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Case Study

A Reflection on the Johnson Creek Watershed Water Quality Improvement Project 1982–1999

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Johnson Creek Watershed

(Photo courtesy of NRCS Watershed Science Institute)

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Executive Summary

Johnson Creek watershed is a 13,450-acre watershed in Whatcom County, Washington. The watershed is dominated by dairy operations. A water quality improvement project was initiated under the PL-566 program in 1982 to restore coho salmon and cutthroat trout fish habitat in Johnson Creek. A voluntary approach was used to install 40 storage ponds, 6 storage tanks, 13,000 feet of distribution pipe, 10,000 feet of drains and gutters, and 5,180 feet of streambank improvements. By the end of the project, 85 percent of the eligible producers and 35 percent of the watershed area were involved in water quality improvement contracts. Followup with participants continued for 5 years following initiation of each contract.

Sporadic monitoring made interpretation of water quality trends difficult, but it appears that water quality has improved little since the project was initiated. Factors contributing to the continued problems in Johnson Creek include land use changes in the watershed, the finite nature of the PL-566 project, lack of regulations and enforcement where needed, and lack of the knowledge we have today about the direct relationship between nutrient management and water quality.

Recommendations for future projects of this nature include:

- Comprehensive monitoring program planned and implemented as an integral part of the project.
- Comprehensive, permanent followup program that allows for adjustments in management based on future land-use changes, changes in watershed goals, and changing technology.
- Evaluation of the need for a phosphorus-based nutrient management strategy rather than a nitrogen-based nutrient management strategy.
- Consideration of the potential benefits of properly designed buffers in protecting water quality in watersheds.
- Comprehensive evaluation of fencing requirements for the entire watershed.
- Development of a total watershed nutrient budget to compare the nutrients imported into the watershed in the form of feed and fertilizer with those leaving the watershed as animals, crops, or animal products, and to compare manure application rates with crop removal rates at the watershed scale.
- As a supplement to the voluntary approach, provisions for enforcement of waste management regulations should this prove necessary to ensure compliance with environmental laws.

Case Study: A Reflection on the Johnson Creek Watershed Water Quality Improvement Project 1982–1999

Introduction

The primary purpose of this study is to evaluate a Public Law 566 (PL-566) project implemented in the Johnson Creek Watershed from 1982 to 1988, including its accomplishments and its effectiveness in meeting environmental goals. A secondary purpose is to recommend ways to help ensure success of future watershed-based water quality improvement projects based on lessons learned in Johnson Creek.

The Johnson Creek Watershed is a 13,450-acre watershed dominated by dairy operations in north central Whatcom County, Washington (fig. 1). In 1982, a PL-566 watershed restoration project was initiated to improve water quality to meet State Class A stream standards in Johnson Creek, thereby improving 11 miles of coho salmon and cutthroat trout fish habitat. Before the PL-566 project was initiated, the Whatcom County Conservation District and Consolidated Drainage District No. 313 had already begun rehabilitating the 11 miles of stream corridor. They were working under the guidance of the U.S. Fish and Wildlife Service, Washington State Department of Fish and Game, and the Soil Conservation Service (now the Natural Resources Conservation Service). Rehabilitation consisted of:

- removing wastes, organic matter, and reed canarygrass that were choking the stream;
- revegetating the streambanks with native snowberry and dogwood cuttings; and
- fencing the rehabilitated stream reaches to limit direct access by livestock.

To enhance this effort, the PL-566 project provided cost-share for animal waste storage, handling, and distribution systems in the watershed. Nutrient management plans were developed for each cooperator as part of the cost-share contract.

In 1980, the Soil Conservation Service (SCS) initiated a 1-year monitoring program to document the baseline water quality in Johnson Creek and its tributaries (Overdorff, 1981). Results of the baseline monitoring indicated that during certain times of the year several tributaries of Johnson Creek failed to meet EPA water quality standards for temperature, pH, turbidity, dissolved oxygen, fecal coliforms, and phosphorus. Under the PL-566 program, the Washington State Department of Ecology (DOE) agreed to continue the monitoring program for 10 years as their matching contribution to the project. Unfortunately, continuous monitoring did not occur.

In 1988, a second 1-year monitoring project was initiated by the DOE (Dickes and Merrill, 1990). This project indicated that by 1989 the PL-566 project had not reached its goal of meeting Class A stream standards to restore fish habitat. With the exception of turbidity, none of the water quality parameters apparently improved between 1981 and 1989. As described later in this report, reliance on discontinuous monitoring data can be misleading since year-to-year climatic variation can play a major role in water quality measurements. Still, the somewhat disappointing results of the 1989 study were a concern to all parties involved in the project.

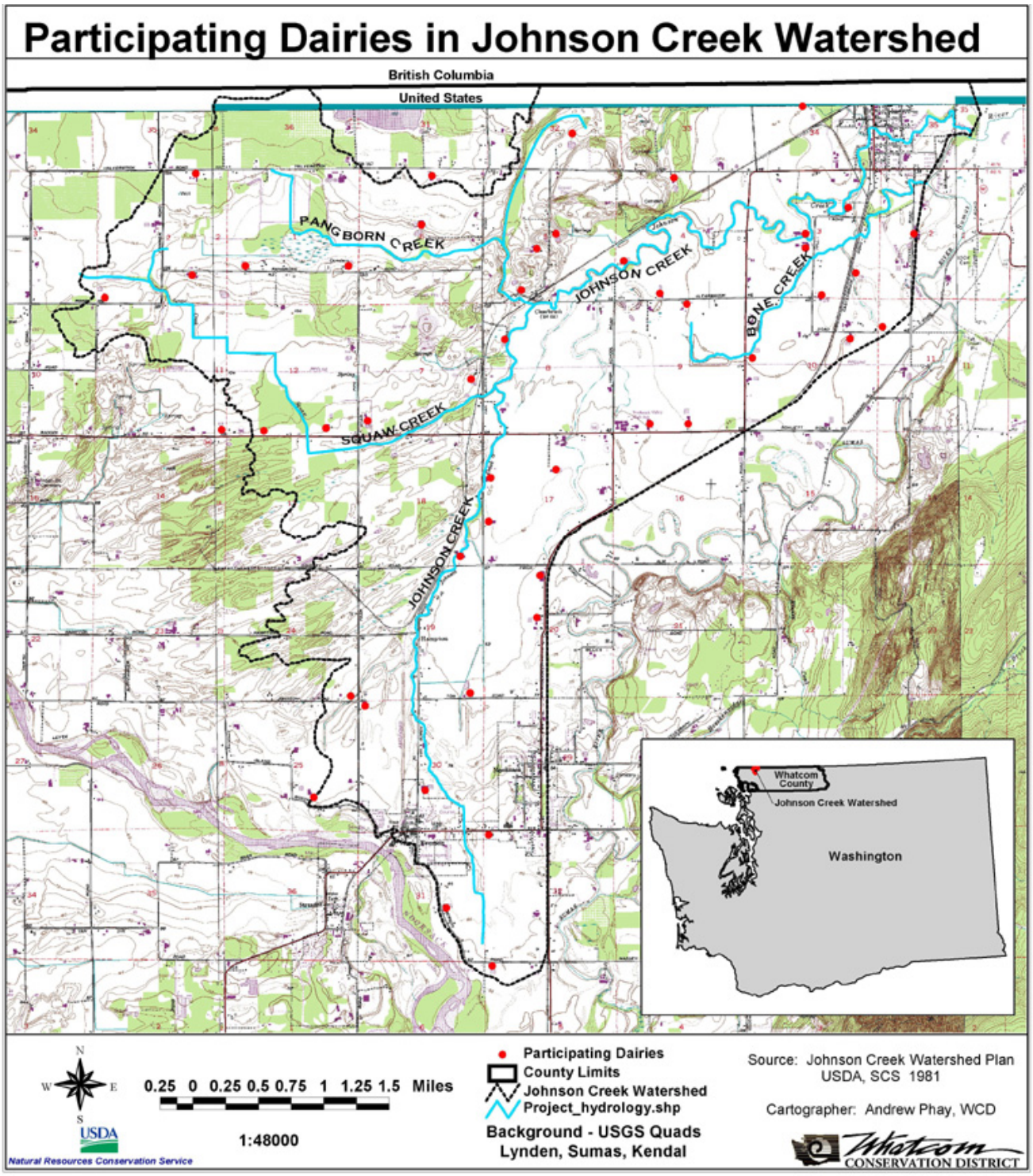
In 1997, in response to a request by the Native Lummi Nation, whose shellfish industry was being threatened by excess fecal coliform bacteria, the United States Environmental Protection Agency (EPA) performed a surprise inspection of dairies throughout the area, including dairies in the Johnson Creek Watershed, for compliance with the Clean Water Act. Of 60 dairies inspected during the 2-day exercise, 42 received warning letters and 6 received fines. EPA involvement instigated a serious, renewed focus on animal waste issues in this area. This report compares today's conditions in the Johnson Creek Watershed with conditions prior to implementation of the PL-566 project. It also suggests possible reasons why the established water quality goals for Johnson Creek were not met and recommends improvements that might be taken with similar water quality projects in the future.

Johnson Creek Watershed

Physical characteristics

Johnson Creek Watershed occupies about 21 square miles (13,450 acres) in the north-central portion of Whatcom County, Washington. This county is in the northwest corner of the state and abuts the U.S.-Canadian border. Johnson Creek drains into the Sumas River and occupies about 40 percent of the Sumas drainage area. Three principle tributaries, Squaw Creek, Pangborn Creek, and Sumas Creek, drain uplands along the western and northwestern

Figure 1 Participating Dairies in Johnson Creek Watershed



portions of the watershed and contribute year-round flow to Johnson Creek. Additional flow enters the creek from numerous drainage ditches during high rainfall events.

Johnson Creek has a nearly flat stream gradient. The average flow velocities within the creek are typically less than 0.5 feet per second (15 cm/s). The three main tributaries have steeper gradients, however, and therefore exhibit higher average velocities. The average annual discharge from Johnson Creek into the Sumas River is about 50 cubic feet per second, but this varies by season and from year to year. The volume of water passing through Johnson Creek at any given time is predominantly influenced by antecedent precipitation.

Climate

The climate of this area is moderately wet and is strongly influenced by the Puget Sound on the west and the Cascade Mountains to the east. The mean annual precipitation is 47 inches, 70 percent of which falls between October and March. The mean annual temperature is 49 degrees Fahrenheit. The average growing season is about 140 days (Gillies et al., 1981).

Land use

Table 1 summarizes the land use in Johnson Creek Watershed (Gillies et al., 1981; Wills, 1998). The percent land area occupied by these land uses has changed little since 1980 (Wills, 1998). About 80 percent of the land area in the watershed is devoted to pasture or hay production in support of dairies that dominate the landscape. Cropland constitutes about 7 percent of the land use. Major crops in 1980 included silage corn, sweet corn, and sweet peas. In the 1990's, there was some conversion to raspberries. Woodland, wetland, and miscellaneous uses (including urban areas) comprise the rest of the watershed. These ratios have changed little since 1980.

Table 1 Johnson Creek Land Use Summary – May 1997

Land use	Acres	Percent of watershed
Pasture and hayland	10,700	80
Cropland	1,000	7
Woodland	750	5
Permanent wetland	50	1
Miscellaneous	950	7
Total	**13,450**	**100**

Dairy farming has persisted as the dominant industry in Johnson Creek watershed over the past 100 years in spite of major land use changes in other parts of Whatcom County (Wills, 1998). While a number of land-use changes have occurred in the watershed since 1980, the land area devoted to dairy production has remained relatively constant.

Changes since 1980

Since 1980, several structural changes have occurred in Johnson Creek watershed that could have potentially affected water quality. These changes include population distribution, farm size, number of farms, and number of animals per farm.

In 1980, the human population of Johnson Creek watershed was 4,535, with 2500 rural residents and 2035 urban residents (Gilles et al., 1981). In 1997, the population had increased slightly to 4,715; however, the distribution had changed dramatically. The majority of the population in the watershed is no longer dispersed rural, but is located in three small communities: Everson, Sumas, and Nooksack. At the same time the number of farms has decreased in the watershed, while the average size of the farms and the average number of cows per farm have increased dramatically. Table 2 summarizes these changes.

History and Description of the PL-566 Project

In 1980, the State of Washington had in place a Wastewater Quality Management plan in response to the Federal Water Pollution Control Act of 1972. Under this plan dairies with more than 200 mature animals were considered concentrated animal feeding operations and were required to work with local conservation districts for planning, design, and other technical assistance to eliminate waste discharge.

Table 2 Characteristics of Johnson Creek Watershed, 1980-1998

	1980	1998	% change
Watershed population	4,535	4,715 [1/]	+ 4
Number of dairies	50	33	– 34
Average farm size (acres)	112	175	+ 56
Total number animal units	8,000	14,000	+ 75
Average herd size	150	424	+ 188
Average number animals per acre	1.34	2.42	+ 81

Dairies with less than 200 mature animals were subject to onsite inspections only if a complaint was made. Because the average dairy size in Johnson Creek at that time was 150 cows, it was expected that voluntary management changes to improve water quality would be slow. The PL-566 project was designed to speed up water quality improvement through voluntary efforts.

The PL-566 project was planned to meet the watershed's dairy waste and nutrient management needs in 1980. The completed watershed plan (Gilles et al., 1981) described the problems observed in Johnson Creek and the Sumas River as a decline in fish habitat and recreational uses. These problems were attributed to degraded water quality parameters (tables 3a, b, and c). The watershed project accelerated technical and financial assistance to dairy owners and/or operators. Except for the lack of continuity with the monitoring program, the project was executed effectively.

Local participation in the voluntary cost-share program was 85 percent. Each participant received technical assistance in the form of a waste management plan and an option to receive cost-share for water quality improvement projects including rainwater handling and animal waste storage, handling, and distribution facilities.

By the end of the project, 4,709 acres (35% of the watershed area) and 45 farmers (85% of the producers) had entered into water quality improvement contracts. Participants were responsible for implementing dairy waste management plans and facility maintenance. Some key features of the completed project were (final project summary, 1992):

- fencing to exclude cows along 5,180 feet of the streambank
- 40 storage ponds
- 6 storage tanks
- 13,000 feet of distribution pipe
- 10,000 feet of drains and gutters around farmstead buildings

Each contract was reviewed annually with its cooperator for the life of the contract (5 years). After the contract was complete, cooperators were expected to continue implementing their plans and maintaining their facilities, but regular SCS site visits were no longer scheduled.

A primary focus of the PL-566 project was on the planning and construction of waste collection, handling, and storage facilities to avoid the need for manure spreading in the winter when rainfall is highest. Waste management plans also included a nutrient management component. Farmers were encouraged to test their soils and manure regularly and assign credit for the manure nitrogen when developing a fertilization plan. Excess manure was seldom an issue at the time. A general rule of thumb was that if there were less than two animal units per acre, the land area would be sufficient to handle waste application, based on nitrogen requirements of the crop. In 1980, nearly all the farms in the watershed met the parameters. Therefore, while nutrient management was considered, waste management was considered the primary problem from a water quality standpoint.

In 1980, phosphorus applied to land was not considered an environmental risk as long as erosion was controlled. Buffers were more often installed for wildlife habitat improvement than as a water quality improvement measure, and watershed nutrient budgets had not yet been developed as a planning tool. Today these issues are considered important aspects of watershed planning.

During the watershed improvement project, farmers gained an awareness of water quality and habitat issues; however, there was no followup enforcement to ensure that operations were conducted in a nonpolluting manner, and the watershed conditions were not consistently monitored.

Water Quality Monitoring in Johnson Creek

As previously noted, monitoring was conducted from October 1980 through September 1981 (Overdorff, 1981) to provide baseline data for the PL-566 project. Ten water sampling sites were established and monitored monthly for 12 months. Two additional sites were established in January 1981 and monitored for 9 months. Seven fish sampling sites were also monitored periodically.

This initial monitoring provided a glimpse of the water quality of Johnson Creek and its tributaries. Table 3a summarizes its results. During this first monitoring period, the water quality in the Johnson Creek watershed often fell below State Class A standards for temperature, turbidity, dissolved oxygen, fecal coliform organisms, and total phosphorus. Of particular concern were the turbidity, dissolved oxygen, and fecal coliform counts, which were thought to result directly from cattle and manure in the streams. The cost-share projects for the watershed program were designed to alleviate these problems. Fencing of the streambanks was intended to exclude cattle from the stream, reducing turbidity and direct manure input. The storage facilities were designed and installed to prevent the need for winter spreading of manure, the period when contamination of the creek through runoff was most likely.

A second 1-year monitoring program was set up in 1988-89 (Dickes and Merril, 1990). Sample sites and monitoring parameters were similar to those initially measured. Almost 10 years later, results were similar. Table 3b summarizes these results for comparison with the baseline data. Except for slight improvements in turbidity and temperature, no defensible

Table 3a Water quality pre-project monitoring summary, October 1980 – September 1981 (adapted from Overdorf, 1981)

Water quality parameter	State class A std.	Range of measurements			No. times class A std. not met	% samples not meeting state class A std.
		Johnson Creek (6 sites)	Squaw Creek tributary (4 sites)	North Fork tributary (2 sites)		
Temperature (°C)	< 18	1.0–20	0.5–18.5	4.0–16.0	4	3.6
Dissolved oxygen (mg/L)	> 8	0–10.1	6.5–11.1	2.3–9.9	61	53
Turbidity (NTU)	≤ 5	1.4–50	1.0–13	1.0–60	44	39
Fecal coliform (#/100 ml)	< 100	110–10,000	12–10,000	10–37,000	94	85
Total phosphorus (mg/L)	< 0.1 mg/L	0.05–0.84	0.01–0.19	0.01–0.32	45	50
Nitrate-N (mg/L)	<10 mg/L	1.1–4.1	2.9–5.1	0.1–7.3	0	0

Table 3b Water quality post-project monitoring summary, September 1988 – May 1989 (adapted from Dickes and Merrill,. 1990)

Water quality parameter	State class A std.	Range of measurements			No. times class A std. not met	% samples not meeting state class A std.
		Johnson Creek (8 sites)	Squaw Creek tributary (4 sites)	North Fork tributary (3 sites)		
Temperature (°C)	< 18	1.8–12.3	1.8–16	5.0–13.5	0	0%
Dissolved oxygen (mg/L)	> 8	0.4–8.7	6.4–11.2	4.0–10.65	55	67%
Turbidity (NTU)	≤ 5	1–110	1–8	1–3	18	23%
Fecal coliform (#/100 ml)	< 100	54–5100	3–57,000	38–2900	93	84%
Total phosphorus (mg/L)	< 0.1	0.04–0.72	0.01–0.59	0.06–3.09	47	62%
Nitrate-N (mg/L)	<10	0.4–23.4	2.3–54.6	4.5–38.6	17	22%

trend in water quality could be determined. It was clear that the water quality in Johnson Creek still did not meet state and federal standards, but it was not possible to tell from the monitoring data whether the water quality had improved or deteriorated over the 8 years between monitoring studies.

Concern over water quality in Johnson Creek Watershed persisted. In December 1995, a third monitoring project was initiated (Wills, 1998). One of this project's specific objectives was to evaluate the effectiveness of the management practices implemented in the watershed using statistically based trend models. The project used monitoring sites and water quality parameters similar to those of the first two projects. Water samples were taken during eight wet-season surveys (January – May) and four dry-season surveys (June – September). Comparative results of the 1995 to 1997 monitoring study are presented in table 3c. Further study correlated annual and seasonal precipitation with water quality measurements and noted that water quality in all three studies was worse during the wet season and tended to improve as runoff decreased in the spring and summer. It was therefore concluded that water quality in Johnson Creek is closely associated with field runoff. These results also confirm the hypothesis that climatic variation plays a significant role in water quality measurements. With this in mind, it is easier to understand how climate differences between the previously monitored 2 years (1980-1981 and 1988-1989) could easily have masked any change in water quality.

The analysis of water quality monitoring data presented in tables 3a, b, and c is a simplistic summary of the limited water quality data measured during the three independent monitoring periods associated with the Johnson Creek PL-566 project. Had data been available, a more comprehensive analysis could have factored in climate effects by comparing wet years to wet years and dry years to dry years, averaging data over seasons rather than over years, and using discharge to stratify the data for comparison.

Recent Activities and Legislation

In 1997, prompted by local Indian tribes, EPA performed a surprise inspection of 60 dairies in Whatcom County. In one weekend, 42 farms received warning letters, and 6 were fined. The intensive inspection precipitated a series of events that eventually led to new State legislation and funding for enforcement of existing laws. Many people at all levels of involvement (including some dairy farmers) feel that consistent enforcement was the missing link in the two decades of water quality efforts in Johnson Creek.

Among other things, Washington State's 1998 Senate Substitute Bill No. 6161 establishes the following water quality requirements:

- Every licensed dairy in the State of Washington must register with the Department of Ecology. Information required includes the number of cows and young stock on the farm, the number of acres owned and rented by the dairy, proximity to waterbodies, whether the farm is implementing a nutrient management plan, and whether the farm is applying nutrients that belong to someone other than the producer.
- All licensed dairy producers, regardless of size, must prepare a dairy nutrient management plan. The plan must be approved by the local conservation district.

Table 3c Water quality monitoring summary, December 1995 -September 1997 (adapted from Wills, 1990)

Water quality parameter	State class A std.	Range of measurements			No. times class A std. not met	% samples not meeting state class A std.
		Johnson Creek (8 sites)	Squaw Creek tributary (4 sites)	North Fork tributary (3 sites)		
Temperature (°C)	< 18	1.1–19.4	0.3–14.5	3.2–13.9	4	1
Dissolved oxygen (mg/L)	> 8	1.1–19.7	4.5–14.1	5.4–12.2	158	43
Turbidity (NTU)	≤ 5	0–80	0–30	0–12	82	23
Fecal coliform (#/100 ml)[1/]	< 100	44–4,900	22–500	24–2,500	35	90 [1/]
Total phosphorus (mg/L)	< 0.1	0.05–0.58	0.02–0.25	0.03–0.56	176	85
Nitrate-N (mg/L)	< 10	0–8.9	4.3–8.1	5.3–15.6	7	3

1/ Approximately 10% of all samples were analyzed for Fecal Coliform Bacteria.

- The State will initiate an inspection program of all dairy farms in the State to survey for evidence of violations, identify corrective actions, monitor development of nutrient management plans, and identify dairy producers who would benefit from technical assistance programs.
- All new dairy farms will develop and implement approved dairy nutrient management plans within 2 years of licensing.
- Nutrient management technical assistance teams will develop and promote new cost-effective approaches for managing dairy nutrients and assist dairy farmers in developing nutrient management plans.
- Penalties will be assessed to repeat violators of water quality laws.

The farmers in Johnson Creek Watershed have mixed opinions about the law, but are generally supportive. Most are concerned with the water quality in their watershed and feel a stronger incentive is needed to encourage polluters to take remedial action.

Stakeholder Views

This section describes the perspectives of three dairy producers who farm in Johnson Creek Watershed and two employees of the Lummi Indian Nation. The farmers all lived in the watershed at the time the PL-566 project was being implemented. They all have opinions about the water quality problem in their watershed and what needs to be done to correct it.

The Lummi do not live in the watershed, but are concerned with fish and shellfish habitat throughout the area. The economic livelihoods of many members of the Lummi Indian Nation are directly impacted by the water quality problems in Johnson Creek Watershed, so their voices also should be heard. The individuals from the Lummi Indian Nation who were interviewed were aware of the PL-566 project, but the tribe had no direct experience with the effort.

Jim Heeringa

A Johnson Creek Watershed Dairy Farmer Since 1972

Name:	**Jim Heeringa**
Acres farmed:	**230**
Crops:	**Silage corn** **Grass silage**
Animals:	**480 milking cows** **50 dry cows** **360 heifers/calves**

(Photo courtesy of NRCS Watershed Science Institute)

Introduction

Jim Heeringa has been farming in the Johnson Creek Watershed since 1972. In 1980, he had about 150 milking cows and 150 heifers on 100 acres of land. His dairy herd has increased an average of 5 to 10 percent per year since 1980, primarily through natural reproduction rather than external purchase of animals. Today he farms 230 acres and owns 480 milking cows, 50 dry cows, and 360 heifers and calves. Jim began increasing the herd because his children were interested in dairying at the time, and he thought it would be necessary. He purchased additional land to allow production of more of his own animal feed. Jim does not plan to add many more animals to his operation. Instead, he proposes to milk fewer, better cows. A new nutrition program for his animals has allowed him to increase milk production without increasing herd size.

PL-566 Participation

Jim decided to participate in the PL-566 program for Johnson Creek because he had no facilities for storing manure over winter. Under the PL-566 program he was able to receive cost share for a manure storage tank, rain gutters around the barn area, and fencing to keep his cows out of the creek. At the same time the local drainage district assisted in a project to clear reed canary grass from the stream channel. A farm plan was developed as part of the PL-566 project. This plan is currently being updated.

Changes in Agriculture

Jim notes that dairy operations are more "high tech" than they used to be, animals are more concentrated, and animal nutrition is emphasized much more strongly now than in 1980. For example, forages are now tested regularly for nutrient content.

Jim thinks dairies will continue to dominate the economy of the Johnson Creek watershed, but he sees fewer, larger dairies in the future. He does not expect a widespread sellout of dairies in the area, but he thinks the smaller dairies may eventually drop out of business.

Why State Water Quality Standards Have Not Been Met in Johnson Creek

Jim feels that not all the water quality goals in Johnson Creek were met because everyone did not participated in the PL-566 program and there was no local enforcement of pollution regulations. He points out that a few people can cause a lot of problems.

What He'd Do Differently

If he had it to do over again, Jim says he would have requested a mandatory maintenance clause in the stream-clearing project. The reed canarygrass that was cleared out of the creekbed in 1980 eventually grew back and cannot be cleared again because of regulations.

Ivan DeVries — A Johnson Creek Watershed Dairy Farmer since 1961

Name:	**Ivan DeVries**
Acres farmed:	**180**
Crops:	**Corn** **Fescue**
Animals:	**320 milking cows** **360 heifers/calves**

(Photo courtesy of NRCS Watershed Science Institute)

Introduction

Ivan DeVries has lived in Johnson Creek since 1961. In 1981, he milked 150 cows and farmed 100 acres. His sons John and Dale have recently taken over the business and now milk about 380 cows and farm 180 acres. The family hopes to update their farm plan soon.

Ivan's operation grew gradually as the family grew. The farm currently supports three families. He felt they had to expand if they were to remain in farming, but he does not think they will grow much more now. Improved nutrition has helped them boost milk production without adding cows.

Ivan and his sons have been advised by the State that they need 20 additional acres of cropland and additional storage capacity to accommodate their current animal waste production. They are hoping to purchase 80 acres and an existing manure pond to meet these requirements. Ivan and his sons recognize the need to manage their manure properly and are working with agencies to meet new State requirements.

In 1981, Ivan was less concerned with manure amounts than with timing of application. At that time, the manure produced was far less than the nutrient requirement of his crops. Today he needs to consider the amount of manure applied as well as the timing of application.

PL-566 Participation

Ivan decided to participate in the PL-566 program because he knew he needed more waste storage. He installed a 635,000-gallon storage tank, pipeline, pump, and measures to control runoff from his animal confinement area with cost share. He was pleased with the results at the time.

Changes in Agriculture

Ivan says the problems with animal health are the same as they were 20 years ago, but more attention is now paid to animal nutrition. Another change is that expert consultants are now used to address specific dairy problems. Crops grown now are somewhat different, also. Because of the concern with excess nutrients, the family no longer grows clover, and they are considering reducing their corn acreage. Manure application on corn ground is restricted after harvest, but manure can be applied to grass well into the autumn.

Why State Water Quality Standards Have Not Been Met in Johnson Creek

Ivan feels that most farmers in Johnson Creek are careful with their manure, though he has no way of knowing for certain what others do. He thinks the overgrowth of reed canarygrass in the stream channels may be contributing to problems today.

What He'd Do Differently

If he had it to do over again, Ivan would have built a storage tank twice as large as the one built in 1981. He did not know how much his herd would grow in 20 years. The tank has worked well, but it is just too small.

Jim Blair

A Family Dairy Farm in Johnson Creek Watershed Since 1962

Name:	**Jim Blair**
Acres farmed:	**210**
Crops:	**Corn** **Orchardgrass**
Animals:	**150 milking cows** **50 heifers**

(Photo courtesy of NRCS Watershed Science Institute)

Introduction

Jim and his wife Bonnie, sons Darren and Shawn, and daughter Lana operate the 210-acre Clearbrook Dairy. Jim's father started the dairy in 1962. It grew for the first few years, and by 1982 had reached the size it is today, approximately 150 milking cows. Unlike many farmers in the area, the Blairs have not felt the need to expand. They have enough acreage to produce most of their own feed, so overhead costs are relatively low, and net income is sufficient. Although the farm has not grown in size, requirements and priorities change. The Blairs are in the process of updating their farm plan.

PL-566 Participation

The Blairs did not decide to participate in the PL-566 program until 3 years after it started. They already had a storage tank. Eventually they decided they could benefit from a larger tank, installation of gutters and downspouts, and a farm plan. They were pleased with the results of their participation.

Changes in Agriculture

Changes on Clearbrook Dairy are largely related to labor division. Now that his children are older, they can take over more of the farm chores. Feed rations have changed somewhat since 1980, and the farm's milk production is a little higher. The Blairs are pleased with current production although it is below the county average. Milk quality and net income are satisfactory.

Changes in the county that concern Jim relate to the encroachment of urban development on farmland and the increase in the number of cows in the area. Urban encroachment results in less land on which to apply manure. Too many animals result in low milk prices and too much manure.

Why State Water Quality Standards Have Not Been Met in Johnson Creek

According to Jim, back in the 1980's a few bad players did not do their part. They refused to participate in the PL-566 program and did not manage their cows or manure in a responsible manner. Most of them are out of business now, and the people who are left are making an effort. Jim feels confident that water quality in Johnson Creek is improving and will continue to improve into the future.

What He'd Do Differently

If he had it to do over again, Jim would probably have built a larger manure storage tank. Although his tank is the largest in the county and his herd size is relatively small, he feels he could use more storage. The tank receives all the runoff from the barnyard and milking area. During wet years the tank fills up. An alternative to larger storage would be to build a roof over the animal confinement area to divert rainwater and reduce the slurry runoff. In the interim, Jim has an agreement to share his neighbor's storage lagoon when runoff exceeds his storage capacity. Jim is definitely doing his part to keep manure out of Johnson Creek. He feels if each person makes an effort to do their part for the creek, everyone will benefit.

Frank Bob Lummi Indian Nation
Gregg Dunphy

Frank Bob, habitat restoration assistant, and **Greg Dunphy**, wildlife biologist, are both employees of the Lummi Indian Nation, but neither speaks for the tribe. The opinions expressed here are their own.

(Photo courtesy of NRCS, Whatcom County Service Center)

Background

The Lummi Indian Tribe was created during the treaty at Point Elliott in 1855 from a group of Semiahmoo people in northern Washington State. The Semiahmoos were a group of Indians who spoke the Salish language. Various dialects of this language stretched from Alaska to New York.

Today, the Lummis occupy the Lummi peninsula and Portage Island west of Bellingham, Washington. Historically, they hunted and fished throughout the region. Many tribes traded wares at the confluence of Johnson Creek and the Sumas River northeast of the present reservation. The Lummi tribe outleases some land for agriculture and forest production. A major source of tribal income has historically been shellfish harvest. However, in recent years many shellfish beds have been closed because of bacterial contamination. This is a major concern to the Lummi Tribe.

PL-566 Participation

The Lummi Tribe was not directly involved in the PL-566 project in Johnson Creek Watershed. However, the tribe recognized the water quality problems both in Johnson Creek and elsewhere and participated in resource assessment projects in several other watersheds in Whatcom County. In those days there was little communication between the tribes and the State of Washington. Communication has improved dramatically since the early 1980's.

Changes in Agriculture

The greatest change Bob and Greg have observed in Whatcom County is the loss of agricultural land to urban development. The second greatest change they see is that small farms are becoming a thing of the past and are being replaced by "big business" farms.

Bob and Gregg would rather have dairies than urban sprawl, but they would like to see them operated in a more environmentally sensitive manner.

Why State Water Quality Standards Have Not Been Met in Johnson Creek

First, enforcement of environmental laws was weak at the time the project was implemented. Second, the stream corridor restoration efforts (i.e., removal of reed canarygrass and streambank stabilization plantings) were inadequate to restore stream function. Plantings failed in some instances, and the "wrong" tree species were often planted.

What They'd Do Differently

Frank and Gregg would have liked the project to have had more followup, both with regard to monitoring of changes in water quality parameters and enforcement of pollution laws. They also feel there should have been emphasis put on water quantity as well as water quality. Finally, they feel that some of the money being used to help struggling dairies in the watershed improve their waste management systems, should be used to help the struggling shellfish industry, which was crippled by the dairy pollution.

Findings

Johnson Creek Watershed has been dominated by dairy operations for over a century. The number of dairies in the watershed has decreased through time, but the number of animals has increased. For more than 20 years, the watershed has experienced degraded water quality, much of which is attributed to the dairy operations in the watershed.

The PL-566 watershed project initiated in Johnson Creek Watershed in 1981 was designed to alleviate the water quality problems and restore fish habitat. The project was well planned and executed. Over 80 percent of the dairies participated in voluntary cost-share projects designed to reduce manure entering the stream system. The project focused on four main areas: manure storage, manure distribution, livestock exclusion, and runoff control from farmstead and barnyard areas. Nutrient management was also an important component of the watershed project, but at that time nutrient management was neither cost-shared nor policed.

Water quality monitoring in Johnson Creek Watershed has been sporadic. A 1-year monitoring program was implemented prior to project implementation for baseline information. The next monitoring project occurred 8 years later and indicated no clear trend. A third set of data was collected in 1995 to 1997, and most water quality parameters showed little or no improvement. However, to conclude that the project had no impact on water quality based on these limited monitoring results could be erroneous. The positive effects of conservation actions on some water quality parameters, particularly chemicals, may take decades to appear. Watershed hydrology, soils, and previous management all impact lag time.

This is not to say that the efforts in Johnson Creek Watershed significantly improved the water quality problems. Elevated levels of fecal coliform bacteria, in particular, indicate continued manure inputs into the stream system. Since cattle have largely been excluded from the stream, these inputs are are most likely coming primarily from event-based field runoff.

At least five factors contribute to the continued problems in Johnson Creek:

1. **Land-use changes in the watershed,** particularly changes in dairy size and total number of animal units
2. **The finite nature of the structural PL-566 project.** Once the 5-year project was complete, no followup inspections occurred. Technical assistance was provided on request only. Farms changed hands regularly, and herd sizes grew continuously on many farms that did not change hands.
3. **Regulations and lack of enforcement.** Until recently, water quality regulations for dairies were limited, and those that existed were not enforced. Depressed milk prices coupled with high feed prices during the early 1990's forced many dairy operators out of business. The remaining operators invested capital in additional cows and milking facilities, resulting in undersized waste management facilities and, in some cases, insufficient land base for proper nutrient utilization. Operators were able to avoid the investment cost in waste facilities because there were no enforced mandates requiring adequate facilities be maintained.
4. **Lack of knowledge.** Twenty years ago the relationship between nutrient management and water quality was known, but less clearly defined than it is today. Today, more is known about nutrient management practices and how they can positively benefit water quality, and more tools are available to help plan and implement nutrient management for both agronomic and environmental goals.
5. **Discontinuous water quality monitoring.** Had continuous water quality monitoring occurred, it could have helped farmers see how their management was affecting the watershed over time. Monitoring to measure success can be used to facilitate the iterative planning process and can be a powerful incentive to improve existing technology. Another advantage of long-term, continuous monitoring is that it can be used to correlate water quality parameters with natural fluctuations in climate from year to year. This improves the accuracy of conclusions about water quality trends.

Lessons Learned

Perhaps the clearest lesson learned from Johnson Creek is that watersheds change over time. Since the location of land use activities within a watershed can significantly affect water quality (Sharpley et al., 1998), changes in land-use distribution can significantly impact the success of land management efforts. Management for water quality can never be considered finished. Maintenance and management adjustments are critical components of all planning projects, especially those involving water quality. Changes that inevitably occur in a watershed over time will require revisiting original plans and reevaluating certain aspects of a watershed project. Individual farm plans need to be reviewed and revised on a regular basis to accommodate changing conditions.

New technologies may also warrant consideration. Scientists and natural resource conservation specialists now know more about nutrient budgets, crop uptake patterns, soil-manure interactions, pasture runoff, and buffer technologies than they did 20 years ago. Watershed projects with a finite set of resources to be used within a finite timeframe can provide water quality benefits, but everyone must recognize their limitations for permanently changing water quality on a watershed scale. The NRCS planning process is an iterative one. Continual evaluation, reassessment, and plan revisions are a part of this process.

Additionally, several individuals intimately involved in Johnson Creek noted that environmental regulations and consistent enforcement of those regulations are necessary components of any successful water quality improvement project. Since it is commonly assumed that most of the pollution in a typical watershed is generated by a relatively small fraction of the land users, a mechanism must be in place to ensure that the uncooperative operators are held accountable for their acts. Recent regulations in Washington State were designed to address this issue. The greatest impact on water quality is achieved when a voluntary, incentive-based approach is the primary way to encourage and obtain natural resource conservation and environmental protection, and a regulation compliance approach exists to provide the backup support for those instances where the voluntary, incentive-based approach does not work. This is especially effective when regulatory approaches include periods for learning and making adjustments before penalties are assessed.

Finally, short-term water quality monitoring may have little meaning as a tool for evaluating the effectiveness of Best Management Practices. A well designed, long-term, continuous monitoring program supplemented by modeling efforts will most likely yield the greatest information about water quality trends in a watershed. For stakeholders, regular, reliable information about the impacts of their management efforts on water quality can provide strong incentive to continue or enhance these efforts. The National Handbook of Water Quality Monitoring is an excellent resource for designing future water quality project monitoring.

Recommendations

Based on lessons learned from Johnson Creek, future watershed projects involving extensive animal waste management issues should include the following elements:

- A comprehensive monitoring program planned and implemented as an integral part of the project.
- A comprehensive, permanent followup program that allows for adjustments in management based on future land-use changes, changes in watershed goals, and changing technology.
- An evaluation of the need for a phosphorus based nutrient management strategy rather than a nitrogen-based nutrient management strategy.
- Consideration of the potential benefits of properly designed buffers in protecting water quality in watersheds.
- A comprehensive evaluation of fencing requirements for the entire watershed.
- Development of a total watershed nutrient budget to compare the nutrients imported into the watershed in the form of feed and fertilizer with those leaving the watershed as animals, crops, or animal products, and to compare manure application rates with crop removal rates at the watershed scale.
- As a supplement to the voluntary approach, provisions for enforcement of waste management regulations, should this prove necessary to ensure compliance with environmental laws.

Current Activities in the Watershed to Improve Water Quality Conditions

Water quality studies in 1990 and 1992 indicated high fecal coliform levels and low dissolved oxygen levels throughout Johnson Creek Watershed. In response to the continued poor water quality in the watershed, the Washington Department of Ecology submitted a TMDL proposal to the EPA. In January 2000, a draft summary implementation strategy was released for review.

The implementation strategy calls for a coordinated effort lead by the Washington Department of Ecology with support from three key agencies: the Whatcom Conservation District, NRCS, and Whatcom County. The DOE has completed on-farm inspections of all the dairies in the watershed. Those dairies with ongoing pollution problems were referred to the conservation district and NRCS for assistance in bringing the farm into compliance. If voluntary compliance is not obtained from operators, enforcement and fines may be employed by the DOE.

Whatcom County regulates land use as part of their authority under the county's Critical Areas Ordinance (CAO). In 1999, the county directed staff resources to CAO enforcement, particularly with regard to inappropriate land-use activity within stream buffer zones (100 feet on fishbearing and 50 feet on non-fishbearing streams). The county has also updated their code regulating onite sewage systems, including certification requirements for operation and maintenance specialists, continuing education requirements for licensed installers, and continuing education requirements for licensed pumpers. In 2000 and 2001, all residents in the watershed will receive mailings informing them of the new operation and maintenance requirements for onsite sewage systems.

Drainage Improvement District (DID) Number 31 was a sponsor of the PL-566 project. In 1999, the DID committed to a plan to enhance riparian vegetation to provide shade needed to moderate stream temperature during the summer and to sequester nutrients, sediment, and bacteria in field runoff.

In 1998, Washington State passed the Dairy Nutrient Management Act. The act requires all dairies to have a farm plan by July 2002 and to implement the farm plan by December 31, 2003. The conservation district and NRCS are assisting producers with their plan development and implementation. The watershed is included in a larger Geographic Priority Area (GPA) under the Environmental Quality Incentives Program (EQIP). EQIP funds, along with state cost-share funds are available for improving waste management systems to those producers who qualify for the programs.

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