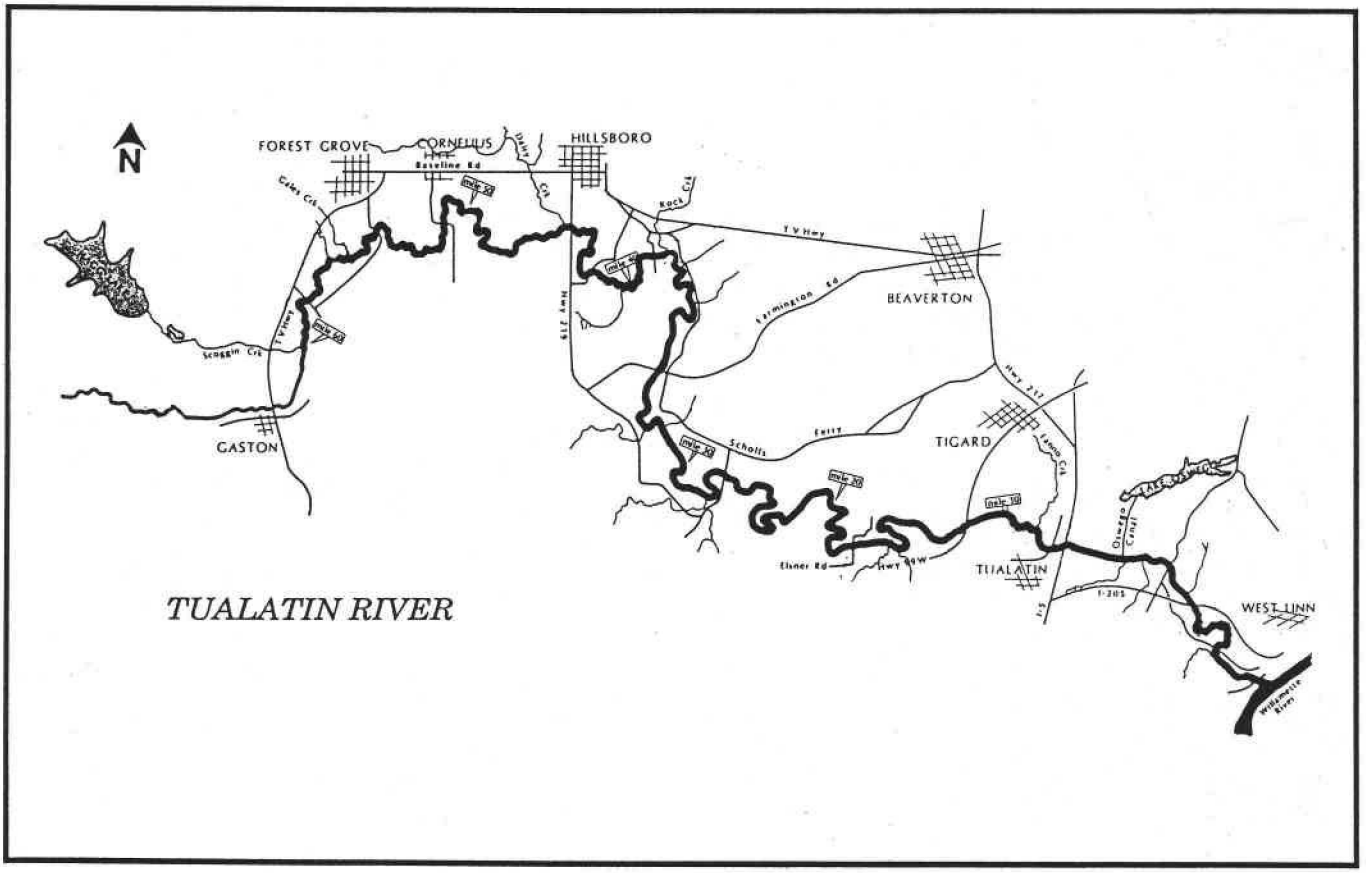
Agricultural Land Use in the Tualatin Basin



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TUALATIN RIVER BASIN SPECIAL REPORTS

The Tualatin River Basin in Washington County, Oregon , is a complex area with highly developed agricultural, forestry, industrial, commercial, and residential activities. Population has grown in the past thirty years from fifty to over 270 thousand. Accompanying this population growth have been the associated increases in transportation, construction, and recreational activities. Major improvements have occurred in treatment of wastewater discharges from communities and industries in the area. A surface water runoff management plan is in operation. Agricultural and forestry operations have adopted practices designed to reduce water quality impacts. In spite of efforts to-date, the standards required to protect appropriate beneficial uses of water have not been met in the slow-moving river.

The Oregon Department of Environmental Quality awarded a grant in 1992 to the Oregon Water Resources Research Institute (OWRRI) at Oregon State University to review existing information on the Tualatin, organize that information so that it can be readily evaluated, develop a method to examine effectiveness, costs and benefits of alternative pollution abatement strategies, and allow for the evaluation of various scenarios proposed for water management in the Tualatin Basin. Faculty members from eight departments at Oregon State University and Portland State University are contributing to the project. Many local interest groups, industry, state and federal agencies are contributing to the understanding of water quality issues in the Basin. This OWRRI project is based on all these research, planning, and management studies.

This publication is one in a series designed to make the results of this project available to interested persons and to promote useful discussions on issues and solutions. You are invited to share your insights and comments on these publications and on the process in which we are engaged. This will aid us in moving towards a better understanding of the complex relationships between people's needs, the natural environment in which they and their children will live, and the decisions that will be made on resource management.

AGRICULTURAL LAND USE IN THE TUALATIN BASIN

by
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Acknowledgements

A number of people assisted in the preparation of this report. Tim Cross, Dept. of Agricultural and Resource Economics, Ron Miner, Dept. of Bioresource Engineering, and Mike Gamorth, Dept. of Animal Sciences at Oregon State University contributed material on livestock and fertilizer use. Arden Sheets and Neil Rambo, Washington County Extension Service provided agricultural land use information. Water distribution data was provided by Heidi Van Zee. Jim Rodgers, Watermaster, Oregon Water Resources Department furnished information on allocation rights for Tualatin Project water. Dan Wilson, with the Tualatin Valley Irrigation District and Wally Otto, with the Bureau of Reclamation provided information regarding Hagg Lake storage and water distribution. Scott Wells, Chris Berger and Mike Knutson, Dept. of Civil Engineering at Portland State University contributed additional information regarding irrigation water withdrawals. Paul Adams, Dept. of Forest Engineering at Oregon State University assisted in forest land use.

Abstract

This report presents estimates of land uses, concentrating on agricultural land in the Tualatin drainage basin. Acreage in different crop groups and agricultural water use and distribution in the watershed were estimated. The total amounts of nitrogen and phosphate applied to agricultural land and the average loading of nutrients per acre in each subbasin were calculated.

Over 60 different crops and a variety of livestock are produced commercially in the Tualatin watershed. Agricultural statistics indicate between 90,000 and 110,000 harvested acres in Washington County. Production trends of livestock and some of the crops are discussed. Individual crops were classified into crop types following an Oregon State University Extension classification. The crop types were then divided into irrigated or non-irrigated, according to the dominant method of production within the group. The acreage of individual crop types was estimated for each subbasin.

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I. INTRODUCTION

A. General Description

The Tualatin watershed (Figure 1) is located in the northwest corner of Oregon, covering approximately 700 square miles. The watershed is bounded to the west by the Coast Range, to the north and south by the Tualatin and Chehalem Mountains, respectively. Elevation ranges from about 3,000 feet along the western edge to 50 feet at the confluence of the Tualatin and the Willamette Rivers. Most of the area is contained in Washington County, with small portions reaching into Tillamook, Yamhill, Columbia, Clackamas, and Multnomah Counties. Ninety percent of the land in Washington County drains into the Tualatin River.

The Tualatin River emerges from the eastern side of the Coast Range and flows generally east to the Willamette River, just south of Portland. Principal tributaries within the Tualatin watershed include: Fanno Creek, Rock Creek, East Fork Dairy Creak, West Fork Dairy Creek, McKay Creek, Gales Creek, and Scoggins Creek.

B. Subbasins

The watershed has been delineated into 29 contiguous subbasins (Fig. 2) according to land form and water flow patterns (NPSMAP, 1991). Generally, the drainage areas for each of the principal tributaries are divided into an upper and lower segment, each represented by a subbasin. The remainder of the subbasins are located in the central valley along the main stem of the Tualatin River. Table 1 lists the subbasins by number, name, river mile, and area. Subbasin 29 of the NPSMAP report, Willamette drainage, was not used in this study.

C. Sources of Land Use Information

Land use information for Washington County will be used. Most agricultural production takes place in the central valley of the basin, which lies entirely within Washington County boundaries.

Land use data for Washington County is available from two sources. First, the Oregon State University (OSU) Economic Information Office collects county level estimates of agricultural production and value annually (Miles, 1992). These estimates,

made by OSU Extension agents and campus specialists, are based on perceived changes in agricultural acreage, productivity, and prices during the year. They also rely on information provided by processors and brokers.

County-level land use data is also available for some crops from the Oregon Agricultural Statistics Service (OASS). OASS uses statistical surveys to compile agricultural production and value estimates by county for wheat, barley, potatoes, hazelnuts and wine grapes (OASS, 1991). Other crops are estimated in this report from statewide surveys and county-level revisions of OSU data. OASS and OSU revised data are generally in agreement, although exceptions do occur. In the current study the revised information is used, except for 1991 figures, which were still preliminary.

The land use distribution by subbasin calculated in this study is based on the best available information gathered from interviews with Washington County Extension Service staff, Neil Rambo, and Extension Specialists on campus, Mike Gamroth, Stanley Miles, Ron Miner, and Tim Cross. This information is generally consistent with agricultural statistics prepared by OASS and OSU. Retired Washington County Agricultural Extension Service Specialist, Arden Sheets, identified locations and provided estimates of crop acreage. In many cases, specific locations and acreage devoted to a particular crop were identified with reasonable certainty. Recorded values for berries, nurseries, alfalfa, and many of the vegetables may be accurate to within 100 acres for a given subbasin. For other crops such as specialty seeds and grains, the acreage values for agricultural production prepared by OASS were distributed according to the "most likely location" as determined by Mr. Sheets and may be accurate to within 1,000 acres for a given subbasin. It is important to emphasize that these values are best guess estimates. Further refining is impractical due to the extremely dynamic nature of crop rotation practices.

The Rural/Natural Resources Plan (RNRP) (1985), prepared by Washington County Department of Land Use and Transportation provided the spatial extent of land designated for agricultural, forest and mixed land uses.

The Nonpoint Source Model for Analysis and Planning (NPSMAP) (1991) prepared by Omicron and Associates was used for subbasin delineation and description. The land use distribution provided in the NPSMAP study for urban, forest, and wetlands provided the basis for land use estimates presented in this report. The NPSMAP values

were adjusted where necessary after incorporating our estimates of agricultural land use to reflect current conditions and to enable complete accounting of all surface areas in each subbasin. Typically, a 5% increase was made to reflect unincorporated urban development in subbasins along the central valley and eastern subbasins on the southwestern fringe of metropolitan Portland.

D. Water Uses

Hagg Lake, behind Scoggins Dam, is located on Scoggins Creek four miles upstream from its confluence with the Tualatin River. The Tualatin Project was built primarily as a supplemental source of irrigation water, since the natural flow of the Tualatin and its tributaries do not provide sufficient volume for irrigation and other uses during the summer months (Otto, 1993; Doty, 1993). The reservoir, authorized in 1948 and completed in 1975 by the Bureau of Reclamation, has a storage capacity of 59,000 acre-feet (U.S. Dept. of the Interior, Bureau of Reclamation). Active storage space is 53,640 acre-feet (USACOE, 1988). The allocation of water is shown in Table 2.

The Tualatin Valley Irrigation District (TVID), formed in 1962, includes approximately 17,500 irrigated acres, and has a water right to 23,000 acre-feet from Hagg Lake. (Wilson, TVID). Most of the irrigated agriculture in the central valley is supported by TVID (Figure 3).

Facilities operated by TVID include two pumping plants (Springhill and Patton Valley), over 90 miles of pressurized pipeline (150 psi) and water meters on about 70% of the system (Wilson, 1992). According to a pamphlet published by the Department of the Interior, about 10,300 acres are served through a pressure system, 2,200 acres are gravity fed through buried pipes, and 4,500 acres are served from water pumped directly from Scoggins Creek and the Tualatin River (U.S. Dept. of the Interior, Bureau of Reclamation).

The Oregon Department of Water Resources has developed a data base for water rights in the Tualatin River basin. About 80% of the approximately 400 water rights on the Tualatin are irrigation rights. It is difficult to calculate the amount of water allocated to each entity with rights to Hagg Lake water. "Water service contracts" rather than "storage accounts" are used on the Tualatin, because the stored water alone cannot supply

all those with rights to stored water. The water service contract results from dependence on return flows and natural flows combined with stored water.

Estimated withdrawals on the mainstem Tualatin between River Mile 0.1 and River Mile 60 amount to 359 cubic feet per second (cfs). Members of the TVID withdraw 110 cfs of this total, and hold 116 water rights (Wells et al., 1992). Because irrigation water rights are based on seasonal use, total withdrawals need to be measured for the month in which they occur. Water for new water rights is available only during the winter and spring months.

II. LAND USE OVERVIEW

A. Classification

The Tualatin watershed of approximately 450,000 acres includes forest, agricultural, and urban land uses. The distribution calculated in this study is shown in Figure 4.

The upper reaches of the watershed, bounded by the Coast Range and the Tualatin Mountains, are characterized by steep forested terrain. The Rural/Natural Resources Plan (Washington County, 1985) identifies much of this area as an "exclusive forest and conservation" land use district. There were 234,000 acres of commercial forests in Washington County in 1979. We estimate there are presently approximately 200,000 forested acres, covering 45% of the Tualatin watershed. This estimate excludes small isolated areas nested in agriculture and urban areas. Paul Adams, College of Forestry, Oregon State University, estimates that approximately 50% of the total surface area is covered by forests including these smaller isolated plots. Forests are an important economic resource, which also provide watershed protection, wildlife habitats, scenic values and recreational uses.

The steep terrain changes rather abruptly to broad alluvial valleys along the lower reaches of the principal tributaries. The upper slopes of the valleys have a mix of forest, agricultural, and rural residential land uses. The Rural/Natural Resource Plan (Washington County, 1985) identifies three mixed agricultural and forest land use districts with specified minimum lot sizes for rural residences of 5, 10, or 20 acres.

Much of the central valley is devoted to agriculture. Fertile soils, elevations ranging between 100 and 200 feet, moderate temperature and damp climate make this area

suitable for growing over 60 different corps commercially. We estimate agricultural land use, either irrigated or non-irrigated, occupies 35% of the land surface in the Tualatin watershed.

Urban land is primarily clustered in the southeastern corner of the watershed, in subbasins along the lower reaches of the Tualatin. Urban land accounts for 21% of the watershed and is nearly equally divided between incorporated and unincorporated land.

B. Irrigated Agricultural Land

The calculated production acreage and percentages of the irrigated crops are shown in Figure 5. Specialty seeds, accounting for 56% of the irrigated land use, include clover, vetch and grasses. Specialty seeds are often rotated with grains and forage crops that may or may not be irrigated.

Vegetables account for 18% of the irrigated agricultural land use. There are approximately 7,100 acres in vegetable production with sweet corn, beans, cucumbers and onions being the most significant crops. Most vegetable crops are grown for processing, with a small amount sold in fresh markets.

Approximately 4,500 acres (12%) of the irrigated agriculture land use is dedicated to berry production. Strawberries, blackberries, Marionberries, blueberries and raspberries are all grown in the watershed. They are sold primarily to processing plants though some make it to the fresh market.

Nurseries account for 14% of the irrigated agricultural land use and are divided into two categories, container nurseries and other nurseries. The other nurseries category includes nursery plants which are grown "in the ground" in bare root, and ball-and-burlap production systems.

C. Non-Irrigated Agriculture

The non-irrigated crop groups grown in the Tualatin Valley are shown in Figure 6. Grains comprise nearly 76% of the non-irrigated crops according to our calculations. Wheat is the most significant grain commodity followed by oats, corn silage and barley acreage. Nut production accounts for approximately 12% of the non-irrigated agricultural land use. Alfalfa is classified as a non-irrigated crop in this report, though it is also

produced under irrigation on some farms. Alfalfa is grown primarily for forage and accounts for approximately 9% of the non-irrigated agricultural land use. Grass hay is included in the pasture acreage. Tree fruit and grape production account for 4% of the non-irrigated land. As with tree fruit, grapes are typically non-irrigated.

D. Livestock

Pastured livestock include beef cattle, horses and sheep. Pasture acreage was determined by dividing the number of animals by the acreage needed to sustain them. According to Mike Gamroth, Extension Specialist, Oregon State University, irrigated pasture can accommodate approximately twice as many animals as non-irrigated pasture. Intermediate values were used in this study, as suggested by Ron Miner, Extension Specialist, Oregon State University to estimate land requirements. These values are shown in Table 3.

According to agricultural statistics (OASS, 1991-92) there are approximately 24,500 non-dairy cattle in Washington County. The assumption was made that approximately 25% are held in confinement. The remainder are pastured. At 2.5 acres per head, there are approximately 47,000 acres of pasture used for non-dairy cattle. Similarly, there are approximately 5,000 horses requiring just over 15,000 acres of pasture. Horses are typically pastured in areas on the fringes of urban development. Sheep were allocated to subbasins with grass seed production (Sheets, 1993). There are roughly 2,000 sheep requiring approximately 1,000 acres of pasture. Dairy cattle are assumed to be raised in confinement, and no pasture land has been allocated for their use. Gamroth (1953) estimates there are approximately 6,300 diary cattle in the Tualatin basin on 38 licensed farms.

E. Land Use Changes

Oregon State University Extension Service reports for Washington County were used to estimate the acreage and value of the primary crops (Miles, 1992). The estimates from 1982-1990 are from the revised figures, the 1991 figure are preliminary. Crop groups (e.g. fruits and nuts, forage, specialty, etc.) have maintained nearly the same percentage of acreage relative to the total agricultural acreage, however changes within

crop groups have occurred. The total number of harvested acres has fluctuated between 109 thousand acres (in 1990) and 89.5 thousand acres in (1987). The value of agricultural production has increased steadily since 1985, and now exceeds 160 million dollars. Approximately 6% of the state's agricultural sales result from Washington County production.

Figures 7 and 8 show the trends in grain, forage, grasses, and specialty seed production from 1982 to 1991. Grain acreage has varied considerably; however, over the past four years there has been a steady increase in harvested acres. In 1990 there were 43,400 harvested acres, a ten year high. Forage crop acreage has remained close to 25,000 acres over the last decade, though production appears to be shifting from alfalfa to other hays.

Grass and specialty seed production has fluctuated between 17,500 and 25,500 acres over the past ten years. Red clover dominates this category, though the number of harvested acres has decreased over the last ten years. Crimson clover and hairy vetch have both increased in acreage over the same period. The value per acre of red clover has decreased relative to the value of crimson clover and hairy vetch.

Figures 9 and 10 show the harvested acres and value of tree fruit and nut, small fruit and berry and vegetable truck crops. Tree fruit and nut acreage has decreased, though the total value of fruit and nut production has decreased only slightly. There have been significant changes in composition of fruit and nut acreage over the past ten years. Grape, filbert and apple production have increased. Harvested acres of walnut, peach, pear and plum trees have decreased. The value per acre of filberts has fluctuated considerably but has generally remained above walnuts and fruits. Small fruit and berry production has increased. Berry varieties grown in Washington County, include raspberries, boysenberries, Marionberries and blueberries as the most important. The number of acres of blueberries, while small, has more than tripled in the last ten years (from 80 to 285 acres). The raspberry acres, both black and red, have remained nearly constant, while boysenberry acres have decreased.

Vegetable production (Figures 9 and 10) increased in the mid-1980s, reaching a high of over 4,000 acres in 1987-88, but has declined in the past five years to a current acreage of approximately 3,100. The number of acres of broccoli and cucumbers have

decreased over the last decade, although cucumbers remain the highest value processes vegetable crop in Washington County. Fresh corn production has fluctuated and has now leveled off around 300 acres, about double the acres of the early 1980s. Processes snap bean acreage decreased in the mid-1980s but rebounded, and is presently the leading processed vegetable by acreage in Washington County.

Specialty crops (nurseries) acreage and sales have increased significantly (Figures 11 and 12). Although the acreage represented by nursery crops is still smaller than 4% of the total agricultural acreage in the county, the value of production accounts for nearly a third of the total agricultural revenue in Washington County. The composition of the plants grown in nurseries is not reported, though roses, fruit and nut tree seedlings and ornamentals are believed to comprise a large percentage of the sales. A 1990 Extension survey (Miles, 1990) indicates that there are 1,728 bare-root acres, 99 ball-and-burlap acres, and 719 container acres in Washington County.

Field crops (potatoes and onions) (Figure 13) represent less than 1% of total agricultural acreage in Washington County. Harvested acres of field crops have decreased from 750 acres in 1989 to 270 acres in 1990.

The value of livestock agriculture has fluctuated considerably (Figure 14). Both the number of dairy cows and non-dairy cattle have increased in the last four years, although both industries have reduced the number of head considerably from the early 1980s. Similarly, the number of sheep and hogs has decreased over the past decade. Poultry production, primarily chicken, showed a notable reduction in 1984, when the number of broilers dropped from 10,000 to 6,000, but has not fluctuated significantly since then.

F. Land Use Distribution by Subbasin

Table 4 presents the distribution of land uses in the Tualatin watershed by subbasin. Table 5 details urban land use by subbasin. Subbasins 0, 3, 4, 8 and 9, on the fringe of the Portland metropolitan area, are substantially developed. Beaverton, Tigard, Tualatin, Hillsboro and Forest Grove are incorporated townships within the Tualatin watershed.

Table 6 details irrigated agricultural land use for each subbasin. Most of the specialty seed crops are grown in subbasins 14, 16, 17 and 19 and to a lesser extent in 7 and 27. Nurseries are located primarily in subbasins 7, 12, 21 and 22. Vegetables are concentrated in the interior valley, subbasins 7, 12, 14, 16, 17, 19 and 21. Berries are distributed throughout the central valley.

The distribution of non-irrigated crops is presented in Table 7. Grains make up the bulk of the dryland agricultural crop acreage, followed by alfalfa, nuts and fruit trees. Wheat is abundant on the upland slopes of subbasins 7, 14, 16, 17, 19, 21, 22 and 27. Subbasin 5 has the largest nut production with approximately 3,000 acres of filberts. Grapes are included with fruit trees because of similarities in maturation, though fruit trees are routinely fertilized at higher rates than are grapes. At least six vineyards with an approximate total of 725 acres are located in the Tualatin basin. The largest vineyard, Montinore Vineyards (approximately 500 acres), is located in subbasin 24.

The approximately 63,000 acres of pasture land in the Tualatin basin includes 47,000 acres for non-dairy cattle, 15,000 acres for horses, and 1,100 acres for sheep (Table 8). Pasture for non-diary cattle is distributed throughout the central valley. Horses are typically pastured in areas on the fringes of urban development. As suggested by Sheets (1993), sheep were allocated to subbasins with grass seed production, subbasins 5, 6, 7, 14, 16, 17 and 19.

Forests cover much of the upper watershed and account for approximately 42% of the total area (Table 9). Subbasins 15, 18, 20, 23, 26 and 28 are almost exclusively forest, with over 90% of the land area in forest. The subbasins along the lower reaches of the principal tributaries generally have between 25% and 65% of their land area covered by forests, with the balance primarily in agriculture. Small forested areas nested in urban and agricultural areas are not included in forest acreage in Table 9. The largest wetland area (1,740 acres) is located in the Hagg Lake subbasin. Most subbasins contain between 150 and 500 acres of wetland.

III. NITROGEN AND PHOSPHORUS FERTILIZER USE

Phosphate and nitrogen applications to agricultural land were estimated from the fertilizer recommendations for specific crops in the Oregon State University Fertilizer

Guides, and from the crop acreage calculated in the previous section. The highest recommended fertilizer application rate for a particular crop was chosen to represent the rates for all crops within a crop group. For example, red clover which receives 120 pounds of phosphorus per acre was chosen to represent the phosphorus application for the specialty seed group rather than crimson clover which receives 80 pounds of phosphorus per acre (Table 10). Fertilizer loading rates, therefore, reflect intensive fertilization.

Areas for each crop group were summed to obtain total fertilizer application for each of the 28 subbasins. The total fertilizer applications were then divided by the total subbasin acreage. Table 11 and Figure 15 present the values for each subbasin, in million pounds per acre per year.

Commercial forests are not routinely fertilized (Adams, 1994). Occasionally, a single application of nitrogen up to 200 pounds per acre, may be applied when the stand reaches 30 years of age. Fertilizer use for urban areas was not estimated. Some lawns and urban grassed areas are heavily fertilized, but no estimates have been made.

IV. SUMMARY

The Tualatin watershed has three major land uses: forest, agriculture and urban. Most of the forested land (42%) is located in the north, northwestern and western parts of the watershed, on the upper reaches of the Tualatin and its tributaries. Urban land is clustered primarily in the southeastern corner of the watershed, in the lower reaches of the Tualatin. Urban land accounts for approximately 21% of the watershed, and is nearly equally divided between incorporated and unincorporated land. Agricultural land is located in the central part of the watershed, approximately 35%. Agricultural land use was the major focus of this report. The distribution of crop types, and distribution of irrigation water were estimated, to delineate current production in the watershed. Nutrient application rates for each crop group were estimated and used to determine loading for each subbasin.

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V. REFERENCES

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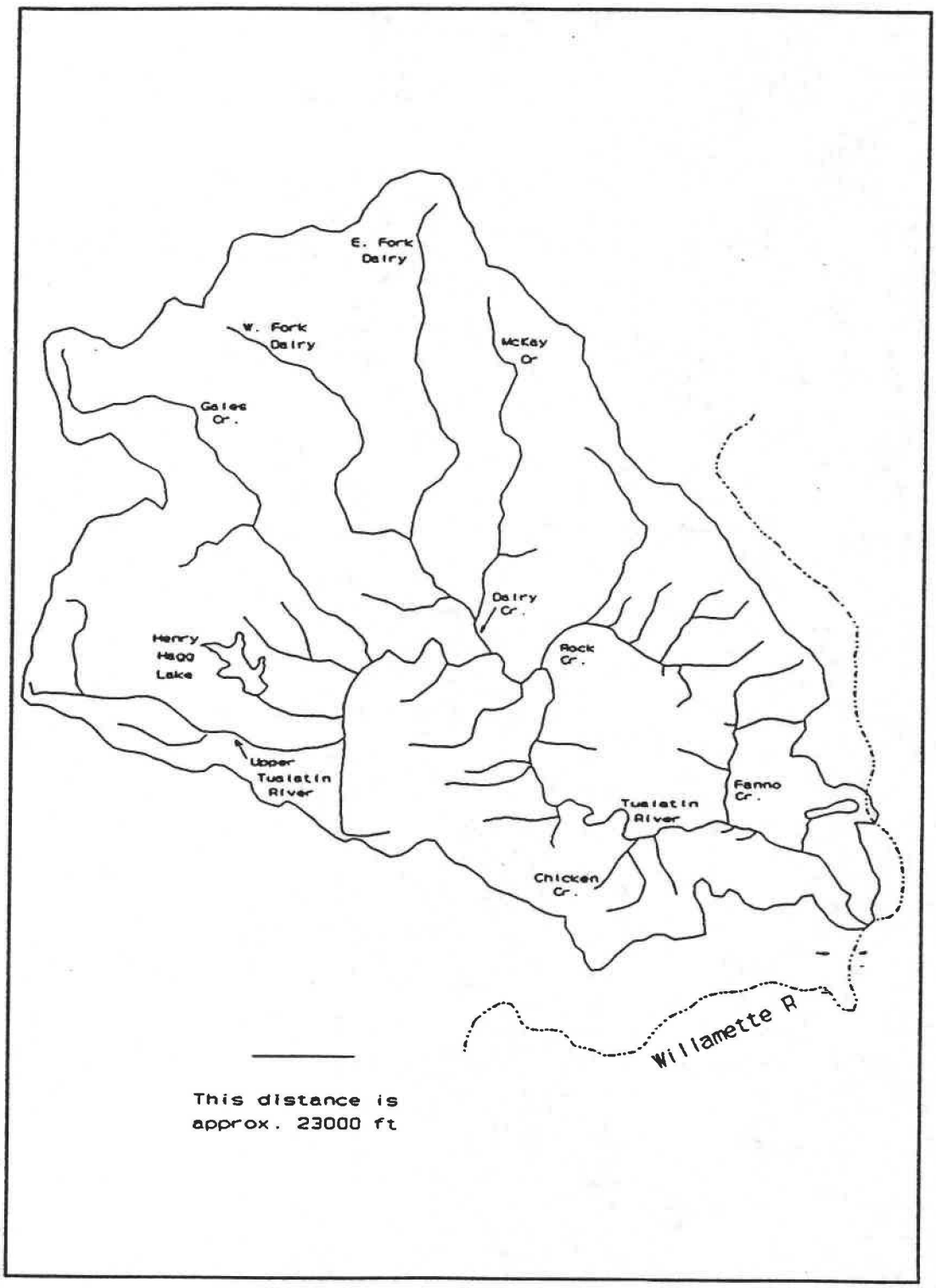

Figure 1. Tualatin watershed boundary and principal tributaries.

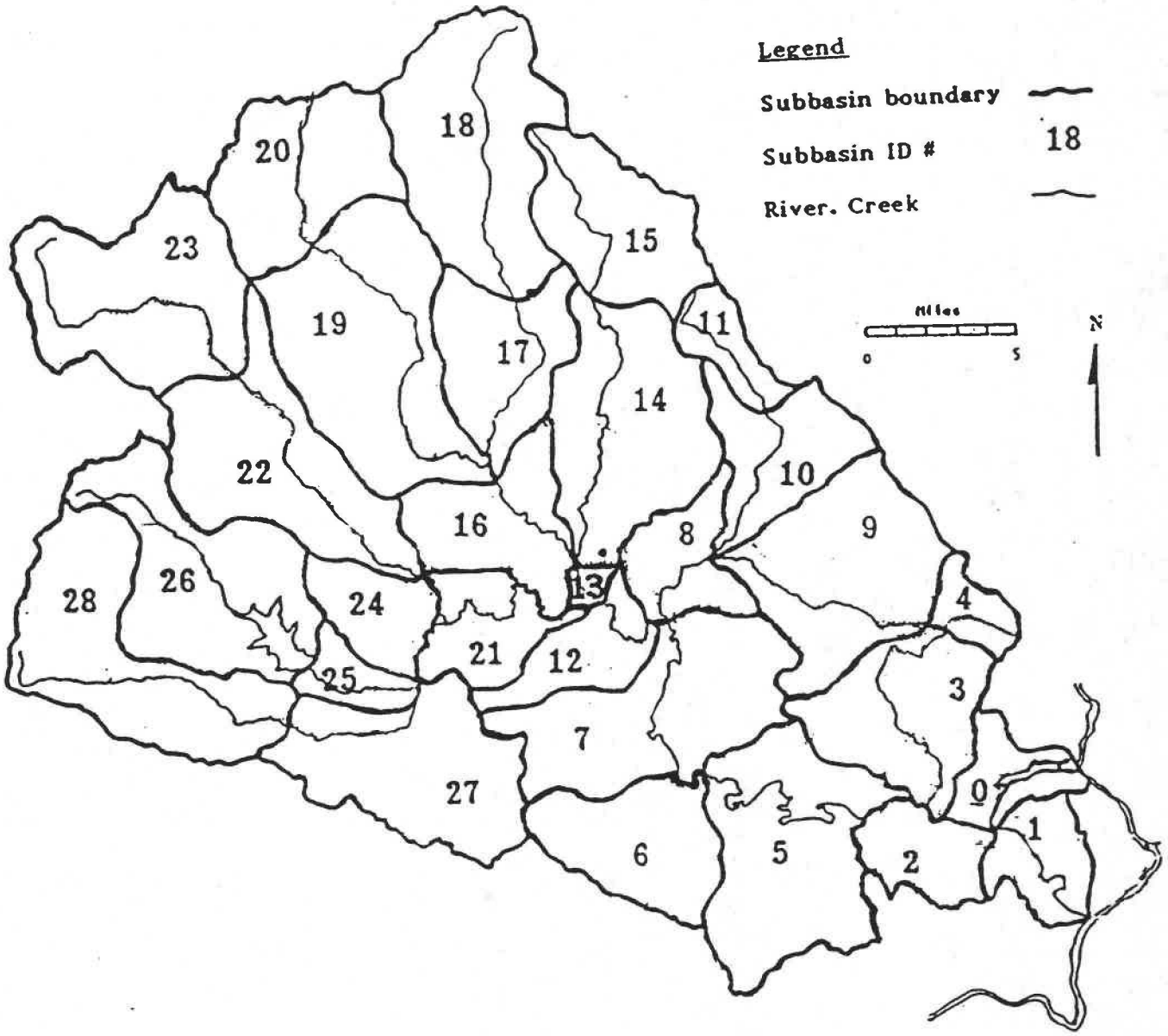

Figure 2. Subbasins of the Tualatin Basin (from NPSMAP, 1991).

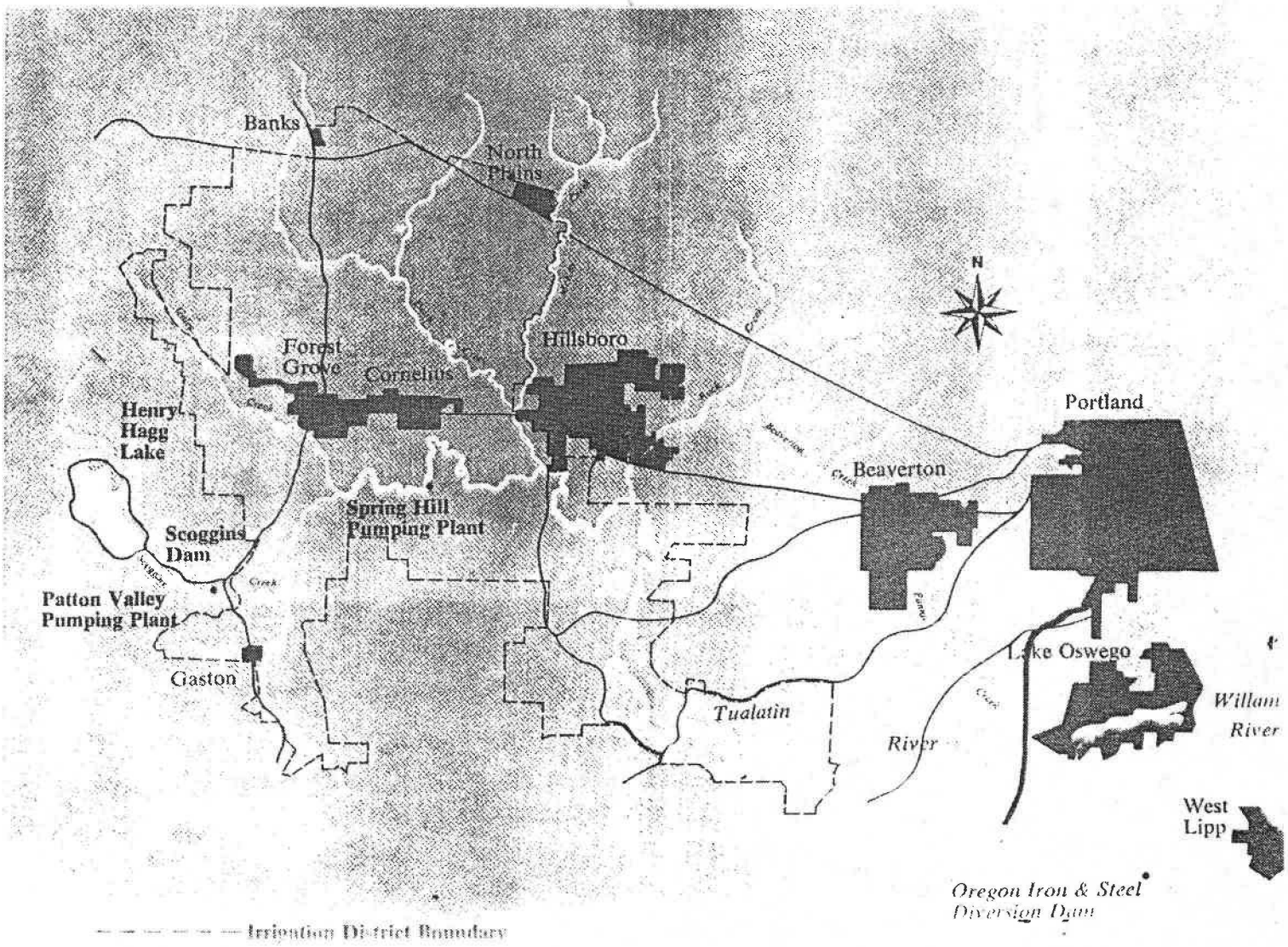

Figure 3. Tualatin Valley Irrigation District.

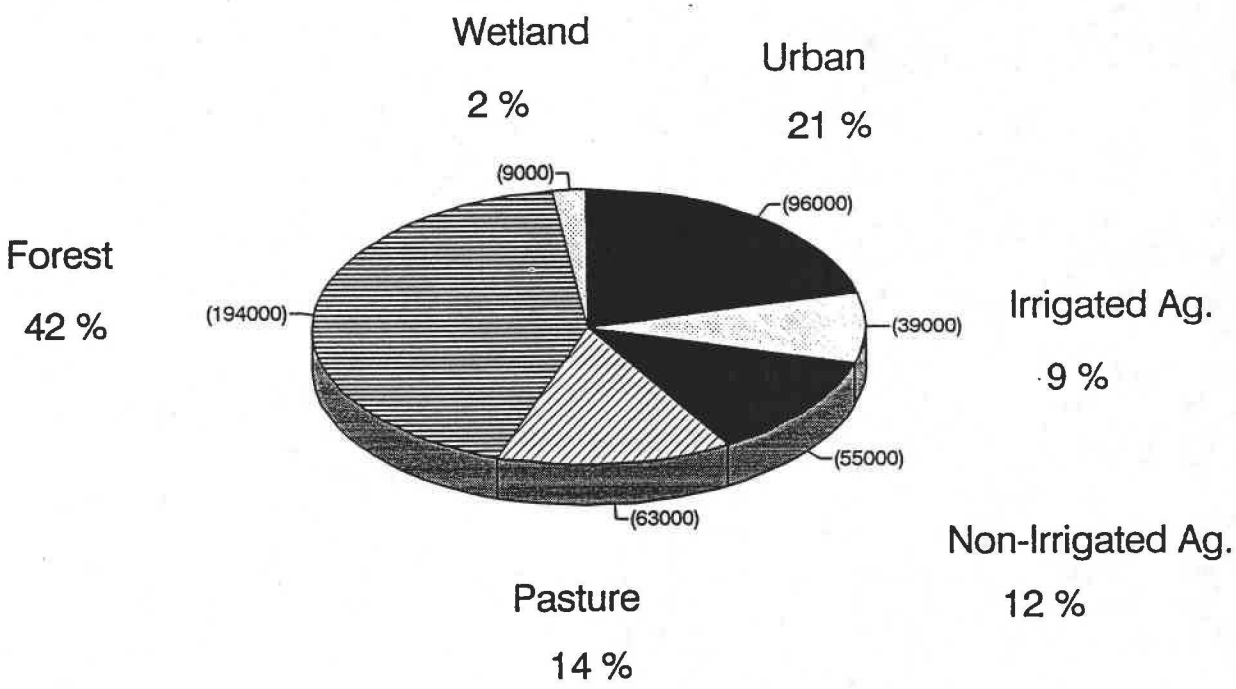

Figure 4. Land use distribution by uses in Washington County

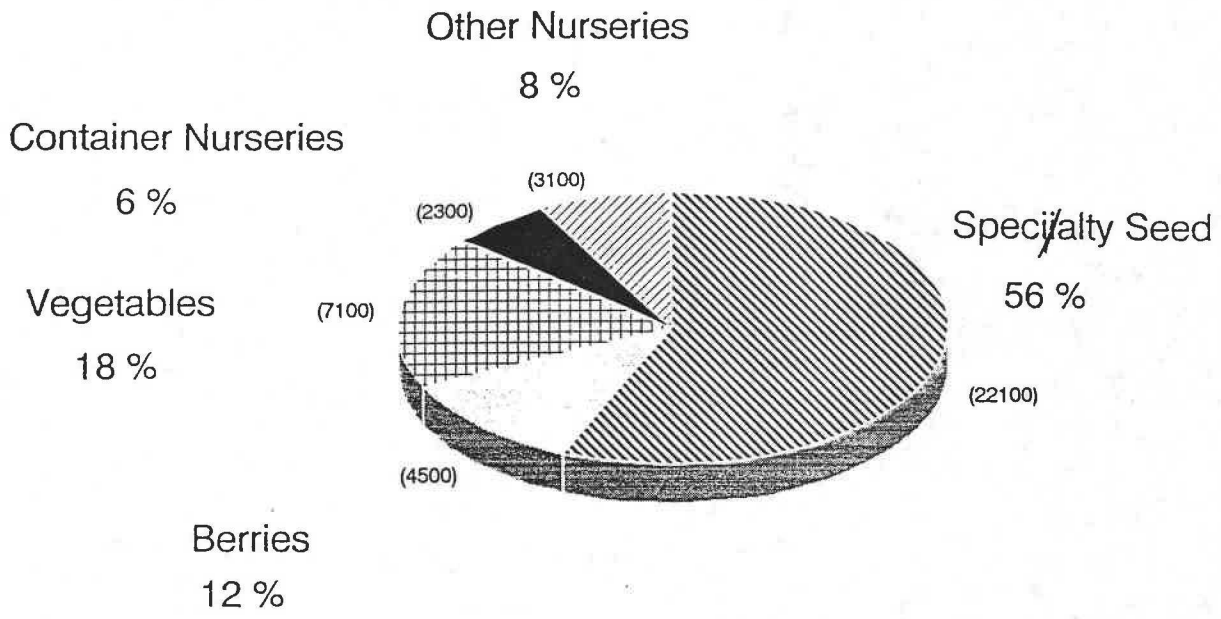

Figure 5. Crops under irrigated agriculture.

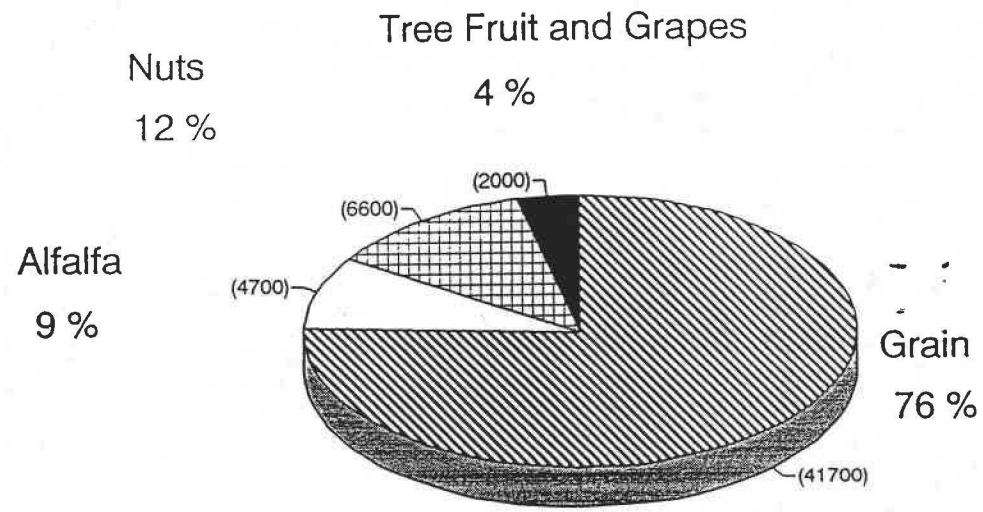

Figure 6. Crops under non-irrigated agriculture.

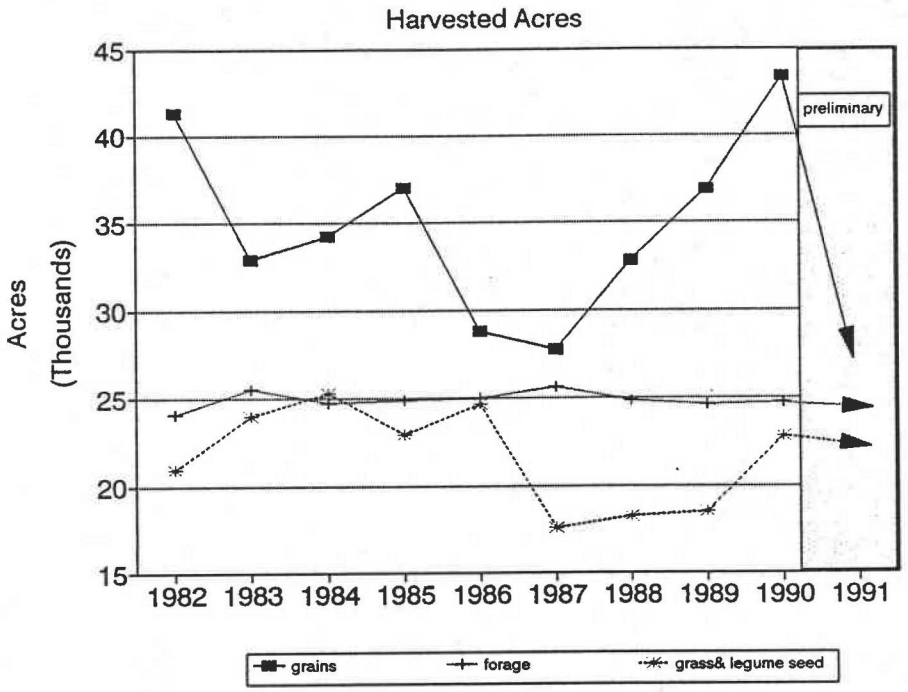

Figure 7. Grain, forage and specialty seed acreage.

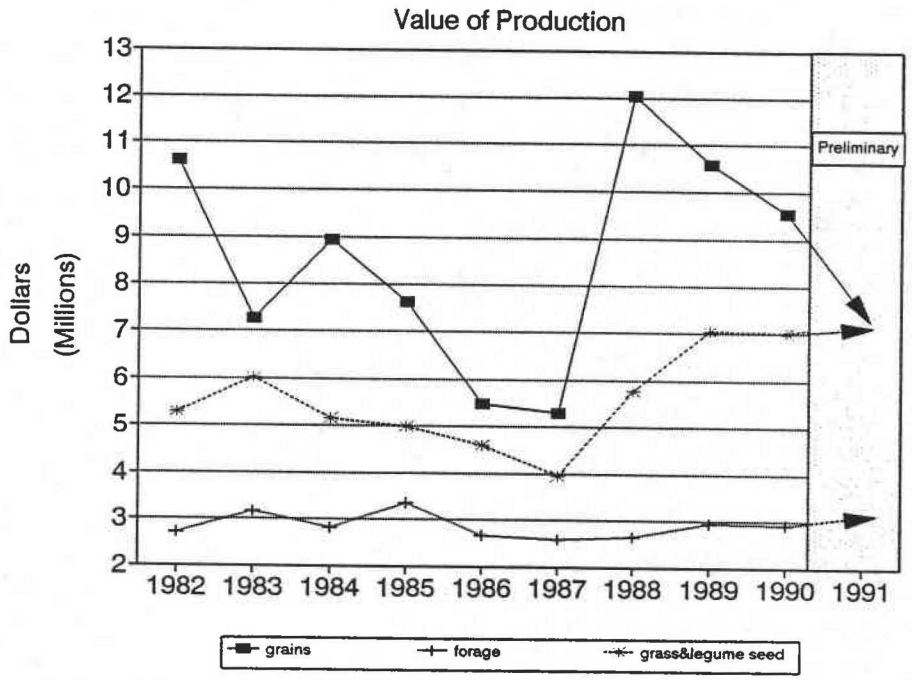

Figure 8. Grain, forage and specialty seed value.

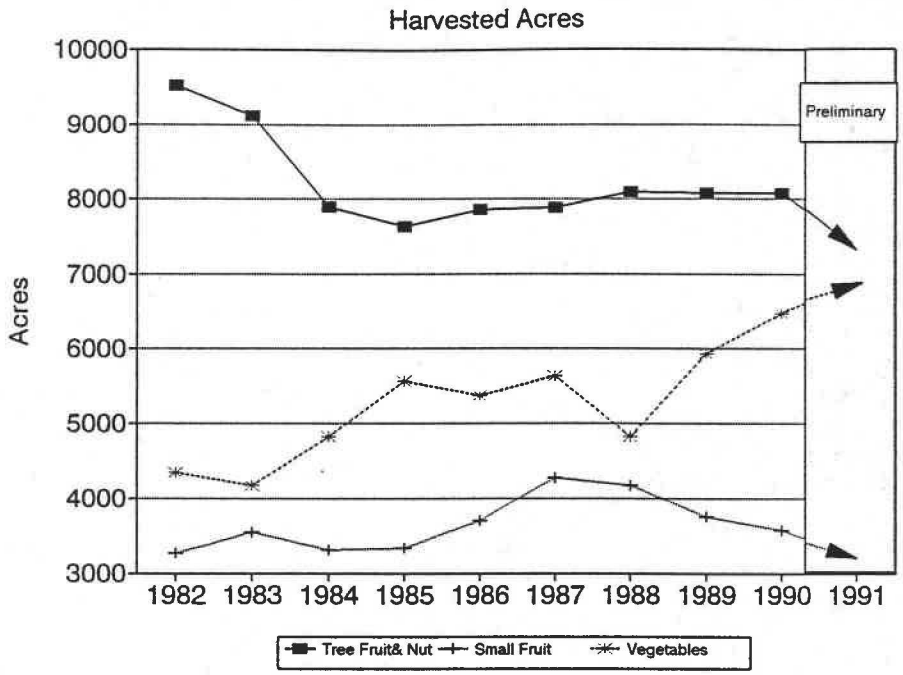

Figure 9. Tree fruit and nut, small fruit and berry, and vegetable acreage.

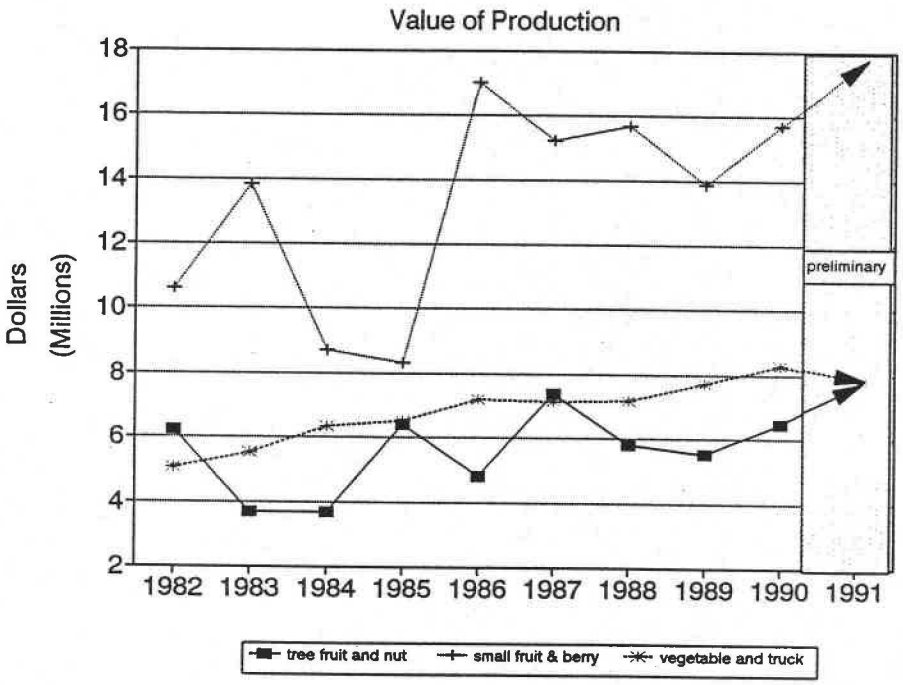

Figure 10. Tree fruit and nut, small fruit and berry, and vegetable value.

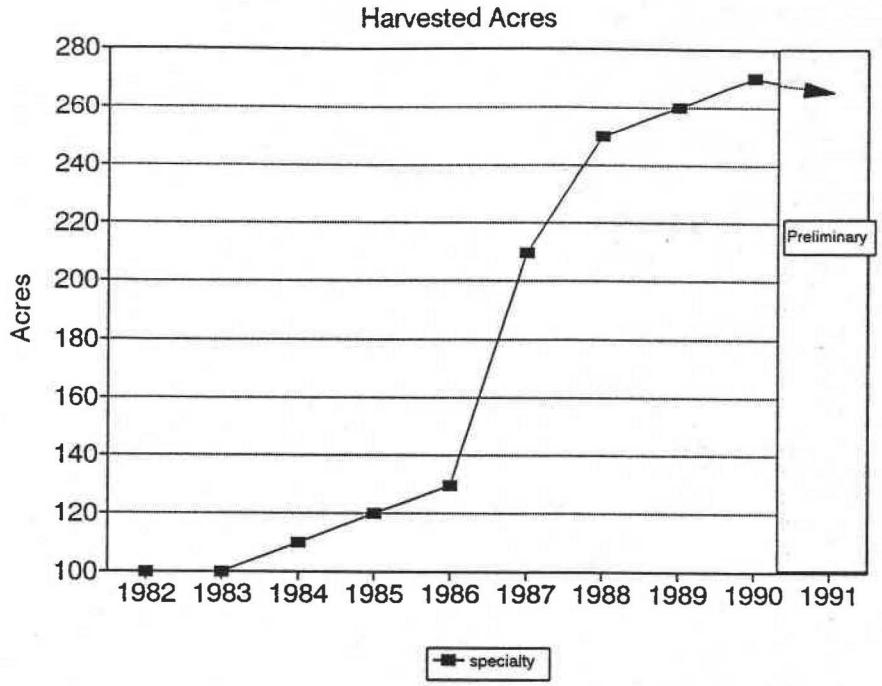

Figure 11. Specialty and nursery acreage.

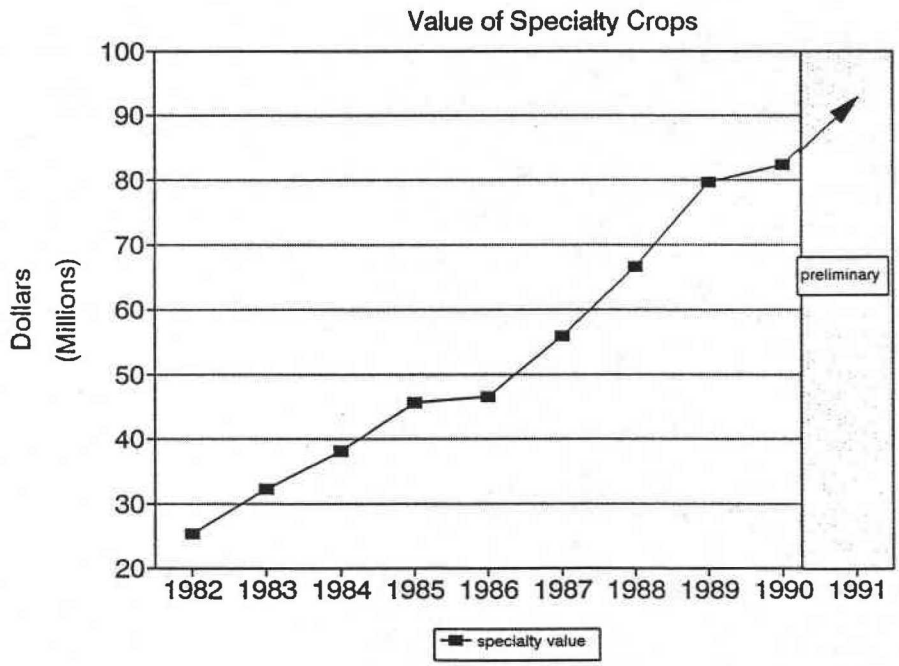

Figure 12. Specialty and nursery value.

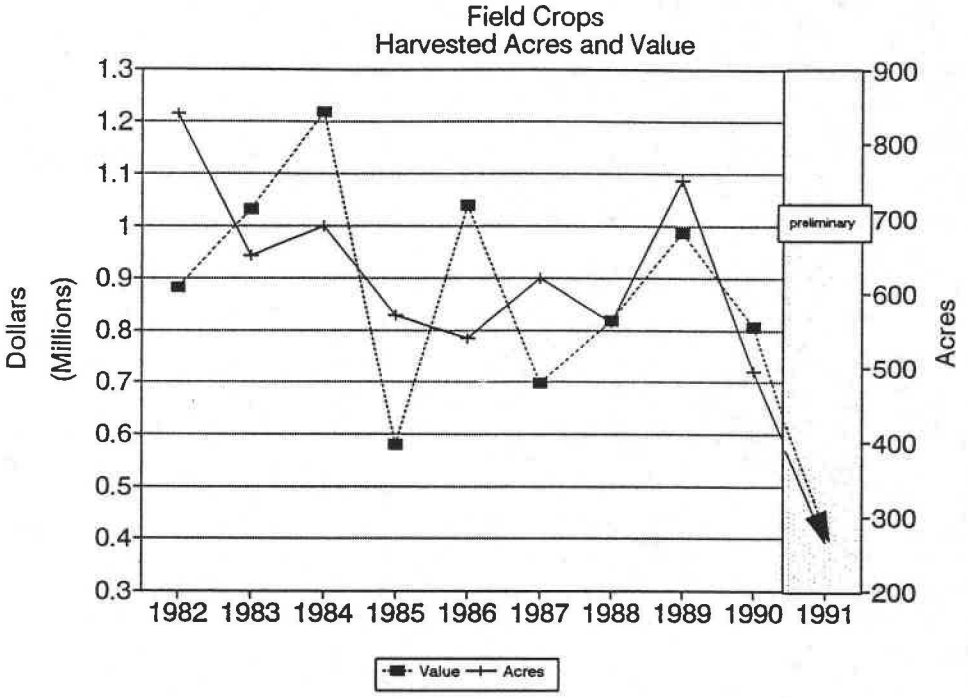

Figure 13. Field crop acreage and value.

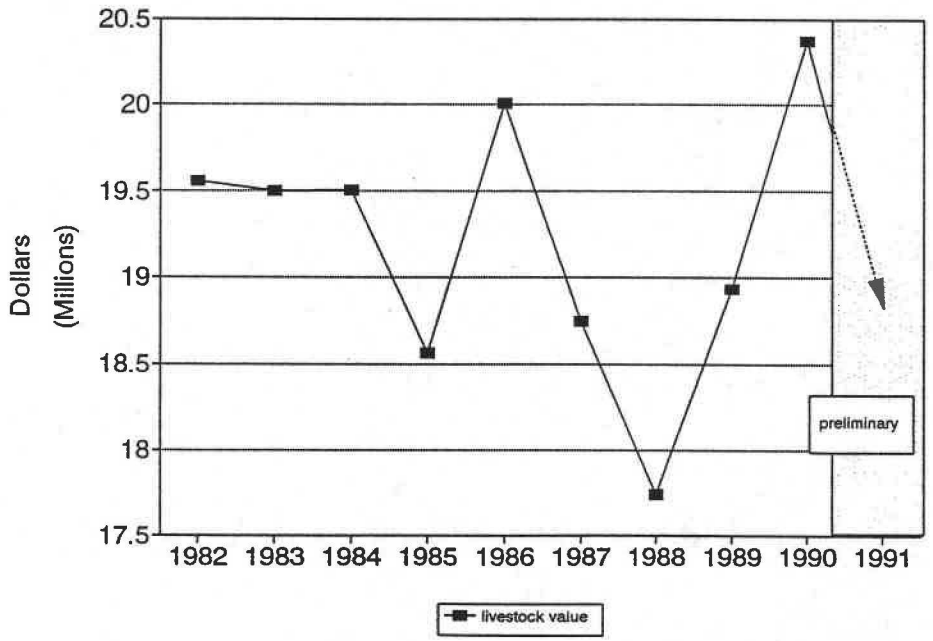

Figure 14. Livestock value.

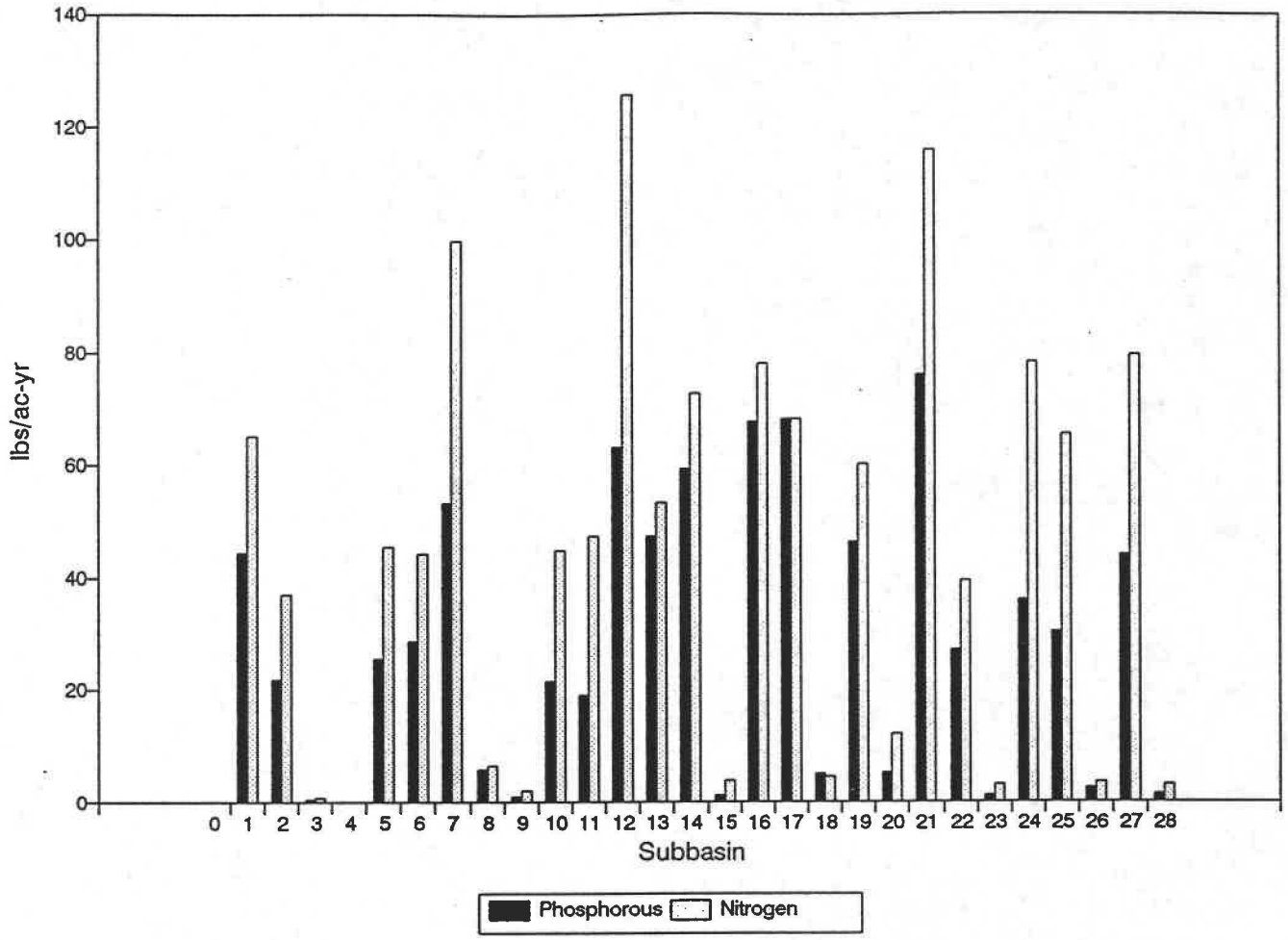

Figure 15. Maximum estimated fertilizer application by subbasin.

Table 1. Subbasin delineation (from NPSMAP, 1991).

Subbasin	Subbasin name	River Mile from	River Mile to	Area (acres)
0	Lake Oswego Basin			6,232
1	Tualatin Main Stem	0	5.5	7,697
2	Lower Fanno Creek	5.5	9.5	7,012
3	Upper Fanno Creek	0	12	17,878
4	Tualatin Main Stem	12	15	3,093
5	Tualatin Main Stem	9.5	27	25,430
6	Tualatin Main Stem	27	30	14,969
7	Tualatin Main Stem	30	38.5	26,303
8	Lower Rock Creek	0	4.2	8,879
9	Beaverton Creek	0	10	22,946
10	Middle Rock Creek	4.2	13	11,810
11	Upper Rock Creek	13	19	4,890
12	Tualatin Main Stem	38.5	45	8,000
13	Lower Dairy Creek	0	2	1,291
14	Lower McKay Creek	0	17	25,665
15	Upper McKay Creek	17	24	16,443
16	Middle Dairy Creek	2	10.5	13,756
17	Lower E. Fork Dairy	0	10	15,161
18	Upper E. Fork Dairy	10	21	26,472
19	Lower W. Fork Dairy	0	16	30,780
20	Upper W. Fork Dairy	16	21	17,637
21	Tualatin Main Stem	45	58.8	9,224
22	Lower Gales Creek	0	15	23,694
23	Upper Gales Creek	15	28	24,329
24	Tualatin Main Stem	58.8	63	8,026
25	Lower Scoggins Creek	0	5	4,521
26	Hagg Lake Basin	5	17.5	24,866
27	Tualatin Main Stem	63	70	22,524
28	Tualatin Main Stem	70	83	25,977

Table 2. Hagg Lake water allocation (ODWR).

Acre feet per year	Use
23,000	Tualatin Valley Irrigation District
14,000	Municipal uses
12,000	Unified Sewerage Agency
4,000	Other

Table 3. Pasture area allocated for animal production in the Tualatin basin (from estimates by M. Gamroth, R. Miner).

Livestock	On irrigated land (acres/head)	On non-irrigated land (acres/head)	Study value (acres/head)
Cattle	1.5	3.0	2.5
Horses	2.0	4.0	3.0
Sheep	0.3	0.6	0.5

Table 4. Land use distribution by subbasin.

Subbasin	Stream segment	Urban	Irrig. Ag.	Non-Irrig. Ag.	Pasture	Forest	Wetland
Basin	Tualatin Basin	96,500	39,200	54,900	63,200	193,800	9,300
0	Lake Oswego Basin	5,730	0	0	0	0	500
1	Tualatin Main Stem	1,690	900	1,000	2,500	1,540	80
2	Tualatin Main Stem	4,560	390	450	1,400	0	210
3	Lower Fanno Creek	17,340	30	100	50	180	180
4	Upper Fanno Creek	3,090	0	0	0	0	0
5	Tualatin Main Stem	7,120	1,480	4,030	6,100	6,230	510
6	Tualatin Main Stem	2,250	1,590	1,330	2,500	7,040	300
7	Tualatin Main Stem	3,420	4,100	4,820	11,300	2,100	530
8	Lower Rock Creek	7,810	210	400	200	0	270
9	Beaverton Creek	21,110	30	160	200	1,030	460
10	Middle Rock Creek	5,910	140	950	3,000	1,540	240
11	Upper Rock Creek	240	100	20	1,450	3,030	50
12	Tualatin Main Stem	720	1,700	960	5,000	180	450
13	Lower Dairy Creek	390	280	500	0	0	130
14	Lower McKay Creek	4,360	5,580	7,280	5,400	2,570	510
15	Upper McKay Creek	490	100	200	0	15,460	160
16	Middle Dairy Creek	2,890	3,240	5,170	1,900	0	550
17	Lower E. Fork Dairy	300	5,020	4,330	1,700	3,490	150
18	Upper E. Fork Dairy	400	450	770	300	24,350	260
19	Lower W. Fork Dairy	2,000	5,260	7,450	4,100	11,080	920
20	Upper W. Fork Dairy	90	0	700	800	16,050	0
21	Tualatin Main Stem	1,110	3,880	3,510	0	280	460
22	Lower Gales Creek	1,450	2,230	2,940	2,400	14,450	240
23	Upper Gales Creek	0	0	100	400	23,840	0
24	Tualatin Main Stem	320	300	1,450	2,900	2,970	80
25	Lower Scoggins Creek	140	100	50	1,900	2,220	140
26	Hagg Lake Basin	0	200	100	500	22,380	1,740
27	Tualatin Main Stem	230	1,880	5,580	7,000	7,660	230
28	Tualatin Main Stem	1,300	0	400	150	24,160	0

Table 5. Urban land use distribution by subbasin.

		Land use distribution			
		Urban			
Segment	Stream	Incorp.	Unincorp.	Total	% Area
Basin	Tualatin Basin	47,900	48,500	96,500	21
0	Lake Oswego Basin	5,230	500	5,730	92
1	Tualatin Main Stem	1,620	80	1,690	22
2	Tualatin Main Stem	3,510	1,050	4,560	65
3	Lower Fanno Creek	12,870	4,470	17,340	97
4	Upper Fanno Creek	2,520	590	3,090	100
5	Tualatin Main Stem	2,030	5,090	7,120	28
6	Tualatin Main Stem	0	2,250	2,250	15
7	Tualatin Main Stem	0	3,420	3,420	13
8	Lower Rock Creek	5,770	2,040	7,810	88
9	Beaverton Creek	5,970	15,140	21,110	92
10	Middle Rock Creek	0	5,910	5,910	50
11	Upper Rock Creek	0	240	240	5
12	Tualatin Main Stem	450	270	720	8
13	Lower Dairy Creek	390	0	390	30
14	Lower McKay Creek	3,340	1,030	4,360	17
15	Upper McKay Creek	0	490	490	3
16	Middle Dairy Creek	2,480	410	2,890	21
17	Lower E. Fork Dairy	0	300	300	2
18	Upper E. Fork Dairy	0	400	400	2
19	Lower W. Fork Dairy	310	1,690	2,000	6
20	Upper W. Fork Dairy	0	90	90	1
21	Tualatin Main Stem	1,010	90	1,110	12
22	Lower Gales Creek	240	1,210	1,450	6
23	Upper Gales Creek	0	0	0	0
24	Tualatin Main Stem	0	320	320	4
25	Lower Scoggins Creek	0	140	140	3
26	Hagg Lake Basin	0	0	0	0
27	Tualatin Main Stem	230	0	230	1
28	Tualatin Main Stem	0	1,300	1,300	5

Table 6. Irrigated agriculture land use distribution.

		Irrigated Agg.						
Subbasin	Stream	Spec. seed	Berries	Vegetable	Cont. nurs.	Other nurs.	Total	% Area
Basin	Tualatin Basin	22,100	4,500	7,100	2,300	3,100	39,200	9
0	Lake Oswego Basin	0	0	0	0	0	0	0
1	Tualatin Main Stem	500	200	200	0	0	900	12
2	Tualatin Main Stem	200	90	100	0	0	390	6
3	Lower Fanno Creek	0	30	0	0	0	30	0
4	Upper Fanno Creek	0	0	0	0	0	0	0
5	Tualatin Main Stem	600	180	500	100	100	1,480	6
6	Tualatin Main Stem	400	390	400	200	200	1,590	0
7	Tualatin Main Stem	2,000	500	500	400	700	4,100	16
8	Lower Rock Creek	200	10	0	0	0	210	2
9	Beaverton Creek	0	0	0	30	0	30	0
10	Middle Rock Creek	100	30	0	0	10	140	1
11	Upper Rock Creek	0	0	0	0	100	100	2
12	Tualatin Main Stem	400	130	470	500	200	1,700	19
13	Lower Dairy Creek	200	40	40	0	0	280	22
14	Lower McKay Creek	4,000	680	750	0	150	5,580	22
15	Upper McKay Creek	0	0	0	100	0	100	1
16	Middle Dairy Creek	1,800	590	650	0	200	3,240	24
17	Lower E. Fork Dairy	3,900	220	600	110	200	5,020	33
18	Upper E. Fork Dairy	400	50	0	0	0	450	2
19	Lower W. Fork Dairy	3,600	410	900	200	150	5,260	17
20	Upper W. Fork Dairy	0	0	0	0	0	0	0
21	Tualatin Main Stem	950	580	1,150	400	800	3,880	42
22	Lower Gales Creek	1,100	180	450	300	200	2,230	9
23	Upper Gales Creek	0	0	0	0	0	0	0
24	Tualatin Main Stem	150	50	0	0	100	300	4
25	Lower Scoggins Creek	0	0	100	0	0	100	2
26	Hagg Lake Basin	200	0	0	0	0	200	1
27	Tualatin Main Stem	1,400	180	300	0	0	1,800	8
28	Tualatin Main Stem	0	0	0	0	0	0	0

Table 7. Non-irrigated agriculture land use distribution.

		Non-Irrigated Agg.					
Segment	Stream	Grain	Alfalfa	Nuts	Tree fruit	Total	% Area
Basin	Tualatin Basin	41,700	4,700	6,600	2,000	54,900	12
0	Lake Oswego Basin	0	0	0	0	0	0
1	Tualatin Main Stem	500	200	150	150	1,000	13
2	Tualatin Main Stem	50	0	200	200	450	6
3	Lower Fanno Creek	0	0	100	0	100	1
4	Upper Fanno Creek	0	0	0	0	0	0
5	Tualatin Main Stem	600	200	3,000	230	4,030	16
6	Tualatin Main Stem	400	300	480	150	1,330	9
7	Tualatin Main Stem	4,100	30	600	90	4,820	18
8	Lower Rock Creek	200	0	200	0	400	5
9	Beaverton Creek	0	0	100	60	160	1
10	Middle Rock Creek	600	100	100	150	950	8
11	Upper Rock Creek	0	0	0	20	20	0
12	Tualatin Main Stem	800	100	50	10	960	11
13	Lower Dairy Creek	400	0	100	0	500	39
14	Lower McKay Creek	6,000	800	450	30	7,280	28
15	Upper McKay Creek	200	0	0	0	200	1
16	Middle Dairy Creek	3,900	1,000	200	70	5,170	38
17	Lower E. Fork Dairy	4,000	400	130	0	4,530	30
18	Upper E. Fork Dairy	500	200	50	20	770	3
19	Lower W. Fork Dairy	6,500	600	150	200	7,450	24
20	Upper W. Fork Dairy	700	0	0	0	700	4
21	Tualatin Main Stem	3,100	200	200	10	3,510	38
22	Lower Gales Creek	2,400	500	30	10	2,940	12
23	Upper Gales Creek	100	0	0	0	100	0
24	Tualatin Main Stem	950	0	0	500	1,450	18
25	Lower Scoggins Creek	50	0	0	0	50	1
26	Hagg Lake Basin	100	0	0	0	100	0
27	Tualatin Main Stem	5,100	50	330	100	5,580	25
28	Tualatin Main Stem	400	0	0	0	400	2

Table 8. Distribution of pasture land use in the Tualatin basin.

		Pasture land				
Segment	Stream	Cattle	Horses	Sheep	Total	% Area
Basin	Tualatin Basin	47,000	15,100	1,100	63,200	14
0	Lake Oswego Basin	0	0	0	0	0
1	Tualatin Main Stem	2,000	500	0	2,500	32
2	Tualatin Main Stem	1,000	400	0	1,400	20
3	Lower Fanno Creek	0	50	0	50	0
4	Upper Fanno Creek	0	0	0	0	0
5	Tualatin Main Stem	3,000	3,000	100	6,100	24
6	Tualatin Main Stem	2,100	250	150	2,500	17
7	Tualatin Main Stem	9,000	2,000	300	11,300	43
8	Lower Rock Creek	100	100	0	200	2
9	Beaverton Creek	0	200	0	200	1
10	Middle Rock Creek	2,000	1,000	0	3,000	25
11	Upper Rock Creek	1,000	450	0	1,450	30
12	Tualatin Main Stem	3,000	2,000	0	5,000	56
13	Lower Dairy Creek	0	0	0	0	0
14	Lower McKay Creek	4,000	1,200	200	5,000	21
15	Upper McKay Creek	0	0	0	0	0
16	Middle Dairy Creek	1,300	500	100	1,900	14
17	Lower E. Fork Dairy	1,100	500	100	1,700	11
18	Upper E. Fork Dairy	300	0	0	300	1
19	Lower W. Fork Dairy	3,000	1,000	100	4,100	13
20	Upper W. Fork Dairy	800	0	0	800	5
21	Tualatin Main Stem	0	0	0	0	0
22	Lower Gales Creek	1,400	1,000	0	2,400	36
23	Upper Gales Creek	400	0	0	400	2
24	Tualatin Main Stem	2,500	400	0	2,900	36
25	Lower Scoggins Creek	1,900	0	0	1,900	42
26	Hagg Lake Basin	500	0	0	500	2
27	Tualatin Main Stem	6,500	500	0	7,000	31
28	Tualatin Main Stem	100	50	0	150	1

Table 9. Distribution of forest and wetlands in the Tualatin basin.

		Forest		Wetland	
Segment	Stream	Total	% Area	Total	% Area
Basin	Tualatin Basin	193,800	42	9,300	2
0	Lake Oswego Basin	0	0	500	8
1	Tualatin Main Stem	1,540	20	80	1
2	Tualatin Main Stem	0	0	210	3
3	Lower Fanno Creek	180	1	180	1
4	Upper Fanno Creek	0	0	0	0
5	Tualatin Main Stem	6,230	24	510	2
6	Tualatin Main Stem	7,040	47	300	2
7	Tualatin Main Stem	2,100	8	530	2
8	Lower Rock Creek	0	0	270	3
9	Beaverton Creek	1,030	4	460	2
10	Middle Rock Creek	1,540	13	240	2
11	Upper Rock Creek	3,030	62	50	1
12	Tualatin Main Stem	180	2	450	5
13	Lower Dairy Creek	0	0	130	10
14	Lower McKay Creek	2,570	10	510	2
15	Upper McKay Creek	15,460	94	160	1
16	Middle Dairy Creek	0	0	550	4
17	Lower E. Fork Dairy	3,490	23	150	1
18	Upper E. Fork Dairy	24,350	92	260	1
19	Lower W. Fork Dairy	11,080	36	920	3
20	Upper W. Fork Dairy	16,050	91	0	0
21	Tualatin Main Stem	280	3	460	5
22	Lower Gales Creek	14,450	61	240	1
23	Upper Gales Creek	23,840	98	0	0
24	Tualatin Main Stem	2,970	37	80	1
25	Lower Scoggins Creek	2,220	49	140	3
26	Hagg Lake Basin	22,380	90	1,740	7
27	Tualatin Main Stem	7,660	34	230	1
28	Tualatin Main Stem	24,160	93	0	0

Table 10. Fertilizer application rates used in calculations (from OSU Fertilizer Guides).

Land use		Max/yr
Urban	Incorp	N/A
	Unincorp	N/A
Irrigated Agg	Specialty seed	120
	Berries	120
	Vegetable	200
	Container nurseries	75
	Other nurseries	50
Non-Irrigated Agg	Grain	60
	Alfalfa	150
	Nuts	0
	Fruit trees	55
Pasture land		60
Forest		0

Nitrogen Application
(OSU Fertilizer Guides)

Land use		Max/yr
Urban	Incorp	
	Unincorp	
Irrigated Agg	Specialty seed	0
	Berries	90
	Vegetable	225
	Container nurseries	300
	Other nurseries	250
Non-Irrigated Agg	Grain	140
	Alfalfa	0
	Nuts	3
	Fruit trees	120
Pasture land		140
Forest		0

Table 11. Maximum fertilizer application for agricultural land by subbasin.

Segment	Stream	P/acre	N/acre
Basin	Tualatin Basin	30	40
0	Lake Oswego Basin	0	0
1	Tualatin Main Stem	40	70
2	Tualatin Main Stem	20	40
3	Lower Fanno Creek	0	0
4	Upper Fanno Creek	0	0
5	Tualatin Main Stem	30	50
6	Tualatin Main Stem	30	40
7	Tualatin Main Stem	50	100
8	Lower Rock Creek	10	10
9	Beaverton Creek	0	0
10	Middle Rock Creek	20	40
11	Upper Rock Creek	20	50
12	Tualatin Main Stem	60	130
13	Lower Dairy Creek	50	50
14	Lower McKay Creek	60	70
15	Upper McKay Creek	0	0
16	Middle Dairy Creek	70	80
17	Lower E. Fork Dairy	70	70
18	Upper E. Fork Dairy	10	0
19	Lower W. Fork Dairy	50	60
20	Upper W. Fork Dairy	10	10
21	Tualatin Main Stem	80	120
22	Lower Gales Creek	30	40
23	Upper Gales Creek	0	0
24	Tualatin Main Stem	40	80
25	Lower Scoggins Creek	30	70
26	Hagg Lake Basin	0	0
27	Tualatin Main Stem	40	80
28	Tualatin Main Stem	0	0