Irrigation Sector Progress to Achieve the 30% Efficiency and Productivity Goal of the Water for Life Strategy

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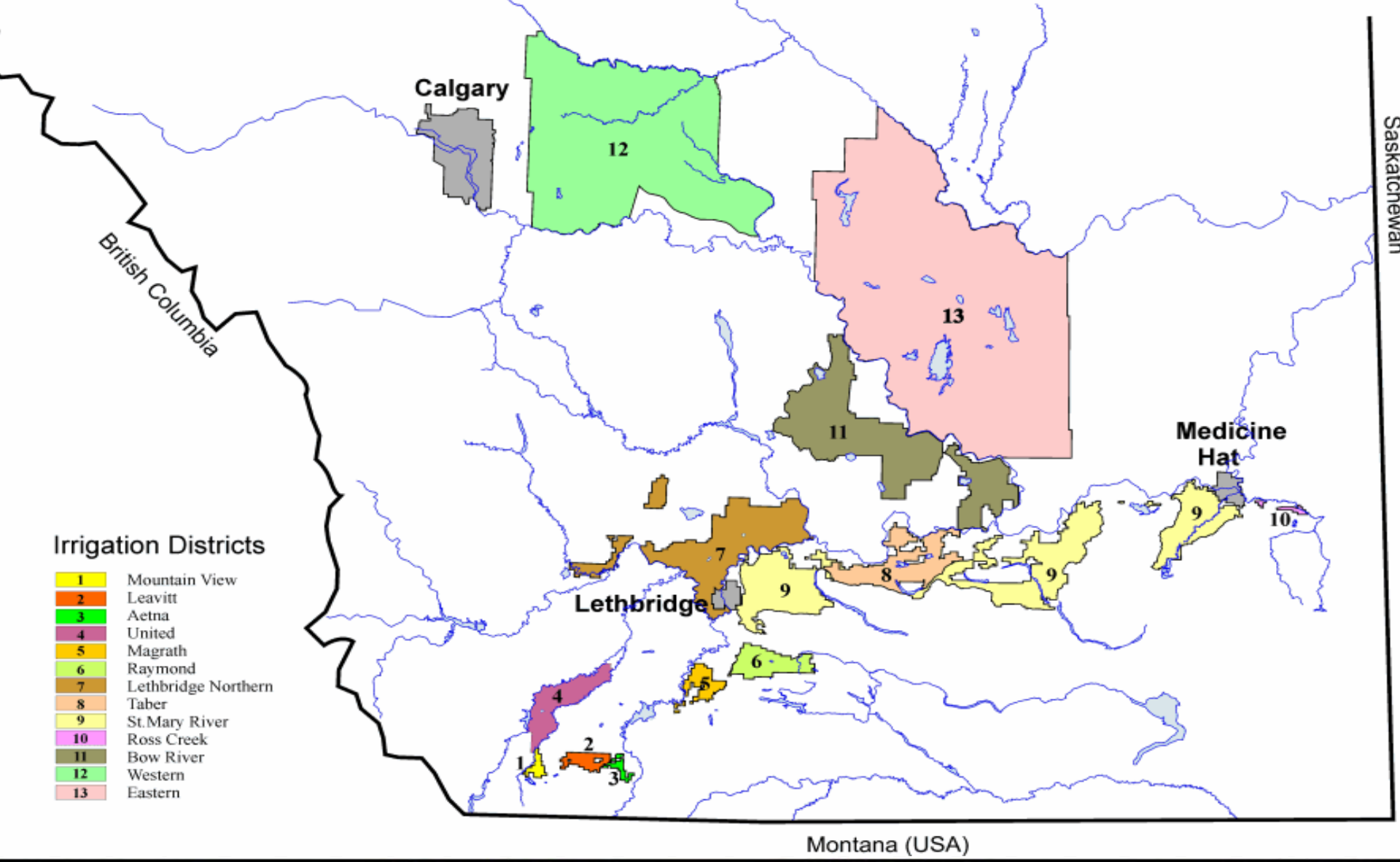
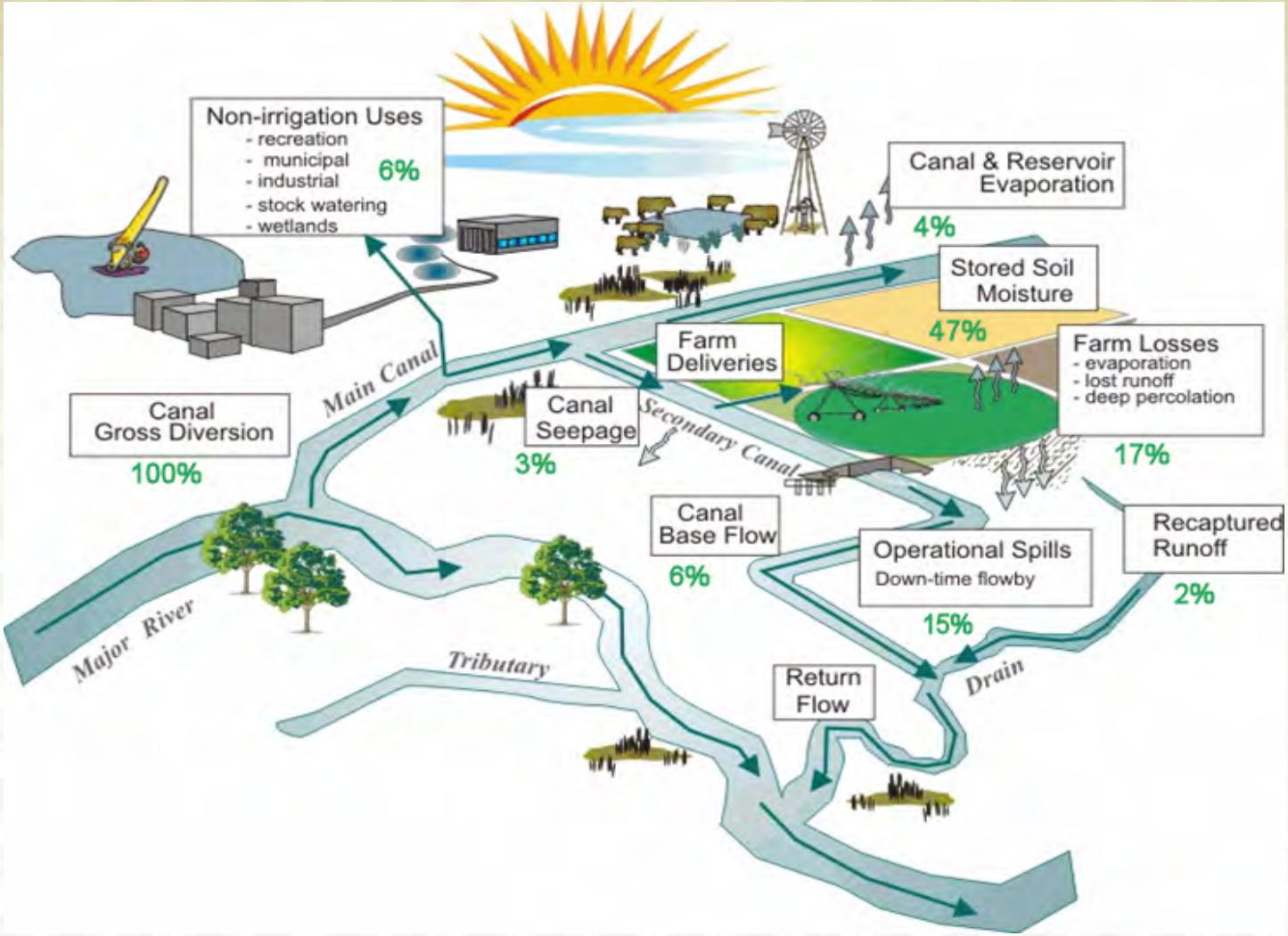
Alberta Irrigation
PROJECTS ASSOCIATION


Calgary
British Columbia
Saskatchewan
Medicine Hat
Lethbridge
Montana (USA)
Irrigation Districts
1 Mountain View
2 Leavitt
3 Aetna
4 United
5 Magrath
6 Raymond
7 Lethbridge Northern
8 Taber
9 St.Mary River
10 Ross Creek
11 Bow River
12 Western
13 Eastern


Non-irrigation Uses
- recreation
- municipal
- industrial
- stock watering
- wetlands
6%
Canal & Reservoir Evaporation
4%
Stored Soil Moisture
47%
Farm Deliveries
Farm Losses
- evaporation
- lost runoff
- deep percolation
17%
Canal Gross Diversion
100%
Main Canal
Canal Seepage
3%
Secondary Canal
Canal Base Flow
6%
Operational Spills
Down-time flowby
15%
Recaptured Runoff
2%
Major River
Tributary
Return Flow
Drain

Water Losses from Irrigation?

When water is applied to land by some form of irrigation system, water can be lost via:

- Evaporation from/of droplets while in the air
- Wind drift of water droplets beyond the target area
- Evaporation of free water on crop leaves and on the ground surface
- Deep percolation of water below the rootzone
- Surface runoff from the field

Efficiencies of Systems

- Wild flood (undeveloped gravity) 30%
- Gravity developed 62%

Efficiencies of Systems

- Side-roll wheel-moves 67%

Efficiencies of Systems

- High pressure pivot 73%

Efficiencies of Systems

- Low pressure drop-tube pivot 84%

  Best practice for field-scale crops

Efficiencies of Systems

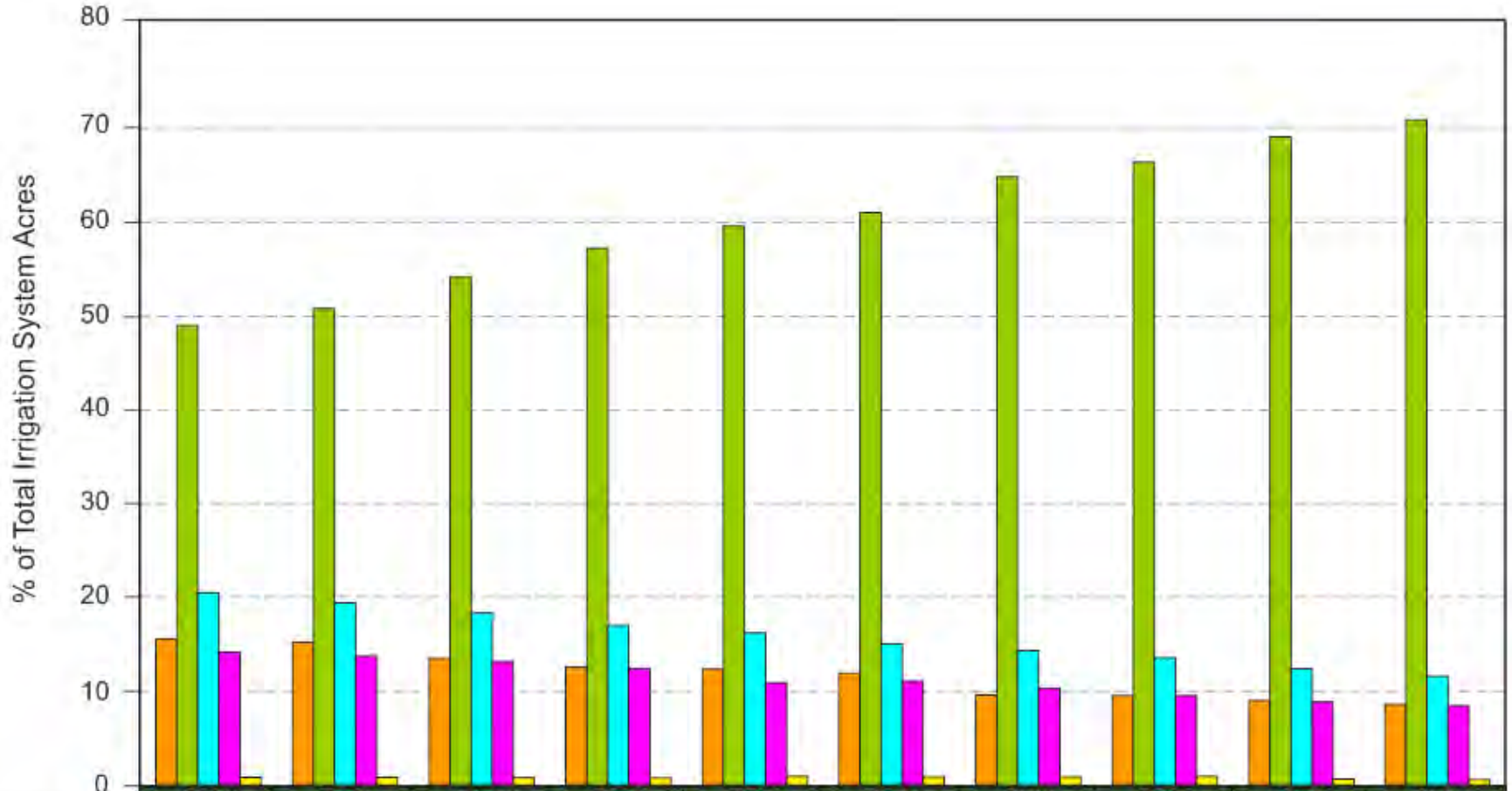
- Micro – drip/trickle irrigation 88%

Being tested out in some corners of fields irrigated with pivots. Also used on some saskatoon orchards, market gardens, and nursery crops which total about 2,000 hectares

Target #2

- ***Target 2. By the year 2015, 70% of irrigated lands in districts will be under best management practices, namely low pressure drop-tube centre pivots, an increase from the 47% documented in 2005.***

Adoption of Best Practices



		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
High Pressure Pivot	Acres	201,601	198,011	176,421	164,072	160,665	156,784	126,864	126,430	120,124	117,111
Low Pressure Pivot		635,880	660,168	705,260	747,187	773,538	802,173	856,707	879,651	922,716	956,422
Wheelmove		265,897	252,831	239,140	222,247	210,606	198,043	189,410	179,837	165,561	157,056
Gravity		183,811	178,411	171,487	162,063	141,885	145,879	136,709	126,217	118,307	114,122
Other		10,600	10,579	10,380	9,870	11,935	11,826	11,626	12,444	8,785	8,941

Target #2

Target 2 was met: 70.7% of the area was irrigated by low pressure pivots

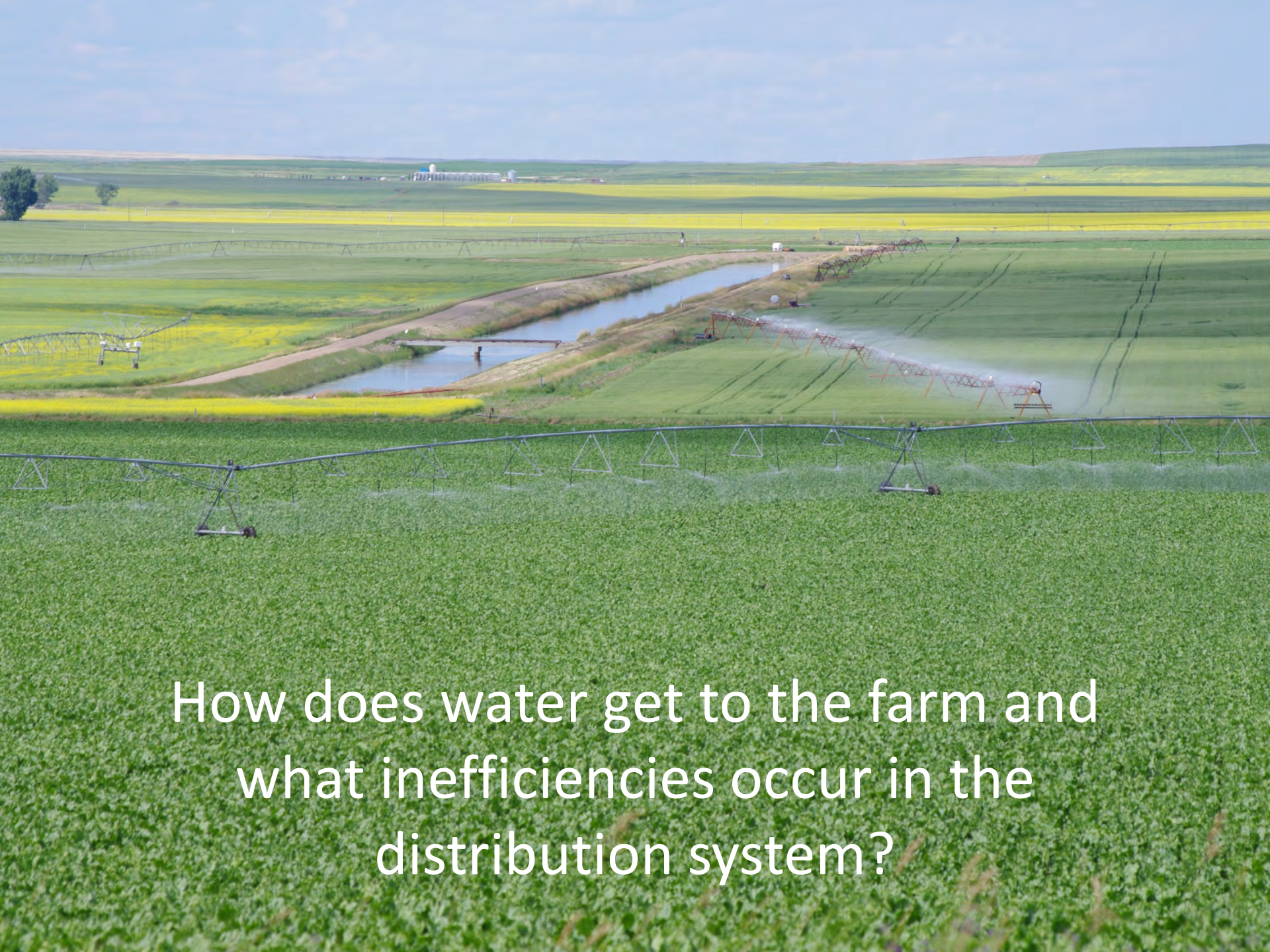

How does water get to the farm and what inefficiencies occur in the distribution system?

Photo courtesy of AEP

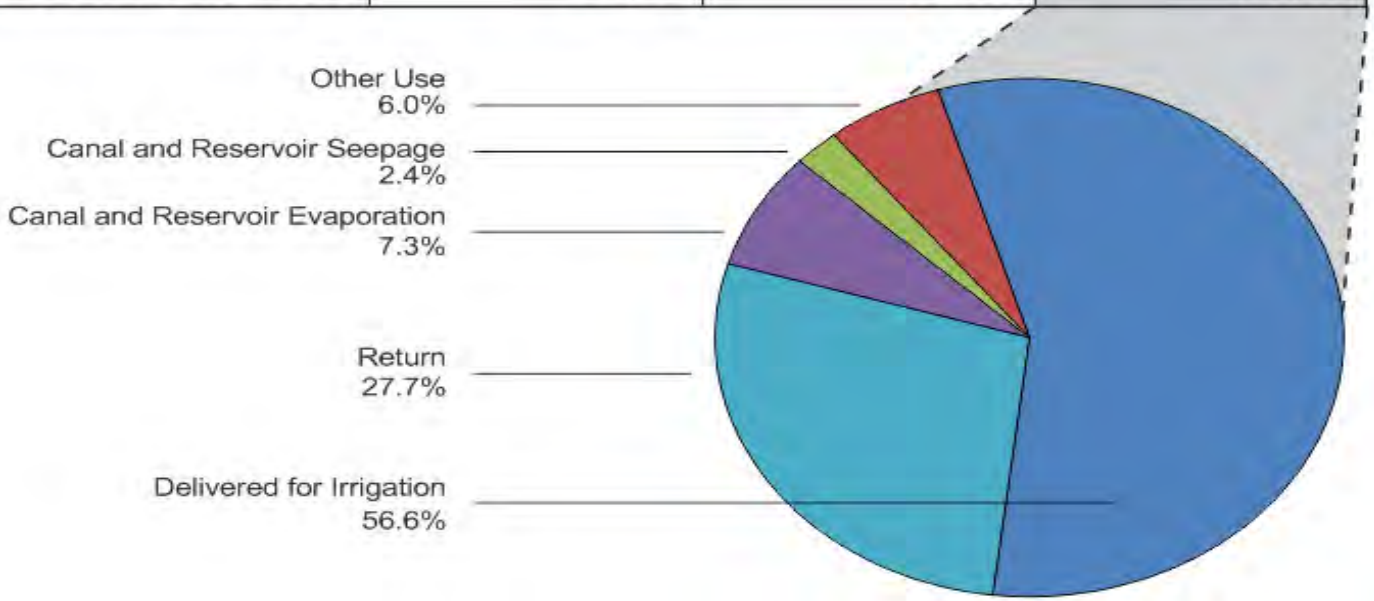

8,000 km of canals and pipelines

Water Losses from the Irrigation Distribution System?

After water is diverted for irrigation, water losses can occur via:

- Evaporation from the surface of water in reservoirs or in canals/laterals
- Seepage from reservoirs or canals/laterals
- Water use by plants along canals/laterals
- Flows that are not matched to demands: excess water gets diverted (becomes return flow)

Water Balance Category	OLDMAN RIVER BASIN	BOW RIVER BASIN	IRRIGATION DISTRICTS
Gross Diversion	562,900	706,900	1,269,800
Net District Storage Change	8,400	18,000	26,400
TOTAL DISTRICT USE	**571,300**	**724,900**	**1,296,200**
Delivered for Irrigation	336,200	397,100	733,300
Other Use	21,200	56,500	77,700
Canal & Reservoir Seepage	13,600	17,000	30,600
Canal & Reservoir Evaporation	40,800	54,300	95,100
Return	159,500	200,000	359,500
TOTAL DISTRICT OPERATIONS	**571,300**	**724,900**	**1,296,200**



What Districts Do to Improve Efficiencies

- Line earthen canals to reduce seepage
- Replace laterals with pipelines (no seepage, evaporation, or water use by plants)
- Automate flow monitoring and control
- Set water-use limits for farm deliveries
- Require notice for turning water on or off
- Encourage water saving; promote CEP at conferences and at Annual General Meetings

Controlling Canal Seepage

- **Losses are 2 to 3 %; membrane liners save water**

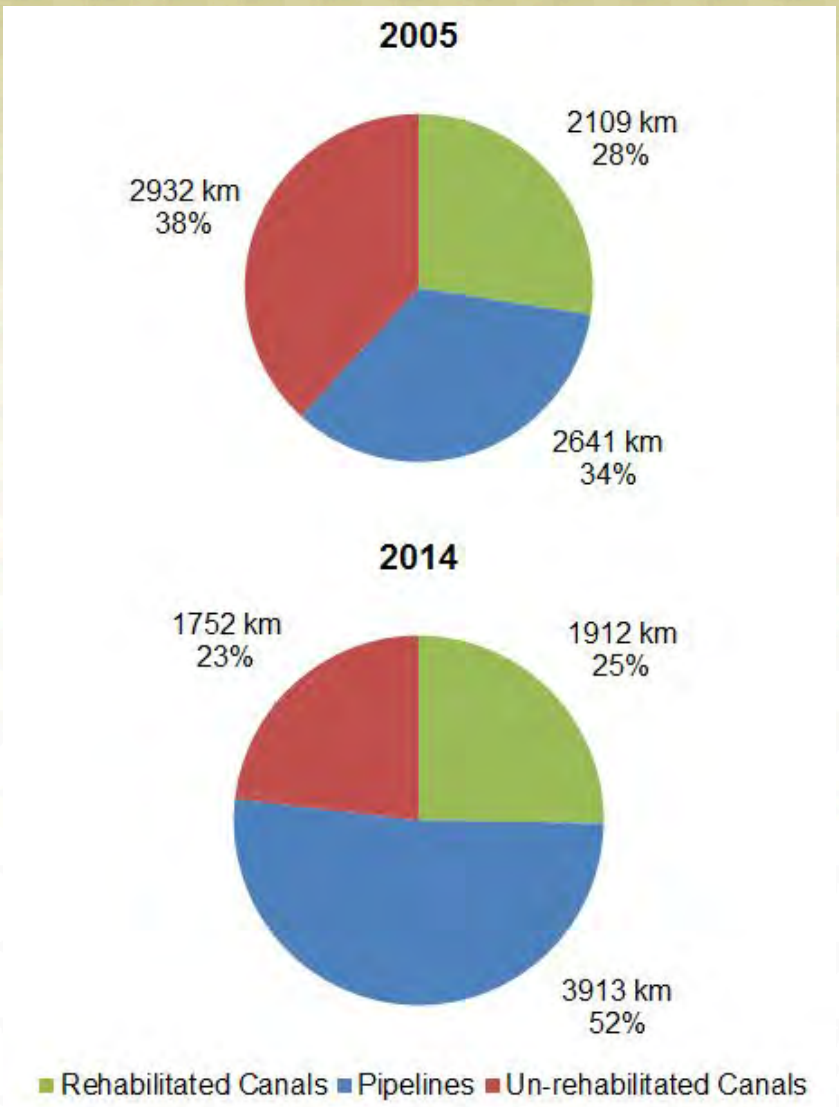
Pipelines

Pipelines Versus Open Chanels

Pipelines

Advantages include

- **No seepage**
- **No evaporation**
- **No water use by phreatophytic plants**
- **On/off capability with appropriate valving which reduces bypass water**


2005
2109 km
28%
2932 km
38%
2641 km
34%
2014
1752 km
23%
1912 km
25%
3913 km
52%
Rehabilitated Canals
Pipelines
Un-rehabilitated Canals

SCADA – Measuring/Controlling water deliveries

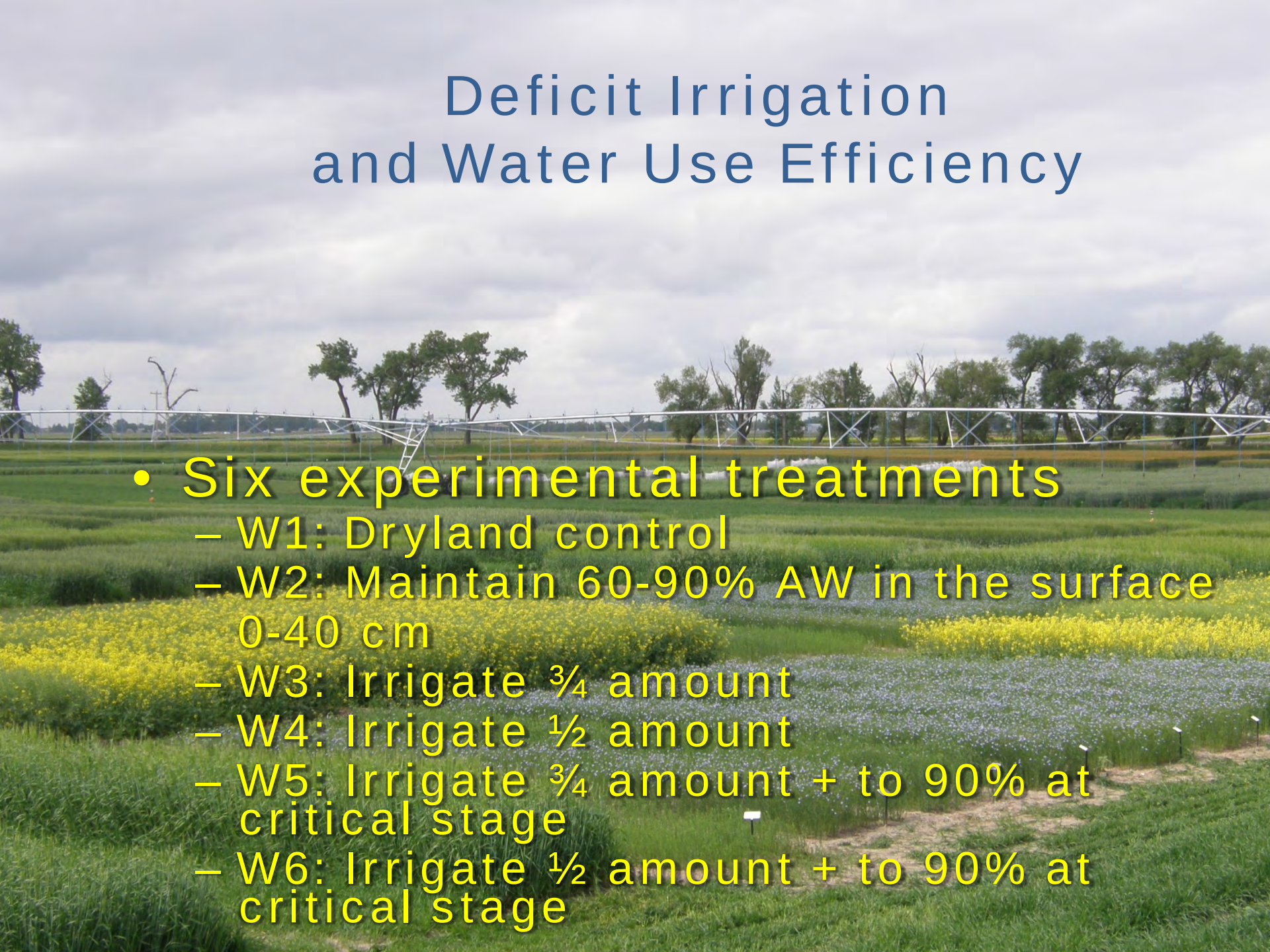
Benefits of better flow control

- **Reduced diversions**
- **Less spill water, i.e., less return flow**

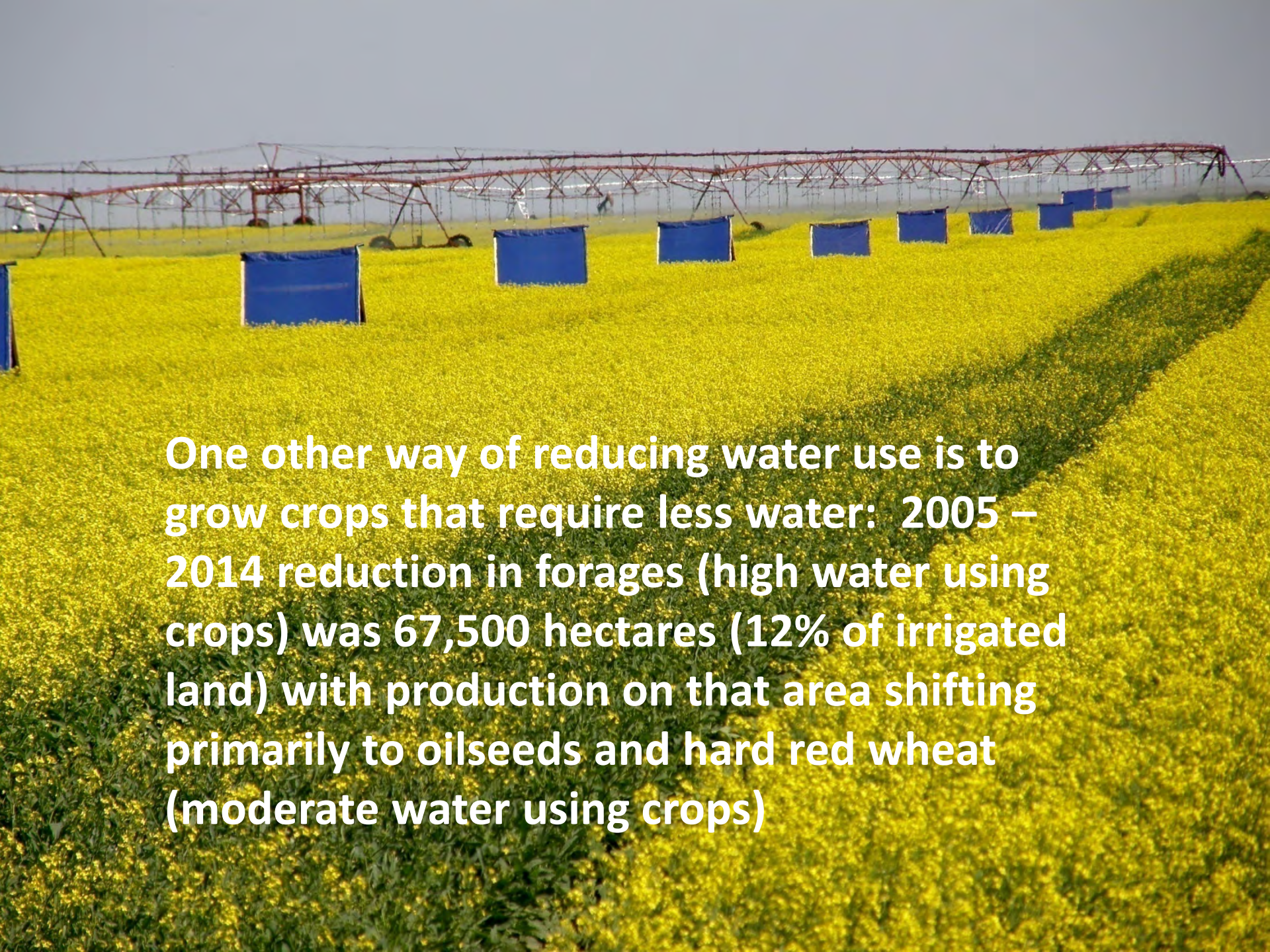
What Alberta Agriculture Does to Improve Efficiencies

- **Irrigation Rehabilitation Program**
  75% government: 25% irrigation district
  - **$19 million in this year's budget**
- **Growing Forward 2 on-farm water efficiency incentive**
- **Research into optimum crop water use**
- **Water measurement workshops**
- **CEP presentations at conferences**

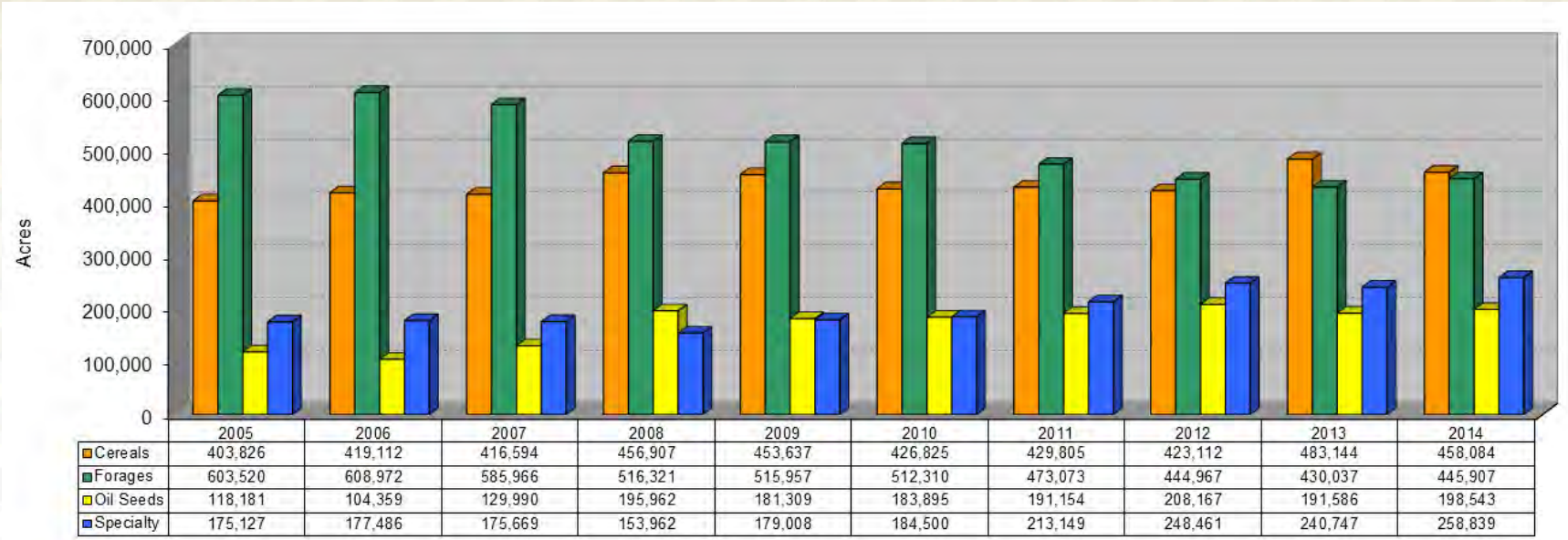
Deficit Irrigation and Water Use Efficiency



- Six experimental treatments
  - W1: Dryland control
  - W2: Maintain 60-90% AW in the surface 0-40 cm
  - W3: Irrigate ¾ amount
  - W4: Irrigate ½ amount
  - W5: Irrigate ¾ amount + to 90% at critical stage
  - W6: Irrigate ½ amount + to 90% at critical stage


One other way of reducing water use is to grow crops that require less water: 2005 – 2014 reduction in forages (high water using crops) was 67,500 hectares (12% of irrigated land) with production on that area shifting primarily to oilseeds and hard red wheat (moderate water using crops)

Decrease in forages, increase in oilseeds and hard red wheat



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cereals	403,826	419,112	416,594	456,907	453,637	426,825	429,805	423,112	483,144	458,084
Forages	603,520	608,972	585,966	516,321	515,957	512,310	473,073	444,967	430,037	445,907
Oil Seeds	118,181	104,359	129,990	195,962	181,309	183,895	191,154	208,167	191,586	198,543
Specialty	175,127	177,486	175,669	153,962	179,008	184,500	213,149	248,461	240,747	258,839

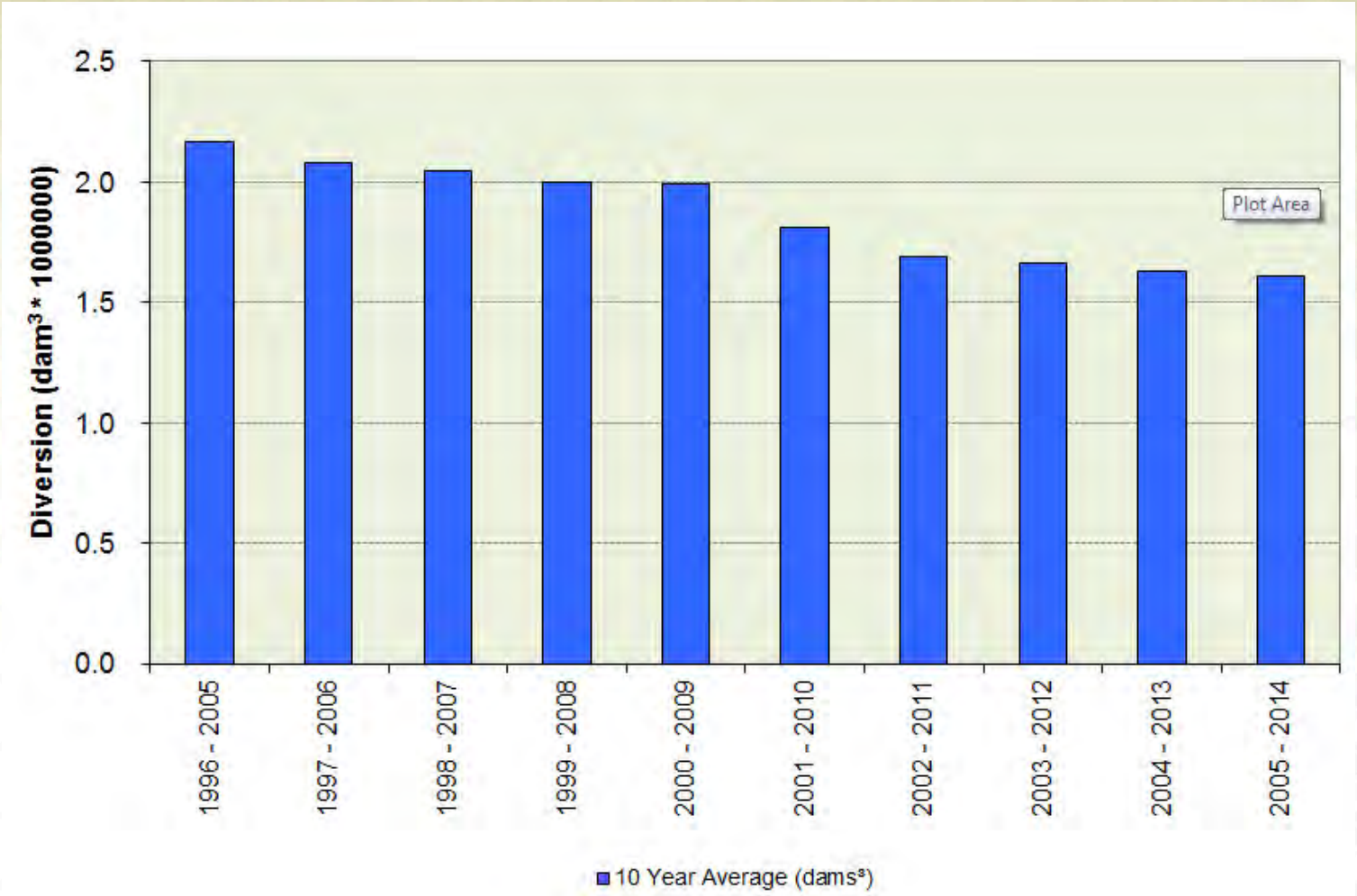
Target #3

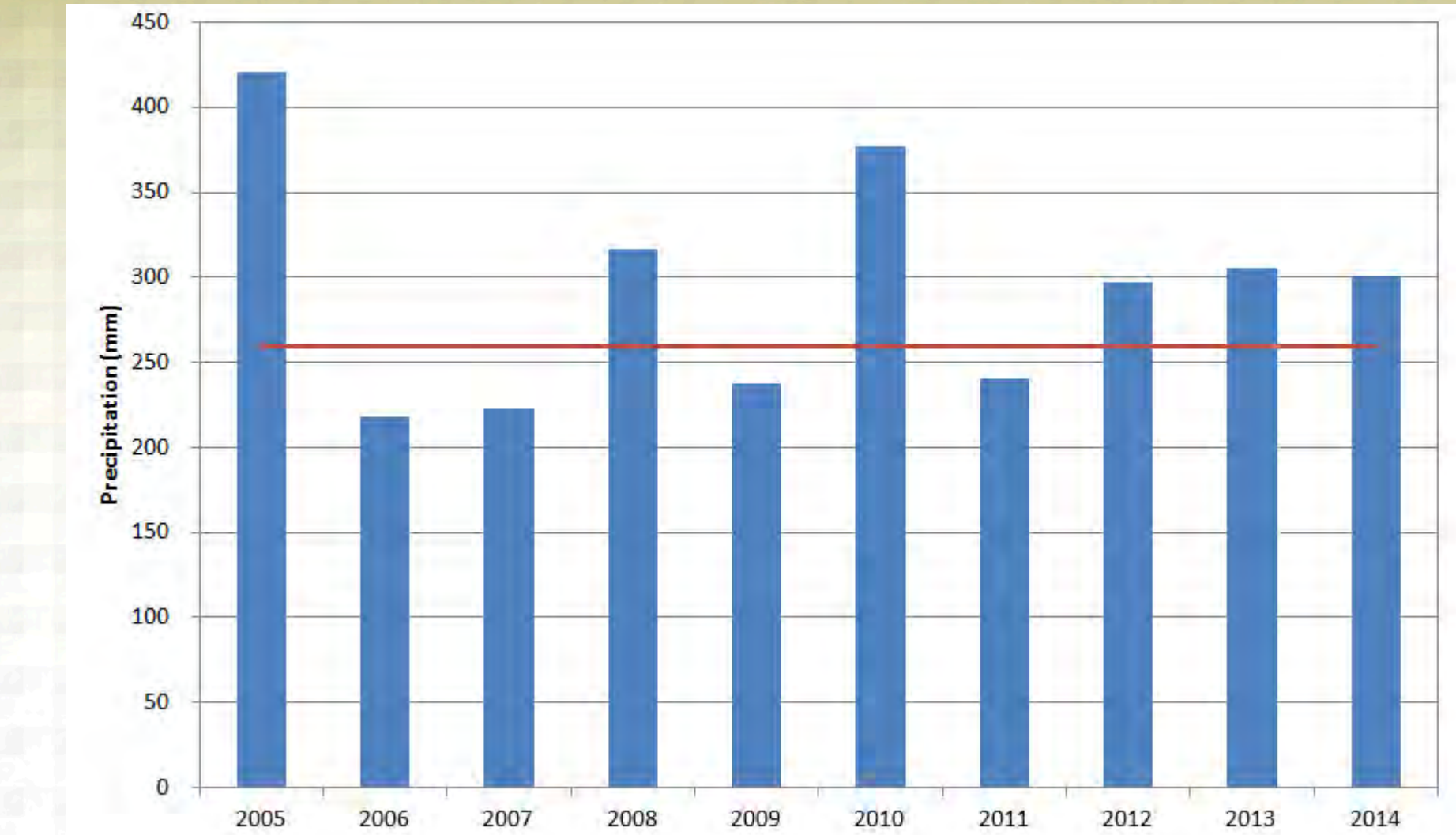
- **Target 3. On a ten-year rolling average basis, the irrigation districts will keep diversions at or below the year 2005 reference benchmark of 2.186 billion M^3 per year.**

Diversions are reduced as efficiencies increase. Efficiencies increase as

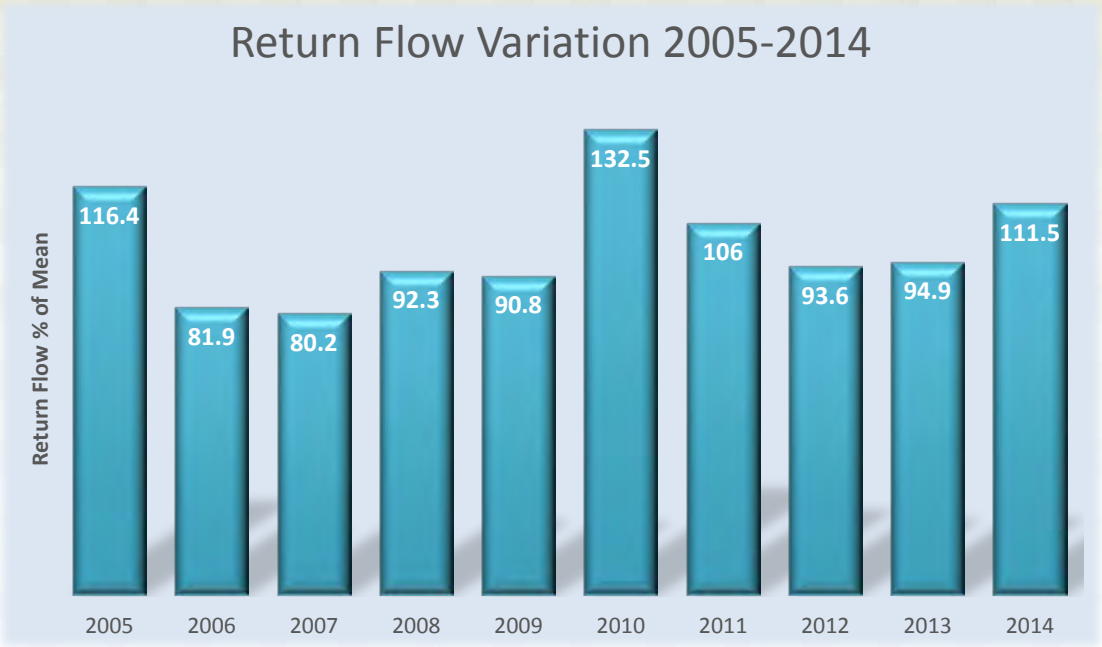
- **Farmers switch to more efficient systems**
- **Farmers grow lower water-use crops**
- **Districts' rehabilitate delivery system by lining canals, replacing canals and laterals with pipelines**
- **Districts increase automatic measurement and remote (SCADA) control of structures**

Reduction in Diversions (10-yr running average) 2005-14




Precipitation (mm)
450
400
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Return Flow (% of mean)



Target #3

- **Target #3 was met: diversions (10-year running average) were well below the 2005 mark of 2.186 Bm^3 -- the 2014 diversion was 1.61 Bm^3**

Target #4

- **Target 4. Within regulations and utilizing water conserved through efficiency gains anticipated through these CEP efforts in the irrigation system, the irrigation sector will make additional water available for other uses such as food processing, environmental objectives, rural water networks, agribusiness, and other water sharing.**

Irrigation District	Other Purposes* (ac-ft)	Total Licensed Volume (ac-ft)
AID	700	9,000
BRID	2,380	450,000
EID	5,000	761,000
LID	1,000	12,000
LNID	39,068	334,450
MID	740	34,000
MVID	340	8,000
RCID	n/a	3,000
RID	4,500	81,000
SMRID	12,000	722,000
TID	8,000	158,000
UID	1,000	66,210
WID	3,500	158,400
Total	**78,228**	**2,797,060**

Target #4

Target 4 was met: some 78,228 ac-ft (9.6 Mm^3) of water were allocated by districts for other uses.

In a functional flow project, over 30,000 ac-ft of stored water was released to maintain function flows (reduce recession rates of rivers to facilitate the establishment of cottonwoods and other riparian species along river valleys)

Target # 5

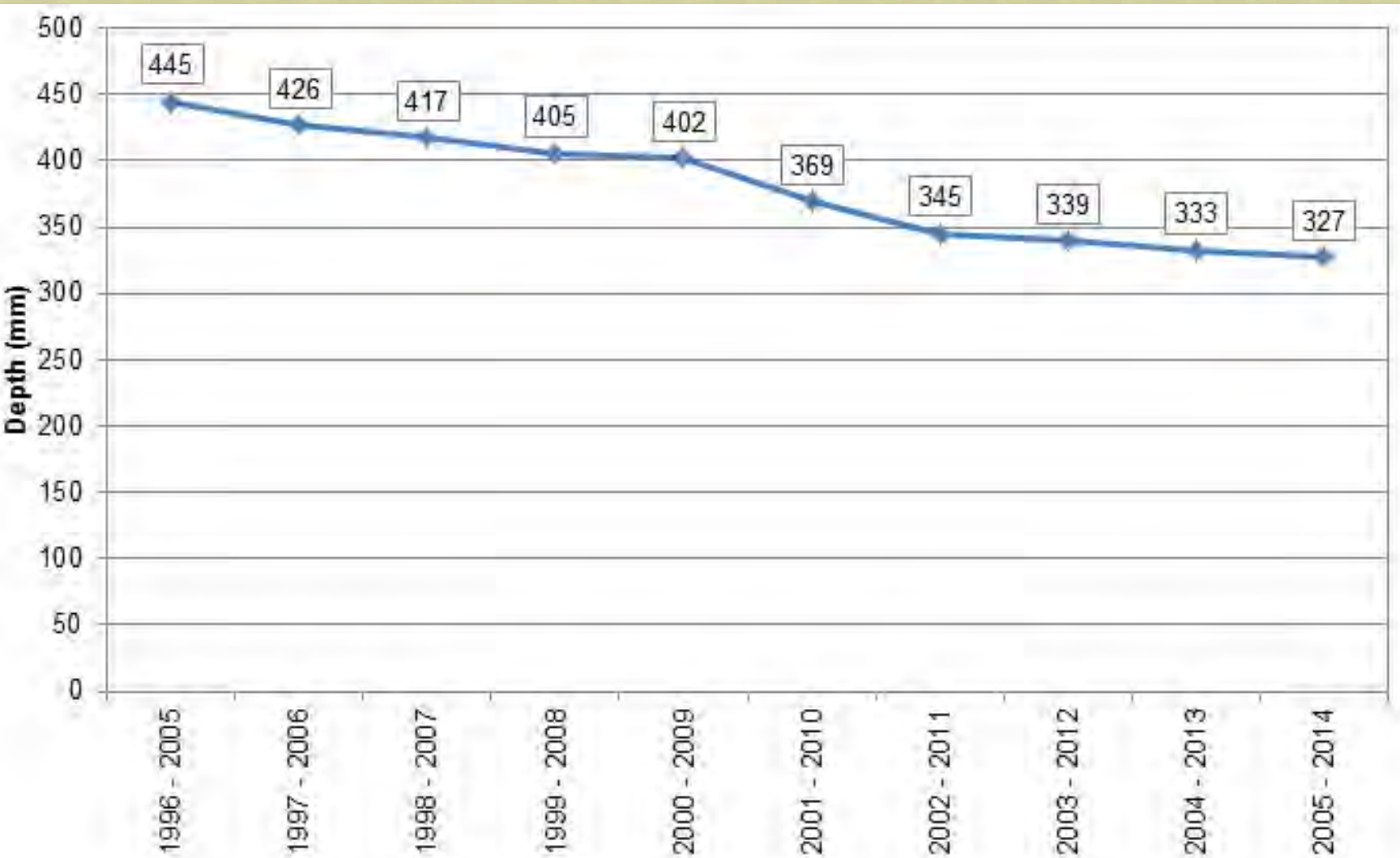
- **Target 5. Growth in irrigation districts will occur using saved water.**

Target # 5

Target 5 was met: From 2005 through 2014 the districts grew 5% (543,291 ha to 571,767 ha). Over this same period, diversions of water decreased 26%.

Target 6

Target 6. On a ten-year rolling average through 2015, irrigation districts will reduce the volume of water diverted from Alberta's rivers, lakes and streams per unit of irrigated area to a level below the 2005 benchmark of 441 mm.


Depth (mm)
500
450
400
350
300
250
200
150
100
50
0
445
426
417
405
402
369
345
339
333
327
1996 - 2005
1997 - 2006
1998 - 2007
1999 - 2008
2000 - 2009
2001 - 2010
2002 - 2011
2003 - 2012
2004 - 2013
2005 - 2014

Target 6

Target 6 was met: The amount of water diverted for the districts' irrigated area declined each year from the 2005 benchmark of 441 mm (later found to be 445 mm) to a low of 327 mm in 2014.

Some years will have a higher diversion volume

- **Now that efficiencies have been increased substantially with enhanced technologies, diversions are expected to be lower in a dry year than would have been otherwise. A dry year like 2015 will test that premise. 2015 data is not available at this time as it is being compiled (canals were shut off the week of October 5).**

How Much Accomplished Since 2005

- More efficient systems on 327,879 acres
- Pipeline installation 1272 km (total 3913)
- Canal lining net -93 km (total 839)
- Switch from forages to primarily oilseeds and wheat (forages declined 67,500 hectares)
- Multiple automated monitoring and remote flow control installations installed

Investment to Become More Efficient and Reduce Diversions (2005 - 2015)

- Farmers – $243,000,000 (estimate at $100,000 per pivot)
- Government – IRP $243,400,000
- Irrigation Districts – IRP $78,300,000
- Irrigation Districts' ICW Projects – $246,425,000
- Total district investment – $324,725,000
- Grand Total – $811,125,000

Target 7

Target 7. The irrigation sector will achieve a 15% increase in efficiency, relative to 2005 levels, by the end of 2015.

The reduction in diversions is the best measure of increased efficiency. Efficiency gains through changes in on-farm equipment and crop selection, irrigation delivery system rehabilitation, automation of flow monitoring, and SCADA control of structures collectively account for the total reduction in diversions.

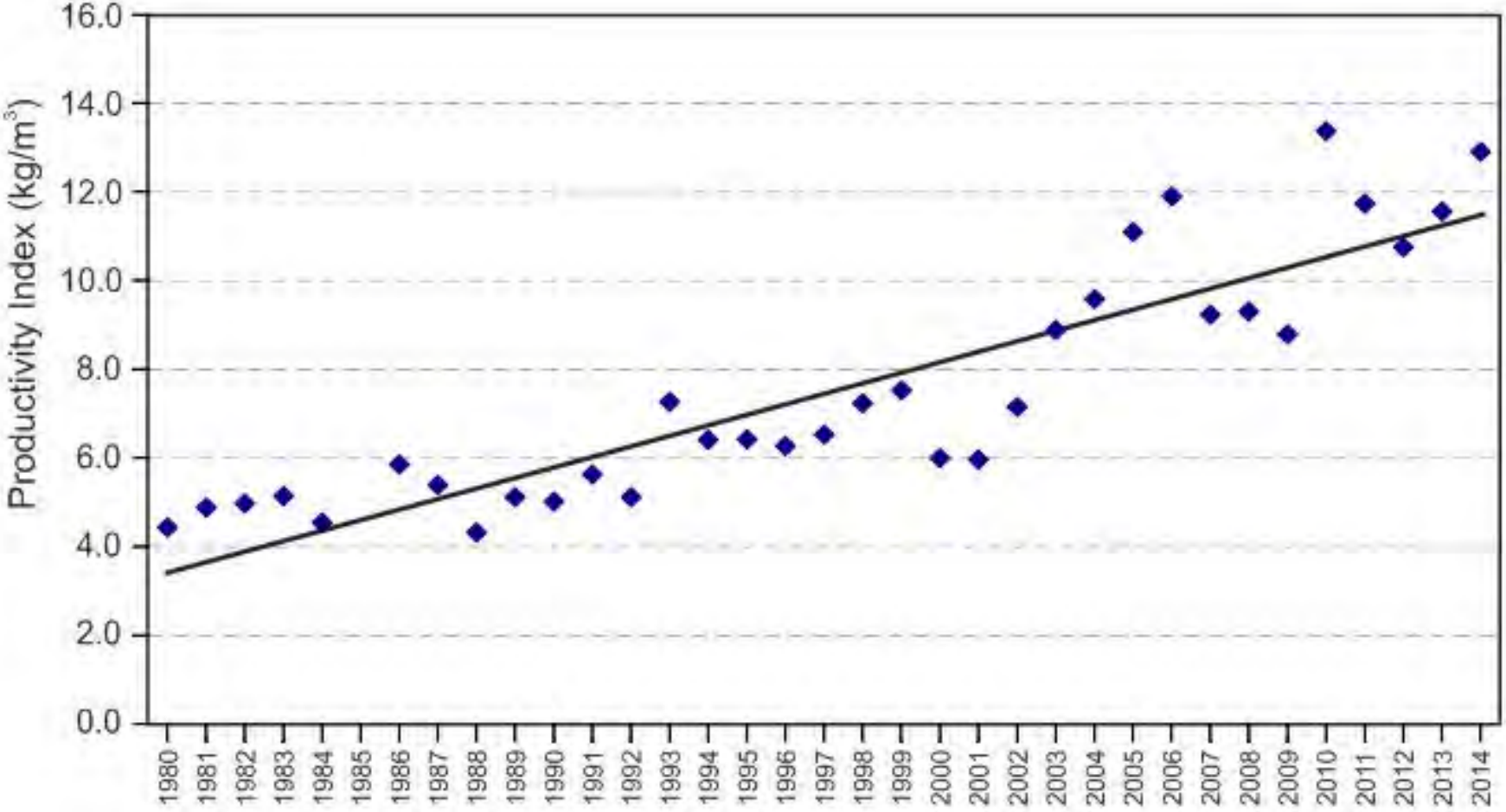
Target 7

Total Diversions 2005	*2.186 Bm^3*
Diversions 2014	*1.610 Bm^3*
Reduction in diversions	*0.576 Bm^3*

Diversions have decreased 26%.
Efficiencies gains total 26%

Target # 8

- ***Target 8. The irrigation sector will increase its productivity by 15% from the reference yield of 2005, based on the indicator crops of sugar beets, potatoes, and soft white wheat.***



Productivity Index (kg/m^3) of sugar beet, soft white wheat and potato in irrigation districts.

Target # 8

Target 8 was achieved: **The increase in the productivity index equals 0.22 kg/m^3 per year. Productivity increased 22% over the 2005 through 2014 period.**

Target # 1

- **Target 1. The irrigation sector will achieve a 30% increase in combined Conservation, Efficiency and Productivity from 2005 through 2015.**

Total CEP Gains in the Irrigation Sector from 2005 through 2012

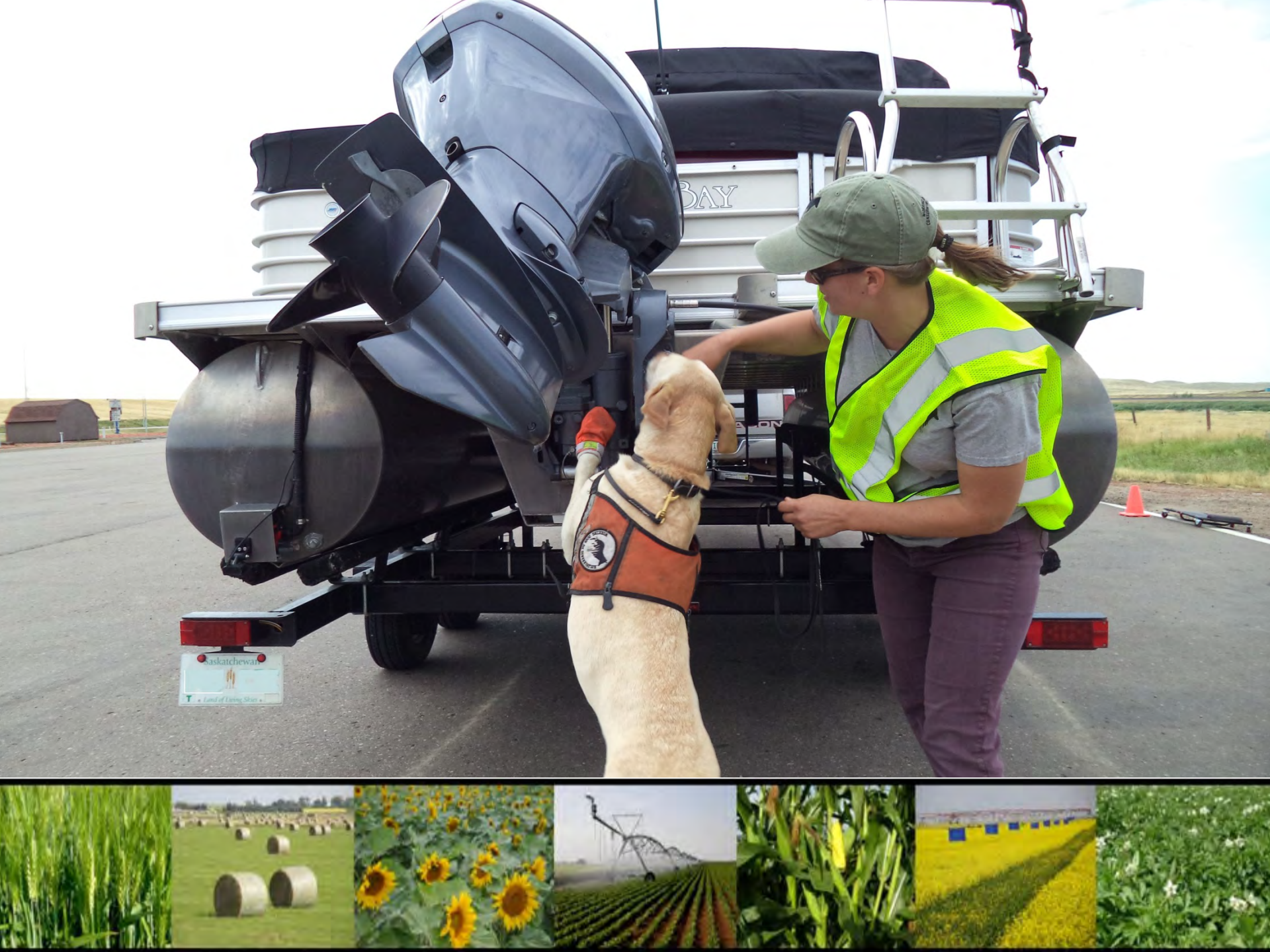
- **Efficiency gains = 26%**
- **Productivity gains = 22%**
- **So Conservation, Efficiency, Productivity gains of the irrigation sector total 48% and have exceeded the Water for Life Strategy goal of a 30% increase from 2005 – 2015.**

Opportunities to Work with Organizations Engaged in Watershed Management and Improve Healthy Aquatic Ecosystems

- Representatives on BRBC, OWC, SEAWA
- Participated in Bow River Phosphorus Management project
- Participated in WaterSMART modelling of the Bow River and then the subsequent modelling of the SSRB

- **Participated on steering committee of the Functional Flow project by U of L (Dr. Stewart Rood) to enhance riparian regeneration**

- **Participated on three Aquatic Invasive Species teams and multiple AWC teams**
- **Contributed $185,000 towards sniffer dog work and training plus promotional materials to help prevent the introduction of invasive mussels to Alberta**
- **An AIPA member participated on Alberta Environment and Sustainable Resource Development's Wetland Policy stakeholder committee**


BAY

- **Collaborated with AAF in a 5-year water quality study in the irrigation district region (just being completed)**
- **Collaborated with AAF on a 5-year study of nitrates in groundwater associated with dairy, feedlot, and manure spreading operations**
- **Collaborated with AAF on a redevelopment and enhancement of the Irrigation Demand Model that is used to estimate irrigation demand on every parcel in every district**

How is the efforts of the Irrigation Industry contributing to the three Water for Life Goals?

Healthy Aquatic Ecosystems:

- **Lower diversions so more water being left in the rivers than would be otherwise.**
- **Functional flow work has resulted in millions of seedlings establishing in riparian areas.**
- **Watercraft inspections have intercepted a number of boats infested with mussels and those boats were decontaminated preventing infestations and dramatic ecological change.**

How is the CEP efforts of the Irrigation Industry contributing to the three Water for Life Goals?

Safe Secure Drinking Water:

- **Members of AIPA have made a formal declaration committing to supply water to communities prior to supplying water for irrigating crops in the situation of a drought**
- **More water is now available for communities due to allotment by districts. Some 30 communities, many rural water co-ops, and thousands of rural families get their water from the irrigation system**

- **Quality of the water being delivered to communities has been monitored for over 160 parameters over a 5-year period. The study is being completed this year and results will be reported thereafter.**

How is the CEP efforts of the Irrigation Industry contributing to the three Water for Life Goals?

Reliable, quality water supplies for a sustainable economy:

- The water quality study has provided potato growers with information required by food processors re the quality of water they use to grow potatoes, and that data is available for others
- An allotment of water has been made for alternate uses such as new food processors or other agri-business

- **An economic study released in August, 2015 showed that the economic impact of irrigation in Alberta is $3.6 billion annually and that Alberta's irrigation production will continue to be important in meeting the need for food in the world**
- **AIPA worked with SouthGrow, a regional economic association of communities, to evaluate their water needs, and committed to make water available to communities for economic development**

Other Environmental Impacts of CEP:

- Replacement of open ditches with pipelines reduces seepage from the ditches. That seepage in some stretches helped create habitat in the form of willows, cattails, and trees. In recognition of that, districts have collectively planted over 900,000 trees and shrubs to help provide upland habitat
- Since the 1940s districts have partnered with Ducks Unlimited and, over time, have created 33,000 ha of wetlands

Opportunities and Challenges

- The rate of replacement of flood, wheel-moves, and high pressure pivots with low pressure pivots will decline, inasmuch as 70% of the area is already covered. There will always be some flood irrigation and wheel-move irrigation due to the shape or size of parcels of land which cannot be irrigated by a pivot
- New technologies may be developed that are more efficient than low pressure pivots while still being economical to grow crops
- Rehabilitation work will continue to replace canals and laterals that loose water, but the more-expensive projects are the ones left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Irrigation in Alberta, Life Depends on It