Integrated Riparian Assessment
For
Tembec in the East Kootenay, British Columbia Operating Areas

Volume 7: Detailed Riparian Assessment for the South Elk Region

Final Report - March 2009

Sage Creek

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Introduction

This volume is the seventh of seven comprising the Integrated Riparian Assessment for Tembec's operating areas in the East Kootenay region of south-eastern British Columbia. The Integrated Riparian Assessment was developed in order for Tembec to maintain or restore riparian ecosystems and all their functions, and so meet the requirements of the Forest Stewardship Council standards (Criteria 6.5bis) for forest management in British Columbia[1].

This volume contains detailed riparian assessments and management strategies for each of the six riparian assessment units in the South Elk Riparian Assessment Region. For each riparian assessment unit, the assessments include background information, key values, the results of the current condition riparian budget analysis, and riparian management strategies for the streams, lakes, and wetlands in the unit, by stream or lake class. Maps of most key values and of the budget analysis are available in digital and hard copy form for each unit; see appendix C and D of Volume 1 for locations. The strategies were developed by a team of Professional Hydrologists and Biologists with considerable field experience in the East Kootenay, using a combination of field work, aerial photo analysis, analysis of existing digital data on key values, and the results of previous hydrological, riparian, and ecological studies in the area. For details on the team and the methodology please see Volume 1.

Detailed riparian assessments for the other five riparian regions in Tembec's operating area in the East Kootenay are found in volumes 3 through 7. These regions are:
Volume 2: North Purcell (TFL 14)
Volume 3: Central Purcell
Volume 4: South Purcell
Volume 5: Central Rocky Mountains
Volume 6: North Elk

Volume 1 of the Integrated Riparian Assessment contains the strategic overview, literature review, scientific rationale, and methodology for the detailed riparian assessments and management strategies presented in Volumes 2 through 7. Volume 1 also outlines the rationale behind the division of Tembec's operating area into six riparian regions and 34 riparian assessment units, and the methodology used to calculate the current amount of riparian buffer areas relative to the budgets in the FSC-BC standard.

Readers are strongly encouraged to read Volume 1 in association with the other volumes, and use the information within it in addition to the detailed guidance specific to each riparian management unit. Key sections of Volume 1 are repeated here because they contain the fundamental recommendations for management within all RAUs.

Key Concepts for Field Implementation of these Management Guidelines

The strategies presented in this volume are premised on the concept that riparian ecosystems are best managed through the delineation of Riparian Management Areas (RMAs) consisting of either Riparian Reserve Zones (RRZs) or Riparian Management Zones (RMZs) or both. In general, RRZs are intended to exclude all forestry operations except road crossings, while RMZs limit the extent of forestry operations.

[1] http://www.fsccanada.org/docs/48B4F585905BF469.pdf

A primary objective of the RMA is to preserve channel – riparian interactions. The most important physical consideration for determining the width of the RRZ is the rate and potential extent of lateral migration of the channel over time. RRZs are primarily required over the active floodplain or valley flat along the margins of larger alluvial stream channels (S1 and S2) where channel migration over time is likely to result in the channel shifting, so an RRZ is needed to ensure that key riparian functions are maintained despite natural encroachment by the stream. Larger RRZs may be required to manage for the key values described for each RAU, such as riparian ecosystems, significant spawning areas for Bull Trout, important foraging habitat for grizzly bears, important wildlife features (i.e. trails, dens, licks, raptor nests, perches) or high value biodiversity components (large trees, standing dead trees, large logs, etc).

RMZs are required along the outer edges of RRZs along S1 and S2 streams and along most S3 to S6 streams. Tree retention levels in RMZs vary from less than 30% to at least 80% of the forest stand for the different Riparian Assessment Units, depending on level of riparian function observed during the reconnaissance field investigation, and on the key values present in the unit. Guidance on specific retention levels for each RAU is provided in the detailed riparian strategies for each RAU.

The exact widths of RRZ and RMZ in specific locations are not specified in these strategies; flexibility is given to the prescribing forester to place retention based on the objectives specified in the management strategies and the key values occurring there. However, the total amount of riparian retention (in units of ha/km of stream or lakeside) must also meet or exceed the riparian budgets provided in the FSC-BC Standards, in addition to maintaining riparian function and key values. An analysis of the current amount of riparian retention relative to FSC requirements has been completed for each unit, and is presented in the detailed strategies for each unit. Prescribing foresters should first place retention according to the detailed strategies, then prioritize any additional retention required remaining for areas related to the key values, and in stream classes where the budget is close to being in deficit (i.e. <110%; no RAUs were identified that were currently in deficit with respect to the FSC budget). For limitations of the budget analysis and considerations for its use see Volume 1.

Field Data Collection

Full implementation of the riparian management strategies requires detailed field work along each watercourse within a cutblock, together with the information in this Volume. Tembec currently (2009) completes at least 2 or 3 detailed field assessments of each riparian area. These assessments identify or field-confirm the key values occurring along specific reaches:

1. Riparian assessment. The entire length of a creek within cutblocks is walked by Professional Foresters or Forestry Technicians and information collected on stream morphology, stream characteristics, fish-bearing status and wetland status. This information is used to classify the stream/wetland according to both provincial and FSC standards. Channel width, bottom channel width, depth, and slope data are collected within 100 m of any proposed stream crossings in order to determine correct culvert size, or if a bridge is necessary.
2. Fish assessments. If there is any uncertainty about whether fish are present in a stream or not, a fish assessment (electo-shocking) is conducted by a Professional Biologist. This information feeds into the classification of the stream.
3. Riparian Area tracking. Data on the percent riparian habitat, structural stage, tree and snag species composition and diameter distribution, shrub coverage, CWD amounts, and any significant habitat features (i.e. bird nests, dens, licks, wallows) or biodiversity

features (veteran trees, high value snags, spruce brooms, etc.) are collected. The estimated maximum, minimum, and average width of the pre-harvest RRZ and RMZ is also recorded, and a diagram of the stream and RMA drawn.

Additional assessments by a Professional Hydrologist are conducted if significant concerns about harvesting impacts on water quality or quantity or terrain stability are present or suspected. ECA (Equivalent Clearcut Area) assessments are also completed for all drainages in which ECAs are approaching or over 25 %, and harvesting is proposed. Information from these assessments feeds into specific riparian designs as necessary and as advised by a Professional Hydrologist. Assessments by a Professional Biologist are also conducted if habitat for rare or endangered species is suspected to occur in the riparian area, or if important wildlife or biodiversity features are found and detailed guidance on RMA development is required.

All the above field information is considered in the development of RMA, along with the guidance provided by the detailed strategies and the current condition of the riparian budget relative to FSC requirements.

Riparian Reserve Zones should be considered in the following locations:

- Aquatic-terrestrial interface[2] of alluvial streams (i.e. active floodplains along intermediate (5 m to 20 m wide) to large (>20 m wide) streams and rivers), and lakes and wetlands;
- Riparian habitats of species-at-risk or species of interest, including important foraging areas for grizzly bear (i.e. those vegetated with horsetails, skunk cabbage, and/or sedges);
- Streams or streams segments with high value fisheries habitat and/or licensed consumptive-use water intakes;
- Where hygric, subhygric, and rare riparian ecosystem types exist, as identified in Table 21 in Volume 1;
- Mature and old cottonwood stands along streams, and hardwood stands along lakes and wetlands;
- Mature and old growth coniferous and mixed wood stands along lakes, rivers, streams, and wetlands, especially in watersheds where these type of riparian stands are rare due to previous wildfire¸ timber harvesting, or development;
- Areas with important wildlife features, such as high-use trails along the watercourse, significant wallows and licks, dens, and raptor nests
- Areas supporting high biodiversity, such as those with a large number of high value snags, large diameter coarse woody debris, and veteran trees
- Other key values as specified in the key values section for each riparian unit

Entry into any Riparian Reserve Zone (RRZ) should only be considered in extenuating circumstances such as severe forest health problems or excessive fuel loadings that may lead to unnaturally catastrophic burns. Tree-parasitic insects and diseases operating at endemic levels are beneficial for the ecology or riparian areas and do not require management intervention.

Riparian Management Zones should be considered in the following locations:

[2] Technical terms are defined in the next section – Glossary.

- Adjacent to RRZs to protect the integrity of the reserve by reducing windthrow and the sediment delivery hazard.
- Adjacent to RRZs where topography/terrain features extend riparian function beyond the obvious valley flat/floodplain slope break. For example, in confined draws/valleys where LWD (large woody debris) is being recruited from upper slopes or where wildlife trees or wildlife corridors are situated along the outer margins and/or glaciofluvial terrace tops adjacent to riparian areas.
- Adjacent to water features where the conditions for delineation of RRZs do not occur but where riparian vegetation is providing a source of LWD that is functioning to maintain channel stability (e.g. small (<5m) streams that do not contain high value fish habitat)
- Adjacent to headwater features to protect wildlife habitat especially for amphibians, and to maintain invertebrate, nutrient and food web input to the downstream fish habitat; depending on the size of the headwater stream complex.
- To increase the ecological value of RRZs by increasing the size of habitat patches beyond RRZs and provide habitat connectivity to upland or other riparian areas.

Because forest harvesting is not excluded in Riparian Management Zones, **a minimum seven (7) meter no-machine zone must be defined** along all classified water features where there is no RRZ or RMZ, except as required for designated crossings. The primary objective of the no-machine zone is to reduce the potential for direct disturbance to the forest floor, understory vegetation, and channel banks from logging equipment.

The delineation of RRZs and RMZs should:

- Follow logical topographic breaks, and/or reflect terrain features. Where streams are confined by steep slopes (>50%), RMZs should extend far enough upslope or to a logical topographic break to manage for windthrow hazards (next bullet) and to minimize sediment delivery.
- Manage for windthrow hazard. Since windthrow may compromise the integrity of riparian buffers, consider special treatments (e.g., feathering of reserve edges, selective removal of susceptible trees, etc.) in areas of high windthrow hazard. Establishment of RMZs with variable retention can prevent windthrow in RRZs. Some windthrow is beneficial for riparian ecosystems, especially if it leads to LWD input into water bodies. However, excessive LWD input can be detrimental by slowing water velocity to the extend of increasing deposition of fine sediment or creating LWD jams that cause the stream to abandon a well-developed channel. This is especially important in small streams where flows can easily be impacted.
- Where present, follow natural stand or ecosystem boundaries, e.g. the transition between Sx dominated and Pl dominated stands, or the boundary between riparian and upland ecosystems.

Where riparian vegetation consists of lodgepole pine leading stands that are currently or are likely to be infested with mountain pine beetle (MPB), the infested and dead standing stems count towards the required percentage of retained stems in RMZs.

Retained stems in RMZs should reflect the pre-harvest species composition of the stand, with the exception that lodgepole pine should be prioritized for removal over other species

because of Mountain Pine Beetle hazard. Retained stems should be a mix of ages and be windfirm.

Retained stems in RMZs are to be distributed as uniformly as possible along the length and width of the riparian buffer. Where a uniform distribution of stems is not possible along at least 70% of the steam length in the area proposed for development, then a site assessment should be undertaken to determine an appropriate management strategy.

Monitoring

A monitoring plan to monitor the implementation and effectiveness of these strategies is currently under development. This plan will include long-term strategic monitoring (updating of the GIS riparian buffer budget analysis), as well as a field component. As part of the monitoring program, objectives will be set, appropriate variables selected and data collected, and the data analyzed and reported on. Existing information and complementary data (i.e. from the Forest and Range Evaluation Program) will be used where possible and practicable. Riparian strategies will then be revised, if necessary, using an adaptive management framework.

Glossary of Terms

The following terms are used throughout the Management Strategies tables:

Terrestrial-aquatic interface: The transition zone between the aquatic ecosystem and the terrestrial ecosystem marginal to water bodies (lakes, wetlands, streams) where water table fluctuations associated with changes in water level influence vegetation and soil properties.

Channel morphology: The form or structure of the channel.

Colluvial deposit: Coarse, unsorted deposits from avalanches, rockfall and other gravity induced failures.

Floodplain: Flat part of a valley bottom adjacent to a river that is made of unconsolidated, river-borne sediment and is periodically flooded during large flood events. A river, gradually or abruptly shifts location over the floodplain and in doing so, re-mobilizes previously deposited sediment.

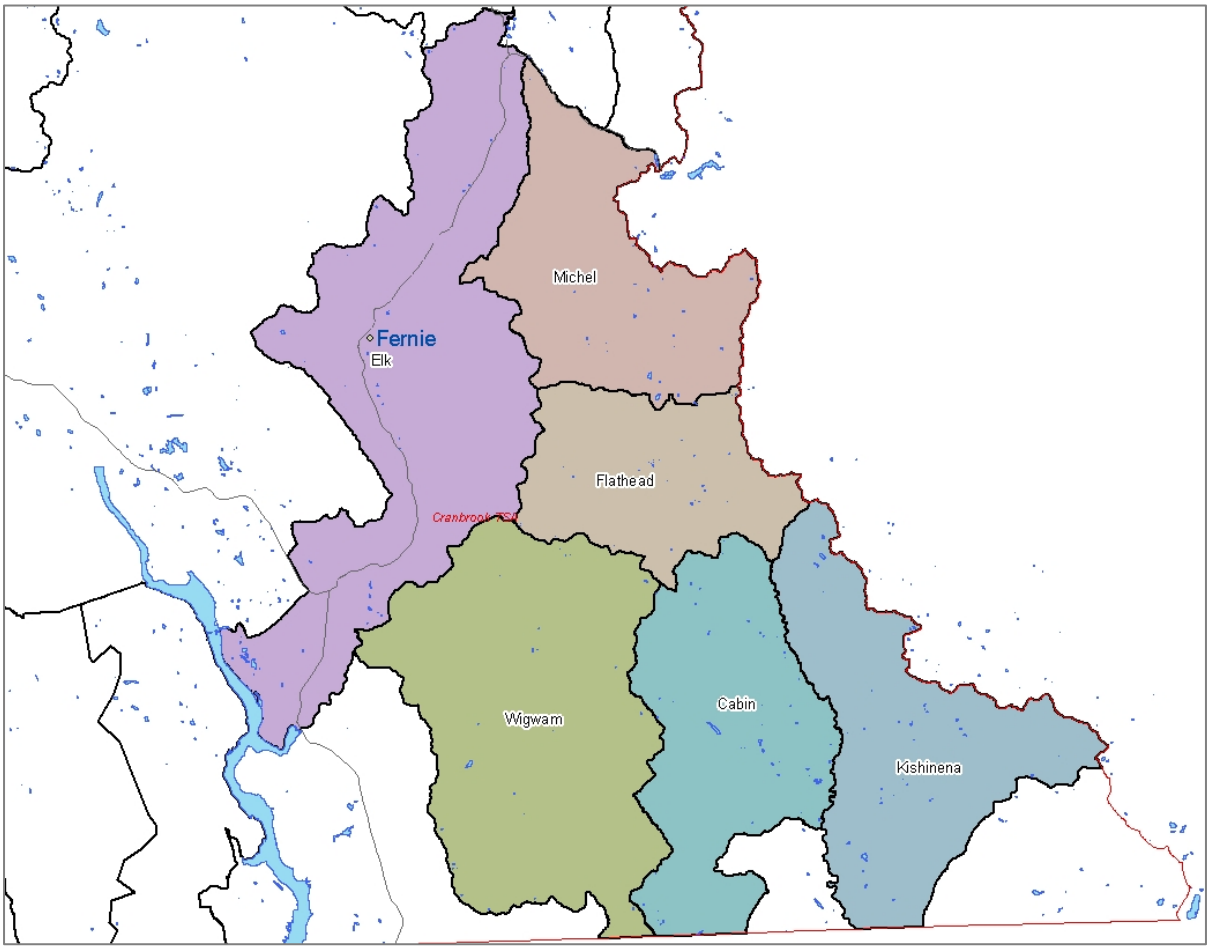
Glacial depression: A depression in the ground formed during glaciation. A kettle is a depression formed when a large block of glacial ice melts out of thick glacial sediment deposit leaving a depression. Some of these depressions are now occupied by water creating lakes or wetlands.

Glaciofluvial scarp:	Thick accumulations of sediment deposited by rivers flowing from melting glaciers filled many of the large river and tributary valleys throughout the Kootenay region. Present-day rivers and streams have eroded down into these sediments creating high raveling scarps of unconsolidated sediments along many of the larger streams and rivers. These are referred to as glaciofluvial scarps.
Lateral bar:	The deposits of sand, gravel and cobbles along the margins of a stream or river.
LWD:	Large woody debris (LWD) in the east Kootenay region generally refers to woody material (eg. branches or stems) greater than 10cm in diameter.
Meander:	The bend in a stream or river.
Reach:	Length of stream channel that displays consistent channel form.
Redd:	A depression dug in the stream substrate where a female fish deposits eggs.
Riparian function:	The physical, biological and chemical interaction of the riparian vegetation with the aquatic environment.
Swale:	A shallow troughlike depression often formed by glacial meltwater during deglaciation that now is dry or only carries minimal amounts of water mainly during rainstorms or snow melt.
Unconfined:	A channel that is unconfined is able to shift to either side of its present course without being constrained by valley sides.
Valley flat:	The relatively flat area of ground in the bottom of a stream valley that is underlain by a combination of alluvium (water borne) and colluvium (gravity deposits). Although the stream can shift over the valley bottom much of the material was not deposited by the stream and is not readily transported by the stream during average flows.

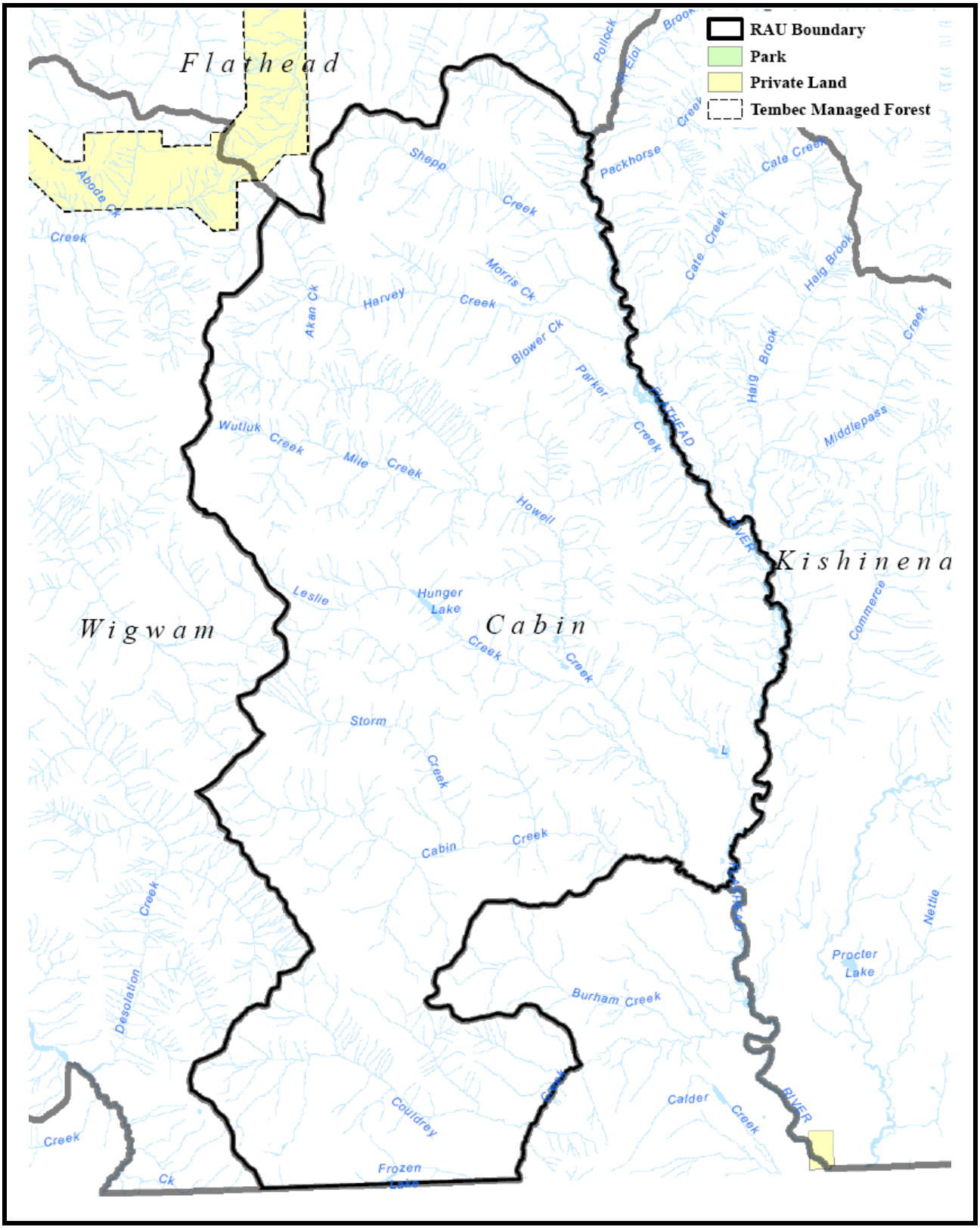
1.0 South Elk Region

The South Elk Riparian Management Region has been subdivided into 6 Riparian Assessment Units. The criteria used to divide the region include similarities in physiography, relief, climate and geologic and hydrologic processes. The Riparian Assessment Units (RAU's) for the South Elk region are:

1. Cabin
2. Elk
3. Flathead
4. Kishinena
5. Michel
6. Wigwam



1.1 Cabin RAU


RAU Boundary
Park
Private Land
Tembec Managed Forest
Flathead
Kishinena
Wigwam
Cabin
Abode Ck
Creek
Shepp
Creek
Pollock
Packhorse
Cate Creek
Cate Creek
Haig Brook
Haig Brook
Creek
Akan Ck
Harvey
Creek
Morris Ck
Blower Ck
Parker
Creek
Middlepass
Wutluk
Creek
Mile
Creek
Howell
Leslie
Hunger
Lake
Creek
Creek
Commerce
Storm
Creek
Cabin
Creek
Desolation
Creek
Nettie
Procter
Lake
Burham Creek
Calder
Creek
Coudrey
Creek
Frozen
Lake
Ck
Creek

1.1.1 Characteristics

Physical Characteristics

Cabin RAU is situated at the southwestern corner of the Flathead watershed and includes major tributaries of Cabin, Howell and Harvey and Shepp Creeks all of which drain towards the Flathead River from alpine regions of the MacDonald Range along the western border. The unit is characterized by rugged, steep ridges underlain by Mississippian limestone and carbonate rocks and broad u-shaped valleys underlain by fine textured mudstones and siltstones of the Triassic to Jurassic Spray Lakes and Fernie Groups. Thick glacial deposits blanket the lowest elevation slopes along the Flathead River.

Elevation ranges from 2500 meters at the headwaters of Harvey and Shepp Creeks to 1300 meters at the Flathead River.

Annual precipitation ranges from 1800 mm at the upper elevations along the western boundary of the RAU to 800mm in the Flathead valley bottom.

BEC Classification

The wide Flathead valley bottom below about 1600 meters is classified as MSdk. The mid-elevation slopes to 2100 meters are in the ESSFdk subzone. The uppermost slopes of the mountains along the western border of the Cabin RAU are classified as Parkland (ESSFdkp) to Alpine Tundra (AT).

Natural Variability in Riparian Function

Riparian vegetation plays a key role in maintaining channel bank and channel bed stability in most of the S2, S3 and S4 streams in Cabin, Howell and Harvey Creeks. Snow avalanches are the main disturbance mechanism in steep headwater tributaries. Flooding is the primary disturbance mechanism in channels with gradients less than about 25%. Field observations along Shepp Creek suggest debris floods occur on average every 10 to 20 years. Fire also plays a role in riparian disturbance and is an important recruitment mechanism for LWD in the wide u-shaped valley of Cabin and Howell Creeks although the return interval of fire in riparian areas is much lower than floods (at least 80-yrs or more).

1.1.2 Riparian Budget

The overall budget for this assessment unit is 2,941 ha of retention, with 41% of this required in specific riparian classes (1,196 ha). S4 streams make up the single biggest component of the retention requirement.

Table 13. Cabin Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	44.1	22.6	30.0	6.8	**50.9**	**35.3**
	L2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L3	6.0	5.8	30.0	1.7	**7.7**	**4.8**
	L4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	6.0	4.6	30.0	1.4	**7.3**	**4.8**
	W2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W3	2.1	1.4	30.0	0.4	**2.5**	**1.7**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	128.4	153.1	65.0	99.5	**227.9**	**102.7**
	S2	160.0	194.0	65.0	126.1	**286.1**	**128.0**
	S3	227.1	142.2	65.0	92.4	**319.5**	**181.7**
	S4	776.1	561.4	65.0	364.9	**1141.0**	**620.9**
	S5a	57.5	59.3	65.0	38.5	**96.1**	**46.0**
	S5b	0.0	296.1	30.0	88.8	**88.8**	**0.0**
	S6a	87.5	87.6	65.0	56.9	**144.4**	**70.0**
	S6b	0.0	1896.0	30.0	568.8	**568.8**	**0.0**
Assessment Unit Retention Budget						**2,941.2**	**1,195.9**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.1.3 Current Condition Assessment

The results of the current condition assessment for the Cabin assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 14. Cabin Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit	Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	4.9	23.7	**18.7**	3,307.9	4,881.6	**1,573.7 Surplus** **148% of Budget**
	L2	-	-	**-**			
	L3	5.3	19.2	**13.9**			
	L4	-	-	**-**			
	NC	-	-	**-**			
Wetland	W1	11.9	31.0	**19.2**			
	W2	-	-	**-**			
	W3	14.3	47.7	**33.4**			
	W4	-	-	**-**			
	W5	-	-	**-**			
Stream River	S1	70.6	301.8	**231.1**			
	S2	241.6	1116.3	**874.7**			
	S3	344.1	879.1	**535.0**			
	S4	715.1	844.4	**129.3**			
	S5a	80.1	326.5	**246.3**			
	S5b	-	53.3	**53.3**			
	S6a	172.2	579.7	**407.5**			
	S6b	-	659.0	**659.0**			

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.1.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Cabin RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. HCVF: This unit contains HCVFs for high value grizzly and carnivore habitat and Tailed Frog streams. See the HCVF mgmt strategies for detailed management guidance in these areas.
2. Wildlife: **Moose** winter range occurs along the Flathead River and the main Flathead valley, as well as Howell, Leslie, Cauldry, and Cabin Creeks. These areas are some of the most important moose winter range in the East Kootenay, second only in moose density to the Upper Elk River. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. Security cover is particularly important for feeding areas close to roads. Avoid creating new roads into riparian zones. **Grizzly**: The riparian zones along the major creeks provide important spring foraging habitat for grizzly. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage). **Tailed Frog**; are known to occur in portions of Leslie, Storm, Burnham, Cabin, and Couldrey Creeks. Follow WHA guidelines in these areas. **Amphibians** - Small, low gradient streams on the Flathead River valley bottom are valuable habitat for amphibians.
3. Fish: **Bull Trout** and **Westslope Cutthroat** are present in all life stages in this unit. Significant Bull Trout redds have been located in Howell and Couldrey Creeks (locations in Tembec's TFM). Avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input. **Rocky Mountain Sculpin** occur in all life stages in the Flathead River, Couldrey, Cabin, and Howell Creeks, and are highly sensitive to sedimentation. Maintain canopy cover on sun-exposed sides along creeks to avoid increase in stream temperature.
4. Terrestrial Habitat: The extensive past logging in this unit, particularly Cabin, Cauldrey, and 29-mile Creeks, has reduced the amount mature and old growth stands at lower elevations, particularly in riparian areas. Retain existing mature/old forest stands in reserves, and recruit large live trees, snags, and a diversity of tree species in previously-logged riparian areas.
5. Hardwoods: There are few hardwood stands present in this unit. Retain existing cottonwood, birch, and aspen trees in riparian areas where they occur.
6. Lakes and wetlands: There are numerous lakes and wetlands in this RAU, especially around and north of Howell Creek. Beaver created wetlands are present along the main channels of the larger tributaries and along the Flathead River. These wetlands provide important habitat for species including grizzly, moose, elk, amphibians, and many species of birds, such as the threatened Olive-sided Flycatcher. Maintain buffers of sufficient width to provide security cover to large mammals (2 s sight distance), maintain large trees and snags for cavity nesting ducks and birds, and perches for aerial insectivores that forage over water.
7. Stream temperature: Stream temperature will be a management concern for streams (S2, S3 and S4) flowing over the low gradient valley bottom of the Flathead River. .

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D in Volume 1.

Unit-specific rational for management strategies

A wide diversity of riparian form and function is apparent in the Cabin RAU. Riparian function along upper elevation headwater channels is linked to channel form and bed load transport rates. Riparian function along small S3 and S4 streams and around wetlands on the Flathead valley bottom provides habitat for many aquatic species including frogs. Riparian vegetation provides shade and a source of woody debris that contributes to channel structure.

Riparian reserves are required along most S1 to S3 streams. High retention management zones are required on S4 and S3 streams on the Flathead valley bottom to protect these small, high value streams from negative impacts to channel structure, water quality or stream temperature.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Flathead River and lower reaches of Cabin Creek are S1 streams. Riparian vegetation consists of cottonwood, spruce and Douglas Fir with alder and willow along channel banks. Larger coniferous and deciduous trees provide protection to channel banks and adjacent forest floor. Riparian vegetation provides protection to the forest floor from erosion during flooding as well as increased, groundwater recharge, and nutrient and organic matter additions to the aquatic food web. .LWD collects at meanders and on channel bars to provide structure to the channel bed. **Management Strategies** A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain to manage for wind throw and wildlife values. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, particularly moose and bears. Retain existing old and mature riparian stands in RRZ as these are rare in this unit.

Stream type	Example	Riparian Management Guidance
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Lower to middle reaches of most of the main tributaries (Cabin, Howell, Harvey, Shepp) are S2. These are relatively high-energy systems. Riparian vegetation includes cottonwood, small diameter spruce with willow and alder along channel banks. Riparian function is generally limited to providing protection to channel banks and adjacent forest floor.. LWD is present along channel margins but does not appear to function in the active channels for any length of time. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a riparian management zone of sufficient width to manage for wind throw and other key values as described above. Ensure the RRZ/RMZ provides adequate security cover for moose and bear feeding and travelling in riparian areas, and adequately protects old and mature riparian stands.

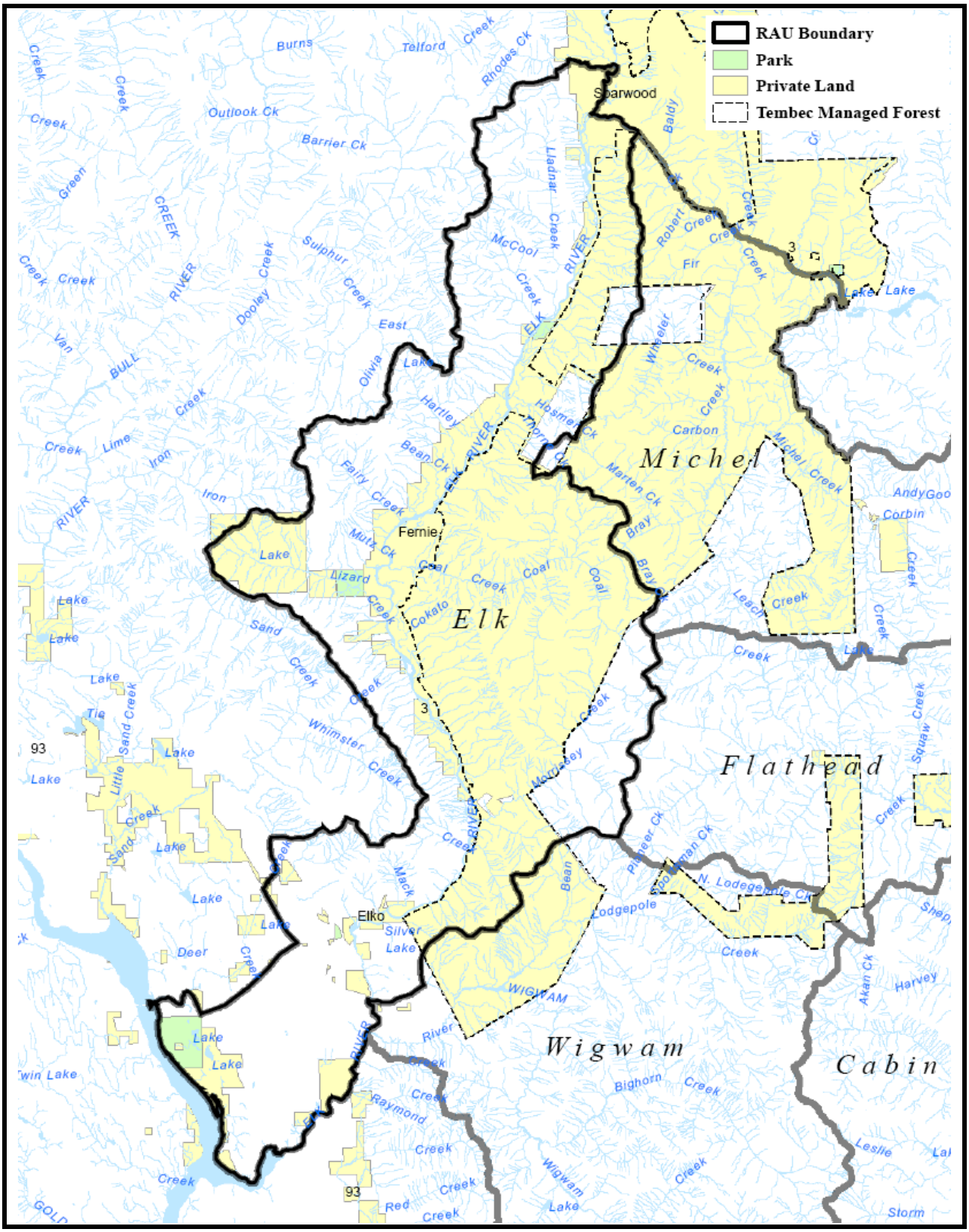
Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams	 	**Riparian Function** S3 streams are generally the lower reaches of the larger tributaries to Cabin, Howell and Harvey as well as the tributaries flowing towards the Flathead river from Trachyte Ridge. Riparian vegetation and function varies depending on location of the stream. On the low gradient Flathead valley bottom deciduous shrubs, grasses and pine provide root strength to channel banks and adjacent forest floor. In higher gradient streams on valley sides riparian vegetation of spruce, pine and deciduous shrubs protect channel banks and provide LWD to the channel. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream. **Management Strategy** A RRZ is required over the valley flat of channels with gradients less than 25%. RMZ are required for streams on the low gradient Flathead valley bottom. Retain at least 80% of the forest stand on the both sides of the channel that is wide enough to provide shade and wind firmness, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. For channels on mid and upper elevation slopes with gradients greater than 25%, retain at least 50% of the forest stand, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Retain existing old and mature riparian stands in RRZ, provide security cover around grizzly and moose feeding areas, and manage for other key values as stated.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Numerous S4 streams drain the lower slopes of Trachyte Ridge and flow in narrow, entrenched channels through the forest on the wide Flathead valley bottom. Riparian vegetation is primarily deciduous shrubs, moss, and herbaceous plants. Small woody debris from branches and roots of the surrounding forest provides some structure to these low gradient channels and regulates sediment transfer during heavy rain events. Shade from the surrounding forest likely moderates temperatures in these small streams. **Management Strategy** Along lower gradient stream segments (<5%) on lower valley slopes and the Flathead valley bottom designate a RMZ that is of sufficient width to provide shade to the channels and protect channel banks and adjacent forest floor from mechanical disturbance. Retain at least 80% of the forested stand on both sides of the channel. For steeper gradient S4 streams establish a wind firm RMZ and retain at least 50% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous understory as possible on either side of the stream channels.
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** The upper reaches of Harvey, Howell and Cabin Creeks are likely S5. Riparian vegetation on the valley flat consists of deciduous shrubs and small diameter spruce and balsam fir. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream. LWD from recruited conifers forms jams that provide bed load storage sites. Functioning LWD plays a key role in channel stability in headwater streams with gradients less than approximately 15%. **Management Strategy** Designate a riparian reserve over the valley flat. A RMZ may be required beyond on the lower slopes adjacent to the reserve to manage for wildlife values, particularly where moose and bear feeding areas as present (sedges, horsetail, willows, dogwood).

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams are generally ephemeral avalanche and debris flow gullies. Riparian function in S6 streams depends on stream gradient and location on the slope. Lower slope streams that have gradients less than approximately 25% display a variable amount of riparian function. On some streams roots and SWD jams comprised of willow influence channel structure and provide short term storage for bedload. In steep gradient channels on upper slopes, riparian vegetation is generally limited to deciduous shrubs that provide protection to channel banks, sediment control and organic matter input.. **Management Strategy** The management strategy will depend on location of the stream. RRZ is required along perennial streams in gullies with gradients less than 25%. On the Flathead valley bottom a RMZ is required in which at least 60% of the forest stand on the both sides of the channel is retained, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. For channels on upper slopes with gradients greater than 25%, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels.

Stream type	Example	Riparian Management Guidance
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Several small lakes are present on the valley flat of the Flathead River just north of Cabin Creek. Numerous lakes are present along the margins of the larger valleys of Cabin and Howell Creeks. Lowland lakes are surrounded by wide marshy areas consisting of grasses and shrubs. Spruce and pine surround the marshes where soils are not saturated. Confined highland lakes are forested to the lakeshore. In both highland and lowland lakes riparian function is primarily biological. Lowland riparian areas are generally much wider than upland areas due to the near-surface water table. Beaver activities are intrinsic to lowland lakes. **Management Strategies** In both cases RRZ's are required around lake margins that are of sufficient width to protect wildlife values and ensure wind firmness. Ensure the RRZ/ RMZ is wide enough to manage for key values as described above, where these exist, and maintain snags for cavity nesting ducks, perches for aerial insectivores, and security cover for large mammals using these riparian areas, especially moose and bears.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are present adjacent to the margins of the active floodplain of the Flathead River and along the margins of many of the main tributaries in the lower gradient reaches. Wetlands are commonly associated with beaver activity. Riparian vegetation supplies organic matter for the terrestrial and aquatic habitat. **Management Strategy** Designate a RRZ over the floodplain of Flathead River and major tributaries (Cabin, Howell, Harvey and Shepp) that is of sufficient width to protect marginal wetland areas from mechanical disturbance and wind throw and maintain the key values present. In confined valleys of the major tributaries RMZ's may be required to manage for wildlife values that extend beyond the valley flat (eg snags for cavity nesting ducks and birds, security cover for large mammals, especially bears, ungulate trails, etc).

1.2 Elk RAU


RAU Boundary
Park
Private Land
Tembec Managed Forest
Sparwood
Fernie
Elkford
Michel
Elk
Flathead
Wigwam
Cabin
Elko
Lake
Creek
RIVER
93
3

1.2.1 Characteristics

Physical Characteristics

Most of the streams draining the Elk RAU are small steep gradient streams flowing from Morrissey, Hosmer and Sparwood Ridges on the east and the towering peaks of the Lizard Range, Mount Fernie, The Three Sisters, Mount Hosmer and Mount Kuleski on the west. Coal Creek is the largest stream in the Elk RAU with an average bankfull width of 12 meters along the lowest reach.

The Elk River follows the strike of a major west side up thrust fault that places Devonian to Triassic age limestone and carbonate rocks on the west against Jurassic to Cretaceous siltstones, mudstones and coal bearing shale on the east (referred to as the Fernie Basin).

The Three Sisters Mountain, at over 2700 meters, is the highest point in the RAU. The Elk River is at 1100 meters at the southern point of the RAU.

Annual precipitation ranges from 2200mm in the alpine regions of western mountains to 800mm in the Elk River valley.

BEC Classification

Valley bottom of Elk River and main tributaries are classified as ICHmk1 up to 1600 meters. ESSFwm mid and upper elevation slopes between 1600m and 2100m. West of the Elk River slopes above 2100m are identified as parkland and alpine tundra. The lower portions of the unit west of Elko are IDFdm2 and PPdh.

Natural Variability in Riparian Function

Flooding and slush avalanches are the most frequent disturbance mechanism in the steep mountain streams that characterize this RAU. Deciduous shrubs of willow and alder are the main riparian vegetation along most of these steep channels. Large diameter cottonwood and mixed age stands of conifers occur in the riparian areas of Coal and Lladner Creeks, which are the largest and lowest gradient streams in this RAU. Fire associated with historical settlement and mining has had a substantial influence on riparian function along small streams draining Morrissey, Hosmer and Sparwood Ridges as well as lower slopes of the Elk River valley.

1.2.2 Riparian Budget

The overall budget for this assessment unit is 1,491 ha of retention, with 48% of this required in specific riparian classes (715 ha). S4 streams make up the single biggest component of the retention requirement.

Table 15. Elk Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	7.0	7.0	30.0	2.1	**9.1**	**5.6**
	L2	5.8	6.5	30.0	2.0	**7.8**	**4.7**
	L3	0.6	0.7	30.0	0.2	**0.8**	**0.5**
	L4	0.5	0.3	30.0	0.1	**0.6**	**0.4**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W2	6.6	5.4	30.0	1.6	**8.3**	**5.3**
	W3	6.8	4.7	30.0	1.4	**8.2**	**5.5**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	22.1	23.9	65.0	15.5	**37.6**	**17.7**
	S2	58.7	68.5	65.0	44.5	**103.2**	**47.0**
	S3	67.1	41.7	65.0	27.1	**94.2**	**53.7**
	S4	596.3	400.9	65.0	260.6	**856.8**	**477.0**
	S5a	6.3	6.8	65.0	4.4	**10.7**	**5.0**
	S5b	0.0	9.4	30.0	2.8	**2.8**	**0.0**
	S6a	116.3	124.3	65.0	80.8	**197.2**	**93.1**
	S6b	0.0	512.0	30.0	153.6	**153.6**	**0.0**
Assessment Unit Retention Budget						**1,490.9**	**715.3**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.2.3 Current Condition Assessment

The results of the current condition assessment for the Elk assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 16. Elk Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit	Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	5.6	27.3	**21.7**	1,490.9	3,142.2	**1,651.3 Surplus** **211% of Budget**
	L2	4.7	25.1	**20.4**			
	L3	0.5	2.8	**2.3**			
	L4	0.4	1.3	**0.9**			
	NC	-	-	**-**			
Wetland	W1	-	-	**-**			
	W2	5.3	20.9	**15.6**			
	W3	5.5	13.5	**8.0**			
	W4	-	-	**-**			
	W5	-	-	**-**			
Stream River	S1	17.7	82.2	**64.6**			
	S2	47.0	219.9	**173.0**			
	S3	53.7	210.0	**156.3**			
	S4	477.0	922.9	**445.9**			
	S5a	5.0	29.5	**24.5**			
	S5b	-	19.4	**19.4**			
	S6a	93.1	516.6	**423.5**			
	S6b	-	1050.7	**1050.7**			

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.2.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Elk RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. HCVF: This unit contains numerous HCVFs for water quality in licensed consumptive-use watersheds on both sides of the Elk River Valley, as well as HCVFs for terrain stability, snow avalanches, and flooding. There is also an HCVF for cutthroat spawning on Morrisey Creek, an HCVF along the lower Elk river for spawning habitat for Bull Trout and Westslope cutthroat, and HCVFs for grizzly movement across Highway 3. See the HCVF mgmt strategies for detailed management guidance in these areas.
2. Wildlife: **Deer/Elk/Sheep** winter in the southern-most low elevation sections of this unit in the trench. Riparian areas are especially important to deer and elk in calving season. **Moose:** winter range along the main riparian area of the Elk River, but are limited due to deep snow. Maintain adequate snow interception cover through closed canopy stands, and retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. **Grizzly**: Riparian areas provide important feeding areas in spring. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage). Retain security cover in riparian areas in the movement corridors, as well as in likely areas for travel, especially close to the highway.
3. Fish: Bull Trout and Westslope Cutthroat are present in all life stages in this unit, and spawn and overwinter in the lower Elk River. Spawning is also known from Hartley, Morrisey and Lizard Creeks, with the later proving to be quite significant. Minor spawning events have also been observed in Hosmer and Mine Creeks. Avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input.
4. Terrestrial Habitat: The extensive past logging and wildfire in this drainage likely reduced the amount of non-lodgepole pine tree species and old growth stands at lower elevations. Retain existing mature/old forest stands in reserves, especially those with a mixed tree-species composition, and recruit large live trees and snags in previously-logged riparian areas.
5. Hardwoods: There are extensive cottonwood stands along the Elk River, some including the oldest known Cottonwood trees in existence (400 yr plus). All cottonwood stands and mixed cottonwood or aspen/conifer stands along the main Elk River should be reserved. Elsewhere, retain existing cottonwood and aspen trees in riparian areas where they occur.
6. Lakes and wetlands: Numerous lakes and wetlands occur in the western portion of this unit in the trench, providing habitat for species such as Painted Turtle and sandpipers. Protecting the riparian ecosystems in these areas from cattle and motorized recreation is very important. A chain of lakes and wetlands occurs in Silver Springs, in a deep, rocky gully. Lewis's Woodpecker is known to occur here – maintain large snags and live trees; ecosystem restoration may be warranted in some areas.
7. Stream temperature: Alpine-sourced tributaries and steep confined valleys make most of this management region relatively insensitive to forestry related impacts on stream temperature. The exception are the areas in the trench, which are highly sensitive to increases in stream temperature, and for which shade is an important function of riparian vegetation.

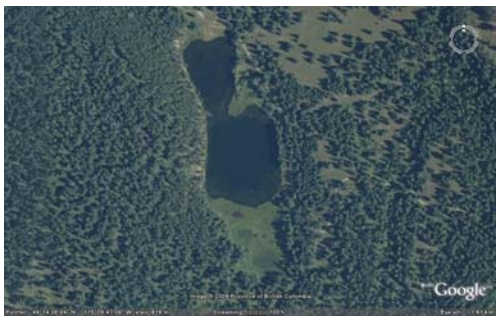
Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** A small portion of the Elk RAU includes a forest adjacent to the Elk River south of Morrissey. Large cottonwood and smaller deciduous trees characterize the riparian vegetation of the Elk River floodplain. The dense root systems of these large cottonwood provide protection to channel banks. Riparian vegetation provides protection to the forest floor from erosion during flooding as well as increased floodwater storage, groundwater recharge, nutrients, organic matter, and input in to the food web. **Management Strategies** A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain to manage for wind throw, sediment delivery and wildlife values. Ensure all cottonwoods are retained in RRZ, along with other riparian ecosystems with mature or old forest.
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Coal and Morrissey Creek and lower reaches of several streams draining the west side of Elk River including Lladner Creek are S2. Riparian function depends on channel gradient, width and watershed aspect. Morrissey Creek and Coal Creek are active channels that experience relatively frequent flooding. Riparian vegetation includes cottonwood, small diameter spruce with willow and alder along channel banks. Riparian function is generally limited to providing protection to channel banks and limiting siltation of spawning habitat during heavy rain events. LWD is present along channel margins but does not appear to function in the channels for any length of time. Historical logging activities and fire have eliminated large diameter Douglas fir and spruce from most of the S2 riparian areas. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a riparian management zone of sufficient width to manage for wind throw, sediment delivery and other key values as described above. Retain existing old and mature conifer stands in RRZ, as well as areas with high value snags and large trees.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S3 streams are generally the lower reaches smaller tributaries to the Elk River and larger tributaries to Coal, Morrissey and Lladner Creeks. Riparian vegetation consists of deciduous shrubs, cottonwood and immature spruce and Douglas fir. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. Riparian vegetation provides root strength to channel banks and adjacent forest floor and a supply of LWD that provides structure to the stream channels where gradients are less than approximately 15%. Vegetated banks also moderate sedimentation transfer to downstream reaches during heavy rain events. **Management Strategy** RRZ will be required over the valley flat of S3 channels with gradients < 15%. Where S3 streams are confined by steep valley sides (>60%) designate a RMZ in which at least 50% of the stand is retained on the both sides of the channel that is sufficient in width to protect the valley flat from wind throw and sediment delivery, and maintain key values. In channels with gradients >15%, designate a RMZ on both sides of the channel and retain at least 50% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. Avoid disturbance to the extent practicable to shrubs within 7 m of the stream banks.

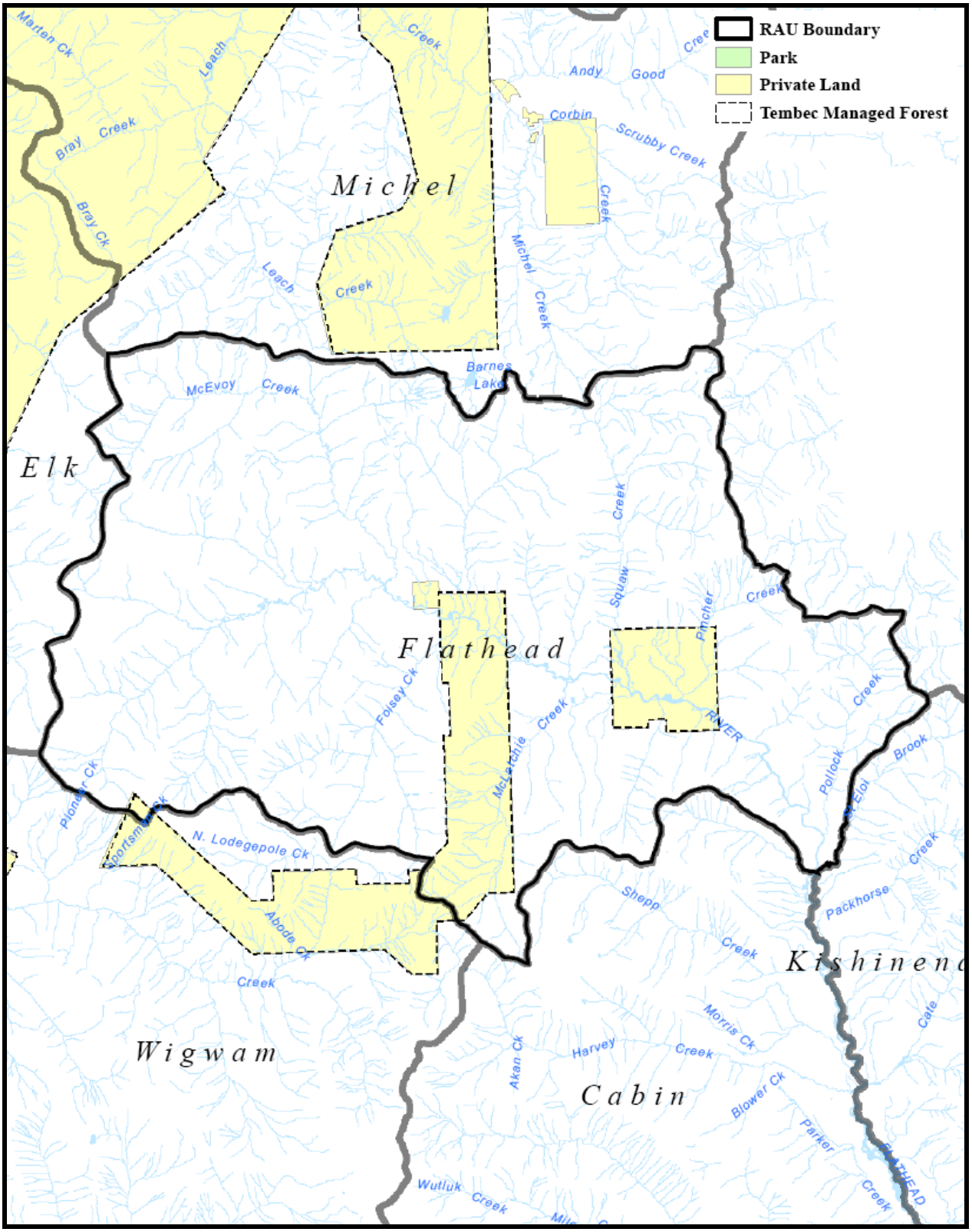
Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** The lower reaches of tributaries to McCool, Lladner and other fish-bearing streams on both sides of the Elk River are S4. Most S4 streams have steep, alpine headwaters and carry frequent debris floods. Riparian vegetation is primarily deciduous shrubs, cottonwood and small diameter spruce, cedar and Douglas fir. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. LWD from riparian stand provides stability to channels with gradients less than about 15%. **Management Strategy** Along lower gradient stream segments (<15%) establish a RMZ over the valley flat or on both sides of the channel that is of sufficient width to ensure continued supply of LWD and protect channel banks and adjacent forest floor from mechanical disturbance. Retain at least 60% of the forested stand on both sides of the RMZ. For streams with gradients greater than 15% designate a RMZ and retain at least 30% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Avoid disturbance to the extent practicable to shrubs within 7 m of the stream banks. Manage for key values.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** The larger tributaries along Sparwood Ridge may be S5 (although FISS indicates fish present) as well as larger steeper tributaries to Morrissey and Coal Creeks. In general these streams are very active debris flow and snow avalanche channels. Riparian vegetation is primarily deciduous trees and shrubs. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream. Debris levees are common along channel banks. Roots of large cottonwood and deciduous shrubs provides protection to channel banks during large flood events and reduce sediment input during heavy rain events. Most S5 streams will be confined in steep-sided gullies. **Management Strategy** Designate a RMZ over the valley flat and retain at least 50% of the stand. The RMZ may extend beyond on the lower slopes adjacent to the reserve to manage for sediment delivery on licensed water supplies or for wildlife values.

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide	 	**Riparian Function** S6 streams occur along both sides of the Elk Valley between Hosmer and Sparwood. Most S6 streams have steep, snow avalanche gullies for headwaters. Lower slope streams that have gradients less than approximately 25% display a variable amount of riparian function. On some lower slope streams SWD jams comprised of roots and branches influence channel structure and provide short term storage for bedload. In steep gradient channels (>25%) on upper slopes, riparian vegetation is generally limited to deciduous shrubs that provide protection to channel banks as well as providing organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream **Management Strategy** The management strategy will depend on location of the stream. On mid-elevation slopes, a RRZ will be required along channels that have a defined valley flat where gradients are less than 25%. On lower elevation slopes where streams are not confined in a gully designate a RMZ on both sides and retain at least 50% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. For steeper gradient streams (>25%) where processes of snow avalanching are evident retain all LWD that is spanning or suspended above the channels and retain as much of the under story as possible.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function**: Several small lakes are present in the operable portion of the Elk RAU that extends into the RMT south of Elko. These are groundwater sourced lakes that fluctuate in water level in response to groundwater levels. **Management Strategy** These lakes were not field assessed. Management strategies will need to be developed on a site-by-site basis. RRZ must be wide enough to provide shade to the lake, as well as maintain key wildlife values such as high value snags and large trees.

Stream type	Example	Riparian Management Guidance
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands occur along the margins of the Elk River on the wide Elk River floodplain and in small glacial depressions in the RMT. On the Elk River floodplain riparian vegetation is dominated by deciduous species including cottonwood and aspen. Riparian vegetation provides protection to channel banks and the vegetated portion of the floodplain during overbank floods. Riparian vegetation recruited during floods collects along channel banks, lateral and mid-channel bars and provides aquatic habitat. The root systems of riparian vegetation improves soil moisture recharge during flood events. **Management Strategy** Wetlands on the floodplain of the Elk River will be included within the designated RRZ's that spans the Elk River valley bottom (See S1 strategy). Strategies for isolated wetlands that occur in glacial depression in the RMT will need to be developed on a site-by site basis. Strategies must include retaining riparian vegetation to provide shade to the wetland, maintaining high value snags for cavity nesting birds and ducks, perches for aerial insectivores, CWD for amphibians, and security cover for ungulates resting near the wetland.

1.3 Flathead RAU



1.3.1 Characteristics

Physical Characteristics

The Flathead RAU includes the northernmost headwaters of the Flathead River. Upper Flathead River, McEvoy, Folsey McLatchie and Squaw Creeks are the main drainages in this RAU. Much of the Flathead RAU is underlain by fine textured, erodible mudstones, siltstone and shales of the Fernie, Blairmore and Alberta Groups. A series of north and northwest trending west-side-down normal faults in the eastern portion of the RAU juxtaposes these younger, erodible sediments of the Fernie Basin against a folded and thrust faulted sequence of Devonian to Triassic limestones, carbonate rocks and coarse clastic rocks along the eastern border of the RAU. The rugged limestone mountains along the eastern edge of the RAU contrast with the more subdued ridges of through the central and western portion of the RAU.

Elevation ranges from over 2400 meters at St.Elol Mountain to 1500 meters at the Flathead River.

Annual precipitation ranges from 1000mm in the valley bottoms to 1400mm along upper elevation ridges.

BEC Classification

Most of the operable portion of the Flathead RAU is classified as ESSFdk. The upper slopes above 2100 meters in the eastern portion of the RAU are classified as parkland (ESSFdkp) and alpine tundra (AT).

Natural Variability in Riparian Function

The underlying geology influences riparian function in the Flathead RAU. Riparian vegetation contributes to maintaining channel bank and channel bed stability in many of the S2 and S3 streams in the central and western portion of the Flathead RAU. Wide colluvial cones indicate that debris floods are common on the steep S3 and S4 streams draining the highest limestone ridges in the northeastern portion of the RAU. Snow avalanches are the main disturbance mechanism in steep headwater tributaries throughout the unit. Flooding is the primary disturbance mechanism in lower gradient channels including Squaw, McLatchie, Folsey and McEvoy Creeks. Fire does not appear to play a significant role in riparian disturbance in the Flathead RAU.

1.3.2 Riparian Budget

The overall budget for this assessment unit is 2,101 ha of retention, with 49% of this required in specific riparian classes (1,036 ha). S4 streams make up the single biggest component of the retention requirement.

Table 17. Flathead Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L3	2.3	2.2	30.0	0.7	**2.9**	**1.8**
	L4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	3.8	1.9	30.0	0.6	**4.4**	**3.0**
	W2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W3	4.5	3.4	30.0	1.0	**5.5**	**3.6**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	84.5	111.2	65.0	72.2	**156.8**	**67.6**
	S2	246.5	342.8	65.0	222.8	**469.4**	**197.2**
	S3	281.2	189.3	65.0	123.0	**404.3**	**225.0**
	S4	477.9	326.8	65.0	212.4	**690.3**	**382.3**
	S5a	113.3	123.8	65.0	80.5	**193.8**	**90.6**
	S5b	0.0	39.4	30.0	11.8	**11.8**	**0.0**
	S6a	80.7	81.9	65.0	53.2	**134.0**	**64.6**
	S6b	0.0	93.8	30.0	28.1	**28.1**	**0.0**
Assessment Unit Retention Budget						**2,101.3**	**1,035.8**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.3.3 Current Condition Assessment

The results of the current condition assessment for the Flathead assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 18. Flathead Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit	Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	-	-	**-**	2,101.3	3,953.3	**1,852.0 Surplus** **188% of Budget**
	L2	-	-	**-**			
	L3	1.8	8.6	**6.8**			
	L4	-	-	**-**			
	NC	-	-	**-**			
Wetland	W1	3.0	6.1	**3.1**			
	W2	-	-	**-**			
	W3	3.6	8.3	**4.7**			
	W4	-	-	**-**			
	W5	-	-	**-**			
Stream River	S1	67.6	335.3	**267.7**			
	S2	197.2	945.5	**748.3**			
	S3	225.0	829.3	**604.3**			
	S4	382.3	797.0	**414.7**			
	S5a	90.6	440.9	**350.3**			
	S5b	0.0	82.6	**82.6**			
	S6a	64.6	318.1	**253.5**			
	S6b	-	181.5	**181.5**			

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.3.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Flathead RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. HCVF: This unit contains an HCVFs for wetlands near Barnes Ranch on the upper Flathead. See the HCVF mgmt strategies for detailed management guidance in this area.
2. Wildlife: **Moose:** The upper Flathead is important spring/summer and early winter habitat for moose. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. **Grizzly**: Riparian areas along the Flathead River provide important feeding areas in spring. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage). **Gillette's Checkerspot** – may occur in moist openings and in wetlands along the Flathead River. Maintain large spruce trees adjacent to wetland areas for roosting.
3. Fish: Bull Trout redds occur along the upper Flathead downstream of Foisey Creek, and this is considered to be a very important spawning area for this species. Avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input. **Rocky Mountain Sculpin** also occur in Foisey Creek. Maintain canopy cover on sun-exposed sides along creeks to avoid increases in stream temperature.
4. Terrestrial Habitat: This unit is relatively undisturbed by industrial development (as of 2008), but may see considerable development through mining and logging in the near future. Retain existing mature/old forest riparian stands in reserves, and maintain adequate security cover for large animals using these areas. In particular, maintain old growth spruce stands along the Flathead River and main tributaries.
5. Hardwoods: There are few hardwood stands in this unit. Retain existing cottonwood and aspen trees in riparian areas where they occur.
6. Lakes and wetlands: Numerous wetlands occur along the margins of the Upper Flathead River, created by beaver. Maintain adequate riparian buffers to provide a food source for beavers (deciduous trees and shrubs) and snags for cavity nesting ducks and birds.
7. Stream temperature: Alpine-sourced tributaries and steep confined valleys make this management region relatively insensitive to forestry related impacts on stream temperature.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Unit-specific rational for management strategies

The underlying geology influences stream gradient, riparian vegetation and channel processes in the Flathead RAU. Streams underlain by fine textured sediment in the central and northern portions of the RAU display a greater degree of riparian function than streams draining the steep limestone slopes in the southeastern part of the unit.

Riparian reserves will be required along all lower gradient (<25%) S1 to S3 streams in the Flathead RAU. The retention level in riparian management zones will depend on location and gradient. Lower gradient streams will require higher levels of retention than steep streams where processes of snow avalanching and debris flows are common.

It is likely that riparian vegetation is not a significant factor in stream temperature in the Flathead RAU due to the presence of mountains along the southern margin that provide shade to the main valley.

Stream type	**Example**	**Riparian Management Guidance**
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Flathead River is designated as S1. Riparian vegetation consists of cottonwood, spruce and Douglas Fir with alder and willow along channel banks. Larger coniferous and deciduous trees provide protection to channel banks and adjacent forest floor. Riparian vegetation provides protection to the forest floor from erosion during flooding as well as increased floodwater storage, groundwater recharge, nutrients, organic matter, and addition to the food web. LWD collects at meanders and on channel bars to provide structure to the channel bed. **Management Strategies** A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain to manage for wind throw and high wildlife values (grizzly and moose habitat). Provide security cover (2 times sight distance) around moose and bear foraging and travelling areas. Old and mature riparian stands should be retained in RRZ.
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Lower to middle reaches of larger tributaries to the upper Flathead are S2 (eg. Squaw Cr.). These are high-energy systems that are moving large amounts of bedload. Riparian vegetation includes small to medium diameter spruce and fir along upper banks. Willow and alder occur on lateral cobble bars and along channel banks. Roots of larger conifers provide stability to channel banks and regulate siltation of spawning habitat during heavy rain events. LWD accumulates along channel margins and on lateral cobble bars. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a riparian management zone of sufficient width to manage for wind throw and other key values as described above. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals. Old and mature riparian stands should be retained in RRZ.

Stream type	**Example**	**Riparian Management Guidance**
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S3 streams are generally the upper reaches of the larger tributaries (eg McLatchie and Squaw). Riparian vegetation and function varies depending on location of the stream. Streams draining from high elevation limestone ridges where processes of debris flows and snow avalanches are frequent have riparian vegetation of deciduous shrubs. Lower gradient streams underlain by Fernie Basin rocks have riparian areas of spruce, balsam and deciduous shrubs that protect channel banks and provide LWD to the channel. **Management Strategy** RRZ will be required over the valley flat of channels with gradients less than 25%. RMZ are required for streams flowing on the Flathead valley flat, or RRZ if key wildlife values are present. Retain at least 60% of the forest stand on both sides of the channel that is wide enough to provide shade and wind firmness, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous understory as possible. For channels with gradients greater than 25%, establish a RMZ and retain at least 30% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Ensure high value snags and large trees are maintained in RRZ.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S4 streams are the lower reaches of headwater tributaries. Snow avalanches and debris flows occur frequently in these steep gradient channels. Riparian vegetation is primarily deciduous shrubs, moss, herbaceous plants. Small woody debris from branches and roots of the surrounding forest provides some structure to these channels. Deciduous species provide organic input (leaf litter) and nutrients, an important energy source for the food web in the immediate area and downstream. **Management Strategy** Along lower gradient stream segments (<15%) on lower valley slopes and the Flathead valley bottom designate a RMZ that is of sufficient width to protect channel banks and adjacent forest floor from mechanical disturbance. Retain at least 60% of the forested stand and avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Retained stems should be wind firm. Along steeper channels establish a RMZ that is wide enough to protect the channel from mechanical disturbance. Retain at least 30% of the forest stand and all undersized stems. Avoid disturbing deciduous species.
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** Most of the main tributaries to the upper Flathead are fish-bearing. It is possible that the steep streams draining the limestone ridges in the northeast portion of the RAU are S5. Most of these streams appear to be ephemeral. Riparian vegetation of deciduous trees and shrubs occur along the margins of debris flow channels. Riparian vegetation plays a limited role in channel structure in these steep headwater systems. Stands of cottonwood and aspen that occur on lower valley slopes may have biological values. **Management Strategy** Develop on a site-by-site basis. Maintain shrub and deciduous trees within 7 m of the channel.

Stream type	**Example**	**Riparian Management Guidance**
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide	Picture not available	**Riparian Function** S6 streams are generally ephemeral avalanche and debris flow gullies. Riparian function in S6 streams depends on stream gradient and location on the slope. Lower slope streams that have gradients less than approximately 25% display a variable amount of riparian function. On some streams roots and SWD jams comprised of willow influence channel structure and provide short term storage for bedload. In steep gradient channels on upper slopes, riparian vegetation is generally limited to deciduous shrubs that provide protection to channel banks, control sediment input, and supply shade, and organic and nutrient inputs to downstream reaches. **Management Strategy** The management strategy will depend on location of the stream. RRZ is required along perennial streams in gullies with gradients less than 25%. On the Flathead valley bottom a RMZ is required in which at least 60% of the forest stand on the both sides of the channel is retained, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. For channels on upper slopes with gradients greater than 25%, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels.s.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Two small lakes are present on the wide valley bottom of the Flathead River. The lake south of the Flathead and east of McLatchie Creek is surrounded by a wide marsh of grasses and deciduous shrubs. Spruce and pine surround the marshes where soils are not saturated. The lake by Bob Cutts Cabin is rimmed by Douglas fir and spruce but trees adjacent to the lakeshore around the lake have been cut. Trees surrounding Bob Cutts lake provide shade and LWD to the lake shore. **Management Strategies** In both cases RRZ's are required around lake margins that are of sufficient width to protect wildlife values and ensure wind firmness.

Stream type	**Example**	**Riparian Management Guidance**
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are present adjacent to the margins of the active floodplain of the upper Flathead River. Wetlands observed during the field review were associated with beaver activity. **Management Strategy** Designate a RRZ over the floodplain of Flathead River that is of sufficient width to protect marginal wetland areas from mechanical disturbance and wind throw, and maintain the high wildlife values associated with these wetlands (moose, grizzly, beaver). In confined valleys of the major tributaries RMZ's are required to manage for wildlife values that extend beyond the valley flat (eg beaver, grizzly, moose, and other wildlife habitat). Ensure high value snags are protecting for cavity nesting birds, and perches are provided for aerial insectivores (i.e., olive-sided flycatcher).

1.4 Kishinena RAU

1.4.1 Characteristics

Physical Characteristics

The Kishinena RAU is situated in the southeastern portion of the Flathead River watershed. It is bordered to the west by the Flathead River and to the east by the Clark Range of the Rocky Mountain Border Ranges. Numerous streams drain from the high alpine regions of the Clark Range. The largest of these are Middlepass, Commerce and Sage Creeks.

Most of the RAU is underlain by a thick sequence of east dipping meta-sedimentary rocks of the Middle Proterozoic Purcell Supergroup. Tertiary mudstones and fine textured sediments of the Kinshenina Group are in fault contact with Proterozoic Purcell Group meta-sediments in the northern portion of the RAU. Thick deposits of fine textured glaciolacustrine sediment blankets the Flathead River valley. Tributaries flowing westward towards the Flathead have cut down through the fine sediment and are locally confined on one or both sides by terrace scarps.

Elevation ranges from just below 1400 meters in the Flathead River valley to over 2500 meters on Commerce Peak

Annual precipitation ranges from 800mm in the main valley bottoms to 1800mm in the alpine areas of the Clark Range.

BEC Classification

The wide Flathead valley bottom below about 1600 meters is classified as MSdk. The mid-elevation slopes to 2100 meters are in the ESSFdk subzone. The uppermost slopes of the mountains along the eastern border of the Kishinena RAU are classified as ESSFdkp.

Natural Variability in Riparian Function

While flooding and debris flows are the main disturbance mechanism along middle and upper reaches of the main tributaries and high gradient streams draining from the upper elevations of the Clark Range, the lower reaches of streams in the southern half of the RAU flow on wide floodplains across the low gradient valley bottom of the Flathead River. The low channel gradient effectively reduces the stream power of these channels and limits the ability of floodwaters to erode channel banks.

Fire is a more frequent riparian disturbance mechanism in the headwater channels on the steep slopes of the Clark Range than on the low gradient wide floodplains of the main tributary channels.

1.4.2 Riparian Budget

The overall budget for this assessment unit is 3,041 ha of retention, with 49% of this required in specific riparian classes (1,478 ha). S4 streams make up the single biggest component of the retention requirement.

Table 19. Kishinena Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	3.1	0.5	30.0	0.2	**3.2**	**2.5**
	L2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L3	3.7	3.2	30.0	1.0	**4.7**	**3.0**
	L4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	29.7	19.8	30.0	5.9	**35.6**	**23.8**
	W2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W3	31.8	22.0	30.0	6.6	**38.4**	**25.4**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	197.9	259.0	65.0	168.3	**366.3**	**158.4**
	S2	171.8	249.0	65.0	161.8	**333.6**	**137.4**
	S3	431.5	275.4	65.0	179.0	**610.5**	**345.2**
	S4	737.7	569.0	65.0	369.8	**1107.5**	**590.1**
	S5a	95.1	100.7	65.0	65.5	**160.6**	**76.1**
	S5b	0.0	65.7	30.0	19.7	**19.7**	**0.0**
	S6a	144.9	148.1	65.0	96.3	**241.1**	**115.9**
	S6b	0.0	400.3	30.0	120.1	**120.1**	**0.0**
Assessment Unit Retention Budget						**3,041.4**	**1,477.7**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.4.3 Current Condition Assessment

The results of the current condition assessment for the Kishinena assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 20. Kishinena Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit	Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	2.5	3.6	**1.1**	3,041.4	5,405.4	**2,364.0 Surplus** **178% of Budget**
	L2	-	-	**-**			
	L3	3.0	12.3	**9.3**			
	L4	-	-	**-**			
	NC	-	-	**-**			
Wetland	W1	23.8	76.4	**52.7**			
	W2	-	-	**-**			
	W3	25.4	87.2	**61.8**			
	W4	-	-	**-**			
	W5	-	-	**-**			
Stream River	S1	158.4	799.8	**641.4**			
	S2	137.4	721.5	**584.1**			
	S3	345.2	1121.9	**776.7**			
	S4	590.1	983.0	**392.8**			
	S5a	76.1	322.8	**246.8**			
	S5b	-	101.4	**101.4**			
	S6a	115.9	465.4	**349.5**			
	S6b	-	710.1	**710.1**			

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.4.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Kishenina RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. HCVF: This unit is wholly contained with the HCVFs for high value grizzly and carnivore habitat. See the HCVF mgmt strategies for detailed management guidance in this area.
2. Wildlife: **Moose:** The mid and lower Flathead riparian area is highly important winter habitat for moose. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. Avoid creating new roads accessing riparian areas. **Grizzly**: Riparian areas along the Flathead River and wetlands around Sage Creek provide important feeding areas in spring. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage). **Gillette's Checkerspot** – may occur in moist openings and in wetlands near Proctor Lake and Sage Creek, as well as other moist openings and riparian areas. Maintain large spruce trees adjacent to wetlands and moist openings for roosting. **Amphibians** - Small streams flowing over the low gradient valley bottoms offer high quality habitat for amphibians.
3. Fish: Bull Trout and westslope cutthroat occur in this unit, but although no redd locations are known, it is likely that spawning occurs in the smaller tributaries (i.e. S3 and S4 streams). Avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input. **Rocky Mountain Sculpin** occur in numerous drainages of the Flathead river; maintain canopy cover on sun-exposed sides along creeks to avoid increases in stream temperature.
4. Terrestrial Habitat: This unit has been extensively logged, with some impacts in riparian areas. Retain existing mature/old forest riparian stands in reserves, and maintain adequate security cover for large animals using these areas. In particular, maintain old growth spruce stands along the Flathead River and main tributaries such as Sage Creek.
5. Hardwoods: Maintain the hardwood component in existing stands.
6. Lakes and wetlands: Large beaver dam complexes occur on the wide valley bottom of the Flathead River southwest from Proctor Lake. Beaver created wetlands also occur along the margins of the larger tributary channels throughout this RAU. Maintain adequate riparian buffers to provide a food source for beavers (deciduous trees and shrubs) and snags for cavity nesting ducks and birds.
7. Stream temperature: Stream side vegetation along smaller streams is very important for maintaining stream temperature, relative humidity levels, and the riparian moisture regime.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Unit-specific rational for management strategies

A wide diversity of riparian form and function is apparent in the Kishinena RAU. Riparian function varies along the main tributaries of Sage, Commerce and Middlepass with proximity to headwater regions. Upper reaches of the main streams that are within the Clark Range are higher energy systems where channel beds are bright and active and banks are scoured. As these streams flow out onto the Flathead valley their gradient drops and riparian vegetation plays a greater role in channel bank stability and channel bed structure. Riparian function along upper elevation headwater channels is limited due to frequent snow avalanches and debris flows. Riparian

function along small, low gradient S3 and S4 streams and wetlands adjacent to the larger streams and the Flathead valley bottom provides habitat for many aquatic species including frogs. In these areas riparian vegetation provides shade and a source of woody debris that contributes to channel structure.

Riparian reserves are required along most S1 to S3 streams. High retention management zones are required on S4 and S3 streams on the Flathead valley bottom to protect these small, high value streams from negative impacts to channel structure, water quality or stream temperature.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Flathead River and lower reaches of Sage Creek are S1 streams. Riparian vegetation consists of Douglas Fir and spruce with cottonwood, alder and willow along channel banks and on cobble bars. Larger coniferous and deciduous trees provide protection to channel banks and adjacent forest floor. Riparian vegetation provides protection to the forest floor from erosion during flooding as well as increased floodwater storage, groundwater recharge, nutrients, organic matter, and addition to the food web. Riparian vegetation also regulates siltation rates of spawning habitat. LWD collects at meanders and on channel bars to provide structure to the channel bed. **Management Strategies** A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain to manage for wind throw and wildlife values. Maintain existing old and mature stands in RRZ, and ensure security cover for large mammals, especially bear and moose, feeding in riparian areas is provided.

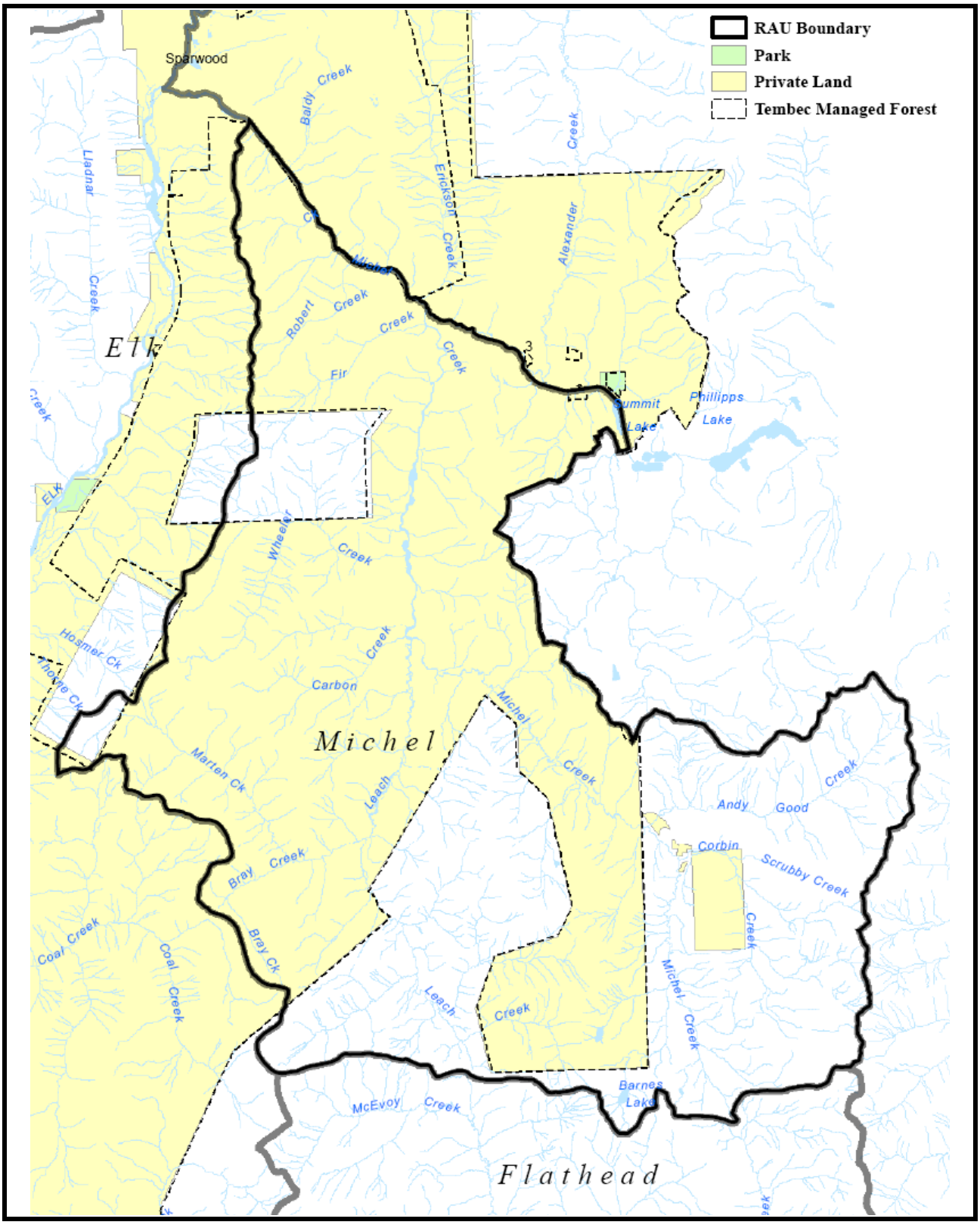
Stream type	Example	Riparian Management Guidance
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Lower to middle reaches of most of the main tributaries (Commerce, Middlepass, Sage) are S2. All of these stream flow from alpine headwaters out across the wide Flathead valley. Along the lower reaches the streams flow in single to multiple channels across wide floodplains that vary from unconfined to locally confined by glaciolacustrine terraces. Riparian vegetation includes cottonwood, small diameter spruce with willow and alder along channel margins and variable age stands of Douglas fir and spruce on upper channel banks. Riparian vegetation provides protection to channel banks during overbank flooding. LWD accumulates along channel margins at meanders and on lateral cobble bars providing bank protection and structure to the channel bed. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a RMZ of sufficient width to manage for wind throw and other key values as described above. Maintain deciduous stands, old and mature conifer stands and adequate security cover for bears and moose using these riparian areas.
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S3 streams are generally the lower reaches of the larger tributaries to Sage, Commerce and Middlepass Creeks. Riparian vegetation consists of alder and deciduous shrubs along channel margins and Douglas fir and spruce on upper channel banks. Riparian vegetation provides protection to channel banks and LWD functions in these small, low gradient channels to provide structure and moderate bedload transport. Riparian vegetation also moderates stream temperature along low gradient reaches, and provides organic input (leaf litter) and nutrients to the stream. **Management Strategy** A RRZ is required over the valley flat of channel situated on the low gradient terrain in the Flathead valley bottom. A RMZ is required adjacent to the RRZ where at least 60% of the forest stand on the both sides of the channel is retained. The RMZ must be wide enough to provide shade to the channels and wind firmness. A wind firm RMZ that retains at least 60% of the forest stand and is of sufficient width to protect channels from mechanical disturbance and provide shade is required along all S3 streams in this RAU. Maintain key values.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S4 streams are the lower reaches of small headwater stream that flow toward the main tributary channels. These streams often flow in narrow, swales through the forest on the low gradient valley bottom. Riparian vegetation is primarily deciduous shrubs, moss, herbaceous plants. Small woody debris from branches and roots of the surrounding forest provides some structure to these low gradient channels, as well as, reducing sedimentation transferred to downstream reaches during heavy rain events. Shade from the surrounding forest moderates temperatures in these small streams as well as providing organic matter to the immediate and downstream food web. **Management Strategy** Along lower gradient stream reaches (<15%) on lower valley slopes and the main valley bottoms designate a RMZ over the moist swale area that is of sufficient width to provide shade to the channels and protect channel banks and adjacent forest floor from mechanical disturbance. Retain at least 80% of the forested stand on both sides of the stream that is wide enough to be wind firm. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. For channels >15%, establish a RMZ that is sufficient width to protect the stream from mechanical disturbance and windthrow. Retain at least 60% of the forest stand and all deciduous and coniferous understory.
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream	No Picture available	**Riparian Function** The uppermost reaches of Commerce and Middlepass creeks may be S5. These areas were not field assessed as part of this project **Management Strategy** Management strategies for S5 streams in the Kishinena RAU will be developed by site.

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide	 	**Riparian Function** S6 streams range from ephemeral avalanche and debris flow gullies to highly productive streams on the wide valley bottoms. Riparian function depends on stream gradient and location on the slope. Riparian vegetation is critical to providing shade and channel structure in valley bottom streams that have gradients less than approximately 15%. In steep gradient channels on upper slopes, riparian vegetation is generally limited to deciduous shrubs that provide protection to channel banks, regulate sediment entering the stream during heavy rain events, and provide organic matter to the immediate area and downstream reaches. **Management Strategy** The management strategy will depend on location of the stream. See management strategies for S4 for low gradient valley bottom streams. For channels on upper slopes with gradients greater than 15%, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Avoid disturbance to the extent practicable to shrubs within 7 m of the stream banks.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Proctor Lake and a smaller unnamed lake are located east of Sage Creek. Both lakes are surrounded by wide marshy areas consisting of grasses and shrubs. Spruce, Douglas fir and pine surround the marshes where soils are not saturated. Confined highland lakes are forested to the lakeshore. In both highland and lowland lakes riparian function is primarily biological. Lowland riparian areas are generally much wider than upland areas due to the near-surface water table. Beaver activities are intrinsic to lowland lakes. Riparian vegetation also buffers the lake from increased nitrogen and phosphorus levels as well as provides organic litter for the terrestrial and aquatic habitats. **Management Strategies** In both cases RRZ's are required around lake margins that are of sufficient width to protect wildlife values and ensure wind firmness. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, CWD for amphibians, and security cover for large mammals.

Stream type	Example	Riparian Management Guidance
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are present adjacent to the margins of the floodplain of the Flathead River and along the margins of many of the main tributaries including Sage and Commerce Creeks Wetlands are commonly associated with beaver activity. Riparian vegetation provides organic matter and nutrients to terrestrial and aquatic habitats. Riparian vegetation also buffers the wetlands from potential increases in nitrogen and phosphorus levels. **Management Strategy** Designate a RRZ over the floodplain of Flathead River and major tributaries (Sage, Commerce and Middlepass) that is of sufficient width to protect marginal wetland areas from mechanical disturbance and wind throw and protect wildlife values. In confined valleys of the major tributaries RMZ's may be required to manage for wildlife values that extend beyond the valley flat (eg ungulate corridors, nesting sites). Protect high value snags for cavity nesting birds and ducks, provide perches for aerial insectivores, maintain CWD for amphibians, and maintain security cover (2 times sight distance) for large mammals.

1.5 Michel RAU



1.5.1 Characteristics

Physical Characteristics

Michel RAU includes the whole of the Michel Creek watershed. Michel Creek flows due north towards Highway 3 and is bound on the west by Sparwood, Hosmer and Leach Ridges and to the east by Loop, Michel and Limestone Ridges of the Border Ranges. Leach Creek is the largest tributary to Michel Creek and drains the southern portion of the Michel RAU.

Michel Creek flows northward along the trend of a normal fault which places younger Jurassic to Tertiary fine textured sediments and coal-bearing shales of the Kootenay and Blairemore Groups on the west against Pensylvanian to Jurassic carbonates and fine textured sediment of the Rocky Mountain and Fernie Groups on the east. Mountains along the eastern border of Michel RAU are comprised of thick limestones and carbonate rocks of the Rundell Group. Rounded ridges underlain by erodibe sediments of the Kootenay and Blairemore Groups characterize western slopes.

Elevations ranges from over 2800 meters on Mount Ptolemy at the headwaters of Andy Good Creek to 1200 meters at the confluence with Alexander Creek.

Annual precipitation ranges from 2200 mm at the upper elevations along the eastern boundary of the RAU to 800mm in the valley bottom in the northern portion of the RAU.

BEC Classification

Lowest elevation slopes of Michel RAU below approximately 1650m are classified as MSdk. ESSFdk occurs between approximately 1650 and 2100 meters on both valley sides. Upper elevations of Sparwood and Hosmer Ridges are ESSFdk. The uppermost elevations of Loop and Michel Ridge are classified as Parkland (ESSFdkp) to Alpine Tundra (AT).

Natural Variability in Riparian Function

Most of the streams in this RAU display cobble levees along channel margins and old, broken LWD along channel banks suggesting frequent debris floods. Riparian vegetation along channel banks is primarily deciduous trees and shrubs. Satellite images of the RAU suggest that stand replacing fires have occurred numerous time in the past. In addition, coal mining activities have been ongoing for many years in the Michel RAU. The road and the rail line that support the coal mine are situated in the main valley bottom adjacent to Michel Creek and have resulted in clearing of riparian areas and berming of channel margins in many locations. It appears that only the riparian areas along lower gradient upper reaches of Leach Creek are relatively undisturbed and have experienced a lower return period of riparian disturbance. Natural instability associated with fine textured bedrock occurs throughout the RAU and results in relatively high rates of sediment delivery to stream channels.

1.5.2 Riparian Budget

The overall budget for this assessment unit is 468 ha of retention, with 50% of this required in specific riparian classes (235 ha). S4 streams make up the single biggest component of the retention requirement.

Table 21. Michel Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	1.4	1.2	30.0	0.4	**1.8**	**1.1**
	L2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L3	2.2	2.0	30.0	0.6	**2.8**	**1.8**
	L4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W3	0.8	0.5	30.0	0.1	**0.9**	**0.6**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	0.0	0.0	65.0	0.0	**0.0**	**0.0**
	S2	7.4	9.8	65.0	6.4	**13.7**	**5.9**
	S3	13.8	8.7	65.0	5.7	**19.5**	**11.1**
	S4	192.3	130.0	65.0	84.5	**276.8**	**153.9**
	S5a	4.9	5.4	65.0	3.5	**8.5**	**3.9**
	S5b	0.0	6.9	30.0	2.1	**2.1**	**0.0**
	S6a	70.6	74.8	65.0	48.6	**119.3**	**56.5**
	S6b	0.0	75.3	30.0	22.6	**22.6**	**0.0**
Assessment Unit Retention Budget						**467.9**	**234.8**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.5.3 Current Condition Assessment

The results of the current condition assessment for the Michel assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 22. Michel Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit	Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	1.1	4.9	**3.7**	467.9	916.3	**448.3 Surplus** **196% of Budget**
	L2	-	-	**-**			
	L3	1.8	7.7	**6.0**			
	L4	-	-	**-**			
	NC	-	-	**-**			
Wetland	W1	-	-	**-**			
	W2	-	-	**-**			
	W3	0.6	1.7	**1.1**			
	W4	-	-	**-**			
	W5	-	-	**-**			
Stream River	S1	-	-	**-**			
	S2	5.9	37.8	**31.9**			
	S3	11.1	45.8	**34.7**			
	S4	153.9	322.3	**168.5**			
	S5a	3.9	22.4	**18.5**			
	S5b	-	13.8	**13.8**			
	S6a	56.5	313.4	**256.9**			
	S6b	-	146.4	**146.4**			

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.5.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Michel RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

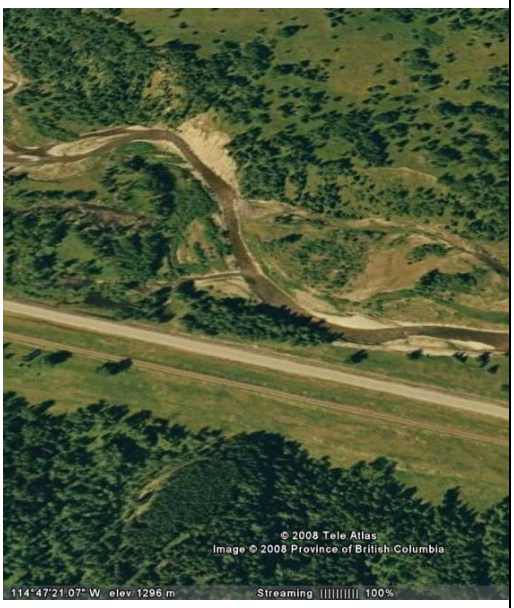
1. HCVF: This unit contains part of an HCVF for grizzly connectivity across Highway 3. There is also an HCVF for terrain stability. Due to the underlying geology, which consists of fine textured shaley soils, there is a lot of very unstable ground in the Michel RAU. Construction of roads through or above steep gradient gullies and swales (>50%) could cause terrain instability if road runoff is not properly managed. See the HCVF mgmt strategies for detailed management guidance in this area.
2. Wildlife: **Moose:** The riparian areas of Leach and Michel creeks provide winter habitat for moose. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. Avoid creating new roads accessing riparian areas. **Grizzly**: Riparian areas provide important feeding areas in spring. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage). **Gillette's Checkerspot** – may occur in moist openings and in wetlands along Michel Creek, as well as other moist openings and riparian areas. Maintain large spruce trees adjacent to wetlands and moist openings for roosting.
3. Fish: Bull Trout, westslope cutthroat and introduced brook trout occur in this unit, with spawning documented in Fir, Wheeler and carbon Creeks. Avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input. Michel Creek is described as one of the best walk-and-wade fly fishing streams in North America. The mainstem of Michel Creek is known to experience high energy floods that depend on LWD accumulations on point bars to provide stability and increase habitat diversity.
4. Terrestrial Habitat: Retain existing mature/old forest riparian stands in reserves, and maintain adequate security cover for large animals using these areas.
5. Hardwoods: Maintain the hardwood component in existing stands.
6. Lakes and wetlands: Beaver created wetlands occur along the margins of Leach Creek. Maintain adequate riparian buffers to provide a food source for beavers (deciduous trees and shrubs) and snags for cavity nesting ducks and birds, as well as security cover for large mammals such as grizzly and moose using these areas.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Unit-specific rational for management strategies

Mining related development has affected the structure and function of riparian areas throughout the Michel RAU. Leach Creek appears to have been less impacted by development activity. Most of the S2 portion of Leach Creek has deciduous shrubs along channel banks suggesting frequent debris flows. In smaller S3 streams, riparian vegetation provides stability to channel banks and structure to the channel bed.

Riparian reserves are required along S1 to S3 streams but riparian function appears to be greatest in the smaller S3 streams in the upper reaches of Leach Creek. Riparian management zones are required on lower gradient portions of S4 to S6 streams adjacent to the Michel and Leach Creeks.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The lower reaches of Michel Creek are S1. Much of Lower Michel Creek flows along road and rail right-of-ways and the creek is crossed numerous times by both. Approaches to the crossings and areas where the road runs adjacent to the channel have been bermed. Few areas of undisturbed riparian were observed along the S1 portion of this stream. Locally the channel is confined by terraces of glacial sediments that provide a source of sediment to the channel. Most of the lower Michel Creek is multi-thread. Where present cottonwood and mixed conifers provide protection to channel banks and floodplain, provides floodwater storage, facilitates groundwater recharge, and attenuates floodflows. LWD collects at meanders and on channel bars to provide structure to the channel bed. **Management Strategies** Most of this area is not within operable land. A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain or to the top of terrace scarps to manage for wind throw and wildlife values.
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** The middle and upper reaches of Michel and Leach are S2 as well as the lower reaches of streams tributary to them. Debris floods are frequent along most of the S2 channels. Deciduous shrubs and cottonwood are the primary riparian species and are established on cobble levees along channel margins. Riparian vegetation provides protection to channel banks during overbank flooding. LWD is not common in these active channels although this may be a legacy of past logging and fires. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a RMZ of sufficient width to manage for wind throw and other key values as described above. Maintain existing mature and old riparian stands in RRZ, and ensure security cover for wildlife trails and feeding areas is provided.

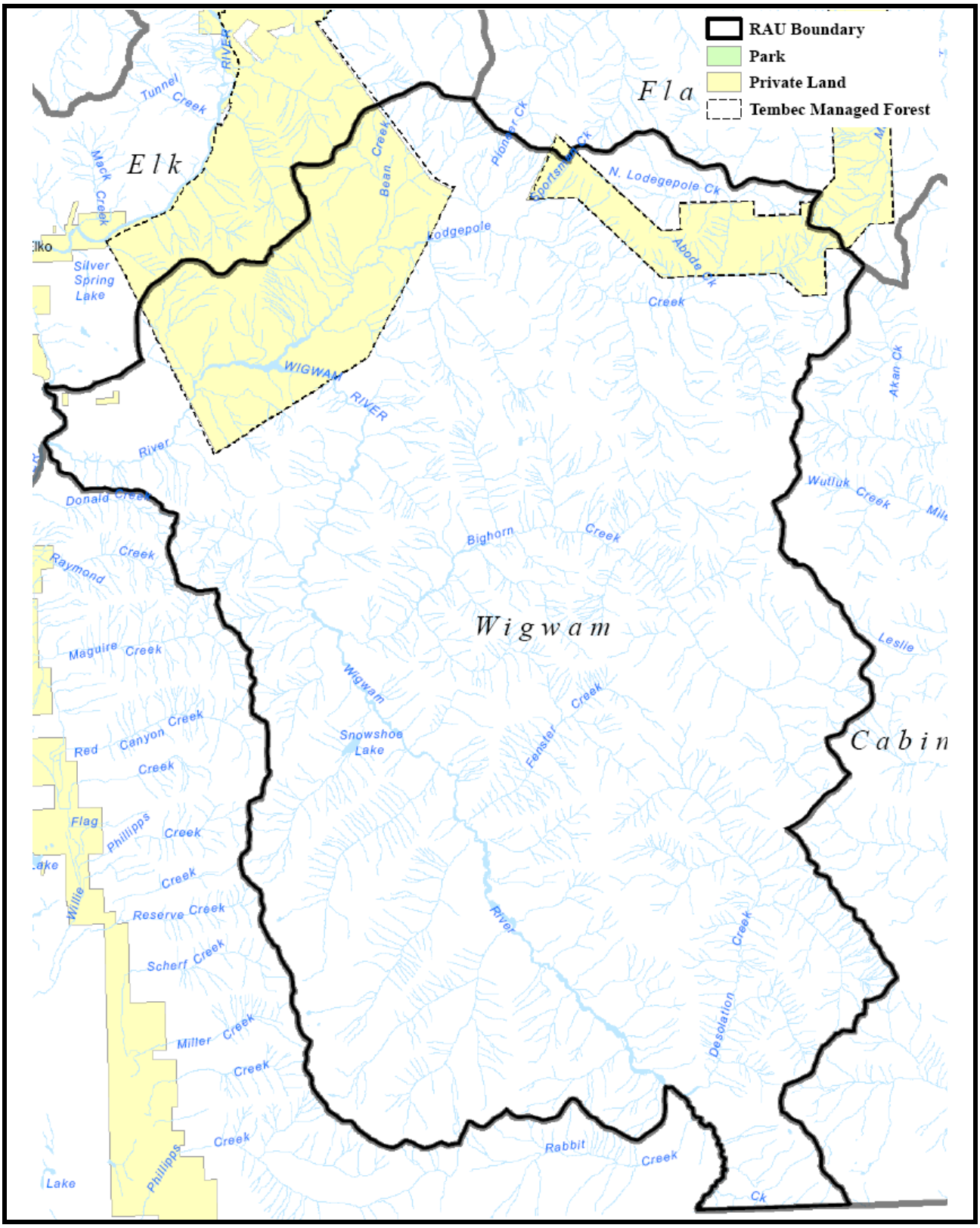
Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams	No picture available	**Riparian Function** S3 streams are generally the uppermost reaches of the main tributaries. Riparian vegetation consists of alder and deciduous shrubs along channel margins and Douglas fir and spruce on upper channel banks. Riparian vegetation provides protection to channel banks, controls sedimentation during heavy rain events, as well as provides organic matter to the area and downstream reaches. LWD is abundant in these small, low gradient channels and provides structure to the channel and moderates bedload transport rates. **Management Strategy** RRZ is required over the valley flat. A RMZ is required adjacent to the RRZ where at least 60% of the forest stand on both sides of the channel is retained. The RMZ must be wide enough to provide supply of LWD and ensure the RRZ is wind firm, as well as maintain key values.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S4 streams are the lower reaches of small headwater stream that flow into the largest stream channels. These streams carry debris flows and snow avalanches and there is usually several channels flowing over a colluvial fan deposit. Many S4 streams support resident fish populations, so habitat requirements of all life stages need to be maintained. Riparian vegetation is primarily deciduous shrubs, moss, herbaceous plants providing organic matter to the immediate area and downstream reaches. Once channel gradient drops below 15% small woody debris from branches and roots of the surrounding forest provides some structure to the channels. **Management Strategy** Along lower gradient stream reaches (<15%) on lower valley slopes and the main valley bottoms designate a RMZ over the width of the swale or fan that is of sufficient width to protect channel(s) and adjacent forest floor from mechanical disturbance. Retain at least 60% of the forested stand over the width of the RMZ. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible. Streams with gradients greater than 15% designate a wind firm RMZ of sufficient width to protect the channel from mechanical disturbance. Retain at least 30% of the forest stand, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** The upper reaches of larger, steep gradient tributaries are likely S5. These streams have riparian areas of thick deciduous shrubs and carry relatively frequent debris flows and snow avalanches. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. Riparian vegetation also regulates sediment input during heavy rain events. **Management Strategy** Avoid mechanical disturbance to gully sides. Retain wind firm stems and all undersized stems. Limiting access through gullies in these highly erodible soils will reduce the likelihood of sedimentation to stream channels. Avoid disturbance to the extent practicable to shrubs within 7 m of the stream banks.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams are small tributaries draining the face areas adjacent to Michel and tributary channels. Most S6 streams are confined in swales or gullies. Riparian vegetation consists of deciduous shrubs. Riparian function is generally limited to roots providing protection to channel banks and valley flat during high flow events. Most S6 streams in the Michel RAU are debris flow channels. Riparian vegetation controls sediment input during heavy rain events, and provides organic matter input to the stream and stream side as well as downstream reaches. **Management Strategy** The management strategy will depend on location and gradient of the stream. For channels on lower slopes or with gradients less than 15% designate a RMZ over swale or gully and retain all wind firm trees as well as deciduous and coniferous under story. Avoid mechanical disturbance to gully/swale sides. Streams on upper slopes with gradients greater than 15%, limit roads and trails through gullies, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)	2 classified lakes and 17 unclassified lakes are listed in the database for the Michel RAU. These lakes were not assessed in the field due to poor access.	Develop strategies by site.

Stream type	Example	Riparian Management Guidance
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are present adjacent to the margins of the main streams including Michel and Leach Creeks. Wetlands are often associated with beaver activity. Riparian vegetation supplies organic matter to the terrestrial and aquatic habitat. **Management Strategy** Designate a RRZ over the floodplain and adjacent valley bottom of Michel Creek and major tributaries where wetlands occur that is of sufficient width to protect marginal wetland areas from mechanical disturbance and wind throw. In confined valleys of the major tributaries RMZ's may be required on lower valley slopes to manage for wildlife values that extend beyond the valley flat (eg beaver feeding areas, ungulate trails, snags for cavity nesting species, perches for aerial insectivores.)

1.6 Wigwam RAU



1.6.1 Characteristics

Physical Characteristics

Wigwam RAU is situated in the Border Ranges of the Rocky Mountains and includes the Upper Wigwam River and Bighorn Creek. Slopes rise gradually from broad, u-shaped valleys becoming steeper at the mid to upper elevations and eventually form steep-sided ridges at the headwaters of the tributary basins.

Several large tributaries flow into the main stem of the Wigwam River including Brewery, Teds Lake, Seymour, Desolation and Fenster Creeks.

Bedrock structure and lithology (i.e. type of rock) controls drainage patterns in the Wigwam RAU. The Wigwam River, Bighorn Creek and the upper reaches of Desolation and Fenster Creeks follow northwest – southeast tending valleys that have formed in erodible rock types that underlie the valley bottoms.

The Galton Range on the west side of the Wigwam River is underlain by layered sedimentary and minor volcanic rocks of the Middle Proterozoic, Purcell Supergroup that are dipping down to the west in the eastern arm of a gently folded syncline. Erodible, siltstone, argillite and quartz wacke from the upper stratigraphic section of the Middle Proterozoic Purcell Supergroup are exposed in the main Wigwam River valley bottom and along Outlier Ridge and at the lower elevations of Inverted Ridge. Middle Cambrian to Upper Cambrian coarse sedimentary rocks of the Flathead Formation overlie the erodible Purcell Supergroup lithologies and form resistant cliffs at the upper elevations of Outlier Ridge north of Desolation Creek. The prominent limestone peaks of Inverted ridge are formed by the Devonian Palliser Formation and Mississippian Rundle Formation which overlie the Flathead Formation rocks along the eastern edge of the study area.

Elevation ranges from over 2100 metres along Inverted Ridge to 1120 metres at the confluence with Bighorn Creek.

Annual precipitation ranges from 1800mm at the upper elevations of Inverted Ridge to less than 800mm in the Wigwam valley bottom near the northwestern border of the Wigwam RAU.

BEC Classification

The Wigwam RAU lies within the Dry climate region of the Nelson Forest Region. The broad valley bottom of the Wigwam River watershed is in the Dry Cool Montane Spruce Subzone (MSdk). Above this the valley sides between approximately 1400 to 2100 metres are mapped as Dry Cool Engelmann Spruce – Subalpine Fir subzone. The very highest ridges, which bound the Wigwam River watershed to the east and west, lie within the Dry Cool Parkland Engelmann Spruce – Subalpine Fir subzone (Braumandle and Curran, 1993).

Natural Variability in Riparian Function

Fire has had a major influence on riparian function throughout most of the Wigwam RAU. A very large stand-replacing fire in the early 1930s has resulted in much of the late succession Douglas fir and spruce riparian stands along the Wigwam River being replaced by lodgepole pine. This has resulted in large-scale channel widening along the main stem channel and an abrupt transition from single thread pool riffle morphology to wide multi thread anastomosing morphology. The presence of very old, previously burnt LWD along larger tributaries including Brewery and Teds Lake Creeks suggest that fire is an important recruitment mechanism for LWD in these larger tributary channels. Snow avalanches are the dominant disturbance mechanism in headwater tributaries throughout the Wigwam RAU.

1.6.2 Riparian Budget

The overall budget for this assessment unit is 3,168 ha of retention, with 42% of this required in specific riparian classes (1,324 ha). S4 streams make up the single biggest component of the retention requirement.

Table 23. Wigwam Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	2.9	2.6	30.0	0.8	**3.7**	**2.3**
	L2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	L3	2.3	2.7	30.0	0.8	**3.1**	**1.9**
	L4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	NC	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Wetland	W1	4.5	3.3	30.0	1.0	**5.5**	**3.6**
	W2	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W3	4.9	3.2	30.0	1.0	**5.9**	**4.0**
	W4	0.0	0.0	30.0	0.0	**0.0**	**0.0**
	W5	0.0	0.0	30.0	0.0	**0.0**	**0.0**
Stream River	S1	249.0	304.3	65.0	197.8	**446.8**	**199.2**
	S2	201.8	261.3	65.0	169.9	**371.7**	**161.4**
	S3	141.8	135.3	65.0	87.9	**229.7**	**113.4**
	S4	605.9	425.0	65.0	276.3	**882.2**	**484.8**
	S5a	132.7	135.4	65.0	88.0	**220.7**	**106.2**
	S5b	0.0	228.5	30.0	68.6	**68.6**	**0.0**
	S6a	309.4	312.7	65.0	203.2	**512.6**	**247.5**
	S6b	0.0	1391.2	30.0	417.4	**417.4**	**0.0**
Assessment Unit Retention Budget						**3,167.9**	**1,324.3**

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.6.3 Current Condition Assessment

The results of the current condition assessment for the Wigwam assessment unit are provided in the table below and mapped in Appendix B. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 24. Wigwam Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	2.3	10.0	**7.6**		3,167.9	7,624.5	**4,456.6 Surplus** **241% of Budget**
	L2	-	-	**-**				
	L3	1.9	10.0	**8.2**				
	L4	-	-	**-**				
	NC	-	-	**-**				
Wetland	W1	3.6	11.6	**8.0**				
	W2	-	0.0	**-**				
	W3	4.0	14.2	**10.3**				
	W4	-	-	**-**				
	W5	-	-	**-**				
Stream River	S1	199.2	996.4	**797.3**				
	S2	161.4	724.4	**563.0**				
	S3	113.4	402.5	**289.0**				
	S4	484.8	816.9	**332.2**				
	S5a	106.2	508.1	**401.9**				
	S5b	-	425.7	**425.7**				
	S6a	247.5	1106.7	**859.2**				
	S6b	-	2598.0	**2598.0**				

Area requirements are current met with significant surpluses occurring in most riparian classes.

1.6.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for the Wigwam RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. HCVF: This unit contains numerous HCVFs, including those for Bull Trout spawning, fish habitat, intact forests, high value grizzly habitat, and high value ungulate winter range. The entire Wigwam and Lodgepole riparian area has been designated HCVF for high value spawning habitat. See the HCVF mgmt strategies for detailed management guidance.
2. Wildlife: **Moose:** The riparian areas of the Wigwam, Bighorn, and Lodgepole provide winter habitat for moose. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. Avoid creating new roads accessing riparian areas. The lower Wigwam provides good winter habitat for deer, elk, and sheep**. Grizzly**: Riparian areas provide important feeding areas in spring. Retain security cover (2x sight distance) around riparian feeding areas (those with sedges, horsetails, and/or skunk cabbage).
3. Fish: Wigwam River is one of the major bull trout spawning channels in the Kootenay River, with spawning concentrated between the Bighorn Creek and Brewery Creek confluences (Cope 2007). The lower Wigwam is also an important spawning area for kokanee, and an overwintering area for many fish. Cutthroat also spawn in the Wigwam and lower Bighorn.
4. Terrestrial Habitat: Retain existing mature/old forest riparian stands in reserves, and maintain adequate security cover for large animals using these areas.
5. Hardwoods: Maintain the hardwood component in existing stands.

6. Lakes and wetlands: Maintain adequate riparian buffers to provide a food source for beavers (deciduous trees and shrubs) and snags for cavity nesting ducks and birds, as well as security cover for large mammals such as grizzly and moose using these areas.
7. Stream temperature: Alpine-sourced tributaries and steep confined valleys make this management region relatively insensitive to forestry related impacts on stream temperature.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Unit-specific rational for management strategies

Riparian vegetation provides stability to channel banks and structure to stream channels along S1 to S3 channels throughout the Wigwam RAU. Riparian reserves are required along all S1 to S3 channels.

Riparian function along S4 and S6 channels varies with stream gradient. Management zones are required on lower gradient S4 and S6 streams. Riparian management strategies have not been developed for S5 streams in the Wigwam RAU due to lack of information about these stream systems.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Wigwam River and lower reaches of Bighorn Cr are S1 streams. Riparian vegetation consists of cottonwood, spruce, pine and Douglas Fir with alder and willow along channel banks. Larger coniferous and deciduous trees provide protection to channel banks and adjacent forest floor. LWD collects at meanders and on channel bars to provide structure to the channel bed. **Management Strategies** A riparian reserve is required over the active floodplain. RMZ is required beyond the floodplain to manage for wind throw and wildlife values. Maintain existing old and mature stands in RRZ, and provide security cover around wildlife trails and feeding areas. Maintain high value snags.

Stream type	Example	Riparian Management Guidance
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Lower to middle reaches of most of the main tributaries to Wigwam are S2. Middle and upper reaches of Bighorn are S2. Riparian vegetation includes mixed age stands of spruce, pine and Douglas fir. Riparian vegetation provides protection to channel banks and LWD to the channels as well as regulates siltation of spawning and rearing habitat during heavy rain events. Streams west of Wigwam generally have abundant functioning LWD. LWD is not present in Desolation Cr due to fire history. Fire is important recruitment mechanism in these channels. LWD provides structure to the channels and accumulates in jams along channel margins. **Management Strategy** S2 streams require a riparian reserve zone over the valley flat and a riparian management zone of sufficient width along lower valley slopes to manage for wind throw and sediment delivery hazards, as well as key wildlife values. Retain security cover around feeding and travelling areas for bears and ungulates, and maintain high value snags and large trees in RRZ.
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S3 streams are generally the lower reaches of the small tributaries to Wigwam and upper reaches of larger tribs such as Brewery Cr. Riparian vegetation includes mixed age stands of spruce, pine and Douglas fir. Riparian vegetation provides protection to channel banks, assists in sediment control during heavy surface rain events, and provides organic matter, nutrients and LWD to the channels. Fire is important recruitment mechanism in these channels. Single pieces and jams of LWD provide structure to the channels. **Management Strategy** S3 streams require a riparian reserve zone over the valley flat and a riparian management zone of sufficient width along lower valley slopes to manage for wind throw and sediment delivery hazards, and any key values that may be present.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** The lower reach of Snowshoe Creek is S4 as well as numerous small streams draining the eastern slope of Wigwam River. Riparian vegetation is primarily deciduous shrubs, providing sediment control and organic matter. Because many streams support resident fish population, habitat requirements of all life stages need to be addressed. Small woody debris from branches and roots of the surrounding forest provides some structure to streams with gradients less than 15%. **Management Strategy** Along lower gradient stream segments (<15%) on lower valley slopes designate a RMZ that is of sufficient width to protect channel banks and adjacent forest floor from mechanical disturbance. Retain at least 60% of the forest stand. For steeper gradient channels, Establish a RMZ and retain at least 30% of the forest stand. Avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels. Retained stems should be wind firm.
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream	No Picture available	**Riparian Function** The upper reaches of larger tributary streams may be S5. These areas were not field assessed. **Management Strategy** Develop strategies for S5 streams by site.

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams are generally ephemeral avalanche and debris flow gullies. Riparian function in S6 streams depends on stream gradient and location on the slope. Lower slope streams that have gradients less than approximately 25% display a variable amount of riparian function. On some streams roots and SWD jams comprised of willow influence channel structure and provide short term storage for bedload. In steep gradient channels on upper slopes, riparian vegetation is generally limited to deciduous shrubs that provide protection to channel banks, surface sediment control during heavy rain events and input organic matter and nutrients into the immediate area and downstream. **Management Strategy** The management strategy will depend on location of the stream. A RMZ is required along streams in gullies with gradients less than 25%. Retain at least 60% of the stand and all woody debris suspended above the gully on both sides of the stream. For channels on upper slopes with gradients greater than 25%, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channels.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Snowshoe Lake is the only classified lake in the operable area of Wigwam RAU. Snowshoe lake is fed by surface water runoff but drains slowly through colluvial deposits of an ancient landslide or glacial moraine. This results in variable depth to the lake and, at times, a very wide sloping gravel lakeshore. Riparian vegetation surrounding the lake consists of cottonwood, aspen and mixed conifers. Due to the fluctuating lake level and steep valley sides riparian area is limited to a narrow zone surrounding the lake. Riparian function is primarily biological. **Management Strategies** Designate a RRZ's of sufficient width to protect biological values and a RMZ with sufficient retention beyond the RRZ to manage for wind throw.

Stream type	Example	Riparian Management Guidance
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are present in a few locations adjacent to the margins of the active floodplain of the Wigwam River. Wetlands are generally situated at the confluence of west-flowing tributaries. Riparian vegetation is important for organic matter and nutrient inputs and for wildlife habitat. **Management Strategy** Designate a RRZ over the floodplain and adjacent valley bottom of the Wigwam River that is of sufficient width to protect marginal wetland areas from mechanical disturbance and wind throw, and protect biological values. Ensure high value snags are protected for nesting sites, perches are provided for aerial insectivores, and security cover is maintained for ungulates and bears using the wetlands.