

A photograph of a waterfall cascading over dark, layered rock formations. The water is white and frothy as it falls, creating a strong contrast with the dark, textured rock. The overall scene is captured in a cool, blue-toned color palette.

Source of Opportunity

A Blueprint for Securing Source Water in Southern Alberta



Water Matters



Source of Opportunity: A Blueprint for Securing Source Water in Southern Alberta

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By Joe Obad, Associate Director and Danielle Droitsch, Executive Director

Water Matters Society of Alberta
P.O. Box 8386
Canmore, Alberta
T1W 2V2
Phone: 403.538.7785
www.water-matters.org

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I V E Y f o u n d a t i o n

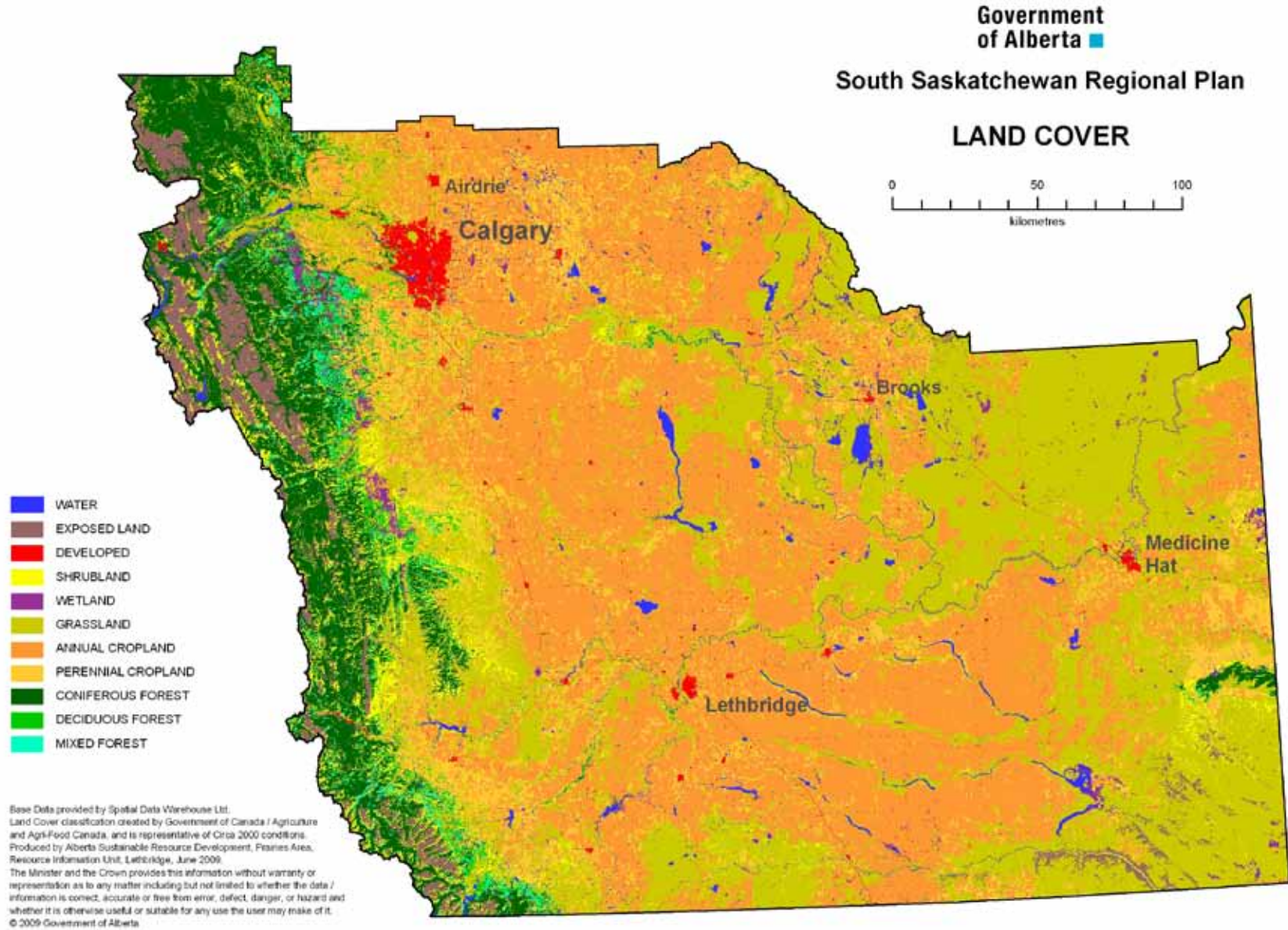
Edited by Margaret Chandler
Layout by Jenaya Webb
Photography by Robert Kershaw

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Table of Contents

Executive Summary	5
I: The value of water to southern Alberta	6
II: Why a blueprint?	7
III: Our future landscape and indicators for measurement	8
IV: Unsustainable land use	10
V: The cumulative impact of multiple land uses	13
VI: Principles for future land-use planning in southern Alberta	15
VII: Recommendations	17
CASE STUDY: Historic efforts to protect the Southern East Slopes	20
VIII: Conclusion	27
Citations	28

South Saskatchewan Regional Plan Area



Most of southern Alberta's source water begins in the Southern East Slopes - the area in green along the Continental Divide

(Map Courtesy of Alberta Environment)

Executive Summary

There is no better time than now to formally recognize the important role of Alberta's Southern East Slopes to water quality and quantity. The Alberta government's commitment to develop a South Saskatchewan Regional Plan (SSRP) for the region under the province's Land-use Framework arrives as citizens of southern Alberta are searching for ways to learn from past lessons and apply an enduring resolve to protect our water resources. *Source of Opportunity* makes the case that a vibrant social and economic landscape in southern Alberta is derived in large part from the landscape's ability to maintain abundant, clean supplies of water at their origin – the Southern East Slopes. While this region has special importance, *Source of Opportunity* also recognizes the critical value of groundwater, particularly in the Prairie region.

Protecting these essential values will require a specific plan of action – a blueprint – to guide us to this future landscape. Otherwise, it is clear that this region will see more deterioration of water quality and quantity. *Source of Opportunity* offers a new direction, a blueprint for source water protection. It suggests that historic efforts to promote the Southern East Slopes failed because government policy and legislation have been too weak. *Source of Opportunity* argues policy needs to match the consistent message from the public to protect our source waters.

Seven core recommendations form *Source of Opportunity's* blueprint for source water protection:

1. Establish a strong system of governance to manage the cumulative effects of development in southern Alberta by creating a roadmap that addresses day-to-day decision making.
2. Set targets for total landscape disturbed, a key indicator to protecting water resources.
3. Adopt strategies to protect source waters in every major and minor watershed.
4. Create a special designation for the Southern East Slopes as a publicly recognized resource for source water protection and other key values. Comprehensive management requires formal legislation or binding policy.
5. Protect key lands within the region including riparian areas, wetlands, and groundwater recharge areas by limiting development.
6. Manage land uses that have higher impacts on water resources including roads, forestry activities, and oil and gas activities.
7. Implement Transferable Development Credit schemes appropriately.

Together, these recommendations provide the basis to secure source water protection and are the heart of this document. Water Matters hopes this document will stimulate ideas among government, municipalities, citizens, landowners, and key industry stakeholders as they participate in the SSRP and land-use planning processes designed to protect Alberta's most precious natural resource.

I: The value of water to southern Alberta

Water is the lifeblood that sustains our communities, environment, and economy in southern Alberta. Water in this part of the province provides drinking water for people, the foundation for a rich web of aquatic and terrestrial life, and our economy. These benefits ripple outward creating a dynamic culture of vibrant self-reliant towns and cities that prosper in a semi-arid climate. To continue to enjoy these benefits, we need to take steps to protect our source waters for future generations.

Over 80 percent of southern Alberta's water comes from its Southern East Slopes.¹ Precipitation that falls east of the Continental Divide may be stored as snow, soak into the ground to become groundwater, or flow into streams and journey east through Alberta's river networks. The mountains and the foothills act as the primary source of water for the South Saskatchewan River Basin. Water that filters into the groundwater network provides 90 percent of rural Albertans with their drinking water.² These waters are our source waters.

The importance of the Southern East Slopes watershed to the new Province of Alberta, as well as to Canada, was recognized in the *Dominion Forest Reserves Act* of 1906, which was passed to "protect the resource for the purpose of maintaining a continuous supply of timber, to benefit water supply, and to protect the animals, fish and birds within the reserves." The creation of the Eastern Rockies Forest Conservation Board in 1947 was an attempt to manage landscapes for the maintenance of water supply and the conservation of forests and other important ecosystems.

In the 1970s, concern over the direction of land use across all of Alberta's East Slopes led to extensive public consultation. Public hearings held in 1973 found 90 percent of the public believed that water "is the primary concern of Albertans."³ These consultations led to the groundbreaking *A Policy for Resource Management of the Eastern Slopes* (1977) that recognized water as one of the most valued resources in the region. More recently in 2002, a government survey found that 87 percent of Albertans wanted sustainable ecosystems, safe drinking water, and reliable quantities of water to drive management decisions affecting water resources.⁴

A 2007 survey conducted by the Southern Alberta Land Trust Society found that over 70 percent of respondents in southwestern Alberta were "very concerned" about diminished water quality, resulting from chemical or bacterial contamination, in wells, springs, and aquifers. These concerns reflect the acceleration of human activity along the Southern East Slopes including energy development, cattle production, acreage development, forestry, and off-highway vehicles. In 2009, another survey indicated that 85 percent of Albertans were either concerned or very concerned about the long-term supply and quality of Canada's freshwater.⁵

Yet, after decades of expressing concern in hearings and surveys, southern Albertans have a landscape that is frailer than ever and whose ability to provide secure quantities of quality source water is at risk.

It is generally agreed that more effective land-use management practices to safeguard public resources like source water are necessary. The provincial government acknowledges, "We have reached a tipping point where sticking with the old rules will not deliver the quality of life we have come to expect."⁶

The quality of source water in southern Alberta today is the result of public policy, land-use practices, and natural phenomenon. Albertans can help shape the public policy for the future of this landscape. But this effort will require understanding how to improve weak policies and, most importantly, how to avoid historic patterns that have stripped the efficacy of previous well-meaning policies.

II: Why a blueprint?

This blueprint is designed to provide real solutions, not to sit on a shelf. Indeed, the blueprint is timed to inform comprehensive land-use planning under the Land-use Framework, which is a crucial opportunity to safeguard source water protection in southern Alberta. It provides recommendations that can be implemented on the ground to achieve source water protection in southern Alberta. It can inform any number of land-use planning processes in southern Alberta including municipal planning but has particular value for the South Saskatchewan Regional Plan and the Calgary Regional Partnership plan.

As the province moves from the high-level framework level to regional plans, it is imperative to move from principles to real action on the ground that reflects the public interest. Veteran planners from provincial government, industry, landowners, and interested citizens know that the Land-use Framework is another attempt among a history of false starts to get land-use planning right in southern Alberta. We hope this blueprint stimulates ideas among government, municipalities, citizens, landowners, and key industry stakeholders as they participate in regional planning and other land-use planning processes.



Photo: Robert Kershaw

After decades of expressing concern in hearings and surveys, southern Albertans have a landscape that is frailer than ever and whose ability to provide secure quantities of quality source water is at risk.

III: Our future landscape and indicators for measurement

Good land-use planning begins with identifying desired outcomes for the landscape and then directing activities to achieve those outcomes. For example, if Albertans want to maintain open, unfragmented landscapes, they need to set targets for maintaining road densities and visualize how future development will work within those limits. Likewise, in order to protect a ready supply of quality water, Albertans must identify limits for both water withdrawals and for pollution.

Therefore, to secure water resources in southern Alberta, both measurements and targets must be established for different types of indicators:

- Physical – “On the ground” physical landscape conditions that support the biological processes essential to abundant and clean source waters.
- Social – Private and public processes that secure the source water requirements of Albertans in perpetuity.
- Economic – Economic decisions that acknowledge the full value of source water for ecological goods and services.

I. Physical outcomes

Landscapes perform vital services to effectively safeguard source water quality and supply. Alberta Environment suggests the following key land indicators for southern Alberta that perform water-related functions:

- Ability to resist erosion and sedimentation in water bodies
- Ability to filter runoff
- Ability to regulate storage and discharge of runoff
- Ability to allow for groundwater recharge⁷

These functions are directly influenced by land use across the South Saskatchewan River Basin.⁸

For the landscape to perform these critical functions, the following conditions are required:

- Major and minor basins (sub-basins and sub-sub-basins) must maintain a reasonable percentage of vegetation cover to capitalize on the role of vegetation as a regulator of natural flow regimes, as a natural filter of water, and as a stabilizer of watercourses. For the purposes of this report, sub-basins are the Bow, Red Deer, Oldman, and South Saskatchewan main stems and sub-sub-basins are those basins on the scale of the Elbow River watershed.⁹
- Native plants, such as fescue grasses, must be maintained and augmented as a defense against the additional human impact on the landscape, drought, and erosion.
- The function of riparian areas (areas along water bodies) must be maintained. This protection also includes maintaining fluvial channel movement to invigorate the landscape and provide essential recharge to wetlands and groundwater. Although riparian areas only make up two percent of the total land base in southern Alberta, they support 80 percent of the fish and wildlife species in all or part of their lifecycles. The quality and quantity of wetlands in the region must stay the same or increase.

- Key recharge areas (land areas with high porosity to precipitation) must be protected from the effects of development, e.g., hardening of surfaces or seeping of pollution through the land surface.

2. Social outcomes

For any stewardship initiative, incentive, policy, or regulation that supports source water protection to work effectively, an informed public needs to understand the value of the following:

- The role that stewardship, especially private land management, can play at the local level to protect land resources for watershed protection.
- The importance of using a diversity of management measures to protect source water.

3. Economic outcomes

Finally, source water protection should be explicitly recognized as providing economic benefits. Economic measures traditionally address a limited range of measures such as Gross Domestic Product and job creation. The adoption of a broader set of economic criteria to take into account the contribution of healthy aquatic ecosystems to a regional economy.

To fully consider all costs and benefits, the planning process should ensure that it fully values the ecological goods and services associated with providing a clean and plentiful supply of water and the costs associated with higher costs of treatment when impaired.¹⁰



Photo: Robert Kershaw

“We have reached a tipping point where sticking with the old rules will not deliver the quality of life we have come to expect.”
– Land-use Framework, Government of Alberta

IV: Unsustainable land use

Alberta's landscape has changed significantly since European settlement began in the late 1800s. Fifty-two percent of the land base in southern Alberta has been impacted by humans. Two-thirds of the native grasslands have been converted to other land uses since the late 1800s.¹¹ An ever-increasing population and the social expectation that Alberta can sustain unrestrained demands on its physical landscape have transformed what was once the "open west" into a landscape under pressure. What follows is a snapshot of some of the pressures.

1. The economic boom

Alberta's economic cycles of boom and bust are well known, and historically the province's fortunes have followed the price of oil and natural gas. More recently, the petroleum industry's expenditures rose from 10.9 billion dollars in 1992 to 45.6 billion dollars in 2006.¹² Largely as a consequence of this growth, Alberta's gross domestic product rose from 135 billion in 1998 to 187 billion dollars in 2007.¹³ This growth has attracted many newcomers to the province and has increased demand for housing and other goods and services. Increased wealth leads to more investment in development and discretionary income for recreation and secondary properties with corresponding pressures on the landscape and water sources.

2. Population

By virtually every projection available, the population in southern Alberta is expected to increase, despite the economic downturn of 2008–09. The bust portion of boom-bust cycles slows population growth, but slower economic times have not resulted in population contraction as in other provinces. In the last 25 years, the population of Alberta has grown by more than a million people to approximately 3.5 million.¹⁴ By 2026, Alberta's population is projected to be five million.¹⁵ Two-thirds of Albertans live and work in the Edmonton-Calgary corridor, a pattern that is expected to continue.

The total population in southern Alberta in 2004 was 1.4 million people. Of this, 84 percent lived in urban areas with the remainder in farming and rural residential areas. Urban areas including Calgary, Airdrie, Lethbridge, Medicine Hat, and Red Deer all experienced double digit growth between 1996 and 2005 (a 25 percent increase in population on average).¹⁶ The southern foothills region (roughly defined as the area from the Continental Divide to Highway 2, and from southern Kananaskis Country to the northern boundary of Waterton Lakes National Park) is projected to more than double from 40,000 residents in 2007 to 95,000 by 2055.¹⁷ The greater Calgary region (defined as the area ranging from Banff to Wheatland County and Crossfield to Nanton) is expected to take in an additional 1.6 million people over the next 60 years.¹⁸

As Alberta's population increases and our economic and recreational activities expand, so does the impact on the landscape.

3. Roads and trails

Roads contribute the largest source of sediment runoff to water bodies in the foothills of Alberta.¹⁹ In southern Alberta, there are now over 127,000 kilometres of major and minor roads and railway.²⁰ The *Southern Foothills Study*, which evaluated the future landscape for the Southern East Slopes, projected an 82 percent increase in new roads (major and minor) and trails increasing from a footprint of 8,297 to 15,041 hectares.²¹

4. Recreation

Many Albertans enjoy spending time in the mountains and foothills. But population growth, combined with more time and money to enjoy the natural spaces, means they are becoming more congested. Tourism activities in the mountains and foothills are expected to increase a staggering 60 percent by 2055.²²

For example, in only a little over a decade, off-highway vehicle (OHV) registrations in Alberta have more than tripled from 19,000 in 1995 to 67,000 in 2006.²³ The number of registered snowmobiles has increased from 19,000 to over 26,000 during the same period.²⁴ This increase does not account for the substantial amount of unregistered OHVs, which has likely risen as well. Municipalities and the province have documented negative impacts of OHVs on watersheds.²⁵

5. Country residential living

Many Albertans prefer to live outside urban areas. Consequently, many rural areas are quickly filling with country residential acreages. “Commuter sheds” and internet commuting now allow workers who were formerly tied to their offices to live away from the city and closer to open space and recreational opportunities.²⁶

The transformation of rural landscapes into country residential development is one of the main causes of agricultural land conversion in the province.²⁷ In 90 percent of the municipalities surveyed by Agriculture, Food, and Rural Development, almost three-quarters of the subdivided farmland had been converted to country residential development.²⁸ In the southern foothills region, it is estimated that residential land development will increase by 158 percent, increasing the number of rural residential units from 500 to 2190 by 2055.²⁹

At the same time, urban areas are expanding outwards. Calgary’s boundaries grew eight-fold from about 104 km² in 1951 to over 848 km² by 2008.³⁰ The City of Lethbridge is also growing, almost doubling its area since 1984. By 2001, Lethbridge’s footprint was 122 km² with an average 40 hectares added annually.³¹

6. Energy

The impact of the energy sector, Alberta’s economic titan, on water resources can be substantial. Seismic cutlines, trails, access roads, drilling pads, processing plants, and pipelines all impact the landscape and the quality and quantity of water by extension. In southern Alberta, there are 51,000 producing oil and gas wells, 184 sweet gas plants, 124 sour gas plants, and 116,860 kilometres of pipelines.³²

It is estimated that seismic lines will double from 6,930 to 14,600 kilometres in the Southern East Slopes region by 2040 even with aggressive reclamation.³³ Together, the aggregated footprint of energy exploration including well sites, roads, and pipelines is expected to double over the next 50 years.³⁴ Throughout the Southern East Slopes, the land impacted from traditional oil and gas and anticipated coal-bed methane production is expected to rise from 4,092 hectares in 2005 to 11,460 hectares by 2055.³⁵

7. Forestry

Forestry in southern Alberta primarily occurs on public land along the Eastern Slopes and in the Porcupine Hills. Long-term cutting agreements are signed between private forestry quota holders and the government. Approximately 16 percent of southern Alberta is forested, and almost all of that land is actively managed for timber production with the remainder in parks.³⁶

The typical harvest method used in the Southern East Slopes and foothills is clear-cutting. According to a study for the Southern Alberta Land Trust Society, if “business as usual” development were to continue the forestry industry would minimally log 1,000 hectares annually for the next fifty years within the *Southern Foothills Study* region alone. In the long term, edges from cut blocks are projected to increase from 2,500 kilometres in 2005 to over 6,500 kilometres by 2055.³⁷ Forestry roads and cut blocks can lead to increased soil compaction, runoff, erosion, and water turbidity; vegetative cover and riparian health can also be negatively affected.

One study that attempted to quantify the cumulative effects of forestry and road development on the watersheds of the Southern East Slopes examined the increased risk of watershed damage in the headwaters of the Oldman, Crowsnest, and Livingston rivers. The study found that from 1910 to 1990, 86 of the 90 watersheds studied had a moderate to high risk for watershed damage during peak flow periods, mainly as a result of forestry.³⁸

8. Agriculture, livestock, and irrigation

Agriculture impacts both water quality and quantity. From a quantity standpoint, irrigation agriculture is the predominant use of water in southern Alberta and accounts for almost 75 percent of the water allocated. Irrigation will continue to be the largest user for the coming decades.³⁹ It is expected that by 2046 irrigation water consumption will increase by 23 percent in the South Saskatchewan River Basin.⁴⁰

The amount of irrigated land in Alberta increased by 16 percent between 1990 and 2000.⁴¹ In the entire South Saskatchewan River Basin (including the Red Deer sub-basin), the total irrigated area was estimated to be 474,291 hectares. Cultivated cropland in the southern foothills region is expected to increase 3.5 percent (283,000 hectares to 293,000 hectares) between 2005 and 2055.⁴²

The amount of land receiving commercial pesticides and fertilizers has nearly tripled in the past 25 years impacting both surface and groundwater.⁴³

Southern Alberta is home to 4.5 million head of cattle, which represents 68 percent of the cattle in the province. There are also 5.5 million chickens and 1.5 million swine. The *Southern Foothills Study* estimated an increase of up to 56 percent in cattle on the Southern East Slopes by 2055. Some of this increase will be from more cattle grazing on native and tame pasture, but much will be from the expansion of feedlots. Feedlots are projected to double in size over the next five decades and will increase water demand and manure production.⁴⁴

There are also 130 agriculture food processing companies in the region. While these food processing industries are a significant economic force, they are not without their impacts.⁴⁵

9. Mining

The degree to which mining will impact the region is uncertain. Mining operations can significantly change runoff patterns by removing vegetation and creating hardened surfaces. Traditional mining on Southern East Slopes includes staked claims for both uranium and magnetite, as well as sand and gravel pits.

Gravel and sand pits have had the greatest mining impact thus far, and they are virtually unregulated. They service the demand for concrete, road maintenance, and construction. The economic and population boom in southern Alberta has increased the demand for gravel deposits. Alberta is also the cement-manufacturing hub for the Prairie provinces.

Because many of these operations directly remove sand and gravel from streambeds or dig up areas connected with groundwater, they can significantly affect local hydrology. Accounting for the impacts of these mines will be critical to understanding long-term source water health. Maintaining an inventory of these operations and their extraction volumes and locations is a crucial first step toward understanding their impacts.

Point and non-point source pollution

It is important to understand the distinction between point source and non-point source pollution.

Point source pollution is a specific, identifiable source of pollution, such as the release of effluents from a wastewater treatment plant or an industrial facility. These facilities, which still pollute even after water treatment, are the result of land-use decisions. For example, wastewater treatment facilities are tied to urban development.

Non-point source pollution is water pollution caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even into our underground sources of drinking water. These pollutants include excess chemicals used on agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks; and bacteria and nutrients from livestock, pet wastes, and agricultural fields.

V: The cumulative impact of multiple land uses

In 2007, a group of ranchers and environmental organizations wrote a letter to Premier Stelmach calling for a “timeout” on major development permit approvals until meaningful landscape planning could occur. They wrote as follows:

The Southern East Slopes represent an iconic landscape of mountains and foothills grading into prairie. It is as close as one can get to the features in Alberta’s coat of arms. Unlike our coat of arms, in which the landscape appears untouched, unblemished and unfragmented, the real landscape has seen many changes. In addition, scale and pace of land use change in the area is unprecedented and is projected to continue. This concerns us as residents and as groups, organizations and individuals who understand and value this region.⁴⁶

These ranchers and environmentalists argue that without a new approach, development, as outlined above, will arrive incrementally through a variety of fragmented decision-making processes. The impacts of single, small projects can appear insignificant. However, each impact accumulates with other impacts over space and time. Cumulative impacts need to be assessed both across the landscape and over significant periods of time. For water-related impacts this broad assessment is especially important because impacts can be felt downstream.

Table 1. Projected footprint change by land-use type in the Southern Foothills Region, 2005 - 2055

Footprint Type	2005 ha	2055 ha	Percentage increase
Major Roads	962	1,803	87.4%
Minor Roads and Trails	7,335	13,238	80.5%
Wind Turbines	138	371	168.8%
In-block Road	650	1,876	188.6%
Electricity Transmission Line	1,600	4,632	189.5%
Gravel Pits and Mines	928	2,379	156.4%
Coal Mine	768	1,018	32.6%
Canal	404	404	0.0%
Agricultural Residences	4,000	4,420	10.5%
Rural Residences	1,000	4,384	338.4%
Town/City	2,301	10,335	349.2%
Recreational Facilities	874	3,832	338.4%
Industrial Plant	136	744	447.1%
Seismic Line	3,465	2,284	-34.1%
Well Site	279	2,597	830.8%
Pipeline	802	6,081	658.2%
Feedlot	100	211	111.0%
Cutblock Area	20,000	22,900	14.5%
TOTAL	45,742	83,509	82.6%

Source: Holroyd, Peggy. 2008. *Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta*. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf

Simply put, the “business as usual” scenario nearly doubles the human footprint on the on the Southern East Slopes and foothills by 2055, greatly straining both source water quality and quantity. According to the *Southern Foothills Study*, if land use and development were to continue at the current pace (“business as usual”) the following would occur:

- Water quantity would be reduced, and demand for it would increase within the study area, while it would already be fully allocated downstream.
- Water quality would degrade.
- Native fescue grasslands would continue to be lost because of a variety of activities and disturbances including the introduction of invasive alien plant species (invasive weeds).
- The landscape would be increasingly fragmented because of new roads, industrial development from the energy and forestry sectors, as well as new residential acreages.⁴⁷

These projections in the “business as usual” scenario are sobering enough alone to warrant serious changes in how Alberta approaches land use in the Southern East Slopes and foothills.

Others predict that ecosystem services in southern Alberta will continue to decline in the long term and that this will impact water supply and quality (see *Less water and more demands* box, below). Specifically, water regulation (the control of runoff and river discharges and the maintenance of flows across the land surface) is expected to decline because of changes in land cover. Losses or declines in the quality of riparian buffers will decrease water quality. As the water supply decreases, the impacts of runoff from agriculture and development will be magnified.⁴⁸

Less water and more demands

Alberta will need to prepare for natural change such as drought and seasonal variations that will result in less water for more people. Recent studies suggest climate change and cyclical droughts could magnify the impacts of land use on source water. Growing scientific evidence suggests Alberta needs to rein in both land use and water consumption to buffer the social, economic, and environmental upheavals associated with water scarcity.

One study suggests that climate change will combine with cyclic drought to cause a crisis in water quantity and quality with far-reaching implications. While Albertans may think of the weather and climate of the 20th century as “normal,” paleoecological studies suggest that the climate was *unusually* stable and moist in the western Prairie Provinces in the 20th century. Alberta is likely to face more droughts in the coming century.

More recent work suggests there will be greater precipitation swings with more water available in winter and spring because of earlier spring runoff and occurrences of rain on snow. Longer, warmer summers will reduce water availability through evaporation. The result will very likely be less surface water and soil moisture and greater variations in water availability from season to season and year to year.

Sources: D.W. Schindler and W.F. Donahue. “An impending water crisis in Canada’s western prairie provinces.” May 9, 2006; Sauchyn, D., and Kulshreshtha, S. 2007. *The Prairies*; in *From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J., Lacroix and E. Bush; Government of Canada, Ottawa, ON.

VI: Principles for future land-use planning in southern Alberta

The following principles are recommended to guide decision making for the regional planning process in southern Alberta. They also clarify how to implement the recommendations that follow in the next section.

I. Environmental management should be comprehensive, binding, and apply across all operational scales.

The identification and measurement of indicators and the setting of thresholds are critical in higher level planning; but unless these affect regulation, policies, or permitting decisions, weak links will persist between comprehensive management and on-the-ground impact.

Protecting environmentally significant areas in relation to source water

Southern Alberta is blessed with wonderfully diverse environmentally significant areas (ESAs), which are often established for wildlife habitat and biodiversity. Some of these areas have already received the highest levels of protection through national and provincial park status, while other ones lack any formal designation. There is often a strong overlap between ESAs and source water protection. However, there are other environmental values including wildlife protection that warrant specific consideration. Identifying specific environmentally significant areas that meet a variety of indicators is beyond the scope of this report. We agree that a protected areas network aimed at preserving biodiversity should be identified as part of a regional plan. Augmenting protected areas to include ESAs would protect important water features such as riparian areas, wetlands (permanent and ephemeral), small streams and springs, and groundwater recharge areas. Effective planning would ensure these areas are connected to each other and not fragmented or cut off, which affects both aquatic species, and regulation supply and water quality.

Although this blueprint cannot fully explore the nature of ESAs, there are some key alignments that should be considered. For example, preserving optimal conditions for sensitive aquatic wildlife like bull trout and westslope cutthroat trout also aligns with source water protection outcomes. The four C's these species need—cold water, clean water, complex habitat structure, and connected habitats—also characterize the conditions needed in upstream watersheds for source water protection. Similar alignments can be made to protect wildlife species such as the grizzly bear and certain diverse habitats.

Source: Arc Wildlife Services Ltd. 2004. Selected Ecological Resources of Alberta's Castle Carbondale: A Synopsis of Current Knowledge. Compiled by Arc Wildlife Services Ltd., Calgary. Prepared for CPAWS Calgary/Banff and Shell Canada.

2. The precautionary approach should guide planning processes.

Where a lack of data occurs, prudence and caution should guide decision making and actions.

3. The full economic benefits of source water protection, including the value of ecological goods and services, and the costs for full ecological restoration must be weighed against the potential benefits of proposed land-use patterns or projects.

The ecological goods and services offered by watersheds and key features such as wetlands, riparian areas, lakes, and even agricultural areas must be fully weighted in any economic modeling of land use.

4. Interim measures and protection must be provided while land-use plans are being developed and implemented to avoid a development permit “rush.”

5. Land management decisions, including subsurface mining and resource development, should be tested against the provincial government’s responsibility to ensure safe drinking water for all its citizens.

6. Both planning and implementation processes should be transparent and strongly informed by public input.

Land management decisions, including subsurface mining and resource development, should be tested against the provincial government’s responsibility to ensure safe drinking water for all its citizens.



Photo: Robert Kershaw

VII: Recommendations

Alberta needs to take specific steps to protect water sources in southern Alberta with a particular emphasis on the Southern East Slopes. The recommendations that follow are made in part to overcome historical hurdles that have foiled earlier initiatives and policies. The most immediate opportunity to implement these recommendations is with the South Saskatchewan Regional Plan. However, virtually every recommendation would also be applicable to the sub-regional plan for the Calgary region.

Recommendation 1: Establish a strong system of governance in regional plan to manage the cumulative effects of development.

The South Saskatchewan Regional Plan and the sub-regional Calgary Regional Plan should institutionalize a cumulative effects approach by creating a roadmap that takes high-level objectives and targets and translates them into day-to-day decision-making actions. Specific governance recommendations are as follows:

- A list of indicators and metrics should be established that are consistent across the entire planning region to manage and measure activities. Some indicators are especially relevant to source water. Alberta Environment's recent report on watershed indicators for measurements of riparian health and rangeland health in southern Alberta should form the basis of such a list.⁴⁹
- Regional outcomes that clearly define limits on the scale, intensity, location, and impacts of land uses should be established for environmental, social, and economic values. The use of quantitative objectives is preferable to qualitative objectives, which are difficult to measure and are often weak with respect to directing landscape change.
- Each regional plan (coordinated closely with its sub-regional plan) should express strong statements of provincial interest that clearly describe priorities and create a process to identify objectives, targets, and trade-offs.
- The specific role of Watershed Planning and Advisory Councils in setting objectives should be defined in the context of the regional plan. To the extent possible, research and objectives already developed by WPACs should be seriously considered in a regional plan. At a minimum, WPACs and their members should have an opportunity to provide input as to what targets should be set with respect to water resource indicators. The Government of Alberta should set interim targets in the absence of consensus recommendations from WPACs. In any event, a regional plan should specify the continuing role of WPACs to identify key indicators, set targets, monitor progress, and act as a conduit to the public.
- A system must be in place to assure that municipal land-use planning is consistent with limits set for total landscape disturbed, including road density and stream crossings. Every municipal development plan and Integrated Resource Plan (or similar planning effort for public land) should be scheduled for an update within a short time frame after the adoption of the regional plan to reflect how the plans operate together to reach targets. Regional plans should specifically identify those approvals or permits that would be subject to source water protection strategies, including but not limited to environmental assessments (under the *Environment Protection and Enhancement Act* (EPEA)⁵⁰), water permits (under the *Water Act*),

and energy permits (under the *Energy Resources Conservation Act (ERCA)*⁵¹). One method to achieve this alignment could be ensuring each Area Structure Plan aligns with regional or sub-regional cumulative effects thresholds.

- The mechanisms under which cumulative effects are managed must be legally binding. In other words, decisions that involve resource allocation, project approvals, and operational planning must support the outcomes and objectives identified by the regional plan.
- A central and independent mechanism should be created to inventory, monitor, and report on indicators. This instrument is necessary to manage cumulative effects of development against targets and thresholds set in the regional plan, and to assist in the evaluation of planning direction. Municipalities, applicants, and the public could use such an inventory to ensure developments adhere to desired limits.

Recommendation 2: Set and reach targets for total landscape disturbed

Effective protection of watersheds will require setting and meeting targets for total landscape disturbance (i.e., land developed for any number of purposes). Several commentators have noted that an intact area of natural assets rather than fragmented patches has important ecological implications. To maintain the full range of ecosystem services and goods for water resources, and a host of other assets, large patches (>10,000 hectares) of natural endemic vegetation, broad well-vegetated riparian corridors, and connected landscapes need to be retained. Such intact patches are critical in southern Alberta where as much as 65 percent of the rainfall is “captured, held, and released within the landscape.”⁵²

Landscape disturbance refers to the amount of land that is cleared of vegetation for purposes of timber harvesting, mining, oil and gas exploration, roads and other linear features, pavement and other impervious surfaces such as roofs, and even agriculture. The largest preventative step available to protect source waters is to maintain forest cover, fescue grasslands, and riparian vegetation. Disturbance or clearing of vegetation causes water to flow more quickly over land, collecting pollution along the way that is then deposited into rivers.

Targets for disturbed landscape would be practical and effective at a sub-basin level (e.g., Bow, Red Deer, and Oldman rivers). But the most effective approach would be to establish such targets at the sub-sub-basin level, such as at the scale of the Elbow River watershed. There is strong evidence to suggest that establishing thresholds at the sub-sub-watersheds provides much greater source water protection. For example, the Elbow River watershed, a major source of drinking water for the Calgary region, may require higher levels of undeveloped land to continue to deliver quality water.

An ecosystem services and goods study for Alberta Environment,⁵³ evaluating different development scenarios for southern Alberta found the following:

- The regulation of water is provided by native prairie assets and forests (as well as anthropogenic assets such as reservoirs and canals). The expansion of urban areas on native prairie landscapes decreases water quality. By contrast, an increase in native prairie assets would increase water regulation.
- The ability of the landscape to control erosion and retain sediment is highly impacted by roads, rails, cities, mines, industrial sites and, to a lesser extent, agriculture. Expansion of urban areas on the native prairies also decreases these ecological goods and services.
- Water supply is negatively affected the expansion of cities and towns on native prairie.⁵⁴

Given the large presence of agricultural lands in southern Alberta, additional targets to prevent the conversion of these lands to rural residential and urban landscapes could promote groundwater infiltration and reduce runoff.

Vegetative cover has several advantages for regulating water quantity and improving water quality, including the following:

- Retention of water into later and drier months
- Increased groundwater storage through root systems
- Reduced sedimentation and erosion
- Increased filtration of pollutants
- Reduced runoff volumes

Some have suggested a target for cumulative disturbed landscape for the Southern East Slopes region be set between 20 and 30 percent.⁵⁵ By 2055, the *Southern Foothills Study* estimates an additional 48,194 hectares will be disturbed bringing the total landscape disturbed in that region to 30.61 percent. This study includes agricultural cropland as disturbed landscape because tillage results in increased erosion, sedimentation, and runoff rates.

A parallel approach to determine disturbed landscape targets is to identify specific zones for urban development and growth (such as the node approach that the Calgary Regional Partnership outlines in its draft plan), areas to remain agricultural, and areas to remain largely undeveloped as natural areas.

To achieve this, it will be necessary to establish percentage targets for land-use zones including urban development, agriculture, forestry, energy development, and road development. For example, specific targets or limits for the number, type, or extent of developed and protected areas could be established (e.g., 12 percent of forestry lease land), followed by collaborative design processes to make those targets a reality. Integrated Resource Planning, or a similar public land planning process, is also required to manage the setting of targets for public lands.

Recommendation 3: Integrate source water protection planning into land planning

Every regional plan should clearly identify specific source water protection strategies in every major sub-basin in the South Saskatchewan River Basin (Bow, Red Deer, and Oldman). As stated above, it is recommended that specific strategies should be directed to the “sub-sub-basin” level, those watersheds located **within** the Bow, Red Deer, and Oldman watersheds. For example, the Elbow River watershed, part of the Bow River watershed is an example of the “sub-sub-basin” level. Strategies should begin with identifying thresholds for total landscape disturbed (discussed above in Recommendation 2) and also include the following:

- Identification of strategies to protect key source water planning areas that are particularly vulnerable to land-use impacts (e.g., recharge zones, groundwater zones susceptible to contamination, wetland complexes, riparian areas).
- Mechanisms to protect and, if needed, restore natural features such as wetlands and riparian zones.
- Consideration of designated protection for highly sensitive areas such as provincial parks or management areas, land acquisition, and easements.

Recommendation 4: Formally establish the Southern East Slopes as a publicly recognized resource for source water protection and other key values

Comprehensive management of Alberta’s Southern East Slopes needs to be formalized through legislation or binding policy to meaningfully affect day-to-day decision making across the region. To overcome historic barriers that have prevented Alberta from protecting source water on the Eastern Slopes, Alberta needs specific changes that provide meaningful targets, manage cumulative effects, and reinforce a culture of commitment by all Albertans.

Three possible options for formal designation of this region follow:

- Revisit and formalize the 1984 *Eastern Slopes Policy* to clearly prioritize the region’s management for quantity and quality of water. The limitations of the 1984 policy, however, must be corrected in order to ensure land management and development is consistent with cumulative targets. Such changes would require binding commitments on day-to-day decisions by agencies and municipalities with the authority to manage land use in this region.
- Craft a new regional policy to establish a central authority (e.g., formalized oversight board) that would monitor and ensure that the cumulative impacts of multiple land uses within the South Eastern Slopes. Such an agency would deal with land-use conflicts as they arise and ensure that the cumulative impact targets are not exceeded. While individual ministries would still proceed under their respective authorizing legislation, a central policy and policy “manager” would ensure that the problems of the past do not reappear.
- Embrace the “Heritage Rangeland” designation. The success of the Black Creek Heritage Rangeland illustrates how large source water areas can be maintained intact while providing commercial use as rangeland. This land designation is underused with only two current areas, Black Creek and the OH

CASE STUDY

HISTORIC EFFORTS TO PROTECT THE SOUTHERN EAST SLOPES

Over the last 60 years, several efforts have been made to protect the source water of the Southern East Slopes. Looking at these efforts and where they have gone astray can help develop a more successful approach today.

Eastern Rockies Forest Conservation Board

In 1947, the Alberta government created the Eastern Rockies Forest Conservation Board (ERFCB). It was one of Alberta's earliest land agencies, and its mandate was to address the health of public land on the Eastern Slopes. It emphasized clear goals that guided and coordinated all its activities, the development of comprehensive guides, and the first system for zoning areas within its entire region.⁵⁶ The general intent was "to protect and develop these lands with the object of maintaining the desirable conditions for watershed management."⁵⁷

Initially, the agency was relatively effective in maintaining an intact forest along the Eastern Slopes, primarily through organizing previously uncoordinated logging. However, development pressures and lack of political will undermined much of its powers. Eventually, public lands were largely placed under the control of the Alberta Forest Service, and the ERFCB's powers to issue resource dispositions were removed. Essentially, the ERFCB went from being a general coordinator of much of the landscape in the Eastern Slopes to setting minor policies and coordinating watershed-monitoring research.⁵⁸

Stripping the ERFCB of its coordinating powers set Alberta on a path of more fragmented decision making by different agencies with little mandate to work together. The ERFCB is an early example of an agency with a broad vision and powers that was weakened through the erosion of its initial mandate.⁵⁹

The 1977 Eastern Slopes Policy

In the early 1970s, the province's Environment Conservation Authority (ECA) undertook extensive public consultation and research that provided recommendations to government. Albertans clearly told the ECA that water needed to be protected in the Eastern Slopes.⁶⁰

This process led to the creation of A Policy for Resource Management of the Eastern Slopes in 1977. The Eastern Slopes Policy, as it came to be called, became the overarching guide for land use in the Green Zone of the Eastern Slopes.

The Eastern Slopes Policy clearly stated what the fundamental values of Albertans were. Its highest priority was "watershed management to ensure a reliable supply of clean water for aquatic habitat and downstream users."⁶¹

The 1977 Eastern Slopes Policy had its limitations, but it did signal a change. Now the landscape was viewed through a cumulative effects lens where human impacts could be measured against environmental thresholds. This new approach was reflected by the Environment Minister, Dave Russell, who stated: "A conservative estimate is that a minimum of 70 percent of the Eastern Slopes region will be maintained in present natural or wilderness areas."⁶²

The updated 1984 Eastern Slopes Policy

In the early 1980s, the government undertook what it called an administrative review of the Eastern Slopes Policy. Unfortunately this review lacked the broad consultation that had characterized the initial 1977 policy. The revised 1984 policy emerged that removed commitments to "normal stream flow and water quality." Instead the 1984 policy was committed to "intensive management" for "water supply stability."⁶³

CASE STUDY

The updated Eastern Slopes Policy deferred to agencies like the Energy Resources Conservation Board (ERCB) for permitting energy exploration independently of landscape-scale consideration.

In 1993, the ERCB attempted to rectify this lack of coordination by issuing Informational Letter (IL) 93-9 directing proposals for “surface disturbances such as pipelines and facilities... [to] be submitted as a part of a ‘development plan’ rather than on a piece-meal or single-well approach.”⁶⁴ On public land, energy development was theoretically guided by the region’s Integrated Regional Plans (IRPs). 93-9 was less clear about private land leaving much to the discretion of the energy proponent as they dealt with directly affected landowners. Through 93-9, basic environmental assessments and public consultation became more frequent. However, a lack of clear direction and thresholds from IRPs left IL 93-9 without a meaningful reference to the cumulative impacts of energy projects. The ERCB has acknowledged this failure and suggested that on public land there remains a need for comprehensive land-use planning with numeric thresholds to guide managers.⁶⁵

The failure of these policies to manage the landscape as one unit was identified as early as 1979 by the Environment Council of Alberta who observed, “...the wise planning and management of our renewal resources depend upon coordination and cooperation of those who administer them.”⁶⁶ In 1995, the government-appointed Future Environmental Directions for Alberta Task Force, stated, “[w]ithout updating and clarifying land-use policy, including determining the relationships among the policy elements, conflict will continue – valley by valley and hill by hill.”⁶⁷

It is worth noting what exactly went wrong with these failed attempts to implement more effective policy:

1. Policies such as the Eastern Slopes Policy lack sufficient legal status and instead only act as a general guide to decision makers. While there is reason to maintain a certain amount of flexibility, “excessive flexibility can be dangerous in an environmental control mechanism.”⁶⁸
2. A formal government decision-making structure is needed for this region in order to align government departmental mandates and avoid ministry conflicts. While earlier integrated resource planning did set some broad principles and objectives and even planning, “[i]t did not penetrate to the structural level of policies, legislation, institutional arrangements and decision-making processes.”⁶⁹ A statutory framework that supports broad land-use planning includes clearly defined procedures and mechanisms to ensure compliance and accountability. Some have noted that the lack of statutory framework allowed the Eastern Slopes planning initiatives “to quietly fade into obscurity once difficulties were encountered.”⁷⁰
3. Meaningful public consultation leads to strong policies. The 1977 Eastern Slopes Policy involved thousands of Albertans and resulted in robust defense of Alberta’s Eastern Slopes watersheds. The 1984 Eastern Slopes Policy, developed without public input, weakened source water protection in the Eastern Slopes.
4. Difficult economic times cannot be an excuse for weak policy. This excuse merely passes even greater challenges along to the next generation. ■



Ranch, designated under the *Wilderness Areas, Ecological Reserves, Natural Areas, and Heritage Rangelands Act*.⁷¹ Additional heritage rangelands would help ensure ongoing protection of the traditional grazing approach that has preserved native grasslands for so many years.

Additional specific strategies to assist source water protection in the South Eastern Slopes

At the operational level, specific strategies can support higher-level strategies to maintain an intact land base for source water. On public land, these additional strategies include the following:

- If Integrated Resource Plans are maintained under the Land-use Framework, they need clear numeric landscape thresholds to bind the actions of managers and development proponents.
- Forestry management should be guided from the perspective of reducing non-point source effluent into headwaters, rather than the current sustained yield model that is driven by timber fiber potential. This change would require setting limits on forest clearing to prevent erosion.
- Regional managers should be able to enforce immediate closures to areas or prevent activities harmful to watershed health, such as off-highway vehicle or industrial activity.
- Remove unnecessary roads.
- Establish industry road-sharing incentives by placing a cumulative limit on roads and other linear development (e.g., seismic lines, pipeline right-of-ways).
- Site and design new roads on non-erodible soil, on low slope areas, and away from riparian areas.
- Replant cutblocks with a mixture of species for biodiversity and genetic resilience.
- Enforce riparian areas with large buffer zones around all streams (including ephemeral streams), vernal pools (ephemeral pools often in forests), wetland areas (including ephemeral wetlands), alluvial aquifers, and sensitive groundwater recharge areas.
- Limit and strictly enforce off-highway vehicle use to areas with Access Management Plans.
- Wherever possible maintain roadless areas as roadless.
- Minimize the number of stream crossings to prevent erosion and sedimentation and contamination to streams.
- In existing rangeland areas, protect streams and groundwater recharge areas from livestock through fencing, or other off-stream livestock management strategies, as well as from residential and other development.
- Map groundwater resources and measure changes relative to adjacent development such as mining and gravel pits.

On private lands, the following strategies are recommended:

- Designate areas of land as agricultural zones not subject to any new development impacts.
- Develop market and non-market based incentives to enable private landholders to adopt stewardship activities. For example, provide further incentives to conserve intact land through conservation easements, such as those provided by Southern Alberta Land Trust Society or the Nature Conservancy.
- Provide incentives for private land holders or lease holders to adopt best management practices for cattle grazing such as distributing livestock evenly, minimizing intensity, avoiding grazing areas during vulnerable periods, and other strategies promoted by organizations such as Cows and Fish to protect sensitive riparian and groundwater recharge areas.⁷²
- For future growth, locate nodes to cluster residential development near large urban areas.
- Determine densification targets for all towns and urban areas over 5,000 people including, but not limited to Calgary, Red Deer, Lethbridge, Brooks, Medicine Hat, Airdrie.

Recommendation 5: Establish objectives for key water resource indicators

To meaningfully account for the cumulative impacts to the landscape, targets should be set to manage the most serious effects on source water. At a minimum, the regional plan should adopt the following indicators to establish targets and associated strategies.

a. Riparian areas

Riparian areas offer a wide range of goods and services for water resources. These include the following:

- Water quality protection including filtration and retention of sediments, nutrients, and other contaminants.
- Water storage consisting of flood moderation, stormwater runoff control, and groundwater recharge.
- Bank stabilization to reduce erosion, sediment transport, and bank failures.
- Maintenance of aquatic and terrestrial habitat with provisions for shade, food, and woody debris; plant and animal dispersal; and essential habitat for riparian-dependent species.⁷³

There are at least two types of targets that could be established for riparian protection:

- Minimum buffer zones (e.g., setbacks) create a zone between development and surface water sources for pollutant and nutrient runoff and aid in temperature and microclimate regulation. It is important to adopt a precautionary riparian buffer throughout the entire South Saskatchewan Regional Plan region at a minimum of 30 metres for smaller streams and 200 metres for larger rivers (e.g., Crowsnest and Oldman). There are both fixed-width and variable-wide riparian buffers, but we suggest a fixed-width in the absence of site-specific information and based on the precautionary principle. However, every municipality and other land or resource development authority should strongly consider exceeding this minimum setback for certain uses including bank stabilization (50 metres) and wildlife habitat (100 metres).⁷⁴ The linkage between the movement of watercourses through dynamic alluvial fans may require greater setbacks or management provisions to allow for channeling and alluvial aquifers that may extend well beyond the visible surface riparian area.
- Percentage for healthy riparian areas (preferably based on sub-sub-basins) that may include, by definition, percentage changes from “unhealthy” areas to “healthy” areas. Targets for riparian health at the sub-sub-basin level can apply a similar approach as was identified in the 2008 provincial riparian assessment.⁷⁵ Specific riparian targets for each river basin should also be identified.

Because native pasture grazing has been identified as a top cause for riparian impacts⁷⁶, the identification of specific strategies is required to reduce this particular type of impact, whether it be through increased volunteer stewardship efforts, incentive-based mechanisms, or increased regulatory enforcement.

Additional land-use strategies should include the following:

- Minimizing infrastructure and urban development in floodplain areas.
- Minimizing land conversion to hardened surfaces, even outside riparian areas.
- Removing invasive plants.
- Minimizing disturbance from grazing, recreation, and certain types of development.
- Avoiding physical alterations to riparian areas as disturbance often leads to soil compaction, which decreases the soil’s ability to store water.

b. Wetlands

Wetland protection offers a significant opportunity for water quality and quantity protection. Implementing a regional “no net loss” strategy is likely the best mechanism to guide targets. Wetland protection strategies must include protection for ephemeral and permanent wetlands, small and large; for habitat of different aquatic species’ lifecycles; and for water filtration and regulation services. In particular, conservation units provided under the proposed *Alberta Land Stewardship Act* offer new incentives for landowners to maintain original wetlands.

c. Fish

Acceptable human footprint and activity should align with acceptable habitat changes to ensure species protection and recovery for fish species, particularly Alberta's five native species. Two specific strategies to protect aquatic habitat are recommended:

- Prohibit logging and development on erodible soils.
- Roads near streams should be reclaimed where not in use.⁷⁷

d. Water quality

Every regional land-use plan under the Land-use Framework should identify a common set of water quality and quantity indicators. Indicators should be based on physical, chemical, and biological parameters. Alberta Environment has already completed important research on this subject.⁷⁸ Reporting and measurements for such indicators at the sub-basin level are strongly recommended. Current practices generalize overall river health, neglecting specific sub-basin targets needed to avoid source water degradation.

In addition to identifying indicators and associated targets, adopting a "watershed sensitivity" approach that identifies those regions that are more susceptible to land-use impacts than others is recommended. Such strategies are being pursued by the Bow River Basin Council and have been effectively implemented in other jurisdictions such as the Yukon.⁷⁹

It may be practical to adopt objectives already identified by the Bow River Basin Council Phase I Watershed Management Plan and the identified specific targets for maximum contaminant loads to meet water quality objectives.

Finally, investigation is required to identify land-use management practices and zoning to achieve total loading objectives (cumulative contribution of multiple point and non-point source pollution for certain parameters) for stormwater runoff.

e. Groundwater sensitive zones

The benefits of protecting groundwater extend far beyond recharge zone. A recent study suggests peak runoff in the Oldman Basin is not predominantly generated by melting snow accumulated during the preceding winter but mainly by relatively young groundwater.⁸⁰ Such findings point to the need to act with caution when disturbing groundwater recharge zones.

Groundwater inventories and thresholds for withdrawal need to be established to understand the nature of this resource. These inventories will also help assess individual and cumulative effects of development, well applications, and withdrawal rates.

The Elbow Alluvial Aquifer

We recommend better land-use management to protect the Elbow River Alluvial Aquifer. While the alluvial aquifer for the Elbow River comprises only five percent of the land in the Elbow watershed, its hydraulic conductivity creates considerable interaction between surface and groundwater. Consequently, we suggest that development on this aquifer can negatively impact water flow and quality because of this hydraulic connectivity. We suggest that additional information be gathered on similar geographic regions.

Source: Lloyd, Eric. 2006. Elbow River Alluvial Aquifer. Prepared for the Bragg Creek Environmental Coalition.

Recommendation 6: Adopt specific targets and thresholds for land uses that have high impacts on water resources

Adopting specific and legally binding targets for land-use activities that directly impact water sources is a critical step to managing the landscape.

a. Linear disturbance and stream crossings

Linear disturbance from roads and other development is one of the most significant impacts to watershed health in southern Alberta and is, therefore, a major indicator of watershed health.

i. Roads and other linear disturbances

Managing road density is likely the most effective approach to maintaining landscapes that support source water protection. Poorly designed and maintained roads and other linear features increase erosion and degrade water quality. Construction of access roads is one of the biggest contributors to erosion and sedimentation in watersheds. A watershed assessment study completed in southwestern Alberta found that land disturbance is the principal risk to watershed integrity, where “surface erosion from land disturbance is overwhelmingly attributable to the extent of road development.”⁸¹

Road densities should be established for different land classifications depending on their propensity to erode and the sensitivity of their watercourses. In general, it is safe to adopt a 0.9 km/km² road density threshold.⁸² Others suggest road densities greater than 0.5 km/km² should not be considered and road densities higher than 1.0 km/km² should be reduced.⁸³ Adopting tiered road density targets as used in watershed assessment procedures for British Columbia has shown success.⁸⁴

High elevation road density limits should be adopted as well as more precautionary targets for “erodible soil.” And, finally, road density limits should be adopted for sensitive fish species.

New road projects should not be allowed to proceed without a plan and funding for decommissioning the road after the life of the project, as well as defining an effective access management plan during a road’s lifetime.

ii. Stream crossings

No net increase in stream crossing strategies should be used to reduce impacts in areas with low or zero presence of roads, seismic lines, oil and gas activity, or whose water quality and quantity are found to be highly vulnerable to land-use impacts. One mechanism would be to identify a specific target for density of stream crossings such as that recommended in the Dehcho Territory of the Northwest Territories with a cautionary target of <0.5/km² and an absolute target of <0.32/km.⁸⁵

b. Forestry clearcut areas

The loss of vegetation reduces soil stability, accelerates erosion and sedimentation, and increases nutrient runoff as well as quantity. Targets for clearcut areas, particularly in upland forests, should be integrated into planning.

c. Landfills

Strong guidelines for landfills must also be adopted because they can affect vulnerable or sensitive water sources. All existing landfills should be reviewed if located in or near vulnerable or sensitive source water areas. Changes to the certificates of approval should require the landfill operator or owner to address threats posed by the landfill. For example, leachate collection systems, treatment systems, and monitoring systems may be required if not already in place.⁸⁶

d. Municipal well siting

Locations for new municipal water sources should be sited with respect to source water protection plans or in accordance with investigations into the sensitivity of the land to contamination.

e. Grazing and agriculture

Several basic grazing and agricultural practices should be implemented to reduce impacts on watersheds, including the following practices:

- Limiting intensity through management thresholds that ensure riparian vegetation health.
- Discouraging land conversion for cropland.
- Encouraging best management practices to reduce runoff from feedlots, cropland, or rangelands.
- Establishing Agricultural Land Reserves such as in British Columbia to reduce land-use conflicts.

f. Urban development

It is essential to limit urban encroachment into the rural land base. The following strategies are suitable to southern Alberta:

- Establishing urban growth boundaries for urban areas including Calgary but also other developing areas.
- Requiring higher urban densities including, but not limited to, the Calgary Region.
- Enforcing clear riparian setbacks for industrial, commercial, and residential development.
- Clustering development, whether country residential development or urban development. The Calgary Regional Partnership has developed a promising model for defining clusters away from critical water source locations.⁸⁷

g. Oil and gas activity

A specific target to limit the footprint of oil and gas development is a critical element in the regional planning process. Changes to Alberta's current oil and gas tenure system may be needed to achieve outcome-based management.

At a minimum, any future rights issuance must be specifically conditional upon meeting regional objectives, thresholds, and zones. Where tenures have already been sold, permitting should be approved only within compliance with the thresholds of a regional plan as detailed above. Having oil and gas permitting on a separate track through the ERCB is no longer acceptable. Where warranted, the Government of Alberta should consider buying back tenure rights in sensitive zones.

For future dispositions, a pre-tenure plan should be developed before the issuance of mineral rights. A pre-tenure plan should evaluate the potential impact of development, such as occurs in British Columbia's Muskwa-Kechika Management Area.⁸⁸

Recommendation 7: Implement Transferable Development Credits appropriately

Development applicants should be able to take advantage of the flexibility offered by Transferable Development Credits (TDCs) where appropriate.

TDCs that effectively remove roads, re-contour stream banks, and replant rights-of-way or that demonstrably reduce equivalent impact areas could provide applicants with methods and tools for introducing new developments where gross cumulative impacts rather than site-specific impacts weaken the prospects of a project's appeal.

As the province embarks upon introducing localized TDCs, some caution is needed to ensure TDCs deliver conservation benefits. The core goal of any TDC system set up in southern Alberta must first be to clearly protect and maintain source water assets within the framework of the regional land use plan. The incentive for development may follow once this first priority is achieved in the TDC. Otherwise, TDCs may become permission slips for potentially inappropriate development based on false offsets. TDCs should not allow for development in areas of high conservation value for source water or other values while upgrading a land area of lesser value. Recognizing the limits of TDCs to provide market-based incentives is critical. In certain areas, other tools such as conservation easements may be more appropriate.

VIII: Conclusion

There is broad consensus, perhaps the greatest in the history of Alberta, that we need to change our approach to land-use management to protect vitally important fundamentals such as source water. As this blueprint and other documents illustrate, Albertans have come to this understanding through a series of hard lessons.

We believe that the recommendations in this document are crucial if future generations are to have the same quality of life that we have enjoyed in the province thus far. Some of the recommendations could be implemented as stand-alone efforts, but the issues facing southern Alberta will ultimately be solved at a basin and sub-basin level.

Therefore, we believe that the South Saskatchewan Regional Plan, under the Land-use Framework, provides the most immediate and strongest opportunity to begin implementing these recommendations. Government, stakeholders, and the general public in this region are prepared and ready to break out of the failed management patterns that have characterized this region.

We recognize, however, that some of the recommendations offered here will best come to fruition in sub-regional or integrated resource planning that will follow the South Saskatchewan Regional Plan. Other commentators have noted the need to drive comprehensive planning for values such as source water protection down to the sub-regional scale to ensure planning for individual sectors does not re-create the fractured decision making we currently face.⁸⁹ We hope that planners, decision makers, development proponents, and the general public will find this blueprint valuable, both at the regional and sub-regional level, as we work together to ensure that Alberta protects the source water of the Southern East Slopes.



Photo: Robert Kershaw

The South Saskatchewan Regional Plan, under the Land-use Framework, provides the most immediate and strongest opportunity to begin implementing these recommendations.

Citations

1. In general, Mountains receive the largest proportion of the earth's precipitation and provide approximately 60 to 80 percent of the world's freshwater sources (Hamilton and Cassells in Dudley and Stolton 2003; Dudley and Stolton 2003, 8). The North Saskatchewan River, for example, receives approximately 86 percent of its flow from the Eastern Slopes and foothills region of its watershed (Golder Associates. 2008. Water Supply Assessment for the North Saskatchewan River Basin. North Saskatchewan Watershed Alliance: Edmonton. [Online] <http://nswa.ab.ca/content/water-supply-assessment>.
2. Agriculture and Rural Development. 2008. Understanding Groundwater. Government of Alberta. [Online] [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/wwwg406](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwwg406).
3. Alberta Energy and Natural Resources. 1977. A Policy for Resource Management of the Eastern Slopes. Government of Alberta. Edmonton.
4. Equus Consulting Group Inc. 2002. Alberta Water for Life: Pooling Your Ideas Summary. Government of Alberta. Edmonton. [Online] <http://environment.gov.ab.ca/info/library/7497.pdf>.
5. Ipsos Reid. 2009. Majority of Canadians consider water to be Canada's most important natural resource (Press Release). March 17, 2009. Unilever and the Royal Bank of Canada [Online] <http://www.rbc.com/environment/bluewater/articles/20090317-waterstudy.html>.
6. Government of Alberta. 2008. Land-use Frame Work. Government of Alberta. Edmonton. [Online] http://www.landuse.alberta.ca/documents/Final_Land_use_Framework.pdf.
7. Coombs, Matthew. 2008. Indicators for Assessing Environmental Performance of Watersheds in Southern Alberta. Government of Alberta. [Online] <http://environment.gov.ab.ca/info/library/7945.pdf>.
8. Chaney, E., Elmore, W., and Platts, W.S. 1993. Livestock grazing on western riparian areas. Northwest Resource Information Center. U.S. Environmental Protection Agency, Washington DC.
9. Beveridge, Meghan. 2008. Piping Between Watersheds: An Analysis of Basin-to-Basin and Sub-Basin to Sub-Basin Diversions in Alberta. Water Matters. Similar to the U.S. Geological Survey's hydrologic unit code classification system, the Water Survey of Canada (WSC) has created an alphanumeric system to identify drainage basins and watersheds in Canada. The system includes three levels of watersheds: major basins (e.g., Saskatchewan River Basin, 05), sub-basins (e.g., Bow River, 05B), and sub-sub-basins (e.g., Elbow River, 05BJ) (PFRA 2006). A more detailed level of naming indicates the hydrometric station number at certain reaches of the stream or river that measures daily rate of flow (WSC 2006).
10. Alberta Environment, 2007. Ecosystem Goods and Services Assessment – Southern Alberta. Phase 2 Report. Presented by Integrated Environments Ltd. And O2 Planning and Design Inc. March 2007.
11. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&categoryid=4>.
12. Canadian Association of Petroleum Producers. 2009. "Net Cash Expenditures of the Petroleum Industry". Statistical Handbook for Canada's Upstream Petroleum Industry. [Online] <http://www.capp.ca/GetDoc.aspx?DocID=146286>.
13. Statistics Canada. 2009. National Accounts Tables. [Online] <http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm>.
14. Government of Alberta. 2008. Land-use Frame Work. Government of Alberta. Edmonton. [Online] http://www.landuse.alberta.ca/documents/Final_Land_use_Framework.pdf.
15. Ibid.
16. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&categoryid=4>.
17. Brad Stelfox and Alan Gardiner. 2007. The Changing Landscape of the Southern Alberta Foothills. http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.
18. Butler, Rick and Shepherd, Colleen. 2009. Calgary Regional Partnership Open House Presentations. [Online] http://www.calgaryregion.ca/crp/media/52184/the_story_of_the_draft_regional_plan.pdf.
19. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
20. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&categoryid=4>.

21. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
22. Ibid.
23. Government of Alberta. 2008. Land-use Framework. Government of Alberta. Edmonton. [Online] http://www.landuse.alberta.ca/documents/Final_Land_use_Framework.pdf.
24. Ibid.
25. Cyr, Rod, Davis, Ron et al. 2004. Report of the Southern East Slopes Task Force. Government of Alberta. This report was prepared by the Municipal Districts (MDs) of Big Horn, Ranchland, and Pincher Creek and the County of Clearwater. The report suggests that camping by a rising number of OHV users has resulted in damage to sensitive streams and riparian areas. The report expressed concern that "these are the headwaters of a number of Alberta's major rivers....[D]rinking water is being threatened or damaged for hundreds of thousands of Albertans."
26. Duecker, Kenneth J. And Nelson, Arthur C. 1990. The Exurbanization of America and Its Planning Policy Implications. Journal of Planning Education and Research.
27. Resource Planning Group, Policy Secretariat. 2002. Loss and Fragmentation of Farmland. Alberta Agriculture, Food and Rural Development. Edmonton.
28. Ibid.
29. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
30. The City of Calgary Land use planning & Policy. 2009. A Calgary Snapshot http://www.calgary.ca/DocGallery/bu/planning/pdf/geodemographics/calgary_snapshots/population_density_urban_growth.pdf.
31. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead - State of the Landscape Report. Government of Alberta. Edmonton. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&subcategoryId=220>.
32. Ibid
33. Gardiner, Alan and Stelfox, Brad. 2007. The Changing Landscape of the Southern Alberta Foothills. http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.
34. Ibid.
35. Ibid.
36. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead - State of the Landscape Report. Government of Alberta. Edmonton. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&subcategoryId=220>.
37. Gardner, Alan and Stelfox, Brad. 2007. The Changing Landscape of the Southern Alberta Foothills. http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.
38. Sawyer, M.D., Mayhood, D.W., et al. 1997. Southern East Slopes cumulative effects assessment. Calgary, Ab. [Online] <http://www.fwresearch.ca/PDFLibrary.html>.
39. Martz, Lawrence, Bruneau, Joel and Rolfe, J. Terry. 2007. Climate Change and Water: SSRB Final Technical Report, Prairie Adaptation Research Collaborative, [Online] <http://www.parc.ca/ssrb/>.
40. Martz, Lawrence, Bruneau, Joel and Rolfe, J. Terry. 2007. Climate Change and Water: SSRB Final Technical Report, Prairie Adaptation Research Collaborative. [Online] <http://www.parc.ca/ssrb/>.
41. Gardner, Alan and Stelfox, Brad. 2007. The Changing Landscape of the Southern Alberta Foothills. http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.
42. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
43. Alberta Environment. 2007. Southern Alberta Landscapes: Meeting the Challenges Ahead - State of the Landscape Report. Government of Alberta. Edmonton. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7771&subcategoryId=220>.
44. Gardner, Alan and Stelfox, Brad. 2007. The Changing Landscape of the Southern Alberta Foothills. http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.
45. Coombs, Matthew. 2008. Indicators for Assessing Environmental Performance of Watersheds in Southern Alberta. Government of Alberta. [Online] <http://environment.gov.ab.ca/info/library/7945.pdf>.
46. Cross, John, Obad, Joe et al. 2007. RE: Some common sense for the uncommonly valuable Southern East Slopes. Calgary, Alberta. [Online] http://www.pekisko.ca/docs/D_070403_stelmach_letter.pdf.
47. Gardner, Alan and Stelfox, Brad. 2007. The Changing Landscape of the Southern Alberta Foothills. [Online] http://www.salts-landtrust.org/sfs/docs/D_070716_phase_onetwo_report_final.pdf.

48. Alberta Environment, 2007. Ecosystem Goods and Services Assessment – Southern Alberta. Phase 2 Report. Presented by Integrated Environments Ltd. And O2 Planning and Design Inc. March 2007.
49. Alberta Environment. 2008. Indicators: Assessing Environmental Performance of Watersheds in Southern Alberta. Edmonton.
50. Government of Alberta. Environmental Protection and Enhancement Act. Queen's Printer. Edmonton, Alberta. [Online] http://www.qp.alberta.ca/574.cfm?page=E12.cfm&leg_type=Acts&isbncln=9780779735495.
51. Government of Alberta. Energy Resources Conservation Act. Queen's Printer. Edmonton, Alberta. [Online] http://www.qp.alberta.ca/574.cfm?page=e10.cfm&leg_type=Acts&isbncln=9780779728534.
52. Alberta Environment. 2007. Ecosystem Goods and Services Assessment – Southern Alberta. Phase 2 Report. Presented by Integrated Environments Ltd. And O2 Planning and Design Inc. March 2007, p.16. [Online] <http://environment.gov.ab.ca/info/library/7794.pdf>.
53. Alberta Environment, 2007. Ecosystem Goods and Services Assessment – Southern Alberta. Phase 2 Report. Presented by Integrated Environments Ltd. And O2 Planning and Design Inc. March 2007. [Online] <http://environment.gov.ab.ca/info/library/7794.pdf>.
54. Ibid.
55. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
56. Kennett, Steven. 2002. Integrated Resource Management in Alberta: Past, Present and Benchmarks for the Future. Canadian Institute for Resource Law. Calgary Alberta. [Online] <http://cir.ca/OP>.
57. Eastern Rockies Conservation Board, Annual Report, (1951) at 2, quoted in Kennett, Steven. 2002.
58. Ibid.
59. Ibid.
60. Alberta Energy and Natural Resources. 1977. A Policy for Resource Management of the Government of Alberta. Edmonton, Alberta.
61. Ibid, p. 4.
62. Alberta Wilderness Association. 1984. A Critique of the 1984 Eastern Slopes Policy and a Comparison of it with the 1977 Policy. Alberta. p. 3.
63. Ibid, p. 4-5.
64. Alberta Energy and Utilities Board. 1993. Informational Letter 93-9 - OIL AND GAS DEVELOPMENTS EASTERN SLOPES (SOUTHERN PORTION). [Online] <http://www.ercb.ca/docs/ils/ils/pdf/il93-09.pdf>.
65. Alberta Energy and Utilities Board. 2000. Decision 2000-18 Canadian 88 Energy Corporation Application to Drill a Critical Sour Gas Well and Construct a Pipeline and Related Facilities in the Castle River Area. Alberta Energy and Utilities Board. [Online] <http://www.ercb.ca/docs/documents/decisions/2000/2000-18.pdf>.
66. Kennett, Steven. 2002. Integrated Resource Management in Alberta: Past, Present and Benchmarks for the Future. Canadian Institute for Resource Law. Calgary Alberta. [Online] <http://cir.ca/OP>. Citing Environment Council of Alberta, The Environmental Effects of Forestry Operations in Alberta: Report and Recommendations (Edmonton: 1979).
67. Government of Alberta. 1995. Ensuring Prosperity – Implementing Sustainable Development, The Report of the Future Environmental Directions for Alberta Task Force. Edmonton.
68. Kennett Steve and Schneider Rick. Alberta by Design: Blueprint for an Effective Land-Use Framework. February 2008. The Pembina Institute and the Canadian Parks and Wilderness Society. p. 8. [Online] http://pubs.pembina.org/reports/Alberta-by-Design_LUF-Report.pdf.
69. Kennett, Steven. 2002. Integrated Resource Management in Alberta: Past, Present and Benchmarks for the Future. Canadian Institute for Resource Law. p. 15. Calgary Alberta. [Online] <http://cir.ca/OP>.
70. Kennett Steve and Schneider Rick. Alberta by Design: Blueprint for an Effective Land-Use Framework. February 2008. The Pembina Institute and the Canadian Parks and Wilderness Society. p. 8 [Online] http://pubs.pembina.org/reports/Alberta-by-Design_LUF-Report.pdf.
71. Alberta Tourism, Parks and Recreation. 2009. Alberta Land Classifications. Government of Alberta. [Online] <http://www.tpr.alberta.ca/parks/landreferencemanual/landclassdescriptions.aspx>.
72. Fitch, L., B. Adams and K. O'Shaughnessy. 2003. Caring for the Green Zone: Riparian Areas and Grazing Management - Third Edition. Lethbridge, Alberta: Cows and Fish Program. [Online] <http://www.cowsandfish.org/pdfs/greenzone3rd.pdf>.
73. Environmental Policy Branch. 2007. Riparian Land Conservation & Management Project: Phase I Final Report. Government of Alberta. [Online] <http://www.brbc.ab.ca/pdfs/SWATMaterials/Riparian.pdf>.
74. The Environmental Law Institute. 2003. Conservation Thresholds for Land Use Planners. Washington, D.C.
75. Alberta Environment (AENV). 2007. Aquatic and Riparian Condition Assessment of the South Saskatchewan River Basin. [Online] <http://environment.gov.ab.ca/info/posting.asp?assetid=7754&searchtype=asset&txtsearch=riparian>.

76. Cows and Fish Alberta Riparian Habitat Management Society. 2008. Overview of Riparian Health in Alberta: Review of Sites from 1997-2006. Prepared for Alberta Environment.
77. Sawyer, M.D., Mayhood, D.W., et al. 1997. Southern East Slopes cumulative effects assessment. Calgary, Ab. [Online] <http://www.fwresearch.ca/PDFLibrary.html>.
78. Coombs, Matthew. 2008. Indicators for Assessing Environmental Performance of Watersheds in Southern Alberta. Government of Alberta. [Online] <http://environment.gov.ab.ca/info/library/7945.pdf>
79. The Yukon Placer Adaptive Management Working Group. 2007. Fish Habitat Management System for Yukon Placer Mining - Adaptive Management Framework. Whitehorse. [Online] http://www.yukonplaceseecretariat.ca/pdf/adaptive_mgmt_framework_nov08.pdf
80. Rock, L. And Mayer, B. 2007. Isotope hydrology of the Oldman River basin, Southern Alberta, Canada. Hydrological Processes.
81. Mayhood, D.W., Sawyer, M.D. and Haskins, W. 2004. Historical risk analysis of watershed disturbance in the southern east slopes region of Alberta, Canada, 1910-1996. Pages 23-29 in G.J. Scrimgeour, G. Eisler, B. McCulloch, U. Silins and M. Monita. Editors. Forest Land–Fish Conference II – Ecosystem Stewardship through Collaboration. Proc. Forest-Land-Fish Conf. II, April 26-28, 2004, Edmonton, Alberta.
82. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
83. Ibid.
84. Salmo Consulting Inc., Developing and Implementing Thresholds in the Northwest Territories — A Discussion Paper (February 2006) and Steven A. Kennett, From Science-Based Thresholds to Regulatory Limits: Implementation Issues for Cumulative Effects Management (March 2006), prepared for a conference on Thresholds: From Theory to Practice, convened by Environment Canada and the Department of Indian Affairs and Northern Development, Yellowknife, NWT, March 13-14, 2006 (www.ceamf.ca/03_reference/Reference_ThresholdWorkshop.htm). Low - <0.9 km/km²; Medium - 0.9-1.72 km/km²; High - >1.72 km/km².
85. Holroyd, Peggy. 2008. Towards Acceptable Change: A Thresholds Approach to Manage Cumulative Effects of Land Use Change in the Southern Foothills of Alberta. Calgary. [Online] http://www.salts-landtrust.org/sfs/docs/D_080128_holroyd_thesis_thresholds.pdf.
86. Finnigan, Darryl and McClenaghan, Theresa. 2004. Protecting Ontario's Water Now and Forever. A Statement of Expectations for Watershed-Based Source Protection from Ontario Non-Governmental Organizations. Canadian Environmental Law Association.
87. Butler, Rick and Shepherd, Colleen. 2009. Calgary Regional Partnership Open House Presentations. [Online] http://www.calgaryregion.ca/crp/media/52184/the_story_of_the_draft_regional_plan.pdf.
88. R. McManus Consulting Ltd. and Salmo Consulting Inc. 2004. Muskwa-Kechika Management Area, Cumulative Effects Assessment and Management Framework (CEAMF).
89. Kennett, Steven A., and Schneider, Richard R. Making It Real: Implementing Alberta's Land-Use Framework. Published October 2008. The Pembina Institute and the Canadian Parks and Wilderness Society [Online] <http://alberta.pembina.org/pub/1715>.



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