THE FLATHEAD VALLEY
AGRICULTURAL IMPACTS REPORT

Prepared for

Montana Department of Environmental Quality
&
The Flathead County River Commission (Flathead County)

By

Alan R. Wendt, P.E., CFM
48 North, P.C.
151 Business Center Loop, Ste A
Kalispell, MT 59901
(406) 756-4848

April 2011

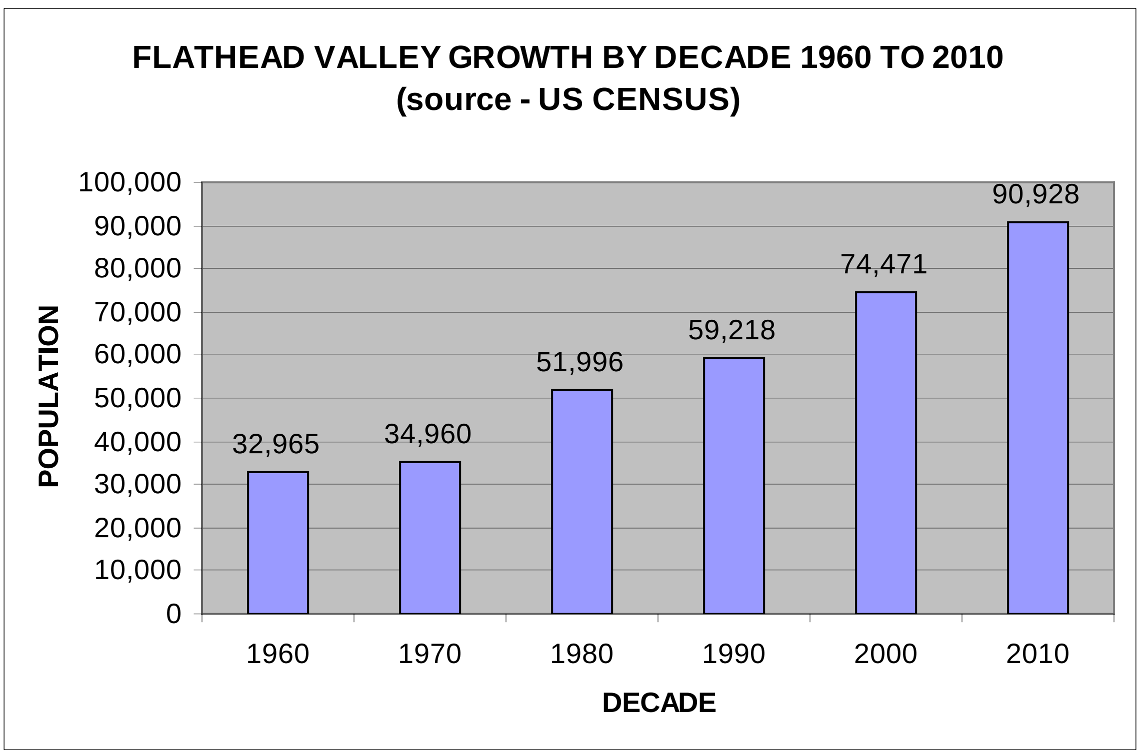
TABLE OF CONTENTS

INTRODUCTION

This purpose of this technical report is to compile and provide a Technical Summary Report (TSR) to the Department of Environmental Quality (DEQ) to assist in the development of Total Maximum Daily Loads (TMDL) report for the Flathead Basin. The Flathead Basin is located in northwest Montana on the west side of the continental divide encompassing land from town of St. Ignatius south of Flathead Lake northward to the Canadian border and into Canada. The headwaters of the North Fork of the Flathead River originates in the Canadian Province of British Columbia, while the Middle Fork, South Fork and all other tributaries of the Flathead originate in Montana.

The following TSR focuses on agricultural area above or north of Flathead Lake where the mouth of the Flathead River enters lake. The delineation of agricultural land roughly follows the tree line around the valley above Flathead Lake (Please see Figure 1-1 "Study Area" detailing the study area in Appendix "A"). Branches of farmland follow the Flathead River and tributaries upstream until forestland overtakes farmland, please note the study area does not include all of the Flathead River Basin nor does it encompass all of Flathead County. The study area is roughly 172,000 acres or 269 square miles.

As of 2010 there were 90,928 people living in the Flathead Valley, the majority of those are located in or adjacent to the study area. This is an increase of 16,457 people from the 2000 census number of 74,471[1]. **The Flathead Valley Growth by Decade 1960 To 2010 chart** below describes growth in the valley.



The Flathead Valley is roughly 3,000 feet above mean sea level (amsl). Due to mountain weather dynamics and Flathead Lake, the climate can vary significantly across the valley. Typical weather conditions recorded at the Northwest Agricultural Research Center (Creston) Kalispell MT for the historical time period from 1983 to 2010 show average temperatures range from a low of 24.0 degrees Fahrenheit in December to a high of 64.3 degrees Fahrenheit in July with a frost-free period of 127 days. The average annual precipitation is 20.21 inches; rainfall fluctuates from a low of 1.17 inches in September to a high of 3.22 in June[2]. It should be noted that location of Creston near Flathead Lake appears to mitigate the temperature highs and lows as well as influencing precipitation patterns with respect to other areas of the valley.

Conversely at Glacier International Airport 8 miles north and 2 miles west of Creston for the historical time period from July 1996 to December 2008, the average temperatures range from a low of 16.4 degrees Fahrenheit in December to a high of 83.1 degrees Fahrenheit in July. Precipitation measured at the airport shows average annual precipitation of 14.98 inches, rainfall fluctuates from a low of 0.63 inches in February to a high of 2.49 in July.[3]

The Flathead Valley also contains a tremendous number of soil types. The Soil Survey for the Upper Flathead Valley Area Montana lists 14 major soil associations. Each association has multiple series or variations in the associations resulting in almost 200 series linked with the 14 different associations[4].

It should be noted that all acreages detailed in this report should be considered approximations. Acreages can vary significantly from year to year based on commodity prices, economic conditions, weather conditions, irrigation water availability, non-resident land owners and many other conditions and situations. This report is intended to provide a snapshot of agricultural conditions for the summer of 2009. Actual acreages will vary from year to year.

Task 1 - How much agricultural land, of what type exists within the Flathead Basin? (e.g., row crops, pasture/hay, irrigated, dry land, grazing, etc.)

Agricultural land was delineated from the NAIP 2009 aerial imagery (July 2009) produced for the NRCS. Crop type was determined by examining the NAIP imagery as well as the imagery from the 2009 Flathead Basin LIDAR & Imagery Project (September 2009), personal knowledge, interviews with local farmers, local agricultural service providers, and windshield surveys.

Determination of land used for agricultural practices was based on review of aerial images, personal site visits, interviews and personal knowledge. Pasture that does not appear to be fertilized, cropped and/or irrigated has not been included in this report. Cropping, haying, and fertilizing leave visible organized tracks, rows or other identifiying marks, grazing land can be identified by visible livestock paths leading in or out of pastures or to feeding or watering locations. Lots approximately 5 acres or less in size, unless clustered with other lots to increase land area to a more usable size were not evaluated.

There are large open areas in the valley that are not classified as agricultural land. This can be related to number of different factors including marginally productive ground, non resident owners, numerous small parcels clustered together, salinity issues, lack of livestock, economic conditions, large amounts of state and federal lands, and delineation practices.

Of the 172,000-acre study area delineated approximately 62,800 acres are in hay, cereal grains, oilseeds, pulse crops, seed potatoes, and summer fallow or other agricultural practices. Of this acreage approximately 20,721 acres are irrigated on a yearly basis.

- Hay constituted approximately 27,150 acres; this includes Alfalfa, grass hays, Sainfoin, Sorghum, and other Legumes used for livestock feeds. It should be noted that due to development pressure significant amounts of agricultural land has been converted to residential uses resulting in a significant reduction in field (lot) size. Much of the developed land is still available for farming, but the reduction in field or lot size along with development improvements restrict most farming practices to hay production only. These small lots are difficult to delineate and record, therefore many lots are evaluated on a case-by-case basis for inclusion into this report.

- Cereal Grains constituted approximately 21,350 acres, cereal grains used in the Flathead Valley include Spring Wheat, Barley and Oats.

- Winter Wheat constituted approximately 4,700 acres.

- Oilseeds constituted approximately 1,500 acres, Oilseeds grown in the Flathead Valley primarily consist of Canola, Dill, Camelina, Mustard, and Sunflower.
- Pulse crops constituted approximately 1,900 acres, and consist of Peas & Lentils.
- There were 260 acres of Seed Potatoes (row crop).
- Mint and Corn have been designated as "Other" crops and account for 341 acres.
- There were 5,600 acres in summer fallow during this year.
- Golf Courses, Parks, Cemeteries and Nurseries accounted for another 1,750 acres.

There is one Concentrated Animal Feeding Operation (CAFO) in the permitting stage, it is located in Section 10, Township 29 north, Range 22 west. There is no nutrient plan available at this time[5].

The United States Department of Agriculture (USDA) tracks number of Cattle by county, the number of Cattle & Calves Flathead Valley are as listed below[6]:

Cattle & Calves	9,200

The Flathead County Appraisers Office lists the following livestock numbers[7]:

Horses	1,683
Cows	3,838
Bison	59
Sheep	129
Goats	93
Pigs	617
Lamas	161
Emu	38
Ungulates (Elk)	191

It should be noted that the comparison of numbers for livestock between the USDA and the Flathead County Appraisers office vary significantly. Discussion with county staff indicated that numbers for animals that could be considered pets such as horses, goats, lama's etc. will be very low. Staff indicated that many owners do not realize that they are considered property and do not report them as such.

TASK 2 - WHERE IS THIS LAND LOCATED?

Agricultural land for this report is broken out into 6 distinct areas (Please see Exhibit 1-2 “Quadrants” in Appendix “A”);

- Smith Valley, this quadrant covers Ashley Creek drainage from the point it leaves the tree line west of town easterly through Smith Lake. It is delineated by forest to the south, west, north and Kalispell to the east (Please see Exhibit 2-1 “Crops Smith Valley” in Appendix “A”).
  11,197 total acres
  26 acres fallow
  1,640 acres hay

- West Valley, this quadrant is bounded by the Smith Valley Quadrant to the south, treeline to the west, US Highway 93 to the east and the boundary with Stillwater along Spring Creek Drive (Please see Exhibit 2-2 “Crops West Valley” in Appendix “A”).
  23,199 total acres
  826 acres fallow
  2,623 acres hay
  5,410 acres cereal grain
  808 acres winter wheat
  256 acres oilseeds

- Stillwater, this quadrant covers the Stillwater drainage from the West Valley Quadrant north along the Stillwater River until the treeline closes in on the north, east and west (Please see Exhibit 2-3 “Crops Stillwater” in Appendix “A”).
  10,715 total acres
  376 acres fallow
  2,660 acres hay
  1,284 acres cereal grain
  105 acres winter wheat
  197 acres other

- Central Valley, this quadrant is bounded by Kalispell and US Highway 2 to the south, US Highway 93 to the west, the Flathead River to the east and the City of Whitefish and the treeline to the north (Please see Exhibit 2-4 “Crops Central Valley” in Appendix “A”).
  41,944 total acres
  1,109 acres fallow
  7,098 acres hay
  3,433 acres cereal grain
  415 acres winter wheat
  139 acres pulse
  42 acres oilseed
  27 acres other

- East Valley, this quadrant is bounded by Montana State Route 35 and Mennonite Church Road to the south, the Flathead River to the west, the treeline to the east and the Flathead River and treeline to the north (Please see Exhibit 2-5 “Crops East Valley” in Appendix “A”).
  25,018 total acres
  450 acres fallow
  4,023 acres hay
  2,949 acres cereal grain
  777 acres winter wheat
  381 acres pulse crops
  210 acres oilseeds
  198 acres seed potatoes
  58 acres other

- Lower Valley, this quadrant is bounded by the treeline to the east and west, Flathead Lake to the south and US Highway 2, Montana State Route 35, and Mennonite Church Road to the north (Please see Exhibit 2-6 “Crops Lower Valley” in Appendix “A”).
  59,873 total acres
  2,774 acres fallow
  9,112 acres hay
  8,281 acres cereal grain
  2,584 acres winter wheat
  1,409 acres pulse crops
  997 acres oilseeds
  65 acres seed potatoes
  59 acres other

There are approximately another 1,750 acres of Golf Courses, Cemeteries, Parks and Nurseries in the Flathead Valley (Please see Exhibit 2-7 “Golf Courses, Parks, Cemeteries & Nurseries” in Appendix “A”)

TASK 3 - HOW MUCH LAND IS IRRIGATED FOR AGRICULTURAL PURPOSES?

The study delineates 20,721 acres of irrigated land; irrigated areas shown are the approximate total irrigated area for the summer of 2009. Of this acreage approximately 7,072 acres are from groundwater and approximately 13,704 acres are from surface water. It is assumed the dry summer of 2009 would be a fairly accurate snapshot of the irrigation in the valley. The delineated areas may not be complete for total available irrigated areas based on a number of factors. These factors include accumulated yearly precipitation, lack of available irrigation water, crop rotation and/or summer fallow, water rights, individual economic situations, and other unknown factors or conditions.

Irrigation areas delineated were derived from aerial photographs, interviews with local farmers and windshield surveys. Queries of the Department of Natural Resources Water Rights (DNRC) database indicate thousands of water rights in the basin[8]. Irrigated areas have not been cross checked with the DNRC water rights database or in any other way analyzed for legal ownership. The DNRC database appears to be outdated with incorrect owners, flow rates, and volumes. The DNRC is currently adjudicating the basin to determine water rights, owners, and uses. The process may take decades with the distinct possibility of extensive litigation before water rights are completely adjudicated.

Smith Valley (Please see Exhibit 3-1 “Irrigation Smith Valley” in Appendix “A”).
96 acres of side roll/hand irrigation
0 acres center pivot irrigation
96 total acres irrigated
Surface water is used to irrigate all 96 acres.

West Valley (Please see Exhibit 3-2 “Irrigation West Valley” in Appendix “A”).
2,981 acres side roll/ hand irrigation
4,260 acres center pivot irrigation
7,241 total acres irrigated
Surface water is used to irrigate 3,880 acres
Groundwater is used to irrigate 3,359 acres

Stillwater (Please see Exhibit 3-3 “Irrigation Stillwater” in Appendix “A”).
796 acres side roll/ hand irrigation
1,020 acres center pivot irrigation
1,815 total acres irrigated
Surface water is used to irrigate all 1,815acres

Central Valley (Please see Exhibit 3-4 “Irrigation Central Valley” in Appendix “A”).
3,381 acres side roll/ hand irrigation
668 acres center pivot irrigation
4,029 total acres irrigated
Surface water is used to irrigate 2,801 acres
Groundwater is used to irrigate 1,230 acres

East Valley (Please see Exhibit 3-5 “Irrigation East Valley” in Appendix “A”).
1,168 acres side roll/ hand irrigation
1,026 acres center pivot irrigation
2,194 total acres irrigated
Surface water is used to irrigate 313 acres
Groundwater is used to irrigate 1,882 acres

Lower Valley (Please see Exhibit 3-6 “Irrigation Lower Valley” in Appendix “A”).
3,067 acres side roll/ hand irrigation
2,259 acres center pivot irrigation
5,326 total acres irrigated
Surface water is used to irrigate 4,727 acres
Groundwater is used to irrigate 601 acres

It should be noted that many irrigation systems co-mingle surface and groundwater in their irrigation systems, determining exact contributions and area of use from each source is difficult and is beyond the scope of this report. For farm operators with access to both surface and groundwater, usage of each is dependant on many factors including depth to ground water, access to surface water, pumping costs etc.

TASK 4 - WHAT TYPE OF IRRIGATION PRACTICES ARE BEING UTILIZED AND WHERE?

Virtually all irrigation in the Upper Flathead River Basin is sprinkler, mister or emitter irrigation. A very small amount of flood irrigation exists in the basin but due to the small amount it is neglected from this report. There is and has been a steady conversion of hand and side roll (wheel move) irrigation to center pivot irrigation. Center pivot irrigation offers significant manpower, electric, and water efficiency savings over hand and side roll irrigation. Older, existing Center Pivot irrigation are undergoing a change from high-pressure sprinkler systems to low-pressure mist emitters, conserving additional water and power. This conversion is almost complete and very few high-pressure impact sprinkler pivots if any exist in the Flathead Valley[9].

Hand, side roll and center pivot irrigation can be found interspersed throughout the valley. Center pivot irrigation may not reach the corners of square fields, short hand or side roll lines are utilized on an individual basis to cover areas the pivot does not reach. Delineation of center pivot vs. side roll/hand move irrigation is especially difficult due to booster pump end guns that can deliver irrigation water more than 100’ from the end of the pivot, and end swing pivots. If side roll/hand irrigation is available for the corners of the field irrigated by a pivot then the entire field was considered to be irrigated by center pivot and delineated as such on the irrigation exhibits.

TASK 5 - WHERE ARE THE KNOWN IRRIGATION WITHDRAWALS AND RETURNS?

The Upper Flathead River Basin has very limited irrigation diversions with no discernable or known collection ditches or returns. The minimal existing flood irrigation returns directly to the stream that it is diverted from and is not collected by irrigation drains[10]. While many ditches have been constructed mostly in the early 1900's very few remain[11]. Most of these ditches ringed the valley capturing smaller streams as they exited the mountains. Unfortunately the DNRC database does not make the distinction of whether a "diversion" is by pump or gravity.

The only major ditch irrigation project in the upper valley that thrived was the Ashley Ditch. Formed in the early 1900's the Ashley Irrigation District irrigated over 2,500 acres in the mid 1960's[12]. The gravity diversion was located just below Smith Lake and returns were located on Bowser Spring Creek and the Stillwater River. The ditch was decommissioned in the late 1970's, water rights sold to the Department of Fish and Game. The Department of Fish and Game restored the water rights Ashley Creek and the Ashley Ditch was abandoned. Only remnants of the ditch remain today, with the northwest edge of Kalispell housing developments replacing significant portions of the irrigation districts tillable land.

TASK 6 - WHAT ARE THE TYPES AND MAGNITUDES OF FERTILIZERS APPLIED TO THESE AGRICULTURAL LANDS?

Fertilizer is by far the largest input cost for farmers in the Flathead Valley, and as such application types, amounts, and timing of application are carefully budgeted to reach yield goals. Many nutrients are required to reach target yields, nutrient balances must be considered in conjunction with soil types, crop types, previous crops and rotations, seedbed utilization, seeding practices and machinery, and irrigation practices. All these variables are considered to prevent underutilization of expensive fertilizer components.

Any nutrient such as Nitrogen and/or Phosphorus that is unused is a direct profit loss to the farmer of not only the cost of the nutrient and application, but the loss of potential crop yield increase. In an effort to assist local farmers, local agricultural providers offer soil-testing services to determine nutrient levels. Soil testing of fallow land prior to seeding is a valuable tool for fertilizer planning and is gaining favor among valley farmers for detailing fertilizer deficiencies and balancing of needed nutrients.

The Flathead Valley has an enormous cross section of soil types, as well as varying rainfall amounts and patterns. The result of these natural conditions results in the need for widely varied fertilizers and practices within the valley to produce the highest yields with the lowest input costs possible, the fertilizer practices listed below are summarized in **Table 6-1**. Please note the fertilizer practices listed below are specific to the Flathead Valley.

Typical types of fertilizer typically used in the Flathead Valley;

- Dry (granular) – typical dry mixes are 16-20-0 (Mono-Ammonium Phosphate - 16% Nitrogen, 20% Phosphorus, 0% Potassium) or 11-52-0 (Mono-Ammonium Phosphate -11% Nitrogen, 52% Phosphorus, 0% Potassium). These blends are typically used to provide the required Phosphorus nutrient component of crop requirement.
- Dry (granular) – Urea 46-0-0 (Ammonia Phosphate - 46% Nitrogen, 0% Phosphorus, 0% Potassium). Typically used to provide the required Nitrogen nutrient component of crop requirement.
- NH_3 (gaseous)– Anhydrous Ammonia (82% Nitrogen). Typically used to provide the required Nitrogen nutrient component of crop requirement.
- Liquid, also know as Fertigation – Nitrogen, Phosphorus dissolved in water, typical mixes for providing Nitrogen are 28-0-0 (28% Nitrogen, 0% Phosphorus, 0% Potassium) or 32-0-0 (32% Nitrogen, 0% Phosphorus, 0% Potassium) while 10-34-0 (Ammonium Phosphate - 0% Nitrogen, 34% Phosphorus, 0% Potassium) is used to provide Phosphorus.

* Note – Dry fertilizers are typically blended to produce a mix with specific characteristics. For example should soil testing indicate that only Nitrogen is required to reach a target yield then Urea would by the logical fertilizer choice.

Fertilizer types and blends may contain many components, some of them inert, only Nitrogen and Phosphorus are detailed in this report. The following crop list details typical fertilizer type, application rate and timing, and irrigation practices.

HAY (Grass, Alfalfa, or mix):

Dryland;

Typical application for Alfalfa are applied in the range of 30 to 50 pounds of Nitrogen and 30 to 50 lbs of Phosphorus as dry granular fertilizer per acre, surface applied early spring utilizing mechanical broadcasting.
Note - Smaller parcels, 5 acres or less or marginal land typically not fertilized and only harvested during wet years.

Irrigated;

Typical application of 50 to 90 lbs of Nitrogen and 30 lbs to 60 lbs of Phosphorus as dry granular fertilizer per acre, surface applied early spring utilizing mechanical broadcasting.

CEREAL GRAINS (Spring Wheat, Barley, Oats, Winter Wheat):

Dryland (spring seeding);

Typical pre-seeding application of 40 to 60 lbs of nitrogen as NH_3 fertilizer per acre applied in banding approximately 4 to 6" deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Irrigated (spring seeding);

Typical pre-seeding application of 40 to 60 lbs of nitrogen in NH_3 fertilizer per acre applied in banding approximately 4 to 6" deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Fertigation (liquid application of fertilizer through irrigation) may be utilized later in the crop cycle to enhance protein content. 30 to 50 lbs of nitrogen applied as liquid fertilizer per acre through irrigation.

Dryland (fall seeding);

Typical application of 10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

50 to 80 lbs of Nitrogen and 60 to 100 lbs of Phosphorus dry granular fertilizer broadcast application applied in late spring

Irrigated (fall seeding);
Typical pre-seeding application of 40 to 60 lbs of Nitrogen as dry granular fertilizer broadcast applied and tilled in.

Typical application of 10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Another application of 80 to 120 lbs of Nitrogen and 100 to 150 lbs of Phosphorus as dry granular fertilzer broadcast application in late spring

Fertigation (liquid application of fertilizer through irrigation) may be utilized later in the crop cycle to enhance protein content. 30 to 50 lbs of nitrogen applied as liquid fertilizer per acre through irrigation.

OIL SEEDS (Canola, Camelina, Dill, Mustard, Sunflower):

Dryland;

Typical pre-seeding application of 40 to 60 lbs of nitrogen as NH_3 fertilizer per acre applied in banding approximately 4 to 6” deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Irrigated;

Typical pre-seeding application of 40 to 60 lbs of nitrogen in NH_3 fertilizer per acre applied in banding approximately 4 to 6” deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Fertigation (liquid application of fertilizer through irrigation) may be utilized later in the crop cycle to enhance protein content. 30 to 50 lbs of nitrogen applied as liquid fertilizer per acre through irrigation.

PULSE CROPS, PEAS & LENTILS:

Dryland;

Typical pre-seeding application of 40 to 60 lbs of nitrogen as NH_3 fertilizer per acre applied in banding approximately 4 to 6” deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Irrigated;

Typical pre-seeding application of 40 to 60 lbs of nitrogen in NH_3 fertilizer per acre applied in banding approximately 4 to 6” deep early spring or 40 to 60 lbs of Nitrogen as dry granular broadcast applied and tilled in.

10 to 20 lbs of Nitrogen and 20 to 40 lbs of Phosphorus as dry granular fertilizer applied with seed, either broadcast or direct seed. Fertilizer rates may be slightly higher with broadcast seeding to ensure seeds are broadcast in correct pattern. Broadcast seed/fertilizer mix is tilled into soil immediately upon application to prevent fertilizer volatilization.

Fertigation (liquid application of fertilizer through irrigation) may be utilized later in the crop cycle to enhance protein content. 30 to 50 lbs of nitrogen applied as liquid fertilizer per acre through irrigation.

SEED POTATOES (row crop):

<u>Irrigated;</u>

Typical application of 130 to 190 lbs of nitrogen and 60 to 80 lbs of Phosphorus as dry granular fertilizer applied by direct seeding.

Fertigation (liquid application of fertilizer through irrigation) may be utilized later in the crop cycle. 40 to 60 lbs of nitrogen applied as liquid per acre through irrigation.

OTHER (Mint & Corn):

<u>Irrigated;</u>

Mint - Fertigation (liquid application of fertilizer through irrigation is used periodically through the crop cycle. 100 to 400 lbs of nitrogen applied as liquid per acre through irrigation throughout the crop year.

Corn - Typical pre-seeding application of 60 to 250 lbs of nitrogen in NH_3 fertilizer per acre applied in banding approximately 4 to 6" deep early spring or 40 to 150 lbs of Nitrogen as dry granular broadcast applied and tilled in.

Table 6-1 Fertilizer Practices (Flathead Valley specific)

Crop	Irrigated	Fertilizer Application Rates in lbs per acre					
		N low	N high	**N avg**	P low	P high	**P avg**
Hay	No	0	70	**50**	0	50	**20**
	Yes	50	90	**70**	30	60	**40**
Cereal Grains	No	50	100	**80**	20	40	**30**
	Yes	80	190	**170**	20	50	**35**
Cereal Grains (Winter wheat)	No	50	100	**100**	20	40	**25**
	Yes	80	150	**140**	20	50	**30**
Oil Seeds	No	50	90	**70**	10	20	**15**
	Yes	70	150	**130**	15	30	**20**
Pulse Crops Peas/Lentils	No	0	20	**10**	0	40	**20**
	Yes	0	40	**30**	0	40	**20**
Seed Potatoes	No	n/a	n/a	**n/a**	n/a	n/a	**n/a**
	Yes	130	250	**200**	60	80	**70**
Other	No	n/a	n/a	**n/a**	n/a	n/a	**n/a**
	Yes	100	400	**250**	80	100	**90**

OTHER FERTILIZER USES;

GOLF COURSES, PARKS, CEMETARIES, & NURSERIES;

Fertilizer practices for golf courses, parks, cemeteries and nurseries are substantially different than traditional agricultural farming practices in that fertilizer usage is determined as much by aesthetic parameters (color, plant densities, overall appearance, etc.) as plant production. Fertilizing for aesthetics reduces fertilizer practices from scientific practices to less scientific parameters, mainly visual inspection. Most golf courses are located near and/or contain water features, this coupled with potentially high fertilizer and irrigation rates create the possibility for Nitrogen and other fertilizer components to easily reach waterbodies.

INSTITUTIONAL, COMMERCIAL & PRIVATE LAWNS;

Fertilizer practices for Institutional, Commercial & private lawns are substantially different than traditional agricultural farming practices in that fertilizer usage is determined as much by aesthetic parameters (color, plant densities, overall appearance, etc.) as plant production and landscaping maintenance scheduling. Fertilizing for aesthetics reduces fertilizer practices from scientific practices to less scientific parameters, mainly visual inspection. Additionally the significant majority of lawns are irrigated and most are adjacent to storm drains providing an easy pathway to water bodies.

TASK 7 - ARE THERE ANY SIGNIFICANT TRENDS IN AGRICULTURAL PRACTICES IN THE FLATHEAD BASIN? (E.G., CONVERSION OF AGRICULTURAL LANDS TO RESIDENTIAL/COMMERCIAL LAND USES.)

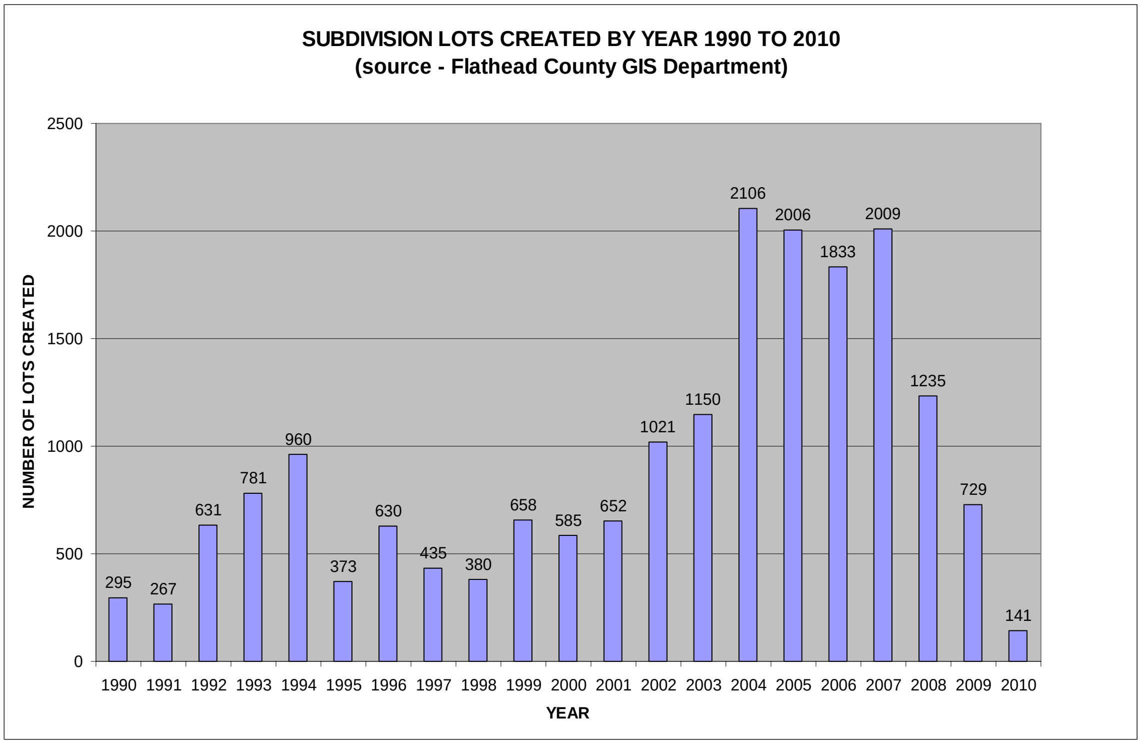
CONVERSION OF AGRICULTURAL LANDS

From 1993 to 2009 Flathead County has recorded approximately 7,250 lots created on land considered to be agricultural in 1993 in the study area[13]. The total acreage of these lots encompasses approximately 12,000 acres of land previously considered utilized by agriculture. Lot coverage data from the county was reduced to lots within the study area and compared to aerial imagery in 1993 versus 2009 to determine if the development was originally agricultural land in 1993. Not all developed land is lost to agriculture, but parcels developed with infrastructure such as roads, drainage improvements, electrical boxes, smaller lots, etc. reduce farming efficiency and increase farming costs.

Subdivision growth data was supplied by the Flathead County GIS department in GIS shape files, converted and imported into CAD supported layers. It should be noted that the county GIS department does not track parcel creation outside of the subdivision process, i.e. Family Transfers and Boundary Line Adjustments (BLA's) in the county database (Please see Exhibit 7-1 "Subdivision Growth, 1993 to 2009" in Appendix "A").

The rate of conversion of agricultural land appears shows a direct correlation to economic conditions in the valley as well as the nation. **The Subdivision Lots Created by Year 1990 to 2010 chart** describes lot creation by the subdivision process per year, again it should be noted that the number of lots included in the table were only created through the subdivision process. The total number of lots created is much higher if other methods of lot creation such as Family Transfer are included. (it should also be noted that this lot count includes lots such as open space, roadways, parks, commercial, industrial and other non-residential uses)

It also should be noted that the trend of accelerated lot creation from 2002 to 2008 appears to be arrested at this time due to current economic conditions, the lots created in 2010 (141) is the lowest subdivision lot count for the time period from 1990 to 2010.



PHASING OUT OF MINT CROPPING

Mint production in the Flathead Valley has declined due to a variety of issues. Lower fertilizer application (due to cost), higher energy costs for distillation, and weeds resistant to herbicides have reduced yield and quality. Competing markets in other parts of the world have increased supply in turn depressing the market conditions and crop prices. Weather related conditions such as droughts and floods in other parts of the global market have raised prices for foodstocks resulting in a dramatic increase in the cereal grain and oilseed market. This increase in market price of cereal grains makes these crops more attractive to local agricultural producers; this in turn reduces acreage available for mint production. All of these factors result in a significant reduction in profitability and acreage for mint production.

USE OF SOIL NUTRIENT TESTING FOR FERTILIZER USE PLANNING

Soil sampling and Agronomy consulting are gaining favor with local farmers, discussion with Cenex Harvest States (CHS) staff point to a significant increase in soil sampling and Agronomy consulting. CHS staff indicated that soil sampling has more than doubled over the last decade.

At a minimum simple soil sampling can provide a snapshot of available nutrients or lack thereof in the soil; this information is used to plan appropriate nutrient applications for the target yield of each particular crop. More extensive Agronomy services are available and utilized by a growing number of farmers include georeferencing the location of each sample, mapping of each individual field, tissue samples and testing of crop during the growing year. These parameters are in turn compared with crop yield, weather conditions, and other contributing factors to determine actual utilization of nutrients. This information in turn is used to plan following year crop nutrient input amounts.

Currently CHS Agronomy staff in association with Agri-Trend Agrology, an independent consulting company, provides services ranging from providing simple soil test results to comprehensive crop and nutrient management consultant services. Agri-Trend staff took over 500 tests in 2010 covering 250 plus fields on approximately 25,000 acres in Flathead County. Each soil sample has two tests conducted, one on soil from 0 to 6” deep and the other on soil from 6” to 12” deep to determine nutrient levels in each individual soil horizon. Sample history is archived into databases for each individual field providing a history of nutrient application, nutrient utilization, crop type and yield, and many other parameters[14].

HISTORIC VS. CURRENT FERTILIZER PRACTICES

Several significant trends in fertilizer practices have evolved in the past few decades;

- Injection of liquid Anhydrous Ammonia (NH_3) for placing nitrogen at the root zone prior to seeding.
- Soil sampling for nutrients
- Usage of air seeders & air drills (no-till or minimum-till applications).

The use of NH_3 has allowed farmer to place nitrogen at the root zone before seed placement, this also allows the farmers to reduce the amount of dry fertilizer placed with the seed reducing cost. By reducing the amount of dry fertilizer required, the reduction in volume of fertilizer can be utilized by placing more seed in the drill. This allows the drill to operate longer before filling. Placement of nitrogen subsurface reduces the amount of surface broadcast fertilization.

Soil sampling is discussed in detail above.

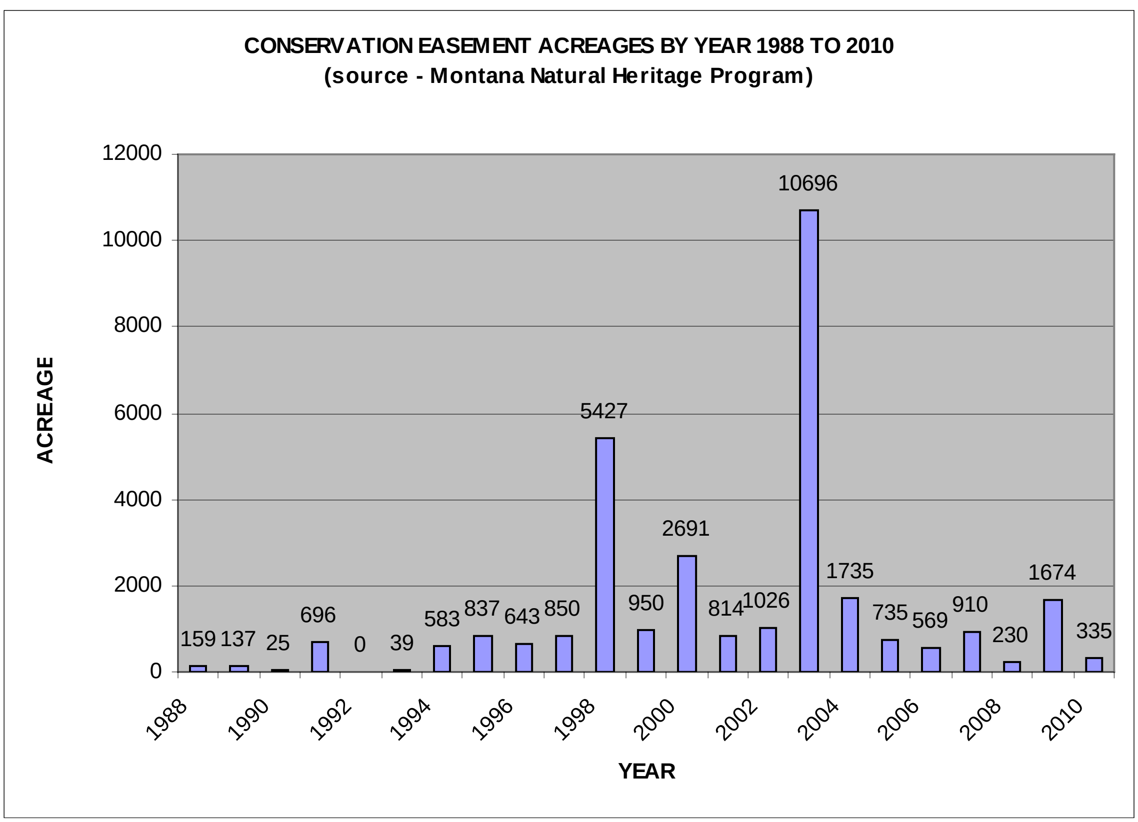
Air seeders and air drills allow no-tillage seeding to minimum-tillage seeding practices, resulting in less surface disturbance and more accurate placement of fertilizer. No-till and Minimum-till reduce surface disturbance in turn reducing erosion (both wind and water), thereby reducing the amount of nutrients that could reach waterbodies. This can reduce the amount of surface broadcast fertilization.

PROTECTION OF LAND THROUGH THE USE OF CONSERVATION EASEMENTS.

There are numerous Conservation Easements in the Flathead Valley, the Montana Natural Heritage Program lists the following Flathead County conservation easement holders for February, 2011[15].

US Forest Service	2,564 acres
US Department of Agriculture	5,999 acres
Montana Fish, Wildlife and Parks	9,960 acres
The Nature Conservancy	2,540 acres
Montana Land Reliance	8,296 acres
Flathead Land Trust	4,806 acres
The Vital Foundation	158 acres
TOTAL	34,324 acres

Conservation easements were overlain on the crop database, area of easement located on agricultural land was delineated and totaled. Of the 34,342 acres listed above agricultural land occupies a minority of the conservation easements at approximately 4,100 acres. (Please see Exhibit 7-2 "Conservation Easements" in Appendix "A" for conservation easements in and adjacent to the study area). Conservation easements by year for the years 1988 to 2010 can be viewed below in the Chart **Conservation Easement Acreages By Year 1988 To 2010**. Conservation easement data can be found in Appendix B.



Easement holders include Flathead Land Trust, The Nature Conservancy, Montana Land Reliance, US Department of Agriculture, Montana Fish, Wildlife & Parks, & The Vital Ground Foundation. There are another 2,564 acres held by the US Forest Service for the time period of 1988 to 2010 of which year-to-year data was not available and therefore not included in the above chart.

---

[1] U.S. Census Bureau, http://quickfacts.census.gov/qfd/states/30/30029.html (accessed April 1, 2011)

[2] Northwest Agricultural Research Center, Weather, Montana State University, http://ag.montana.edu/nwarc/about.htm#climate (accessed January 12, 2011)

[3] Desert Research Institute Site Search http://www.wrcc.dri.edu/summary/gpi.mt.html (accessed January 17, 2011)

[4] United States Department of Agriculture Soils Conservation Service in Association with Montana Agricultural Experiment Station. 1960, *Soil Survey of the Upper Flathead Valley Area, Montana*, US Government Printing Office.

[5] Personal communication with MDEQ staff, MDEQ water protection Bureau, April 7, 2011

[6] United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), http://www.nass.usda.gov/Statistics_by_State/Montana/Publications/cntytoc.htm, accessed April 11, 2011.

[7] Flathead County Appraisers Office staff, telephone interview, April 7, 2001

[8] Montana Department of Natural Resources Water Right Query System, http://nris.mt.gov/dnrc/waterrights/default.aspx (accessed January 17, 2011)

[9] Personal knowledge, personal interviews, site visits.

[10] State Engineers Office. 1965, *Water Resources Survey, Flathead and Lincoln Counties* (pp. 33, 43, 44), Montana, Reporter Printing & Supply Co.

[11] State Engineers Office. 1965, *Water Resources Survey, Flathead and Lincoln Counties* (pp. 33, 43, 44), Montana, Reporter Printing & Supply Co., personal knowledge, site visits.

[12] State Engineers Office. 1965, *Water Resources Survey, Flathead and Lincoln Counties* (pp. 43,44), Montana, Reporter Printing & Supply Co.

[13] GIS Coverage for Lots Created from 1990 to 2010, Provided by Nathan Holm, Flathead County GIS, October 2010

[14] Personal Interview, Marcus Braaten, Agronomist, Certified Crop Adviser & Agri-Trend Agri-Coach, April 6, 2011

[15] Montana Natural Heritage Program, http://mtnhp.org/stew/2011_Ease_Sum_County.pdf (accessed April 8, 2011)