Mystic Lake Hydroelectric Project
Riparian Vegetation Monitoring Plan

Public

FERC Project 2301

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EXECUTIVE SUMMARY

PPL Montana owns and operates the Mystic Lake Hydroelectric Facility (FERC Project No. 2301, hereafter referred to as the "project") in the Absaroka Mountains near Fishtail, Montana. The project is located on West Rosebud Creek, in Stillwater and Carbon counties, Montana. The Federal Energy Regulatory Commission (FERC) boundary for the entire project (referred to as the "project boundary") is located on U.S. Forest Service (USFS) lands within the Custer National Forest and encompasses 673.5 acres of federal lands. Lands within and adjacent to the project boundary are managed by the Custer National Forest.

On December 15, 2006, PPL Montana submitted the Final License Application (FLA) with FERC for the project. USFS filed Section 4(e) Terms and Conditions on May 3, 2007, and modified these conditions November 30, 2007. FERC approved the FLA and issued an order for the new license on December 17, 2007. The existing license will expire December 31, 2009 and the new 40-year license will be in effect starting January 1, 2010.

Under Ordering Paragraph E of the new license, FERC incorporated the conditions submitted by the USFS under section 4(e) of the FLA into the Mystic license. Condition Number 18 of the USFS 4(e) conditions calls for PPL Montana to file with the FERC a riparian vegetation monitoring plan, approved by USFS. Per the December 17, 2007 New License Order, PPL Montana is required to submit the first riparian vegetation monitoring report to the Commission by January 1, 2011. PPL Montana is voluntarily submitting this report ahead of schedule.

In the summer of 2009, PPL Montana established permanent monitoring transects along West Rosebud Creek in collaboration with USFS staff. Following the baseline data collection in 2009, the permanent transects will allow changes in riparian vegetation communities along West Rosebud Creek to be monitored from subsequent data collection efforts through the term of the license.

Due to site limitations identified during the 2009 site inspection, it was determined by PPL Montana and the USFS that the modified Daubenmire methodology PPL Montana proposed to utilize in the FLA would not be effective for monitoring at the selected site (Site 1). The width of the riparian area in the only location that was identified as suitable for monitoring purposes was less than 200 feet wide (specified as the standard transect length in the original Daubenmire methodology). However, the width of the riparian corridor at Site 1 is limited by natural slopes and topographic breaks/contours. Therefore, through coordination with USFS, the original Daubenmire methodology was modified to suit the selected monitoring area.

Site 1 was the only suitable monitoring site identified during the 2009 on-site evaluation. At Site 1, the location of the four transects established for long-term riparian vegetation monitoring efforts only includes one stream channel type (B). The other potential monitoring locations, including stream channel type C, were determined to be inadequate due to the influence from hydrologic features other than West Rosebud Creek, or other influences such as cattle grazing. Both PPL Montana and the USFS expressed concerns during the 2009 on-site evaluation that monitoring efforts at the selected location (channel type B) would not provide beneficial

information regarding the hydrologic influence resulting from modification of flows for recreation purposes. Although monitoring in Type C channel reaches would be more effective to assess riparian vegetation changes resulting from project operations, no suitable Channel Type C study sites are available on USFS lands. The selected study location (in the Channel Type B) is the only location in the project area that meets the study location selection criteria.

As the four transects were established in a riparian zone associated with the Type B stream channel reach, it is unlikely that major changes to vegetative communities will be observed in the selected location. The stream reach associated with the selected monitoring site is characterized by large substrate consisting of predominantly boulder and cobble, stable banks, and a stream gradient of approximately 3.5 to 4 percent. The existing stream characteristics will likely limit the hydrologic influence that project operations (e.g., augmenting river flows for whitewater recreation) have on the vegetation due to the confined stream channel and narrow floodplain width.

PPL Montana and the USFS have determined that the implemented monitoring effort may not provide beneficial information for long-term monitoring of impacts/modification to riparian vegetation due to project operations (e.g., augmented flows for recreation use). The following factors were identified to be limitations to the quality of data collected and the benefits for future comparisons: only one site (and one stream channel type) was determined to be adequate for sampling; shorter transects (with less vegetation) were sampled; narrow floodplain width at the monitoring location; variance of hydrologic influence to the riparian vegetation due to stream channel morphology is likely minimal; and a small number of species (e.g., cottonwoods) that are reliable indicators of modifications in the hydrologic regime are present at the monitoring site.

Although the new license requires future riparian vegetation monitoring efforts to be completed once every 5 years throughout the duration of the 40-year license, PPL Montana has recommended to USFS, and received concurrence, that future monitoring efforts are completed once every 10 years based on limitations of physical site characteristics. The 10-year monitoring interval would continue for the duration of the 40-year license and the next monitoring effort would be conducted in 2019.

1.0 PROJECT DESCRIPTION

PPL Montana owns and operates the Mystic Lake Hydroelectric Facility (FERC Project No. 2301, hereafter referred to as the "project") in the Absaroka Mountains near Fishtail, Montana. The project is located on West Rosebud Creek, in Stillwater and Carbon counties, Montana. The Federal Energy Regulatory Commission (FERC) boundary for the entire project (referred to as the "project boundary") is located on U.S. Forest Service (USFS) lands within the Custer National Forest and encompasses 673.5 acres of federal lands. The site is located at approximately 6,400 to 7,600 feet above mean sea elevation and is bordered by the Absaroka-Beartooth Wilderness Area. Lands within and adjacent to the project boundary are managed by the Custer National Forest.

In FERC's December 17, 2007 Order issuing the new license, the project boundary was adjusted and increased in size from 611.1 acres to 673.5 acres. Figure 1 illustrates the 673.5-acre project boundary. The current project boundary encompasses: Mystic Lake and the Mystic Lake Dam; West Rosebud Lake and the West Rosebud Lake Dam (Re-regulation Dam); the flowline, surge tank, penstock, and powerhouse; and PPL Montana's Camp that is located adjacent to the powerhouse. The Camp includes four homes for PPL Montana employees, three maintenance buildings, transmission lines, and appurtenant facilities.

The project's authorized capacity is 11.25 megawatts (MW). The project has two reservoirs on West Rosebud Creek: (1) Mystic Lake, which is the project's storage reservoir; and (2) West Rosebud Lake, which is located downstream from Mystic Lake and is used to moderate peaking flows from the powerhouse.

Water flowing into Mystic Lake is impounded by Mystic Lake Dam, which is a 45-foot-high, 368-foot-long concrete arch-type structure. Mystic Lake has a full pool elevation of 7,673.5 feet above mean sea elevation and a total volume of approximately 47,000 acre-feet. Water from the lake flows through the project's 2.4-mile-long flowline to the powerhouse, which contains two Pelton turbines with an installed capacity of 11.25 MW. Two 50-kilovolt (kV), 5.38-mile-long transmission lines run from the powerhouse to NorthWestern Energy's Line Creek switchyard.

After exiting the powerhouse, water re-enters West Rosebud Creek and flows for a distance of approximately 1 mile to West Rosebud Lake, which is impounded by the Re-regulation Dam. The Re-regulation Dam is a 19-foot-high by 420-foot-long earth-filled structure that modulates peaking flows from the powerhouse.

PPL Montana operates the project in both base load and peaking modes depending on water availability, electric demands, and license constraints. Mystic Lake is used to store water during heavy runoff months (May through July), which is used to augment flows during the remainder of the year.

2.0 PURPOSE

On December 15, 2006, PPL Montana submitted the Final License Application (FLA) with FERC for the project (PPL Montana 2006). USFS filed Section 4(e) Terms and Conditions on May 3, 2007, and modified these conditions November 30, 2007. FERC approved the FLA and issued an order for the new license on December 17, 2007. The existing license will expire December 31, 2009 and the new 40-year license will be in effect starting January 1, 2010.

Under Ordering Paragraph E of the new license, FERC incorporated the conditions submitted by the USFS under section 4(e) of the FLA into the Mystic Project license. Condition Number 18 of the USFS 4(e) conditions calls for PPL Montana to file with the FERC a riparian vegetation monitoring plan, approved by USFS. The Monitoring Plan (Plan) shall meet the protocol as described in Appendix B of Volume IA – Public, Final License Application, Applicant Prepared Environmental Assessment (December 15, 2006).

Condition 18 specifies that the Plan shall be designed to detect changes in the riparian vegetation, if any, as a result of changes in fluvial processes caused by operation of the Mystic Lake Hydroelectric Plant for the duration the license term. PPL Montana is required to establish permanent riparian transects along West Rosebud Creek in order to quantify riparian habitat and monitor trends. These permanent transects shall allow changes in the riparian communities along West Rosebud Creek to be detected after subsequent monitoring efforts performed through the 40-year term of the license.

Per the December 17, 2007 New License Order, PPL Montana is required to submit the first riparian vegetation monitoring report to the Commission by January 1, 2011. PPL Montana is voluntarily submitting this report ahead of schedule.

3.0 SITE SELECTION

The riparian vegetation monitoring protocol (hereafter referred to as the "2006 RMP") specified in the FLA, included site selection criteria for permanent riparian transects to be established for monitoring trends resulting from changes in fluvial processes caused by operation of the project. The 2006 RMP identified three potential locations where transects could be established on National Forest System Lands to provide baseline data for future riparian vegetation monitoring efforts (Figures 2-A through 2-D). The locations were selected through evaluation of aerial photographs taken in July 2005 and were not field-verified for the selection criteria provided below. The potential locations for the riparian transects included:

- The north-central portion of Section 6, Township 7 South, Range 17 East upstream of the USFS's grazing allotment boundary (Site 1, Figure 2-B);
- The southwest corner of Section 28, and the northwest corner of Section 33, Township 6 South, Range 17 East, in the area of the Pine Grove Campground (Site 2, Figure 2-C); and
- The southwest portion of Section 2, Township 7 South, Range 16 East, immediately downstream from the powerhouse in the shrub/sedge riparian type (Site 3, Figure 2-D).

An on-site evaluation of the three potential riparian vegetation monitoring sites was completed by Morrison-Maierle, Inc., Environmental Services Group (MMI) representatives and Mark Nienow, Custer National Forest, Forest Hydrologist on July 20, 2009 to identify locations of the permanent riparian transects that were to be established. Each site was evaluated utilizing the following criteria:

- Sites will be established in riparian areas associated with C or wider B channel types (Rosgen and Silvey 1998);
- Sites will be selected in areas with a minimum of other impacts (e.g., grazing and campsites);
- Areas influenced by water sources other than West Rosebud Creek (tributaries, springs, or wet meadows) will be avoided
- Transects will be established perpendicular to the slope of the valley; and
- Transects will be positioned in a manner to capture the maximum variety of fluvial surfaces.

Site 1

Site 1 (Figure 2-B) was selected by PPL Montana and the USFS as the preferred location for permanent riparian vegetation monitoring transects. A seep is located within the proposed monitoring area in the central portion of Figure 2-B (where the riparian area is identified as being its widest). The seep area is located down-gradient from a drainage; hydrology is conveyed via culvert underneath West Rosebud Road into the seep area. This area was determined to be the only location where a 400-foot-wide transect (as specified in the modified Daubenmire methodology for riparian vegetation monitoring that is discussed in the following sections) could be established. However, as site selection criteria also specify, riparian vegetation monitoring could not take place in areas that are influenced by hydrologic sources other than West Rosebud

Creek. Therefore, it was determined by PPL Montana and the USFS that four transects would be established in an area of the Type B stream channel (Rosgen and Silvey 1998) located approximately 500 feet upstream of the drainage/seep that coincides with the West Rosebud Creek riparian area (Figure 3 identifies the location of the four riparian vegetation monitoring transects).

Site 2

Site 2 (Figure 2-C) was not selected by PPL Montana and the USFS as an appropriate location for riparian vegetation monitoring due to the active cattle grazing observed within the riparian corridor during the July 20, 2009 site visit. It was determined that cattle grazing at this location could substantially affect the riparian vegetative species and bias monitoring results. In addition, a USFS campground (Pine Grove Campground) is located immediately adjacent to/downstream from the proposed riparian vegetation monitoring site. This location is also likely subjected to greater recreation use than the other potential monitoring sites on West Rosebud Creek.

Site 3

The proposed Site 3 (Figure 2-D) is located upstream of West Rosebud Lake and the Re-regulation Dam. Site 3 was not selected by PPL Montana and the USFS as an appropriate location for riparian vegetation monitoring because there are no anticipated changes to operations in the new license that would impact the hydrologic regime upstream of the Re-regulation Dam. Mystic Lake Dam operations will remain the same when the new license is in effect and therefore, no changes to riparian vegetation attributed to hydrologic influences from operations would be anticipated. In contrast, PPL Montana will periodically augment flows for recreation use (whitewater boating) downstream of the Re-regulation Dam when hydrologic conditions are determined to be suitable. Therefore, USFS recommended selecting riparian vegetation monitoring sites downstream of the Re-regulation Dam and did not select Site 3.

4.0 METHODOLOGY

A modified version of the Daubenmire method for vegetation sampling was utilized for monitoring at the selected site (Site 1) along the West Rosebud Creek riparian area (Figure 3). The typical Daubenmire method for vegetation sampling involves systematically placing a 20x50 centimeter (cm) frame along a permanent transect (Daubenmire 1959). The method is designed to collect species-specific data for canopy cover, frequency, and percent composition by canopy cover. The Daubenmire method is also designed for measuring vegetative material located below waste height.

Techniques used for implementation of the Daubenmire method were extracted from Coulloudon et al. (1999) and Coles-Ritchie et al. (2003). The transect is permanently established by driving a metal stake (rebar) into the ground at each end of the transect, recording the coordinates and azimuth/distance from a landmark to the beginning point of the transect, and taking general photographs of the transect. A 200-foot-long tape is stretched between the permanently established stakes. The 20x50 cm frame is placed every 4 feet (starting at zero) along the tape, on alternating sides of the tape. The 20x50 cm frame is marked to delineate six separate vegetative canopy cover classes. The frame is placed along the tape 50 times and at each placement the canopy cover class is recorded for each species. Table 1 describes the six Daubenmire canopy cover classes.

Table 1. The Daubenmire Canopy Cover Classes (Daubenmire 1959)

Canopy Cover Class	Range of Coverage	Midpoint of Range
1	0-5%	2.5%
2	5-25%	15.0%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85.0%
6	95-100%	97.5%

The 2006 RMP specifies that a modified Daubenmire method be utilized for sampling the riparian vegetation in the project area. The modified Daubenmire method included:

- Increasing the size of the sampling frame from 20x50 cm to 50x200 cm and doubling the distance between frame placements (from every 4 feet to every 8 feet along the tape);
- Doubling the length of the transects from 200 feet to 400 feet, to sample a wider range of fluvial surfaces;
- Performing line intercept sampling procedures along the transect measuring canopy cover for all species of shrubs and trees; and
- Tracking size class and height of species most affected by fluvial processes [cottonwoods (*Populus sp.*) and willows (*Salix sp.*)] encountered in the line intercept.

Records on each transect data form were to be summarized to calculate canopy cover, frequency, and percent composition for each species on site (Coulloudon et al. 1999). These data can be

stratified by fluvial surface types, thus tracking plant/soil moisture relations. Any major changes over time in species cover by fluvial surface type can be related to changes in the hydrologic cycle. Photographs were to be taken at established points at specific azimuths along with the tabular data to visually and quantifiably document changes in the riparian vegetation.

Canopy cover for trees and taller shrubs were to be captured by the addition of a line intercept, located along each of the Daubenmire transects. Line intercept data collection will follow protocol provided by the USFS' General Technical Report: *Line Intercept Sampling Method* found in Lutes et al. (2006). Measurements to the nearest inch will be taken of the crown spread of each shrub and tree species that are bisected by the line. In order to determine if taller vegetation is bisected by the line, a densitometer will be utilized, holding it directly over the tape. Size class and height of species that are most affected by fluvial processes (cottonwoods and willows) would be recorded along the line intercept transect (Lutes et al. 2006). The data collected by the addition of the line intercept are intended to provide a measure of species composition based on crown cover.

Per the new Mystic Lake Project License, baseline data collection for this riparian vegetation monitoring plan was to be initially implemented (actually completed in 2009) with subsequent monitoring every 5 years at the established transects for the duration of the license (40 years).

Due to site limitations identified during the July 20, 2009 site inspection, it was determined by PPL Montana and the USFS that the modified Daubenmire methodology PPL Montana proposed to utilize in the 2006 RMP would not be effective for monitoring at the selected site (Site 1). The width of the riparian area in the only location that was identified as suitable for monitoring purposes was less than 200 feet wide (specified as the standard transect length in the original Daubenmire methodology). However, the width of the riparian corridor at Site 1 is limited by natural slopes and topographic breaks/contours. Therefore, through coordination with USFS, the original Daubenmire methodology was modified to suit the selected monitoring area. The methodology that was implemented resulting from site limitations included the following protocol:

- Four permanent transects (Transects 1 through 4) were established at lengths of 152 feet, 128 feet, 136 feet, and 100 feet, respectively (see Figure 3 for locations).
- Rebar stakes were driven into the ground at the end of each transect and numbered aluminum caps (according to the transect number) were placed on each rebar stake.
- GPS coordinates for each transect (2 points on each end at the rebar stakes) were recorded using a sub-meter Trimble GeoXH GPS unit and an azimuth bearing for each transect was recorded (Table 2).
- Photographs were taken from the ends of each transect along the length of each transect (Appendix B).
- A 200-foot-long measuring tape was extended from rebar stake to rebar stake along each transect.
- A 20x50 cm Daubenmire frame was placed every 4 feet (starting at zero) along the transect tape and vegetation was sampled at each quadrat on alternating sides of the tape. Data from each frame placement were then recorded on Daubenmire Method data sheets and summarized on Daubenmire Summary data sheets (data sheets are provided in

Appendix A). Data collected included quadrat number, plant species, and cover class per species observed (Table2).

- Line intercept protocol was also utilized on each transect. Measurements to the nearest inch were recorded of the crown spread of each shrub and tree species that were bisected by the line. In addition, a densitometer was utilized by holding it directly over the transect tape to identify if taller vegetation was bisected by the line. Data were recorded on Line Intercept Form data sheets (Appendix A). Data collected included the distance each species intercepted the transect, species identified, life form (shrub or tree), whether the vegetation was alive or dead, and the size class (Appendix A).

Table 2. GPS Coordinates for Each Transect. Coordinate system is Montana NAD83 2500 State Plane, International Feet and Datum is NAD83.

Transect ID and Location	Northing	Easting
1 North	368172.105	1921722.669
1 South	368010.215	1921746.787
2 North	368211.641	1921786.871
2 South	368107.57	1921840.281
3 North	368263.03	1921850.994
3 South	368127.547	1921893.801
4 North	368282.348	1921963.289
4 South	368202.945	1922008.617

5.0 RESULTS

In the summer of 2009, PPL Montana established the permanent monitoring transects along West Rosebud Creek in collaboration with USFS staff. Following the baseline data collection in 2009, the permanent transects will allow changes in riparian vegetation communities along West Rosebud Creek to be monitored from subsequent data collection efforts through the term of the license. Although the new license requires future riparian vegetation monitoring efforts to be completed once every 5 years throughout the duration of the 40-year license, PPL Montana is recommending future monitoring efforts are completed once every 10 years based on limitations of the physical site characteristics (see Section 6). The 10-year monitoring interval would continue for the duration of the license.

Riparian vegetation monitoring was completed by MMI on July 21, 2009 for four transects that were established in coordination with USFS on July 20, 2009. The four transects were evaluated using the Daubenmire method and line intercept protocol. The Daubenmire Method, the Daubenmire Summary, and the Line Intercept data sheets are provided in Appendix A. The data recorded during the on-site monitoring effort will serve as baseline information for future monitoring efforts that will be completed every 10 years throughout the duration of the 40-year FERC license.

Daubenmire Data

Daubenmire data were collected and summarized for each transect and are presented in Tables 3, 5, 7, and 9. The tables include the following summary information: the species observed; percent canopy cover; species composition; and frequency of each species' occurrence within each transect. Percent canopy cover was calculated by taking the total canopy for each species and dividing it by the number of quadrats that were sampled along each transect. Species composition was calculated by dividing the total canopy for each species by the total canopy for all species observed along each transect and multiplying the number by 100. Frequency was calculated by dividing the number of occurrences (total number of quadrats in which each species was observed) by the number of total quadrats sampled along each transect and multiplying the number by 100.

Line Intercept Data

A summary of the line intercept data for each transect is provided in Tables 4, 6, 8, and 10. Percent canopy cover was calculated along each transect utilizing the line intercept protocol outlined in Section 3.0. Data that were recorded included: the distance of intercept along each transect; species; life form (tree or shrub); whether the tree or shrub was alive or dead; percent of tree/shrub species along the transect; and size class of all vegetation intercepting the transect (refer to Appendix C for a list and description of the tree/shrub class sizes).

Transect 1

Daubenmire Data

Table 3. Transect 1 – Daubenmire Summary Data

Species (scientific name)	Species (common name)	Percent Canopy Cover	Species Composition	Frequency
Actaea rubra	baneberry	1.4	3.5	5.2
Angelica arguta	white angelica	1.4	3.5	5.2
Arnica cordifolia	heart-leaf arnica	1.4	3.7	18.4
Betula occidentalis	water birch	0.8	2.0	5.2
Cirsium arvense	Canada thistle	0.1	0.3	5.2
Deschampsia cespitosa	tufted hairgrass	1.3	3.2	10.5
Epilobium angustifolium	fireweed	0.9	2.2	7.9
Equisetum arvense	field horsetail	1.4	3.5	15.8
Fragaria virginiana	wild strawberry	1.9	4.8	23.7
Galium boreale	northern bedstraw	0.7	1.8	15.8
Geranium richardsonii	white geranium	1.6	4.2	3.2
Geum macrophyllum	large-leaf avens	0.9	2.2	7.9
Heracleum lanatum	cow-parsnip	0.9	2.2	7.9
Juniperus horizantalis	creeping juniper	3.0	7.7	7.9
Mahonia repens	creeping Oregon grape	0.9	2.2	7.9
Mertensia ciliata	streamside bluebells	0.4	1.0	2.6
Osmorhiza berteroi	mountain sweet-cicely	0.8	2.0	5.2
Phleum pratense	timothy	0.07	0.2	2.6
Picea engelmannii	Engelmann spruce	0.8	2.0	5.2
Platanthera dilatata	leafy white orchid	0.1	0.3	5.2
Pyrola chlorantha	greenish-flowered wintergreen	1.1	2.7	15.8
Rosa acicularis	prickly rose	2.0	5.0	15.8
Rubus idaeus	wild red raspberry	0.1	0.3	5.2
Salix geyeriana	Geyer willow	1.8	4.5	7.9
Senecio integerrimus	western groundsel	2.2	5.7	15.8
Senecio pseudaureus	streambank groundsel	0.8	2.0	2.6
Shepherdia canadensis	Canada buffaloberry	0.8	2.0	2.6
Spirea betulifolia	birch-leaved spirea	3.4	8.7	31.6
Symphoricarpos albus	common snowberry	5	12.7	44.7
Thalictrum occidentale	western meadow-rue	0.4	1.0	2.6
Vacciniium scoparium	grouse whortleberry	1.3	3.2	10.5

Line Intercept Data

The canopy cover along Transect 1 consisted of 58 percent tree species and 14 percent shrub species. Approximately 28 percent of Transect 1 was not covered by tree or shrub species. Table 4 provides the percentage of canopy cover by species observed. For information about the size classes of species observed during the line intercept protocol, refer to the data sheets provided in Appendix A.

Table 4. Transect 1 – Line Intercept Data

Species (Scientific Name)	Species (Common Name)	Life Form (Tree or Shrub)	Percent Canopy Cover
Picea engelmannii	Engelmann's spruce	Tree	35%
Pinus contorta	lodgepole pine	Tree	21%
Abies lasiocarpa	subalpine fir	Tree	2%
Betula occidentalis	water birch	Shrub	11%
Salix geyerana	Geyer willow	Shrub	3%
		No Canopy Cover	28%
		TOTAL	100%

Transect 2

Daubenmire Data

Table 5. Transect 2 – Daubenmire Summary Data

Species (scientific name)	Species (common name)	Percent Canopy Cover	Species Composition	Frequency
Achillea millefolium	common yarrow	0.08	0.1	3.1
Angelica arguta	white angelica	2.6	4.4	12.5
Aster foliaceus	leafy aster	0.5	0.8	3.1
Betula occidentalis	water birch	0.08	0.1	3.1
Carex utriculata	beaked sedge	4.4	7.4	18.8
Cirsium arvense	Canada thistle	0.7	1.2	12.5
Deschampsia cespitosa	tufted hairgrass	7.5	12.7	34.4
Epilobium angustifolium	fireweed	0.5	0.8	3.1
Epilobium ciliatum	hairy willow-herb	0.2	0.3	6.3
Equisetum arvense	field horsetail	0.6	1.1	9.4
Fragaria virginiana	wild strawberry	2.2	3.7	25.0
Galium boreale	northern bedstraw	0.2	0.3	6.3
Geranium richardsonii	white geranium	0.6	1.1	9.4
Geum macrophyllum	large-leaf avens	0.08	0.1	3.1
Heracleum lanatum	cow-parsnip	0.9	1.6	6.3
Juncus balticus	Baltic rush	1.0	1.7	9.4
Juniperus horizantalis	creeping juniper	8.3	14.0	21.9
Mimulus guttatus	common monkeyflower	0.5	0.8	3.1
Phleum pratense	timothy	2.2	3.7	12.5
Picea engelmannii	Engelmann spruce	0.9	1.6	6.3
Pyrola chlorantha	greenish-flowered wintergreen	0.2	0.4	9.4
Ribes aureum	golden currant	1.2	2.0	3.1
Rosa acicularis	prickly rose	1.6	2.6	15.6
Rubus parviflorus	western thimbleberry	1.6	2.8	6.3
Salix geyeriana	Geyer willow	4.7	7.9	21.9
Senecio integerrimus	western groundsel	2.7	4.5	15.6
Senecio pseudaureus	streambank groundsel	0.5	0.9	6.3
Spirea betulifolia	birch-leaved spirea	2.8	4.8	9.4
Symphoricarpos albus	common snowberry	0.5	0.8	3.1
Thalictrum occidentale	western meadow-rue	0.08	0.1	3.1
Vacciniium scoparium	grouse whortleberry	3.0	5.0	12.5

Line Intercept Data

The canopy cover along Transect 2 consisted of 31 percent tree species and 7 percent shrub species. Approximately 62 percent of Transect 2 was not covered by tree or shrub species. Table 6 provides the percentage of canopy cover by species observed.

Table 6. Transect 2 – Line Intercept Data

Species (Scientific Name)	Species (Common Name)	Life Form (Tree or Shrub)	Percent Canopy Cover
Picea engelmannii	Engelmann's spruce	Tree	4%
Pinus contorta	lodgepole pine	Tree	27%
Betula occidentalis	water birch	Shrub	5%
Salix geyerana	Geyer willow	Shrub	2%
		No Canopy Cover	62%
		TOTAL	100%

Transect 3

Daubenmire Data

Table 7. Transect 3 – Daubenmire Summary Data

Species (scientific name)	Species (common name)	Percent Canopy Cover	Species Composition	Frequency
Achillea millefolium	common yarrow	0.2	0.3	8.8
Angelica arguta	white angelica	1.5	2.1	5.9
Antennaria alpina	alpine pussytoes	0.07	0.1	2.9
Arnica cordifolia	heart-leaf arnica	0.4	0.6	2.9
Betula occidentalis	water birch	0.4	0.6	2.9
Carex geyeri	elk sedge	0.5	0.7	5.9
Carex utriculata	beaked sedge	3.8	5.2	11.8
Cirsium arvense	Canada thistle	0.07	0.1	2.9
Cirsium foliosum	elk thistle	0.5	0.7	5.9
Deschampsia cespitosa	tufted hairgrass	12.4	16.8	32.4
Epilobium angustifolium	fireweed	0.07	0.1	2.9
Epilobium ciliatum	hairy willow-herb	0.07	0.1	2.9
Equisetum arvense	field horsetail	1.0	1.4	11.8
Galium boreale	northern bedstraw	0.9	1.2	2.9
Galium triflorum	sweet-scented bedstraw	0.07	0.1	2.9
Geranium richardsonii	white geranium	1.1	1.5	14.7
Geum macrophyllum	large-leaf avens	0.1	0.2	5.9
Glyceria striata	fowl mannagrass	0.4	0.6	2.9
Heracleum lanatum	cow-parsnip	1.1	1.5	2.9
Hieracium albiflorum	white hawkweed	0.1	0.2	5.9
Juniperus horizantalis	creeping juniper	6.8	9.2	17.6
Maianthemum racemosum	false Solomon's-seal	0.6	0.8	8.8
Mertensia ciliata	streamside bluebells	0.4	0.6	2.9
Mimulus guttatus	common monkeyflower	1.1	1.5	2.9
Phleum pratense	timothy	34.0	6.2	14.7
Poa palustris	fowl bluegrass	3.8	5.2	11.8
Pyrola chlorantha	greenish-flowered wintergreen	1.5	2.0	14.7
Rosa acicularis	prickly rose	2.9	4.0	29.4
Salix boothii	Booth willow	1.8	2.5	2.9
Salix eriocephala	yellow willow	6.8	9.2	17.6
Salix geyeriana	Geyer willow	7.6	10.4	38.2
Senecio integerrimus	western groundsel	0.07	0.1	2.9
Senecio pseudaureus	streambank groundsel	4.3	5.8	26.5
Solidago canadensis	Canada goldenrod	0.07	0.1	2.9

Table 6. Transect 3 – Daubenmire Summary Data (Continued)

Species (scientific name)	Species (common name)	Percent Canopy Cover	Species Composition	Frequency
Spire a betulifolia	birch-leaved spirea	4.3	5.8	14.7
Symphoricarpos albus	common snowberry	1.3	1.8	11.8
Thalictrum occidentale	western meadow-rue	0.2	0.3	8.8
Vacciniium scoparium	grouse whortleberry	0.4	0.6	2.9

Line Intercept Data

The canopy cover along Transect 3 consisted of 49 percent tree species and 21 percent shrub species. Approximately 30 percent of Transect 3 was not covered by tree or shrub species. Table 8 provides the percentage of canopy cover by species observed.

Table 8. Transect 3 – Line Intercept Data

Species (Scientific Name)	Species (Common Name)	Life Form (Tree or Shrub)	Percent Canopy Cover
Picea engelmannii	Engelmann's spruce	Tree	13%
Populus tremuloides	quaking aspen	Tree	1%
Pinus contorta	lodgepole pine	Tree	35%
Betula occidentalis	water birch	Shrub	2%
Salix geyerana	Geyer willow	Shrub	10%
Salix eriocephala	yellow willow	Shrub	9%
		No Canopy Cover	30%
		TOTAL	100%

Transect 4

Daubenmire Data

Table 9. Transect 4 – Daubenmire Summary Data

Species (scientific name)	Species (common name)	Percent Canopy Cover	Species Composition	Frequency
Abies lasiocarpa	subalpine fir	1.3	2.3	12.0
Antennaria alpina	alpine pussytoes	0.1	0.2	4.0
Arnica cordifolia	heart-leaf arnica	1.2	2.1	4.0
Betula occidentalis	water birch	1.2	2.1	4.0
Calamagrostis rubescens	pinegrass	2.5	4.4	24.0
Carex utriculata	beaked sedge	8.6	15.2	52.0
Cirsium arvense	Canada thistle	0.2	0.4	8.0
Cirsium foliosum	elk thistle	0.1	0.2	4.0
Cynoglossum officinale	houndstongue	0.1	0.2	4.0
Deschampsia cespitosa	tufted hairgrass	3.4	6.0	20.0
Epilobium ciliatum	hairy willow-herb	0.1	0.2	4.0
Equisetum arvense	field horsetail	0.3	0.5	12.0
Fragaria virginiana	wild strawberry	0.2	0.4	8.0
Galium boreale	northern bedstraw	0.1	0.2	4.0
Galium triflorum	sweet-scented bedstraw	0.1	0.2	4.0
Geranium richardsonii	white geranium	0.1	0.2	4.0
Geum macrophyllum	large-leaf avens	0.9	1.6	16.0
Glyceria striata	fowl mannagrass	0.2	0.4	8.0
Hieracium albiflorum	white hawkweed	1.6	2.8	8.0
Juncus balticus	Baltic rush	10.0	17.6	16.0
Juniperus horizantalis	creeping juniper	1.5	2.6	4.0
Juncus torreyi	Torrey's rush	0.1	0.2	4.0
Potentilla fruticosa	shrubby cinqeufoil	0.7	1.2	8.0
Ribes lacustre	prickly currant	0.6	1.1	4.0
Rosa acicularis	prickly rose	3.1	5.5	44.0
Salix geyeriana	Geyer willow	14.9	26.3	72.0
Scirpus acutus	small-fruit bulrush	0.6	1.1	4.0
Senecio pseudaureus	streambank groundsel	1.3	2.3	32.0
Senecio triangularis	arrow-leaf groundsel	0.3	0.5	12.0
Symphoricarpos albus	common snowberry	0.6	1.1	4.0
Thalictrum occidentale	western meadow-rue	0.1	0.2	4.0
Viola orbiculata	round-leaved yellow violet	0.6	1.1	24.0

Line Intercept Data

The canopy cover along Transect 4 consisted of 27 percent tree species and 29 percent shrub species. Approximately 44 percent of Transect 4 was not covered by tree or shrub species. Table 10 provides the percentage of canopy cover by species observed.

Table 10. Transect 4 – Line Intercept Data

Species (Scientific Name)	Species (Common Name)	Life Form (Tree or Shrub)	Percent Canopy Cover
Picea engelmannii	Engelmann's spruce	Tree	5%
Pinus contorta	lodgepole pine	Tree	22%
Betula occidentalis	water birch	Shrub	3%
Salix geyerana	Geyer willow	Shrub	14%
Salix eriocephala	yellow willow	Shrub	12%
		No Canopy Cover	44%
		TOTAL	100%

6.0 STUDY PLAN

As previously stated, the data collected from the initial riparian vegetation monitoring effort conducted in July 2009 will serve as the baseline data for subsequent monitoring efforts. The data provided in this report will allow for future analyses and observations of change(s) in the riparian vegetation along the established transects. However, because no previous data have been collected at the transect locations (established in July 2009), no conclusions can be made as to the potential hydrologic influence that operations at the Mystic or Re-regulation Dams have on the riparian vegetation communities at this time.

In addition, the location of the four transects established for long-term riparian vegetation monitoring efforts only includes one stream channel type (B). The other potential monitoring locations (as identified in the 2006 RMP), including stream channel type C, were determined to be inadequate due to the influence from hydrologic features other than West Rosebud Creek, or other influences such as cattle grazing. Type B stream channels maintain stream gradients of 2 to 4 percent, entrenchment ratios of 1.4 to 2.2, and relatively confined floodplains (Rosgen and Silvey 1998). As the four transects were established in a riparian zone associated with the Type B stream channel reach, it is unlikely that major changes to vegetative communities will be observed in the selected location. The stream reach associated with the selected monitoring site is characterized by large substrate consisting of predominantly boulder and cobble, stable banks, and a stream gradient of approximately 3.5 to 4 percent. The existing stream characteristics will likely limit the hydrologic influence that project operations (e.g., augmenting river flows for whitewater recreation) have on the vegetation due to the confined stream channel and narrow floodplain width.

Both PPL Montana and the USFS expressed concerns during the July 20, 2009 on-site evaluation that monitoring efforts at the selected location would not provide beneficial information regarding the hydrologic influence resulting from modification of flows for recreation purposes. Although monitoring in Type C channel reaches [less than 2 percent stream gradients, entrenchment ratio of greater than 2.2, and wider floodplain widths (Rosgen and Silvery 1998)] would be more effective to assess riparian vegetation changes resulting from project operations, no suitable Channel Type C study sites are available on USFS lands. The selected study location (in the Channel Type B) is the only location in the project area that meets the study location selection criteria.

PPL Montana and the USFS have determined that the implemented monitoring effort may not provide beneficial information for long-term monitoring of impacts/modification to riparian vegetation due to project operations (e.g., augmented flows for recreation use). The following factors were identified to be limitations to the quality of data collected and the benefits for future comparisons: only one site (and one stream channel type) was determined to be adequate for sampling; shorter transects (with less vegetation) were sampled; narrow floodplain width at the monitoring location; variance of hydrologic influence to the riparian vegetation due to stream channel morphology is likely minimal; and a small number of species (e.g., cottonwoods) that are reliable indicators of modifications in the hydrologic regime are present at the monitoring site.

Although the new license requires future riparian vegetation monitoring efforts to be completed once every 5 years throughout the duration of the 40-year license, PPL Montana has recommended to USFS, and has received concurrence, that future monitoring efforts are completed once every 10 years based on physical site characteristic limitations. The 10-year monitoring interval would continue for the duration of the 40-year license. A subsequent (second) riparian vegetation monitoring effort is proposed to be completed in 2019.

7.0 REFERENCES

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APPENDIX A

Daubenmire and Line Intercept Data Sheets

Daubenmire Summary Data Sheets

Daubenmire Summary

Page 1 of 3

Study Number	Date	Examiner	Allotment Name & Number	Pasture
FCRC 2301	7/21/09	E. NUGENT		

Study Location: Transect 1 — Number of Quadrats: 38

Cover Class	Mid-Point	Species	ACTRUB		ANGARG		ARNCOR		BETOCC		CIRARV		DESCES		EPIANG		EQUARV		FRAVIR		GALBOR		GERRIC	
			Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1	1-5%	2.5					4	10			2	5	1	2.5	1	2.5	3	7.5	5	12.5	5	12.5	1	2.5
2	5-25%	15	1	15	1	15	3	45	2	30			3	45	2	30	3	45	4	60	1	15	4	60
3	26-50%	37.5	1	37.5	1	37.5																		
4	51-75%	62.5																						
5	76-95%	85																						
6	96-100%	97.5																						
Total canopy				52.5		52.5		55		30		5		47.5		32.5		52.5		72.5		27.5		62.5
Number of Samples				38		38		38		38		38		38		38		38		38		38		38
% canopy cover				1.4		1.4		1.4		0.8		0.1		1.3		0.9		1.4		1.9		0.7		1.6
Species composition				3.5		3.5		3.7		2.0		0.3		3.2		2.2		3.5		4.8		1.8		4.2
Frequency				5.2		5.2		18.4		5.2		5.2		10.5		7.9		15.8		23.7		15.8		3.2

Illustration 10

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 1 — Number of Quadrats:

Cover Class	Mid-Point	Species: VEUMAC		Species: HERLAN		Species: JUNHOR		Species: MAHREP		Species: MERCIL		Species: OSMBER		Species: PHLPRA		Species: PICENG		Species: PLADIL		Species: PYRCHL		Species: ROSACI	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1	1-5%	2.5	1	2.5	1	2.5			1	2.5					1	2.5			2	5	4	10	3	7.5
2	5-25%	15	2	30	2	30	1	15	2	30	1	15	2	30			2	30			2	30	2	30
3	26-50%	37.5					1	37.5															1	37.5
4	51-75%	62.5					1	62.5																
5	76-95%	85																						
6	96-100%	97.5																						
Total canopy			32.5		32.5		115		32.5		15		30		2.5		30		5		40		75
Number of Samples			38		38		38		38		38		38		38		38		38		38		38
% canopy cover			0.9		0.9		3.0		0.9		0.4		0.8		0.07		0.8		0.1		1.1		2.0
Species composition			2.2		2.2		7.7		2.2		1.0		2.0		0.2		2.0		0.3		2.7		5.0
Frequency			7.9		7.9		7.9		7.9		2.6		5.2		2.6		5.2		5.2		15.8		15.8

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 1 — Number of Quadrats:

Cover Class	Mid-Point	Species: RUBIDA		Species: SALGEY		Species: SENINT		Species: SENFBE		Species: SIHCAN		Species: SPIBET		Species: SYMALB		Species: THAOCC		Species: VASCO		Species		Species	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	2	5			4	10					4	10	7	17.5			1	2.5				
2 5-25%	15			2	30			1	30	1	30	8	120	9	135	1	15	3	45				
3 26-50%	37.5			1	37.5	2	75							1	37.5								
4 51-75%	62.5																						
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			5		67.5		85		30		30		130		190		15		47.5				
Number of Samples			38		38		38		38		38		38		38		38		38				
% canopy cover			0.1		1.8		2.2		0.8		0.8		3.4		5		0.4		1.3				
Species composition			0.3		4.5		5.7		2.0		2.0		8.7		12.7		1.0		3.2				
Frequency			5.2		7.9		15.8		2.6		2.6		31.6		44.7		2.6		10.5				

Total
1,500

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture
FERC 7301	7/21/09	E. NYQUIST		

Study Location: Transect 2 — Number of Quadrats: 32

Cover Class	Mid-Point	Species		Species		Species		Species		Species		Species		Species		Species		Species		Species	
		ACHMIL		ANGARG		ASTFOL		BETOCC		CARUTR		CIRARV		DESCES		EPIANG		EPICIL		EQUARV		FRAVIR	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	1	2.5					1	2.5	1	2.5	3	7.5	3	7.5			2	5	2	5	4	10
2 5-25%	15			3	45	1	15			5	75	1	15	3	45	1	15			1	15	4	60
3 26-50%	37.5			1	37.5									5	187.5								
4 51-75%	62.5									1	62.5												
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			2.5		82.5		15		2.5		140		22.5		240		15		5		20		70
Number of Samples			32		32		32		32		32		32		32		32		32		32		32
% canopy cover			0.08		2.6		0.5		0.08		4.4		0.7		7.5		0.5		0.2		0.6		2.2
Species composition			0.1		4.4		0.8		0.1		7.4		1.2		12.7		0.8		0.3		1.1		3.7
Frequency			3.1		12.5		3.1		3.1		18.8		12.5		34.4		3.1		6.3		9.4		25

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 2 — Number of Quadrats:

Cover Class	Mid-Point	Species: GALBOR		Species: GERRIC		Species: GEUMAC		Species: HELLAN		Species: JUNBAL		Species: JUNHOR		Species: MIMGUT		Species: PHLPRA		Species: PICENG		Species: PYRCHL		Species: RIBAUR	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	2	5	2	5	1	2.5			1	2.5					1	2.5			3	7.5		
2 5-25%	15			1	15			2	30	2	30	2	30	1	15	2	30	2	30				
3 26-50%	37.5											4	150			1	37.5					1	37.5
4 51-75%	62.5																						
5 76-95%	85											1	85										
6 96-100%	97.5																						
Total canopy			5		20		2.5		30		32.5		265		15		70		30		7.5		37.5
Number of Samples			32		32		32		32		32		32		32		32		32		32		32
% canopy cover			0.2		0.6		0.08		0.9		1.0		8.3		0.5		2.2		0.9		0.2		1.2
Species composition			0.3		1.1		0.1		1.6		1.7		14.0		0.8		3.7		1.6		0.4		2.0
Frequency			6.3		9.4		3.1		6.3		9.4		21.9		3.1		12.5		6.3		9.4		3.1

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 2 | Number of Quadrats:

Cover Class	Mid-Point	Species: ROSACI		Species: RUBPAR		Species: SALGEY		Species: SENINT		Species: SENPSE		Species: SPIBET		Species: SYMALB		Species: THAOCC		Species: VASCO		Species		Species	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	2	5					1	2.5	1	2.5					1	2.5	1	2.5				
2 5-25%	15	3	45	1	15	5	75	3	45	1	15	1	15	1	15			2	30				
3 26-50%	37.5			1	37.5	2	75	1	37.5			2	75										
4 51-75%	62.5																	1	62.5				
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			50		52.5		150		85		17.5		90		15		2.5		95				
Number of Samples			32		32		32		32		32		32		32		32		32				
% canopy cover			1.6		1.6		4.7		2.7		0.5		2.8		0.5		0.08		3.0				
Species composition			2.6		2.8		7.9		4.5		0.9		4.8		0.8		0.1		5.0				
Frequency			15.6		6.3		21.9		15.6		6.3		9.4		3.1		3.1		12.5				

Total
1,890

Illustration 10

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture
FCLC 7301	7/21/09	E. NYQUIST		

Study Location: Transect 3

Number of Quadrats: 34

Cover Class	Mid-Point	Species		Species		Species		Species		Species		Species		Species		Species		Species		Species		Species	
		ACHMIL		ANGARG		ANTALP		ARNCOR		BETOCC		CAREEY		CARUTR		CIRARV		CIRFOL		DESCES		FPIANG	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	3	7.5			1	2.5					1	2.5			1	2.5	1	2.5			1	2.5
2 5-25%	15			1	15			1	15	1	15	1	15	2	30			1	15	3	45		
3 26-50%	37.5			1	37.5									1	37.5					5	187.5		
4 51-75%	62.5													1	62.5					3	187.5		
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			7.5		52.5		2.5		15		15		17.5		130		2.5		17.5		420		2.5
Number of Samples			34		34		34		34		34		34		34		34		34		34		34
% canopy cover			0.2		1.5		0.07		0.4		0.4		0.5		3.8		0.07		0.5		12.4		0.07
Species composition			0.3		2.1		0.1		0.6		0.6		0.7		5.2		0.1		0.7		16.8		0.1
Frequency			8.8		5.9		2.9		2.9		2.9		5.9		11.8		2.9		5.9		32.4		2.9

682.5

Illustration 10

Daubenmire Summary

Page 2 of 4

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 3 — Number of Quadrats: 34

Cover Class	Mid-Point	Species: EPICIL		Species: EQUARV		Species: GALBOR		Species: GALTRI		Species: GERRIC		Species: GEUMAC		Species: GLYSTR		Species: HERLAN		Species: HIEALB		Species: JUNHOR		Species: MERCIL	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	1	2.5	2	5			1	2.5	3	7.5	2	5					2	5	1	2.5		
2 5-25%	15			2	30	1	30			2	30			1	15					2	30	1	15
3 26-50%	37.5															1	37.5			1	37.5		
4 51-75%	62.5																			1	62.5		
5 76-95%	85																						
6 96-100%	97.5																			1	97.5		
Total canopy			2.5		35		30		2.5		37.5		5		15		37.5		5		230		15
Number of Samples			34		34		34		34		34		34		34		34		34		34		34
% canopy cover			0.07		1.0		0.9		0.07		1.1		0.1		0.4		1.1		0.1		6.8		0.4
Species composition			0.1		1.4		1.2		0.1		1.5		0.2		0.6		1.5		0.2		9.2		0.6
Frequency			2.9		11.8		2.9		2.9		14.7		5.9		2.9		2.9		5.9		17.6		2.9

415

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 3 — Number of Quadrats: 34

Cover Class	Mid-Point	Species MIMGUT		Species PHLPRA		Species POAPAL		Species PYRCHL		Species ROSACI		Species SALBOO		Species SALERI		Species SALGEY		Species SENINT		Species SENSBE		Species MAIRAC	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5			1	2.5			2	5	4	10					4	10	1	2.5	1	2.5	2	5
2 5-25%	15			1	15	2	30	3	45	6	90			4	60	5	75			7	105	1	15
3 26-50%	37.5	1	37.5	2	75	1	37.5									3	112.5			1	37.5		
4 51-75%	62.5			1	62.5	1	62.5					1	62.5			1	62.5						
5 76-95%	85													2	170								
6 96-100%	97.5																						
Total canopy			37.5		155		130		50		100		62.5		230		260		2.5		145		20
Number of Samples			34		34		34		34		34		34		34		34		34		34		34
% canopy cover			1.1		34.0		3.8		1.5		2.9		1.8		6.8		7.6		0.07		4.3		0.6
Species composition			1.5		6.2		5.2		2.0		4.0		2.5		9.2		10.4		0.1		5.8		0.8
Frequency			2.9		14.7		11.8		14.7		29.4		2.9		17.6		38.2		2.9		26.5		8.8

1192.5

Illustration 10

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 3

Number of Quadrats: 34

Cover Class		Mid-Point	Species: SOLCAN Number	SOLCAN Product	Species: SPIRET Number	SPIRET Product	Species: SYNACB Number	SYNACB Product	Species: THAOCC Number	THAOCC Product	Species: VASCO Number	VASCO Product	Species Number	Species Product	Species Number	Species Product	Species Number	Species Product	Species Number	Species Product	Species Number	Species Product	Species Number	Species Product
1	1-5%	2.5	1	2.5	2	5	3	7.5	3	7.5														
2	5-25%	15			1	15					1	15												
3	26-50%	37.5					1	37.5																
4	51-75%	62.5			2	125																		
5	76-95%	85																						
6	96-100%	97.5																						
Total canopy				2.5		145		45		7.5		15	219	2,505										
Number of Samples				34		34		34		34		34												
% canopy cover				0.07		4.3		1.3		0.2		0.4												
Species composition				0.1		5.8		1.8		0.3		0.6												
Frequency				2.9		14.7		11.8		8.8		2.9												

Illustration 10

Daubenmire Summary

Study Number FERC 1301 | Date 7/21/09 | Examiner E. NYQUIST | Allotment Name & Number | Pasture

Study Location Transect 4 | Number of Quadrats 25

Cover Class	Mid-Point	Species ABILAS Number	ABILAS Product	Species ANTALP Number	ANTALP Product	Species ARNCOR Number	ARNCOR Product	Species BETOCC Number	BETOCC Product	Species CALRUB Number	CALRUB Product	Species CARUTR Number	CARUTR Product	Species CIRARV Number	CIRARV Product	Species CIRFOL Number	CIRFOL Product	Species CYNOFF Number	CYNOFF Product	Species DESCES Number	DESCES Product	Species EPICIL Number	EPICIL Product
1 1-5%	2.5	1	2.5	1	2.5					4	10	2	5	2	5	1	2.5	1	2.5	1	2.5	1	2.5
2 5-25%	15	2	30			1	30	1	30	1	15	9	135							3	45		
3 26-50%	37.5									1	37.5	2	75							1	37.5		
4 51-75%	62.5																						
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			32.5		2.5		30		30		62.5		215		5		2.5		2.5		85		2.5
Number of Samples			25		25		25		25		25		25		25		25		25		25		25
% canopy cover			1.3		0.1		1.2		1.2		2.5		8.6		0.2		0.1		0.1		3.4		0.1
Species composition			2.3		0.2		2.1		2.1		4.4		15.2		0.4		0.2		0.2		6.0		0.2
Frequency			12		4		4		4		24		52		8		4		4		20		4

470

Illustration 10

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 4 — Number of Quadrats: 25

Cover Class	Mid-Point	Species: EQUARV		Species: FRAVIR		Species: GALBOR		Species: GALTRI		Species: GERRIC		Species: GEUMAC		Species: GLYSTR		Species: HIEALB		Species: JUNBAL		Species: JUNHOR		Species: JUNTOR	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1	1-5%	2.5	3	7.5	2	5	1	2.5	1	2.5	1	2.5	3	7.5	2	5	1	2.5					1	2.5
2	5-25%	15											1	15										
3	26-50%	37.5															1	37.5			1	37.5		
4	51-75%	62.5																	4	250				
5	76-95%	85																						
6	96-100%	97.5																						
Total canopy			7.5		5		2.5		2.5		2.5		22.5		5		40		250		37.5		2.5	377.5
Number of Samples			25		25		25		25		25		25		25		25		25		25		25	
% canopy cover			0.3		0.2		0.1		0.1		0.1		0.9		0.2		1.6		10		1.5		0.1	
Species composition			0.5		0.4		0.2		0.2		0.2		1.6		0.4		2.8		17.6		2.6		0.2	
Frequency			12		8		4		4		4		16		8		8		16		4		4	

Daubenmire Summary

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Study Location: Transect 4 — Number of Quadrats: 25

Cover Class	Mid-Point	Species: POTFRU		Species: RIBLAC		Species: ROSACI		Species: SALGEY		Species: SCIMIC		Species: SENBSE		Species: SENTRI		Species: SYMALB		Species: THAOCC		Species: VIOORB		Species	
		Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product	Number	Product
1 1-5%	2.5	1	2.5			7	17.5	1	2.5			7	17.5	3	7.5			1	2.5	6	1		
2 5-25%	15	1	15	1	15	4	60	13	195	1	15	1	15			1	15						
3 26-50%	37.5							3	112.5														
4 51-75%	62.5							1	62.5														
5 76-95%	85																						
6 96-100%	97.5																						
Total canopy			17.5		15		77.5		372.5		15		32.5		7.5		15		2.5		15	1417.5	570
Number of Samples			25		25		25		25		25		25		25		25		25		25		
% canopy cover			0.7		0.6		3.1		14.9		0.6		1.3		0.3		0.6		0.1		0.6		
Species composition			1.2		1.1		5.5		26.3		1.1		2.3		0.5		1.1		0.2		1.1		
Frequency			8		4		44		72		4		32		12		4		4		24		

Daubenmire Method Data Sheets

Study Number: FERC 2301	Date: 7/21/09	Examiner(s): E.Nyquist; R. Morgan	Allotment Name & Number:	Pasture:
Transect Number and Location: Transect 1 - length = 152 feet			**Number of Quadrats: 38**	

	Quadrat #																																					
Plant Species ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**
ACTRUB																									3	2												
ANGARG																				3		2																
ARNCOR												1	2	1			2		1	2	1																	
BETOCC								2	2																													
CIRARV																												1					1					
DESCES																													1		2	2	2					
EPIANG								2													2			1														
EQUARV																					2	1	2	1							2					1		
FRAVIR								2	1	1				2			1		2	1		2	1															
GALBOR									1			1							2				1				1		1									
GERRIC										2		2							2	1							2						1					
GEUMAC																											2			2	1							
HERLAN																										2	1			2								
JUNHOR																																		2	3			4
MAHREP										2			2	1																								
MERCIL																															2							
OSMBER																													2	2								
PHLPRA															1																							
PICENG											2			2																								
PLADIL																											1	1										
PYRCHL				1	2		1		2			1																		1								
ROSACI							2		3	1						1								2							1							
RUBIDA									1													1																
SALGEY																															2	3	2					
SENINT		1																					1				1	3	3	1								
SENPSE																												2										
SHECAN																																						2
SPIBET	1	1	2		2	2	2		1								2		1			2													2	2	
SYMALB	1							2	2	1	3	2	2	2	1			1			1	2	2	1										2		2		1
THAOCC																															2							
VACSCO			1			2	2														2																	

Study Number: FERC 2301	Date: 7/21/09	Examiner(s): E. Nyquist; R. Morgan	Allotment Name & Number:	Pasture:
Transect Number and Location: Transect 2 - length = 128 feet			Number of Quadrats: 32	

	Quadrat #																														
Plant Species ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
ACHMIL					1																											
ANGARG				3	2							2	2																			
ASTFOL			2																													
BETOCC									1																							
CARUTR																	2	2	1	2	4	2	2									
CIRARV								1							1	2		1														
DESCES					1	2		3	2	3	1	2			3	1								3	3							
EPIANG																										2						
EPICIL																		1		1												
EQUARV				1																						1	2					
FRAVIR		1	1	2	1		2															2		1		2						
GALBOR				1							1																					
GERRIC											1	2	1																			
GEUMAC										1																						
HERLAN														2	2																	
JUNBAL				2	2			1																								
JUNHOR																							2		2	3	3	5	3	3		
MIMGUT																			2													
PHLPRA		2				2	3							1																		
PICENG												2	2																			
PYRCHL												1					1						1									
RIBAUR	3																															
ROSACI		1	2										2			1									2						
RUBPAR					2									3																		
SALGEY								2										2		2	2	3	3	2								
SENINT									2	2	3							2							1							
SENPSE													2				1															
SPIBET																												2			3	3
SYMALB																										2						
THAOCC									1																							
VACSCO						1	2																								4	2

Study Number: FERC 2301	Date: 7/21/09	Examiner(s): E. Nyquist; R. Morgan	Allotment Name & Number:	Pasture:
Transect Number and Location: Transect 3 - length = 136 feet			Number of Quadrats: 34	

	Quadrat #																															
Plant Species ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
ACHMIL						1		1		1																								
ANGARG			2		3																													
ANTALP																																	1	
ARNCOR																																		2
BETOCC	2																																	
CARGEY																													2	1				
CARUTR				3																				4		2	2							
CIRARV																													1					
CIRFOL											2						1																	
DESCES													2	3	3	3	4	4	4	3	2	4	2						3					
EPIANG																									1									
EPICIL																										1								
EQUARV		1	2					1																						2				
GALBOR																														2				
GALTRI												1																						
GERRIC									1	2																1			2		1			
GEUMAC																			1				1											
GLYSTR				2																														
HERLAN																									3									
HIEALB						1																												1
JUNHOR	4	3					6	1		2																							2	
MERCIL				2																														
MIMGUT																											3							
PHLPRA		2	4		3	3		1																										
POAPAL									4	2	3	2																						
PYRCHL					2	2						2							1										1					
ROSACI		2								2	2					2				1	1	2								1	2	1		
SALBOO																													4					
SALERI																				2	5	2	2		2	5								
SALGEY						2		4				2	3		1	2	1			2			3	3	2		1	1						
SENINT									1																									
SENPSE					2						2	2	3	2	2	1	2					2												
MAIRAC							1			2		1																						
SOLCAN														1																				
SPIBET													1																	1	2	4	4	
SYMALB	1	1																													3			1
THAOCC																		1	1				1											
VACSCO		2																																

Study Number: FERC 2301	Date: 7/21/09	Examiner(s): R. Morgan; E. Nyquist	Allotment Name & Number:	Pasture:
Transect Number and Location: Transect 4 - length = 100 feet		Number of Quadrats: 25		

	Quadrat #																							
Plant Species ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
ABILAS		1	2	2																					
ANTALP																									1
ARNCOR																									2
BETOCC		2																							
CALRUB	1	2	1			1	3									1									
CARUTR					2			2	3	1	2	1	3	2	2	2	2	2	2						
CIRARV		1		1																					
CIRFOL																	1								
CYNOFF															1										
DESCES																				3	2	2	2	1	
EPICIL											1														
EQUARV							1															1	1		
FRAVIR	1	1																							
GALBOR							1																		
GALTRI								1																	
GERRIC	1																								
GEUMAC									1					2	1					1					
GLYSTR					1								1												
HIEALB																					1		3		
JUNBAL																			2	2	2	2			
JUNHOR																								3	
JUNTOR				1																					
POTFRU	2			1																					
RIBLAC																	2								
ROSACI			1					1				1	1	1	1	2		2	2	1	2				
SALGEY	2	1			3	4	2	2	2	3	2	2	2		2	2	3	2	2	2	2				
SCIMIC															2										
SENPSE		2			1				1			1		1	1			1		1					
SENTRI							1	1									1								
SYMALB																									2
THAOCC														1											
VIOORB				1			1	1		1				1				1							

Line Intercept Data Sheets

Table B.2-4. Line Intercept data collection form

USDA Forest Service — Line Intercept Field Form

LINE INTERCEPT FORM

General Information

Site ID: TRANSECT 1

DATE (MMDDYYYY): 7/21/09

EXAMINER — LAST: NYQUIST — FIRST: ERIK — Middle Initial: S

Current Transect: ____ Data Entry Mode: ____

Intercept

Intercepts

Intercept #	Start	Stop	Intercept	Life Form	Plant Code	Live/Dead	Size Class	Shrub Age	Shrub form
1	0	7.0	7.0	T	PICENG	L	MT		
2	0	12.6	12.6	T	PINCON	L	MT		
3	14.0	18.4	4.4	T	PICENG	L	SA		
4	25.0	30.3	5.3	S	BETOCC	L	TL		
5	39.4	47.2	7.8	T	PICENG	L	SA		
6	50.7	53.1	2.4	T	PICENG	L	SA		
7	54.2	56.9	2.7	T	ABILAS	L	SA		
8	60.2	67.4	7.2	T	PINCON	L	PT		
9	69.5	75.8	6.3	T	PICENG	L	SA		
10	78.6	80.9	2.5	T	PICENG	L	SE		
11	78.4	81.2	2.8	S	BETOCC	L	TL		
12	78.8	83.2	4.4	S	SALGEY	L	VT		
13	79.8	88.2	8.4	T	PINCON	L	PT		
14	85.2	106.3	21.1	T	PICENG	L	LT		
15	114.8	118.5	3.7	S	BETOCC	L	TL		
16	130.3	131.4	1.1	T	PICENG	L	SA		
17	128.3	133.2	4.9	S	BETOCC	L	VT		
18	141.1	143.9	2.8	T	PINCON	D	SA		
19	148.5	150.0	1.5	T	PINCON	L	SA		

Table B.2-4. Line Intercept data collection form

USDA Forest Service — Line Intercept Field Form

LINE INTERCEPT FORM

General Information

Site ID: TRANSECT 2 ®

DATE (MM/DD/YYYY): 7-21-09 ®

EXAMINER LAST: NYQUIST ® FIRST: ERIK ® Middle Initial: S

Current Transect: Data Entry Mode:

Intercept

Intercepts

Intercept #	Start	Stop	Intercept	Life Form	Plant Code	Live/Dead	Size Class	Shrub Age	Shrub Form
1	28.1	34.2	6.1	S	BECOCC	L	TL		
2	34.3	35.6	1.3	S	SALGEY	L	TL		
3	38.2	39.4	1.2	T	PICENG	L	SE		
4	43.9	44.8	0.9	T	PICENG	L	SE		
5	47.0	49.9	2.9	T	PICENG	L	SE		
6	50.8	52.3	1.5	S	SALGEY	L	TL		
7	52.1	54.4	2.3	T	PINCON	D	PT		
8	55.0	57.6	2.6	T	PINCON	D	PT		
9	58.2	62.6	4.4	T	PINCON	D	SA		
10	95.6	104.6	9.0	T	PINCON	L	PT		
11	103.5	111.8	8.3	T	PINCON	L	PT		
12	112.0	117.6	5.6	T	PINCON	L	PT		
13	123.2	125	1.8	T	PINCON	L	PT		

LINE INTERCEPT FORM

General Information

Site ID TRANSECT 3 ®

DATE (MMDDYYYY) 7-21-09 ®

EXAMINER LAST NYQUIST ® FIRST ERIK ® Middle Initial S

Current Transect Data Entry Mode

Intercept

Intercepts

Intercept #	Start	Stop	Intercept	Life Form	Plant Code	Live/Dead	Size Class	Shrub Age	Shrub form
1	0	1.8	1.8	T	PINCON	L	SE		
2	0	3.3	3.3	S	BETOCC	L	TL		
3	1.9	8.9	7.0	T	PICENG	L	SA		
4	4.3	5.2	0.9	T	POPTRE	L	SE		
5	13.8	19.5	5.7	S	SALGEY	L	TL		
6	13.9	21.8	7.9	T	PINCON	L	SA		
7	26.8	41.2	14.4	T	PINCON	L	PT		
8	51.8	56.6	4.8	S	SALGEB	L	TL		
9	63.2	74.2	11.0	T	PICENG	L	PT		
10	76.6	89.0	12.4	S	SALERI	L	TL		
11	89.9	93.5	3.6	S	SALGEY	L	TL		
12	111.2	123.1	11.9	T	PINCON	L	MT		
13	128.0	132.2	4.2	T	PINCON	L	PT		
14	130.0	135.5	5.5	T	PINCON	L	PT		
15	138.0	140.0	2.0	T	PINCON	L	PT		

LINE INTERCEPT FORM

General Information

Site ID Transect 4

DATE (MMDDYYYY) 7/21/29

EXAMINER LAST NYQUIST FIRST ERIK Middle Initial S

Current Transect ____ Data Entry Mode ____

Intercept

Intercepts

Intercept #	Start	Stop	Intercept	Life Form	Plant Code	Live/Dead	Size Class	Shrub Age	Shrub form
1	2.0	5.2	3.2	S	BETOCC	L	TL		
2	1.9	3.9	2.0	T	PINCON	D	SA		
3	8.9	10.8	1.9	T	PICENG	L	SE		
4	12.6	15.8	3.2	T	PICENG	L	SE		
5	15.9	21.8	5.9	S	SALECY	L	TL		
6	19.4	21.6	2.2	S	SALGEY	L	MD		
7	25.8	29.4	3.6	S	SALGEY	L	TL		
8	34.8	38.8	4.0	S	SALGEY	L	MD		
9	52.8	55.9	3.1	S	SALERI	L	TL		
10	61.0	67.2	6.2	S	SALERI	L	TL		
11	80.7	91.7	11.0	T	PINCON	L	PT		
12	90.2	95.3	5.1	T	PINCON	L	SA		
13	96.0	100.0	4.0	T	PINCON	L	PT		

APPENDIX B

Photographs

Photo 1. View north of Transect 1 from the southern rebar pin; bearing 350 degrees.

Photo 2. View south of Transect 1 from 10 feet north of northern the rebar pin; bearing 170 degrees.

Photo 3. View northwest of Transect 2 from the southern rebar pin; bearing 330 degrees.

Photo 4. View southeast of Transect 2 from 10 feet north of the northern rebar pin; bearing 150 degrees.

Photo 5. View northwest of Transect 3 from 5 feet south of the southern rebar pin; bearing 330 degrees.

Photo 6. View southeast of Transect 3 from 5 feet north of the northern rebar pin; bearing 150 degrees.

Photo 7. View northwest of Transect 4 from 3 feet south of the southern rebar pin; bearing 334 degrees.

Photo 8. View southeast of Transect 4 from 5 feet north of the northern rebar pin; bearing 154 degrees.

APPENDIX C

Line Intercept Tree and Shrub Size Classes

Tree and Shrub/Herbaceous Size Class information extracted from USDA Forest Service General Technical Report RMRS-GTR-164-CD (Lutes et al. 2006).

Tree Size Class		
Codes	**Description (English units)**	**Description (Metric units)**
TO	Total Cover	Total Cover
SE	Small (<1 inches DBH or <4.5 ft height)	Seedling (<2.5 cm DBH or <1.5 m height)
SA	Sapling (1.0 inches-<5.0 inches DBH)	Sapling (2.5-<12.5 cm DBH)
PT	Pole tree (5.0 inches-<9.0 inches DBH)	Pole tree (12.5-<25 cm DBH)
MT	Medium tree (9.0 inches-21.0 inches DBH)	Medium tree (25-<50 cm DBH)
LT	Large tree (21.0 inches-<33.0 inches DBH)	Large tree (50-<80 cm DBH)
VT	Very large tree (>33.0 inches DBH)	Very large tree (>80 cm DBH)
NA	Not applicable	Not applicable

Shrub and Herbaceous Size Class		
Codes	**Description (English units)**	**Description (Metric units)**
TO	Total Cover	Total Cover
SM	Small (<0.5 ft height)	Small (<0.15 m height)
LW	Low (0.5-<1.5 ft height)	Low (0.15-<0.5 m height)
MD	Medium (1.5-<4.5 ft height)	Medium (0.5-<1.5 m height)
TL	Tall (4.5-<8 ft height)	Tall (1.5-<2.5 m height)
VT	Very tall (>8 ft height)	Very tall (>2.5 m height)
NA	Not applicable	Not applicable