CHAPTER 8

SURFACE WATER COALITION WATER USE

This chapter presents information on SWC water use. There are two sections in this chapter:

- The first part of the chapter evaluates the historic (1930-2004) WD01 diversion records and documents a decline in SWC member's natural flow diversions, storage accrual and carry-over.
- The second part of the chapter presents an analysis of the SWC irrigation requirements.

EVALUATION OF SWC DIVERSION RECORD

SWC members are entitled to divert water for irrigation according to the priority and diversion rate or quantity as specified in natural flow water rights and storage water rights or contracts. The priority and diversion limits associated with the SWC members' rights (presented in **Appendix** A) and the available natural flow control how much water each irrigation district may divert. WD01 maintains a historic record of SWC members' diversions. The WD01 records were used to evaluate the historic water diversions of the SWC entities and changes in the SWC water supply, as described below.

Water Supply Evaluation Methods

Specific hydrologic analyses methods were used to evaluate changes to SWC members' historic diversions and supplies. These methods include the graphical review of annual, monthly, and daily diversion data, the comparison of diversions from hydrologically similar years[1], and the computation of decadal (and longer) averages to estimate the magnitude of water supply declines. The results of these evaluations are summarized in the sections that follow.

Evaluation of Total Annual Supply for all SWC Members

From a peak in the late 1960s and early 1970s, total diversions have declined by approximately 500,000 acre-feet per year. Even though SWC irrigated acreage has been fairly

[1] Hydrologically similar years analysis is summarized in Chapter 6.

constant over the last 60 to 70 years and SWC natural flow supply has been insufficient to meet their irrigation demand, the pattern of total SWC April-September water diversions shows a trend toward lower diversions over the past 25 years. This is in spite of the fact that over the 1930-2004 period, the SWC has added significant amounts of reservoir storage supply.

Annual SWC diversion records were used to develop historical summaries of total water diversion trends for the period 1930 through 2004. Total annual diversions for each of the seven SWC members are presented in **Figure 8-1**. Data shown in this graph are adjusted to reflect the total April – September diversions over a consistent 75-year record (1930-2004).[2] Use of a consistent data record allows more accurate comparisons between similar hydrologic conditions and across the entire 75-year record. Similar, consistent records were developed for storage water diversions and natural flow diversions (the components of the total diversion) for the same 1930-2004 period. Diversion records for each SWC member are included in **Appendix AQ**.

Figure 8-1 shows decreasing total annual water diversions (especially, and increasingly during dry periods) for MID/BID, TFCC, AFRD2, and NSCC. The total annual diversion for all seven SWC members shows a definite declining trend from a high above 3.5 million acre-feet per year for the 1960s to an average of 3.0 million acre-feet per year for the 1990s and 2000s. The total decline in this period is 500,000 acre-feet per year.

The annual water diversion totals were divided by the annual total acreage irrigated to obtain 1930-2004 graphs of total water diversion per irrigated acre for each of the seven SWC members. This information is presented in **Figure 8-2.** The total diversion per acre of irrigated land shows that SWC members receive less water per acre during dry periods than during wet periods. The figure also shows that, in the period since about 1970, there are some decreases in diversion per irrigated acre, particularly for Burley and Minidoka Irrigation Districts, and for Milner Irrigation District. Also, the graphs show that for the SWC overall, on a per-acre basis the SWC diversions have not increased, but have declined over the record.

Declines in Total SWC Annual Water Supply

The record of combined SWC annual diversion (shown in **Figure 8-3**) shows significant volumetric declines in average and dry years for both total and natural flow diversions. The

[2] The WD01 end-of-year diversion data prior to 1978 generally is from April to September, while the post-1978 data is for the entire water year. An annual diversion dataset was developed for a consistent April to September period to allow comparison over the historic record.

record of SWC storage diversions shows corresponding, although smaller increases that reveal an attempt by SWC members to replace their depleted natural flow supplies using their valuable storage water. This increased reliance upon storage exacerbates the overall water supply shortage situation by producing less carry-over and the potential for drastic shortages in multiple year droughts.

In terms of average total diversions, the decline in supply from the 1950s and 1960s to the post-1990 period is approximately 500,000 acre-feet per year, from an average of 3.5 million, to 3.0 million acre-feet per year (excluding wet years). The decline in average natural flow diversion for the same periods is approximately 600,000 acre-feet per year, from 2.1 million acre-feet per year in the 1950s and 1960s, to less than 1.5 million acre-feet per year in the 1990s and 2000s. The fact that declines are more significant for dry years and for natural flow than for total diversion illustrates the seriousness of the water supply impacts.

In terms of progressive total diversion decreases in dry periods, the decline is seen by comparing the 1961 diversion of about 3 million acre-feet, to the 1977 diversion of 2.8 million acre-feet, and then to the 2004 diversion of 2.7 million acre-feet. This latter total includes the use of almost 1.5 million acre-feet of storage water. The dry year natural flow diversions go from a four year average including and ending in 1961 of 1.6 million acre-feet average, to 2.1 million acre-feet in the four years ending in 1977, to less than 1.3 million acre-feet in 2004. Hydrological analysis indicates that the 2000s drought, while severe, is less severe than previous dry periods in the 20th century[3]. Thus the diversions are the lowest ever observed, while the basin hydrology is comparable to previous historic dry periods.

Comparison of Annual SWC Natural Flow Diversion for Average Years

Using a similar years approach comparing years based on total unregulated surface inflow above American Falls (described in Chapter 6), combined SWC natural flow diversions show a clear decrease when comparing average water years since 1990 with water years before and including 1960. **Table 8-1** compares the combined SWC natural flow diversion for water years after 1990 against natural flow diversion for similarly average years prior to and including 1960. The table shows that SWC members' average year natural flow diversion has decreased by an average of more than 200,000 acre-feet per year. This represents a decrease in natural flow water supply of about 9 percent. Individual yearly comparisons show greater losses. Water

[3] Analysis of the historic water supply to the basin over the 20th century is presented in Chapter 5 of this report.

year 2000, which was very similar to 1953 in terms of total, unregulated surface water inflow above American Falls, provided the SWC with 248,000 acre-feet less water supply, a decrease of more than 13 percent.

Comparison of Annual SWC Natural Flow Diversion for Dry Years

The decline in natural flow diversions is most pronounced during dry years. The combined SWC dry year natural flow diversions have declined by more than 18 percent as a result of decreased water availability. **Table 8-2** compares the SWC natural flow diversion for water years after 1990 against natural flow diversion for similarly dry years prior to and including 1960. The table shows that the SWC members' dry year natural flow diversion has decreased in the range of 15,000 acre-feet to 495,000 acre-feet (with an average of more than 255,000 acre-feet) during the six driest post-1990 years. This represents a decrease in natural flow water supply of more than eighteen percent. Individual yearly comparisons show even greater losses. Water year 2001, which was very similar to 1940 in terms of total surface water inflow above American Falls, provided the SWC with more than 434,000 acre-feet less water supply, a decrease of 28 percent. The next section looks at this decline in more detail, to identify where in the irrigation season the natural flow supply has changed most significantly.

Declines in Total SWC Water Supply During the Irrigation Season

The decline in total SWC supply is most-evident in the monthly total diversion record and the daily natural flow diversion comparisons for the combined SWC members. During the entire historic record up to approximately the 1970s, certain SWC members have always enjoyed stable mid-irrigation season natural flow diversions. During dry periods prior to the 1970s, the May through July total diversions were almost always at least 9,000 to 12,000 cfs. Since the 1970s and increasingly into the most-recent record during the 1990s and 2000s, the total SWC supply has dropped dramatically - to the point where the 2004 total diversions in July dropped from 13,000 cfs to below 10,000 cfs. Specific changes, by month, comparing the 1950s with the 1990s and 2000s, include the following:

- May declines in total diversion from 11,000 cfs to 8,000 - 9,000 cfs
- June declines from 11,000 cfs to 9,500 cfs and lower in dry years
- July declines from 13,000 cfs to 11,000 cfs
- August declines from 12,000 cfs to 9,500 cfs (with natural diversion declines from 9,000 cfs to 7,000 cfs)
- September declines from 9,000 cfs to 7,000 cfs.

The reduction in SWC supply observed in the historic record affects the SWC members as follows: 1) the SWC natural flow supply has declined in terms of quantity of flow supplied for all SWC members, 2) the SWC natural flow supply that is provided during the entire year for the SWC members with early-priority natural flow rights (TFCC & NSCC) has dropped roughly in half from the historic full supply and is no longer reliable during the middle of the irrigation season, 3) additional reservoir storage is required to be diverted during average and dry years, reducing the amount of storage available for carry-over to augment irrigation supply shortages that occur during multiple dry-year events (like the recent droughts recorded from 2001 to 2004), 4) SWC must decrease the amount of water delivered to farms during the middle portion of the irrigation season in order to conserve storage water for later use to augment decreased natural flow in the event that natural flow does not increase.

Data in the form of monthly graphs of historical water diversion are presented below to illustrate the impacts to SWC members' water supply caused by declines in monthly total and natural flow. All of the monthly graphs (**Figures 8-4 – 8-6**) show declines in every month of the irrigation season (May through September).

Graphs of mid-season total SWC daily natural flow diversion for similar dry years (examples shown in **Figures 8-7 and 8-8**) illustrate the flow-based cause of this change in water supply. Each of these plots compares a post-1990 dry water year with the two most similar (in terms of dryness) pre-1960 water years. The graphs display daily natural flow diversion for July through September. The second graph in each pair displays the cumulative natural flow diversion through the middle part of the growing season. Both the daily timestep graphs and the cumulative graphs begin in late June to highlight mid-season water supply changes by removing the effects of partially recorded, early year winter water diversions and varying water use segregation start dates from the comparison.

In **Figure 8-7**, which compares 1992 with 1931 and 1940, the daily natural flow supply to the SWC during the pre-groundwater pumping years is quite constant throughout July and August, at between 2,700 and 2,900 cfs. Because of lower natural flow, natural flow diversion in 1992, in contrast, is much less consistent, and much lower. The pattern in the 1992 natural flow diversion line reflects the daily variation in available natural flow. In other words, although the years are similarly dry upstream of the Snake River Plain, the natural flow at the SWC diversion points is much lower. For this year, the difference in total volume of natural flow during the three-month July through September period is more then 80,000 acre-feet, as shown in the cumulative plot in the lower half of **Figure 8-7.** The same reduction in natural flow supply is shown in **Figure 8-8**, comparing 2003 with 1935 and 1960. For SWC every single post-1990 dry year compared shows similar decreases in mid-summer natural flow diversion compared with pre-1960 dry years. The daily flow comparison graphs for each of the post-1990 dry water years are included in **Appendix A.**

<u>Comparison of Available Days of Sufficient Natural Flow Diversion in Dry Years for Total SWC</u>

The number of days per year during dry conditions when SWC members can use only their natural flow rights without utilizing storage water has declined significantly. Previous comparisons have shown that SWC natural flow diversions are lower during recent years than during similar years prior to 1960. This section shows that SWC member's ability to rely upon their natural flow water rights as a sole source of supply has also been adversely impacted. This results in SWC member using their limited supply of reservoir storage water more frequently and decreasing its carry-over storage and therefore the reliability of its total supply.

A similar analysis to that performed comparing dry year and average year natural flow diversions during similar years is shown for the number of days per year that SWC members divert using only their natural flow water rights (i.e., take water but do not need to take any storage water). Daily water diversion records were analyzed for each of the seven SWC members for each water year 1930 – 2004. The number of days of diverted water were counted up for each year for three classes: a) days with Any Diversions, b) Any Natural Flow, and c) Only Natural Flow. The results of this accounting for all of the SWC members are shown in **Table 8-3** for comparable dry years prior to 1960 and post-1990.

The table shows that since 1990, the SWC members received a supply of natural flow that was adequate to meet all of their water needs on many fewer days than during similarly dry years prior to 1960. For the six post-1990 dry years compared, the average reduction in the number of days per year of only natural flow diversion is 71 days. This compares with a total number of days of natural flow diversion (for the 15 dry years shown) that averages only 197 days. This reduction in the number of days of dependable natural flow is significant. In certain dry years, most notably 2004, the number of days with a reliable natural flow water supply is more than cut in half.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to SWC Historic Water Supply

In the May 2, 2005 Order, IDWR (IDWR Order) set "reasonable carry-over" and "minimum full supply" values for SWC members that are significantly lower than SWC's historical carry-over and water supply prior to and even including the effects of groundwater pumping. SWC's combined historical carry-over levels are higher than the IDWR Order in 37 out of the past 45 years. This is in spite of the fact that SWC's carry-over levels have decreased somewhat since 1960, due to the effects of groundwater pumping. SWC's combined total annual diversions have exceeded the IDWR Order combined minimum full supply in 40 out of the last 45 years of record, making it no where close to a full supply.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 3,105,000 acre-feet for the combined SWC members based upon total water diversion data from 1995. **Figure 8-9** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that SWC diverted more water than this in 40 out of the last 45 years of record. In each of these years of higher total diversion, it was necessary to use storage water to increase the supply. This was done at the expense of providing a full carry-over volume. Because the diversion of additional storage water while drawing down their carry-over volume will tend to produce a potentially less secure water supply during the next irrigation season, the decision to divert storage water rather than to hold it in storage is not made lightly. The SWC members would be unlikely to endanger their future water supplies by using their storage water if the additional diversion was above the "full supply needed". Thus the historical data prove that the SWC members need significantly more water than suggested in the IDWR Order.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for the total of all SWC members of 188,600 acre-feet. As shown on **Figure 8-9**, more carry-over was available in all except eight years during the last 70 years of record. More carry-over than the IDWR Order "Reasonable Carry-over" was always available for the period since full-buildout of the Upper Snake Reservoir storage system (Palisades Reservoir constructed in the late 1950s) and prior to the last two decades (when reach gains have been shown to be impacted strongly by ESPA ground water use), except for 1961.

Twin Falls Canal Company

The water supply of TFCC shows significant decline in natural flow diversions since about 1970. The decline is most easily observed in the decreasing natural flow during subsequent dry periods in the record. During each dry period the strength of the decline becomes more pronounced. TFCC relies upon their October 11, 1900 natural flow right for the great majority of their water supply. In recent years, and progressively since the 1970s, mid-season declines in natural flow of approximately 1,000 cfs are seen in the daily diversion record. On a monthly basis, these declines average 400 cfs and result in TFCC needing to supplement their natural flow supply with storage water. Because TFCC has a relatively small volume of storage available, this results in decreases in TFCC's carry-over storage which makes their dry year supply less reliable.

TFCC Natural Flow and Storage Water Rights

The TFCC's October 11, 1900 natural flow water right is the most senior natural flow water right below the American Falls reach to Milner Dam[4]. TFCC holds 3,000 cfs of the total 3,400 cfs for the October 11, 1900 water right and NSCC holds 400 cfs of this right. This early priority flow right provides TFCC (and NSCC) with first priority to natural flow (including Snake River reach gains) from the American Falls reach to Milner Dam. This high flow rate, high priority natural flow water right provides the foundation of the TFCC water supply. In addition, TFCC also holds a 600 cfs natural flow right with a December 22, 1915 priority and a 180 cfs right with an April 1, 1939 priority. The TFCC reservoir storage contracts total 245,930 acre-feet. Storage contracts include 97,183 acre-feet with a May 24, 1913 priority in Jackson Lake, and 147,582 acre-feet with a March 29, 1921 priority and 1,165 acre-feet with a March 30, 1921 priority in American Falls Reservoir. TFCC water rights are shown in **Appendix A.**

Declines in TFCC Annual Water Supply

The TFCC has experienced a decline in the annual amount of natural flow available for diversion. The natural flow decline is most easily observed during subsequent dry periods in the record. During each dry period the strength of the decline becomes more pronounced. The declines in natural flow diversions affect (decrease) the TFCC total diversions and the annual carryover as well.

[4] Except for miscellaneous small rights totaling less than 200 cfs.

The historical water diversion by TFCC for the 1930-2004 period is shown in **Figure 8-10**. TFCC diversion records are included in **Appendix AQ**. The top lines on this figure show the number of acres irrigated and the total April – September annual water diversions, natural flow diversions, and storage diversions. The bottom half of the figure shows the total storage diversions and the end-of-season carry-over and the total of storage diverted plus carry-over, which represents the total annual storage accrued to the TFCC storage account. Because the historical record of total annual water diversion does not have a consistent basis, the annual water diversion data were adjusted to a consistent April to September record.

The TFCC annual water diversion and storage data reveal that the total diversion volume declines on average and for dry periods after the late 1960s. In **Figure 8-10** the total diversions decline from an average of over 1.08 million acre-feet per year in the 1960s to an average of about 990,000 acre-feet per year in the 1990s and 2000s. This same trend is more pronounced in the record of TFCC natural flow diversions which peak in the 1960s at an average of about 940,000 acre-feet per year, and decline to an average of about 840,000 acre-feet per year in the 1990s and 2000s. There is somewhat less decline in their total annual diversions because of a greater diversion of storage water in the 1990s and 2000s compared to earlier periods. This is in spite of the fact that TFCC has relatively little storage compared with their total water diversion, and attempts to minimize storage use so as to save it to avoid crop losses during subsequent dry years. TFCC's greater dependence upon storage water in recent years to satisfy annual water demands results in reduced carry-over water. Dry-year TFCC carry-over volumes are typically between zero and 60,000 acre-feet in the period since about 1975. In the 30-year period since 1975, fourteen years show carry-over of less than 60,000 acre-feet. Only seven of these were dry years. Dry year carry-over volumes in the 30 years before 1960 were only this low in six extremely dry years. In some water years, TFCC leases storage water to other water users or to the water bank. These amounts are almost always small compared with total TFCC water use. In the 71-year period (1934-2004), TFCC leased water in 28 years and the average of their leases and rentals over the period was 8,669 acre-feet/year. The record of TFCC storage water rentals and leases is included in **Appendix AQ**.

The annual diversion and storage data shown in **Figure 8-10** also show a pattern of increasingly low dry year water supply. Looking at just the low points on the natural flow graph, and starting in 1955, 1961 is lower, 1977 is lower again, 1992 is lower than 1977, 1992 is lower than 1977, and 2003 is lower than 1992. This increasing decline reveals a progressively serious impact to the water TFCC water supply.

The next two sections look at changes in annual natural diversions flow for two hydrologic conditions: dry years and average water supply years.

Comparison of TFCC Annual Natural Flow Diversion for Average Years

Using a similar years approach, TFCC natural flow diversions show a clear decrease when comparing average water years since 1990 with water years before 1960. **Table 8-4** compares the TFCC natural flow diversion for water years after 1990 against natural flow diversion for similarly average years prior to and including 1960. The table shows that this TFCC's average year natural flow diversion has decreased by an average of more than 67,000 acre-feet per year. This represents a decrease in natural flow water supply of about seven percent. Individual yearly comparisons show greater losses. Water Year 1995, which was very similar to 1952 in terms of total surface water inflow above American Falls, provided the TFCC with 187,000 acre-feet less water supply, a decrease of more than 20 percent. This is particularly significant in that 1995 was chosen in IDWR's May 2, 2005 Order as representing a "Minimum Full Supply Needed", while examination of the record indicates that much less water was received than is typical for this type of year.

Comparison of TFCC Annual Natural Flow Diversion for Dry Years

The decline in natural flow diversions described is most pronounced during dry years. The TFCC dry year natural flow diversions have declined by more than ten percent as a result of decreased water availability. **Table 8-5** compares the TFCC natural flow diversion for water years after 1990 against natural flow diversion for similarly dry years prior to and including 1960. The table shows that this company's dry year natural flow diversion has decreased by range of 69,000 acre-feet to 116,000 acre-feet (with an average of more than 83,000 acre-feet) during the six driest post-1990 years. This represents a decrease in natural flow water supply of more than ten percent. Individual yearly comparisons show even greater losses. Water year 2003, which was very similar to 1960 in terms of total surface water inflow above American Falls, provided the TFCC with more than 170,000 acre-feet less water supply, a decrease of almost 20 percent. The next section looks at this decline in more detail, to identify where in the irrigation season the natural flow supply has changed most significantly.

Declines in TFCC Water Supply During the Irrigation Season

The decline in TFCC natural flow supply is most-evident in the monthly natural flow diversion record. During the entire historic record up to approximately the 1970s, TFCC has always enjoyed stable middle-season natural flow diversions, even during dry years of least 2,200 to 2,300 cfs. Since the 1970s, and increasingly into the most-recent record during the 1990s and 2000s, the TFCC natural flow supply has dropped dramatically- to the point where the 2004 natural flow diversions dropped to 1,300 to 1,400 cfs- a maximum decline of about 1,000 cfs. This situation affects TFCC in the following ways: 1) TFCC has suffered shortages in supply which are increasing during the historic record, 2) TFCC can no longer depend on natural flow as a reliable source of supply during July, August and September, 3) TFCC must decrease the amount of water delivered to farms during the middle portion of the season in order to conserve storage water to be used to augment decreased natural flow later in the season in the event that natural flow does not increase, 4) TFCC storage carry-over is entirely depleted during dry periods.

Data in the form of monthly graphs of historical water diversion are presented below to illustrate the impacts to TFCC water supply caused by declines in monthly natural flow. The monthly graphs (**Figure 8-11**) for the early part of the irrigation season (May and June) show more frequent use of storage water since 1975 to meet full water needs as compared to earlier periods. Similarly, these early season graphs show a decreasing supply of natural flow in recent years, particularly in May. The declining trend in early season natural flow and the increasing trend in early season storage water use are more pronounced in the mid-season (July and August) TFCC water diversions. As shown in **Figure 8-12**, diversion of storage water in July has increased significantly, from an average between 500 and 1,000 cfs in the 1930s, 1940s and early 1950s, to an average between 1,000 and 2,000 cfs in the late 1950s, 1980s, early 1990s, and 2000s. This dependence upon mid-season storage water is caused by a decreasing supply of natural flow in July and August. During dry periods prior to 1960 the July natural flow was above 2,100 cfs. After 1960 the July natural flow during dry periods drops to as low as 1,600 cfs. Over the entire period of record (excluding extremely wet years), the TFCC natural flow diversion in July averages over 2,600 cfs for years before 1950, and less than 2,200 cfs for years after 1990. This is a significant reduction in water supply during the hottest part of the growing season. To make up for it, they are forced to deplete their storage water to maintain a full supply.

Graphs of mid-season TFCC daily water diversion for similar dry years (examples shown in **Figures 8-13 through 8-15**) illustrate the impacts from decreased natural flow water supply. Each of these plots compares a post-1990 dry water year with the two most similar (in terms of dryness) pre-1960 water years. The graphs display daily natural flow diversion for July through September. The second graph in each pair displays the cumulative natural flow diversion through the middle part of the growing season. Both the daily timestep graphs and the cumulative graphs begin in late June to highlight mid-season water supply and to correct the early record bias from partially recorded winter water diversions and varying water use segregation start dates.

In **Figure 8-13**, which compares 1992 with 1931 and 1940, the daily natural flow supply to TFCC during the pre-groundwater pumping years is quite constant throughout July and August, at between 2,300 and 2,500 cfs. Because of lower available natural flow, natural flow diversion in 1992, in contrast, is much less consistent, and much lower. The pattern in the 1992 natural flow diversion line reflects the daily variation in available natural flow. In other words, although the years are similarly dry upstream of the Snake River Plain, the natural flow at the TFCC diversion point is much lower. For this year, the difference in total volume of natural flow during the three-month July through September period is more then 60,000 acre-feet, as shown in the cumulative plot in the lower half of **Figure 8-13**. The same reduction in natural flow supply is shown in **Figures 8-14 and 8-15**, comparing 2003 with 1935 and 1960, and 2004 with 1960 and 1955. For TFCC every single post-1990 dry year compared shows similar decreases in mid-summer natural flow diversion compared with pre-1960 dry years.

The daily flow comparison graphs for each of the post-1990 dry water years are included in **Appendix AR**.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to TFCC Historic Water Supply

In the May 2, 2005 Order, IDWR (IDWR Order) set a "reasonable carry-over" and "minimum full supply" values for TFCC that are significantly lower than TFCC's historical carry-over and water supply prior to the effects of groundwater pumping. TFCC's historical carry-over levels are higher than the IDWR Order in 26 out of 30 years prior to 1960. TFCC's carry-over levels have decreased somewhat since 1960, but still have exceeded it in 10 out of the last 30 years. TFCC's total annual diversions have exceeded the IDWR Order minimum full supply in 20 out of the last 45 years of record, making it more of an average supply, than a full supply.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 1,075,900 acre-feet for TFCC based upon total water diversion data from 1995. **Figure 8-16** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that TFCC diverted more water than this in 20 out of the last 45 years of record. In most of these years of higher total diversion, storage water was used to increase the supply. This was done at the expense of providing a full carry-over volume. Because the diversion of additional storage water while drawing down their carry-over volume will tend to produce a potentially less secure water supply during the next irrigation season, the decision to divert storage water rather than to hold it in storage is not made lightly. The TFCC would be unlikely to endanger their future water supplies by using its storage water if the additional diversion was above what was needed.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for TFCC of 38,400 acre-feet. As shown on **Figure 8-16**, in the 30 years prior to 1960 more than this amount of carry-over was available in all except four years. Since 1975, this amount of carry-over has only been available in ten out of 30 years, in the other 20 years less was available. This decrease in TFCC carry-over volume is an effect of the decreases in natural flow diversion described previously. TFCC has been forced to utilize more of their storage water to meet their minimum water needs.

North Side Canal Company

The water supply of the NSCC has significantly declined in terms of dry, comparable-year natural flow diversions. Year-to-year comparable declines exceed 40 percent for 2004, compared with 1955. NSCC's total and natural flow diversions have also decreased on an average annual basis and when comparing hydrologically average years. These declines (which, excluding wet years average about 10 percent) affect their total diversions and reservoir carry-over as well.

NSCC Natural Flow and Storage Water Rights

NSCC's October 11, 1900 natural flow water right[5] is the most senior natural flow water right in the Blackfoot to Milner reach. NSCC holds 400 cfs of the total 3,400 cfs in the October 11, 1900 water right and TFCC holds 3,000 cfs of this right. This early priority flow right provides NSCC (and TFCC) with first priority to natural flow (including Snake River reach gains) below Blackfoot and throughout the American Falls reach to Milner Dam. NSCC also holds a 2,250 cfs natural flow right with a October 7, 1905 priority, a 890 cfs natural flow right with a June 16, 1908 priority, a 300 cfs natural flow right with a December 23, 1915 priority, and a 1,260 cfs right with an August 6, 1920 priority. The NSCC reservoir storage contracts include 312,007 acre-feet with a May 24, 1913 priority in Jackson Lake, 116,600 acre-feet with a March 29, 1921 priority in Palisades Reservoir and 9,248 with a March 29, 1921 priority and 422,043 acre-feet with a March 30, 1921 priority in American Falls Reservoir. Compared with TFCC, NSCC has more natural flow rights but they are of a lower priority. Therefore, NSCC is very reliant on early season natural flow and the preservation of the reliability of reservoir storage rights.

Declines in NSCC Annual Water Supply

A significant decline in NSCC's total and natural flow diversions. These declines (which, excluding wet years average about 10 percent) affect their total diversions and reservoir carry-over as well.

The historical water diversion by NSCC for the 1930-2004 period (April to September) is shown in **Figure 8-17**. NSCC diversion records are included in **Appendix AQ**. The top lines on this figure show the number of acres irrigated and the total April-September annual water diversions, natural flow diversions, and storage diversions. The bottom half of the figure shows the end-of-season carry-over and the total of storage diverted plus carry-over, which represents the total annual NSCC storage accrual.

The NSCC annual water diversion and storage data reveal that the total diversion volume tends to decline after the late 1960s. In **Figure 8-17**, the total diversion declines from an average of over 1.09 million acre-feet per year to an average of about 970,000 acre-feet per year in the 1990s and 2000s. This same trend is reflected in the record of NSCC natural flow diversions which peak in the 1960s at an average of about 550,000 acre-feet per year, and decline to an average of about 450,000 acre-feet per year in the 1990s and 2000s. NSCC also experiences a 40,000 acre-foot decline in their average storage water diversion in the 1990s and 2000s

[5] Except for miscellaneous small rights totaling less than 200 cfs.

compared to earlier periods prior to the full impacts of groundwater pumping. The decline in natural flow diversion and in storage water diversion are each significant because NSCC has a very balanced water supply with approximately half of their annual supply coming from natural flow and half from storage water. The fact that NSCC has not been able to offset decreases in natural flow by greater diversion of storage water indicates that their storage supply is limited and also impacted by groundwater pumping. Because NSCC experiences a severe cut-back in their natural flow water in dry years, they must carefully utilize their storage and maintain as much carry-over as possible to avoid crop losses during dry years. **Figure 8-17** shows greater dependence upon storage water in recent years to satisfy annual water demands resulting in reduced carry-over water. Dry year NSCC carry-over volumes are more frequently less than 100,000 acre-feet in the period since about 1975, compared with the 30 years before 1960. In some water years, NSCC leases storage water to other water users or to the water bank. These amounts are almost always small compared with total NSCC water use. In the 71-year period (1934-2004), NSCC leased water in five years and the average of their rentals over the period was 3,216 acre-feet/year. The record of NSCC storage water rentals and leases is included in **Appendix AQ**.

Comparison of NSCC Annual Natural Flow Diversion for Average Years

Using a similar years approach, NSCC natural flow diversions show a clear decrease when comparing average water years since 1990 with average water years before 1960. **Table 8-6** compares the NSCC natural flow diversion for water years after 1990 against natural flow diversion for similarly average years prior to and including 1960. The table shows that this company's average year natural flow diversion has decreased by an average of more than 61,000 acre-feet per year. This represents a decrease in natural flow water supply of over eleven percent. Individual yearly comparisons show greater losses. Water Year 2000, which was very similar to 1953 in terms of total surface water inflow above American Falls, provided the NSCC with 103,000 acre-feet less water supply, a decrease of more than 20 percent. Similar decreases in natural flow supply are seen in every average year in the post-1990 period.

Comparison of NSCC Annual Natural Flow Diversion for Dry Years

The decline in natural flow diversions described above for hydrologically average water years is more pronounced when considering only dry years. The dry year natural flow diversions of the NSCC have declined by more than twenty-five percent as a result of decreased water availability. **Table 8-7** compares the NSCC natural flow diversion for water years after 1990 against natural flow diversion for similarly dry years prior to and including 1960. The table shows that this company's dry year natural flow diversion has decreased by an average of more than 90,000 acre-feet per year. This represents a decrease in natural flow water supply of more than twenty-five percent. Individual yearly comparisons show much greater losses. Water year 2004, which was very similar to 1955 in terms of total surface water inflow above American Falls, provided the NSCC with more than 212,000 acre-feet less water supply, a decrease of more than 40 percent. The next section looks at this decline in more detail, to identify where in the irrigation season the natural flow supply has changed most significantly.

Declines in NSCC Water Supply During the Irrigation Season

The decline in NSCC total diversions is evident in the monthly and daily flow diversion records for the company. As a summary of monthly conditions and impacts, graphs of total diversions, diversions of natural flow, and diversions of storage water were prepared for each month, May through October (**Appendix AR**).

Individual monthly graphs of historical water diversion show several important trends. Early season (May and June) graphs show less total water diversion in the 1990s and 2000s, compared with the 1950s and 1960s.

Graphs of May and June NSCC diversions show two identifiable trends with respect to total diversions. From a high in the 1950s and 1960s of 3,000 to 3,500 cfs of total diversions, NSCC's May and June diversions have fallen to between 2,000 and 3,000 cfs in May, and 2,500 to 3,500 cfs in June. This increasingly strong trend is also found in mid-season (July and August) NSCC water diversion. As shown in **Figure 8-19**, total water diversion in July has decreased, from an average of 3,900 cfs in the 1950s and 1960s to an average under 3,500 cfs in the most recent 15 years. Declines for the same periods in August total diversions are from 3,700 cfs to 3,200 cfs. From a water rights perspective, diversion declines are likely caused by one or more of NSCC's natural flow rights being regulated off under post-groundwater pumping conditions, while it was on during pre-pumping conditions. Decreased water supply in this critical, peak demand time of year are likely to have a direct impact upon crop production potential.

Graphs of mid-season NSCC. daily water diversion for similar dry years (example shown in **Figure 8-20**) illustrate decline in natural flow water supply. Each of these plots compares a post-1990 dry water year with the two most similar (in terms of dryness) pre-1960 water years. The graphs display daily natural flow diversion for July through September.

In **Figure 8-20**, which compares 1992 with 1931 and 1940, the NSCC daily natural flow supply is between 300 and 350 cfs throughout the July and August. Natural flow diversion in July and August of 1992, in contrast, is much less consistent, and averages 260 cfs less than 1931 and 1940. The difference in total volume of natural flow during the April through September period between 1992 and 1940 is more then 216,000 acre-feet, as shown in the **Table 8-7**, presented earlier. Similar reductions in natural flow supply are shown in the other daily and monthly water diversions graphs included in **Appendix AR**.

Comparison of Available Days of Sufficient Natural flow diversion in Dry Years for NSCC

The number of days per year during dry conditions when NSCC can use only its natural flow rights without utilizing storage water has declined significantly. Previous comparisons have shown that NSCC natural flow diversions are lower during recent years than during similar years prior to 1960. This section shows that NSCC's ability to rely upon its natural flow water rights as a sole source of supply has also been adversely impacted. This results in NSCC using its limited supply of reservoir storage water more frequently and decreasing its carry-over storage and therefore the reliability of its total supply.

A similar analysis to that performed comparing dry year and average year natural flow diversions during similar years is shown for the number of days per year that NSCC diverts using only its natural flow water rights (i.e., takes water but does not need to take any storage water). Daily water diversion records were analyzed for each of the seven SWC members for each water year 1930 – 2004. The number of days of diverted water were counted up for each year for three classes: a) days with Any Diversions, b) Any Natural Flow, and c) Only Natural Flow. The results of this accounting for all of the SWC members are shown in **Table 8-8** for comparable dry years prior to 1960 and post-1990 .

The table shows that since 1990, the NSCC received a supply of natural flow that was adequate to meet all of their water needs on many fewer days than during similarly dry years prior to 1960. For the six post-1990 dry years compared, the average reduction in the number of days per year of only natural flow diversion is 15 days. This compares with a total number of days of natural flow diversion (for the 15 dry years shown) that averages only 43 days. This reduction in the number of days of dependable natural flow is significant. In certain dry years, most notably 1992, 2001, and 2004, the number of days with a reliable natural flow water supply is more than cut in half.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to NSCC Historic Water Supply

In its May 2, 2005 Order, IDWR set "reasonable carry-over" and "minimum full supply" values for NSCC that are significantly lower than NSCC's historical carry-over and water supply prior to the effects of groundwater pumping. NSCC's historical carry-over levels exceeded the state's volume in 27 out of 30 years prior to 1960 and in 36 out of 45 years after 1960. NSCC's total annual diversions have exceeded the state's minimum in 38 out of the last 45 years of record, making the IDWR order determination more of a minimal supply, than a full supply.

Figure 8-21 shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that NSCC has diverted more water than the IDWR order determination for (988,200 acre-feet) 38 out of the last 45 years of record. In most of these years, diversion of storage water was made at the expense of providing a full carry-over volume. Drawing down their carry-over volume, will tend to produce a potentially less secure water supply during the next irrigation season, the decision to use storage water rather than to hold it in storage is not made lightly. The NSCC would be unlikely to endanger their future water supplies by using storage water if the additional supply were truly above the "Minimum Full Supply Needed".

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for NSCC of 83,300 acre-feet. This represents less than 10 percent of their total storage capacity, and just 8 percent of their historical average total (April – September) diversions. As shown on **Figure 8-21**, in the 30 years prior to 1975 more than this amount of carry-over was available in all except three years. Since 1975, more than this amount of carry-over has been available in all except seven years. While the historical data do show a trend towards reduced carry-over levels in recent years, to call this minimal volume of carry-over "reasonable" displays a lack of understanding of the NSCC's water operations.

Groundwater pumping and its effects on NSCC. natural flow and storage water diversion have significantly decreased the company's natural flow water supply and threatens their ability to carry water over to increase the reliability of subsequent years' water supply.

American Falls Reservoir District #2

The water supply of the American Falls Reservoir District #2 (AFRD2) shows significant declines in natural flow diversions since about 1970. The natural flow decline is most easily observed in the decreasing natural flow during average years in the record. During each of the four most recent average water years, AFRD2 has lost between 11,000 and 110,000 acre-feet of natural flow water supply, compared with pre-1960 conditions. Considering that average natural flow diversions for all average water years examined is only 150,000 acre-feet per year, these losses are dramatic. AFRD2 has a large American Falls Reservoir storage right. American Falls Reservoir fill is dependent on reach gains in the American Falls reach. These reach gains are in decline, and the AFRD2 water supply data for the last four years indicate significant impacts from reduced reach gains. When combined with significant, recent year declines in AFRD2 carry-over volumes, the changes threaten the reliability of AFRD2's water supply.

AFRD2 Natural Flow and Storage Water Rights

AFRD2 has only low-priority "flood" rights. These include March 30, 1921 priority rights of 850 cfs and 1,700 cfs. These late priority rights mean that, except for high flow conditions in the spring and fall of average to wet years, AFRD2 is almost totally reliant upon its reservoir storage rights. Even in wet years, AFRD2's natural flow rights and canal capacity only provide 5/8-inch of water per acre of land. The AFRD2 reservoir storage contract is for 393,550 acre-feet in American Falls Reservoir, with a March 30, 1921 priority.

Declines in AFRD2 Annual Water Supply

AFRD2 diversion records are included in **Appendix AQ**. The AFRD2 has experienced a decline in the annual amount of natural flow available for diversion. Because its direct diversion water rights are later priority, AFRD2 receives too little water to compare during dry years, and the natural flow decline is most easily observed in the decreasing natural flow observed during average water years in the record. During each average year in the 1990s and 2000s, the decline in natural flow has been clear. The declines in natural flow diversions affect (decrease) the AFRD2 total diversions and the annual carryover as well, although these changes in total diversion are somewhat obscured by the variability of the AFRD2 natural flow supply and year-to-year flow conditions.

The AFRD2 annual water diversion and storage data reveal that the total diversion volume declines after the early 1970s. In **Figure 8-22** the total diversion declines from an average of over 449,000 acre-feet per year in the fifteen years before 1975 to an average of about

407,000 acre-feet per year after 1990. This same trend is more pronounced in the record of AFRD2 natural flow diversions which peak in the 1960s and 1970s at an average of about 154,000 acre-feet per year, and decline to an average of about 90,000 acre-feet per year after the 1990s. There is somewhat less decline in AFRD2's total annual diversions because of a greater diversion of storage water in the 1990s and 2000s compared to earlier periods. Average storage use for the same comparative period increases by more than 20,000 acre-feet per year. Because AFRD2 has a large amount of storage compared with their total water diversion, it has been able to meet its water supply needs in most years. However, this has been achieved by greater dependence upon storage water and has resulted in reduced carry-over water and an increasingly insecure dry year water supply.

Recent, dry year total storage supply (storage used plus carry over) to AFRD2 has been reduced in comparison to storage supply available during previous dry year conditions[6]. AFRD2 carry-over volumes have been near zero, making it entirely dependent upon the refilling of American Falls for its next year's water supply. Twelve of the last 20 years have seen AFRD2 carry-over storage of less than 50,000 acre-feet. Dry year carry-over volumes in the years before 1960 were only this low five times out of 20 years, and only in extremely dry years. In some water years, AFRD2 leases storage water to other water users or to the water bank. These amounts are always small compared with total AFRD2 water use. In the 71-year period (1934-2004), AFRD2 leased water in one year and the average of their leases over the period was 116 acre-feet/year. The record of AFRD2 storage water rentals and leases is included in **Appendix AQ**.

The next two sections look at changes in annual natural diversions for two hydrologic conditions: dry years and average water supply years.

Comparison of AFRD2 Annual Natural Flow Diversion for Average Years

Using a similar years approach, AFRD2 natural flow diversions show a clear decrease when comparing average water years since 1990 with water years before 1960. **Table 8-9** compares the AFRD2 natural flow diversion for water years after 1990 against natural flow diversion for similarly average years prior to and including 1960. The table shows that AFRD2's average year natural flow diversion has decreased by an average of more than 53,000 acre-feet per year. This represents a decrease in natural flow water supply of about thirty percent.

[6] Less storage plus carryover was recorded during the mid-1970's. This was likely due to the impacts of reconstruction of American Falls Reservoir during this period.

Individual yearly comparisons show greater losses. Water Year 1993, which was very similar to 1946 in terms of total surface water inflow above American Falls, provided the AFRD2 with 110,000 acre-feet less water supply, a decrease of more than 50 percent. Other average years evaluated show similar declines compared to similar years.

Comparison of AFRD2 Annual Natural Flow Diversion for Dry Years

The decline in natural flow diversions described above for hydrologically average water years is less pronounced when considering only dry years. This is because AFRD2 receives little natural flow water and is increasingly dependent on the reliability of American Falls Reservoir storage is in dry years as compared to wet years. Still, the analysis shows that the dry year natural flow diversions of the AFRD2 have declined by more than forty percent compared with the average of all 15 dry years in the analysis, and reductions in natural flow caused by decreased reach gains have caused decreased American Falls Reservoir storage accumulation.

Table 8-10 compares the AFRD2 natural flow diversion for water years after 1990 against natural flow diversion for similarly dry years prior to and including 1960. The table shows that this company's dry year natural flow diversion has decreased by an average of more than 9,600 acre-feet per year. This relatively minor volume of water takes on a greater significance when compared with the average dry year natural flow diversion of only 23,400 acre-feet per year. Individual yearly comparisons show greater losses, although two years (1994 and 2003) display slightly more water than during comparable pre-1960 years. Water year 2004, which was very similar to 1955 in terms of total surface water inflow above American Falls, provided the AFRD2 with zero natural flow diversions. Water year 1955 had 74,000 acre-feet of natural flow diversions, Thus 2004's decrease was 100 percent.

Declines in AFRD2 Water Supply During the Irrigation Season

The decline in AFRD2 total diversions is evident in the monthly total flow diversion records for the company. The graphs of monthly diversions show a clear curve, with peak diversion rates in the 1960s and 1970s, declining by approximately 200 cfs in the 1990s and 2000s.

Data in the form of monthly graphs of historical water diversion are presented below to illustrate the impacts to AFRD2 water supply caused by declines in monthly total diversion. The monthly graphs (**Figure 8-23**) for the early part of the irrigation season (May and June) show less total diversion since 1975, compared to earlier periods in the 1950s and 1960s. As shown in

Figure 8-24, total diversion in July has decreased slightly, from an average around 1,600 in the 1950s, 1960s, and early 1970s to an average around 1,400 cfs in the 1990s, and 2000s. August trends appear similar. The AFRD2 total diversion in July averages over 1,600 cfs for the 1950s and 1960s, and 1,400 cfs for years after 1990. August values show the same magnitude of decline, from 1,500 cfs to 1,300 cfs for the respective years. This is a significant reduction in water supply during the hottest part of the growing season.

Comparison of Available Days of Sufficient Natural Flow Diversion in Dry Years for AFRD2

The number of days per year during dry conditions when AFRD2 can use only its water rights without utilizing storage water has declined. Previous comparisons have shown that AFRD2 natural flow diversions are lower during recent years than during similar years prior to 1960. This section shows that AFRD2's ability to rely upon its natural flow water rights as a sole source of supply has also been adversely impacted, indeed has nearly been eliminated in dry years. This results in AFRD2 using its supply of reservoir storage water more frequently and decreasing its carry-over storage and therefore the reliability of its total supply.

A like analysis to that performed comparing the volume of similar dry year and average year natural flow diversions is shown for the number of days per year that AFRD2 diverts using only its natural flow water rights (i.e., takes water but does not need to take any storage water). Daily water diversion records were analyzed for each of the seven Coalition members for each water year 1930 – 2004. The number of days of diverted water were counted up for each year for three classes: a) days with Any Diversions, b) Any Natural Flow Diversions, and c) Only Natural Flow Diversions. For the pre-1960 and post-1990 comparable dry years the results of this accounting for AFRD2 are shown in **Table 8-11**[7].

The table (**8-11**) shows that since 1990, the AFRD2 received a supply of natural flow that was adequate to meet all of their water needs on many fewer days than during similarly dry years prior to 1960. For the four post-1990 dry years compared, the average reduction in the number of days per year of only natural flow diversion is 23 days. This 23-day reduction compares with a total number of days of natural flow diversion (for the 13 dry years shown with data) that averages only 23 days. This average reduction of fifty percent in the number of days of

[7] Segregation data were unavailable for AFRD2 in 1992 and 1994. These years were eliminated from the analysis.

dependable natural flow is significant. In certain dry years, most notably 2002 and 2004, AFRD2 had zero days with a reliable natural flow water supply.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to AFRD2 Historic Water Supply

In its May 2, 2005 Order, IDWR set a "minimum full supply" value for AFRD2 that is not appropriate in comparison with AFRD2 historical water supply. AFRD2's total annual diversions have exceeded IDWR's estimate of minimum full supply in 36 out of the last 45 years of record, making it more of a minimal supply, than a full supply.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 405,600 acre-feet for AFRD2 based upon total water diversion data from 1995. **Figure 8-25** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that AFRD2 diverted more water than this in 36 out of the last 45 years of record. In most of these years, this water diversion was made at the expense of providing a large carry-over volume. Because the diversion of additional storage water while drawing down their carry-over volume will tend to produce a potentially less secure water supply during the next irrigation season, the decision to divert storage water rather than to hold it in storage is not made lightly. The AFRD2 would be unlikely to endanger the reliability of their future water supplies if the additional supply were truly above the "Minimum Full Supply Needed". AFRD2 storage supply is heavily reliant on American Falls Reservoir fill. Decreased reach gains into American Falls Reservoir will reduce AFRD2 storage in American Falls Reservoir, and the impacts are most pronounced during dry year conditions when AFRD2 natural flow supply is reduced, and demand is highest.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for AFRD2 of 51,200 acre-feet. As shown on **Figure 8-25**, in the 30 years prior to 1960 more than this amount of carry-over was available in all except five years. Since 1975, more than this amount of carry-over has only been available in 15 out of 30 years. The average historical carry-over for the entire 1930-2004 period is more than twice this amount, at 106,000 acre-feet.

Minidoka Irrigation District and Burley Irrigation District

The water supply of the combined Minidoka Irrigation District and Burley Irrigation District (MID/BID) shows significant declines in natural flow diversions after 1990, compared with similar years prior to 1960[8]. The natural flow decline is most easily observed in the decreasing natural flow during dry years in the record. During each of the six most recent dry water years, MID/BID has lost between 38,000 and 88,000 acre-feet of natural flow water supply, compared with pre-1960 conditions. Considering that average natural flow diversions for all dry water years examined is only 227,000 acre-feet per year, these losses are large.

MID/BID Natural Flow and Storage Water Rights

The Minidoka Irrigation District and Burley Irrigation District (MID/BID) have medium- and late-priority natural flow rights. Their combined natural flow rights include 1,726 cfs of March 26, 1903 priority, 1,000 cfs with an August 6, 1908 priority, and 430 cfs with an April 1, 1939 priority. Their first right is second in line behind TFCC's and NSCC's October 11, 1900 right. The MID reservoir storage contracts include 127,040 acre-feet in Jackson Lake with an August 23, 1906 priority, 63,308 acre-feet in Lake Walcott with a December 14, 1909 priority, 58,990 acre-feet in Jackson Lake with a August 18, 1910 priority, 5,328 acre-feet in Palisades with a March 29, 1921 priority and 29,672 acre-feet in Palisades with a July 28, 1939 priority, and 82,216 acre-feet in American Falls with a March 31, 1921 priority. BID's reservoir storage contracts include 31,892 in Lake Walcott with a December 14, 1909 priority, 2,672 acre-feet in Palisades with a March 29, 1921 priority and 36,528 acre-feet in Palisades with a July 28, 1939 priority, and 155,395 acre-feet in American Falls with a March 30, 1921 priority. In some water years, MID/BID leases storage water to other water users or to the water bank. These amounts are almost always small compared with total MID/BID water use. In the 71-year period (1934-2004), MID/BID leased water in 21 years and the average of their leases over the period was 22,579 acre-feet/year. The record of MID/BID storage water rentals and leases is included in **Appendix AQ**.

Declines in MID/BID Annual Water Supply

The MID/BID has experienced a significant decline in the annual amount of natural flow diverted. The record of MID/BID natural flow diversions peaks in the 1960s and 1970s at an average of about 417,000 acre-feet per year, and decline to an average of about 307,000 acre-feet per year after 1990 (**Figure 8-26**). Recent, dry year MID/BID carry-over volumes have been

[8] Water supply data for MID and BID are combined in WD01 records and are also presented as a combined total in this report.

low. Average carryover since 1990 has been slightly lower than average carryover during the 1960s and 1970s.

The next two sections look at changes in annual natural diversions for two hydrologic conditions: dry years and average water supply years. The total diversions decline from an average of over 760,000 acre-feet per year in the fifteen years before 1975 to an average of about 580,000 acre-feet per year after 1990. The reason for some of this decline in total water diversion from the 1950s to the 1990s was due to implementation of more efficient water conveyance and delivery systems primarily within MID. MID/BID diversion records are included in **Appendix AQ**.

Comparison of MID/BID Annual Natural Flow Diversion for Average Years

Using a similar years approach, MID/BID natural flow diversions show a clear decrease when comparing average water years since 1990 with water years before 1960. **Table 8-12** compares the MID/BID natural flow diversion for water years after 1990 against natural flow diversion for similarly average years prior to and including 1960. The table shows that this company's average year natural flow diversion has decreased by an average of almost 34,000 acre-feet per year. This represents a decrease in natural flow water supply of about nine percent. Individual yearly comparisons show somewhat greater losses. Water Year 1991, which was very similar to 1939 in terms of total surface water inflow above American Falls, provided the MID/BID with 69,000 acre-feet less water supply, a decrease of about 20 percent. Other average years evaluated show similar declines compared to similar years.

Comparison of MID/BID Annual Natural Flow Diversion for Dry Years

The decline in natural flow diversions described above for hydrologically average water years is more pronounced when considering only dry years. Dry year natural flow diversions of the MID/BID have declined by more than twenty percent compared with the average of all 15 dry years in the analysis.

Table 8-13 compares the MID/BID natural flow diversion for water years after 1990 against natural flow diversion for similarly dry years prior to and including 1960. The table shows that MID/BID's dry year natural water diversion has decreased by an average of more than 73,000 acre-feet per year. This volume of water is compared with the average dry year natural flow diversion of only 227,000 acre-feet per year. Individual yearly comparisons show greater losses. Water year 1992, which was very similar to 1931 in terms of total surface water inflow above American Falls, provided the MID/BID with 122,000 acre-feet less natural flow diversion. The next section looks at this decline in more detail, to pinpoint where in the irrigation season the natural water supply has changed most significantly.

Declines in MID/BID Water Supply During the Irrigation Season

The decline in MID/BID total diversions is evident in the monthly total flow diversion records for May, June, July, and August. The graphs of total monthly diversions show a clear decrease, with peak diversion rates in the 1960s and 1970s, declining by as much as 1,000 cfs in the 1990s and 2000s.

Data in the form of monthly graphs of historical water diversion are presented below to illustrate the impacts to MID/BID water supply caused by declines in monthly total diversion. The monthly graphs (**Figure 8-27**) for the early part of the irrigation season (May and June) show less total diversion since 1975, compared to earlier periods in the 1950s and 1960s. As shown in **Figure 8-28**, total diversion in May, June, July, and August has declined, by between 400 and 800 cfs. Total diversions in May during the 1960s and 1970s averaged 2,400 cfs. Since 1990, they have averaged 1,600 cfs. Total diversions in June during the 1960s and 1970s also averaged 2,400 cfs. Since 1990, they have averaged 2,600 cfs. Total diversions in July during the 1960s and 1970s averaged 3,000 cfs. Since 1990, they have averaged 2,200 cfs. Total diversions in August during the 1960s and 1970s averaged 2,600 cfs. Since 1990, they have averaged 1,800 cfs. This is a reduction in water supply during the hottest part of the growing season.

Comparison of Available Days of Sufficient Natural Flow Diversion in Dry Years for MID/BID

The number of days per year during dry conditions when MID/BID can use only its natural flow water rights without utilizing storage water has declined. Previous comparisons have shown that MID/BID natural flow diversions are lower during recent years than during similar years prior to 1960. This section shows that MID/BID's ability to rely upon its natural flow water rights as a sole source of supply has also been adversely impacted. This results in MID/BID needing to rely on its supply of reservoir storage water more frequently.

A similar analysis to that performed comparing dry year and average year natural flow diversions during similar years is shown for the number of days per year that MID/BID diverts using only its natural flow water rights (i.e., takes water but does not need to take any storage water). Daily water diversion records were analyzed for each of the seven Coalition members for each water year 1930 – 2004. The number of days of diverted water was counted up for each year for three classes: days with Any Diversions, Any Natural Flow, and Only Natural Flow. **Table 8-14** shows the results of this accounting for MID/BID for comparable dry years prior to 1960 and post-1990.

Table 8-14 shows that since 1990, the MID/BID received a supply of natural flow that was adequate to meet all of their water needs on fewer days than during similarly dry years prior to 1960. For the six post-1990 dry years compared, the average reduction in the number of days per year of only natural flow diversion is 11 days. This compares with a total number of days of natural flow diversion (for the 15 dry years shown) that averages 48 days. This reduction in the number of days of dependable natural flow is significant. In certain comparable dry years, the number of days of reliable natural flow is nearly reduced in half.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to MID/BID Historic Water Supply

In its May 2, 2005 Order, IDWR set a "minimum full supply" value for MID/BID that is significantly lower than MID/BID's historical water supply. MID/BID's total annual diversions have exceeded the state's minimum in every year of the historic record except two. The selection of 1995 as a full supply year is unreasonable. Similarly IDWR's decision that MID/BID's "reasonable carryover" should be zero is also inconsistent with historical records.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 534,500 acre-feet for MID/BID based upon total water diversion data from 1995. **Figure 8-29** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that MID/BID diverted more water than this in every other water year except 1934. In water year 1995, MID/BID used less total water than in any year in the last 70. In most water years the use of storage water to supplement natural flow supply is made at the expense of providing a large carry-over volume. Because the diversion of additional storage water while drawing down their carry-over volume will tend to produce a potentially less secure water supply during the next irrigation season, the decision to divert storage water rather than to hold it in storage is not made lightly. The MID/BID would be unlikely to endanger their future water supplies if the additional supply were truly above the "Minimum Full Supply Needed". Particularly because it represents one of the lowest water use years in the record, IDWR's selection of 1995 as MID/BID's minimum full supply would appear unreasonable.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for MID/BID of zero. As shown on **Figure 8-29**, in the 30 years prior to 1960, carry-over was available in all except two years. Since 1975, carry-over has been available in every year except 1988. The zero value for carry-over is unreasonable for MID/BID Certainly the overall MID/BID water supply operations benefits from the use of carry-over. The average historical carry-over for the entire 1930-2004 period is 218,000 acre-feet.

Milner Irrigation District

The natural flow water supply of the Milner Irrigation District (MIL) shows significant declines in diversions when comparing the period 1965- 1985 with post 1990. The natural flow decline averages more than 50 percent. MIL has made up for these declines in natural flow by diverting more storage water, leaving their total diversions essentially unchanged. This pressure to use storage water has resulted in a decline in MIL carry-over since about 1985.

MIL Natural Flow and Storage Water Rights

MIL has relatively low-priority natural flow rights and medium priority storage rights. Their direct diversion rights include 135 cfs with a November 14, 1916 priority, 121 cfs with an April 1, 1939 priority, and 37 cfs with an October 25, 1939 priority. Their reservoir storage contracts include 44,951 acre-feet in American Falls with a March 30, 1921 priority and 45,640 acre-feet in Palisades with a July 28, 1939 priority.

Declines in MIL Annual Water Supply

As shown on **Figure 8-30**, MIL experienced a significant increase in annual diversions from the 1930s, through the 1940s and 1950s associated with increasing irrigated acreage. The historical water diversion by MIL for the more consistent 1965-2004 period is shown in **Figure 8-31**. The MIL annual water diversion and storage data reveals that the total diversion volume increases significantly from the 1930s through the 1950s, then remains essential constant through the 2000s. The trend and changes in the record of annual natural flow diversions is somewhat different. Natural flow diversions in the period 1965 through 1985 average 35,000 acre-feet per year. Natural flow diversions in the period after 1990 average just 16,000 acre-feet per year. For these same two time periods, total diversions average 60,000 acre-feet per year and 58,000 acre-feet per year, respectively, meaning that the total water supply was essentially constant, while the natural flow supply declined by more than 50 percent. This is a significant change in total natural flow diversion to MIL. Recent, dry year MIL carry-over volumes have been low, and less than other dry periods on record from 1940 to 2005. In some water years, MIL leases storage water to other water users or to the water bank. These amounts are almost always small compared with total MIL water use. In the 71-year period (1934-2004), MIL leased water in five years and the average of their leases over the period was 645 acre-feet/year. The record of MIL storage water rentals and leases is included in **Appendix AQ**. MIL diversion records are also included in this Appendix.

Declines in MIL Water Supply During the Irrigation Season

The decline in MIL total diversions is evident in the monthly total flow diversion records for May, July, and August. The primary issue for MIL is recent decreases in natural diversions. However, because of MIL demand growth between 1930 and 1960, pre-1960 water years are not directly comparable against post-1990 years, as they are for other SWC members.

Data in the form of monthly graphs of historical water diversion are presented below to illustrate the impacts to MIL water supply caused by declines in monthly total diversion. The monthly graphs (**Figure 8-32**) for the early part of the irrigation season show somewhat less total diversion during the 1990s and 2000s, compared with the 1970s. As shown in **Figures 8-32 and 8-33**, total diversion in May, July, and August has declined, by approximately 50 cfs. This is a significant reduction in water supply during the hottest part of the growing season.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to MIL Historic Water Supply

In its May 2,2005 Order, IDWR set a "minimum full supply" value for MIL that is significantly lower than MIL's historical water supply. MIL's total annual diversions have exceeded the state's minimum in every year of the historic record except two. The selection of 1995 as a full supply year is unreasonable. Similarly IDWR's decision that MIL's "reasonable carryover" should be 7,200 acre-feet is also inconsistent with historical records.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 50,800 acre-feet for MIL based upon total water diversion data from 1995. **Figure 8-34** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that MIL diverted more water than this in 12 out of 14 years since 1990. In water year 1995, MIL used less total water than in any recent year except 2004. Because MIL has consistently used more water than the IDWR's "full supply" it would not appear to be a reasonable value.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for MIL of 7,200 acre-feet. As shown on **Figure 8-34**, in the 30 years prior to 1960, MIL carry-over has exceeded this amount in 43 out of 45 years since 1960. To the extent that IDWR intends to use this "reasonable carryover" to restrict MIL storage operations or water entitlement, the figure would appear to be unreasonably low compared with the historical record. Certainly MIL water supply operations benefit from the use and availability of carry-over. The average historical carry-over for the entire 1960-2004 period is 44,000 acre-feet.

A & B Irrigation District

The total water supply of the A&B Irrigation District (A&B) shows no significant changes in diversions throughout the 1957-2004 period[9]. Recent declines in carry-over storage do appear to be a problem. Three of the last four years have seen carry-overs levels lower than any others in the last 40-years. Because of a lack of segregation data, it is not possible to determine whether the reduced carry-over is a result of reduced natural flow diversions or a decrease in A&B's ability to refill their reservoir storage.

A&B Natural Flow and Storage Water Rights

The A&B Irrigation District (A&B) has a low-priority natural flow and storage rights. Their direct diversion right is 267 cfs with an April 1, 1939 priority. Their reservoir storage contracts include 46,826 acre-feet in American Falls with a March 30, 1921 priority and 90,800 acre-feet in Palisades with a June 28, 1939 priority.

Declines in A&B Annual Water Supply

The pattern of annual A&B irrigation diversions is remarkably constant. As shown on **Figure 8-35**, A&B annual diversions have ranged from a minimum of 42,000 acre-feet to a maximum of 61,000 acre-feet, without apparent trends. Without diversion data from similar dry periods from the 1930s and 1940s to compare against, and given the absence of clear trends for recent years, it not possible to draw many conclusions about changes in A&B water supply.

The historical water diversion by A&B for the 1957-2004 period is shown in **Figure 8-35**. A&B diversion records are included in **Appendix AQ**. The top lines on this figure show the number of acres irrigated and the total April – September annual water diversions, natural flow diversions, and storage diversions. The bottom half of the figure shows the total storage

[9] A&B Irrigation District did not exist prior to 1957.

diversions and the end-of-season carry-over and the total of storage diverted plus carry-over, which represents the total annual storage accrued to the A&B storage account. Because the historical record of total annual water diversion does not have a consistent basis, the annual water diversion data was adjusted to a consistent April to September basis to allow equivalent comparisons of water diverted through the historic record.

The A&B annual water diversion and storage data reveals that the total diversion volume remains essentially constant throughout the period of record. The trend and changes in the record of annual natural flow diversions is somewhat different. Excluding wet years, natural flow diversions in the period prior to 1980 average 10,100 acre-feet per year. Excluding wet years, natural flow diversions in the period after 1990 average just 6,900 acre-feet per year. For these same two time periods, total diversions average 51,000 acre-feet per year and 55,000 acre-feet per year, respectively, meaning that the total water supply was higher in the later period, while the natural flow supply declined by more than 30 percent. This is a significant change in total natural flow diversion to A&B. During water year 2004, Unit A lands in the District experienced a significant lack of water availability.

Recent, dry year A&B carry-over volumes have been low, with a trend downward. Excluding wet years, carryover since 1990 is markedly lower than in the 1960s and 1970s. Storage water records back this up, with approximately 17% more storage diverted during post-1990, non-wet years, compared with pre-1980 non-wet years. In some water years, A&B leases storage water to other water users or to the water bank. These amounts are almost always small compared with total A&B water use. In the 48-year period (1957-2004), A&B leased water in 15 years and the average of their leases over the period was 12,187 acre-feet/year. The record of A&B storage water rentals and leases is included in **Appendix AQ**.

Because the District did not exist prior to 1957, no examinations are possible based on similar hydrologic years comparing post-1990 with pre-1960 conditions.

Comparison of IDWR May 2 Order for Reasonable Carry-over and Minimum Full Supply to A&B Historic Water Supply

In its May 2, 2005 Order, IDWR set a "minimum full supply" value for A&B that is significantly lower than A&B's historical water supply. A&B's total annual diversions have exceeded the state's minimum in eight out of the last ten years and in all except 15 years of the 48-year historic record. The selection of 1995 as a full supply year is unreasonable for A&B.

Similarly IDWR's decision that A&B's "reasonable carryover" should be zero is also inconsistent with historical records.

The IDWR May 2, 2005 Order set a "Minimum Full Supply Needed" of 50,000 acre-feet for A&B based upon total water diversion data from 1995. **Figure 8-36** shows a comparison of the IDWR's "Minimum Full Supply Needed" to the historic annual diversions. Examination of the annual data shows that A&B diverted more water than this in eleven out of 14 years since 1990. In water year 1995, A&B used less total water than in any recent year except 2004, and in 2004, low diversions were the result of a lack of an adequate water supply for the irrigation of lands within unit A of the District. Because A&B has consistently used more water than the IDWR's "full supply" it would not appear to be a reasonable value.

The IDWR May 2, 2005 Order established a "Reasonable Carryover" volume for A&B of 8,500 acre-feet. As shown on **Figure 8-36**, A&B carry-over has exceeded this amount in 46 out of 48 years of record. To the extent that IDWR intends to use this "reasonable carryover" to restrict A&B storage operations or water entitlement, the figure would appear to be unreasonably low compared with the historical record. The IDWR Order carry-over value is unreasonable for A&B. Certainly A&B water supply operations benefit from the use and availability of carry-over. The average historical carry-over for the entire 1957-2004 period is 74,000 acre-feet, more than eight times the IDWR value.

EVALUATION OF SWC IRRIGATION REQUIREMENTS

Objective

The objective of this analysis was to estimate irrigation system water requirements for SWC member systems as influenced by the water demand from irrigated crops.

Crop Water Requirements

The crop water requirement is termed the evapotranspiration or consumptive use and is crop type and species dependent. The objective of irrigation is to supply water to the roots of all crops in a timely manner so that the roots can extract adequate moisture from the soil to prevent stress on the plant. The evapotranspiration or consumptive use is driven by ambient air temperature, humidity, and wind speed above the crop canopy. The crop water requirement (CU), is offset by the effective precipitation which infiltrates the soil to the root zone. The required irrigation water is therefore the difference between the CU and the effective precipitation and is called the consumptive irrigation requirement (CIR). The CU and CIR vary throughout the irrigation season and vary widely from year to year depending on the seasonal weather patterns.

Field Headgate Requirement

The field CU is the basis for analysis of diversion requirements for irrigation systems. In order to provide the crop CU at the root zone of the plant, water must be applied to the fields by means of some type of application system. Historically, water was applied through ditches and furrows between plant rows to allow percolation or infiltration of water into the soil and thus to the plant roots for uptake. Sprinkler irrigation, where pressurized water is applied through nozzles, is now the preferred application method and much of the irrigated land in the Eastern Snake River Plain has been converted to sprinkler. The percent of the water applied to the fields which is effective in meeting the crop water requirement, CU, is called the application efficiency. The field headgate requirement is therefore the crop consumptive irrigation requirement, CIR, divided by the application efficiency. Furrow irrigation results in farm field runoff which is included in the application efficiency. Field application efficiencies for furrow irrigation can vary from <30% to 50% depending on the soil type, field slope, and irrigation management. Project application efficiencies using sprinkler irrigation, (either hand lines, wheel lines, or center pivots), can be as high as 75% or 80%.

Diversion Requirement

The diversion requirement or amount of water required to be diverted from a river, well, or reservoir via an open channel system includes transmission losses, operational waste, and the field application requirement. Transmission system losses are primarily the result of seepage from the canals and laterals which is dependent on the canal or lateral geometry and the soil type in the canal prism. Operational waste is that water which is discharged from the distribution system as a result of leaks in delivery structures or discharge from wasteways or the ends of canals and laterals. Operation of an open channel irrigation delivery system always results in operational waste because control of diversion and delivery is not precise enough to eliminate all spills and deliver all water in the channels through farm headgates. Estimates and measurements of operational waste vary from 10 to 30 percent or more of diversion depending on the delivery system length, shape, and lateral network. System water management policy and expertise and the degree of automation and control also influence the operational waste magnitude.

Canal Seepage

Canal seepage rates are determined by the infiltration rates of soils and by the wetted area of the canal prism. Operational seepage rates can generally only be determined by precise inflow-outflow measurements, by ponding sections of the canal, or by seepage meter methods. There are several empirical methods of estimating canal seepage rates using relationships developed from measured data. One such method, which is accepted by the State of Idaho Department of Water Resources is that developed by Worstell which utilizes empirically determined seepage rates based on soil types. This procedure is outlined in the report Guidelines for the Evaluation of Irrigation Diversion Rates (Hubble Engineering and Associated Earth Sciences, 1991) developed for IDWR (often referred to as the "Hubble Report"). This procedure recognizes and recommends seepage rates in cubic feet per square foot per day (ft/day) for soil types varying from clayey to sandy soils as well as various types of canal linings.

Procedure

A recognized procedure for planning or evaluation of irrigation systems is to calculate the diversion requirement based on crop distribution, application procedures and efficiency, and system losses. This procedure was used to substantiate the water diversion requirements of the seven SWC member irrigation systems based on beneficial use as compared with estimates based on historical diversions for specific years or periods. General planning criteria requires a selection of a risk level. For this analysis, a risk or probability level of 90% was selected for the consumptive use parameter. This essentially assumes that the water diversion requirement determined would provide an adequate supply in 9 years out of 10.

The procedure used was as follows:

1. The irrigated area for each district was determined from irrigation company data including the published Water Conservation Plan Reports, crop and water reports filed with the U.S. Bureau of Reclamation, or IDWR shape files prepared in conjunction with the Snake River Basin Adjudication. Acreages for the most recent years for which data were available were used to reflect current practices.

2. Crop distribution for each district was determined from irrigation company data including USBR crop reports, Water Conservation Plan Reports, or USDA Crop Statistics data for counties. The crop acreage was utilized to determine the percent of each type of crop within the service area of each district that was irrigated during the most recent period for which data was available.

3. Monthly average consumptive use for each crop for each district was determined from published data in the publication "Consumptive Use for Crops in Idaho" (Allen and Brockway, 1983). Both the crop consumptive use and the crop consumptive irrigation requirement were determined and the 90% probability level for each monthly average CU or CIR determined using the standard normal density function for each parameter.

4. For each month of the irrigation season, the weighted average volume of water in acre-feet required for each crop for the district was determined based on the percent crop distribution. The total monthly water volume requirement for the district was determined for each of four levels of consumptive use or consumptive irrigation requirement: average CU, average CIR, CU90%, and CIR 90%.

5. General soil types for each irrigation district, or sub-area of each district were determined from NRCS Soil Survey Data published for each county.

6. The distribution system, including main canals and laterals as determined from system maps furnished by each district, was digitized on rectified 2004 aerial photos. Channel lengths and widths of each canal or lateral were determined from the aerial photos and/or from interviews with company managers.

7. Seepage coefficients (Worstell) were determined for each sub-reach of each canal or lateral based on the soil type through which the channel was built. Seepage for each sub-

reach was calculated based on the Worstell procedure using the channel length and calculated seepage loss per mile.

8. Monthly seepage loss volumes for the entire distribution network of each system were determined.
9. Monthly diversion volume requirements were calculated by addition of the monthly seepage loss volumes to the field headgate requirements. Since no consistent measured operational waste volumes for each of the districts are available, the calculated diversion volume is conservative.

Irrigation Requirement Results

Diversion requirements for each district were calculated based on the average CU, average CIR, CU90 and CIR90. **Table 8-15** summarizes the calculated monthly and total seasonal Surface Water Coalition Water Requirements for each district in acre-feet and the annual volume in acre-feet/acre. The calculated diversion requirements include only seepage losses from the canal and lateral systems and do not include operational waste.

Table 8-16 shows the calculated water annual water requirement based on the average CIR compared to IDWR's estimate of the Minimum Full Supply needed for each district based on the May 2, 2005 IDWR Order. The estimated Minimum Full Supply needed was determined based on reported 1995 diversions for each Coalition member system.

Table 8-17 shows the calculated annual water requirements based on the CIR90% compared to IDWR's estimate of the Minimum Full Supply needed for each district based on the May 2, 2005 IDWR Order. The estimated Minimum Full Supply needed was determined based on reported 1995 diversions for each Coalition member system.

Irrigation Requirement Conclusions

The procedure used to calculate irrigation system water diversion requirements using crop water requirements and system efficiencies and losses is a recognized procedure utilized by State and Federal water resource agencies. Consumptive use values and transmission loss estimating procedures used in these analyses are recognized by the State of Idaho and other resources agencies. The calculated monthly volume water requirements for the Surface Water Coalition member districts are technically feasible and attainable with district facilities and represent reasonable estimates of beneficial use of the resource. Utilization of calculated diversion requirements for planning and evaluation of irrigation systems is justifiable.

Comparison of the calculated diversion requirements for Coalition member systems with the IDWR's estimate of the Minimum Full Supply needed as determined in the May 2, 2005 order shows that the IDWR Minimum Full Supply volumes are in all cases significantly less than the calculated values based on crop water requirements. Utilization of an arbitrary year diversion volume as a measure of beneficial use for an irrigation project is not justified. Using an arbitrary year historical diversion volume as a measure of minimum full supply does not account for variability in either intra-season consumptive use or precipitation.

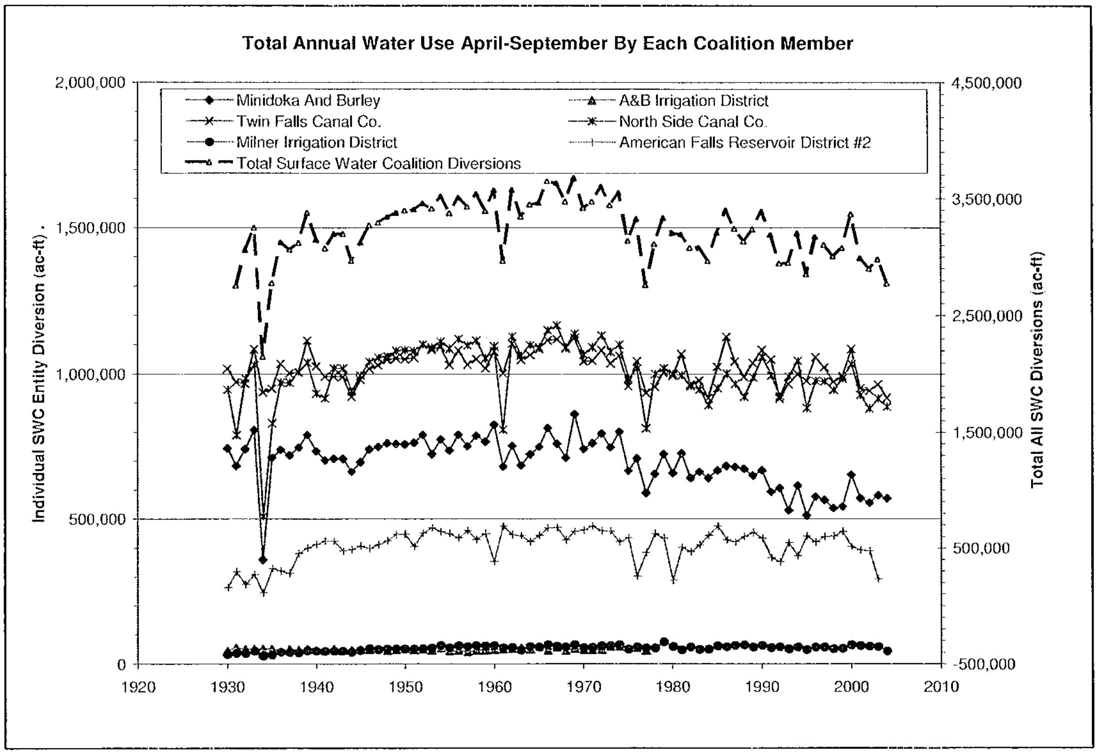
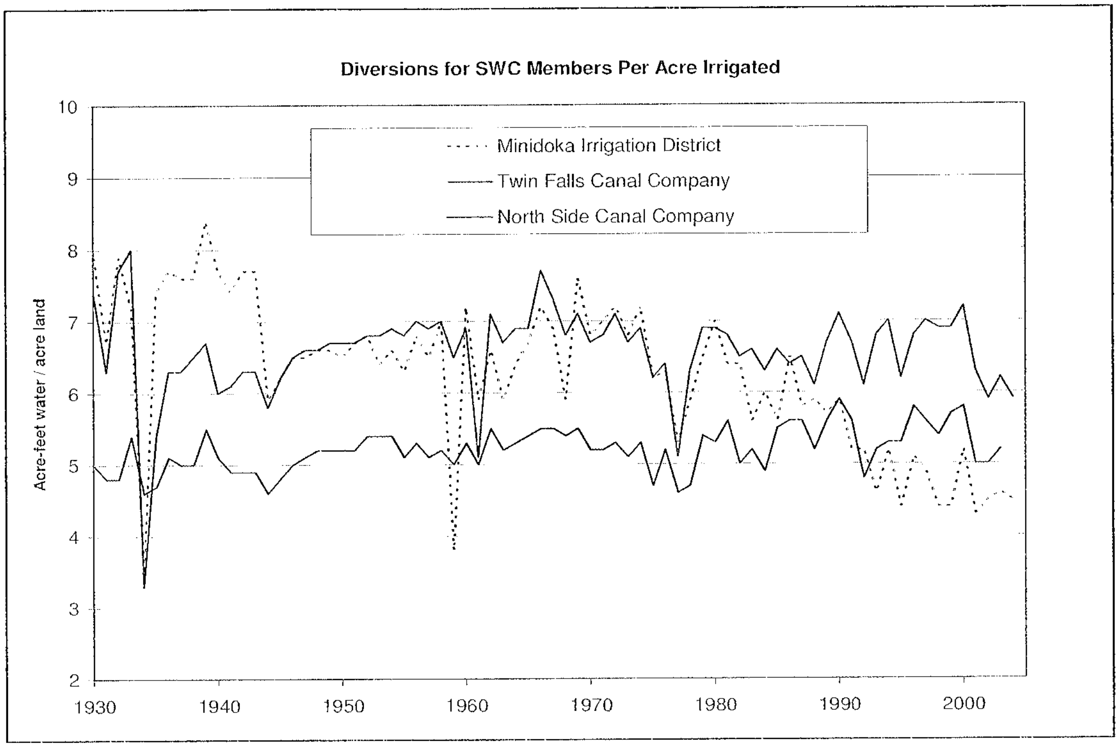


Figure 8-1 Total Annual Diversion By Each Coalition Member



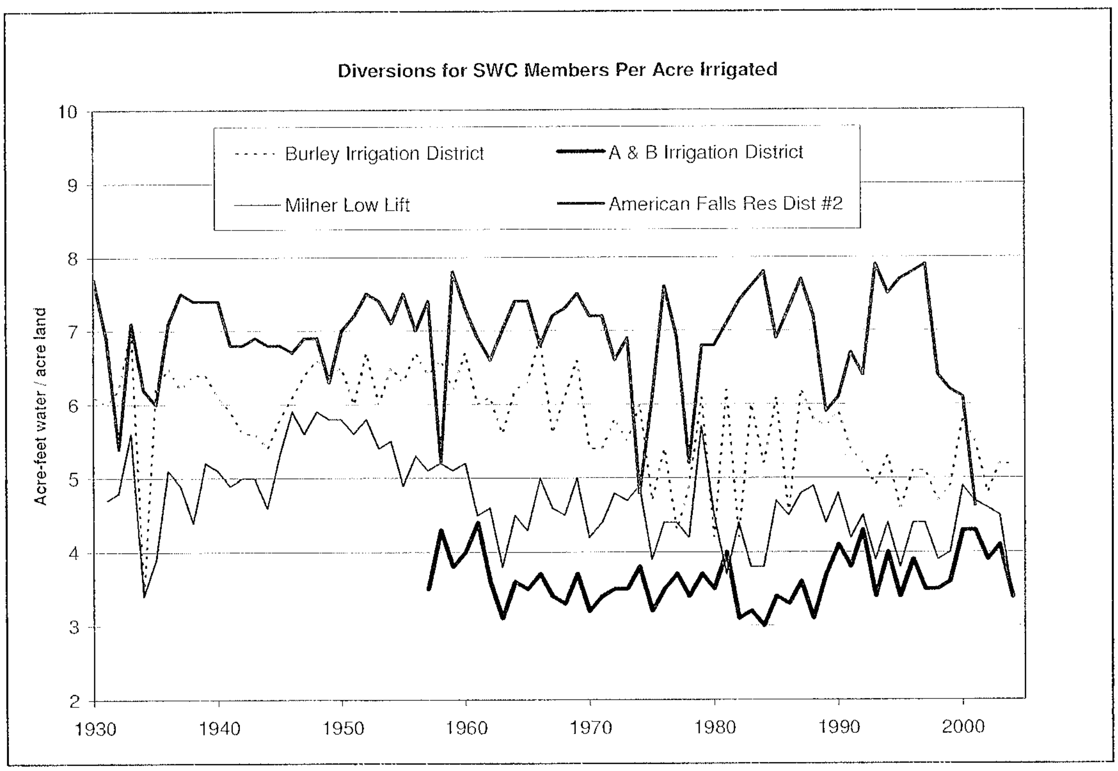
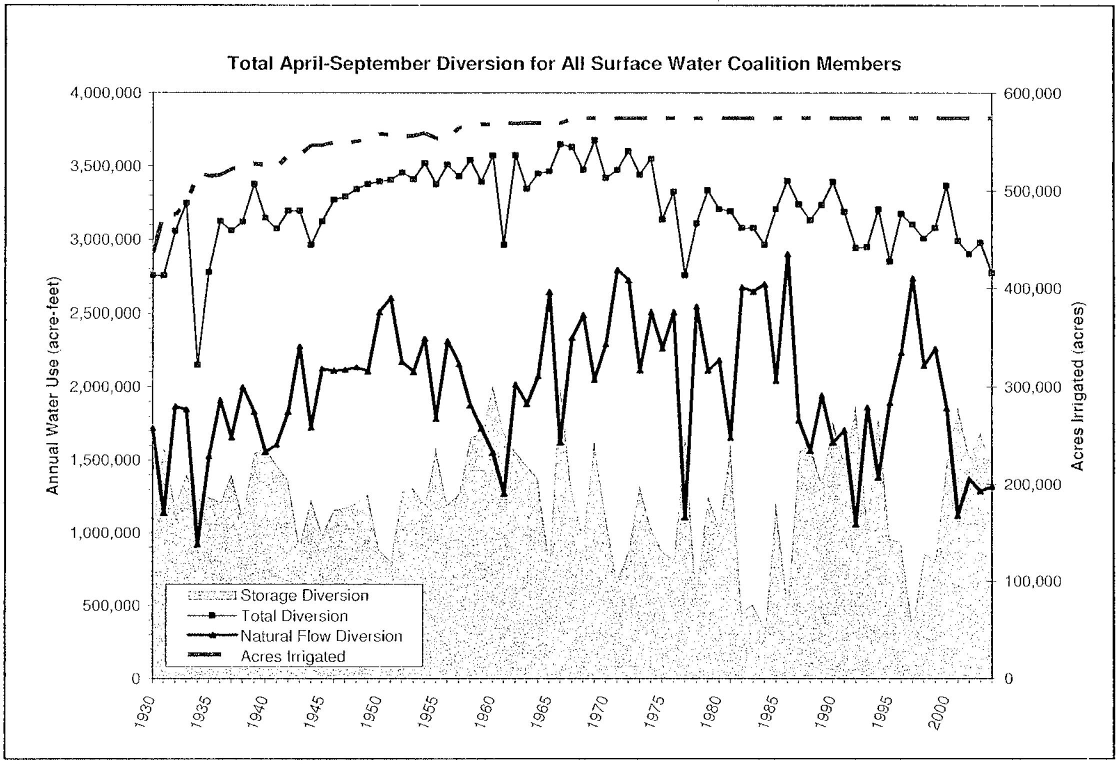


Figure 8-2 Diversions Per Acre for each SWC Member



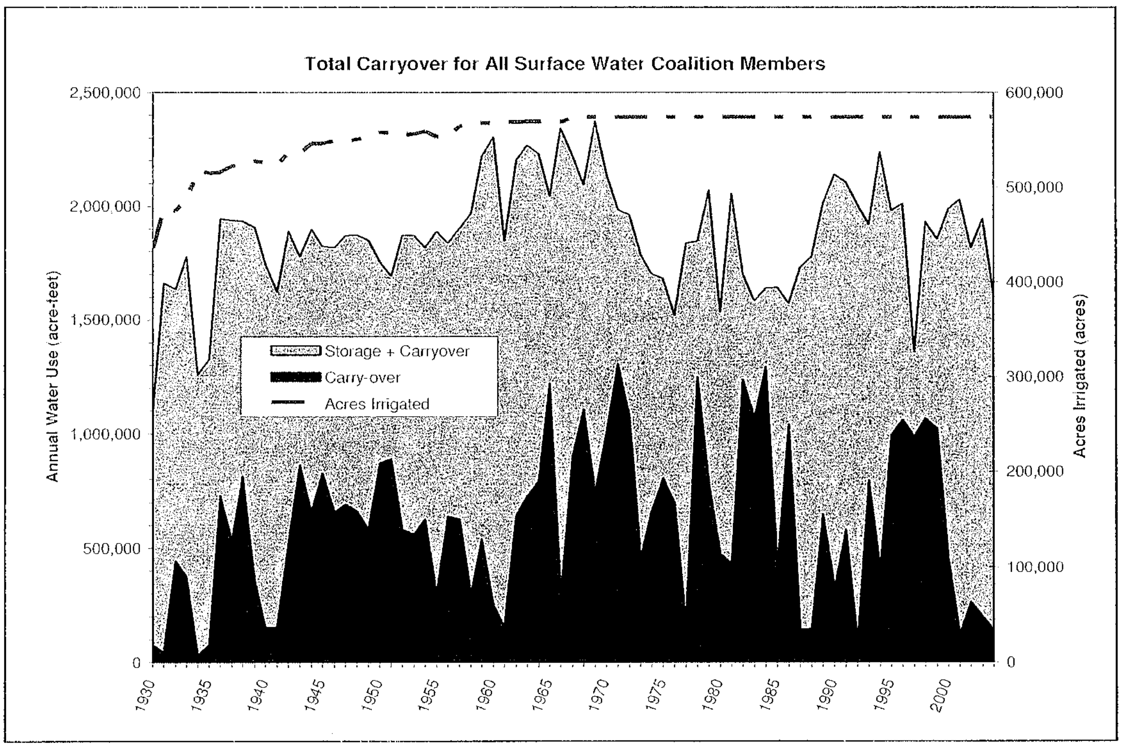


Figure 8-3 Combined SWC Annual Diversion and Total SWC Carryover

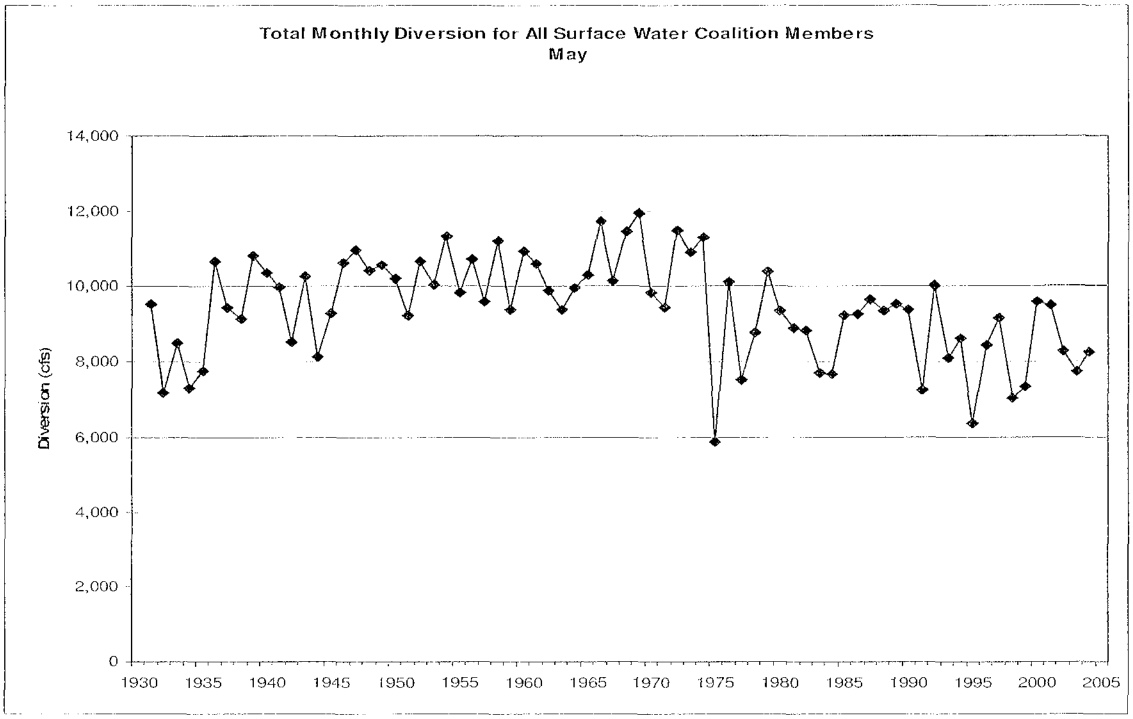
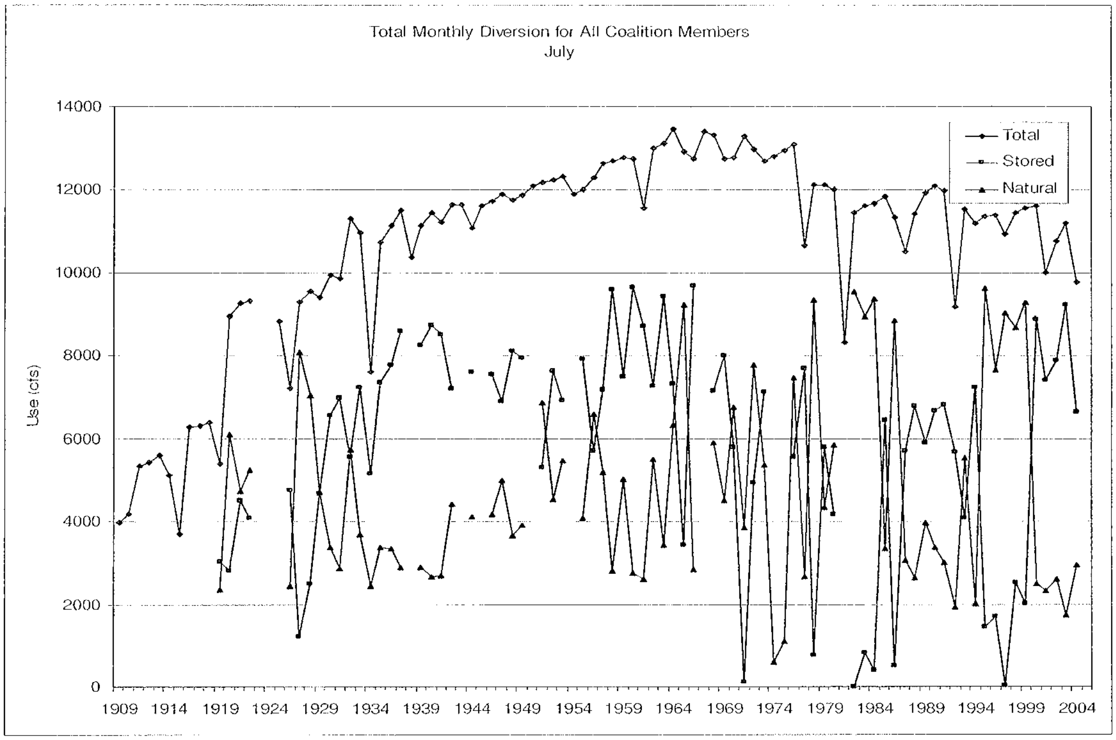


Figure 8-4 Early Season Monthly Combined SWC Diversion



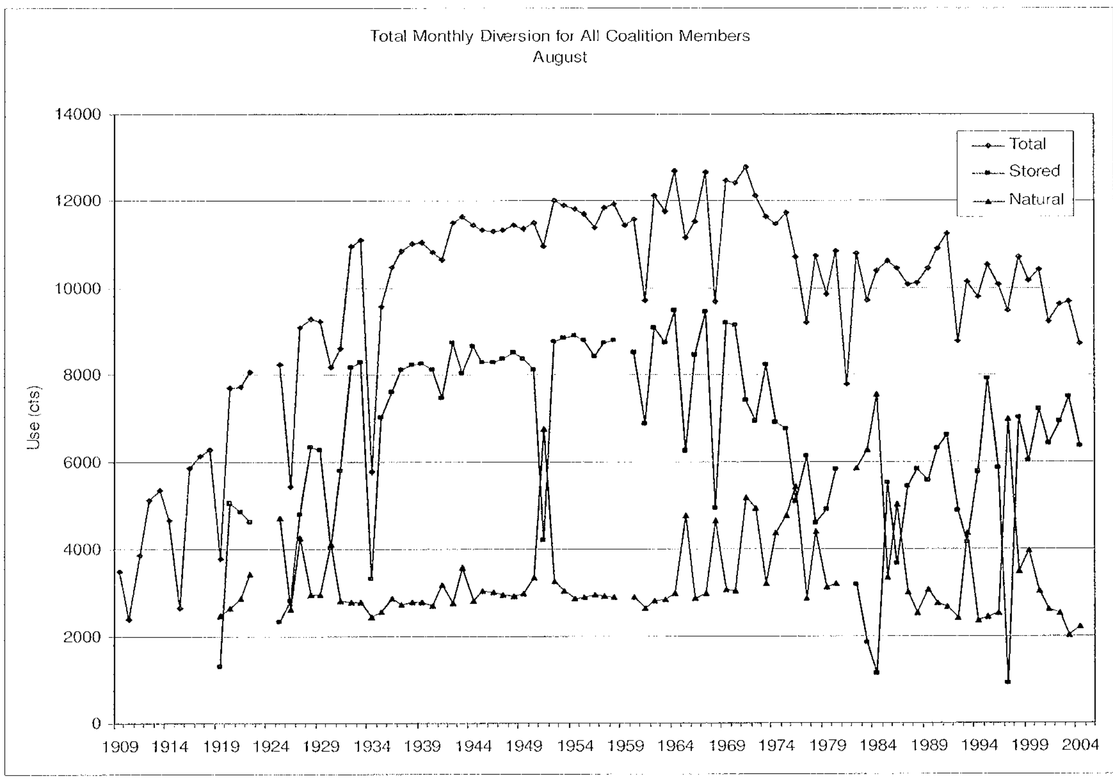


Figure 8-5 Mid-Season Monthly Combined SWC Diversion

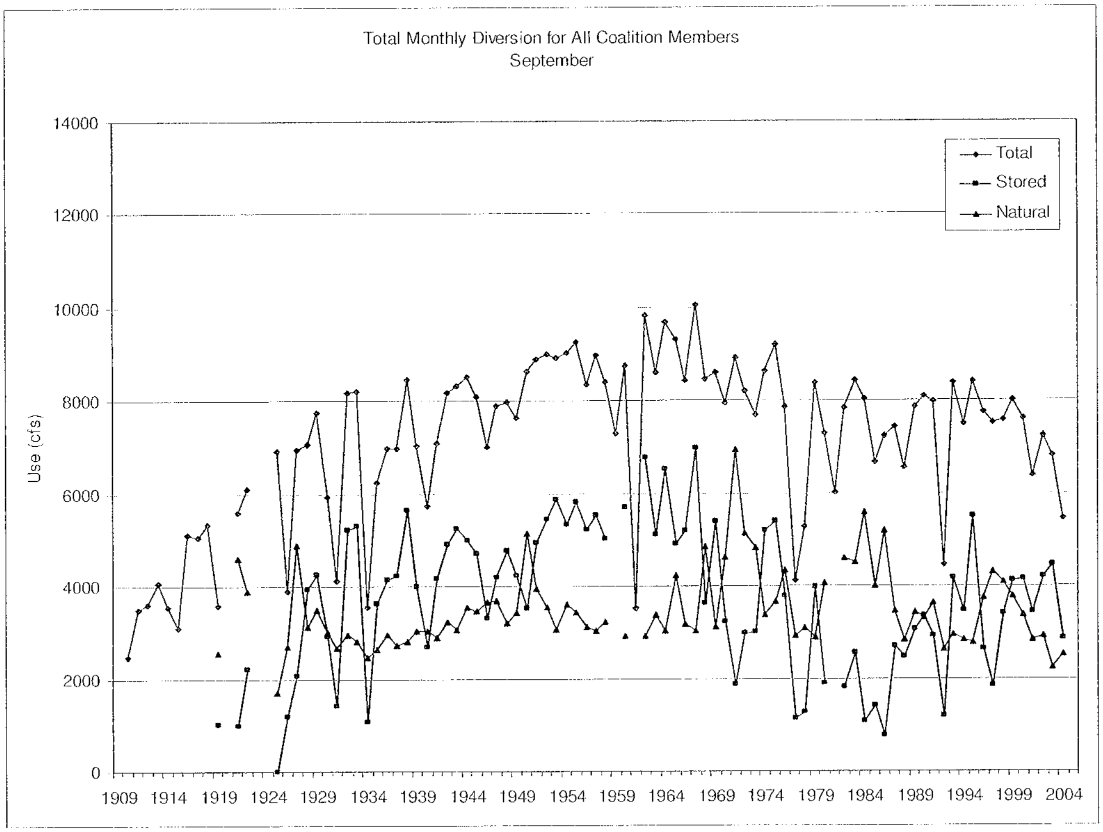
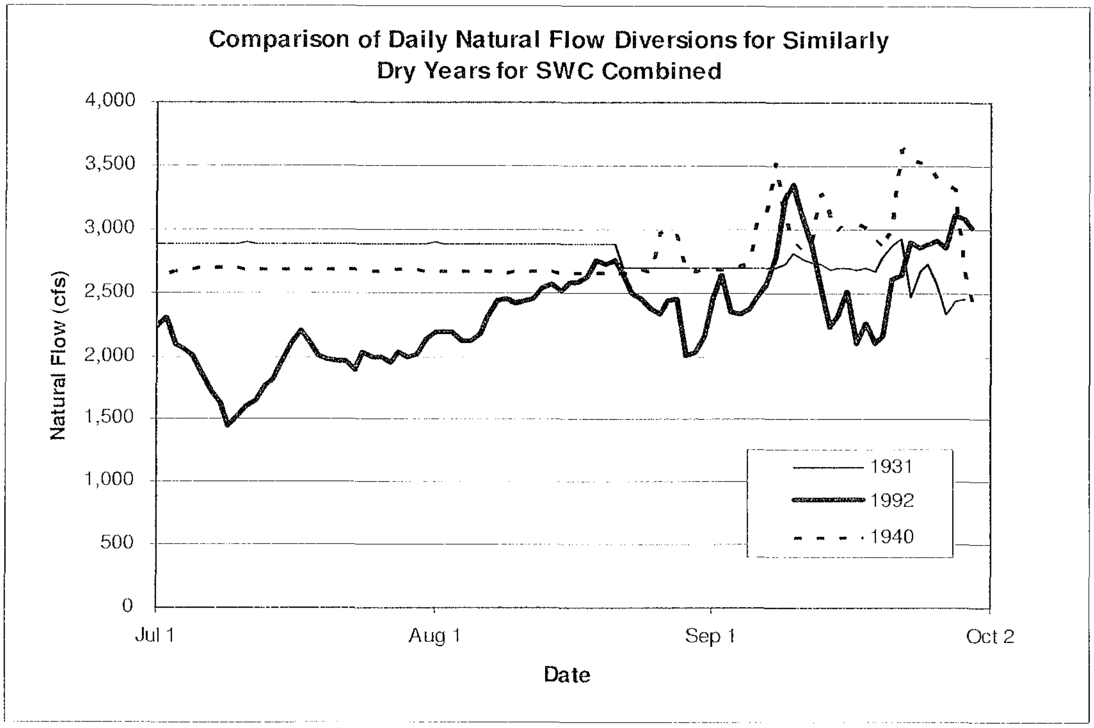


Figure 8-6 Late Season Monthly Combined SWC Diversion



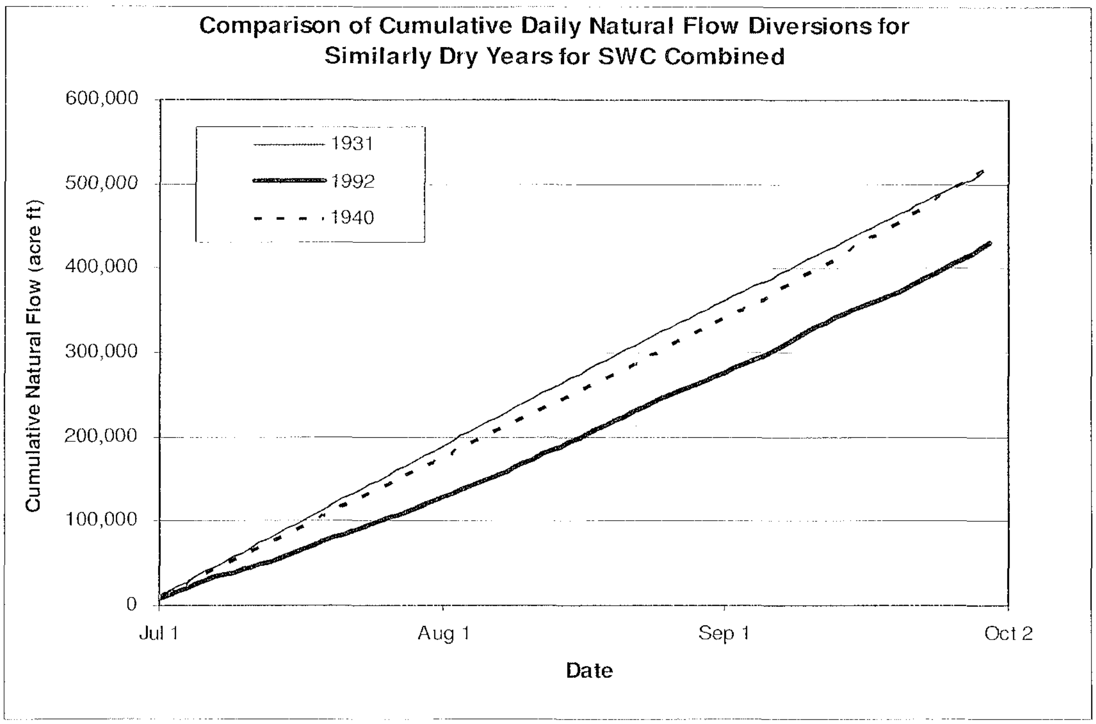
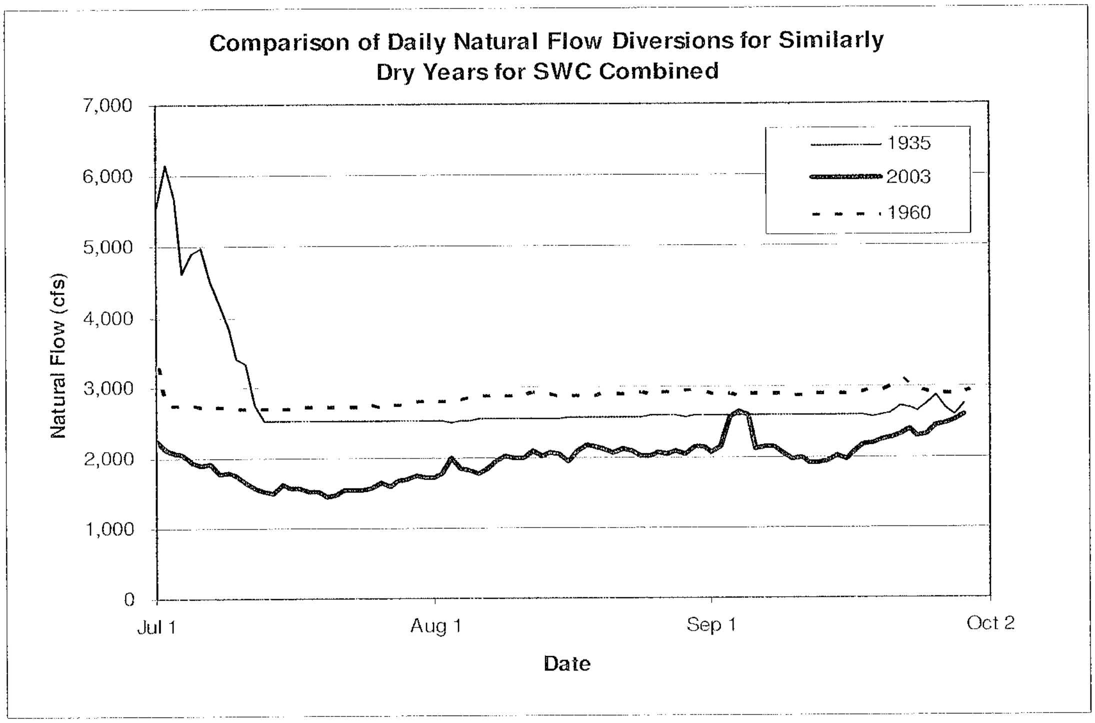


Figure 8-7 Comparison of SWC Combined Daily and Cumulative Daily Natural Flow Diversions - 1992



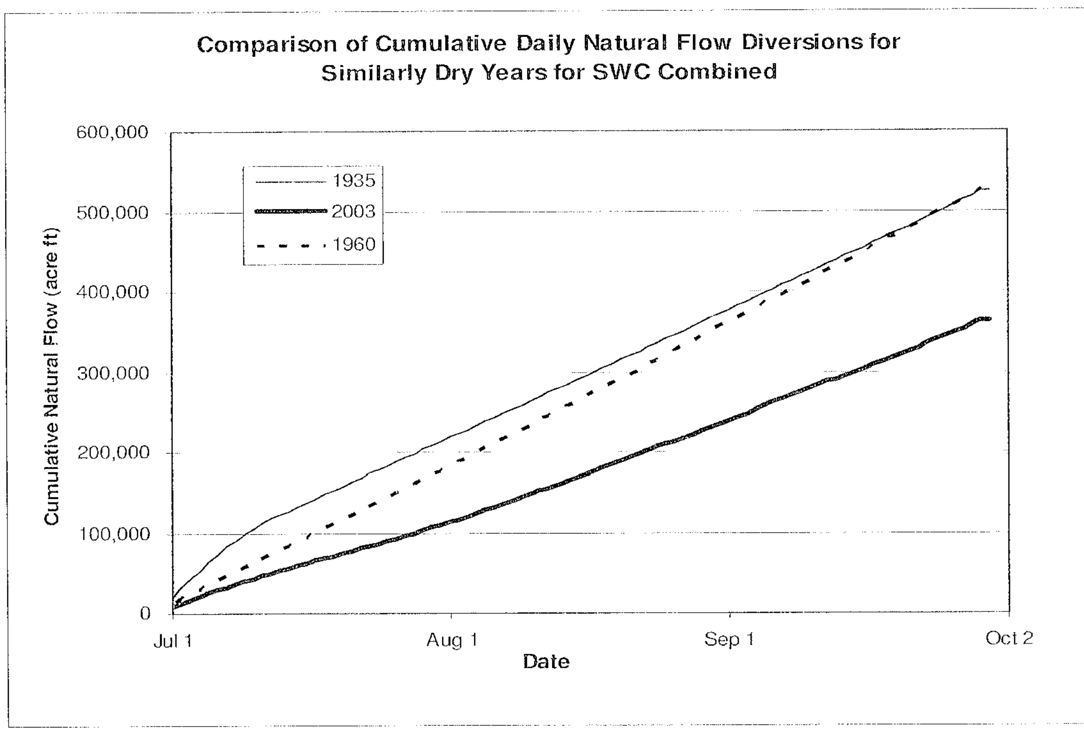


Figure 8-8 Comparison of SWC Combined Daily and Cumulative Daily Natural Flow Diversions - 2003

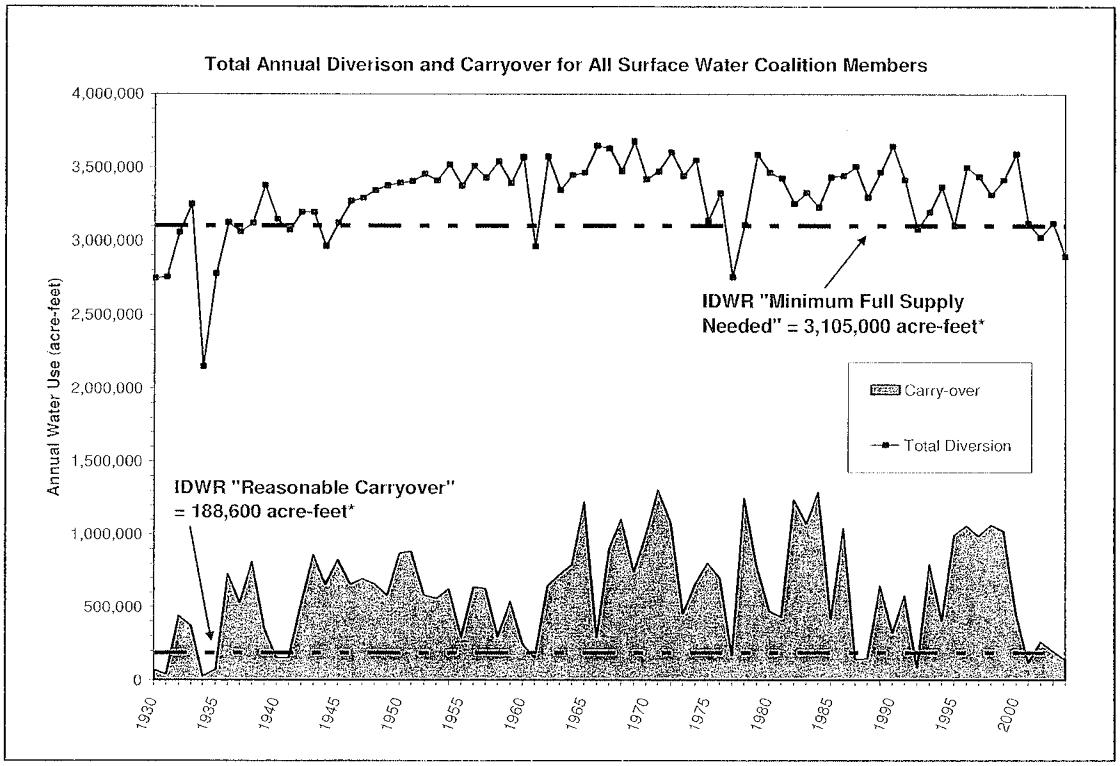
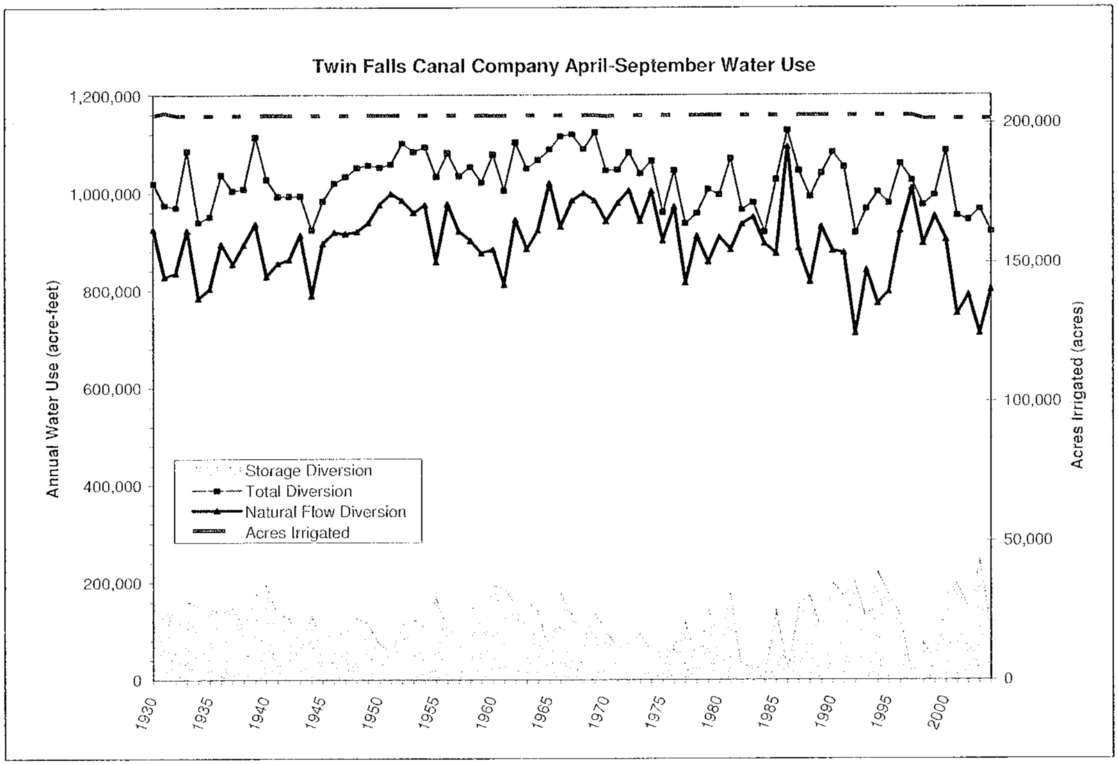


Figure 8-9 IDWR Order Versus Combined SWC Annual Diversion and Carryover



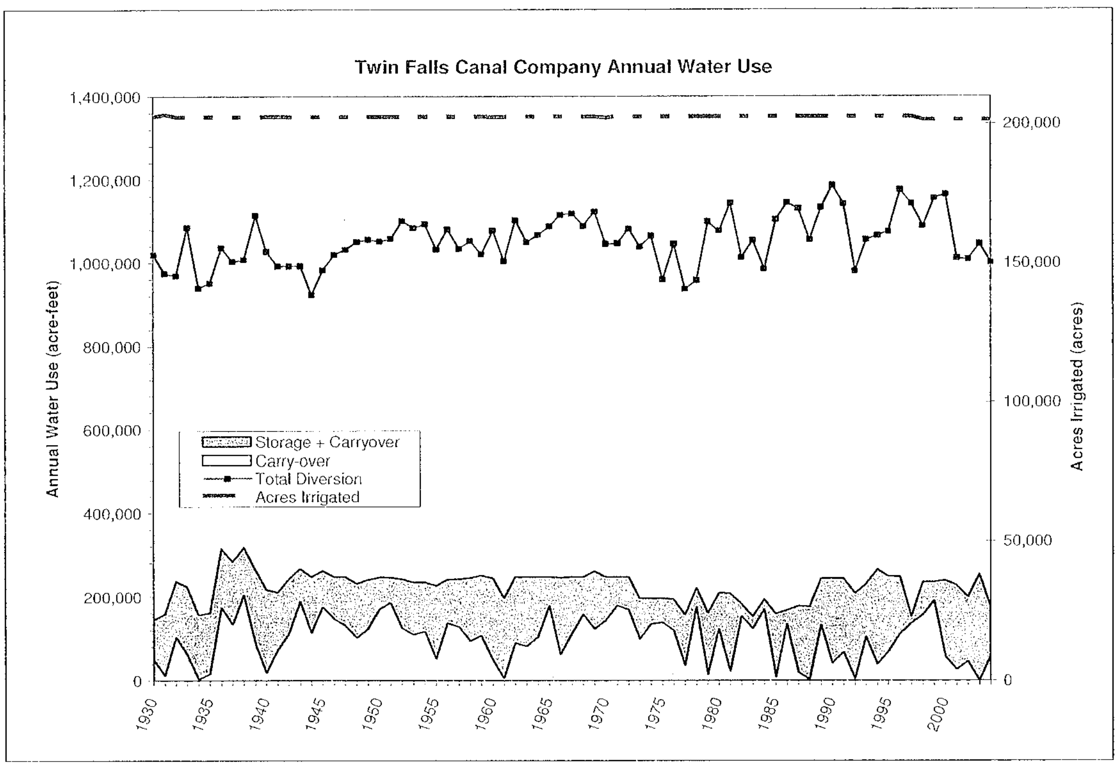
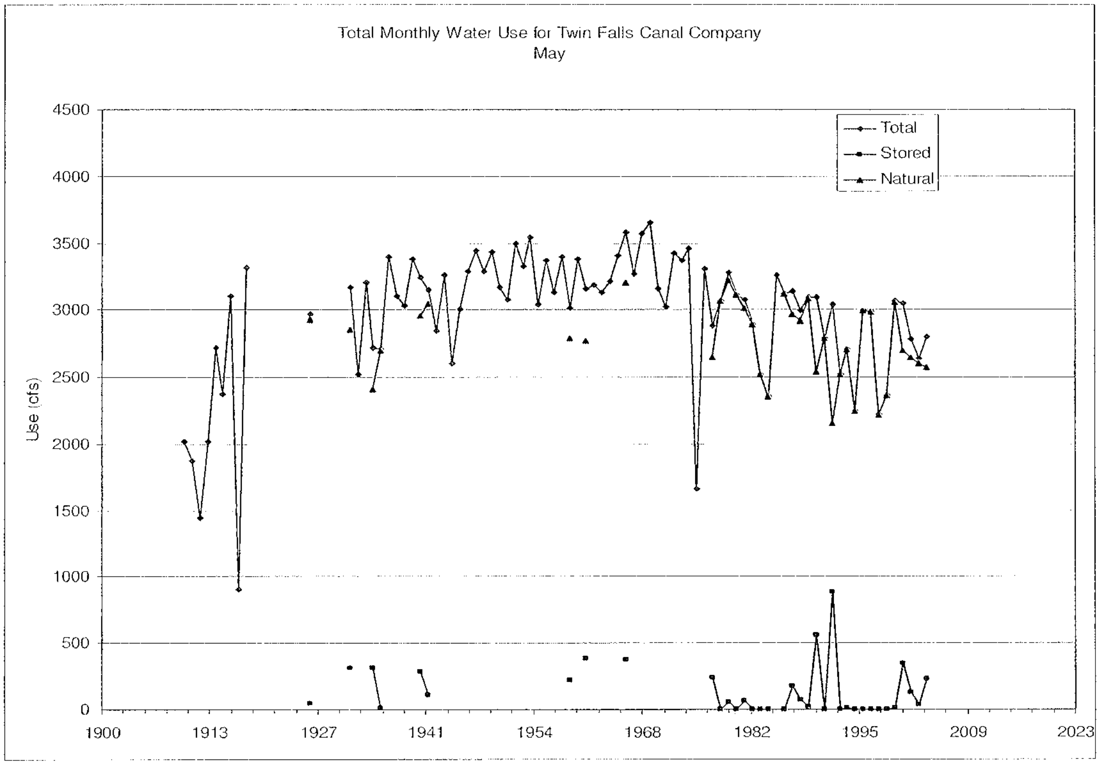


Figure 8-10 Annual TFCC Diversion and Water Use



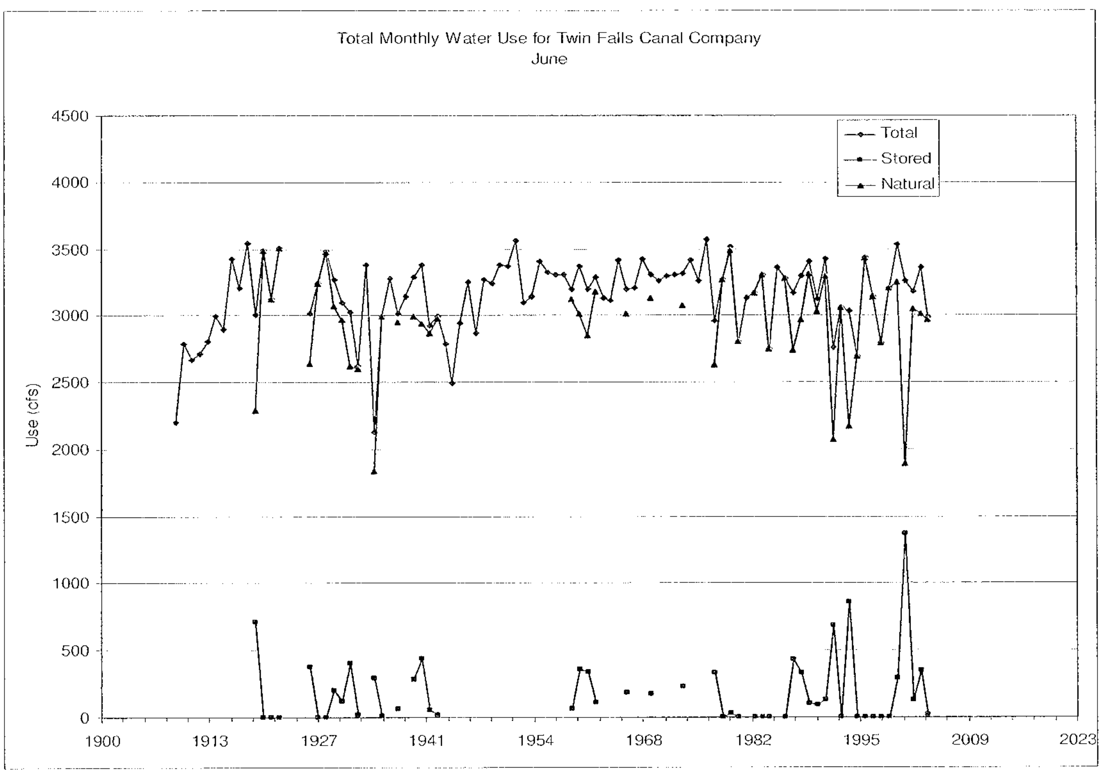
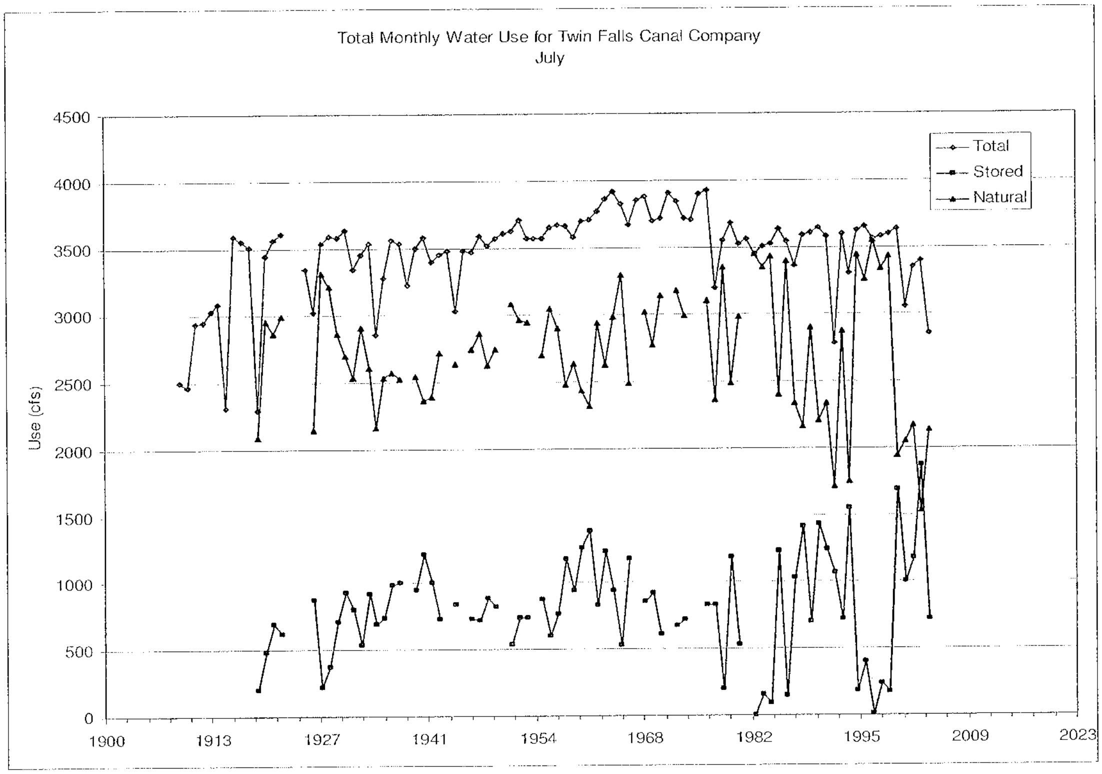


Figure 8-11 Early Season Monthly TFCC Diversion



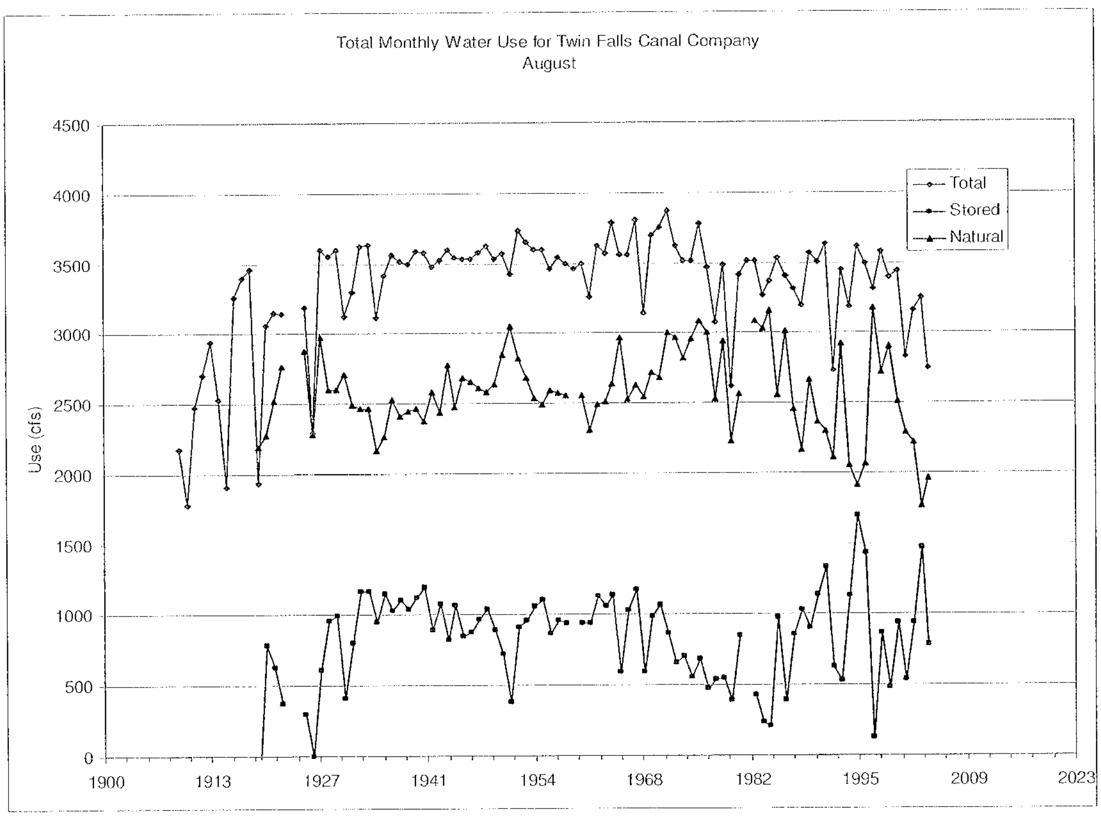
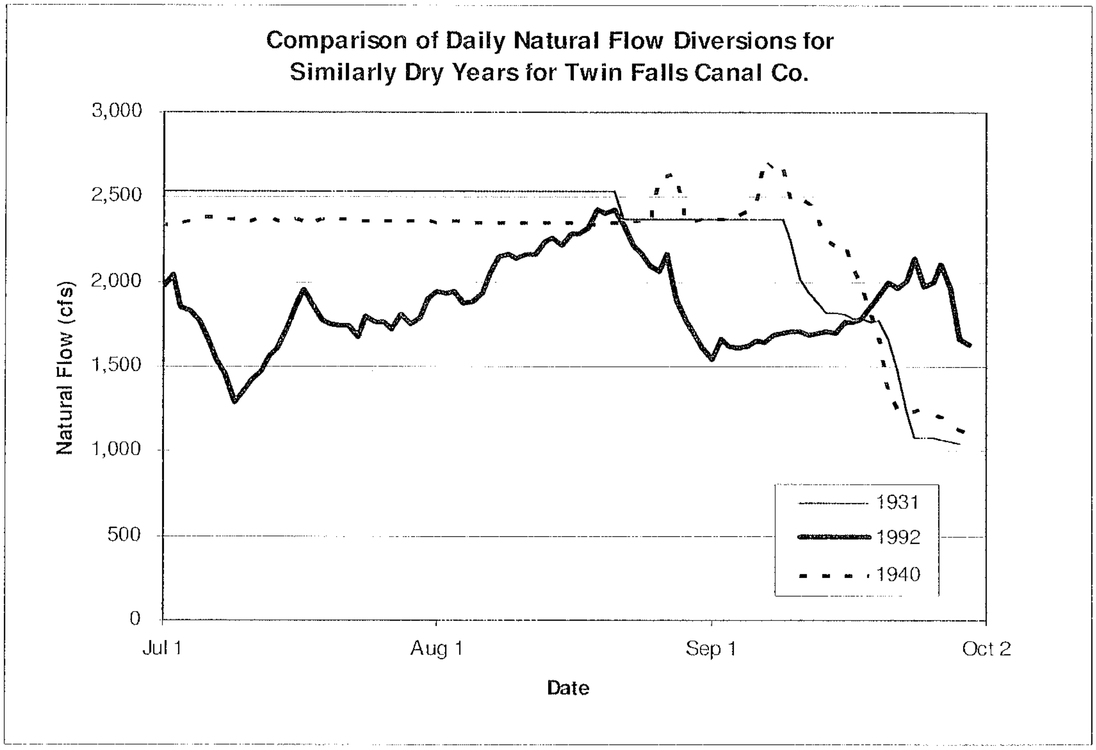


Figure 8-12 Mid-Season Monthly TFCC Diversion



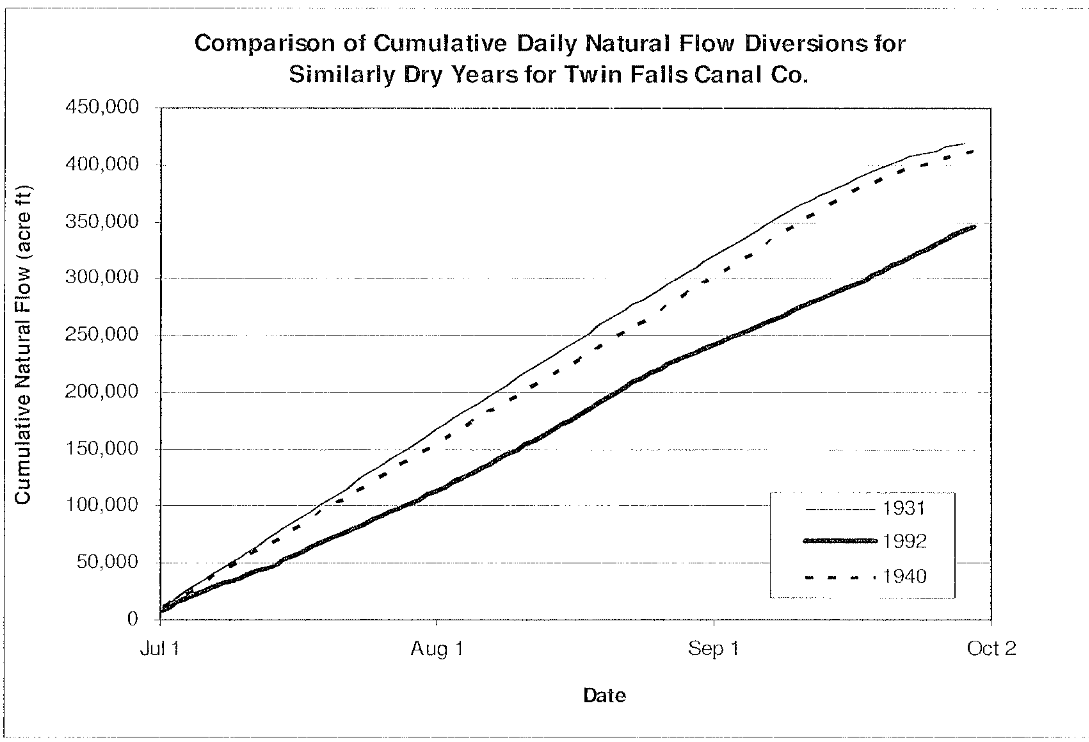
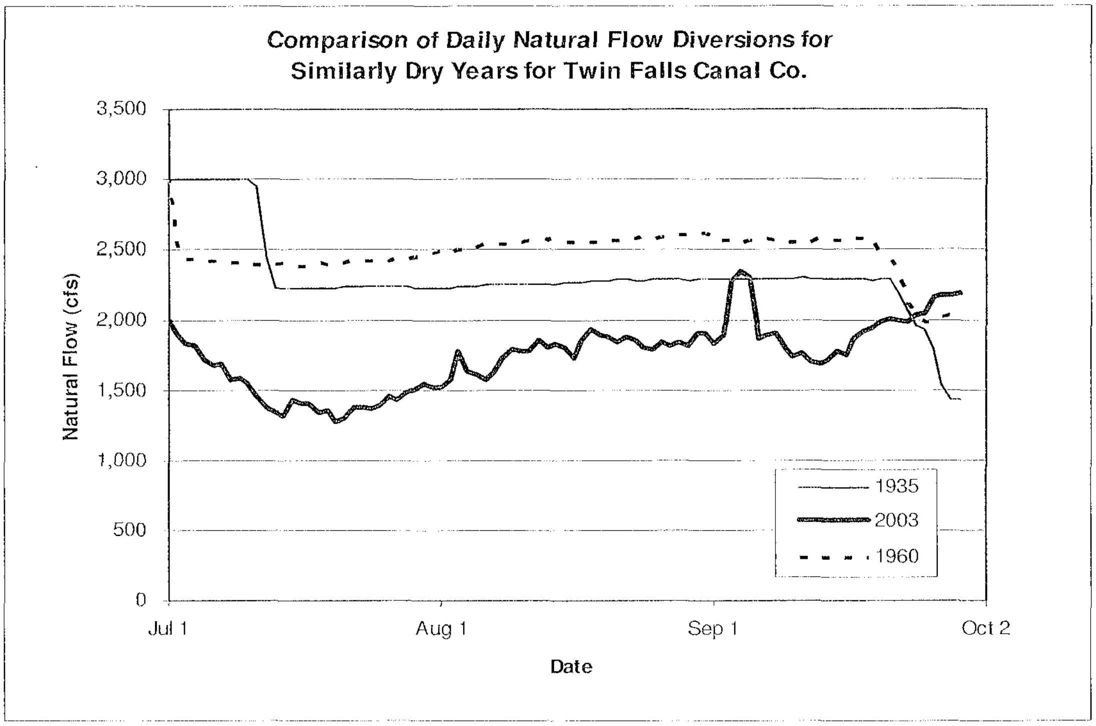


Figure 8-13 Comparison of TFCC Daily and Cumulative Daily Natural Flow Diversions - 1992



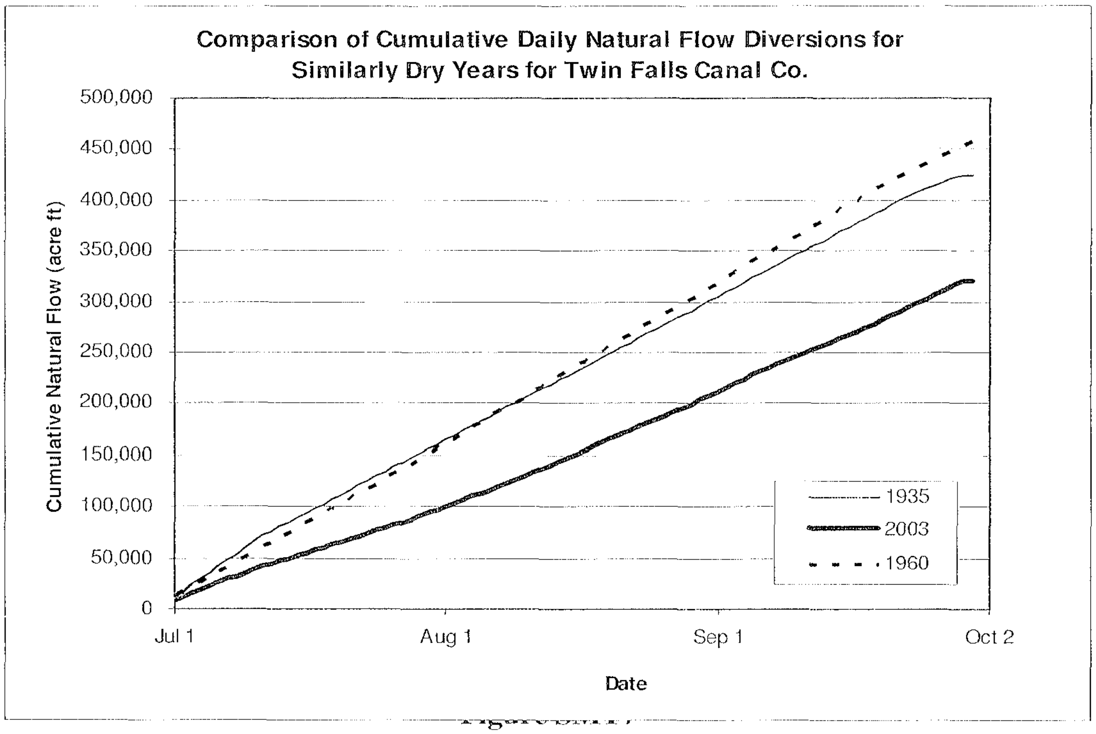
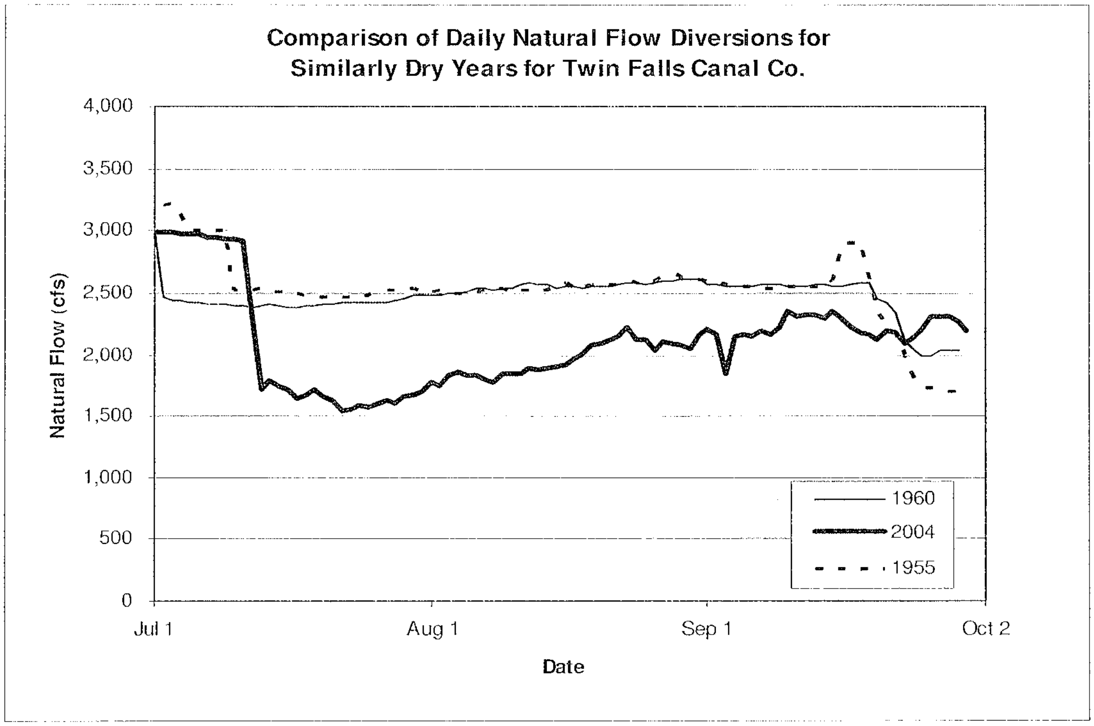


Figure 8-14 Comparison of TFCC Daily and Cumulative Daily Natural Flow Diversions - 2003



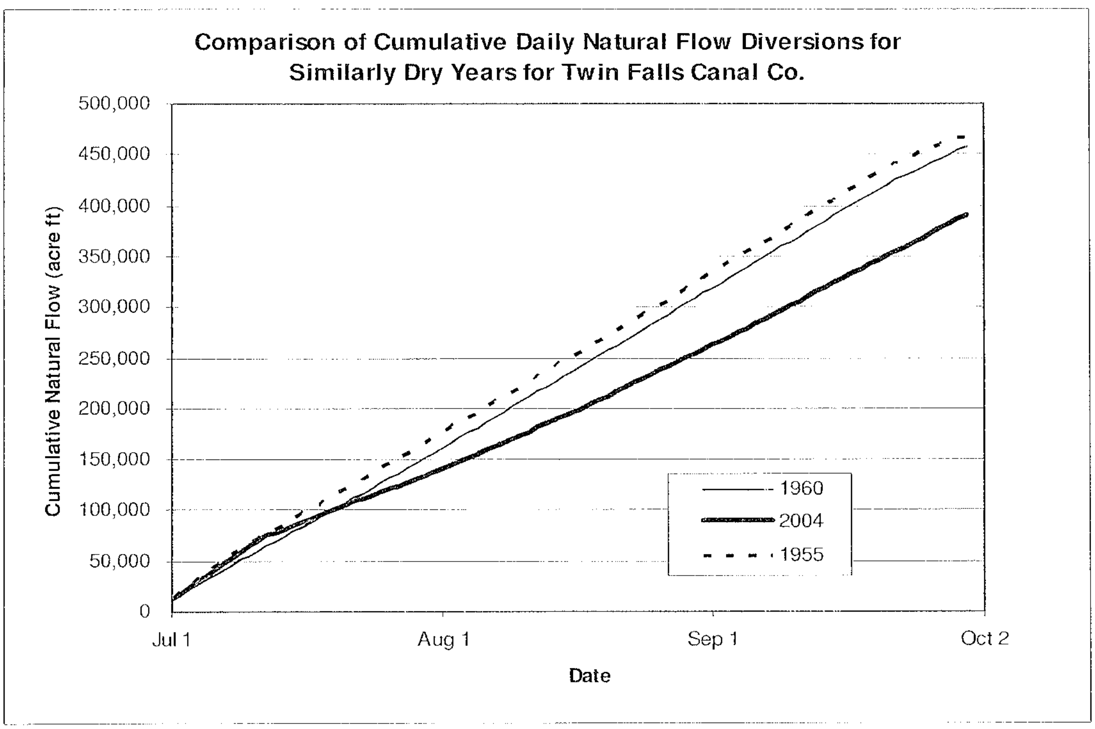


Figure 8-15 Comparison of TFCC Daily and Cumulative Daily Natural Flow Diversions - 2004

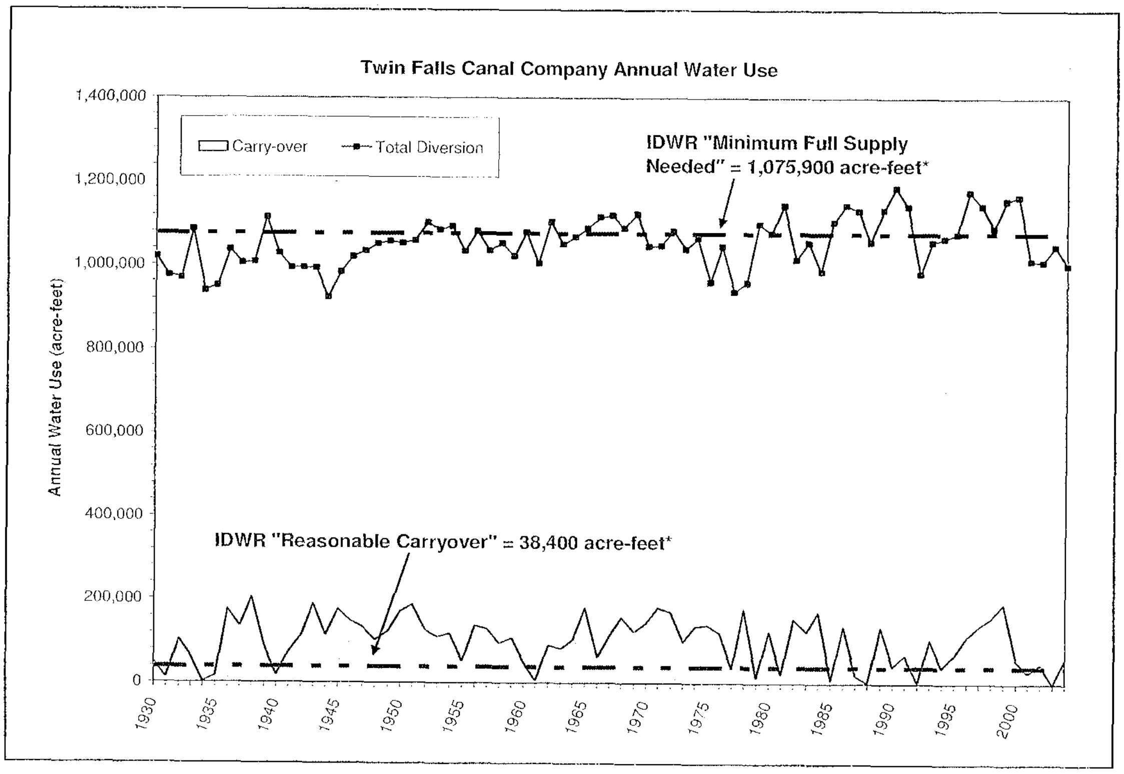
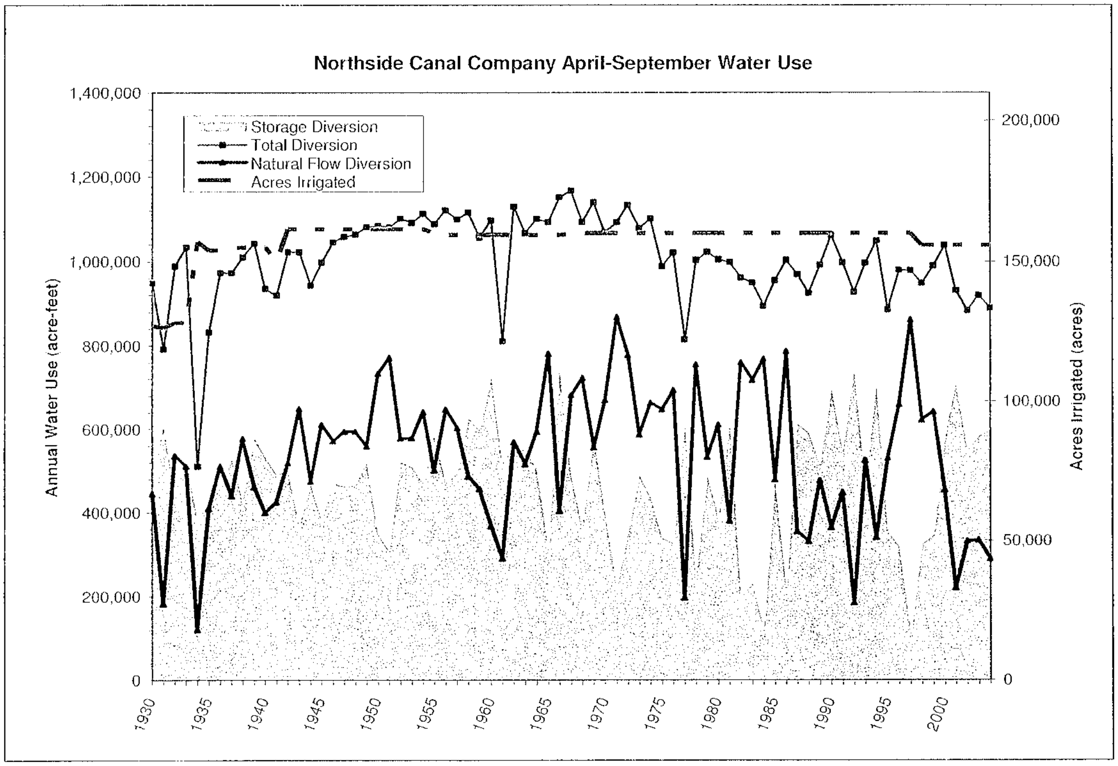


Figure 8-16 IDWR Order Versus TFCC Annual Diversion and Carryover



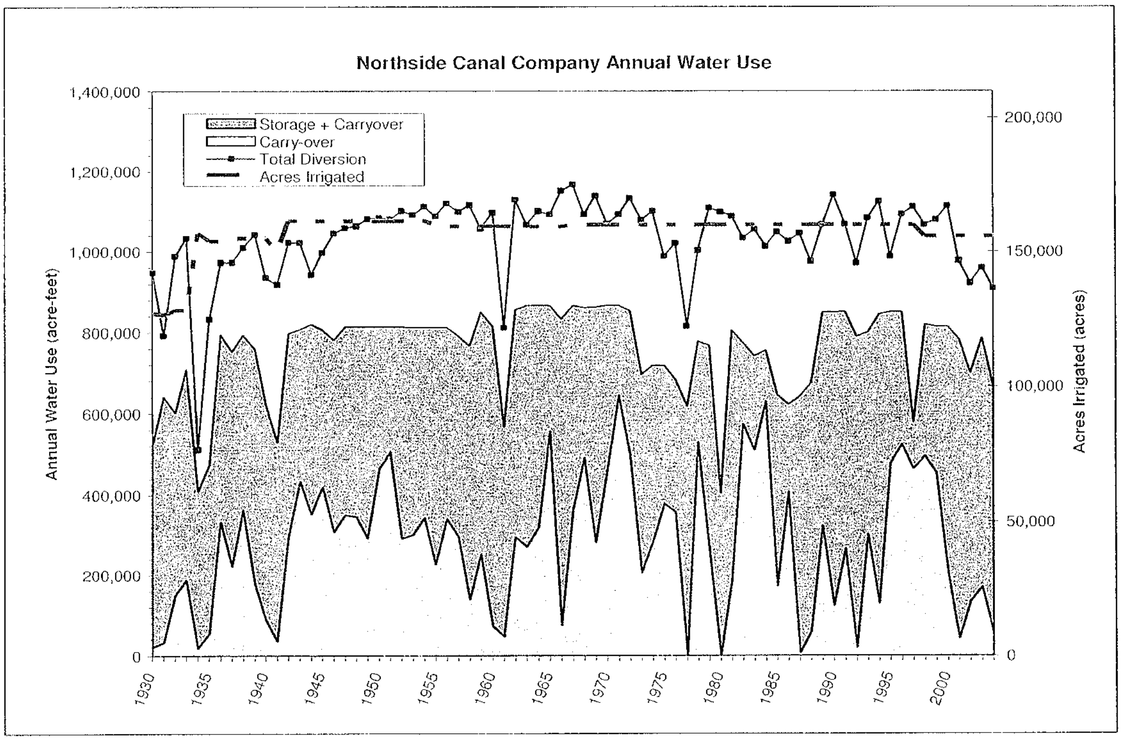
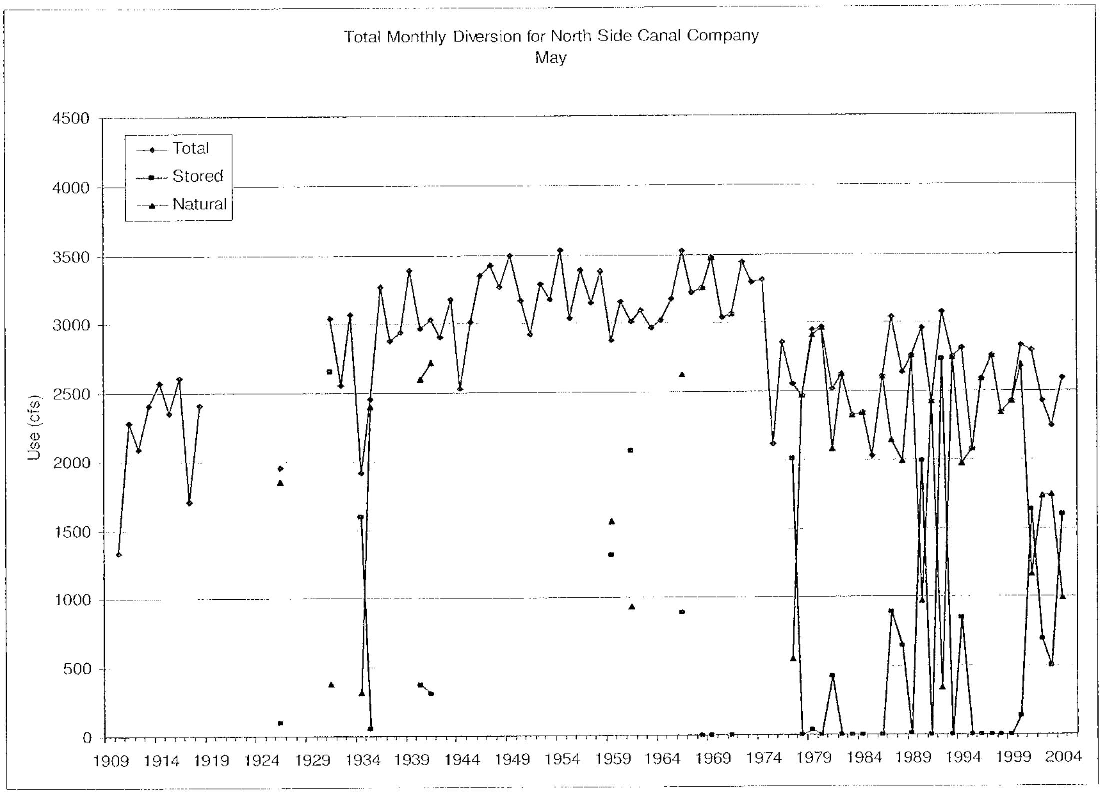


Figure 8-17 Annual NSCC Diversion and Water Use



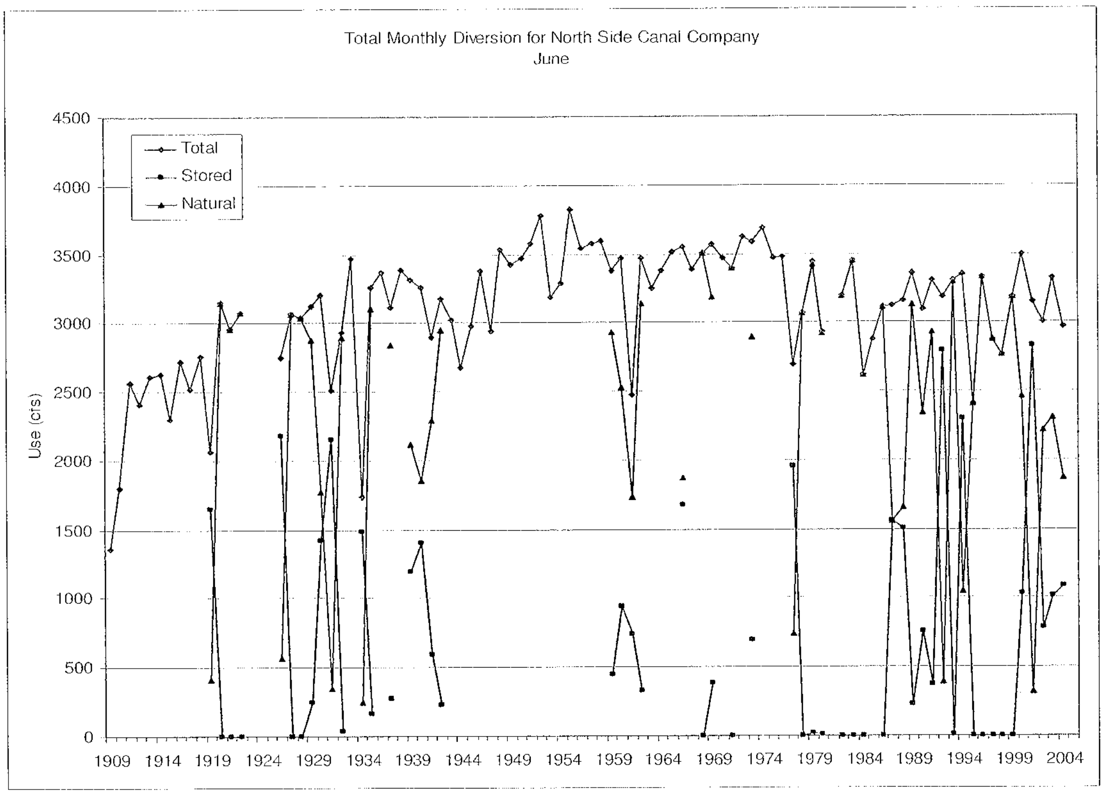
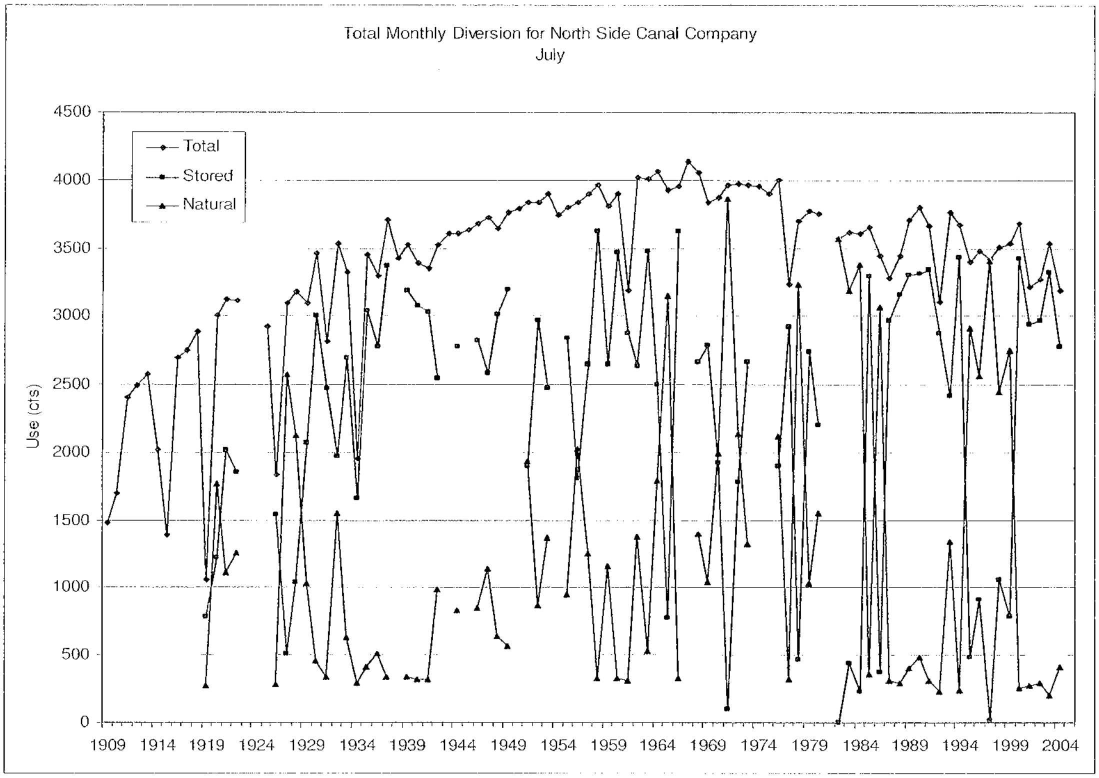


Figure 8-18 Early Season Monthly NSCC Diversion



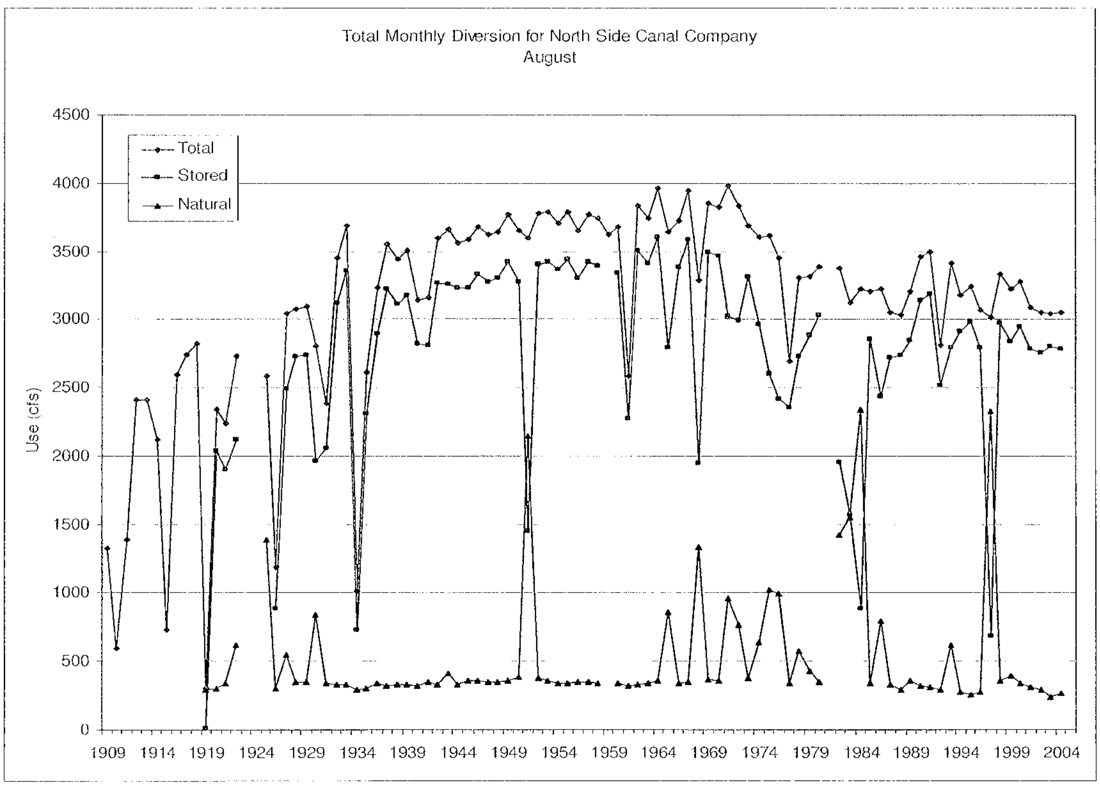
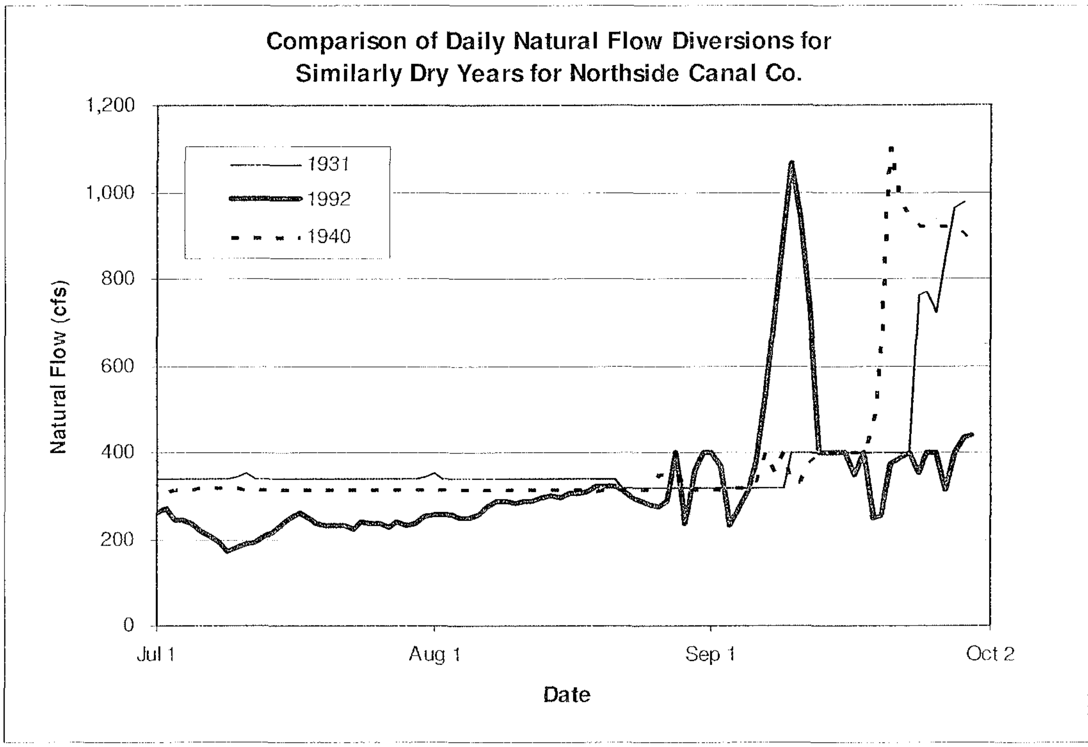


Figure 8-19 Mid- Season Monthly NSCC Diversion



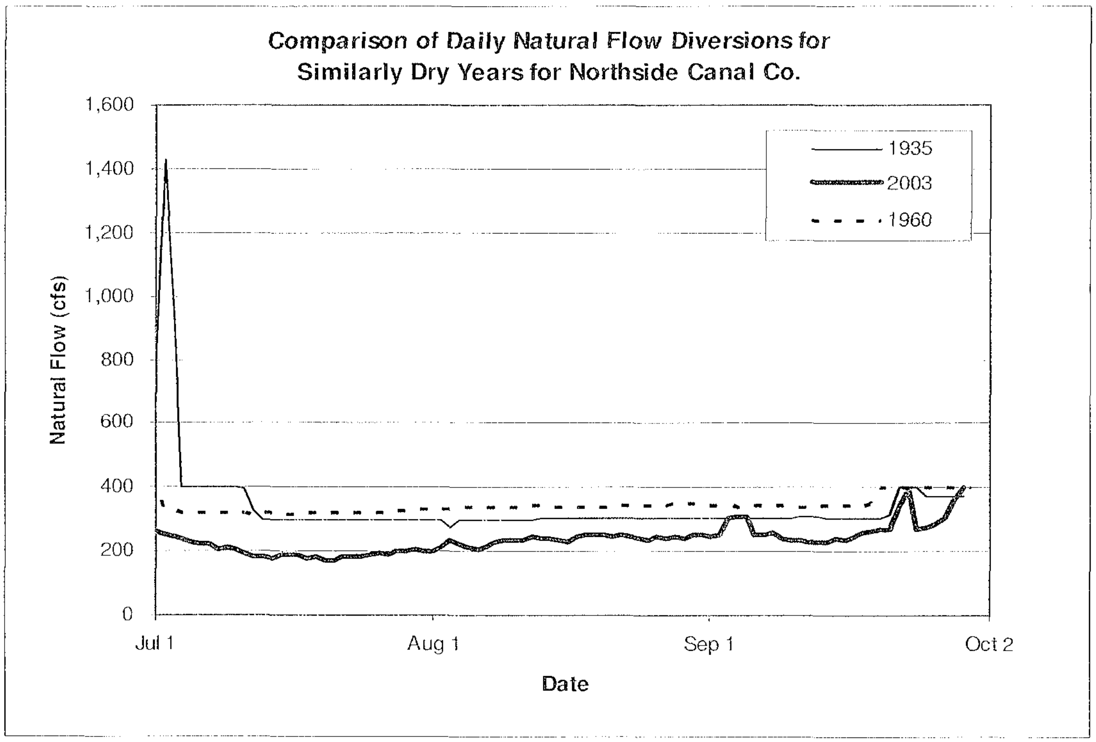


Figure 8-20 Comparison of NSCC Daily and Cumulative Daily Natural Flow Diversions - 2003

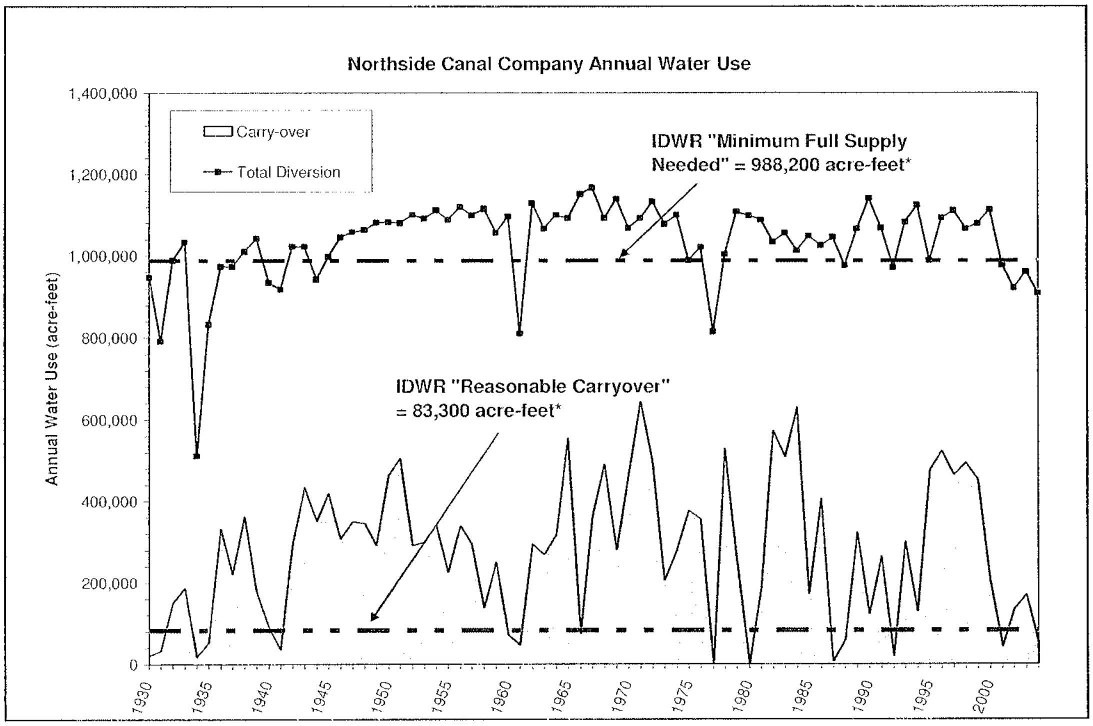
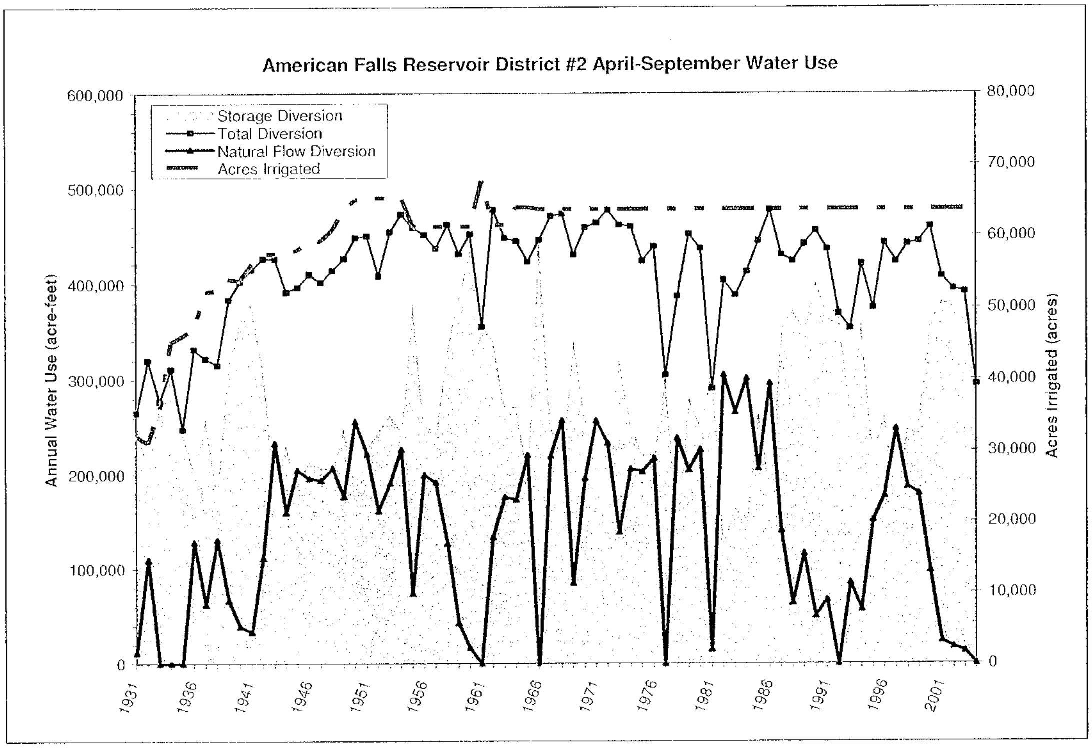


Figure 8-21 IDWR Order Versus NSCC Annual Diversion and Carryover



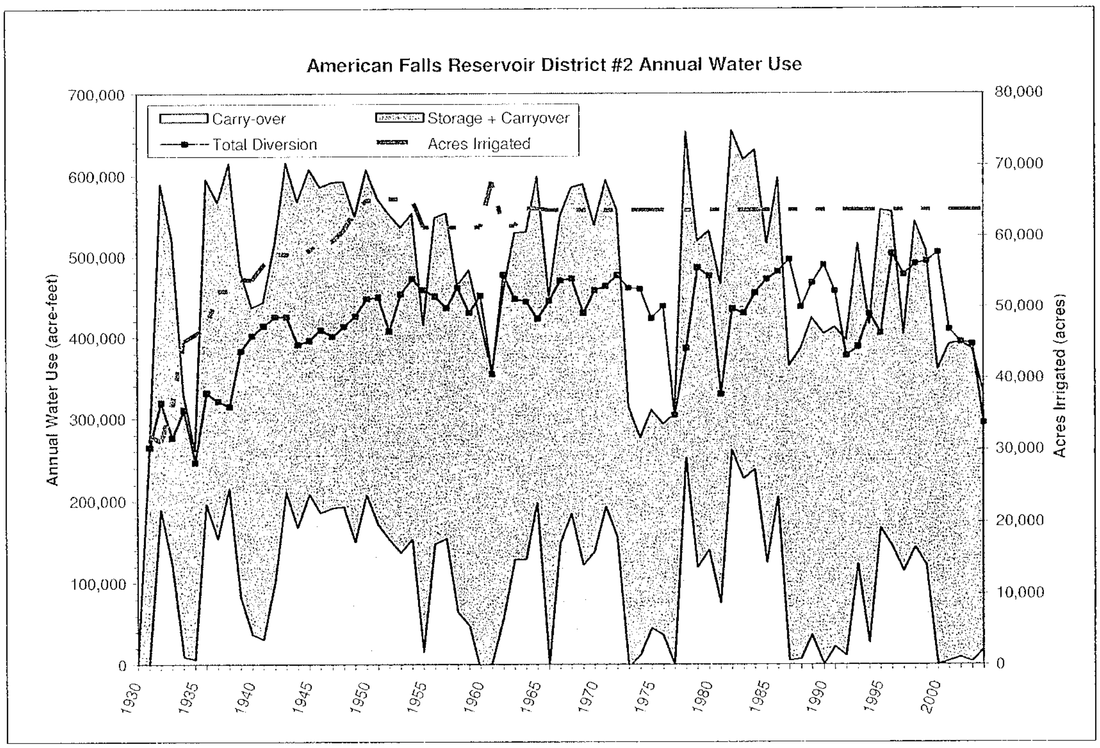
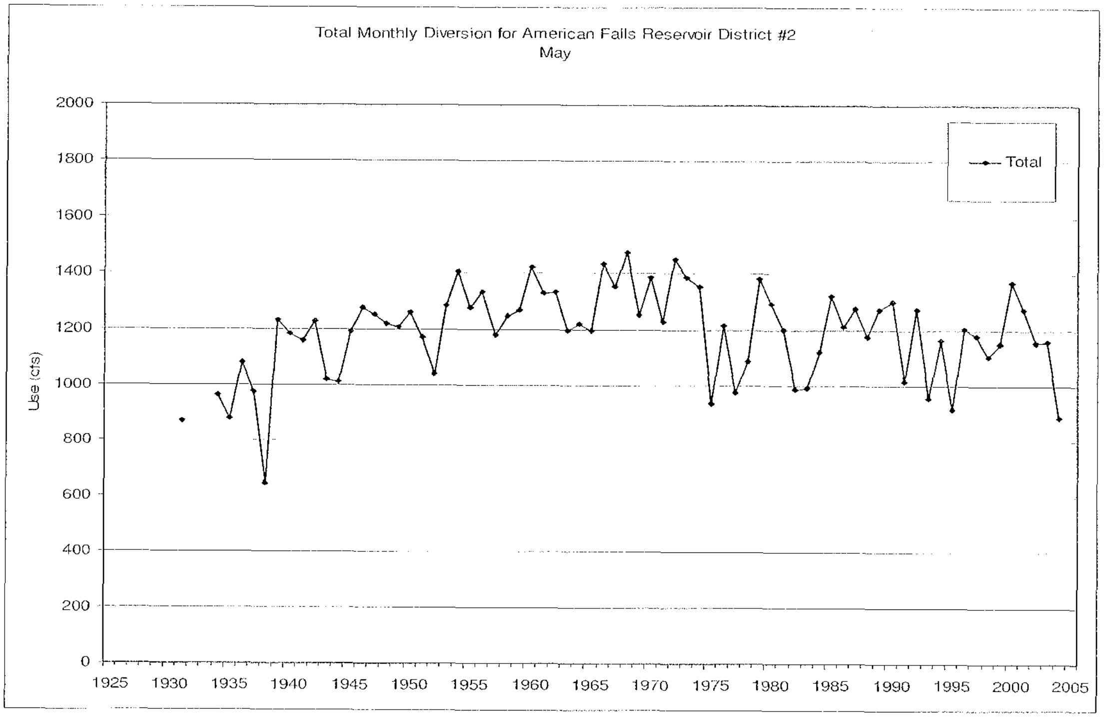


Figure 8-22 Annual AFRD2 Diversion and Water Use



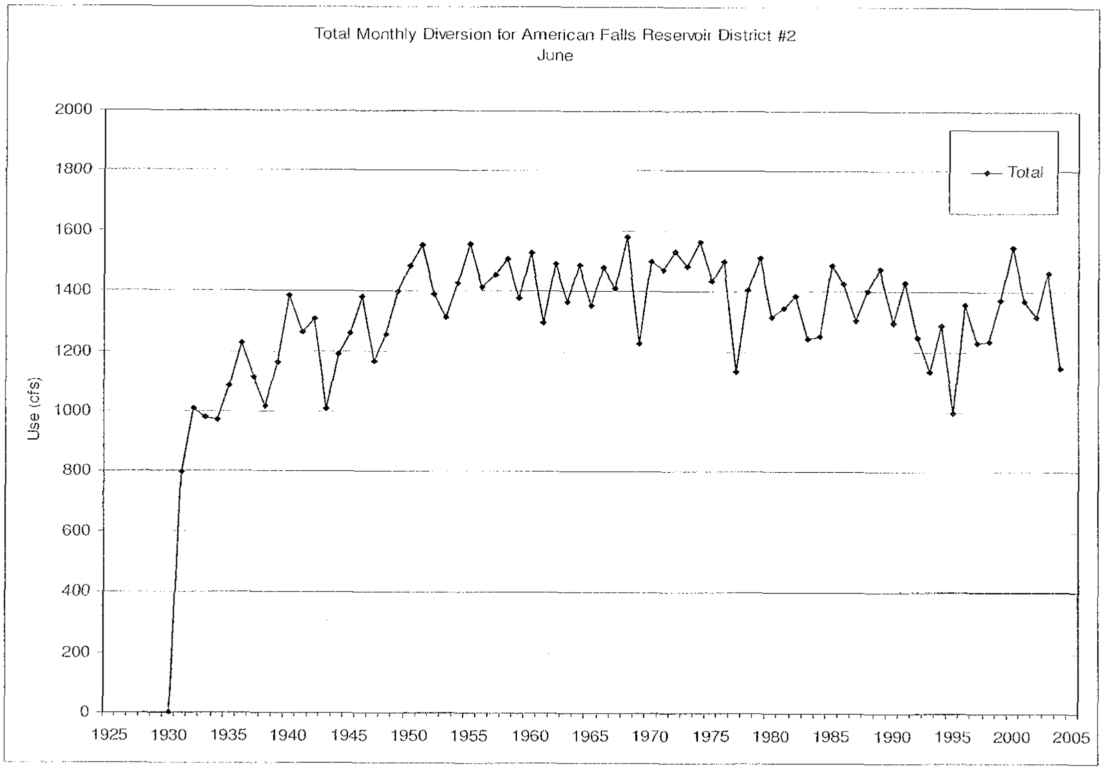
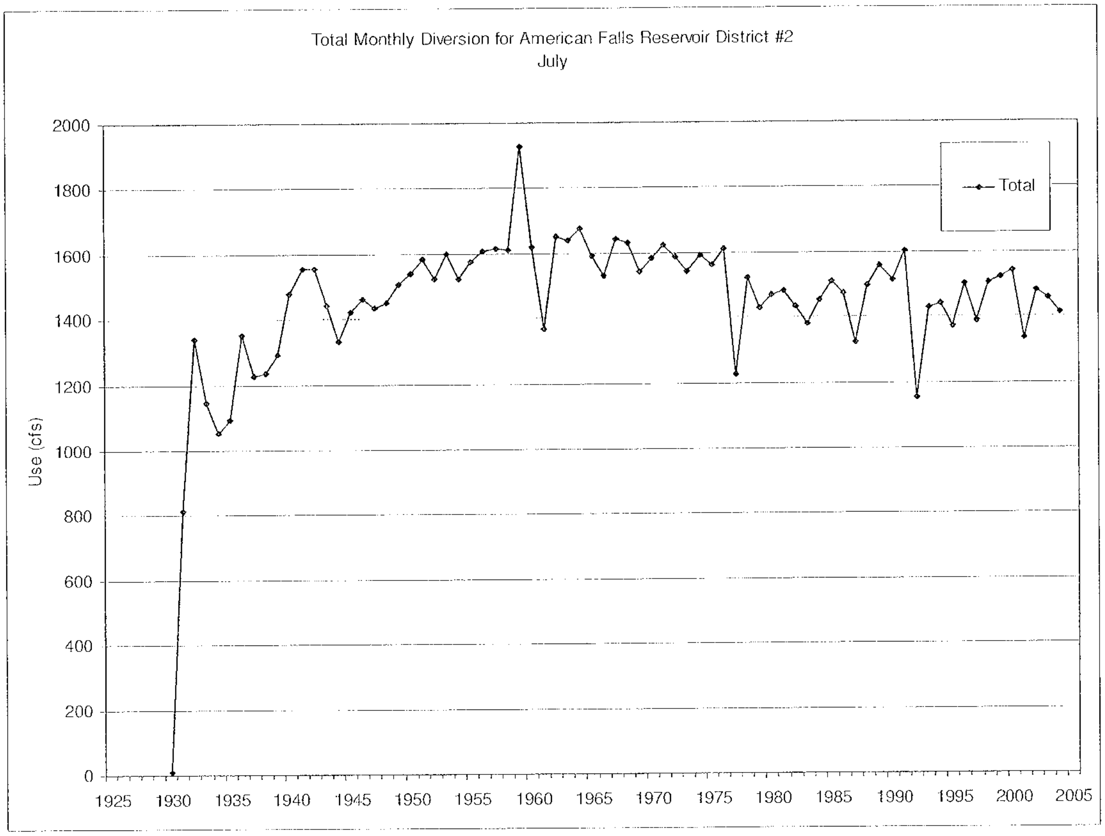


Figure 8-23 Early Season Monthly AFRD2 Diversion



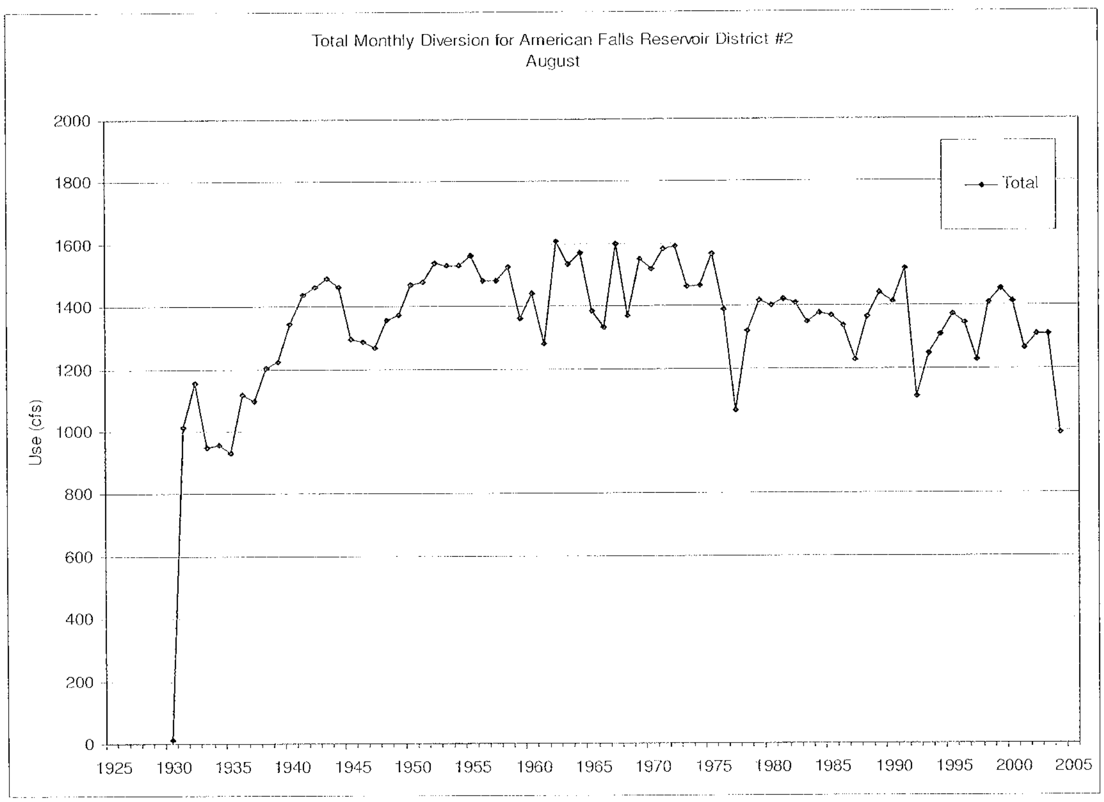


Figure 8-24 Mid-Season Monthly AFRD2 Diversion

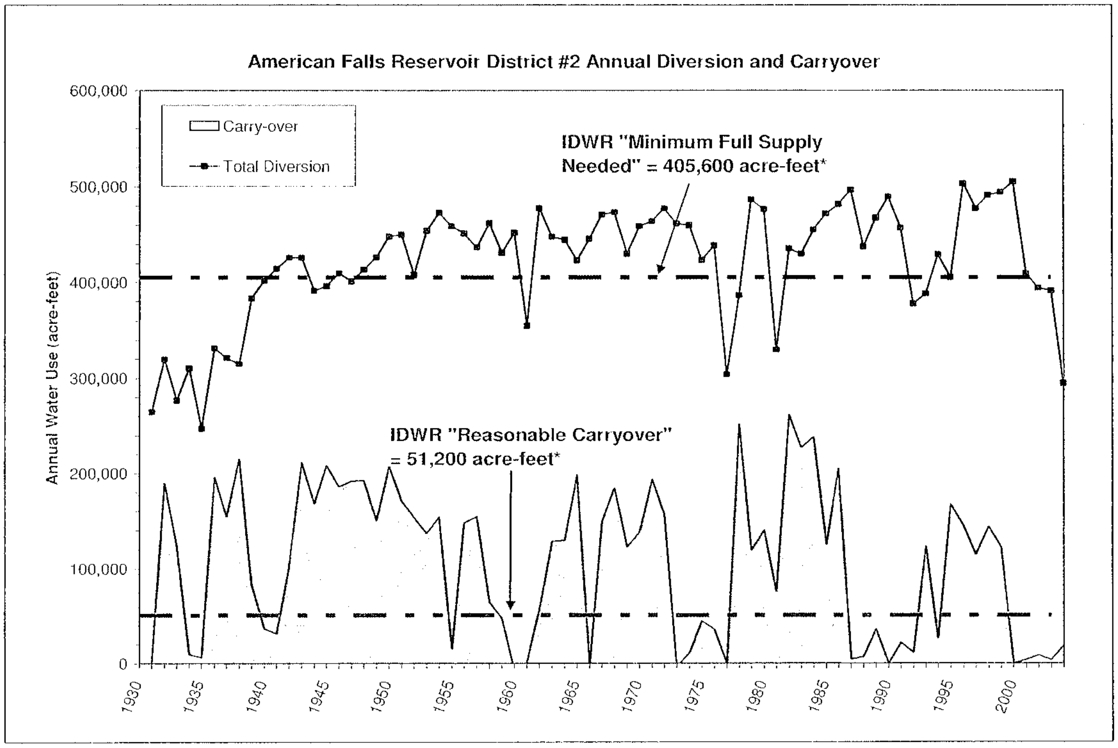
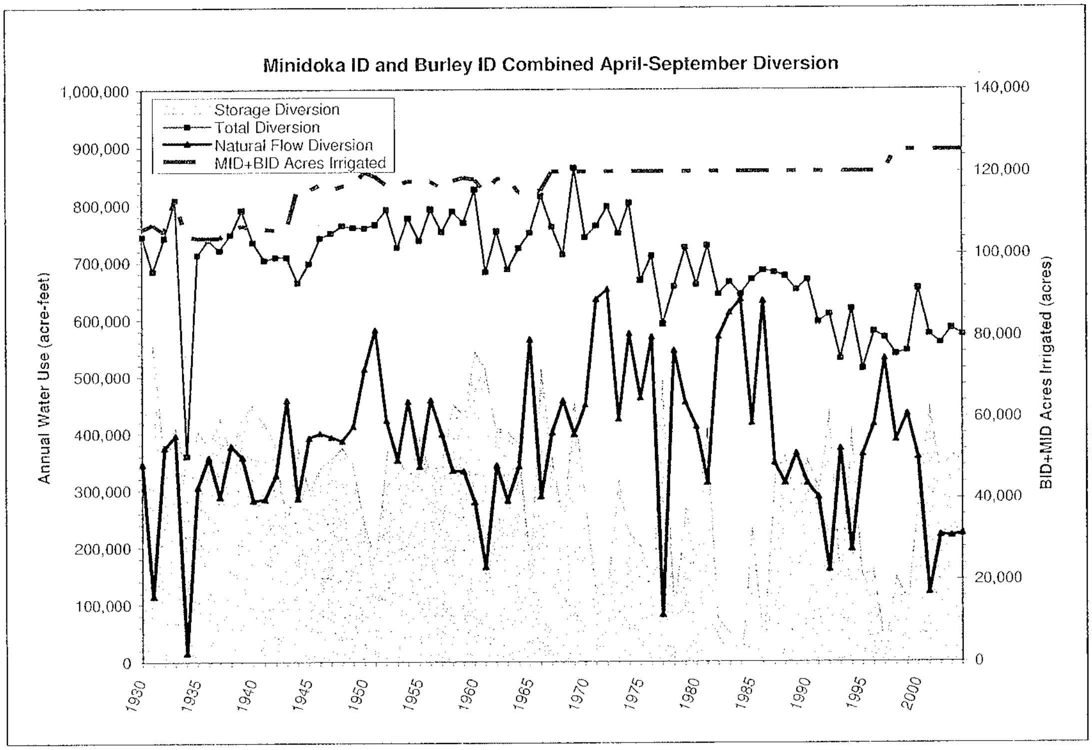


Figure 8-25 IDWR Order Versus AFRD2 Annual Diversion and Carryover



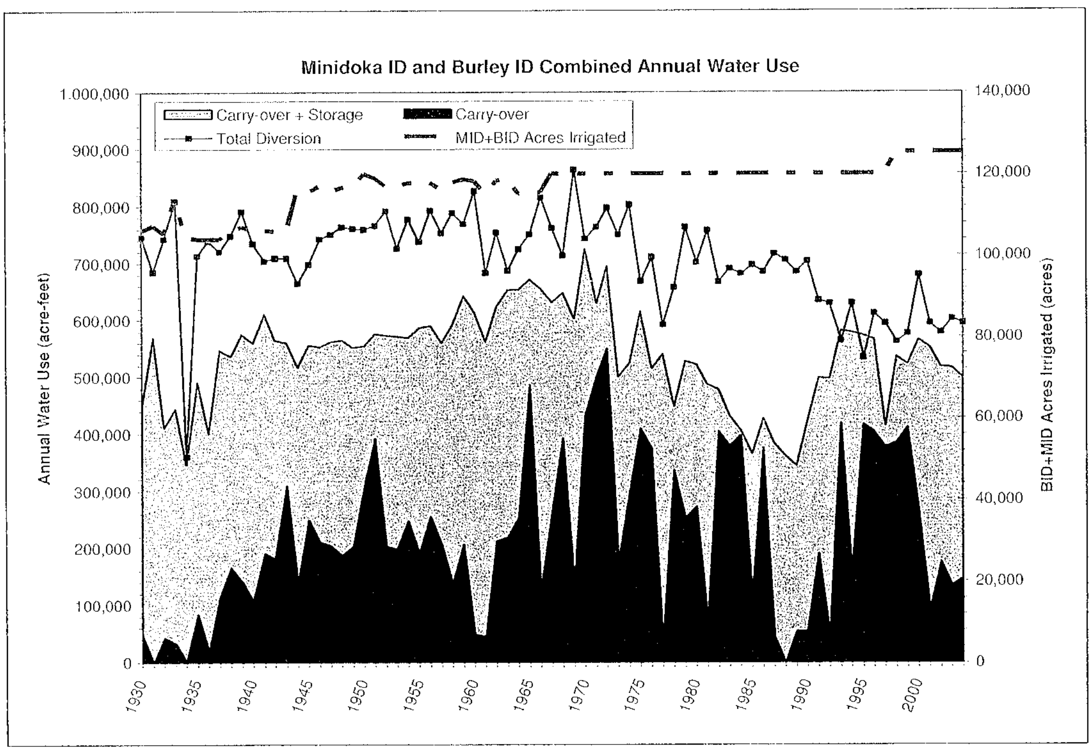
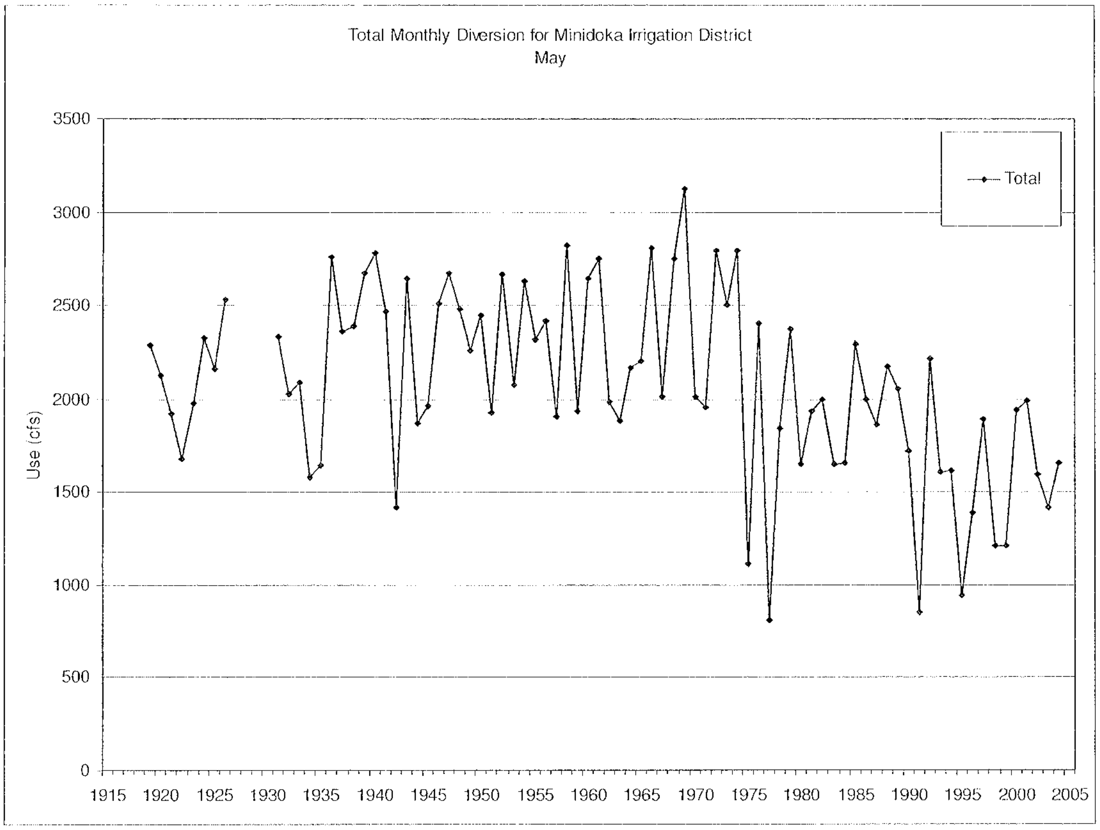


Figure 8-26 Annual MID/BID Diversion and Water Use



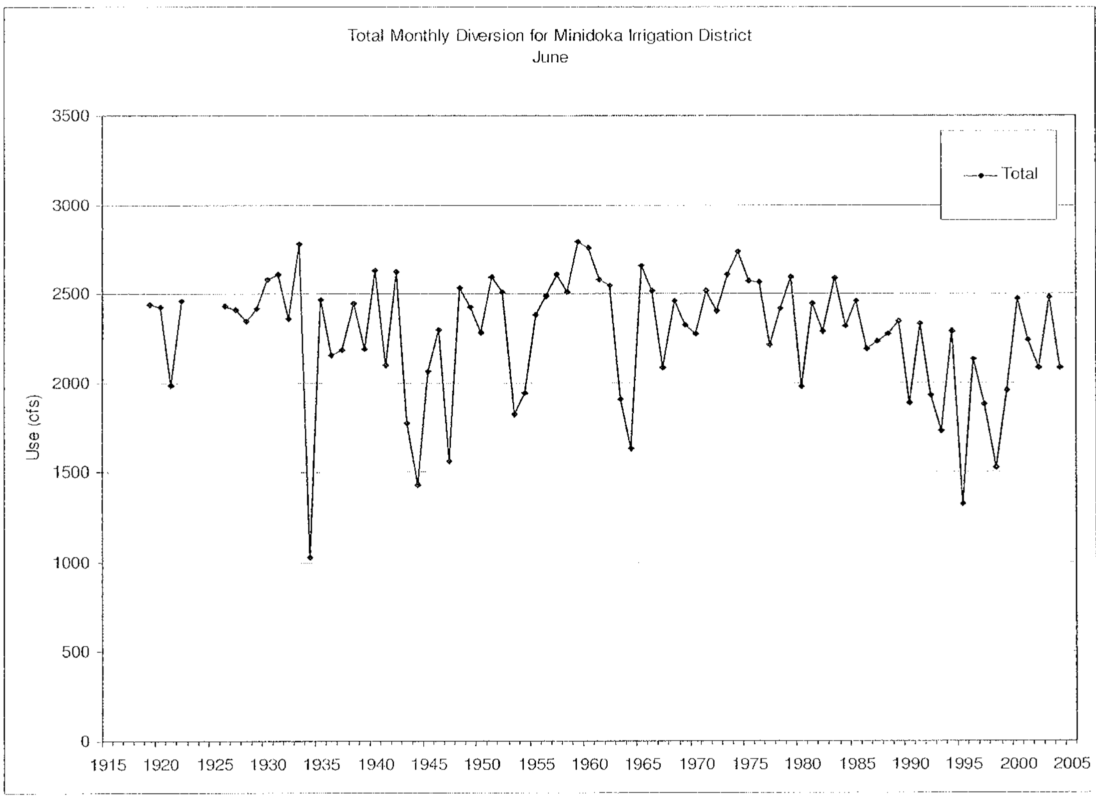
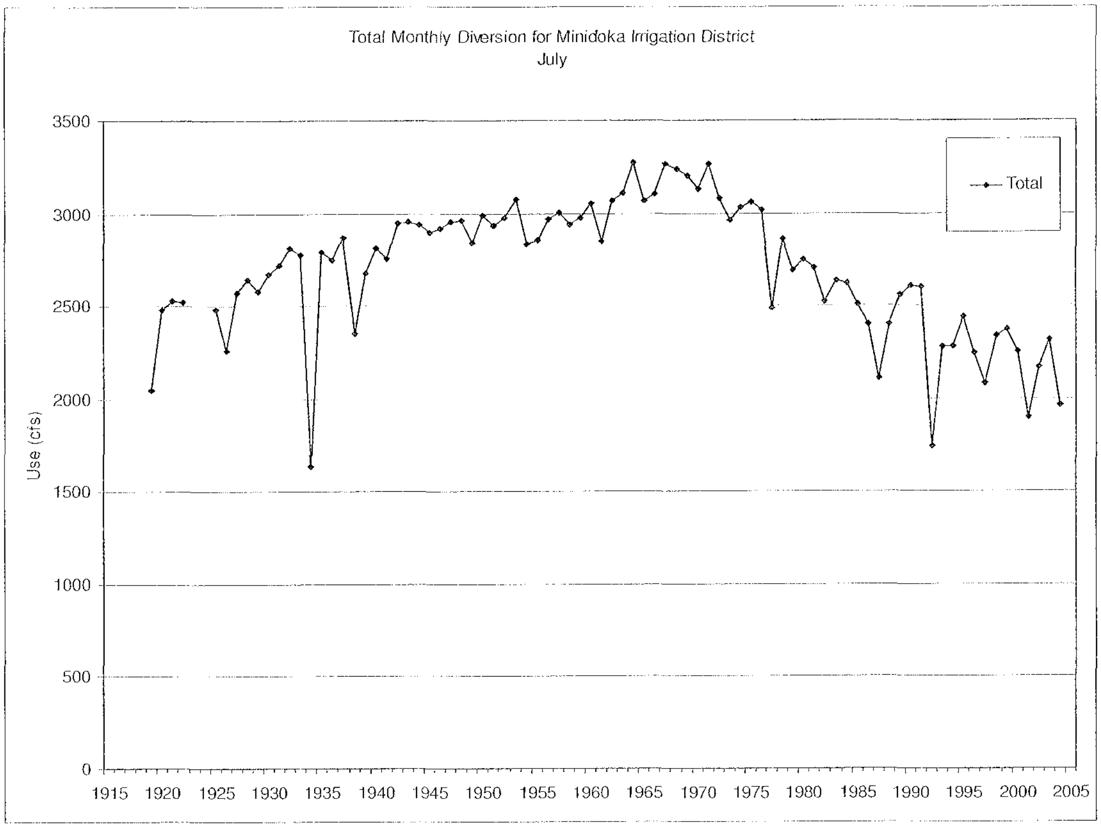


Figure 8-27 Early Season Monthly MID/BID Diversion



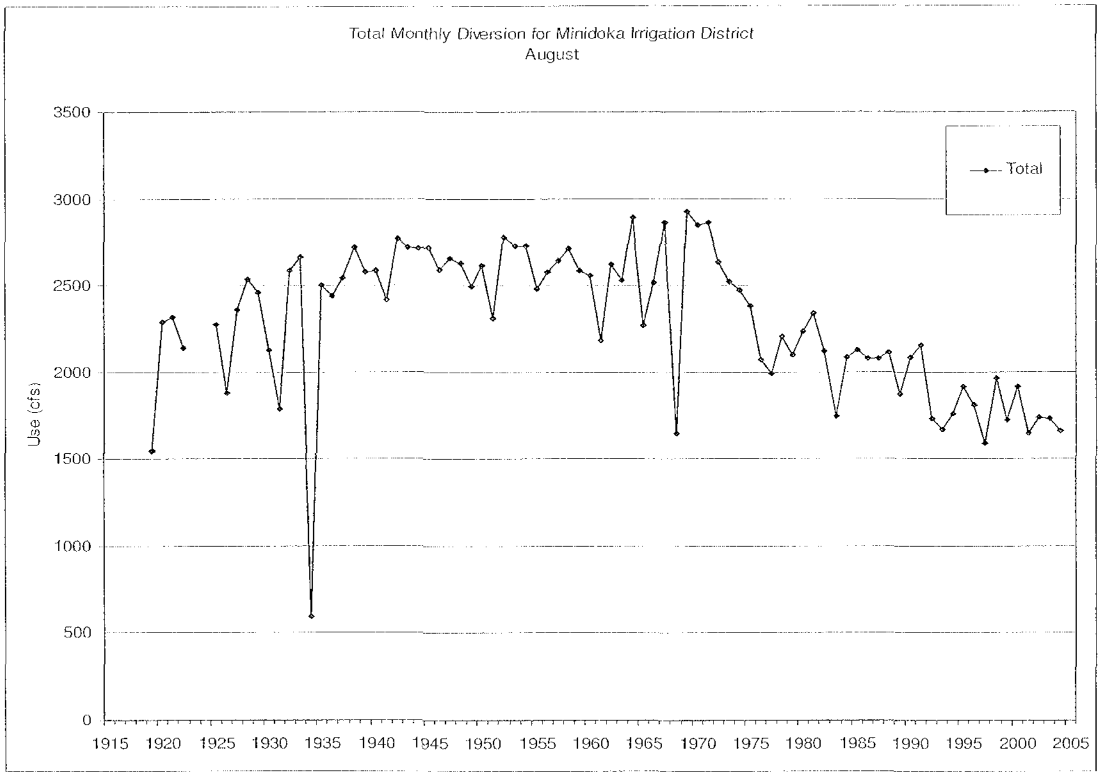


Figure 8-28 Mid-Season Monthly MID/BID Diversion

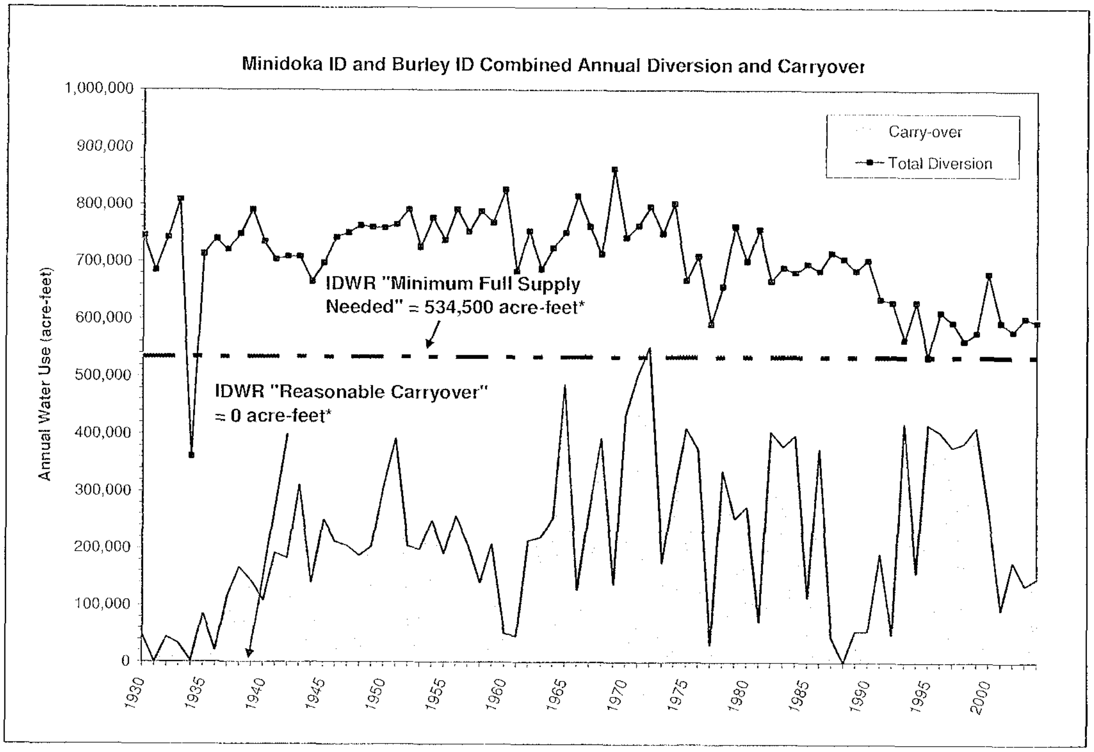
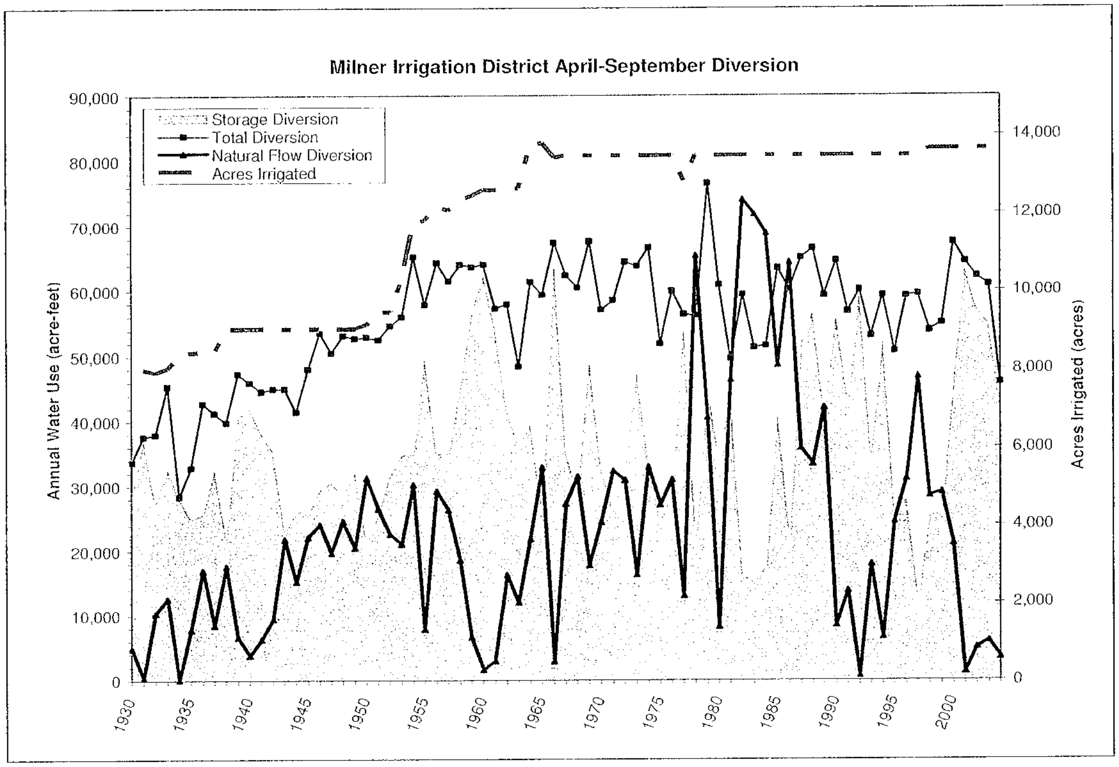


Figure 8-29 IDWR Order Versus MID/BID Annual Diversion and Carryover



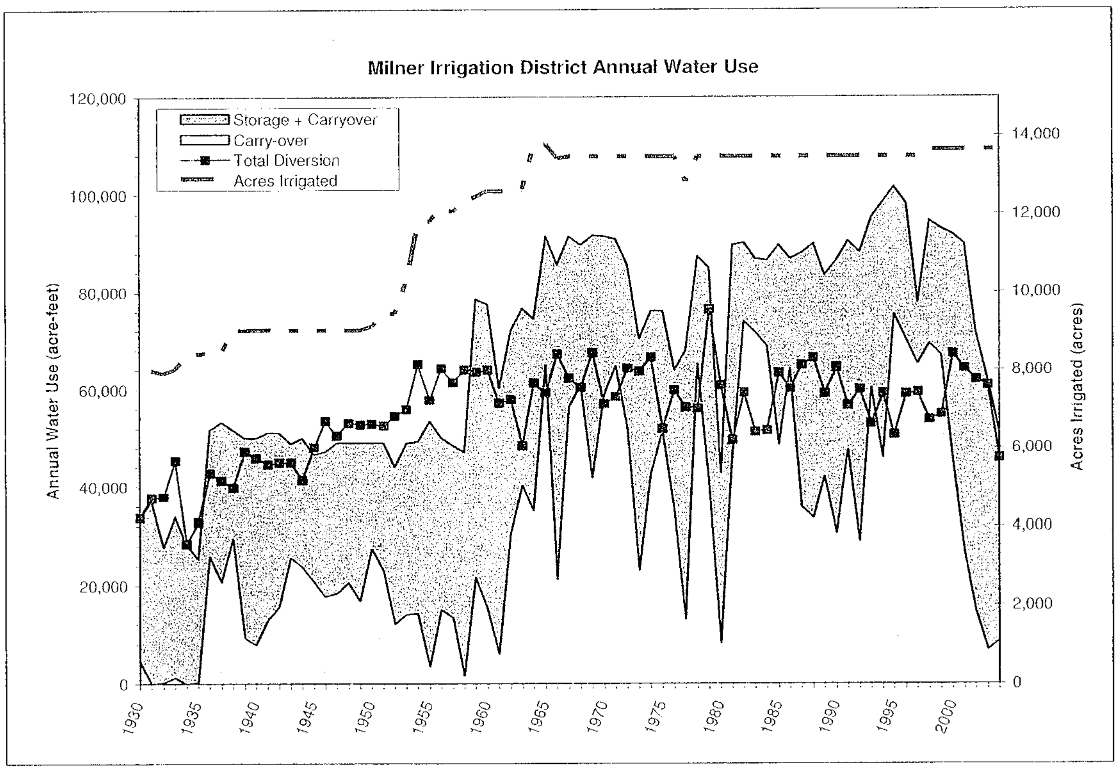


Figure 8-30 Annual MIL Diversion and Water Use

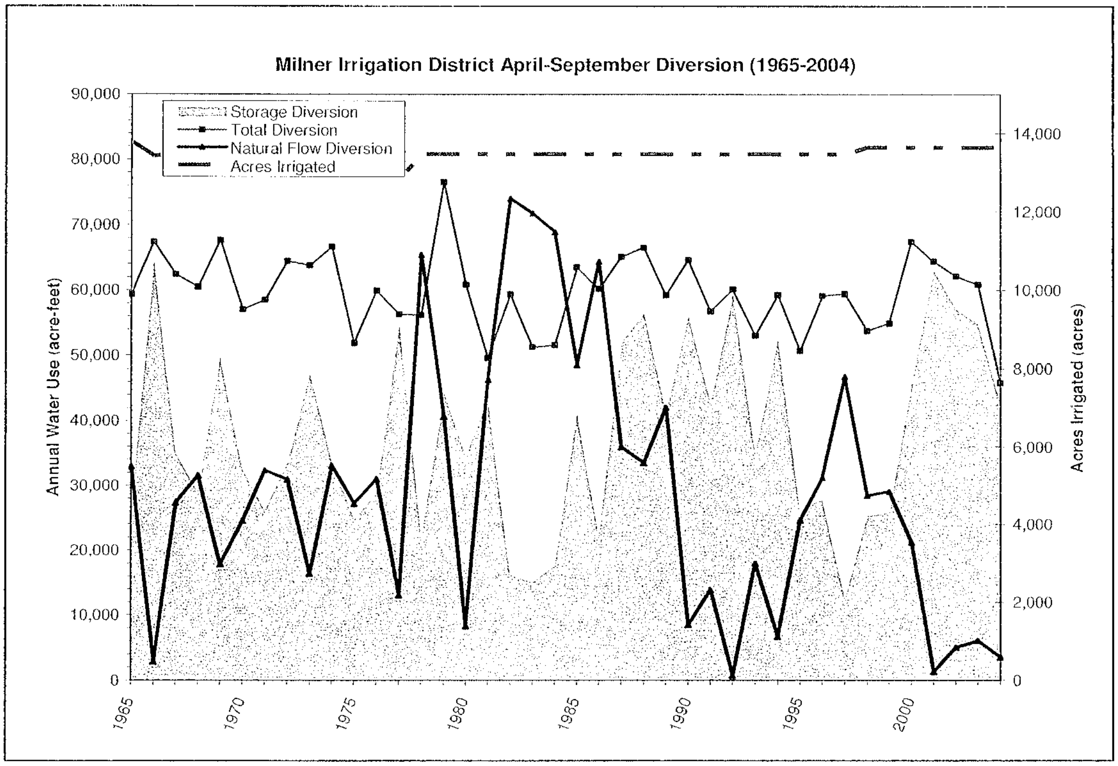
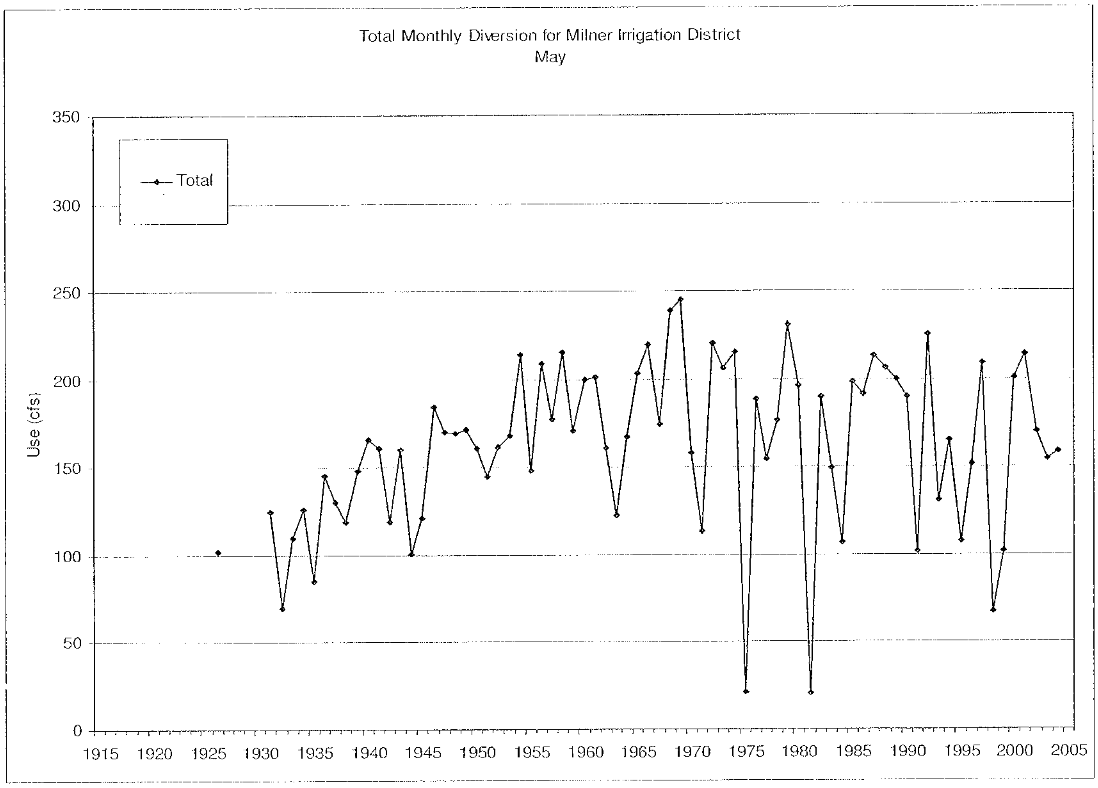


Figure 8-31 Annual MIL Diversions – 1965-2004



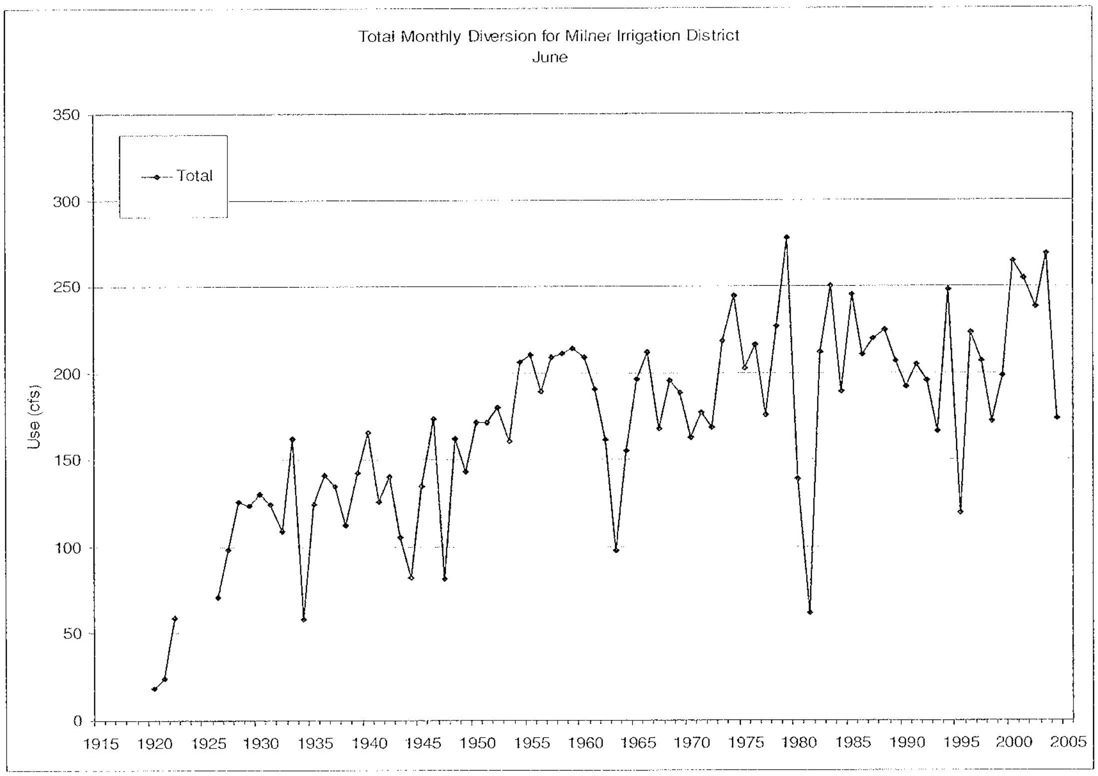
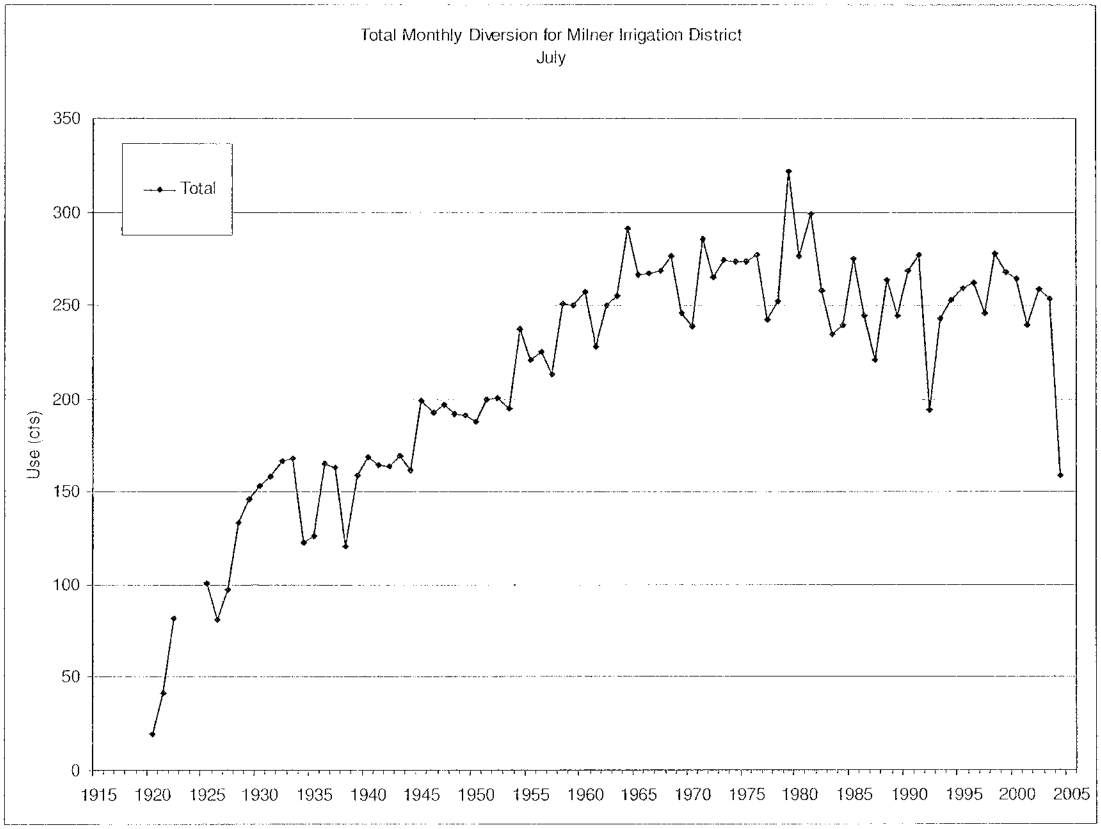


Figure 8-32 Early Season Monthly MIL Diversion



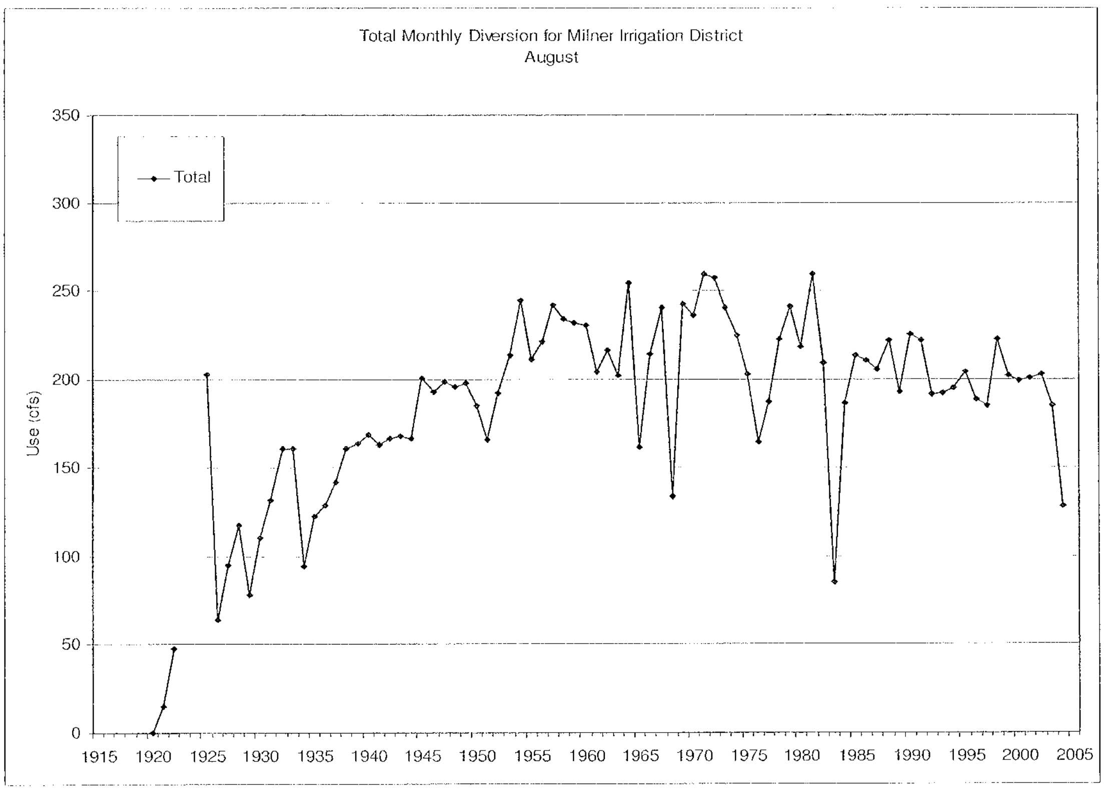


Figure 8-33 Mid-Season Monthly MIL Diversion

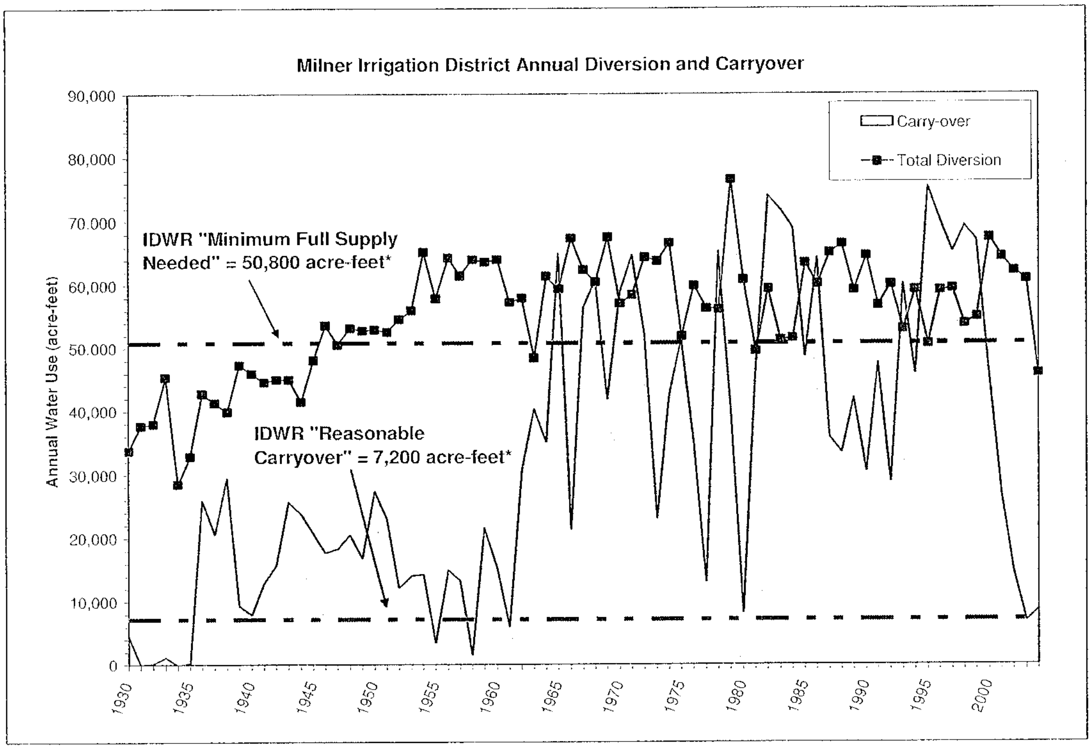
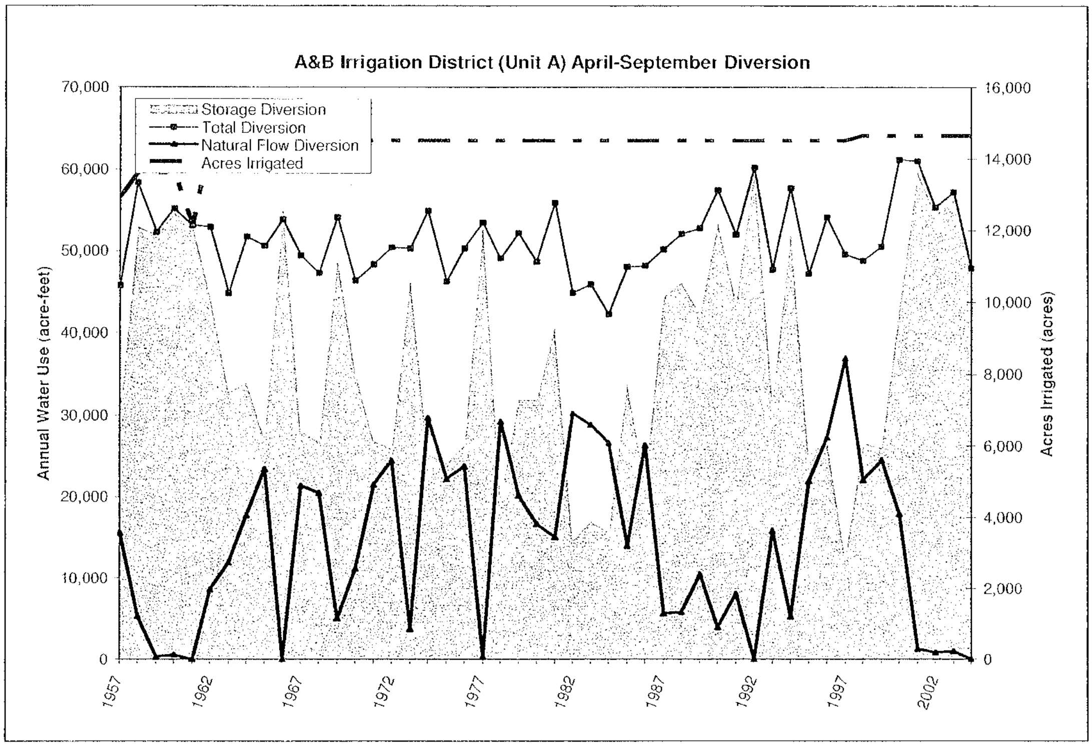


Figure 8-34 IDWR Order Versus MIL Annual Diversion and Carryover



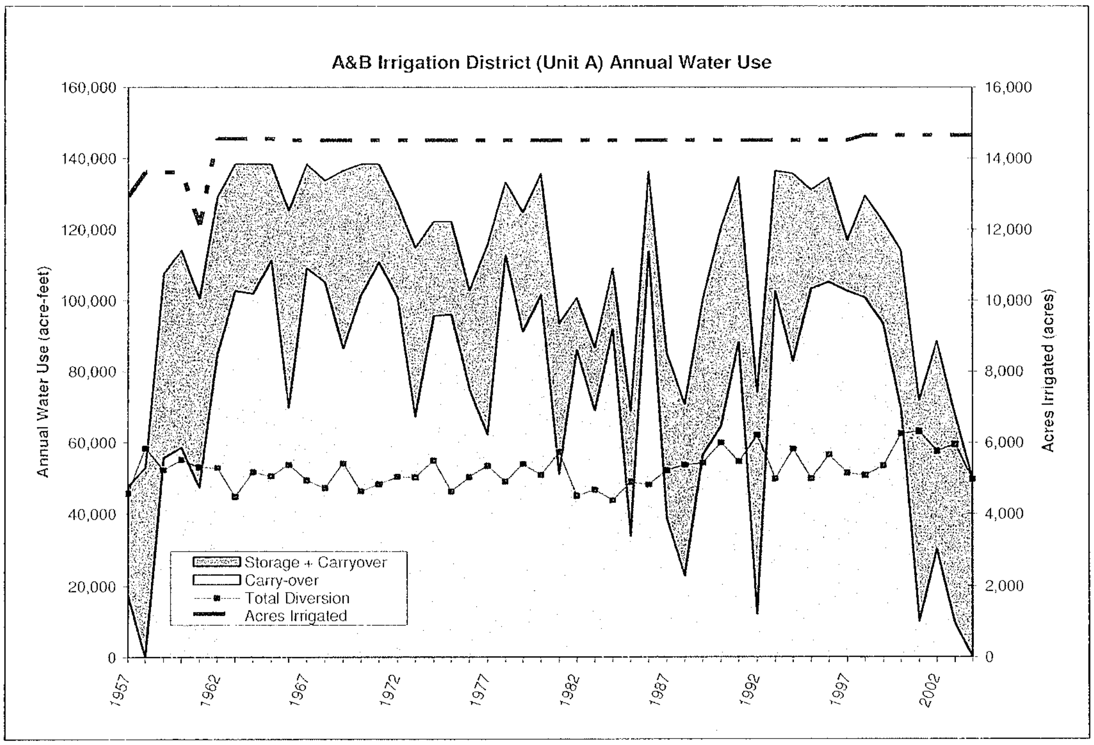


Figure 8-35 Annual A&B Diversion and Water Use

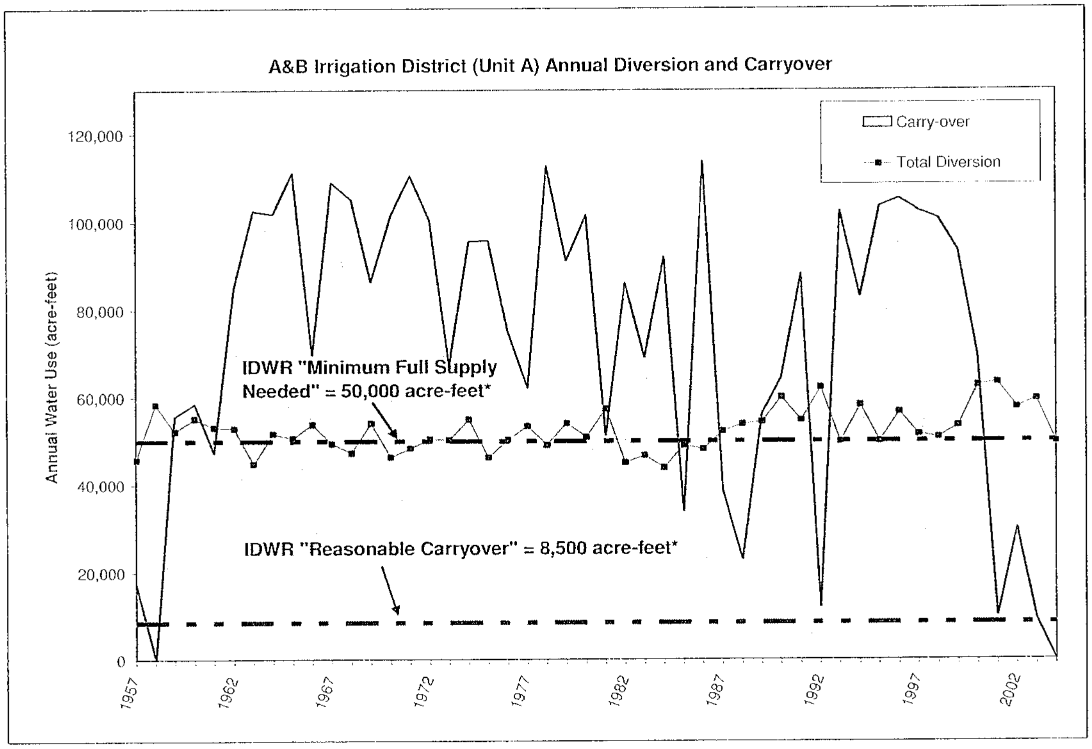


Figure 8-36 IDWR Order Versus A&B Annual Diversion and Carryover

Table 8-1 Comparison of Total SWC Natural Flow Diversions – Dry Years

Table of Total SWC Flow Diversions Use for Similar Average Years
Comparing post-1990 years with pre-1960 years

Rank*	Water Year	Total SWC Natural Flow Diversions (April-Sep) (acre-ft)	Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
			Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
27	1939	1,830,000			
28	1991	1,704,000	-126,000	-171,000	-148,500
29	1958	1,875,000			
31	1932	1,868,000			
32	2000	1,855,000	-13,000	-248,000	-130,500
34	1953	2,103,000			
37	1946	2,111,000			
38	1954	2,330,000			
39	1948	2,134,000			
40	1949	2,108,000			
41	1936	1,911,000			
43	1938	1,998,000			
46	1947	2,118,000			
49	1993	1,859,000	-259,000	-252,000	-255,500
50	1946	2,111,000			
53	1957	2,158,000			
55	1995	1,892,000	-266,000	-279,000	-272,500
57	1952	2,171,000			
Averages		**2,150,400**	**-166,000**	**-237,500**	**-201,750**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 average years are shown and compared.

Table 8-2 Comparison of Total SWC Natural Flow Diversions – Average Years

Table of Total SWC Natural Flow Diversions for Similarly Dry Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
Rank*	Water Year	Total SWC Natural Flow Diversions (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
1	1934	922,000			
3	1931	1,136,000			
4	1992	1,060,000	-76,000	-495,000	-285,500
5	2001	1,121,000	-15,000	-434,000	-224,500
7	1940	1,555,000			
8	1994	1,381,000	-174,000	-224,000	-199,000
10	1941	1,605,000			
11	1937	1,655,000			
12	2002	1,368,000	-287,000	-161,000	-224,000
13	1935	1,529,000			
14	2003	1,287,000	-242,000	-264,000	-253,000
15	1960	1,551,000			
16	2004	1,319,000	-232,000	-466,000	-349,000
18	1955	1,785,000			
19	1930	1,721,000			
Averages		**1,399,667**	**-171,000**	**-340,667**	**-255,833**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-3 Comparison of Total SWC Days of Only Natural Flow Diversions

Table of Number of Days of Only Natural Flow Diversions for Similarly Dry Years

Comparing post-1990 years with pre-1960 years

		Number of Days of Only Natural Flow Diversions						Post-1990 Only Natural Flow Days Compared with pre-1960 Only Natural Flow Days		
Rank*	Water Year	Minidoka & Burley Irrigation Districts	Twin Falls Canal Co	North Side Canal Co.	Milner Low Lift	American Falls Res District #2	Total SWC Natural Flow Diversion	Compared with next Driest Year	Compared with next Wettest Year	Average of next Wettest and Driest Comparisons
1	1934	2	21	7	0	0	30			
3	1931	23	48	18	7	7	103			
4	1992	29	56	18	0	0	103	0	-102	-51
5	2001	29	54	23	9	18	133	30	-72	-21
7	1940	54	55	47	22	27	205			
8	1994	51	77	43	0	0	171	-34	-39	-37
10	1941	54	67	52	28	9	210			
11	1937	65	76	59	33	33	266			
12	2002	58	78	53	11	0	200	-66	-47	-57
13	1935	58	83	68	38	0	247			
14	2003	54	58	47	11	2	172	-75	-107	-91
15	1960	63	69	55	46	46	279			
16	2004	39	80	28	3	0	150	-129	-215	-172
18	1955	88	94	74	47	62	365			
19	1930	58	92	59	25	89	323			
Averages		48	67	43	19	20	197	-46	-97	-71

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls.
Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-4 Comparison of TFCC Natural Flow Diversions – Average Years

Table of Twin Falls Canal Co. Natural Flow Diversion for Similar Average Years
Comparing post-1990 years with pre-1960 years

Rank*	Water Year	Total Natural Flow Diversion (April-Sep) (acre-ft)	Post-1990 Natural Flow Diversion Compared with pre-1960 Natural Flow: Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
27	1939	937,000			
28	1991	877,000	-60,000	-26,000	-43,000
29	1958	903,000			
31	1932	836,000			
32	2000	904,000	68,000	-55,000	6,500
34	1953	959,000			
37	1946	919,000			
38	1954	976,000			
39	1948	920,000			
40	1949	939,000			
41	1936	895,000			
43	1938	894,000			
46	1947	916,000			
49	1993	841,000	-75,000	-78,000	-76,500
50	1946	919,000			
53	1957	922,000			
55	1995	798,000	-124,000	-187,000	-155,500
57	1952	985,000			
Averages		**907,778**	**-47,750**	**-86,500**	**-67,125**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 average years are shown and compared.

Table 8-5 Comparison of TFCC Natural Flow Diversions - Dry Years

Table of Twin Falls Canal Co. Natural Flow Diversions for Similarly Dry Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
Rank*	Water Year	Natural Flow Diversions (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
1	1934	785,000			
3	1931	827,000			
4	1992	712,000	-115,000	-117,000	-116,000
5	2001	752,000	-75,000	-77,000	-76,000
7	1940	829,000			
8	1994	774,000	-55,000	-81,000	-68,000
10	1941	855,000			
11	1937	854,000			
12	2002	791,000	-63,000	-14,000	-38,500
13	1935	805,000			
14	2003	712,000	-93,000	-172,000	-132,500
15	1960	884,000			
16	2004	802,000	-82,000	-56,000	-69,000
18	1955	858,000			
19	1930	925,000			
Averages		**811,000**	**-80,500**	**-86,167**	**-83,333**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-6 Comparison of NSCC Natural Flow Diversions – Average Years

Table of North Side Canal Co. Natural Flow Diversion for Similar Average Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversion Compared with pre-1960 Natural Flow		
Rank*	Water Year	Total Natural Flow Diversion (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
27	1939	461,000			
28	1991	448,000	-13,000	-39,000	-26,000
29	1958	487,000			
31	1932	537,000			
32	2000	455,000	-82,000	-124,000	-103,000
34	1953	579,000			
37	1946	572,000			
38	1954	642,000			
39	1948	595,000			
40	1949	559,000			
41	1936	512,000			
43	1938	579,000			
46	1947	595,000			
49	1993	526,000	-69,000	-46,000	-57,500
50	1946	572,000			
53	1957	604,000			
55	1995	532,000	-72,000	-47,000	-59,500
57	1952	579,000			
Averages		546,333	-59,000	-64,000	-61,500

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 average years are shown and compared.

Table 8-7 Comparison of NSCC Natural Flow Diversions – Dry Years

Table of North Side Canal Co. Natural Flow Diversions for Similar Dry Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
Rank*	Water Year	Natural Flow Diversions (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
1	1934	121,000			
3	1931	182,000			
4	1992	185,000	3,000	-216,000	-106,500
5	2001	220,000	38,000	-181,000	-71,500
7	1940	401,000			
8	1994	341,000	-60,000	-84,000	-72,000
10	1941	425,000			
11	1937	442,000			
12	2002	332,000	-110,000	-78,000	-94,000
13	1935	410,000			
14	2003	334,000	-76,000	-34,000	-55,000
15	1960	368,000			
16	2004	290,000	-78,000	-212,000	-145,000
18	1955	502,000			
19	1930	446,000			
Averages		333,267	-47,167	-134,167	-90,667

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-8 Comparison of NSCC Days of Natural Flow Diversions

Number of Days of Only Natural Flow Diversions for Similarly Dry Years - North Side Canal Co. Comparing post-1990 years with pre-1960 years					
Number of Days of Only Natural Flow Diversion			Post-1990 Only Natural Flow Days Compared with pre-1960 Only Natural Flow Days		
Rank*	Water Year	North Side Canal Co.	Compared with next Driest Year	Compared with next Wettest Year	Average of next Wettest and Driest Comparisons
1	1934	7			
3	1931	18			
4	1992	18	0	-29	-15
5	2001	23	5	-24	-10
7	1940	47			
8	1994	43	-4	-9	-7
10	1941	52			
11	1937	59			
12	2002	53	-6	-15	-11
13	1935	68			
14	2003	47	-21	-8	-15
15	1960	55			
16	2004	28	-27	-46	-37
18	1955	74			
19	1930	59			
Averages		43	-9	-22	-15

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-9 Comparison of AFRD2 Natural Flow Diversions – Average Years

American Falls Res. Dist.#2 Natural Flow Diversion for Similar Average Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversion Compared with pre-1960 Natural Flow		
Rank*	Water Year	Total Natural Flow Diversion (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
27	1939	67,000			
28	1991	67,000	0	-60,000	-30,000
29	1958	127,000			
31	1932	110,000			
32	2000	99,000	-11,000	-92,000	-51,500
34	1953	191,000			
37	1946	196,000			
38	1954	226,000			
39	1948	207,000			
40	1949	177,000			
41	1936	128,000			
43	1938	131,000			
46	1947	194,000			
49	1993	86,000	-108,000	-110,000	-109,000
50	1946	196,000			
53	1957	191,000			
55	1995	152,000	-39,000	-10,000	-24,500
57	1952	162,000			
Averages		**150,389**	**-39,500**	**-68,000**	**-53,750**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 average years are shown and compared.

Table 8-10 Comparison of AFRD2 Natural Flow Diversions – Dry Years

American Falls Res. Dist.#2 Natural Flow Diversion for Similar Dry Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
Rank*	Water Year	Natural Flow Diversions (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
1	1934	0			
3	1931	12,000			
4	1992	0	-12,000	-39,000	-25,500
5	2001	24,000	12,000	-15,000	-1,500
7	1940	39,000			
8	1994	58,000	19,000	25,000	22,000
10	1941	33,000			
11	1937	62,000			
12	2002	18,000	-44,000	18,000	-13,000
13	1935	0			
14	2003	14,000	14,000	-3,000	5,500
15	1960	17,000			
16	2004	0	-17,000	-74,000	-45,500
18	1955	74,000			
19	1930	0			
Averages		**23,400**	**-4,667**	**-14,667**	**-9,667**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-11 Comparison of AFRD2 Days of Natural Flow Diversions

Number of Days of Only Natural Flow Diversions for Similarly Dry Years - American Falls Reservoir District #2 Comparing post-1990 years with pre-1960 years					
Number of Days of Only Natural Flow Diversion			Post-1990 Only Natural Flow Days Compared with pre-1960 Only Natural Flow Days		
Rank*	Water Year	American Falls Res. Dist. #2	Compared with next Driest Year	Compared with next Wettest Year	Average of next Wettest and Driest Comparisons
1	1934	0			
3	1931	7			
4	1992	0			
5	2001	18	11	-9	1
7	1940	27			
8	1994	0			
10	1941	9			
11	1937	33			
12	2002	0	-33	0	-17
13	1935	0			
14	2003	2	2	-44	-21
15	1960	46			
16	2004	0	-46	-62	-54
18	1955	62			
19	1930	89			
Averages		**23**	**-17**	**-29**	**-23**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared. Data missing for 1992 and 1994.

Table 8-12 Comparison of MID/BID Natural Flow Diversions – Average Years

Minidoka & Burley Irrig. Dist. Natural Flow Diversion for Similar Average Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversion Compared with pre-1960 Natural Flow		
Rank*	Water Year	Total Natural Flow Diversion (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
27	1939	358,000			
28	1991	289,000	-69,000	-45,000	-57,000
29	1958	334,000			
31	1932	375,000			
32	2000	358,000	-17,000	5,000	-6,000
34	1953	353,000			
37	1946	401,000			
38	1954	456,000			
39	1948	387,000			
40	1949	412,000			
41	1936	358,000			
43	1938	378,000			
46	1947	394,000			
49	1993	373,000	-21,000	-28,000	-24,500
50	1946	401,000			
53	1957	399,000			
55	1995	363,000	-36,000	-60,000	-48,000
57	1952	423,000			
Averages		**378,444**	**-35,750**	**-32,000**	**-33,875**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 average years are shown and compared.

Table 8-13 Comparison of MID/BID Natural Flow Diversions – Dry Years

Minidoka & Burley Irrig. Districts Natural Flow Diversion for Similar Dry Years Comparing post-1990 years with pre-1960 years					
			Post-1990 Natural Flow Diversions Compared with pre-1960 Natural Flow		
Rank*	Water Year	Natural Flow Diversions (April-Sep) (acre-ft)	Compared with next Driest pre-1960 Year (acre-ft)	Compared with next Wettest pre-1960 Year (acre-ft)	Average of next Wettest and Driest Comparisons (acre-ft)
1	1934	16,000			
3	1931	115,000			
4	1992	161,000	46,000	-122,000	-38,000
5	2001	121,000	6,000	-162,000	-78,000
7	1940	283,000			
8	1994	197,000	-86,000	-88,000	-87,000
10	1941	285,000			
11	1937	289,000			
12	2002	221,000	-68,000	-85,000	-76,500
13	1935	306,000			
14	2003	220,000	-86,000	-60,000	-73,000
15	1960	280,000			
16	2004	223,000	-57,000	-119,000	-88,000
18	1955	342,000			
19	1930	346,000			
Averages		**227,000**	**-40,833**	**-106,000**	**-73,417**

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-14 Comparison of MID/BID Days of Natural Flow Diversions

Number of Days of Only Natural Flow Diversions for Similarly Dry Years - Minidoka & Burley Irrig. Districts. Comparing post-1990 years with pre-1960 years					
Number of Days of Only Natural Flow Diversion			Post-1990 Only Natural Flow Days Compared with pre-1960 Only Natural Flow Days		
Rank*	Water Year	American Falls Res. Dist. #2	Compared with next Driest Year	Compared with next Wettest Year	Average of next Wettest and Driest Comparisons
1	1934	2			
3	1931	23			
4	1992	29	6	-25	-10
5	2001	29	6	-25	-10
7	1940	54			
8	1994	51	-3	-3	-3
10	1941	54			
11	1937	65			
12	2002	58	-7	0	-4
13	1935	58			
14	2003	54	-4	-9	-7
15	1960	63			
16	2004	39	-24	-49	-37
18	1955	88			
19	1930	58			
Averages		48	-4	-19	-11

* Ranking is based on estimated annual unregulated surface inflow to the Snake River above American Falls. Only 1960 and earlier and post-1990 dry years are shown and compared.

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use

A&B Irrigation District Water Requirements Analysis													
PROJECT WATER REQUIREMENTS													
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	0	2369	5518	10440	13460	6888	3063	1105	42842	ac ft		2.48	af/ac
average IR	0	1796	4735	9646	13195	6683	2842	898	39795	ac ft		2.30	af/ac
CU 90%	0	2671	5980	11349	13664	7052	3327	1217	45260	ac ft		2.62	af/ac
CIR 90%	0	2534	5770	11266	13583	7000	3454	1156	44764	ac ft		2.59	af/ac
Estimated Field Application Efficiency	45	60	70	70	70	70	60	45	61	percent			
Field Headgate Requirement													
average CU	0	3948	7884	14914	19229	9840	5105	2455	63373	ac ft		3.66	af/ac
average IR	0	2993	6764	13780	18849	9548	4737	1995	58667	ac ft		3.39	af/ac
CU 90%	0	4452	8543	16212	19520	10074	5545	2705	67052	ac ft		3.88	af/ac
CIR 90%	0	4224	8243	16094	19404	10000	5757	2568	66291	ac ft		3.83	af/ac
Estimated Base Transmission Losses	0	1979	4091	3959	4091	4091	3959	1979	24147	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	0	5927	11974	18872	23319	13930	9064	4434	87521	ac ft		5.06	af/ac
average IR	0	4973	10854	17739	22940	13638	8696	3975	82814	ac ft		4.79	af/ac
CU 90%	0	6431	12634	20171	23610	14165	9503	4685	91199	ac ft		5.27	af/ac
CIR 90%	0	6203	12333	20053	23495	14091	9716	4548	90439	ac ft		5.23	af/ac
Project Efficiency													
average CU	0	0.40	0.46	0.55	0.58	0.49	0.34	0.25	0.49	Based on Project CU			
average IR	0	0.36	0.44	0.54	0.58	0.49	0.33	0.23	0.48	Based on Project CIR			
CU 90%	0	0.42	0.47	0.56	0.58	0.50	0.35	0.26	0.50	Based on Project CU 90%			
CIR 90%	0	0.41	0.47	0.56	0.58	0.50	0.36	0.25	0.49	Based on Project CIR 90%			

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

AFRD2 Water Requirements Analysis

PROJECT WATER REQUIREMENTS

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	0	12668	28871	39351	43604	28509	16499	5951	175452	ac ft	0	2.81	af/ac
average IR	0	10552	24252	36211	42703	27343	15167	4669	160898	ac ft	0	2.58	af/ac
CU 90%	0	14357	30897	42954	44544	29939	18357	6546	187594	ac ft	0	3.01	af/ac
CIR 90%	0	14025	29748	43094	44371	30527	18501	6320	186587	ac ft	0	2.99	af/ac
Estimated Field Application Efficiency	60	65	70	70	70	70	60	55	65	percent	62%sprinkler		
Field Headgate Requirement													
average CU	0	19489	41244	56215	62292	40727	27498	10820	258284	ac ft		4.14	af/ac
average IR	0	16234	34645	51731	61005	39062	25279	8489	236444	ac ft		3.79	af/ac
CU 90%	0	22088	44139	61363	63634	42769	30595	11903	276491	ac ft		4.43	af/ac
CIR 90%	0	21577	42497	61563	63388	43610	30836	11491	274962	ac ft		4.41	af/ac
Estimated Base Transmission Losses	1083	16248	33579	32496	33579	33579	32496	16248	199307	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	1083	35737	74823	88711	95871	74306	59993	27067	457592	ac ft		7.33	af/ac
average IR	1083	32482	68224	84226	94584	72640	57775	24737	435751	ac ft		6.98	af/ac
CU 90%	1083	38336	77718	93859	97213	76348	63091	28151	475798	ac ft		7.62	af/ac
CIR 90%	1083	37825	76076	94059	96967	77189	63331	27739	474269	ac ft		7.60	af/ac
Project Efficiency													
average CU	0	0.35	0.39	0.44	0.45	0.38	0.28	0.22	0.38	Based on Project CU			
average IR	0	0.32	0.36	0.43	0.45	0.38	0.26	0.19	0.37	Based on Project CIR			
CU 90%	0	0.37	0.40	0.46	0.46	0.39	0.29	0.23	0.39	Based on Project CU 90%			
CIR 90%	0	0.37	0.39	0.46	0.46	0.40	0.29	0.23	0.39	Based on Project CIR 90%			

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

Burley Irrigation District Water Requirements Analysis													
PROJECT WATER REQUIREMENTS													
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	0	5468	14467	24129	33234	20714	10725	3529	112265	ac ft		2.48	af/ac
average IR	0	3846	11627	21344	32276	19571	9766	2689	101118	ac ft		2.23	af/ac
CU 90%	0	6173	15358	25988	33386	21244	11782	3869	117801	ac ft		2.60	af/ac
CIR 90%	0	5845	14257	25201	33126	22029	11710	3681	115849	ac ft		2.55	af/ac
Estimated Field Application Efficiency	55	60	67	67	67	67	63	55	63	percent			
Field Headgate Requirement													
average CU	0	9113	21592	36013	49604	30916	17023	6416	170678	ac ft		3.76	af/ac
average IR	0	6410	17353	31856	48173	29210	15502	4889	153393	ac ft		3.38	af/ac
CU 90%	0	10288	22922	38789	49830	31708	18702	7034	179274	ac ft		3.95	af/ac
CIR 90%	0	9741	21280	37613	49442	32878	18587	6693	176235	ac ft		3.89	af/ac
Estimated Base Transmission Losses	764	11459	23682	22918	23682	23682	22918	11459	140564	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	764	20572	45274	58931	73285	54598	39941	17875	311241	ac ft		6.86	af/ac
average IR	764	17869	41035	54774	71855	52892	38420	16348	293957	ac ft		6.48	af/ac
CU 90%	764	21747	46604	61707	73512	55390	41620	18493	319837	ac ft		7.05	af/ac
CIR 90%	764	21200	44961	60531	73124	56560	41505	18152	316799	ac ft		6.98	af/ac
Project Efficiency													
average CU	0	0.27	0.32	0.41	0.45	0.38	0.27	0.20	0.36	Based on Project CU			
average IR	0	0.22	0.28	0.39	0.45	0.37	0.25	0.16	0.34	Based on Project CIR			
CU 90%	0	0.28	0.33	0.42	0.45	0.38	0.28	0.21	0.37	Based on Project CU 90%			
CIR 90%	0	0.28	0.32	0.42	0.45	0.39	0.28	0.20	0.37	Based on Project CIR 90%			

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

Milner Irrigation District Water Requirements Analysis														
PROJECT WATER REQUIREMENTS														
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total					
	0	15	31	30	31	31	30	15						
Project Monthly CU and IR														
average CU	0	1476	4184	7158	9691	5455	2201	569	30734	ac ft			2.27	af/ac
average IR	0	1023	3504	6334	9418	5043	1984	458	27765	ac ft			2.05	af/ac
CU 90%	0	1670	4392	7603	9736	5639	2459	623	32122	ac ft			2.37	af/ac
CIR 90%	0	1546	4288	7388	9681	5922	2397	608	31831	ac ft			2.35	af/ac
Estimated Field Application Efficiency	55	55	63	63	63	63	63	55	60	percent				
Field Headgate Requirement														
average CU	0	2683	6642	11362	15383	8659	3493	1035	49257	ac ft			3.64	af/ac
average IR	0	1860	5562	10055	14950	8004	3149	833	44414	ac ft			3.28	af/ac
CU 90%	0	3037	6971	12068	15454	8951	3903	1132	51516	ac ft			3.80	af/ac
CIR 90%	0	2811	6807	11728	15367	9401	3805	1105	51023	ac ft			3.77	af/ac
Estimated Base Transmission Losses	0	761	1573	1523	1573	1573	1523	761	9288	ac ft	(Worstell Method)			
Diversion Requirement														
average CU	0	3444	8215	12885	16956	10232	5016	1796	58545	ac ft			4.32	af/ac
average IR	0	2622	7135	11577	16523	9577	4672	1594	53702	ac ft			3.96	af/ac
CU 90%	0	3798	8545	13590	17027	10524	5425	1893	60804	ac ft			4.49	af/ac
CIR 90%	0	3572	8380	13250	16940	10974	5327	1866	60311	ac ft			4.45	af/ac
Project Efficiency														
average CU	0	0.43	0.51	0.56	0.57	0.53	0.44	0.32	0.52	Based on Project CU				
average IR	0	0.39	0.49	0.55	0.57	0.53	0.42	0.29	0.52	Based on Project CIR				
CU 90%	0	0.44	0.51	0.56	0.57	0.54	0.45	0.33	0.53	Based on Project CU 90%				
CIR 90%	0	0.43	0.51	0.56	0.57	0.54	0.45	0.33	0.53	Based on Project CIR 90%				

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

Minidoka Irrigation District Water Requirements Analysis

PROJECT WATER REQUIREMENTS

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	0	10591	24675	46680	60186	30798	13697	4939	191566	ac ft		2.48	af/ac
average IR	0	8031	21171	43132	58998	29884	12710	4015	177940	ac ft		2.30	af/ac
CU 90%	0	11944	26740	50745	61097	31532	14876	5444	202377	ac ft		2.62	af/ac
CIR 90%	0	11333	25800	50375	60735	31301	15446	5168	200158	ac ft		2.59	af/ac
Estimated Field Application Efficiency	50	55	60	60	60	60	55	50	56	percent			
Field Headgate Requirement													
average CU	0	19256	41126	77801	100310	51330	24904	9878	324604	ac ft		4.20	af/ac
average IR	0	14601	35284	71887	98330	49806	23109	8029	301047	ac ft		3.89	af/ac
CU 90%	0	21717	44567	84574	101828	52553	27047	10888	343174	ac ft		4.44	af/ac
CIR 90%	0	20605	43001	83958	101225	52169	28083	10336	339376	ac ft		4.39	af/ac
Estimated Base Transmission Losses	0	5758	11900	11516	11900	11900	11516	5758	70251	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	0	25014	53026	89317	112210	63230	36420	15637	394854	ac ft		5.10	af/ac
average IR	0	20359	47185	83404	110231	61707	34625	13788	371298	ac ft		4.80	af/ac
CU 90%	0	27475	56467	96091	113729	64453	38564	16646	413424	ac ft		5.34	af/ac
CIR 90%	0	26363	54901	95474	113125	64069	39600	16094	409627	ac ft		5.30	af/ac
Project Efficiency													
average CU	0	0.42	0.47	0.52	0.54	0.49	0.38	0.32	0.49	Based on Project CU			
average IR	0	0.39	0.45	0.52	0.54	0.48	0.37	0.29	0.48	Based on Project CIR			
CU 90%	0	0.43	0.47	0.53	0.54	0.49	0.39	0.33	0.49	Based on Project CU 90%			
CIR 90%	0	0.43	0.47	0.53	0.54	0.49	0.39	0.32	0.49	Based on Project CIR 90%			

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

North Side Canal Co Water Requirements Analysis													
PROJECT WATER REQUIREMENTS													
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	0	28626	62500	91112	117234	81871	48319	14324	443985	ac ft		2.74	af/ac
average IR	0	23101	54221	83118	115338	79135	44789	11532	411234	ac ft		2.54	af/ac
CU 90%	0	32446	67297	98906	118781	84532	52954	15582	470499	ac ft		2.90	af/ac
CIR 90%	0	31521	64494	97359	118253	86908	54874	15719	469128	ac ft		2.89	af/ac
Estimated Field Application Efficiency	60	65	72	72	72	72	65	60	67	percent			
Field Headgate Requirement													
average CU	0	44040	86806	126544	162825	113710	74336	23873	632134	ac ft		3.90	af/ac
average IR	0	35541	75307	115441	160191	109909	68906	19220	584516	ac ft		3.60	af/ac
CU 90%	0	49917	93468	137370	164974	117406	81468	25970	670572	ac ft		4.14	af/ac
CIR 90%	0	48493	89575	135221	164241	120705	84421	26199	668855	ac ft		4.13	af/ac
Estimated Base Transmission Losses	0	62355	96650	93532	96650	96650	93532	46766	586136	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	0	106395	183456	220076	259475	210360	167868	70639	1218270	ac ft		7.51	af/ac
average IR	0	97896	171957	208973	256841	206559	162439	65986	1170652	ac ft		7.22	af/ac
CU 90%	0	112272	190118	230902	261624	214056	175001	72736	1256708	ac ft		7.75	af/ac
CIR 90%	0	110848	186225	228753	260891	217355	177953	72965	1254991	ac ft		7.74	af/ac
Project Efficiency													
average CU	0.00	0.27	0.34	0.41	0.45	0.39	0.29	0.20	0.36	Based on Project CU			
average IR	0.00	0.24	0.32	0.40	0.45	0.38	0.28	0.17	0.35	Based on Project CIR			
CU 90%	0.00	0.29	0.35	0.43	0.45	0.39	0.30	0.21	0.37	Based on Project CU 90%			
CIR 90%	0.00	0.28	0.35	0.43	0.45	0.40	0.31	0.22	0.37	Based on Project CIR 90%			

Table 8-15 Summary of Surface Water Coalition Water Requirements by Consumptive Use (Continued)

Twin Falls Canal Co Water Requirements Analysis													
PROJECT WATER REQUIREMENTS													
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total				
	0	15	31	30	31	31	30	15					
Project Monthly CU and IR													
average CU	2403	37427	86800	113882	140753	88463	46925	17301	533954	ac ft		2.63	af/ac
average IR	1107	29428	74901	100290	136453	81566	41961	13662	479369	ac ft		2.37	af/ac
CU 90%	2861	42401	91183	120960	141439	91501	52369	18903	561618	ac ft		2.77	af/ac
CIR 90%	2008	39578	89110	117480	140750	96194	51116	18484	554721	ac ft		2.74	af/ac
Estimated Field Application Efficiency	55	60	62	62	62	62	55	50	59	percent			
Field Headgate Requirement													
average CU	4370	62378	140000	183680	227020	142682	85318	34602	880051	ac ft		4.34	af/ac
average IR	2013	49047	120809	161758	220086	131558	76292	27325	788887	ac ft		3.89	af/ac
CU 90%	5202	70668	147070	195097	228128	147583	95216	37806	926770	ac ft		4.57	af/ac
CIR 90%	3651	65963	143725	189484	227017	155152	92939	36968	914899	ac ft		4.51	af/ac
Estimated Base Transmission Losses	0	29592	61157	59184	61157	61157	59184	29592	361025	ac ft	(Worstell Method)		
Diversion Requirement													
average CU	4370	91971	201157	242865	288178	203839	144502	64195	1241077	ac ft		6.12	af/ac
average IR	2013	78639	181966	220942	281244	192715	135477	56917	1149913	ac ft		5.67	af/ac
CU 90%	5202	100260	208227	254281	289285	208740	154400	67399	1287795	ac ft		6.35	af/ac
CIR 90%	3651	95555	204883	248669	288174	216309	152123	66561	1275925	ac ft		6.29	af/ac
Project Efficiency													
average CU	0.55	0.41	0.43	0.47	0.49	0.43	0.32	0.27	0.43	Based on Project CU			
average IR	0.55	0.37	0.41	0.45	0.49	0.42	0.31	0.24	0.42	Based on Project CIR			
CU 90%	0.55	0.42	0.44	0.48	0.49	0.44	0.34	0.28	0.44	Based on Project CU 90%			
CIR 90%	0.55	0.41	0.43	0.47	0.49	0.44	0.34	0.28	0.43	Based on Project CIR 90%			

Table 8-16 SWC Water Requirements Based on Average Consumptive Irrigation Requirements Compared with IDWR Estimated Minimum Full Supply

	Minidoka	Burley	A & B	Twin Falls	North Side	Milner	AFRD#2
Annual Diversion Using Average CIR	371,298	293,957	82,814	1,149,913	1,170,652	53,702	435,751
1995 Minimum Full Supply*	280,200	254,300	50,000	1,075,900	988,200	50,800	405,600
Difference	**91,098**	**39,657**	**32,814**	**74,013**	**182,452**	**2,902**	**30,151**

* Based on April 19, 2005 Order

Table 8-17 SWC Water Requirements Based 90 Percent Probability Consumptive Irrigation Requirements (CIR90%) Compared with IDWR Estimated Minimum Full Supply

	Minidoka	Burley	A & B	Twin Falls	North Side	Milner	AFRD#2
Annual Diversion Using CIR90%	409,627	316,799	90,439	1,275,925	1,254,991	60,311	474,269
1995 Minimum Full Supply*	280,200	254,300	50,000	1,075,900	988,200	50,800	405,600
Difference	**129,427**	**62,499**	**40,439**	**200,025**	**266,791**	**9,511**	**68,669**

* Based on April 19, 2005 Order