource Division, C.L.B.R.R., Guelph

Objectives: Field scale study of liquid manure applications to identify pathways and process of nutrient and bacterial transport to tile drains and ground water with emphasis on preferential flow. The objectives include the validation of water quality models (GLEAMS, DRAINMOD) with field scale data and to use the models to identify scenarios in which water quality standards are likely to be exceeded.

Expected Outputs: Agronomic monitoring with liquid hog manure as the source of the N requirement for corn production; the determination of basic solute transports parameters for each soil type; tile water quantity/quality measurement in response to manure treatments; ground water quality; and solute transport measurements. The use of reactive and nonreactive tracers will be used to indicate the affect of initial soil moisture levels on solute travel times and macropore flow. Results should enable prediction of environmentally safe rates of liquid manure application to land, and development of methods for manure application in no-till systems.

Ending: 1996-97

The Effects of Livestock Manure Application and Management on Surface Water Quality. GLWQP 10

Contractor: D. King, G.C. Watson, G.J. Wall, and B.A. Grant, A.A.F.C., Guelph 519-766-9180

Objectives:

1) To evaluate several manure management application techniques and timing of application used in conservation management systems to determine the best method to minimize downward movement of nutrients and bacteria to tile drains:
2) To compare fuel consumption requirements of manure management application techniques and recommend practices with field scale testing;
3) To formulate remedial steps for reducing nutrient and bacterial contamination of tile drains.

Results and Conclusions: A modified injection technique (ie. disturbance of the macropores by cultivation prior to injection), can significantly reduce nutrient and bacteria contamination in both surface runoff and tile drain water, compared to conventional techniques.

Liquid manure application on medium-textured soils under no-tillage (NT) may result in excessive levels of nutrient and bacteria contamination in tile drain waters. Observation of manure contaminants in tile drain water shortly after manure application suggests downward movement by preferential flow. While posing an environmental concern, the loss of nutrients to tile drains from liquid manure applied at rate equivalent to crop nitrogen requirements is relatively low from a crop production standpoint.

The prototype modified injection technique required slightly more draft, power and fuel than conventional injection, but not so much more as to pose an obstacle to adoption by farmers.

The system used for monitoring flow in tile drains proved to be an inexpensive and reliable method to monitor relatively low flow rates continually over an extended period of time.

Investigating Methods of Integrating Liquid Manures into a Cropping System and the Effect on Soil and Water Quality. RF 02/97

Contractor: David Charlton, Ecolog. Services For Planning, 361 Southgate Drive, Guelph, N1G 3M5

Objectives: To examine in cooperation with farmers the effectiveness of several methods and rates of liquid manure application within conservation farming systems; and to investigate techniques for retaining the nutritive value of manure in the root zone.

Expected Outputs: Evaluations of the prescribed rate of manure, determined by soil test for N, as a source of nitrogen, in comparison with mineral fertilizer; effectiveness of the manure from different types of livestock; and importance of timing of the manure application relative to the stage of growth where comparisons are directed to the feasibility of soil injection, sidedressing or top dressing of liquid manures.

Ending: 1996-97:

Managing Cover Crops and Tillage to Conserve Nitrogen following Manure Applications LSII 113

Contractor: Perth County Pork Producers, Cattlemen and Milk Committee with Dr. T. Vyn, Univ. of Guelph

Objectives: To evaluate the ability of various cover crop species to absorb nitrogen from fall applications of manure and to reduce nitrogen losses over winter.
To examine the effect of the type of manure and tillage system on nitrogen conservation and utilization.

Results: Trials were conducted at two sites in 1992-93. At Sebringville, soil nitrate-N levels in late November were greater where liquid hog manure was applied than where solid dairy cattle manure was used. Both were greater than the check. Because of late planting, cover crops were able to absorb relatively little nitrogen, although concentrations were higher in plants grown in manured plots. In the spring (April 30 and May 20), soil nitrate-N levels were always higher in plots that were fall plowed than in no-till; by June 24, there was no difference between tillage treatments, except where red clover was grown. Fall application of manure did not increase soil nitrate levels until the June 24 sampling date.

At Elora, tillage prior to application of liquid manure did not alter the nitrate-N concentrations in the upper 30 cm. Cover crop growth and total N in biomass were much greater in the manured plots, than in the check plots, but plant N concentrations were not different. Soil nitrate-N levels were significantly higher were there was no cover crop.

Manure Management to Sustain Water Quality NSCP 7

Contractor: Dr. M. J. Goss, University of Guelph

Objectives: 1) To evaluate the risk of nitrate leaching from fall-applied cattle manure on land previously under alfalfa.
2) To determine if the risk of nitrate leaching can be reduced through use of cover crops, incorporation of straw or sowing of winter wheat.

Results: Growth and yield of corn and the yield of barley were largely unaffected by treatment.
Barley lodged preferentially on plots receiving manure.
Nitrogen released by ploughing of the alfalfa sod was sufficient for the corn crop.
The main release of nitrogen from cover crops occurred late in the growing season.
The nitrogen soil test did not adequately reflect the release of nitrogen from crop residues.
None of the fall treatments to immobilize nitrogen was adequate to reduce the risk of nitrate leaching significantly.

Field Drainage Tile Water Quality Study LS II 66

Contractor: Eastern Ontario Progressive Farmers Assoc.;
Pierre-Yves Gasser, Ag-Knowledge, Ontario

Objectives: To determine if liquid manure applications on barley stubble adversely affects the quality of water emitted from underlying drainage tiles.

Results: E. coli counts in tile water increased 10 fold between 16 and 25 hours after spreading of liquid poultry manure. The concentration of ammonia in the water also increased over the same period, going from non-detectable to 2.3 mg/L in 55 hrs.

Renfrew Manure Analysis, Sampling and Spreader Calibration Project LSII 99

Contractor: Renfrew S.C.I.A., c/o Paul Sullivan, OMAFRA, Nepean

Objectives: To provide farmers with information regarding the nutrient analysis of the manure from their farms and the rates at which they are applying manure.

Results: No final report was included in the file.

Oxford Manure Application Study LSII 40

Contractor: Oxford SCIA, c/o Chris Brown, OMAFRA, Woodstock

Objectives: 1) To evaluate crop response to the application of different types of manure at varying application rates.
2) To collect information regarding the nutrient contents of different types of manures.
3) To measure application rates and assess uniformity of spreading patterns.

Results: Information was compiled on the nutrient contents of 139 samples of manure over a 3 year period. There was little year-to-year variability in the analysis of the manure from an individual storage provided that the livestock ration and management of the system was not changed significantly.

There was little or no response in yield to manure use at most sites, relative to unmanured checks. The large amount of nitrogen in unmanured soil was also confirmed by spring soil nitrate-nitrogen tests. Little nitrate-N tests was present in the soil in the fall, although total N supply applied from "normal" application rates exceeded crop requirements in most cases, especially for liquid hog manure. Data from four experiments indicate the variability in spreading patterns - in general, the application rate close to the spreader was at least double that halfway between spreader paths. Some information illustrating the effect of wind on the spreading pattern from irrigated manure is presented.

Poultry Liquid Manure Applications in Growing Corn RCC 72

Agriculteurs Innovateurs de l'Est Ontarien - four year project

Although Ontario best management practices recommend incorporation of manure, the members of this organization feel that this is not 100% compatible with ridge tillage systems, especially for fall manure applications. Strip cropping poses a further problem by limiting the application width to 15 feet. Farmers presently practising ridge tillage and strip tillage have unanswered questions regarding the safest and most economical way to apply manure to farm land:

- How many tonnes of manure can be safely applied to the crop?
- What is the most economical way to apply the manure?
- When is the most appropriate time to apply the manure?

Pierre-Yves Gasser, Agricultural Consultant, (613) 789-9603.

Manure Management in High Residue Applications RCC 29

Charing Cross Conservation Club - four year project

This project involves trying to develop a system that will allow use of manure in high residue systems, using different coulter configurations to build up soil organic matter and to improve soil structure.

Rob Smyth, Director, (519) 436-0501.

17D: Use of Organic Urban Wastes on Farmland

Industrial Organic Compounds in Selected Canadian Municipal Sludges and Agricultural Soils SQEP 11

Contractor: M. D. Webber, Wastewater Technology Centre, Burlington, Ontario

Objectives:

1) To determine the concentrations of selected industrial organic contaminants in Canadian agricultural soils;
2) the potential for organic contamination of soils from application of municipal sludges to agricultural lands.

Results and Conclusions:

1) Results for the 24 SQEP benchmark sites and 6 intensively cropped soils from southern Ontario indicated that there was no significant contamination with base-neutral and acid extractable compounds (BN&As).

   PCBs, organochlorine pesticides (OCs), organophosphorus pesticides and a variety of herbicides were either not detectable or present in small amounts in most soils. It was concluded that residues of none of these compounds poses a significant hazard to the environment or to agricultural crops.

2) Two southern Ontario soils were treated with sludges from Hamilton and Sarnia (thought to represent the worst cases of industrial organic contamination). Even treating the soils at rates greatly exceeding the recommended loading for Ontario resulted in only slight increases in the levels of polynuclear aromatic hydrocarbons, PCBs and OCs in these soils. These contaminants were generally not detectable in seven other soils, which had received from one to three applications of other sludges. It was concluded that application of sludges to agricultural soils according to Ontario recommendations does not represent a significant hazard to agriculture or the environment.

Closed Loop Recycling - Composted Biodegradable Organic Urban Waste Application on Agricultural Lands. MA 06/97

Contractor: David Charlton, Ecolog. Services For Planning, 361 Southgate Drive, Guelph, N1G 3M5

Objectives: The study will evaluate the properties of several compost materials and monitor the effects of compost applications to agricultural land on the soil properties, surface and subsurface water quality, and on corn growth and yield.

Expected Outputs: Evaluation of annual applications of composted materials on two soil types should provide information on the effects of compost type and degree of soil incorporation on soil moisture early in the season; the tendency of products of compost decomposition to migrate in the soil profile; the composition of runoff water after compost application; effects of compost application on corn growth; effect of compost additions on soil biology; the reconciliation of the compost application with concepts of reduced soil tillage and the probable agronomic and environmental implications of long-term use of composted materials.

Ending: 1996-97

Soil Rehabilitation After Land Levelling LS II 43

Contractor: Niagara Peninsula Fruit and Vegetable Growers' Assoc.
c/o Maribeth Fitts, OMAFRA, Vineland Station

Objectives: To demonstrate the benefits of land rehabilitation prior to replanting after land levelling or excavation.

Results: Plots were established comparing cattle manure, mushroom compost and paper mill waste as soil amendments. Comparison of alfalfa and sorghum-sudan grass as cover crops were superimposed on the main plots.

Eighteen months after application, the nutrient content of the soil receiving any of the amendments were still higher than the controls. Paper mill waste was the least effective in supplying nutrients. Amendments all increased the organic matter content of the soil to about 5.0%, as compared to from 4.5% for the control.
There was no significant difference between the cover crop species on soil properties; their main benefit was in controlling erosion. (Cover crops had to be re-seeded in the second year, so only were present for one growing season.)

Screening of Bestialities Approved for Land Utilization in Corn RCC 96
Dundas Soil and Crop Improvement Association - four year project

Club members will determine if there is any indication of potential environmental and/or agronomic problems/benefits associated with land utilization of the following approved bestialities: Casco, Ault and Champlain biosolid by-products. With a research permit from the Ministry of the Environment, the bestialities will be inter-row injected 6" deep into standing corn with a Nuhn six row injection system. They were applied at their maximum rate and 1/2 their maximum rate in 1993. The following parameters will be monitored from 1993 to 1996. A fourth treatment of a conventional synthetic fertility program will also be included as a check.

Monitoring over the four year period will involve:
- groundwater quality
- adverse and/or beneficial changes to soil nutrient availability
- changes in plant nutrient uptake
- changes in yield potential of corn as compared to a conventional synthetic fertilizer treatment

Cliff Metcalfe, c/o Eastern Crop Doctor Reg'd, (613) 774-5695.

Improved Placement & Utilization of Bestialities in a Conservation Cropping System RCC 99
Halton Conservation Club - four year project

The main objectives of this Club are to improve the distribution of bestialities for a more uniform dispersion of nutrients while at the same time reducing the ridges caused by the application equipment. Levels of nitrate nitrogen, phosphorous & heavy metals in soil, and heavy metals in leaf tissue after biosolid application will also be studied. On three sites located in Milton (2) and Moffat, Ontario, the group hopes to achieve the following:
- a smoother soil surface after injection which will allow for no-till
- more uniformity of nutrients in the root zone - no stripping effect
- greater awareness of regional farmers of the Sludge Utilization Program and how it can be integrated with conservation tillage

Richard Sovereign, Chairman, (905) 335-9506

<u>18A: Horticultural Crops: Soil Management</u>

Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil Properties in Southwestern Ontario LS 7005

Contractor: R.W. Johnston, Ag. Chemistry Section, RCAT

Objectives: To enhance and maintain the physical and chemical properties of coarse textured soils suitable for vegetable production, and to find cost effective water and wind erosion control measures to reduce soil degradation.

Results: **Crop Rotations**
Soybeans or tomatoes following the rye cover crop had the least weed escapes from the first herbicide application.

As a result of crop rotation, soil structure and drainage appears to be improving at both locations. The soil improving benefits of rotation appear to be gaining. Continuous tomatoes continues to be the lowest yielding culture. Those rotations in which tomatoes followed a legume - red clover or alfalfa and those tomatoes following incorporation of large amounts of straw showed improved growth and yield. The rye-tomato rotation was one of the lower yielding rotations in 1992.

Tomatoes have been quite response to nitrogen, although nitrogen tended to increase the green tomatoes.

Crop Rotations and Cover Crop Effects on Erosion Control, Tomato Yields and Soil Properties in Southwestern Ontario RF 07/97

Contractor: Mr. Ken Stevenson and R. W. Johnston, Soil Science and Horticultural Soil Management, Ridgetown College of Agricultural Technology, Ridgetown**,** ONT, N0P 2C0

Objectives: To better evaluate the effects of rotations on soil structure, evaluate and measure drainage differences, evaluate differences in moisture holding capacity, and any further improvements in tomato yields. It is also proposed to further evaluate changes in weed, insect and disease control.

Expected Outputs: The first four years of research have shown increased tomato yields by 36-40 t/ha in favour of rotated vs monoculture, tomato quality was improved, water ponding reduced on the soil on rotated plots and increased earthworm activity stimulated in rotated plots. The effects of rotation and cover crops in place at two locations near Dresden and Leamington could not be fully assessed in such a short time frame. The longer time for evaluation will provide a more reliable recommendation for farmers on proper rotation and cover crop management.

Ending: 1996-97

Impact of Soil Compaction on the Production of Processing Vegetables and Other Cash Crops LS 7014
Contractor: C.K. Stevenson, RCAT

Objectives:
1. To conduct a literature review on the effect of soil compaction on the production of processing vegetables (i.e., tomatoes, sweet corn, green peas and green and wax beans) and other cash crops and to survey the state of the art for the prevention and relief of this problem.
2. To illustrate the significance of and improve the awareness of soil compaction among growers.
3. The literature review could act as a stepping stone to applied research on soil compaction.

Results: NO FINAL REPORT WAS RECEIVED - DUE DATE 12/01/91

A Cover Cropping Strategy for First Early Potato Production LS 7009
Contractor: Dr. A.W. McKeown, Horticultural Experiment Station

Objectives: To evaluate the effects on emergence, yield and diseases of early potatoes of:
a) several broadleaf and grass species as cover crops
b) early July and September sowings of cover crops
c) a single fall disk vs. all soil preparation in spring.

Results: Rye, wheat and oats were compared to bare soil controls in July and August plantings. Oilseed radish, spring canola, winter canola and soybeans were also evaluated as potential July planted cover crops. No consistent differences in emergence, yield and specific gravity of potatoes were observed following any of the cover crops.

Cereal cover crops had no effect on root lesion nematodes but soybeans increased nematode populations which apparently lowered the yield of Superior potatoes. Oilseed radish and winter canola cover crops resulted in nematode populations somewhat higher but not significantly different from those of bare soil controls and yield of potatoes equal to the controls. Use of canola and oilseed radish show promise as covercropping options in early potato production.

Introducing No-Till Systems into Crop Rotations Based Upon Tomato Production RCC 59
Kent County Vegetable Growers Assoc.

Cover Crop Management for Vegetable Production LS II 87
Contractor: District 1 and 2, Ontario Vegetable Growers
c/o Anne Verhallen, RCAT

Objectives: To evaluate a number of practices that should contribute to reduced soil loss and/or improved resource utilization in vegetable production.

Results: The final report to LSII included observations on the following projects listed below. No data was presented.
- cover crops after processing peas (corn, oats, soybeans, sorghum-sudan grass)
- partners in nitrogen for tomatoes (3 sites)
- use of strips of cereals for wind abatement in raised beds (4 planting patterns monitored.)
- monitoring of irrigation scheduling at 6 sites to validate computer model.
- starter fertilizer placement study (9 growers)

A literature review, "Conservation Tillage and Wildlife Management: How do they impact one another?", was completed. (based on 16 documents or books) Concludes that wildlife habitat can be improved through conservation tillage and that wildlife can benefit the farming system.

Feasibility of Using Permanent Grass Cover in Vineyards LS II 102

Contractor: Niagara Peninsula Fruit and Vegetable Growers' Assoc.
c/o Maribeth Fitts, OMAFRA, Vineland Station

Objectives: To compare the suitability of newer, less competitive perennial grass cultivars against annual grass systems and bare ground for erosion control and nutrient management in vineyards.

Results: Perennial grass covers ("Lowgrow" perennial ryegrass and "Supra" bluegrass) did not have an adverse effect on the nutrients available to the grapes, after 2 years of growth, and appear suitable for use in vineyards, at least in the short term.

The Impact of Alternative Drainage Methods on Water Effluent Quality and Quantity of Niagara's Concord and Niagara Grapes LS II 60

Contractor: Ontario Grape Growers' Marketing Board
H.W. Fraser, OMAFRA; K. H. Fisher, HRIO; C. Attema, NPCA

Objectives: To monitor the quality and quantity of subsurface water draining from a vineyard with 4 drainage treatments (mole drains, 50 mm tile, 100 mm tile and undrained control).
To monitor grape vigour and yields for 5 years.
To evaluate soil compaction in the vineyard.
To assess the economic and environmental impact of each system.

Results: Drains were installed in 1992. Vineyard performance was variable in 1992, but in 1993, mole drained rows yielded much less than the other treatments. Tile drainage visibly resulted in much improved drainage, relative to the control.
Details of installation methods, water measuring devices, piezometer results, turbidity and nutrient analyses and vineyard performance are presented. Study will continue through 1996.

18B: Greenhouse Management

Management Practices Supporting Environmental Sustainability for Greenhouse Vegetable Production LS II 72

Contractor: Ontario Greenhouse Vegetable Producers' Marketing Board

Objectives: To analyze current greenhouse management practices.
To conduct workshops informing growers about management practices that support environmental sustainability.

Results: Surveys were sent to 344 growers; 34 valid replies were received. Collection and recycling of nutrient solutions was identified as an area where practices could be improved and where there is a need for information. Many also required information about IPM and recycling or disposal of wastes.
A workshop, attended by 35 growers, was presented. A handout was prepared outlining major environmental concerns for greenhouses, additional references and a environmental audit worksheet.

Management Practices Supporting Environmental Sustainability for Greenhouse Flower Production LS II 91

Contractor: Flowers Canada Ontario, Niagara Chapter

Objectives: To identify greenhouse management practices currently in place or planned, that support environmental sustainability.
To identify grower concerns about the environment.
To identify grower needs for information workshops on environmental relevant to the greenhouse industry.

Results: Surveys were sent to 280 growers; 46 valid replies were received. Collection and recycling of nutrient solutions was identified as an area where practices could be improved and where there is a need for information. Many also required information about recycling or disposal of wastes.

A workshop was presented offering solutions or suggestions for major environmental issues. A handout was prepared outlining the environmental concerns for greenhouses, additional references and a environmental audit worksheet.

19A: Conservation Cropping Systems - General

Farm Mapping - Management with a G.I.S. RCCP 45

Agriculteurs Innovateurs de l'Est Ontarien - one year project

Club members plan to implement new G.I.S.- and G.P.S.-based technology on 5 sites. Once in place, these systems will allow a farmer to:

- accurately monitor yields on a field by field or strip by strip basis.
- accurately monitor fertility levels on a field or grid basis.
- accurately monitor weed control strategies on a field or grid basis.
- reallocate crop inputs according to soil productivity potential.
- gain a better understanding of biological processes on their farms

Pierre-Yves Gasser, Agricultural Consultant, (613) 789-9603

Farming for Maximum Efficiency and Environmental Sustainability RRCP 78

Innovative Farmers of Ontario - four year project

The MAX Program is an established farm management and analysis tool which provides producers with the opportunity to compare current production methods with other producers. The program in Ontario will be known as the "E Plus" Program.

Stewardship Information Bureau, (519) 767-5020.

Differences in Soil Conservation Between Operator-owned and Rented Land LS 7008

Contractor: Dr. W. van Vuuren, Dept. of Ag. Economics and Business, U. of Guelph

Objectives: 1) To compare soil management practices affecting soil erosion between rented and owner-operated land.
2) To examine whether differences in management practices among tenants related to the contract.
3) To examine how well the stewardship lease under the Land Stewardship Program is working.

Results: Results indicate poorer soil quality on the rented land. In the majority of cases, poorer soil drainage, more gully erosion, ponding and loss of organic matter were found on rental parcels.

Few differences in annual crop and soil management practices or in the incidence of erosion control and compaction correction practices were found between owned and rented land.

Differences in use of soil improvements between owned and rented land were observed. More drainage and installation of wind breaks would be done if land tenure were more certain.

Written leases, especially those longer than one year, are associated with soil conserving practices, e.g. chisel plowing, erosion control, compaction correction, and wind breaks.

In the authors' opinion, increased soil conservation on rented land may be achieved by encouraging written, longer term lease arrangements with compensation clauses for unexhausted durable soil inputs at the expiry date of the lease. More work, however, needs to be done in the area of adapting these type of leasing arrangements into Ontario agriculture.

Review of No-Till Information for Ontario: Corn, Soybeans, Winter Wheat LS II 71
Kent County SCIA, (author: Janice Elliot, Summer Ass't., OMAFRA, RCAT)

19B: Cropping Systems and Water Quality

Environmental Effects of Conservation and Conventional Cropping Systems. RF 03/97

Contractor: Ms. Jane Sadler-Richards, Ecologistics Ltd, 490 Dutton Drive, Suite 1A, Waterloo, N2L 6H7

Objectives: To determine on sites with known histories of conservation and conventional crop production, the effects of the conservation or conventional systems on soil and water quality, focusing on pesticide and nutrient movement. Implicit in the goal is concern that by emphasizing erosion control, overland flow may be reduced at the expense of leaching and environmental filtering.

Expected Outputs: Comparisons of paired locations will be made, providing definition of inherent soil characters (landscape position, slope, soil profile, depth to impervious layer, particle size distribution) and dynamic characteristics (water release, infiltration rate, organic carbon, extractable nitrates, nitrites and P, microbial activity and extractable pesticides). Water quality measurements will be made on surface runoff waters, water from tile drains, and groundwater. It is expected that collection of water samples will be coordinated with pesticide and nutrient application and major rainfall events.

Ending: 1996-97

Maintenance Program for Three Southwestern Ontario Watersheds. LMAP 16/94

Contractor: David Hayman, Upper Thames Conservation Authority, R. R. #6, London, ONT N6A 4C1

Objectives:

1) To encourage continued adoption of conservation tillage and cropping practices on three watersheds (Essex, Kettle, Kintore)
2) To monitor the water quality of the streams in the watersheds using existing monitoring equipment from previous programs.

Expected Outputs: Besides providing continuing support for the landowners in adopting conservation tillage/cropping practices, this project will provide an ongoing record of the water quality and quantity as well as the agricultural practices on these watersheds.

Ending: 1994-95: COMPLETED, IN REVIEW

Upper Avon River Rural/Urban Conservation Club four year project RRCP 17

This club was formed as a result of water quality problems identified within the Upper Avon River watershed, specifically the Cook and Kuhn tributaries, as well as the main branch of the Avon river as it enters Stratford. An integrated water quality monitoring station, was installed by Environment Canada. The real-time data (temperature, dissolved oxygen, turbidity and water level) will be used to determine the long-term impact of club activities on general water quality of the Avon River. Also, benthic and fisheries information have been collected along the river. These data will help provide baseline information to measure the effect of changes in the watershed. A water quality sampling routine has been finalized. Six permanent stations have been selected for sampling. Samples were collected during the months of October, November and December '93. The Ministry of the Environment and Energy laboratory in London has agreed to provide analysis for club members.

Craig Merkley, Upper Thames River Conservation Authority, (519) 451-2800.

The Effect of Soil Quality on Field Scale Runoff under Conventional and Conservation Tillage Systems NSCP 8

Contractor: Dr R. Walker and Dr. R. Tossel, Beak Consultants Ltd.,

Results: Compared to conventional-till microbasins, no-till areas had:
- higher surface residues.
- higher organic matter content.
- increased soil moisture retention.
- higher soil moisture content during all seasons.
- lower bulk densities.
- generally, lower soil pH.
- more rapid degradation of metolachlor residues.
- no significant differences in groundwater Chemistry.
- lower surface runoff nitrate and metolachlor concentrations.

Effect of Controlled Drainage/Subirrigation on Tile Drainage Water Quality and Crop Yields at the Field Scale. MA 08/97

Contractor: Dr. Ian van Wesenbeeck, Harrow Research Station, Agriculture and Agri-Food Canada

Objectives:
1) To determine economic benefits of the CD/SI at the farm scale to the farmer;
2) To provide a field scale dataset for scaling up models calibrated at the plot scale (from Great Lakes Water Quality Study, Harrow);
3) To add information on water quality in existing conventional and no-till monitored watersheds established in SWEEP program;
4) To study the partitioning of nutrient losses between the tile drains and groundwater for a CD/SI system at field scale

Expected Outputs: This study will provide on-farm demonstrations of the advantages of Controlled Drainage/Subirrigation systems to the farmer from an economic viewpoint, as well as from a nutrient management/water quality viewpoint.

Ending: 1996-97

Measuring the Effect of Crop Residue or Live Cover Crops in Conservation Tillage Systems on Soil and Water Quality RF 06/97

Contractor: Dr. Ian Van Wesenbeeck, Harrow Research Station, Agric. Canada, Harrow, ONT N0R 1G0

Objectives: To improve the effectiveness of red clover as a cover crop on clay soil by:
- measuring changes in soil structure, hydraulic properties and the influence on soil biomass and N-cycling attributable to red clover in a wheat-corn-soybean rotation,
- altering the method and time of killing,

- discovering the limiting factors to corn growth planted into wheat-red clover residue
- observing the impact of red clover cover on weed management.

Expected Outputs: New information, or confirmation of existing information, which will assist in superior recommendations for the management of crop residue or live cover crops on clay soil.

Ending: 1996-97

19C: Cropping Systems and Soil Properties

Crop Residue Decomposition and Organic Matter Dynamics in Alternative Management Systems on Coarse-textured Soils. NSCP 9

Contractor: R. Beyaert, Delhi Research Station, AGRICULTURE AND AGRI-FOOD CANADA

Objectives:

1) To identify a method for measuring or estimating soil organic matter levels as they relate to soil management systems and which can be useful for characterizing changes in soil quality.
2) To relate these estimates of OM changes to changes in soil chemical and physical properties.

Results:

Total weight of above-ground non-harvested crop residues differed among crops, cropping systems and tillage practices, and in general, paralleled differences in crop yield.

Surface-applied residues initially decomposed more slowly than those incorporated into the soil, but approached similar rates by the end of the second year. Roots decomposed more slowly than incorporated above-ground residues.

Less residual nitrogen was available from surface-applied residues than from those incorporated into the soil.

No-till practices resulted in stratification of decomposition products near the soil surface.

Crop Rotation Effects on Crop Yields and Soil Properties in Southwestern Ontario LS 7011

Contractor: D.S. Young C.K. Stevenson, C.S. Baldwin and B.R. Doidge, RCAT

Objectives:

1. To study the effects of red clover plowdowns left for various lengths of time on -
   a) succeeding yields of corn
   b) chemical and physical soil properties
   c) economics of crop production in the rotation
   d) the change in nutrients found in the soil
   e) the change in uptake of different nutrients by crops
   f) nitrogen rates to succeeding crops.

2. To study the effects of different crop rotations on -
   a) succeeding crop yields
   b) chemical and physical soil properties
   c) economics of crop production with different rotations
   d) the change in nutrients in the soil
   e) the change in update of different nutrients by crops.

Results: FINAL REPORT HAS NOT BEEN RECEIVED DUE 03/31/94

Determining the Factors Responsible for, and Methods to Overcome the Limitations of Conservation Cropping Systems on Clay Soils RF 04/97

Contractor: Dr. Tony Vyn, Crop Science Building, University of Guelph, Guelph, ONT, N1G 2W1

Objectives:

To establish essential seed-bed criteria for good crop emergence and growth on clay soils and to define tillage strategies to meet these criteria under conservation cropping systems where the rotations are corn-soybeans and wheat-soybeans or wheat-corn. The test crop will be corn or soybeans in each case.

Expected Outputs:

The tillage systems will include the moldboard plow, chisel plow, mulch-disc and zone tillage. Major soil measurements will be residue cover at planting, soil temperature, soil moisture in the seedbed, penetrometer resistance of the seed bed, soil aggregate size, soil bulk density, soil macroporosity, time to ponding, crop emergence, early crop biomass and grain yield. In-sights into problems of conservation tillage on clay soils, and strategies for overcoming are expected.

Ending:

1996-97

Improving the Degraded Structure on Fine Textured Soils with Deep Tillage and Grass and Legume Crops LS 7012

Contractor: Claude Weil, ACAFT

Objectives:

1. To measure the effects of soil compaction on crop growth and yield on a Bearbrook fine textured soil.
2. To evaluate the effectiveness of subsoiling in improving soil structure between depths of 20 to 60 cm for a range of soil moisture contents above and below the plastic limit.
3. To measure moisture content at which Bearbrook soils are most susceptible to compaction.
4. To analyse soil physical properties in compacted vs. loosened soils.
5. To develop guidelines on the use of subsoiling for fine textured soils.

Results:

FINAL REPORT NOT RECEIVED - DUE DATE WAS 09/30/91

Improving the Degraded Structure of a Clay Loam Soil with Deep Tillage and Grass and Legume Crops LS 7013

Contractor: W. Curnoe, KCAT, et al

Objectives: To develop agronomic practices to restore the productivity of fine textured soils which have been seriously degraded as a result of continuous corn cropping with conventional tillage.

Results: A no-tillage system was imposed on a structurally degraded fine-texture soil (Humic Gleysol) that had been under continuous corn with moldboard tillage for more than 20 years. After 3 years of no-tillage, several soil structural properties were compared with the conventional tillage treatment to assess whether the soil structure had improved.

No significant difference ($P<0.05$) was found between tillage treatments for the saturated hydraulic conductivity, porosity and penetration resistance in the surface 5 cm. Measurements of soil penetration resistance and in situ saturated hydraulic conductivity (K_{wp}) using the well permeameter method were sensitive to structural changes that had occurred at 5-20 cm depth. The K_{wp} at this depth was significantly greater in the moldboard treatment than in the no-tillage treatment. Resistance measurements indicated significantly greater soil strengths at 10-20 cm under no-tillage. Aggregate stabilities were assessed by wet sieving twice during the growing season. No-tillage resulted in larger soil aggregates, especially at the surface, compared with the moldboard tillage.

These data suggest that degraded soils with low structural stability may initially further deteriorate with elimination of tillage, from loss or reduction of mechanically formed pores.

Management of Fine Textured Poorly Drained Soils for Intensive Agriculture LS 7002

Contractor: Dr. J.A. Stone, Harrow Research Station

Objectives: To contribute to the development of a row crop management package which will improve and maintain soil structure through a) evaluation of several legume - grass forage mixes to provide improvement in soil structure
b) determination of the minimum amount of tillage required to obtain yields equivalent to conventional tillage in a corn-soybean rotation and determination of the effect of reduced tillage on soil structure (1988-91)
c) evaluation of intercropping corn with forages under conventional and conservation tillage systems relative to soil structure, nitrogen requirements, and effects on yield.

Results: **Rotations:** Weather conditions had a greater influence on yields and plant growth parameters than rotations.

Tillage: The effects of weather conditions and tillage treatments on soybean yields were inconsistent because of interactions. The best row crop tillage treatment yield were for fall chisel plowing followed by fall chisel plowing for the corn crop and only spring secondary tillage for the following soybean crop. Ridge tillage had similar yields but was the most inconsistent over years and locations. Percent plant residue was highest for ridge, spring secondary and fall chisel plowed tillage treatments. Soil moistures were higher after corn rotations and chisel plowed tillage treatments of corn and soybeans. Soil aggregate size improved with chisel plowing and minimum spring secondary tillage while ridge tillage maintained water stable aggregate structure better than chisel or moldboard plowing. Rotations did not improve wet aggregate stability over the three years. Bulk density and soil porosity results were inconsistent for tillage treatments and rotations.

Inter-cropping: There were no significant differences for yields among the treatments for any year. Planting intercrops at the 3-4 leaf stage resulted in higher yields than planting intercrops at corn planting. Corn yields were enhanced by inter-cropping in some situations compared to no bare soil. Planting intercrops such as hairy vetch or reed canary grass should support yields equal to conventional row crop production.

Management of Fine Textured Poorly Drained Soils For Intensive Agriculture: Characterization of a Forage Factor which Enhances the Growth of Corn in Rotation - Parts I & II LS 7006 & LS 7007

Contractor: I - Dr. Ann Oaks, McMaster University,
II - Dr. J.A. Stone, Harrow Research Station,

Objectives:
1. To contribute to the development of a row crop management package which will improve and maintain soil structure.
2. To establish which forage crop enhance the growth of the subsequent corn crop and whether any forage crops influence the sheath forming ability of the seedling root.

Results: *Inoculation of corn with forage soils in greenhouse conditions*:
1. inocula of the cropping treatment soils give substantial growth responses in a greenhouse corn growth assay
2. growth responses are much smaller for soils collected after a corn cropping season
3. the relative performance of the various soils are very different when collected before or after the corn crop.

Growth of corn in field plots:
1. differences in emergence between forage soils were small
2. highest silking rate index was observed on alfalfa soil.
3. at 6 weeks, shoot weights on the best soil (alfalfa) were more than double those on the worst (crested wheat grass)

4. the top yielding group of cropping treatment soils were soybean, corn, sweet clover, Austrian winter pea, red clover, white clover, alfalfa, birdsfoot trefoil and hairy vetch. Yields on legume soils were significantly higher than on non-legume soils

Soil aggregation and soil sheath forming ability
Poor reproducibility of the results both in terms of relative sheath size with different forage soils and absolute sheath size suggest that the results are of limited use.

Crop Production with a No-traffic Tillage System LS 7015
Contractor: D.S. Young, RCAT

Objectives:
1. To enhance and maintain the quality of the soils of Southwestern Ontario, and find cost effective crop rotations which maintain soil quality and reduce soil degradation.
2. To study effects of compaction and tillage practices on:
   a) yields of corn.
   b) selected soil chemical and physical properties.
   c) changes in selected plant nutrients in the soil.
   d) the change in uptake of different nutrients by corn.

Results: *Soil Property Summary*
1. The annual post-harvest imposition of a 12 tonne axle load prior to fall tillage operations caused significantly higher penetrometer resistance within and below the plow layer of soils whether conventional or reduced tillage practices were employed. Differences in penetrometer resistance in the plow layer between load and no load situations were greater for zero-till than for either chisel or moldboard.
2. Tillage systems and resulting plow layer soil conditions had little effect on the depth to which repeated axle loadings affected subsoil penetrometer resistance. Penetrometer resistance below 35 cm depth was not significantly affected by the axle load.
3. On the loam soil, soil moisture in the 0 to 15 cm depth interval was often significantly lower when all traffic was eliminated. These differences were more evident during periods of lower than average precipitation.
4. Controlling traffic did appear to result in lower soil bulk densities than more random traffic patterns on the silt loam and clay loam sites. Soil bulk densities were significantly lower for FPU treatments for at least one depth at each site when averaged across all tillage systems but not within any specific main tillage treatment. However, on the loam site, differences in bulk density were found only among tillage systems.

Plant Effects Summary
1. Use of a controlled traffic system generally resulted in poorer early growth of corn within chisel or moldboard systems, caused in some cases by reduced soil moisture levels in the seedbed. In some cases, later season corn growth was enough to compensate for any early season lag.
3. The reduction in corn yields often experienced with zero tillage (when corn follows corn) was not overcome by eliminating traffic from the plot area.
4. Differences in final grain yield among traffic systems were generally not significant.
5. Soybean yields (in the one site/year) were equally unaffected by tillage or traffic systems.

Soil Stewardship Cropping Systems for Corn & Soybean Production LS 7004
Contractor: Dr. B.D. Kay, LRS, U. of Guelph, Principal Researcher

Objectives: This study focused on the use of forages (particularly legumes) and a reduction in tillage as possible ways to improve soil structure and reduce nitrogen use, through:
(a) assessment of cropping systems for soybeans utilizing different tillage and combinations of preceding crops,

(b) refinement of management practices for the use of red clover as a companion crop underseeded in corn or cereals,
(c) evaluation of different forage species as cover crops and
(d) development of the capability to predict the response of a range of different soils when forages are used.

Results:

Crop Rotation and Tillage Effects on Soybean Production - A series of 2-year field experiments evaluated the effect of cropping history and tillage practice on soil structure, soil erosion, and soybean yield. Preceding year cropping treatments were: 1) Corn, 2) Wheat, 3) Wheat with red clover, 4) Soybeans, and 5) Fall rye cover crop. The tillage systems were: 1) Zero-till, 2) Spring tandem disc, and 3) Fall moldboard plow.

Soils tended to be the most structurally stable following either wheat or wheat with red clover and the least stable following soybeans. Structural stability was not improved by the inclusion of fall rye after soybeans.

Zero-till minimized the potential for soil erosion. Zero-till planting in relatively high amounts of residues often reduced soybean yields, compared to fall moldboard plowing, mainly because of pests rather than inferior soil physical properties.

Zero tillage is recommended for soybean production on sandy loam soil following all crops except winter wheat plus red clover. Zero tillage is also recommended following soybeans on loams or clays loams. The option of spring cultivation only appears to be feasible on loams and sandy loams which are well-drained following all crops but wheat plus red clover. Conservation tillage on clay loams could involve fall primary tillage since spring cultivation alone often resulted in yields which were lower than both moldboard plowing and zero tillage.

Tillage Requirements for Corn and Soybeans Following Soybeans LS II 58

Contractor: Dr. Tony Vyn, University of Guelph

Objectives: To demonstrate tillage options for corn and soybean production following soybeans while measuring crop yields and potential for soil erosion (through rainfall simulation studies).

Results: Trials were conducted at four sites in 1992 to compare several tillage systems and planter attachments.
Reduced tillage greatly reduced the potential for soil erosion.
A single pass with a field cultivator in the spring was sufficient tillage for either corn or soybeans
No tillage reduced yields of both crops at some sites.
Where planter attachments which only moved crop residues were used, crop yields were somewhat less than where attachments those which loosened the soil were used.
There appeared to be no advantage to using attachments with more than one coulter for planting systems.

Literature Review Pertaining to Buffer Strips NSCP 11

Soil and Water Conservation Information Bureau

<u>**19D: Conservation Cropping Systems Demonstrations**</u>

Variable Input Application RRCP 84

Kent Precision Farming Club - four year project

The basic elements of a system for "precision farming" are:

- information on position in the field.
- a means to record application or planting rates.
- a means to control application rates.
- yield monitoring.
- integrating the above information with soil test data and other observations into a field map to further refine the "system" next year.

Elements of this system have already been developed by club members. This season a refined electric planter population controller using radar for position information has been tested. The information from a number of fields was recorded onto a memory cartridge in the tractor and this data was then transferred to a computer. The equipment performed well and was designed to be robust and easy to use (just "plug and play"). Essential information was displayed in the tractor cab; data processing was done on the office computer.

Other pieces of equipment will be integrated into the system with the goal of first being able to record all the input levels as they are varied manually across the field. The ultimate goal is to vary input levels automatically using a preprogrammed memory card, based on the field mapping data.

Determining yield responses to input changes will be an ongoing effort. Areas with different populations and receiving different nitrogen levels will be monitored and hand yield checks will be taken. These will be compared with the values recorded using the yield monitor. Soil cores to 1.0 metre will be taken to measure nitrate levels in areas receiving different rates of nitrogen to determine the potential impact on ground water quality.

Doug Smith, Project Leader, (519) 692-5240.

Tillage and Yield Study Group LS II 29a

Contractor: Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Results: Information was collected regarding the production practices and yield for corn, soybeans and winter wheat, from up to 26 farms over 4 years. Net returns per acre were calculated using standard cost figures. No attempt to summarize the information by year or for the project is included, except to note that as producers on coarse or medium-textured soils, gained experience with reduced tillage systems, they tended to become more profitable than conventional tillage.

Conservation Farming for Profit RRCP 97

Peel Soil Conservation Club - two year project

This Club was formed from farmers in both Peel and Halton counties. This project consists of classroom and field studies (approx. 42 hours), on-farm comparison of conservation farming projects (on a minimum of 10 acres on their own farm), and classroom presentation and discussion of conservation farming projects.

Most farmers are uncertain about the benefits of conservation farming and are not about to change their existing methods without a clear understanding about how the methods work and what benefits are to be realized. Each member will have a different idea on what conservation farming means for their farm. One purpose of this project is to expose the members to more ideas than they currently are aware of.

Gord Armstrong, (905) 843-1795.

Ontario Ridge Till and Strip Cropping Club - four year project

<u>Ridge Till and Strip Cropping Field Days</u> RRCP 67

Two field days were held in August of 1993 in Thamesville and St. Isidore de Prescott. Both were well attended. Also in August, a field tour was conducted in order to view members' farms in Elgin, Lambton and Kent Counties.

<u>Comparison of Strip Cropping with Field Cropping Management</u>

In 1993, the experiments addressed the question of the effect of strips on soybean yield, at four sites, two in the South and two in the East. The eastern sites compare the yield of 30" soybeans in plots with 18 rows between 6 row corn strips with soybeans in plots with 6 rows between corn strips, and, a comparison between the yield of 30" soybeans in plots with 20 rows between 4 row corn strips with soybeans in plots with 8 rows between corn strips. In the south, the yield of 14" soybeans in plots bordered by 6 rows of 30" soybeans with 30" soybeans in plots bordered by 6 row corn strips is being compared. A second site is comparing the yield of 30" soybeans in plots with 18 rows between 6 row corn strips with soybeans in plots with 6 rows between corn strips.

Joe Omielan, Co-ordinator, (519) 240-3769.

Rye Cover Crop in Corn LS II 29d

Contractor: Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Results: Rye was over-seeded into standing corn at the 5-leaf stage and was killed with Roundup in the fall; soybeans were seeded no-till in the following spring. Rye appeared to cause no major problems for either the corn or soybeans. Rye caused some suppression of weed growth.

Pre-Tillage of Winter Wheat (or other cereal crops) Stubble in a No-Till or Minimum Tillage System RCC 68

Middlesex Pre-Till Club - four year project

Activities involve the study of the effect of fall tilling a portion or a small strip of soil after winter wheat has been harvested. Various techniques to overcome the problems associated with wheat stubble will be evaluated on a field scale basis. Plots will contain from two to five treatments ranging from complete no-till to use of disc, airway, row-till tools, etc. Plots will be replicated twice where possible, with a number of plots over 4 years used to generate significant results. A technician was hired to co-ordinate and set up plot structure, record data and compare various plot treatments.

Twenty field sites were set up. Various tillage treatments such as Plow, Disc, Cultivator, No-Till, Airway, and Row Buster were chosen for each field site and a plot map was drafted. Information was also recorded on soil type, drainage, residue as well as weed pressure. When tillage treatments were done, field notes were taken by the technician on soil moisture conditions in the field, visual assessment of tillage action, residue left after tillage and notations as to how the equipment worked in field conditions.

Rick McCracken, (519) 289-5576.

Para-Tillage: A Jump Starter for a Conservation Tillage Program RRCP 09

South Lambton Conservation Tillage Club - 3 year project

Beginning in the spring of 1994, four separate test areas, comprised of four, two acre plots of harvested wheat stubble each, will be established to enable club members to make soybean yield comparisons using para-tillage and no tillage systems. Test areas are located in Lambton County. It is the objective of this group to show that a conservation tillage system can be used without any accompanying yield reduction on Brookston clay soils.

Barry McFadden, Pres., S. Lambton Conservation Tillage Club, (519) 683-6012

Conservation Tillage for Profit RRCP 110a

Wellington County Conservation Club - 1 year project (COMPLETED)

A combination of classroom sessions and field demonstrations helped club members investigate various conservation tillage methods. Areas of study included: No Till vs. Minimum Till/John Deer 750 vs. Great Plains/Soybeans following Soybeans; Conventional/Minimum Till/Soybeans following Wheat, Corn or Soybeans; and, Soybeans following Alfalfa in No Till vs. Conventional Till with Fertilizer vs. No Fertilizer

Elaine Williamson, c/o Willoa Associates, at (519) 856-2165.

Conservation Farming **RRCP 110b**
Wellington County Conservation Club - one year project

A continuation of the successful "Conservation Tillage for Profit" course held in the spring and summer of 1993. This time, members in Wellington County will gain valuable experience in conservation farming principles and practices through a combination of classroom sessions, field demonstrations and individual on-farm projects.

Each participant will be required to submit a report on the results of their individual projects to be published through the Wellington County SCIA as reference material for interested farm operators.
Martin de Groot, President, (519) 638-3481.

No-Till Demonstrations and Trials LSII 61
Contractor: North Kent No-till Group

Objectives: To compare yield, emergence, weed populations and control, residue cover, plant populations and economic considerations of conservation tillage against conventional tillage on variable soils.

Results:
Strip trials were conducted with corn, soybeans and winter wheat on five farms over 2 years.
No-till winter wheat yielded as well as conventional.
No-till soybeans yielded about 1.5 bu/ac less than conventional, but because of savings in time and tillage, no-till was more profitable.
No-till corn yielded about 9 bu/ac less than conventional; after adjustment for savings in time and tillage, no-till was less profitable by about $15 per acre. Comments about the effectiveness of various planter attachments and adjustments made to equipment are also included.

Soil Conditioning for No-till Systems LS II 22a
Contractor: Essex Conservation Club, c/o Bill Stevens, OMAFRA, Esssex

Objectives: To investigate the usefulness of the Aerway tillage unit for:
- improving water infiltration on Brookston clay and speeding residue breakdown;
- bedding tomatoes on sandy loam soil.

Results: The Aerway unit was tested in one growing season. No measurable differences in crop yield, soil temperature or infiltration were noted. Co-operators felt that the Aerway could be a useful transition tool towards no-till, through improved infiltration, and in partially incorporating cereal residues on dry soil.
Co-operators intend to continue the project after LS II.

Economic Conservation Yield Monitoring Program LS II 35
Contractor: Essex Conservation Club

Objectives: To promote sustainable cropping and tillage practices through monitoring on-farm projects.

Results: Information was collected from farm plots over three years regarding tillage system, pesticide and fertilize use, and crop yield for corn, soybeans and winter wheat.

Net returns per acre were estimated using standard custom work rates and commodity prices. A estimated conservation value was also assigned to each system as a means of evaluating expected environmental benefit from conservation practices.

No-till Demonstrations LS II 22b

Contractor: East Kent No-till Farmers

Objectives: To evaluate and demonstrate use of a coulter-caddy system for growing corn, soybeans and winter wheat on sandy soils.

Results: Over two years, there was little difference in yields between no-till and conventionally planted crops. Estimated economic advantage per acre for no-till over conventional was $30.80 for soybeans, $22.60 for wheat and $16.80 for corn, largely because of reduced cost for tillage. Annual weed pressure was greater in conventional tillage; perennial weeds were worse in no-till.

Evaluation of No-till in Corn and Soybeans LSII 65

Contractor: Erie Thames No-Till Innovators

Objectives: To design, build and evaluate a triple frame modular no-till planter for corn and soybeans.

Results: A planter equipped with fertilizer boxes and 13 planter units was built and tested over 2 years. Results from test plots comparing corn hybrids, soybean varieties, plant populations or planters are presented.

On-farm Demonstrations and Trials LSII 80

Contractor: Electric Reduced Tillage Group

Objectives: To compare different types and placements of starter fertilizer, in reduced and conventional tillage.
To improve nitrogen fertilizer placement in reduced tillage.

Results: Results from test plots over two years, comparing starter fertilizers, corn hybrids and tillage systems are presented. Fertilizer placement was enhanced through use of side-knife coulters. The combination of residue managers and unit-mount coulters worked well in clearing residues from the seed row.
Yields were slightly higher in conventional tillage, but reduced tillage was more profitable.

Comparison of No-till Planting Equipment for Soybeans LSII 81

Contractor: South-west Kent No-till Group

Objectives: To compare the suitability of 3 no-till planters for planting soybeans on Brookston Clay.

Results: Results from test plots over two years are presented comparing 3 planters for soybean emergence, plant population and yield. soybeans in 7" or 10" rows outyielded those in 15" rows by about 5 bu/acre. Weed control was much better in the narrower rows.

No-till Equipment for Brookston Clay LSII 105

Contractor: Townline No-tillers Group, c/o Bill Stevens, OMAFRA, Essex

Objectives: To compare no-till and conventional systems for Brookston clay.

Results: No data are included in the file. Results apparently were included with Essex SCIA Annual Reports.

No-till Systems for Brookston Clay LSII 106

Contractor: Anderdon No-tillers Group, c/o Bill Stevens, OMAFRA, Essex

Objectives: To compare no-till and conventional systems for Brookston clay.
To test a PTO ditcher for making ditches in no-till fields.

Results: No data are included in the file. Results from two years apparently were included with Essex SCIA Annual Reports. Concludes that yields could be maintained with no-till.

Evaluation of Corn Hybrids under Ridge-till, Zone-till and Conventional Tillage Systems LSII 115

Contractor: Kent Corn Producers' Assoc. and Gordon Scheifele, RCAT

Objectives: To evaluate the performance of recommended corn hybrids (over 2800 CHU) under 3 tillage systems over 3 years.
With Dr. H. Hope, Agriculture Canada, to work towards development of a system for screening hybrids to predict their suitability for no-till.
To identify more clearly factors which affect corn performance in reduced tillage systems.

Results: Trials were conducted at 2 locations over 3 years. There was no significant relationship between coleoptile emergence and final stand or yield. Hybrid by environment interactions were no different under reduced tillage than under conventional. No specific hybrid traits was found to be more important under reduced tillage than conventional. The ranking of hybrid performance was generally the same, regardless of tillage system.

Conservation Technology and Practices in the Cultivation of Canola LS II 7

Contractor: Ontario Canola Growers' Association

Objectives: To compare and demonstrate different tillage systems.
To compare harvest methods, (swathing vs. direct combining)
To compare the effectiveness of several no-till drills.

Results: Trials were conducted at two locations in each of 3 years.
In general, it was shown that spring canola can be grown successfully using no-till without adverse effect on yields or free fatty acids (FFA). However, it may be necessary to increase seeding rates.
Direct combining tended to increase levels of FFA in the seed.
In no-till canola, applying fertilizer near the seed did not affect stands, but appeared to reduce yields (non-sig.)
With winter canola, no-till resulted in lower yields than conventional tillage.

Reduced Tillage in Spring and Winter Canola Production RRCP 122

Ontario Canola Growers Association - one year project

The goals of the club members involved in this project were to promote Canola as a crop, to help producers determine if specific production systems are suitable and or desirable in their farm operation, and to determine the effectiveness of conservation tillage practices in spring and winter canola production. To achieve this goal, three spring canola trials were conducted on a site in Grand Valley, and one winter canola trial was conducted at another location near Ripley.

The first spring canola trial was conducted to determine the effect of various tillage systems on canola yields, oil quality and economic return. The second trial compared the effect of two harvesting methods, direct combining of the standing crop and swathing followed by combining, on the yield, oil quality, and economic returns of spring canola. The third trial investigated the optimum seeding rate needed when a no-till or broadcast seeding method was used. The winter canola tillage trial was conducted to determine the effect of various tillage systems on canola yields, oil quality and economic returns.

1) spring canola yields at the Grand Valley location were quite low. Some factors that may have contributed to the low yields were excessive soil moisture early in the season which restricted root development, weed pressure, and uneven plant stands in some plots.
2) In the spring canola tillage experiment there were no significant differences for yield among the tillage systems.
3) The harvesting method had no significant effect on yield.
4) The yields from the no-till drills and broadcast seeding experiment tended to increase as the seeding rate increased
5) In the winter canola tillage experiment the mouldboard plough treatment had the highest yield and the no-till treatment had the lowest yield.
6) The economic and oil quality analyses have not been completed.

Mr. Murray Smeltzer, Chairman, (519) 291-4811.

Forages for Soil and Profit RRCP 34

Renfrew Soil and Crop Improvement Association - two year project

A total of 13 farm operations are involved (9 dairy farms, 2 beef farms and 2 cash crop hay). Club members believe that more information is needed by farmers in Renfrew County to enhance their hay production practices. This project aims to identify the most important production inputs for growing and harvesting hay.

Members of the Club are participating with Crop Insurance in a pilot project to determine the feasibility of on-farm forage yield coverage. Hay yields for all farms have been collected to establish an average farm yield.
Paul Sullivan, Project Advisor, c/o OMAFRA (613) 828-9167.

Wilkesport Demonstration Club RRCP 42
Wilkesport Conservation Club - four year project

A 30 acre field in Lambton County has been divided into seven sections, to demonstrate conservation techniques. Four sites will have a conservation emphasis and three sites will be sown conventionally. Tillage, fertility, weed control, pest management and economics will be studied and compared within each section. Analysis of these techniques will provide farmers choices that have been proven to work.
Lambton S C I A, c/o Gabrielle Ferguson, OMAFRA, Petrolia (519) 882-0180.

20A: Pest Management: Field Crops

Reduced Chemical Input Systems for Improved Water Quality. GLWQP 12
Contractor: M.A. McGovern, J.L.B. Culley, and A.S. Hamill, A.A.F.C, Ottawa, 613-995-5011

Objectives: To determine whether the combination of chemical and mechanical methods of weed control can reduce the use of herbicides while maintaining corn yields, by evaluating the following:
- broadcast vs. banded over the row vs. slot placement of nitrogen.
- herbicide persistence and movement as affected by soil type and climate.
- agronomic benefits of row banding of herbicides and inter-row cultivation.
- agronomic benefits of mixing herbicides with 28 % UAN solution.

Results: Atrazine, metolachlor and metribuzin applied at minimum label rates provided reasonable weed control and appeared to have been degraded to very low soil concentrations by harvest. Degradation of atrazine appeared to be more rapid in southwestern Ontario than in eastern Ontario. On coarse-textured soils, banded herbicide application with inter-row cultivation reduced corn yields as compared to broadcast application without cultivation. There appeared to be no agronomic weed control benefit from mixing herbicides with 28% UAN.

The yield benefit from a corn-soybean rotation was confirmed (about 10 %). Results suggest that higher rates of nitrogen may be agronomically appropriate in southwestern Ontario, as compared to eastern Ontario, and that they would not materially affect the groundwater contamination risk.

Integrated Soil, Crop and Water Management Systems to Abate Herbicide and Nitrate Contamination of the Great Lakes: Herbicides GLWQP 04
Contractor: J.D. Gaynor, C.S. Tan, C.F.Drury and T.W.Welacky, A.A.F.C., Harrow 519-738-2251

Objectives: To investigate the effects of the following (singly and in combinations) on herbicide losses from treated fields to surface or tile drainage water and crop performance (corn):
- controlled drainage,
- reduced tillage,
- banded herbicide application,
- intercropping with annual ryegrass.

Results: Herbicides applied in a band over the row reduced herbicide use and improved water quality in direct proportion to the reduction in the area treated. Water quality was improved by both intercropping and conservation tillage. Controlled drainage increased herbicide losses through surface runoff, but reduced losses through tile drainage by an equivalent amount so that the total was unchanged.

Management of Corn Rootworms on Farms by Monitoring Eggs RCC 75

Department of Environmental Biology (University of Guelph) - **four year project**

Test traps were set up for monitoring of the eggs. Twenty-five sites were located in the following counties: Huron, Perth, Middlesex, Hastings, Prince Edward, Lennox & Addington, Waterloo and Wellington Counties. Forty traps per site were placed and serviced regularly from Guelph and from Sterling.

Cliff Ellis, Department of Environmental Biology, University of Guelph, (519) 824-4120, ext. 3076.

No-Till Demonstration Plot LS II 23

Contractor: Rondeau Agricultural Conservation Corp.

Objectives: To demonstrate various ways of growing corn and soybeans under no-till conditions.

Results: Over three years, there appeared to be a slight yield advantage in corn for banding spraying and cultivating, as compared to broadcast spraying. Banding spraying plus cultivation also resulted in a cost savings of about $21.50 per acre per year.

There was little difference in soybean yield between 7.5" and 19" row widths. Soybeans in 38" rows yielded much less.

Band Spraying, Inter-row cultivation, and Sidedress Nitrogen Application for Corn in Eastern Ontario LS II 63

Contractor: Carleton SCIA, c/o Paul Sullivan, OMAFRA, Nepean

Objectives: To evaluate the feasibility of band spraying and inter-row cultivation for corn in eastern Ontario.

Results:

Tests were conducted on four farms in each of 2 years comparing broadcast application of herbicides against banding plus a variety of cultivation options (one or two cultivations, with or without rotary-hoeing). Over the 2 years, all of the banding plus cultivation treatments provided good weed control and yields equivalent to broadcast applications. Net incomes were higher from any of the banding plus cultivation treatments than from broadcast spraying.

Band Spraying LS II 29c

Contractor: Lambton SCIA, c/o Gabrielle Ferguson, OMAFRA, Petrolia

Results: Experiences of 3 co-operators were monitored over 2 years. Band spraying plus cultivation provided acceptable weed control without reducing yields and resulted in a net savings of about $22 per acre. Comments on equipment and adjustments are included.

Evaluation of a Vegetation Detecting Weed Sprayer LS II 70

Contractor: Rondeau Agricultural Conservation Corporation,
Jack Rigby, R. R. # 2, Blenheim, N0P 1A0

Objectives: To evaluate the "Detectspray System" as a means of reducing the amount of herbicide applied in situations of less than complete coverage of soil with weeds.

Results: The sprayer was tested at 5 locations in 1992-93 in weed infestations ranging from moderate to heavy. Reduction in the volume of spray applied ranged from 55% to 25%, respectively. Weed control was satisfactory.

Papers describing operation of the sprayer were presented by Jack Underwood to the Canadian Society of Agricultural Engineers and to the Expert Committee on Weeds - Eastern Section in 1992.

The high cost of the unit ($12,000 in 1992) may limit usage of this technology to operators with large acreages.

Integrated Weed Control, Nutrient Management and Reduced Tillage in Corn and Soybeans RCC 25
Carleton Soil & Crop Improvement Association - three year project

Three large scale plots were set-up to compare weed control methods, nitrogen rates and timing of application. A large part of this project involves the modification of equipment. A Land Tracker Caddy with a modified 750 gallon tank was set up with a semi-mounted 12 row Case IH 900 planter. Wheel settings were adjusted to 60 and 120 inch spacings. Red ball monitors were installed for detecting plugged nozzles. Red ball banding kits were installed onto the planter for band spraying over the row at planting. Hydraulic and electrical hook-ups were extended for tractor hook-up. The tank was equipped with bottom fill connections. Saddle tanks were mounted onto the tractor for carrying liquid starter fertilizer.

A Hinicker 5000 Cultivator was adapted with NH_3 Hinicker heat exchanger allowing adjustments of nitrogen rates. It was set up for band spray post emergence. A Navigator system was added for improved tracking. The members believe that they will need to go to the trench mark for early cultivation. Wand "crop feelers" didn't work in short corn.
Rick Schouten, Coordinator, (613)489-3667.

Long Term Economical & Environmental Feasibility Study of Using a Vegetation Detecting Sprayer for Weed Control in Conservation Cropping RCC 08

Rondeau Agricultural Conservation Corporation - five year project

A weed sprayer with individual vegetation detecting nozzles will be examined as a method of weed control in conservation cropping, with reduced used of chemicals. Approximately 10 areas of 50 acres each, located in the Rondeau Bay Watershed of Kent County, are being used as test plots. A self propelled sprayer will be purchased and a vegetation detection boom integrated with the unit. This sprayer activates individual nozzles to spray where there is green vegetation. The main objectives of this project are to evaluate and demonstrate the economic viability of the Sprayer, its positive impact on farming practices, and its multifaceted use over many applications.
Herb Groenewegen, Rondeau Agricultural Conservation Corp., (519) 676-4806.

20B: Pest Management: Horticultural Crops

Alternative Methods for Colorado Potato Beetle Control RCC 16
Southwestern Ontario Potato Beetle Club - two year project

The Colorado Potato Beetle is the major insect pest of tomatoes and potatoes and resistance to insecticides is increasing. The objectives of this project are to test the effectiveness of various cultural and biological control measures for the Colorado Potato Beetle and to reduce insecticide use on test plots in Kent and Essex County.

Club members found that potato trap strips were effective in containing beetle damage, as well as improving the effect of sprays through close monitoring. The release of predator bugs was an interesting portion of the project and club members found it gratifying to see a few natural predators "doing their thing" on the beetles and larvae.
Janice Elmhirst, Ridgetown College of Agricultural Tech., (519) 674-5456.

Non-Chemical Methods of Control of the Colorado Potato Beetle in Potatoes
Ontario Potato Pest Management Club - four year project RCC 76

Experimental sites were established by club members in 12 locations in the Alliston area in 1993. At each site, a plastic-lined trench was constructed along the edge of the potato field soon after the crop was planted to intercept the potato beetle populations that emerged from the margin of the fields. At three of the above locations a more detailed experimental design was established. It involved combinations of various non-chemical approaches to beetle control including plastic-lined trenches, propane flaming, release of a stink bug predator, and the use of the bacterial toxin, M-Trak.

Mark Sears, Envir. Biology, Univ. of Guelph, (519)824-4120, ext 3567

Water and Chemical Management Systems for the Turfgrass Industry RCC 120
Guelph Turfgrass Institute

Wetlands/Woodlands/Wildlife Program

Gary McCullough, Program Coordinator Canadian Wildlife Service, Ontario Region	Environment Canada 152 Newbold Court London, Ontario N6E 1Z7 Telephone: (519) 681-0486
Laurie Maynard, Program Manager Canadian Wildlife Service, Ontario Region	Environment Canada 75 Farquhar Street Guelph, Ontario N1H 3N4 Telephone: (519) 766-1593

The objective of the Wetlands/Woodlands/Wildlife (WWW) Program is to promote development and adoption of sustainable farm management practices and new technologies to address priority wetlands conservation, woodlands conservation, and drain management issues, in ways that benefit both agriculture and wildlife in the long term.

The 10 projects all have the following characteristics:

- farmer participation and support in implementation of practices and in demonstration tours;
- direct benefits to wildlife and farmers;
- evaluation and monitoring of techniques used;
- demonstration of techniques that are transferable to other farmsteads;
- proposed resolutions to potential conflicts between agriculture and wildlife and their habitat;
- many government and non-governmental organizations provide resources and advice;
- partnerships between agriculture and conservation groups;
- effective and affordable practices that promote long-term benefits to wildlife and agriculture;
- demonstration value through tours and open-air seminars.

Project Summaries

BIGHEAD RIVER DEMONSTRATION PROJECT

Lead Organization: Grey County Soil and Crop Improvement Association
Contact: Ray Robertson, (519) 986-2040
Location: Bighead River watershed, in Grey County

Description: The Bighead River watershed is predominantly agricultural and subject to considerable spring runoff. To address related concerns about water quality for humans, livestock and wildlife, this project features approaches such as: exclusion fencing for livestock near streams; alternate watering facilities and stream crossings; riparian areas - tree planting and bank stabilization; fisheries rehabilitation; wetland and floodplain enhancement; soil conservation.

CONSERVING BIODIVERSITY IN AGRICULTURAL ECOSYSTEMS OF THE CAROLINIAN LIFE ZONE

Lead Organization: Federation of Ontario Naturalists
Contact: Kim Gavine, (416) 444-8419
Locations: Long Point Region Conservation Authority, Kent Creek and Dedrich Creek watersheds

Hamilton Region Conservation Authority, Spencer Creek watershed

Description: The Carolinian zone of southwestern Ontario is subject to competing interests of agriculture and wildlife. To build partnerships among farmers, naturalists and conservation authorities, sites will demonstrate: native species revegetation techniques applied to woodlot and wetland edges, natural corridors, streams and fencerows; methods to address potential conflicts between agriculture and wildlife habitat.

COLD CREEK DEMONSTRATION PROJECT
Lead Organization: Ontario Federation of Anglers and Hunters
Contact: Ed Reid, (705) 748-6324
Locations: Cold Creek subwatershed in Northumberland and Hastings counties, near Trenton

Description: Landowners are offered incentives to adopt practices that protect, create or enhance fish and wildlife habitats, and that are compatible with sustainable farming practices, such as: delayed grazing; restricted cattle access; alternative watering systems; contiguous woodland; silvipasture; community nursery; wild turkey habitat enhancement; lure crops/wildlife food; utility corridor agreements; and riparian habitat enhancement.

LAUREL CREEK WATERSHED DEMONSTRATION PROJECT
Lead Organization: Grand River Conservation Authority
Contact: Peter Mason, (519) 621-2761
Locations: Beaver Creek watershed, Regional Municipality of Waterloo

Description: Natural heritage areas in this watershed have been fragmented by agriculture and other land uses. This project aims at establishing vegetation links and protection and enhancement of wetlands, woodlots and streams, in ways consistent with economically sustainable agriculture.

Using an ecosystems approach, the project's main components will be: conservation tillage; improved livestock management along watercourses; land retirement; and stream improvement.

LA CITÉ COLLÉGIALE'S WETLANDS/ WOODLANDS/ WILDLIFE PROJECT IN THE HAWKESBURY AREA
Lead Organization: La Cite Collegiale
Contact: Jacques Bouvier, (613) 632-2483
Locations: Seven sites in and around Township of East Hawkesbury, 100 km east of Ottawa

Description: Forest cover in the Hawkesbury area is sparse and confined to scattered, young hardwood stands with few conifers. Activities aimed at addressing woodlands and wetlands conservation include:

- planting shrubs and trees, and installing fencing to promote regeneration and exclude livestock;
- demonstrating good woodlot management that balances the needs of people and wildlife;
- planting along unstable, eroding slopes;
- establishing windbreak and wildlife borders along denuded wire fences.

SNAKE RIVER AND MUSKRAT BASIN DEMONSTRATION PROJECT
Lead Organization: Ontario Federation of Anglers and Hunters
Contact: Ed Reid, (705) 748-6324
Locations: Snake River and Muskrat Lake area of Renfrew County

Description: Techniques will be demonstrated on private lands to help maintain agricultural production and enhance wildlife habitats. Management practices will include: delayed grazing; restricted livestock access; alternative watering systems; contiguous woodlands; silvipasture; loggerhead shrike habitat enhancement; lure crops/wildlife food; upland and riparian habitat enhancement.

ISSUES AND OPPORTUNITIES FOR WILDLIFE HABITAT CONSERVATION IN AGRICULTURE

Lead Organization: Lower Trent Region Conservation Authority
Contact: Barry Jones, (613) 394-4829
Locations: Sites in upper Bay of Quinte drainage basin, on Little, Selby and Wilton creeks.

Description: In support of the Bay of Quinte Remedial Action Plan, this project will include demonstrations to create and enhance wildlife habitat and support agricultural goals through: windbreaks and shelterbelts; reforestation; intercropping; silvipasture; cover plantings/lure crops; fencerows; retirement of fragile land; livestock fencing; streambank stabilization.

ENHANCEMENT OF CADDY-BOTT DRAIN IN MIDDLESEX COUNTY

Lead Organization: Upper Thames Region Conservation Authority
Contact: Paul Fish, (519) 451-2800
Locations: Middlesex County, along main Caddy-Bott drain, Harvey Branch drain, Bott Branch drain, Caddy Creek, and Highway #2 through townships of West Nissouri and North Dorchester.

Description: Demonstration of best management techniques in the restoration and maintenance of the Caddy-Bott Drain will include: windbreak plantings; conservation cropping and tillage practices; drain enhancements, such as increasing stream buffer width, to reduce bank slumping, improve wildlife diversity, and reduce erosion.

MANAGING AGRICULTURAL DRAINS TO ACCOMMODATE WILDLIFE

Lead Organization: Ontario Soil and Crop Improvement Association
Contact: Andrew Graham, (519) 767-4601
Locations: James Berry drain and Cranberry Creek municipal drain in Haldimand-Norfolk Region; South Branch of South Nation River municipal drain in Dundas County; and Halls Creek in Oxford County

Description: Three sites will demonstrate and explore new ways of managing agriculture drains to accommodate needs of fish and wildlife through:

- bioengineering techniques, natural channel design, buffer strip development, retention ponds, and sediment traps
- monitoring of previous and new works under the Drainage Act and Fisheries Act will help determine cost-effectiveness.

LINKING SUSTAINABLE AGRICULTURE AND WETLANDS CONSERVATION

Lead Organization: Ducks Unlimited
Contact: Rick Wishart, (705) 721-4444
Locations: Bruce, Haldimand/Norfolk, Brant, Oxford, Waterloo, Wellington, Simcoe, Leeds/Grenville, Victoria, the lower Great Lakes shoreline portion of southwestern Ontario, and the Little Clay Belt in northeastern Ontario

Description: This project has three components:

- conservation farming, which uses a range of cropland management practices that benefit both agriculture and wildlife - under Ontario Land CARE (Conservation of Agriculture, Resources and Environment)
- native species plantings, which demonstrate the value of native species for wildlife cover and forage crops, as well as the viability of commercial seed production that could provide specialty crop income for landowners
- alternative forage sites for geese so that management practices that reduce crop damage on uplands directly associated with wetlands can be evaluated.

21: Wetlands and Streambanks

Project to Evaluate and Demonstrate Wetland Restoration RCC 14
Essex Wetland Restoration Club - 3 year project

With the assistance of staff from The Essex Region Conservation Authority, club members created 3 wetlands using existing agricultural, poorly drained areas. Environmental health will be monitored by measuring the wetland community and from water and sediment sampling. Buffer areas 15' wide were established around each wetland. Transplanting of such emergents as water plantain, marsh grass and lotus has been completed. Lilac trees and bulbs have been planted for additional habitat and aesthetics. Transplanting will continue as conditions permit.

Essex Region Conservation Authority, (519) 776-5209.

Ontario Land Care - Extension Project Sites RCC 77
Ducks Unlimited Canada - four year project

Five project sites in different counties across Ontario are in the process of being established to demonstrate management practices that benefit agriculture and also improve waterfowl/wildlife habitat. Grazing will remain the primary use of the land and the pastures will be managed by local Pasture Committees.
Leeds Community Pasture: A major wetland on this site was enhanced by constructing a dyke and water control structure. The interior fencing was completed to divide the pasture into 5 paddocks, 100 acres of pasture was renovated by seeding and fertilizing and agreement has been reached for 2 small wetlands to be fenced to keep the cattle out.
Victoria Community Pasture: A small wetland with a new dyke and water control structure. Work has been started on a second large dyke.
Bruce Community Pasture:
Site 4: Planned location of this site is Guelph.
Site 5: Planned location of this site is east of Toronto.

Galen Driver, c/o Ducks Unlimited Canada, (705) 721-4444.

South Simcoe Conservation Club Wetland Project RCC 92
South Simcoe Conservation Club

Land Use Adjacent to Southern Ontario Wetlands LMAP 6
Snell and Cecile Environmental Research

The purposes of this project are to: provide an estimate of Ministry of Natural Resources evaluated wetland adjacent to each of agricultural land, built-up areas and other land uses in southern Ontario; and to provide spatial trend estimates of the proportions of types of farm operation adjacent to the evaluated wetlands in southern Ontario.

Elizabeth Snell, Snell and Cecile Environmental Research, (519)821-5710.

COMPUTER SIMULATION OF BMP'S - A strategy to locate and manage artificial wetlands, ponds, infiltration systems and overland flow treatment systems in Ontario LMAP 7
Claude Weil, Alfred College

Over the past twenty years, there has been increasing public pressure to improve the quality of recreational waters in urban areas. Best Management Practices (BMP's), such as wet ponds, have been extensively tested and are routinely constructed. Global urban strategies for the control and treatment of stormwater runoff have been established using powerful computer planning models such as **QUALHYMO** (Rowney, 1985) and Express SWMM (Nix et al, 1989).

The objective of the work is to provide decision makers with a computer model for the management of water quality in rural areas using: artificial wetlands, slow and fast infiltration beds, facultative and aerobic ponds and overland flow systems.

For each watershed, such a model would allow the definition of a network of selected BMP's. Their type, location, design, operational mode and interaction would be defined for local climatic and land use conditions.

A Program to Assess Surface- and Groundwater Quality At Farm Sites Selected for Artificial Wetland Construction LMAP 14/94

Contractor: Assoc. of Conservation Authorities of Ontario, 418A Sheridan Street, Peterborough, ONT K9H 3J9 (Contact: Mr. David Hayman, Upper Thames Conservation Authority, R. R. #6, London, ONT N6A 4C1)

Objectives: 1) To identify approximately 12 farm sites across the province of Ontario which would meet at least one of the accepted design layouts for constructing an artificial wetland;
2) To install equipment for the monitoring of both surface and groundwater quality at each of the identified farm sites identified in Objective 1 in advance of the construction phase (which is to be completed by the end of 1994), to provide baseline water quality information.

Expected Outputs: The report from this project will document the various Artificial Wetland designs used in the study, and will provide detailed information on the instrumentation used to monitor water quality (surface, groundwater) at the sites.

Ending: 1993-94: COMPLETED, IN REVIEW

To Investigate the Establishment Subsequent Growth and Erosion Control Potential of Certain Tree and Shrub Species on Gully and Stream Banks LS 7010

Contractor: A. Skepasts, Head, Agronomy Section, NLCAT

Objectives: To show how gully/stream bank stabilization will prevent further erosion and consequent loss of arable soil.
To investigate the effectiveness of tree or shrub species in stream bank/gully erosion control.

Results: Three of the four species planted in 1989 established successfully. The rather poor establishment of snowberry may have resulted from dry weather during and following transplanting. By the spring of 1993, Norway spruce appeared to have suffered severe dieback, possibly due to the unusual weather during the fall and winter of 1992. The two remaining species, red osier dogwood and highbush cranberry appear to have survived. Data showed that highbush cranberry increased in height rapidly in the two years after transplanting, while both species rapidly increased in width.

Erosion of the gully bank due to surface runoff was not a serious problem during the course of this project. The tree and shrub cover, along with existing grasses, protected the slope from rainfall and spring runoff. In addition, the surviving species are providing cover for wildlife in the gully.

23: Woodlots and Wildlife

Farm Shelterbelt Design and Demonstration LS 7014

Contractor: Dr. V. Chanasyk, Landscape Architecture, U. of Guelph

Objectives:
1. To review shelterbelt design theory and to incorporate the most relevant aspects of it into the design of farm shelterbelts and amenity plantings.
2. Working with farmer clients to design farm plantings with regard to specific needs associated with shelter, snow, wind and climate control, soil erosion, food production, energy conservation, recreation and wildlife conservation.
3. To establish a farm shelterbelt demonstration project which may be used by OMAF and the University of Guelph for purposes associated with agricultural and rural landscape extension.

Results: NO FINAL REPORT RECEIVED - RESEARCHER HAS RETIRED FROM THE UNIVERSITY OF GUELPH

Agroforestry Research in Ontario LS 7003

Contractor: Mr. C. Nanni, Principal Researcher, RCAT.

Objectives:

1. To provide conservation benefits to landowners.
2. Provide direct and indirect benefits to the landowner.
3. Afford landowners the opportunity to diversify.
4. Provide information for fact sheets on: intercropping systems, marginal lands, income from woodlots, plantations, windbreaks and shelterbelts, tree species selection, biomass production, reclamation of abandoned or seriously degraded land, and design criteria for streambanks.

Results: *Intercropping* - Initial tree establishment in 1989 at all three locations was made easy owing to the cooperation of the weather. The narrow row intercropping system (16') became a grove or plantation (thereby losing the intercropping ideal) in the three year period. The wide row intercropping locations will remain in cash crop rotation for at least one more year before scaling down to one pass of cropping operations rather than two.

Seedling Trial - Red Pine container stock exhibited a 39% mortality while bare root showed only 13% mortality. White Pine container stock was 29% vs. 37% mortality for bare root. For Norway Spruce 72% mortality was exhibited, in the container stock plots and 38% mortality in the bare root plots.

Mortality was much higher (65%) with seedlings planted into untilled, or pasture type conditions, where no soil tillage or herbicide applications were carried out, as compared to bare soil (16%).

Further breakdown showed even higher mortality rates for container when compared with bare root stock, for all species.

Agroforestry Research and Development LS 7000

Contractor: Prof. Andrew M. Gordon, OAC, Principal Researcher

Objectives:

1 To promote the use of agroforestry practices by establishing a research-demonstration area on a tract of land located in Guelph on Victoria Road.

2. To develop appropriate intercropping system that will allow the compatible, simultaneous farming of land for multiple crops, including trees.
3. To further refine existing tree species-site interactions through the development of site index curves that will allow for the mass production of trees for profit on lands currently considered agriculturally marginal.
4. To develop riparian systems of trees and other plants, in mono or multi-species combinations.
5. To develop shelterbelt systems of single or multi-rowed tree species and to develop implementation strategies for such systems.

Results: Several theses have been completed from funding of this project. Numerous articles have been published in professional journals, conference proceedings, lay journals and the media. The following are the theses done on this project.

The effects of corn row orientation and width on the growth of interplanted black walnut and red oak seedlings - M.Sc. thesis by Hugh McLean Sept. 1990.

Economic analysis of intercropping as an alternative cropping system for tobacco farms - M.Sc. thesis by Dan Ball September, 1991. (Determined that tobacco producers have the capacity to carry the costs of establishing nut orchards.)

Nitrogen cycling in a black locust/barley intercropping system - Ph.D. thesis by Phocus Ntayombya (Showed that intercropping with black locust has the potential to improve N nutrition of barley and soil fertility.)

Effect of three crop-types on tree growth in an intercropping system - Ph.D. project by Peter Williams.

Site index curves and site factors affecting the growth of white pine and Norway spruce in southern Ontario

Effects of free carbonates in the soil on red pine growth

Establishment of tree seedlings on marginal pasture in an agro-silvo-pastoral system - M.Sc. thesis by Peter Bezkorowajnyj July, 1990. (Red oak was the most and white pine the least suitable species for the site. Application of manure slurry reduced consumption of both pasture grasses and poplar leaves; differences in browsing damage, seedling growth, and soil compaction between "slurry" and "no slurry" were noted.

Riparian reforestation of agricultural fields to reduce inorganic nitrogen leaching into streams - M.Sc. thesis by Greg O'Neill August, 1991. (Carolina poplar trees lowered NO_3-N concentration from the saturated zone. Increasing tree density further reduced the NO_3-N concentration. Shrub willow trees were not effective in lowering the NO_3-N concentration.)

Establishment of demonstration windbreaks at the Cambridge Research Station

Using optical porosity to evaluate the shelter effectiveness of windbreaks in southern Ontario - M.Sc. thesis by Anne Loeffler May, 1990. (Optical porosity can be used to predict minimum relative windspeeds and may therefore be useful as a guide in the field evaluation of windbreaks.)

Effect of Different Maple Bush Management Techniques on Tree Growth RCC 117
Assoc. des Producteurs Francophones d'Acericulture de l'Ontario

Literature Review on Wildlife Habitats in Agricultural Landscapes MA 09/94

Contractor: Mr. Lyle Friesen, Canadian Wildlife Service, Environment Canada, 100 Gamelin Blvd., Hull Que K1A 0H3.

Objectives: 1) To review the current literature on the impact of agricultural activities on wildlife habitats, and the relevance of wildlife habitats in agricultural landscapes;
2) To make recommendations for improving habitat conditions for wildlife.

Expected Outputs: A report with a detailed literature review on the interactions between agricultural activities and wildlife habitat, identifying some of the benefits that wildlife habitat has to offer to agroecosystems, and including an extensive list of recommendations for improving wildlife habitats.

Ending: 1993-94: COMPLETED; AVAILABLE FEB '95

The Development Of An Ontario Goose Depredation Survey Project
Canadian Wildlife Service LMAP 9

The Canadian Wildlife Service, Environment Canada, has completed a survey of all Migratory Bird Convention Act Canada Goose depredation permit holders over the past three years. The results of the survey will be utilized by the information / tech initiative. It is designed to relate back to earlier population surveys and will include the determination of sampling intensity, selection of the appropriate topographic maps and aerial photographs, identification of sample plots and preparation of the survey data form. The population survey will be implemented in agricultural areas of Southern Ontario by CWS staff in 1994/95.

Laurie Maynard, Environmental Conservation Branch, C.W.S. (519) 766-1593

Wildlife Habitat Enhancement on the Farm LMAP 10
Maitland Valley Conservation Authority

The project is a planning process integrating the enhancement of wildlife habitat into the development of agro-ecological farm management plans. It involves a cooperative and participatory process between the landowner and a professional facilitator to enhance wildlife habitat areas within marginal or environmentally sensitive areas on the farm.

Phil Beard or Chris Hoskins, Maitland Valley Cons. Auth., (519)335-3557.

24: Other

The Community Supported Agriculture Project RCC 48
one year project
The activities of this project are divided into four separate components. They are: Community Participation, Season Extension, Community Supported Agriculture Manual, and Heritage Seeds.

Community Participation - In order to provide the community with the opportunity to see how their food is grown, and to observe sustainable farming practices within the context of an integrated farm, two "open" farm days and a "pick your own" day were held in July and September. Informal discussions were held regarding the farming practices used and most people were surprised as to the amount of vegetables one can harvest from such a relatively small piece of land.

Short notes were delivered to all customers regarding the farm and all upcoming events. Each note usually included two recipes suited for the vegetables in season. It seemed that this continuous report on the status of the farm connected the community members with the club members. They became increasingly conscious of the effects of weather on their vegetables, and the problems club members faced.

Season Extension - Cold frames were built using cedar logs and lights and were very effective. Certain crops were harvested three weeks earlier than the previous season. Cold frames were also built for the fall and the row covers protected the broccoli and cabbage from the early frosts.

CSA Manual - A two page questionnaire was given to all members and personal interviews were conducted with about half of the members to provide information to help others interested in starting their own CSA.

Heritage Varieties - On the open farm days the traditional "three sisters" mounds corn/beans/squash using mainly heritage varieties, were shown to CSA members..

Chris Beeman, Co-ordinator, (613) 549-4800, or Tamsyn Rowley, (519) 822-2410.

Literature Review of Methods Used to Conduct and Evaluate On-Farm Research RF 01/94

Contractor: Ms. Jane Sadler-Richards, Ecologistics Ltd

Objectives: 1) To identify relevant sources of information with emphasis on work in North America since 1975;
2) to categorize and describe on-farm study designs and data evaluation methods;
3) to comment where possible on the potential impact of the studied designs as options in future studies.

Expected Outputs: The identification and discussion of the merits of study designs and data evaluations most useful to on-farm research projects and large plot situations in which farmers may be involved.

Ending: 1993-94 COMPLETED, AVAILABLE FEB '95

Appendix F: Committees and Sub-committees within the OASCC System.

Committee	Abbrev.	Sub-committees*
Agricultural Economics	OAERSC	Marketing Natural Resources Development Farm Mgt. and Production Economics Rural Community Development
Agriculture and Food Engineering	OAFERSC	Energy and Processing Power and Machinery Rural Environment Structures and Buildings
Animal	OARSC	Aquaculture; Beef; Broiler; Dairy; Deer; Egg Layer; Equine; Fur-bearing; Goat; Pork; Sheep; Turkey
Field Crops	OFCRSC	Cereal Crop; Corn; Forage Crop Oil and Protein Seed Crops Pulse; Tobacco
Food Processing	OFPRSC	Food Engineering Meat Products and Processing Grain/oilseed Products and Processing Fruit/vegetable Products & Processing Dairy Products & Processing
Horticultural Crops	OHCRSC	Agroforestry; Apiculture & Pollination Berry Crops; Crucifer Crops; Ginseng; Grape and Wine; Greenhouse Flowers; Greenhouse and Protected Crops; Low Acreage and Specialty Crops; Marketing; Muck Crops; Nursery, Landscape and Turf; Pome Fruit; Potatoes; Stone Fruit; Tomatoes
Pest Management	OPMRSC	Crop Protection; Weed; Livestock Pest Management
Soil, Water and Air	OSWARC	Agrometeorology Soil Management Water Management Soil Survey and Land Use

* in many cases, review of research results and other information and drafting of recommendations is done by committees within these sub-committees.