AGRICULTURAL BEST MANAGEMENT PRACTICES

MOSES LAKE RESTORATION PROJECT

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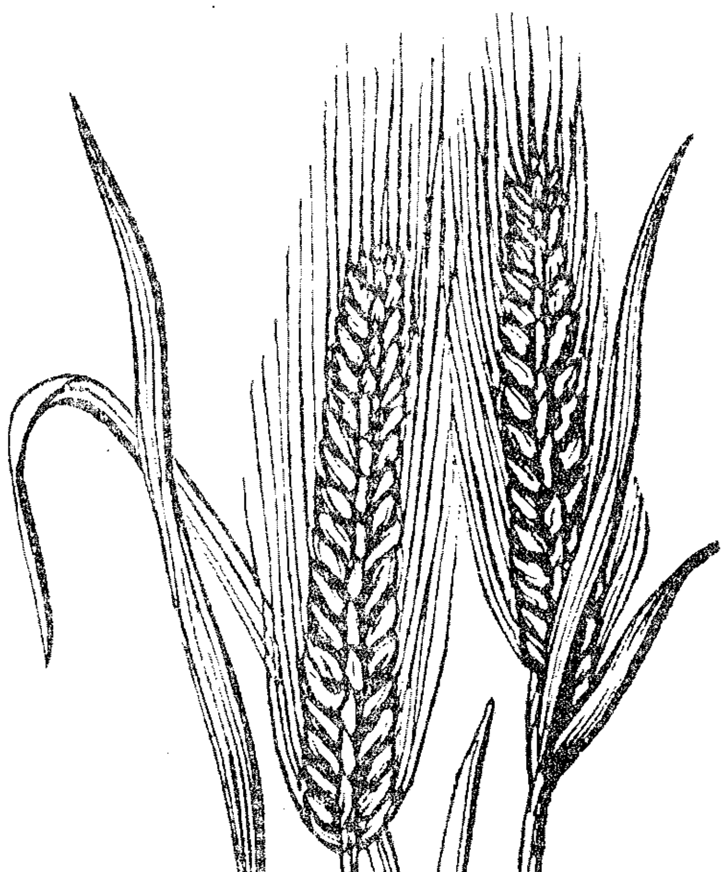

JANUARY 1981

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PREFACE

This report on agricultural best management practices (BMPs) presents an assessment of the irrigated and dryland agricultural 208 water quality management plans in the Moses Lake drainage basin. The intent of the report is to indicate how the current program implementation will complement the Moses Lake Restoration Project by improving the quality of water diverted into the lake. The discussions are as specific as possible; however, the non-point nature of agricultural pollution, the extensive study area involved, and the highly variable conditions of climate, terrain, and soils within even small areas necessitate a somewhat general approach.

SUMMARY

This report examines the existing dryland and irrigated practices in the Moses Lake drainage area, the expected impact of the 208 non-point source water quality management programs in surface water pollution abatement, and the effects these activities will have on the Moses Lake Restoration Project.

The Moses Lake watershed, the study area for this investigation, extends from Moses Lake east to about 30 miles from Spokane and occupies over 2,400 square miles. Approximately 60 percent of the drainage basin is utilized for agricultural purposes; the remainder is predominantly rangeland.

The 1972 federal Water Pollution Control Act mandated federal and state efforts to clean up the nation's waters. In Washington, the Section 208 Non-Point Source Water Quality Management Plan addresses agricultural pollution. Local water quality committees were elected to identify local problems and the solutions appropriate to their situations. The Department of Ecology, in directing the state-level 208 planning process, decided to address the control of sediment as its major objective. While settleable solids are not the only water quality parameter of concern, it was determined that control measures for this component would provide the greatest improvement to surface water quality.

The major problem associated with dryland farming in the study area results from winter and spring runoff from fields with inadequate stubble mulch protection in their winter wheat-summer fallow sequences. For irrigated farmland, the main adverse water quality impact is with increased turbidity in runoff waters from the end of fields. Local water quality committees have prepared best management practice (BMP) statements for the dryland program which will reduce pollution problems, and the Department of Ecology (DOE) has identified 25 BMPs which would help specific situations on irrigated farmland.

Two major problems exist in any evaluation of existing and future agricultural practices and their impacts on Moses Lake. The primary one is a lack of data on (1) the impact under current conditions; (2) the impact BMP implementation will have on improving water quality conditions; and (3) the effects this reduction will have on water quality in Moses Lake. Agricultural practices undoubtedly contribute

to water quality degradation. Yet the variety and extent of the problems and the lack of monitoring systems precludes quantifying the impact. Research is being conducted to correct some areas of this problem, but the results are not yet available. Without baseline information, it is impossible to determine with certitude what, if any, additional measures should be taken.

Nutrient phosphorus is associated with eroded sediments, and Moses Lake's eutrophic conditions have been shown to be related to phosphorus in a manner similar to most eutrophic lakes. However, there is little evidence of a sediment problem, since no dredging has been necessary in the lake or Potholes Reservoir due to settling solids. This further confounds predictions about the effect reducing incoming sediment loads in tributary waters will have on Moses Lake water quality.

The primary conclusion of this evaluation was that 208 irrigated and dryland programs are operating as well as can be expected, given the limited manpower and financial resources under which they operate. A number of recommendations are offered which have more to do with influencing the social and economic conditions so that farmers can implement BMPs into their management schemes without undue financial hardship.

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INTRODUCTION

The proposed restoration project of Moses Lake has been described in detail in the August 1980 Draft Environmental Impact Statement prepared for the Moses Lake Irrigation and Rehabilitation District. In essence, water quality would be enhanced as the result of additions of low nutrient Columbia River waters to the lake via the East Low Canal-Rocky Coulee Wasteway-Parker/Pelican Horn route and possibly via a spur into the main lake from the W-20 lateral of the West Canal. Of secondary, but nonetheless significant, importance relative to the state of eutrophication in the lake is the quality of the other sources of water which feed into Moses Lake. Those sources, excluding Rocky Coulee Wasteway, are: subsurface seepage, Crab Creek, Rocky Ford Creek, precipitation and treated sewage effluent. Plans exist for the latter to be diverted out of the lake within the next several years. Therefore, it is not considered further in this report. The quality of precipitated waters is primarily determined by air pollution levels, which again is outside the scope of this report. Together these sources generally constitute only between 1 and 3 percent of the total inflow budget (see Table 5-7 in the DEIS). The water quality in Crab Creek, Rocky Ford Creek, and to some extent accreted groundwaters is affected by the irrigation and agricultural methods and activities practiced within the respective watersheds. This applies also to waters fed via Rocky Coulee Wasteway during non-peak Columbia River flow periods; at those times subsurface waters originating on irrigated lands seep into return flow collector ditches and the wasteway itself, whereupon the waters reach Moses Lake. Direct accretion also occurs in a similar manner; however, as the land adjacent to Moses Lake becomes developed for residential use rather than agricultural, this effect will diminish somewhat.

Purpose and Scope

The three sources directly impacted by agricultural practices -- groundwater, Crab Creek, and Rocky Ford Creek -- together comprise about 55 percent of the inflow budget for Moses Lake, clearly a substantial portion. This report will examine the existing agricultural and water quality conditions, the changes most likely to occur in the future, and the best management practices available and appropriate in the Moses Lake drainage area.

Relationship Between Eutrophic State and Non-Point Source Pollutants

In general, the effects of non-point source nutrient loadings are not well documented. The best evidence available comes from studies of lake sediments where correlations can be made with relatively recent land use patterns.[5] Also, in 1974 a National Eutrophication Survey sampled tributary streams and 574 lakes in the United States and found general relationships between levels of nutrient concentrations in flowing waters and the sources of non-point source pollutants. Phosphorus was the principal nutrient examined. It is this nutrient which has been determined to be the most frequent determinant, or limiting nutrient, affecting trophic states in the majority of lakes.[5] Omernik[8] found in a nationwide study of nonpoint source-stream nutrient level relationships that concentrations of phosphorus and nitrogen increased as the percentage of a watershed in agriculture and urban uses increased. Unfortunately, the comparative nature and scope of that study precludes any site-specific extrapolations.

Phosphate nutrients tend to move with sediments in runoff and return flow waters. Nitrites and nitrates, on the other hand, are water-soluble and their movement into surface waters is relatively independent of soil loss.

Non-Point Source Water Quality Management Program

The 1972 federal Water Pollution Control Act mandated federal and state efforts to clean up the nation's waters. The Environmental Protection Agency (EPA) was designated as the principal authority for implementing the act, but local planning and identification of local solutions was left up to states and local agencies. In Washington, the state Department of Ecology (DOE) was granted jurisdiction for developing the Section 208 non-point source water quality management program. EPA reviewed and certified the programs as designed (see Appendix D). This program is addressing three agricultural sources: dairy waste, irrigation return flows, and dryland agriculture. The latter two plans are considered in this report with respect to their impacts on Moses Lake. For the irrigated agriculture water quality management plan, DOE retained the planning responsibilities, but the Conservation Commission became responsible for the dryland agriculture planning process.

The decision was made to concentrate dryland planning efforts to 11 counties in eastern Washington in order to maximize the effectiveness based on allocated manpower and resources. Conservation districts were invested with the actual implementation responsibilities because they have the necessary expertise and rapport with the farming community. The conservation districts formed water quality committees (WQCs) to represent agricultural interests within the districts. Those active in the Moses Lake watershed study area were the Adams County WQC, the Ephrata and North Grant County divisions of the Grant County WQCs, Lincoln County WQC, and area 2 of the Spokane County WQC. Adams County did not receive any funding for the dryland program, and thus has been severely constrained in its activities. Grant and Lincoln Counties make up the majority of the Moses Lake study area, and hence their programs were given the most attention.

The 208 irrigated agriculture plan addresses five counties with the same intent to concentrate manpower and resources so that effectiveness could be increased. In the Moses Lake study area, only Grant County has a funded irrigated agriculture 208 program. This area is part of the Columbia Basin Irrigation Project; thus the major block of irrigated farmland in the study area occupies the region near Moses Lake.

While there are many water quality parameters which are indicators of degraded conditions, DOE determined to direct its efforts towards sediment control only. The rationale for this decision is as follows:

> "After a review of water quality data during the assessment, DOE staff decided to direct initial 208 planning efforts only toward the control of sediment. While the department recognized that sediment is not the only water quality parameter of concern in irrigated areas, it was believed that its control would provide the greatest improvement in receiving water quality. As discussed in the management plan, control of sediment might also provide control of other sediment-related parameters such as phosphate and pesticides. Implementation of BMP may also reduce the movement of nitrates and salts to receiving waters."[13]

The assessment contained in this report, that of the impact agricultural practices in the Moses Lake drainage basin will have on the Moses Lake Restoration Project, rests ultimately on the success the existing 208 agricultural water quality programs have in obtaining their non-point source pollution abatement goals. Thus, in essence this evaluation is a survey of those programs in the study area with an emphasis given to the potential for beneficial impacts resulting to Moses Lake.

Authorization

This report was prepared in accordance with the "Agreement for Professional Services" between the Moses Lake Irrigation and Rehabilitation District and Brown and Caldwell, consulting engineers of Seattle, Washington, dated February 12, 1980.

Funding

This project was supported by grant funds from the Department of Ecology pursuant to Washington Referendum 26 and from the U.S. Environmental Protection Agency, pursuant to Public Law 92-500, the Clean Water Act.

PERTINENT STUDY AREA CHARACTERISTICS

The Moses Lake watershed comprises upper Crab Creek and its tributaries, the Rocky Ford Creek drainage basin, and the corridor of land around the lake which drains directly into it. The entire watershed constitutes the study area for this report, the boundaries for which are shown in Figure 1.

Columbia River water is also diverted into Moses Lake via the East Low Canal and Rocky Coulee Wasteway, which are facilities of the Columbia Basin Irrigation Project. Intermittent small volumes of seepage and runoff water from the Rocky Coulee area enter Rocky Coulee Wasteway through a dike at the junction with the East Low Canal. This amount, however, is probably insignificant to the total Moses Lake water budget. Detailed descriptions of the hydraulics and water sources for Moses Lake are provided in the draft environmental impact statement (EIS) for the Moses Lake Restoration Project. Table 1 identifies all sources of inflow to the lake and summarizes their relative contributions.

Table 1. Source and Contribution of Inflow to Moses Lake During Five 1-Year Periods

Water source	Percentage contribution				
	Mar 1978-Feb 1979	Mar 1977-Feb 1978	Oct 1969-Sep 1970	Oct 1968-Sep 1969	Mar 1963-Feb 1964
East Low Canal (via Rocky Coulee Wasteway)	31	43	0	0	3
Groundwater	27	24	28	19	30
Crab Creek	24	19	47	56	29
Rocky Ford Creek	15	12	23	22	35
Other[a]	3	2	2	3	3

[a]Precipitation, sewage treatment plant, and outflow backwash.

Adapted from Table 5-7 in the draft EIS for the Moses Lake Restoration Project.

Because this study focuses on the impacts of agricultural practices on water quality in Moses Lake, Columbia River water is considered outside the scope of the report. As detailed in the restoration project DEIS, water reaching Moses Lake via the East Low Canal is generally of high quality--low in nutrients and conductivity. This is expected to continue to be the case. Agricultural practices definitely impact groundwater quantity and quality; however, the Water Quality Planning Division of the state Department of Ecology (DOE)

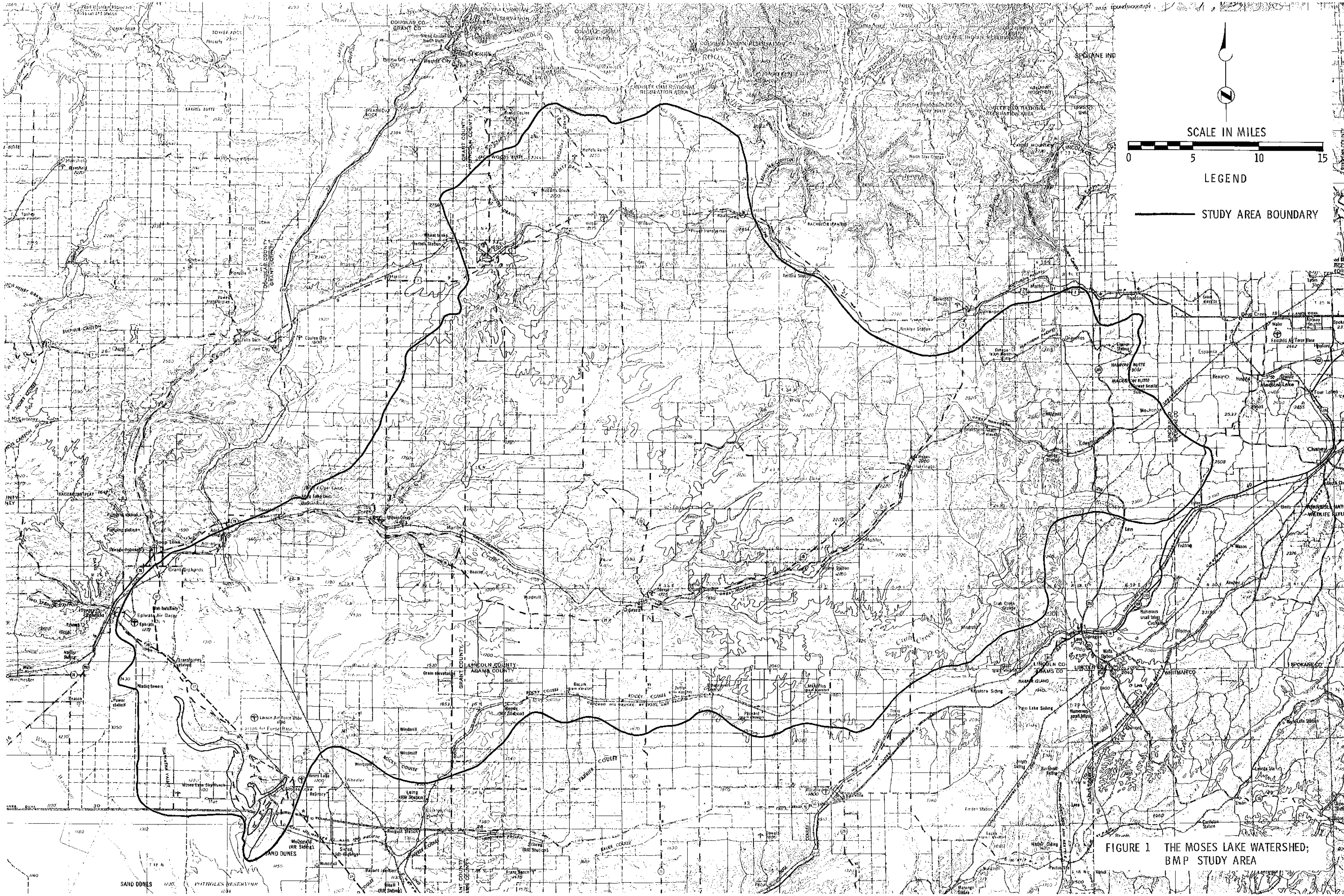


FIGURE 1 THE MOSES LAKE WATERSHED; BMP STUDY AREA

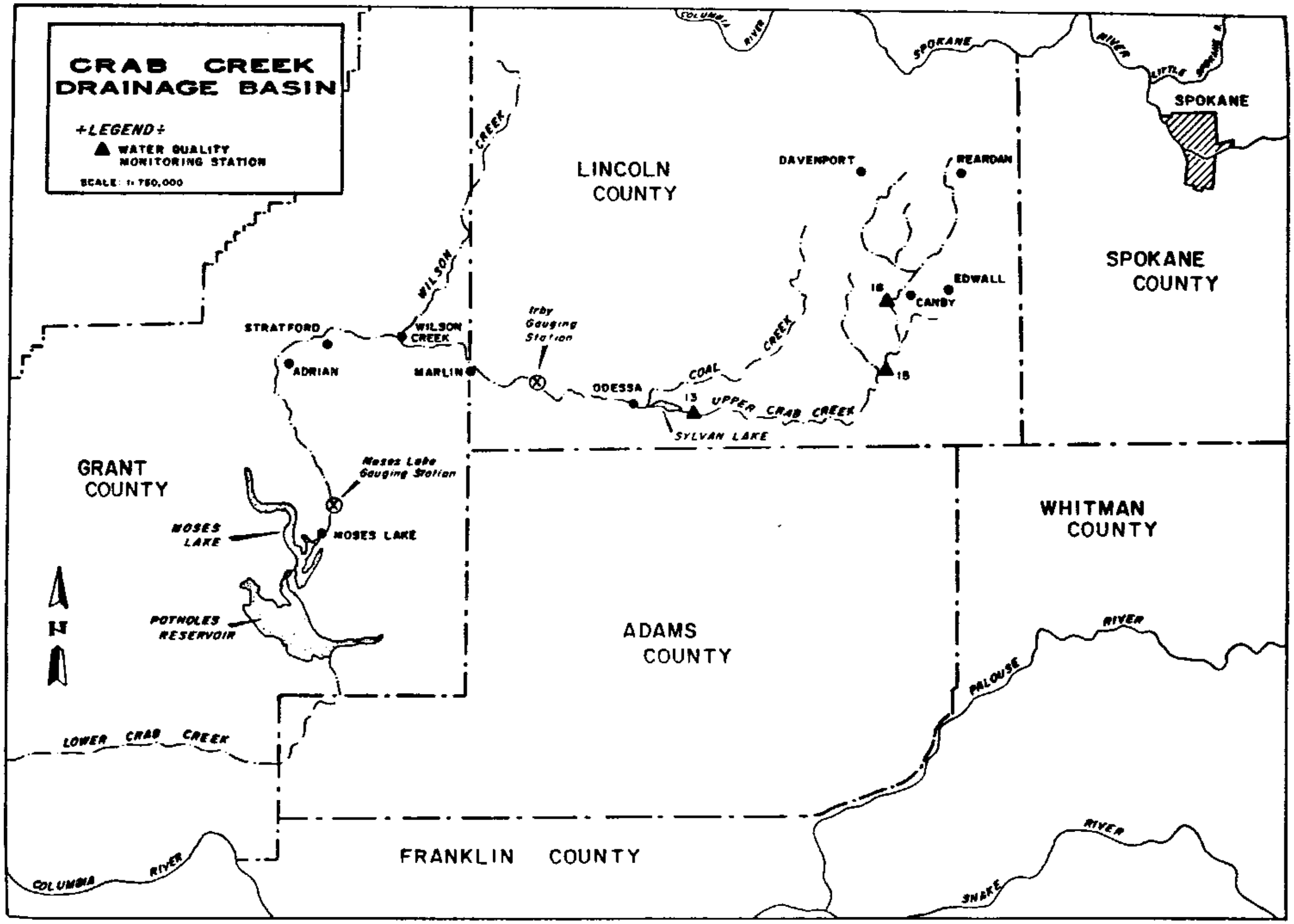


Figure 2. Crab Creek Drainage Basin

Source: Spokane CSO Abatement Project Draft EIS[2]

Natural flow in Rocky Ford Creek increased markedly with the advent of the Columbia Basin Irrigation Project in the early 1950s. Annual flows have been relatively uniform since then. (See Table 5-8 in the DEIS for the Moses Lake Restoration Project.) The average discharge of Rocky Ford Creek between 1943 and 1976 was 79.60 cfs.

A large trout farm uses the spring water for hatching eggs and rearing trout and then discharges it in Rocky Ford Creek.

Climate

The climatic conditions, together with soil and topographic type, influence the farming practices of a particular area and, in turn, determine the best management practices (BMP) which are applicable to the local site. Excluding consideration of availability of irrigation waters, precipitation is probably one of the most important determining factors.

The Moses Lake drainage basin is located in the region of eastern Washington characterized by dry summers and humid winters. Approximately 60 percent of the annual precipitation falls in the fall, winter, and spring between November and March. The moisture stored in the soil influences nonirrigated crop production. Figure 3 shows the annual rainfall received throughout the study area.

"Precipitation divides the Eastern Washington dryland farming region into a summer fallow zone and an annual cropping zone. The summer fallow zone is divided into a 'dry' farm area receiving 6 to 12 inches of annual precipitation, and an 'intermediate' area where annual precipitation is 12 to 15 inches. In areas receiving 15 to 18 inches annually, a three-year rotation is prevalent."[12]

A non-detailed description of precipitation and topography is provided in the Section 208 Dryland Agriculture Water Quality Management Plan.

Temperature (i.e., date of spring thaw) and irrigation water feed schedules are the primary "climatic" determinants of irrigated farming.

Land Use

Table 2 shows the relative composition of the Moses Lake drainage basin with respect to land use type. These land use categories are shown visually in Figure 4. This report is concerned with the impact of irrigated and dryland agricultural activities on Moses Lake water quality. Approximately 60 percent of Moses Lake drainage basin is used for irrigated and dryland agriculture.

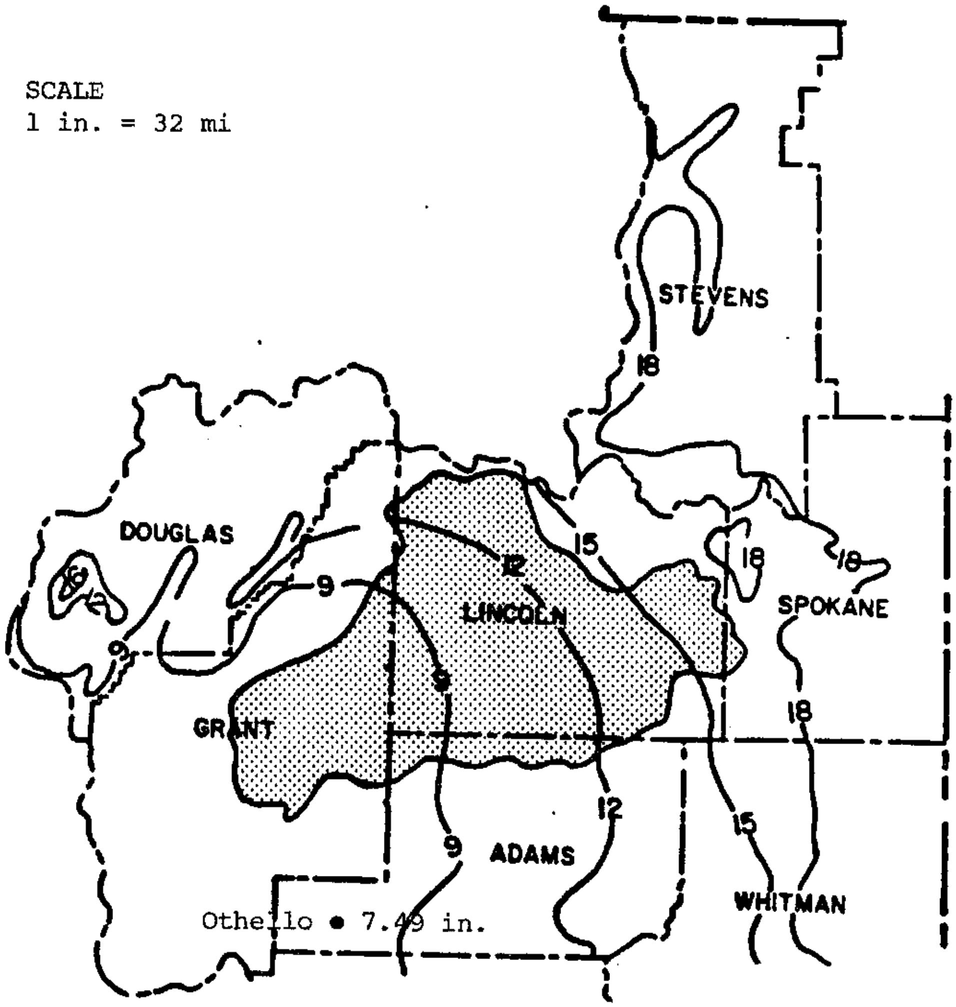


Figure 3. Best Management Practice Precipitation Zone Map

Adapted from Appendix VI, Spokane CSO Abatement Project,[2] and Annual Precipitation Zones Map of Adams County, U.S. Soil Conservation Service.

Table 2. Land Use in the Moses Lake Drainage Area

Land use	Area, square miles	Area, hectares	Percentage of study area
Irrigated cropland	172	110,080	7
Dryland cropland	1,279	818,560	52
Rangeland	984	629,760	40
Urban	25	16,000	1
TOTAL	2,460	1,574,400	100

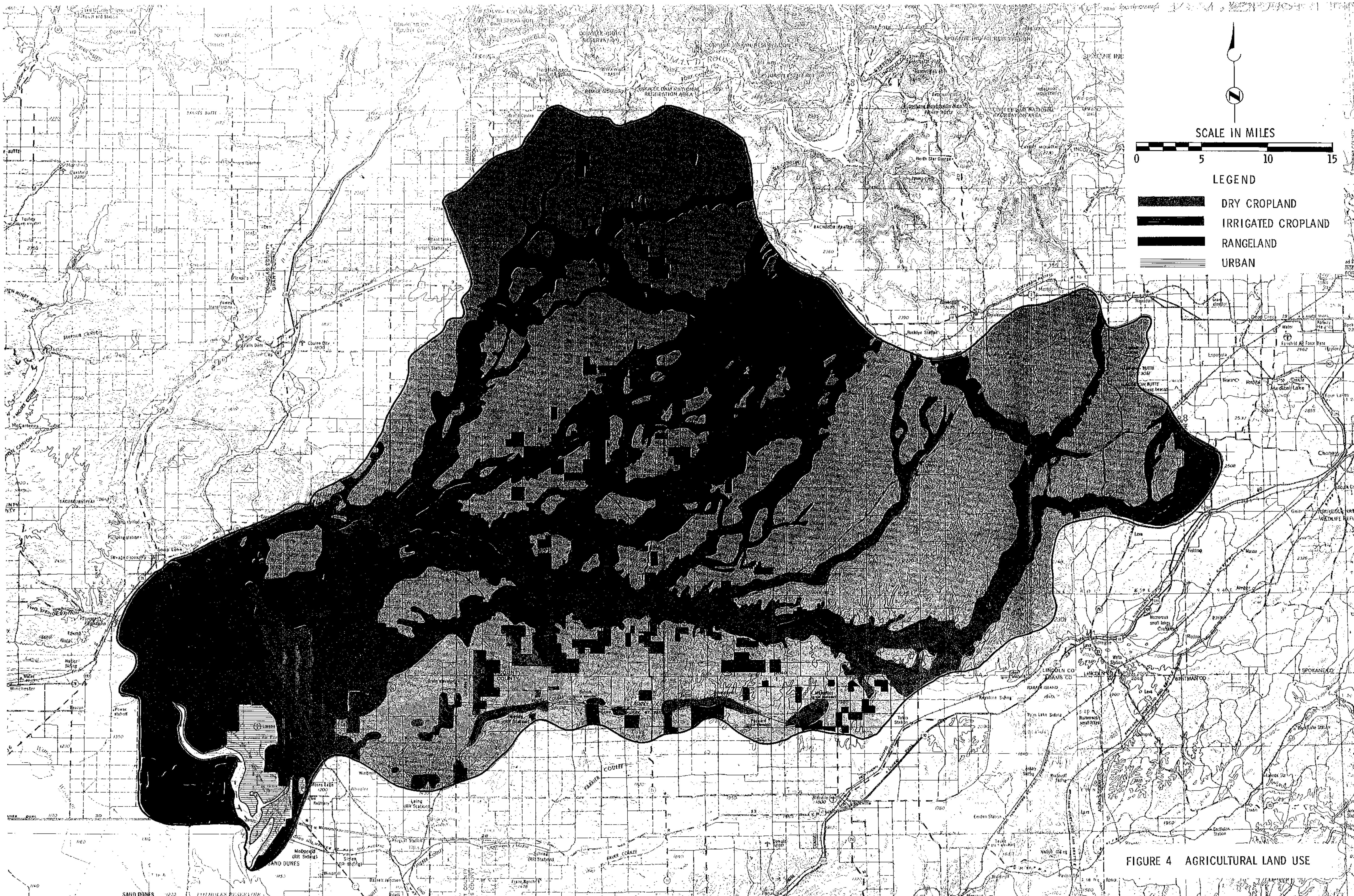


FIGURE 4 AGRICULTURAL LAND USE

Priority Areas

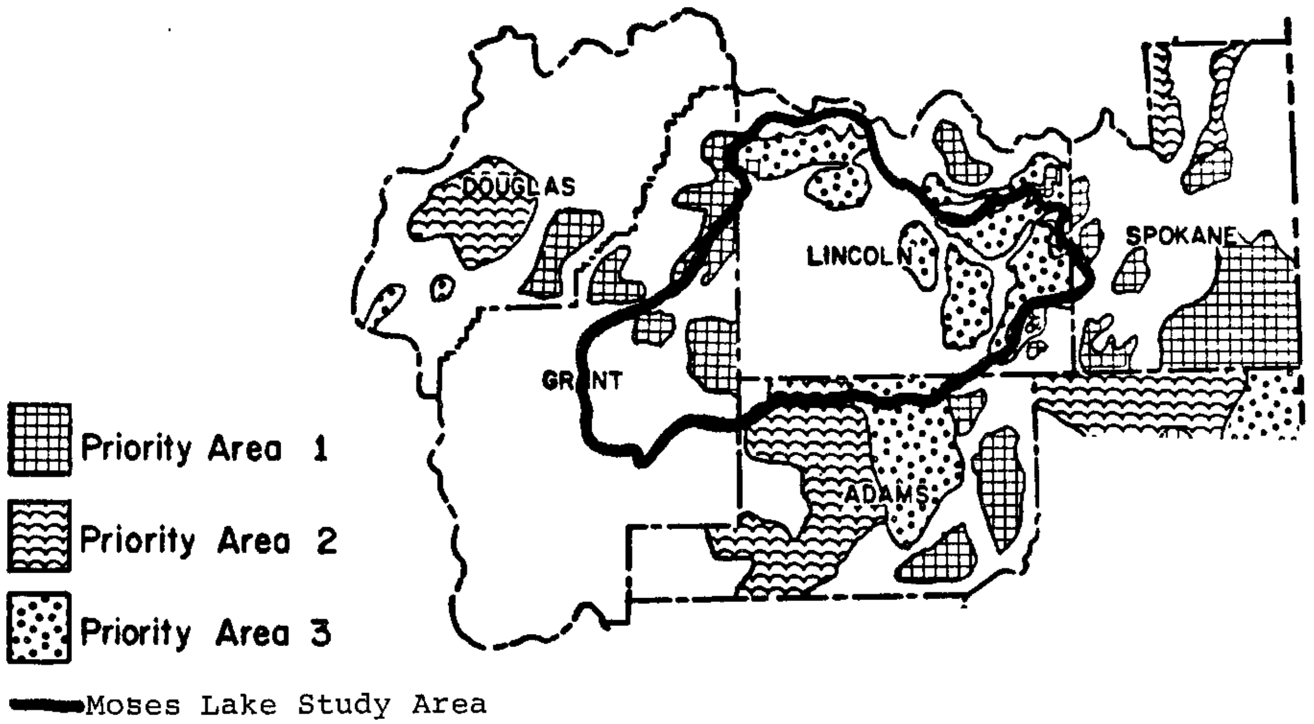
As the initial phase of the 208 implementation process, counties and conservation districts were directed to identify priority problem areas in order to make more effective use of the limited money and personnel resources available. This has been done and is shown in Figure 5. As can be seen from the figure, the study area encompasses about half of the highest dry land priority areas in Grant County and most of the third-level priority areas in Lincoln County, as well as some Priority Area 3 land in Adams County. (More detailed information about sediment loss priority areas in the Moses Lake and Ephrata Conservation Districts in Grant County is provided in Appendix C.)

The Soil Conservation Service in each county has prepared various maps of land classifications. Figure 6 is adapted from water erosion hazard maps by those counties in the Moses Lake study area.

As stated above, because of manpower and funding constraints, initial implementation efforts at the local level have been directed at the identified priority areas. This somewhat constricts the 208 planning area, but assures the most effective utilization of resources under the imposed limitations under which local and state agencies operate.

Water Quality

A detailed description of water quality in Moses Lake and the major tributary waters is provided in the draft environmental impact statement (DEIS) of the Moses Lake Restoration Project. (See pages 5-16 to 5-27.)



Due to map scale some small areas have been consolidated or eliminated. Detailed maps at larger scale are available in the counties

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Map developed by conservation districts and local citizens using their knowledge of local topography, soils, erosion, and precipitation.

Figure 5. County-Established Priority Problem Areas

Adapted from Appendix VI of the final draft of <u>Dryland Agriculture Water Quality Management Plan</u>, September 1979, Section 208, Public Law 95-217.

CURRENT PRACTICES AND NATURE OF THE PROBLEM

Many of the problems with erosion and subsequent rural water pollution in the Moses Lake study area are typical of general problems facing agriculture in the United States today. The diffuse nature of topsoil erosion, excessive tillage exacerbated by supertractors and heavy equipment, farm economics and labor considerations, one-crop farms, inefficient irrigation, and other factors all contribute to the problem. Federal programs have also encouraged planting on marginal land and in many cases penalized farmers with long-range, conservation-oriented management practices. Only some of these factors are under the control of farm operators themselves, and only those factors that are under direct control of farm operators can be influenced by the 208 agricultural water quality management (WQM) plans. The situation and solutions are so complex that no single program can reasonably be expected to afford the entire solution. But much improvement can be generated at the local agency and farm level.

DRYLAND AGRICULTURE

Most of the dryland farming in the study area occurs in precipitation belts of 6 to 15 inches annually. Wheat and other small grains are the major crops grown without irrigation in these areas.[3,6,11] The principal cropping sequence is winter grain, summer fallow.[12] This rotation of acreage into production can result in up to 50 percent of the tilled land lying fallow each year.[11] Fallowing is practiced for the purpose of accumulating moisture in the soil so that the next crop will have a better yield. In the higher precipitation zones, i.e., the eastern portion of Lincoln County and Spokane County, wheat is also the principal crop, and annual cropping, as well as 3- and 4-year rotation sequences, is the most common practice.[12]

Most runoff and erosion occurs when winter or early spring precipitation falls on frozen or thawed layers overlying still-frozen ground. Thus contributions to the sediment problem associated with dryland agriculture in the Moses Lake drainage area should be most evident during winter and early spring.

Identified Problems

Each of the county water quality committees (WQCs) in the study area has prepared a county-level dryland best management practices (BMPs) statement. The problems each of these agencies has identified for its area are listed below.

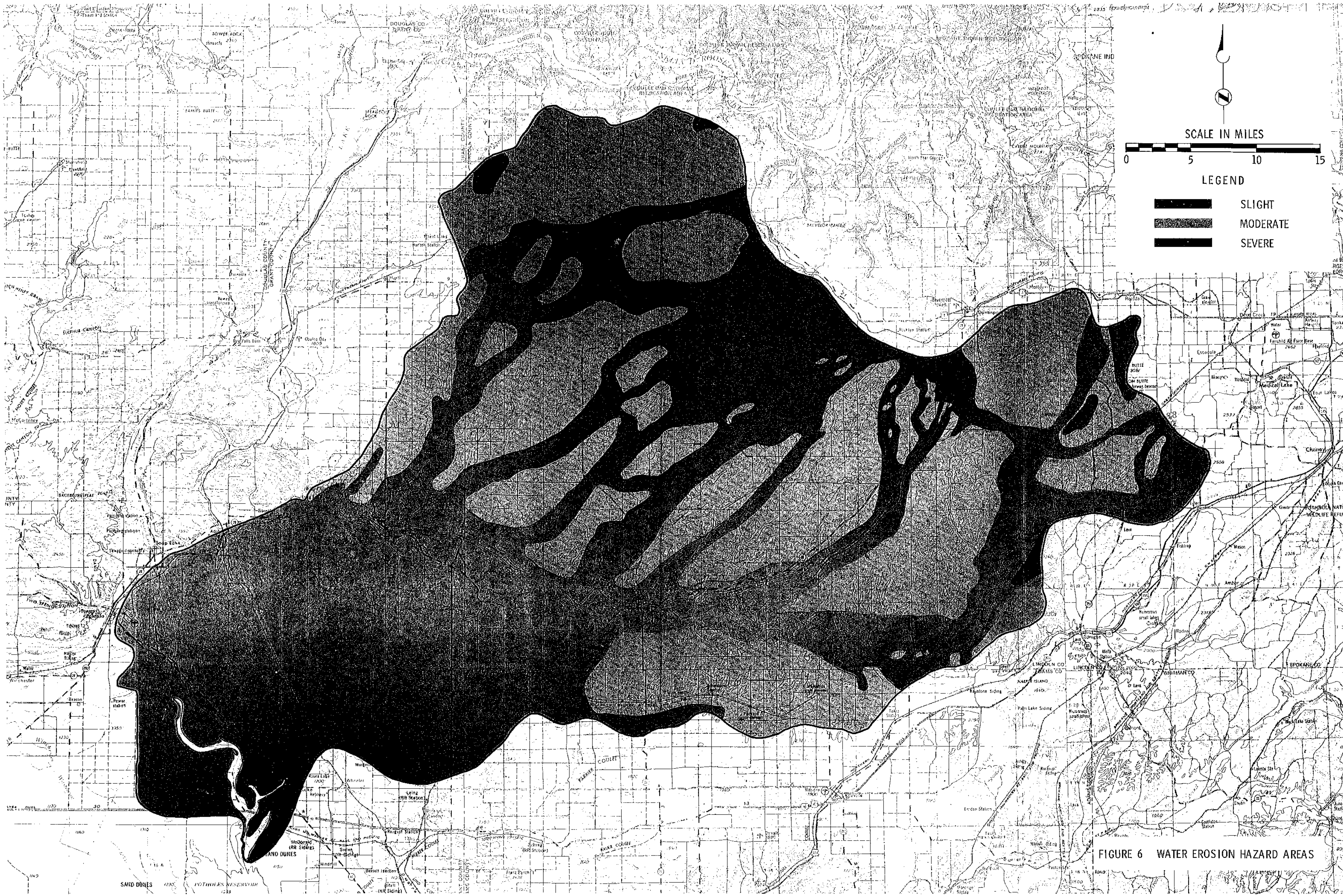

FIGURE 6 WATER EROSION HAZARD AREAS

About 90 percent of Lincoln County's dryland cropland is located within the Moses Lake drainage basin, and this constitutes well over 60 percent of the dryland farmland in the study area. Adams and Spokane Counties identified dryland farming problems, whereas Grant County primarily identified improvement practices. However, on the general level of these investigations (as opposed to field or farm site specificity) many of the problems can be generalized to the region encompassed by the study area.

Lincoln County. "The major pollution problem in the county results from winter and spring runoff from mismanaged fields of winter wheat seeded on summer fallow. The average amounts of annual precipitation make summer fallow necessary in Lincoln County crop rotations."[12]

Adams County. "In much of Adams County, wind is as much of an erosion hazard as is water. Practices to date have assisted in controlling both wind and water erosion. The major water erosion problem is caused by excess tillage."[12]

Grant County. Grant County has problems similar to those of Lincoln and Adams Counties.

Spokane County. "Most years there is rapid runoff when the soil is frozen. This generally occurs in midwinter and early spring.

"Hard summer thunderstorms cause severe erosion in isolated areas most summers.

"Excessive tillage speed in the fall is a problem.

"Winter and spring erosion is increased by summer fallowing soils in the high end of the precipitation belt that cannot store two years' moisture."[12]

Discussion. Eroded soil yields in the study area range from 0.02 to 1.5 acre-feet per square mile per year.[11] Most of the upper Crab Creek basin experiences the higher values.[11] Assuming 1 acre-foot weighs approximately 2,600 tons,[a] this range would be 52 to 3,900 tons per square mile per year. For the study area, with 1,279 square miles of dryland cropland, between 66,500 and 4,988,000 tons of soil are lost annually. The actual amounts are probably in the higher range of the spectrum because the upper Crab Creek drainage basin constitutes such a large portion of the study area. For Lincoln County alone, which does constitute a large portion of the study area, the WQC estimated annual soil losses of just under 600,000 tons.[13]

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[a]Assuming 1 cubic foot equals 120 pounds.

Erosion is a serious problem in that it deteriorates the valuable soil resource. With respect to Moses Lake water quality, sediment loads in runoff waters are also important in determining nutrient loads and subsequent effects on the state of eutrophication in the lake. The difficulty is that not all of the sediments lost to the fields end up in Moses Lake or its tributaries. Some areas drain into depressions which serve as sediment sinks, roadways may trap eroded soils, etc. However, a significant portion does end up in streams and lakes. The Lincoln County Water Quality Committee estimated soil delivery rates to streams to vary between 15 and 20 percent of the estimated loss.[13]

Annual phosphorus (P) and inorganic nitrogen (N) losses in runoff from agricultural lands throughout the western United States have been found to range between .033 and .18 pounds per acre for P and between .55 and 16.56 pounds per acre for inorganic N.[8] Nutrient delivery rates to streams are unknown and would have to be sampled in the study area, but it is known that lakes trap P so that there exists a cumulative impact. Considering that the Moses Lake watershed has over 925,000 acres of agricultural land, even assuming similarly low delivery rates of 15 to 20 percent to streams, thousands of pounds of phosphorus and nitrogen are entering surface waters, even at the low end of the estimated range. The same study found that runoff waters from row crop, grassland, and urban areas also contained high concentrations of phosphorus, NO_3-N, and NH_3-N. Rangeland is another contributor; NH_3-N results from the hydrolysis of urea, and phosphorus is contained in the solid waste from livestock. Because animals tend to congregate around watering holes, the delivery rate to surface waters is probably especially high relative to the acreage involved.

In their county and conservation district-level BMP statements, each water quality committee prepared estimates of the soil loss percentage improvement achievable and expected if BMPs were incorporated on the acreage determined to need improved management techniques through existing plans. Lincoln County estimated a 66 percent improvement, Adams County a 42 percent improvement, the Ephrata district a 10 percent improvement, and the North Grant County district a 20 percent improvement. With the soil loss volumes involved, these improvements would constitute a significant reduction of soil erosion. And reduced soil losses would improve surface water quality to some degree with respect to settleable solids and potential phosphorus nutrient loadings, although the extent is unknown.

IRRIGATED AGRICULTURE

Most of the irrigated farmland in the Moses Lake watershed is part of the Columbia Basin Irrigation Project (CBP). However, Lincoln County has over 50,000 acres of irrigated cropland, and there are sections of irrigated land in Grant County outside the boundaries of the CBP. Those irrigation systems outside the CBP are well-dependent systems. New larger volume irrigation wells approach 1,580 feet deep and yield volumes as high as 2,500 gallons per minute.[6] Older wells for both irrigation and domestic use were of shallow depths, 100 to 800 feet, and the volume of withdrawal for irrigation seldom exceeded 1,000 gallons per minute (gpm).

Furrow irrigation systems used to be the norm, but with increasing technology many operators have shifted to sprinkler systems. At present about 56 percent of the land in the CBP is sprinkler-irrigated, whereas 46 percent is irrigated by furrow systems. Sprinkler systems are expected to be used on almost all new land brought into production in the future, primarily because of the lower labor costs involved. This will have ramifications on the BMP actually incorporated, because many are designed for furrow irrigation systems.

Identified Problems

The following discussion of water quality problems generated by irrigated agriculture is from the Irrigated Agriculture Water Quality Management Plan, January 1979.[14]

> Water quality is relatively poor in most surface waters on the basin that receive return flows. A review of existing data by DOE, and an analysis of beneficial uses impacted by poor water quality, revealed that sediment was the primary pollutant of concern.
>
> Other potential pollutants from irrigated agriculture include total coliform bacteria, dissolved salts, nutrients, and pesticides. Except for coliform bacteria, there is no current evidence that these pollutants cause water quality violations. Future planning efforts will continue to examine these parameters and their impacts on beneficial uses within the 208 planning area.
>
> Irrigation water within the basin is distributed primarily through a long series of open canals which deliver water to the head-ditches of individual units. On-farm water application is primarily by furrow irrigation or by sprinkler.

Degradation of water quality can occur anywhere within the distribution, application, and collection system. The primary adverse water quality impacts occur within the application and collection systems. The most noticeable effect on water quality is an increase in turbidity as the water runs off the lower end of a field. This increase in turbidity is most prevalent in areas of steeper slopes where heavily cultivated row crops are grown under furrow irrigation. Little runoff occurs from application by sprinkler systems, except in isolated cases where the application rate exceeds the soil intake rate.

On-farm practices that affect water quality vary widely, and their impact depends on a variety of structural and management measures. Soil type, steepness of slope, slope length, type of crop, method and amount of tillage, and degree of irrigation efficiency all influence their impact on water quality.

Although turbidity is the most obvious water quality impact, it is highly variable and not always a reliable measure of impaired beneficial uses. The 208 water quality program focused, instead, on the parameter of settleable solids because it is a more direct measure of soil lost from the farm and has an obvious detrimental impact on beneficial uses.

Several additional water quality impacts may be indirectly related to sediment concentration in return flows. Coliform bacteria, phosphate nutrients, and pesticides may move with sediment in return flows. Control of soil erosion may reduce the movement of these pollutants into surface waters.

Movement of nitrate and dissolved salts into surface waters is relatively independent of soil loss. Because of their high solubility, these pollutants can be carried to receiving waters by subsurface flows. Adoption of improved water management techniques as a BMP for erosion control, may result in a reduced loss of nitrates and salts as well.

AGRICULTURAL BEST MANAGEMENT PRACTICES (BMPs) FOR THE MOSES LAKE DRAINAGE AREA

Nonpoint agricultural sources of water pollution are generally not amenable to collection and treatment. Instead careful management techniques of land and water resources must be employed to eliminate or at least reduce the problems at their inception. This chapter describes the practices, identified by the counties and/or conservation districts having jurisdiction in the Moses Lake study area, which will help achieve nonpoint source water quality management goals of Section 208 of the federal Clean Water Act (Public Law 95-217).

DRYLAND BEST MANAGEMENT PRACTICES

The agricultural best management practices developed by both the state and local water quality committees are intended as a guide to farmers in reducing their agricultural pollution problems. However, even at the local level they must remain somewhat general because topography and soils are so variable that within a single operator's tract of land more than one or two may be appropriate. Thus, it is impossible for the purposes of this report to go beyond the level of specificity developed by the counties and conservation districts; the next step under the current program is up to the individual farmers. However, the following list of practices identifies those which are generally applicable to sites in the Moses Lake study area. The list is a composite of BMPs identified by the Ephrata and North Grant County water quality committees and by those in Adams, Lincoln, and Area 2 of Spokane Counties.

<u>Alternative Cropping Sequences and Early Fall Seeding Dates by Precipitation Zones</u>

1. 9 inches and under

    a. Winter (cereal) grain--summer trashy fallow (stubble mulch); leaving a minimum of 20 percent of crop residues on or near land surface to protect soil.

    b. Fall seeding to be completed by September 8 for Lincoln County (September 15 deemed acceptable by Ephrata conservation district and Adams County; Setember 20 targeted by North Grant County conservation district).

2. 9 to 12 inches

   a. Summer fallow--winter grain.

   b. Summer fallow--winter grain--spring grain; i.e., recrop in areas of 12-inch precipitation or more and in years of adequate moisture.

   c. Fall seeding to be completed by September 12.

3. 12 to 15 inches

   a. Summer fallow--winter grain.

   b. Summer fallow--winter grain--spring grain.

   c. Fall seeding to be completed by September 16.

4. 15 to 18 inches

   a. Summer fallow--winter grain.

   b. Summer fallow--winter grain--spring grain.

   c. Summer fallow-winter grain--spring grain--spring grain.

   d. Annual cropping.

   e. Fall seeding to be completed by September 20.

<u>Cultural and Support Practices</u>

1. Fall tillage, with subsurface implements where feasible (chiseling and subsoiling).

2. Maintain a stubble mulch using a variety of implements in several different sequences of operations.

3. When possible reduce crop residues only sufficiently to allow for deep furrow seeding and no till seeding (on experimental basis).

4. Control weeds on summer fallow with stubble mulch.

5. Divided cross-slope farming which involves dividing a slope into a crop and summer fallow or two different types of crops with farming operations across the slope.

6. Terraces,[a] wind breaks, double seeding, and early seeding with grass for drainageways and retirement of land that is extremely shallow or too steep to allow permanent cover. Another practice is to grass hilltops that are low yielders and need soil building, and critical eroding areas.

7. Green manure crops which are turned under while green or soon after maturity for soil improvements; grass in the crop rotation.

8. Drop structures for reducing water velocities and inherent energy and debris basins and desilting ponds to induce deposition of silt and other debris from flowing water.

9. Straw relocation which involves mechanically moving straw from heavy production areas to light production areas.

10. Tile drainage on grainland.

IRRIGATED AGRICULTURE BMPs

The 208 Irrigated Agriculture Technical Advisory Committee defined BMP as "agronomic, management, or structural practices that, when used singly or in combination with other practices as a component of an approved farm plan, address the minimum essential treatment needed to solve site-specific water quality problems."

The local water quality committees have identified 25 management practices which, if used by irrigation farmers, would help improve water quality. Individual practices do not become BMP until they are actually employed through an approved conservation district farm specific plan. The _Management Practices Handbook for Irrigated Agriculture_, an appendix of the _Irrigated Agriculture Water Quality Management Plan_, describes these 25 practices in detail; however, the handbook is not intended as detailed technical information. For technical assistance local farmers should discuss their particular situation with their conservation district specialists.

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[a]Embankments or combination of embankments and channels constructed across the slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

The following "shopping list" of currently approved practices (additions can be made if technological advances occur, and practices can be deleted if local conservation districts so deem following analysis of their effectiveness) falls intermediary to the list provided in the Water Quality Management Plan and the relatively detailed description provided in the BMP handbook. The brief definitions provided below will give an idea of the types of management activities that would improve surface water quality in the Moses Lake drainage area.

Irrigation System BMP

Two irrigation systems are most generally applicable for the study area agriculture: rill, or furrow systems and sprinkler systems. The former is most adapted to lower intake rate soils with no steep slopes; sprinklers can be used to irrigate fields with high intake rate soils which have steeper slopes or hills. Both systems must be tailored to the specific crop and field requirements with respect to peak irrigation demands, delivery volumes, and application rates equal to or below the lowest intake rate of the soil irrigated.

Land leveling: grading a field to encourage uniform and efficient water application and to avoid waterlogging and erosion.

Lined ditches: preventing waterlogging, deep percolation and erosion during transport of water by lining the canal, lateral, or ditch with asphalt, concrete, etc.

Siphon tubes: to regulate the water flow to furrows from the delivery open head ditch in order to reduce erosion.

Buried pipe with water control valves: another system of controlling the flow to furrows is using buried pipe with furrow valves which can be regulated relative to velocity, especially under steep slope and high intake rate soil conditions, which are highly erodable.

Portable sectional handliners: can be used in place of rill or sprinkler systems on irregularly shaped fields, or for fields with obstacles like power lines where rill irrigation is inappropriate. They can also be used temporarily to irrigate young rill crops during highly erosive periods.

Center pivot systems: are applicable to level, circular fields with high intake rate soils. They are energy intensive, although requiring low labor, systems.

Solid set systems: are permanent sprinklers most applicable to long-term crops such as orchards, vineyards, and other permanently planted fields.

Drip (trickle) and modified drip systems: another permanent, fixed irrigation system that applies water very slowly directly to the plants' root zone through valves (emitter valves) from the main line. This system causes little if any erosion but may be costly to install because of its permanent nature. Modified drip systems have adjustable emitter valves and can be flushed free of debris.

Portable or dual systems: portable pipe can be used as a temporary or secondary system with an established rill or sprinkler system to meet specialized field or scheduling demands.

Irrigation Scheduling BMP

Effective application of the right amounts of water at the right time is of paramount importance to irrigated farming, both for optimal crop growth and to prevent soil loss and surface water degradation. A variety of flow regimes are possible to meet specific situations, especially for rill irrigation systems. Sprinkler systems, on the other hand, have limited modifications possible for water application techniques other than changing the water pressure, sprinkler head spacing, and nozzle size.

Constant rate flow: this method involves applying small, low energy (non-erosive) streams for the total irrigation set. The benefits are reduced erosion, reduced outflow losses and lower labor requirements. One potential disadvantage is an increase in deep percolation water losses.

Fixed-time irrigation: this method can be used to reduce erosion in freshly cultivated furrows by feeding constant rate flows into the furrows in regular 12-to-24-hour cycles. Successively higher volumes can be applied until the desired irrigation level is reached.

Cutback irrigation: involves running large, slow streams of water through the furrows for approximately 25 percent of the irrigation time and then reducing flows to equal soil intake rates for the remaining irrigation period. One way this can be achieved is through the use of modified flow siphons.

Modified flow siphons: initial large diameter siphon tubes are replaced by smaller tubes or modifiers are inserted which reduce subsequent flows.

Pressed (slicked) furrows: are useful on high intake rate soils such as sandy loams. This practice involves compacting the soil in the furrows to decrease water intake rates and can allow for small streams to be applied at faster rates to longer furrows.

Tailwater Management

A number of practices, designed to fit particular field conditions, can be incorporated into farming practices which control tailwaters, or runoff, produced by most irrigation systems. Many of the practices described above are aimed at minimizing the amount of tailwater resulting from the individual system; however, it is difficult to create an irrigation management scheme that is 100 percent effective under all weather, etc. conditions. Therefore, the measures described below should be considered in combination with other techniques to control erosion and water quality degradation from the tailwater collection point to the area of discharge, treatment, or reuse.

Turn-back flows: this practice is particularly suited to a flat rill irrigation system laid out on low intake rate soils. It involves constructing an earthen dam at the lower end of the furrows which stop or divert back tailwater flows. This reduces runoff and enhances water infiltration.

Mulching: consists of mixing coarse material such as straw, crop residue, or gravel into the surface of wide, flatly shaped collection ditches to slow tailwater velocities and to help settle suspended sediments.

Drop structures: are useful where the collection system traverses steep grades which would promote erosive velocities being reached in the ditches. Check dams, along with small antecedent sediment basins, slow tailwaters before they flow over the dam and fall to a more gradual slope before reaching the next drop structure. Plastic pipe or sheeting can also be used to protect the ditch in places of steep elevation.

Buried pipe: this practice utilizes buried pipe to transport runoff waters to the discharge outlet, reuse system, etc. Tailwater from the furrows enters the buried pipe by a drop inlet structure. Such a system is valuable where large volumes of water must be transported long distances over steeply sloped ground.

Vegetative strips: two uses can be made from planting vegetation, i.e., grasses or legumes; in collection ditches. Filter strips are employed to trap sediments and are generally annual plants because of their high growth rates. Grass-sodded waterways protect collection ditches from erosion by large volumes of water but they are not recommended for areas with large sediment deposits which would tend to smother the plants.

Sediment basins: are settling basins to collect the sediments precipitating out of suspension when the water velocities are slowed in shallow ponds.

Reuse systems: a reuse system is feasible whenever tailwaters can be collected at a common point. The water is either transported by gravity to a lower field or pumped back to the initial delivery point and mixed with arriving irrigation water. Reuse systems are particularly valuable on low intake rate soils where water use efficiencies may be low.

Soil Management

Agricultural water quality is directly related to the quality and conditions of soils in the irrigated areas. Tillage and cultivation practices can influence to a large extent the erodible character of soils.

Reduced tillage: refers to a reduction in the number of seasonal tillage operations and also to techniques that are subsurface or deep and therefore disrupt the soil surface as little as possible. Reduced tillage practices maintain large surface soil aggregates and avoid excess soil compaction, both of which increase water infiltration and reduce the hazard of erosion. They are applicable to all soil types and farming operations.

Residue management: involves leaving or depositing large amounts of organic matter on the field surfaces, and incorporating high residue crops such as corn and small grains, cover crops and green manure crops into the cropping rotation. These measures increase water uptake and reduce surface erosion. They are especially valuable on sloping fields with minimum textured soils, but are useful on all conditions.

ASSESSMENT

Unfortunately, because there is no water quality sampling network sufficient to provide data for interpretation, it is impossible to quantify the direct effects the 208 program has had or is having in the Moses Lake drainage area per se. In addition, the management efforts have not been operative very long, and nonpoint pollution abatement measures must necessarily occur over a number of years before visible effects can be measured because of the numerous variables and confounding factors involved. The fact that both the irrigated and dryland 208 management plans are voluntary in design further determines the pace at which results can reasonably be expected.

The difficulties in assessing the 208 programs are not particular to this report. The Agricultural Technical Advisory Committees to DOE are at the present time trying to determine how to realistically measure the success of the 208 programs, given that direct water quality monitoring is infeasible.

An attempt was made to get an indication of how well the programs are working in the Moses Lake study area by examining the level of local involvement in the BMP programs and identifying the major constraints impeding a rapid and widespread achiement of the program goals. These are discussed for the irrigated and dryland agricultural programs in this chapter.

However, a few general comments, applicable to the entire program, are appropriate as an introduction to the specific discussions below. Realistically, a volunteer program has certain inherent problems, or at the very least delays, in implementation. Dissemination of information, or outreach, about the particulars of the program plays a greater role, and this takes time. Farmers have seen programs come and go and are understandably hesitant about intensive participation in a new one, particularly a program which requires a commitment of time, money, and labor. Their hesitation need not be interpreted as a lack of concern about water quality issues or as an indicator of low eventual involvement. Rather, it is a predictable response, under the circumstances, and consideration of it should be incorporated into a realistic schedule for goal achievement.

A second general constraint upon 208 evaluation, in the Moses Lake study area and elsewhere, is the lack of documented data on the effectiveness of proposed techniques in reducing nonpoint agricultural pollution. Without a quantifiable knowledge of BMP impacts, it is impossible to predict with any accuracy the results of various control programs and, more specifically, to provide farmers with a cost-benefit analysis adapted to their particular situation. Thus a critical device in a voluntary program for persuading farmers to participate is unavailable. This information would be just as crucial to any other type of program, i.e., incentive or regulatory.

Washington State University, the Soil Conservation Service, and the Cooperative Extension Service are involved in a number of research projects, i.e., the Block 86 study in the Columbia basin and the Model Implementation Program (MIP) in the Yakima basin, which are providing the kinds of information necessary to assess the effectiveness of BMPs. However, definitive results from these studies are not yet available.

Dryland Agriculture 208 Program in Moses Lake Study Area

There are a number of factors which must be considered in an assessment of the impacts dryland farming has on Moses Lake water quality. The majority of dryland farmland in the Moses Lake study area is in Lincoln County, relatively distant from the lake itself. Undoubtedly dryland farming practices do influence water quality in Crab Creek and its tributaries, but again it is difficult to determine exactly to what extent. As indicated in Chapter 2, Crab Creek dries up most summers between Odessa and Wilson Creek, which should reduce the direct transport of sediments east of this area into Moses Lake. However, sediments deposited in the stream basins prior to and during dry periods can be picked up and carried downstream later during later winter and spring precipitation and runoff seasons.

As can be seen in Figure 2-4, many of the major tributaries to Crab Creek--Coal Creek, Wilson Creek, and Canniwai Creek--and Crab Creek itself are bordered by a corridor of rangeland, with several significant reaches of irrigated land. This land use pattern also serves to buffer the direct impact of dryland farming practices on water quality in streams. Livestock management practices in this area are clearly important to surface water quality.

The absence of a useful system of water quality monitoring stations (one exists at Urby, and one exists just north of Moses Lake near Parker Horn at 7 Northeast County Road) makes it impossible to estimate the significance of these influences.

Soil erosion is a significant problem in much of the study area's dryland farmland. But how much of the eroded soils actually reach the streams and constitute a water quality problem? The Lincoln County Water Quality Committee estimated between 15 and 20 percent of surface soil lost from the fields is delivered to the streams. Given the intermittent character of Crab Creek and other streams, the percentage of this sediment which reaches and impacts Moses Lake is substantially lower. Under existing conditions, Moses Lake does not appear to suffer from severe sediment problems, as evidenced by the fact that no dredging for purposes related to settling sediments has been necessary.

Local Involvement. Lincoln County will be the primary focus for the dryland program assessment because over 60 percent of the dryland farmland in the Moses Lake drainage basin lies in Lincoln County; Adams County has no funded dryland program; and emphasis in Grant County has been more oriented towards irrigated agriculture management. Ninety percent of Lincoln County's dryland farmland is in the Moses Lake study area. The figures listed below are for the entire county area. They were not adjusted because it was not known whether the individual contacts were farmers within the study area. But the 90 percent figure should be kept in mind.

The Lincoln County Conservation District's efforts have been directed toward developing site plans, which may entail smaller parcels than entire farm plans. At the present time there are 100 operators who have been personally contacted and for whom site plans or technical advice has been prepared. The remaining 750 dryland operators will be individually contacted within the next two years. Many operators, after indirect contact with the program via the educational efforts of demonstrations, newspaper articles, etc., have incorporated BMPs or support practices into their farming activities, as evidenced by windshield surveys. However, the extent and significance of such undocumented changes are impossible to estimate.

Constraints. As is almost always the case, financial factors constitute the major impediment in the existing program. A permanent source of funding for manpower, and for more of it, would help convince farmers of the stability of the program. And more cost-share monies available to individual operators, in addition to the amounts already allocated and in addition to the funds available to large groups--watersheds and drainages, for example--through the Rural Clean Water Act, would encourage participation in the program. The large group recipient cost-share programs are more difficult to manage and administer. Thus local Conservation District agents have indicated that smaller areal emphasis might provide more effective use per dollar. That manpower and financial resources would be inadequate was recognized by DOE in its Dryland Agriculture Water Quality Management Plan: "The resources available are limited and are probably below the levels which are needed to realistically meet the goals and objectives of the plan."[12]

The second major constraint identified by local agents, particularly with respect to dryland grain production, was the conflict between federal short-term production control programs and the necessity for a long-term management perspective inherent in a conservation plan.

> Short-term production control programs have been used to stabilize the grain production industry and to assure the producer a return for his labor and investment. A conservation plan incorporates grain crops with soil building corps in a rotation with tillage and support practices that will reduce soil erosion and sedimentation. Long-range conservation planning is difficult to sustain with short-term (annual) production program determinations. Soil building crops, tillage programs, and support practices require long-range planning and management for implementation. Administration of short-term commodity production programs fails to recognize the value of the long-term soil building crops, tillage programs, and support practices. Producers who enter into a voluntary long-term conservation program have placed themselves at a disadvantage when compared with producers who do not make a long-term conservation commitment and can adjust to annual changes in the production-oriented program.[12]

The Dryland Agriculture Water Quality Management Plan (Final Draft, September 1979) identified the above factors as potential problems, as well as five other variables:

1. Farm prices and operator's profit margins.
2. Awareness and/or concern about water quality problems.
3. Dependence on a voluntary program.
4. Dependence upon a complaint process.
5. The effectiveness of the employed management practices.

Most farm operators are concerned about soil erosion and sediment problems, if only because of the loss of productivity associated with poor management techniques. That the cause and effect between BMP and water quality improvement is poorly understood has been discussed, although research in this area is ongoing. And a voluntary program, by its very nature, implies a longer time span for visible improvements to water quality. The DOE understood the operative constraints for the plan, and there have been no surprises. The general consensus is that probably the most significant contributing factor toward the realization of WQMP goals is the fluctuating economy and the profitability of individual operations. Again, this leads to the conclusion that reaching nonpoint agricultural goals will take time.

Irrigated Agriculture 208 Program in the Moses Lake Study Area

Since the beginning of the irrigated agriculture 208 program in Grant County, which is the only funded irrigation program in the Moses Lake study area, in 1979, at least 80 percent of the farmers have been informed, by one means or another, about the concerns of tailwater management and runoff. Fifty percent of the total farming community are cooperating with their conservation disctrict. The financial and manpower shortages in the irrigated agriculture program are just as acute as the dryland situation. There is one resource technician to serve seven conservation districts. Prior to the eruption of Mount St. Helens, these handicaps appeared to local agents to be extreme. Operating at their peak capacity progress in terms of contacts and farm plan development was slow. However, the eruption of the volcano, with its extensive ash deposition in the Columbia basin, brought in a lot of emergency aid money and personnel. See Figure 7. This situation has influenced the water quality program, even where attention was not directed to that parameter specifically.

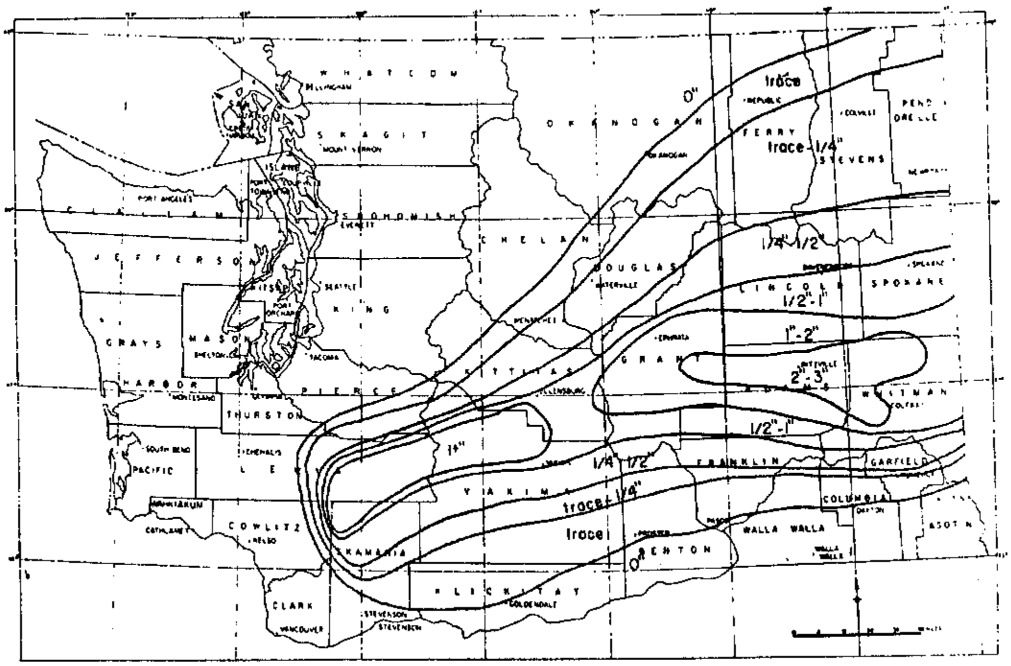

Figure 7. Preliminary Ash Thickness Distribution, Mount St. Helens Eruption, May 18, 1980

Source: Rainier National Bank[9]

The Columbia Basin was prioritized for receipt of Agricultural Conservation Program (ACP) cost-share monies, and a number of specialists were designated to the area to help with the emergency. These resources are not permanent; however, farmers applying for assistance through the federal programs are also channeled through the 208 farm plan program. In addition, the ash assistance measures being put into practice from these other programs often constitute BMP or BMP support practices; particularly the structural measures employed to compat ash problems in the near term will serve to improve water quality in the long run. Information about water management techniques is also becoming widespread, which will be valuable in the long term. The potential for erosion, runoff, and water quality problems is substantially increased by the ashfall for the next year or so, and so even with more technical assistance available, degradation of water quality may occur for a while. But when the most acute impacts of the eruption have subsided, some long-term benefits of the increased management input may be realized.

Local Involvement. The major portion of three conservation districts makes up the irrigated farmland which lies in the Moses Lake drainage basin and that is involved in the irrigated agriculture 208 program. These districts are: Moses Lake, Ephrata, and parts of Warden. The annual progress report for the program is in preparation and will be available early in 1981. The following figures are for the first three quarters of 1980.

There were 780 direct personal contacts made in this area. Sixty farms, with a total of 8,900 acres, applied BMP. Conservation plans for an additional 1,500 acres are in the process of being developed and will soon be applied.

Most Effective BMPs. According to Dr. King, who is involved in the Block 86 BMP research study, the most cost-effective BMPs for this area under current economic conditions are the structural sediment basins and field filter strips. While not the most cost-effective, water management practices on the fields themselves would probably generate the greatest improvement in a site-specific and areawide context. However, water management practices usually involve a fairly substantial capital investment or require increased labor commitments.

Constraints. The constraints are the same as described in the dryland agriculture section and identified by DOE in the Irrigated Agriculture Water Quality Management Plan of January 1979.

Impact on Moses Lake

The DOE decided at the onset of the 208 planning process that it would concentrate its energies, at least initially, toward the control of sediment. Because of the chemical nature of phosphorus, which attaches to particulates, sediment control measures would serve to reduce phosphorus concentrations in the feed waters to Moses Lake. "Phosphorus control usually is of greatest importance in lake restoration programs . . . because of its importance as a limiting nutrient. . . ."[1]

Nitrites and nitrates, on the other hand, remain soluble in water and are not, therefore, directly affected by sediment control practices. Rather, nitrogen pollution loadings in surface waters, and in this study to Moses Lake, will be affected more by water management techniques which reduce tailwater volumes and discharges, coupled with careful fertilizer application methods which control the amounts of nitrogen applied to the soils.

Careful fertilizer scheduling is becoming more and more expedient as costs for chemicals rise. However, as discussed in the section on irrigated 208 program effectiveness, water management BMPs, while among the most valuable and effective methodologies, are also difficult to "sell" to farmers because of large capital and labor costs.

According to the above analysis, realistic implementation expectations for the dryland and irrigated 208 programs in the Moses Lake drainage basin are most likely to reduce phosphorus loadings to Moses Lake--at least, improvement should initially occur with respect to this parameter--and have less effect on nitrogen pollution loading to the lake. As efficient fertilizing methods improve, and as farmers are periodically able, financially, to make capital improvements in their water distribution systems, some reduction in nitrogen loadings to Moses Lake might occur. However, this predicted effect may be countered by the increase in irrigated farmland acreage, and therefore water usage and runoff, as the East High area of the Columbia Basin Project Area is developed.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The most general conclusion of this survey was that the 208 Agricultural Water Quality Management Programs in the Moses Lake drainage basin are working as well as can be expected given the constraints they are operating under. However, these constraints--a shortage of financial and manpower resources--are significant. The existing programs have essentially succeeded in developing the framework for an effective program, but they are extremely limited in any real operational sense. With an infusion of funds, substantial progress could be achieved; the set-up phases of such a project have been completed.

The most serious problems identified are:

- Funding and manpower shortages.
- Federal production control programs conflict with conservation programs.
- The availability of cheap (abundant) water contributes to poor management practices, i.e. over-irrigation and erosion.
- Many irrigation systems (both sprinkler and flood) are not designed and/or managed properly.
- Summer following is a major source of erosion.

The Department of Ecology recognized at the onset of the program that the "resources available are limited and are probably below the levels which are needed to realistically meet the goals and objectives of the plan."[12] Clearly there is a need for more resources to be made available.

The hidden costs of not providing these resources should also be emphasized. There are many costs to the public and water-users for not supporting a good erosion and sediment control program, which are being paid year after year: road cleanup, road ditch and culvert cleanup, lost storage capacity in reservoirs, increased treatment demands for domestic waters, reduced fish and wildlife, reduced agricultural production, and recreational lake deterioration are just a few examples. These costs could be substantially reduced by redirecting the funds into a good conservation and management program, possibly by even more than the cost of the program itself, which could provide the public with a net benefit.

To the extent that existing efforts succeed, the quality of water, primarily irrigation return flows and natural runoff waters, flowing into Moses Lake will be improved. The parameters that should show the greatest improvement are suspended solids and nutrient phosphorus loadings. Phosphorus is generally considered to be the limiting nutrient in most reaches of Moses Lake (except Pelican Horn--see the water quality discussion in the Moses Lake Restoration Project DEIS). The data necessary to predict annual nutrient losses from the terrestrial watershed are unavailable; and therefore it is impossible to estimate any percentage reduction expected to result from agricultural BMP implementation in the drainage area. It is, however, known that generally lakes function as phosphorus "traps" within large watersheds. This capacity implies that reductions in the phosphorus loads in incoming waters will not result in an instantaneous equal reduction in phosphorus concentrations in Moses Lake. Again it is impossible to quantify what this means in terms of visible effects. However, it is assumed that any reduction will be beneficial in the long run.

Two trends in agricultural land use are likely to affect the future conditions in the Moses Lake drainage basin: the development of the East High area of the Columbia Basin Project (CBP) area will convert additional large tracts of dryland farmland to irrigated land in the study area; and outside of the CBP area, there is likely to be a continued increase in the number of well irrigation systems scattered throughout the dryland farmland region. Most tillable land in the area is under cultivation, so little development of dryland farmland is anticipated.

<u>Recommendations</u>

Approximately one-quarter of the East High area slated for development lies in the Moses Lake drainage area; presumably much of the return flows generated in this area could impact Moses Lake. Future irrigated farmland, which is as yet undeveloped, has the advantage, relative to conservation practices, of allowing for the installation of structural systems creating BMP at the onset of development. Thus the capital costs of conversions are eliminated. To incorporate BMP structures may be slightly more costly than less efficient systems; therefore one recommendation is to continue to provide cost-share funds and possibly additional incentives such as tax credits or priority eligibility for low-interest loans if operators install BMP in newly developed irrigation systems.

Another possible strategy is to require a farm plan and the use of appropriate structural <u>and</u> management BMPs as conditions for receiving water in newly developed areas. Since the federal project to deliver water is a cause of the major irrigated area problems, it is only fitting to ask for control on future development.

There are a variety of other activities which could implement the 208 management efforts, in addition to alternatives to the program itself. For example:

1. Requiring farms to be certified in an approved conservation plan to become eligible for low interest loans.[4]

2. Federal price supports and crop insurance could also be dependent upon certification of a farm plan.[4]

3. Acreage limitations on grain should be eliminated from future federal commodity programs.

Careful management of nitrogen fertilizers to maximize yields while minimizing nitrate loss in percolating and runoff waters would help reduce nitrogen pollution.

There are alternatives of a more regulatory vein, such as economic penalties such as soil loss taxes or direct land use limitations, performance standards, etc. Such programs would be contrary to the expressed preference of most people associated with the 208 program, and would be very costly to implement. Until the effectiveness of the existing voluntary program can be evaluated and quantified, such action would be hard to justify.

While livestock management is outside the scope of this report, activities occurring on rangeland around Moses Lake do influence water quality in the lake. Rocky Ford Creek, as can be seen in Figure 4, is surrounded by rangeland. Careful management of livestock numbers and grazing intensity as well as fencing buffer zones along creeks and streams would help alleviate the impact of range related pollution problems.

APPENDIX A

BIBLIOGRAPHY

APPENDIX A

BIBLIOGRAPHY

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APPENDIX B

CONTACTS

CONTACTS

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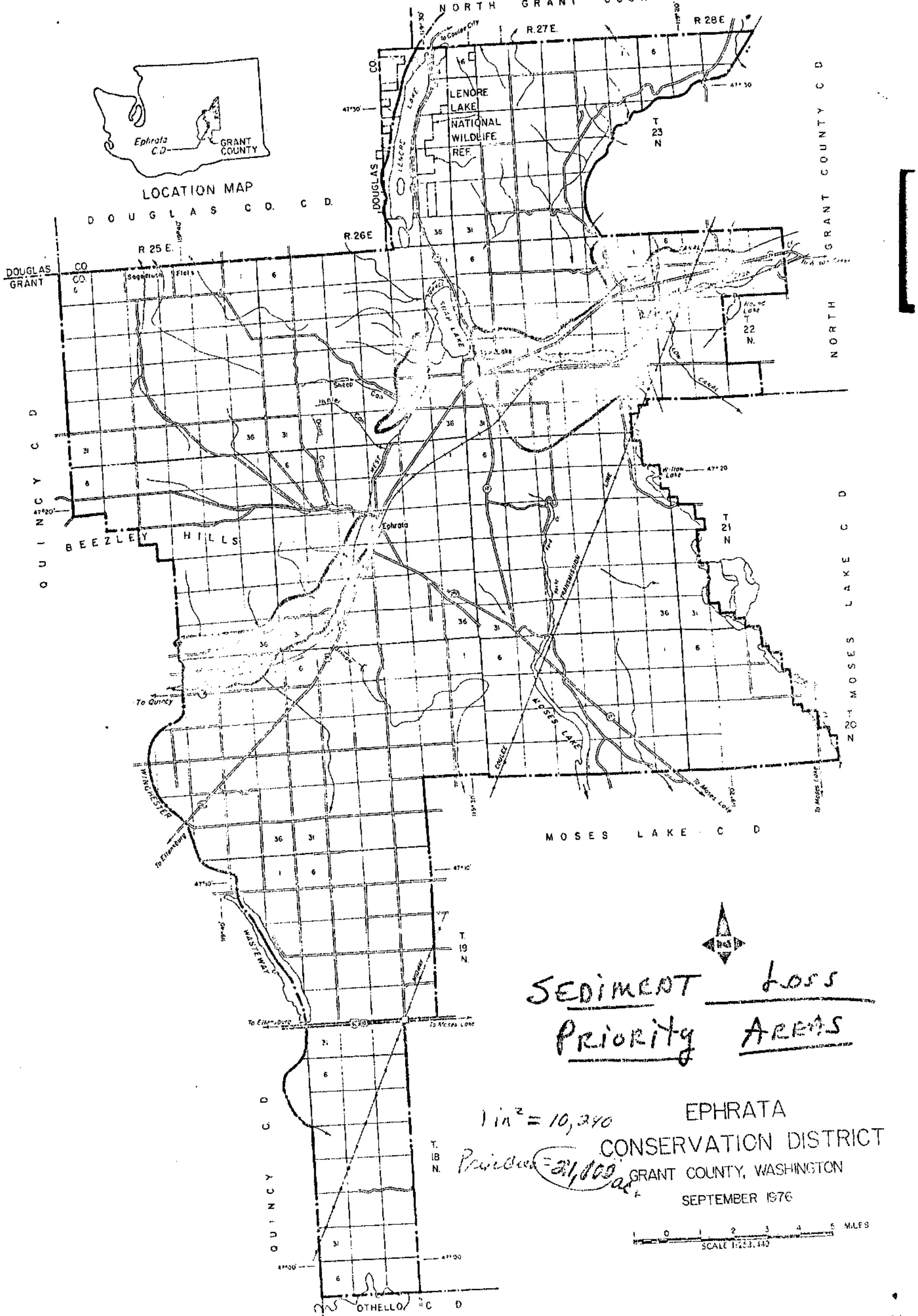
Felix Entermann	Washington State University
Dr. Larry King	Washington State University

APPENDIX C

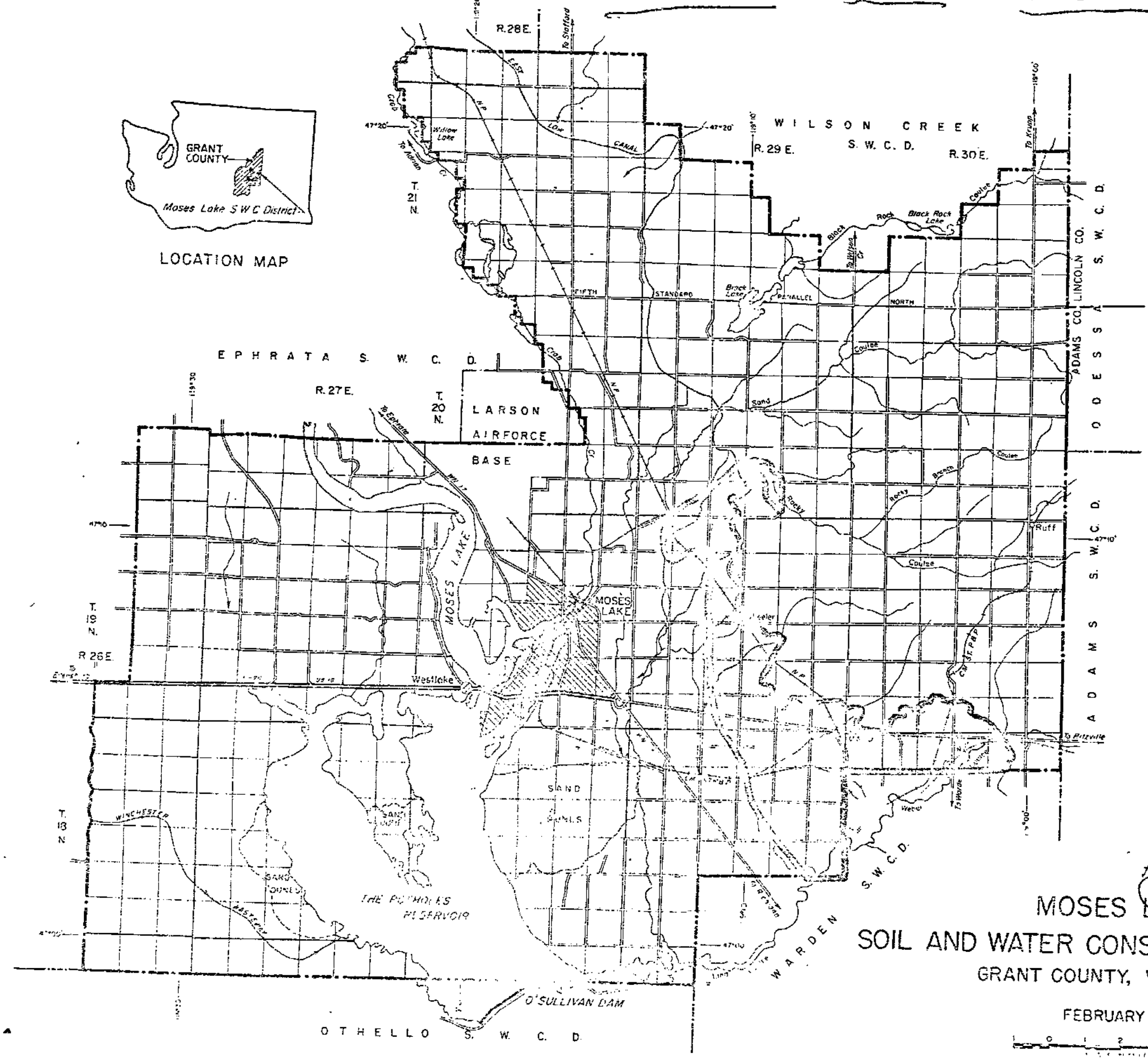
SEDIMENT LOSS PRIORITY AREAS IN GRANT COUNTY



U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

EPRATA C.D.,(69) WASH M7-PL-11029

Sediment Loss Priority Areas.



MOSES LAKE
SOIL AND WATER CONSERVATION DISTRICT
GRANT COUNTY, WASHINGTON

FEBRUARY 1965

1 in.² = 10,240 ac.

19,560 ac.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE M-4319

MOSES LAKE S.W.C.D.(28), WASH. 7-P-13402-L

APPENDIX D

EPA CORRESPONDENCE CERTIFYING
DOE 208 WATER QUALITY MANAGEMENT PROGRAMS

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE

SEATTLE, WASHINGTON 98101

DEPARTMENT OF ... TRANSPORTATION ... OLYMPIA WA ...

JAN 4 9 16 AM

REPLY TO ATTN OF: M/S 446

JAN - 3 1980

Honorable Dixy Lee Ray
Office of the Governor
Legislative Building
Olympia, WA 98504

Dear Governor Ray:

The Environmental Protection Agency has completed its review of the State certification of the Dryland Agriculture Water Quality Management Plan. This review included a period for public review of our proposed approval action. Based on your certification and our review, I am conditionally approving this plan.

Your certification designated conservation districts as the management agencies responsible for plan implementation. The districts have the central role of program direction and multi-agency coordination. This new or expanded role will require manpower for them to serve effectively in plan implementation. For this reason approval of the plan was conditioned upon providing a permanent funding arrangement to support the needed manpower, and upon the completion and signing of the Management Agency Implementation Statements by the conservation districts.

A copy of the Notice of Proposed Approval Action that was distributed for the public review is enclosed. Within the notice is listed the additional planning needs to be considered in the annual review and evaluation of the plan implementation.

The Department of Ecology and the Washington State Conservation Commission are to be commended for the diligent way they pursued the development of the plan, for the sensitivity exhibited toward the agricultural community in working with them in development of the plan, and for the plan itself.

Sincerely,

Donald P. Dubois
Regional Administrator

Enclosure

cc: Wilbur Hallauer, DOE
Wayne Reid, Conservation Comm.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: M/S 453

JUN 21 1979

Honorable Dixy Lee Ray
Office of the Governor
Legislative Building
Olympia, WA 98504

Dear Governor Ray:

The Environmental Protection Agency has completed its review of the State certification of the Irrigated Agriculture Water Quality Management Plan. This review included a period for public review of our proposed approval action. Based on your certification and our review, I am conditionally approving this plan.

Your certification designated conservation districts as the management agencies responsible for plan implementation. The districts have the central role of program direction and multi-agency coordination. This new or expanded role will require manpower for them to serve effectively in plan implementation. For this reason approval of the plan was conditioned upon providing a permanent funding arrangement to support the needed manpower.

A copy of the Notice of Proposed Approval Action that was distributed for the public review is attached. Within the notice is listed the additional planning needs to be considered in the annual review and evaluation of the plan implementation.

The Department of Ecology is to be commended for the diligent way they pursued the development of the plan, for the sensitivity exhibited toward the agricultural community in working with them in development of the plan, and for the plan itself.

Sincerely,

Donald P. Dubois
Regional Administrator

Attachment

cc: Wilbur Hallauer, DOE

bcc: [illegible]

APPENDIX E

REVIEW COMMENTS

BY

JIM BARRETT
ENVIRONMENTAL PROTECTION AGENCY

Comments by Barrett on
Moses Lake Restoration Project Report
1/13/81

Ed —

The report takes several positions which I do not agree with.

1. They have not come to grips with recognizing the problems from a practical standpoint. They cite the fact that there is no measurable (monitored) evidence of problems and refer to a lack of dredging as a reason to conclude there is no settling solids. Yet in the report they indicate numerous instances of measuring erosion rates, sediment delivered to streams, etc, and statements by experts, and agencies that have the expertise, that there are problems and that the use of BMPs will solve the problems. I think it is about time to reach a conclusion that an expert opinion in the field, and measurable erosion, etc. can be accepted as evidence without asking for measurable proof, becau[se] we will never be able to do that.
I think the soil loss measurements and the statements throughout the report (indicating erosion rates and nutrient ratios in soils) are more indicative of a problem, than an absence of dredging being evidence of no problem.

2. The report concludes that there is a program operational. — This is wrong. The framework has been developed, but there really hasn't been any serious implementation, and there is no evidence that there will be. Therefore, relying on business as usual, with a little encouragement, is not an acceptable approach. The report should tell it like it is. — Say there is no funding and manpower to do the job — Say that ASCS grain program is conflicting with conservation programs — Say that lots of cheap water leads to over irrigation and erosion, and that many systems (both sprinkler and flood) are not designed or managed properly — Say that summer fallowing is a major cause of erosion — Etc.

3. It is pure speculation to conclude that emergency programs (due to St. Helens Ash) will solve the long standing problems that do exist. In other areas, where emergency funds & assistance was available and utilized, no real long-term benefits were achieved, and I see no reason for any difference here. When the ash is no longer a problem it will be business as usual.

4. The report should at least provide some insight into costs to the public and water users due to no programs or inadequate programs (cleanup of roads, road ditches & culverts, lost storage capacity in reservoirs, treatment of domestic water, reduced fish & wildlife, damage to pumps, etc.) All of these are costing lots & lots of money each year, and no one seems to mind paying, but It should be pointed out that a good erosion & sediment control program would substantially reduce these costs — probably by more than the program costs. — Re-Direction!

5. In the Conclusion the report brings up an area (East High area of the CBP) which will/or is to be developed. This is the first time the area is mentioned, or maybe I missed it earlier, but there is no mention of requiring the use of BMPs as conditions for receiving & using water from the project. Since the Fed Project to deliver water is a cause of the major irrigated area problems, it is only fitting to ask for control on future development.

6. This relates to comment 4 — There should be some incentives discussed — as a result of cost re-direction, etc.

7. See items in margins, etc. of the report for more detail.