Potential Natural Vegetation Temperature TMDLs

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Objectives

- Present steps used to produce a temperature TMDL based on riparian shade.
- Discuss the Coeur d'Alene Lake Tributaries PNV temperature TMDL.

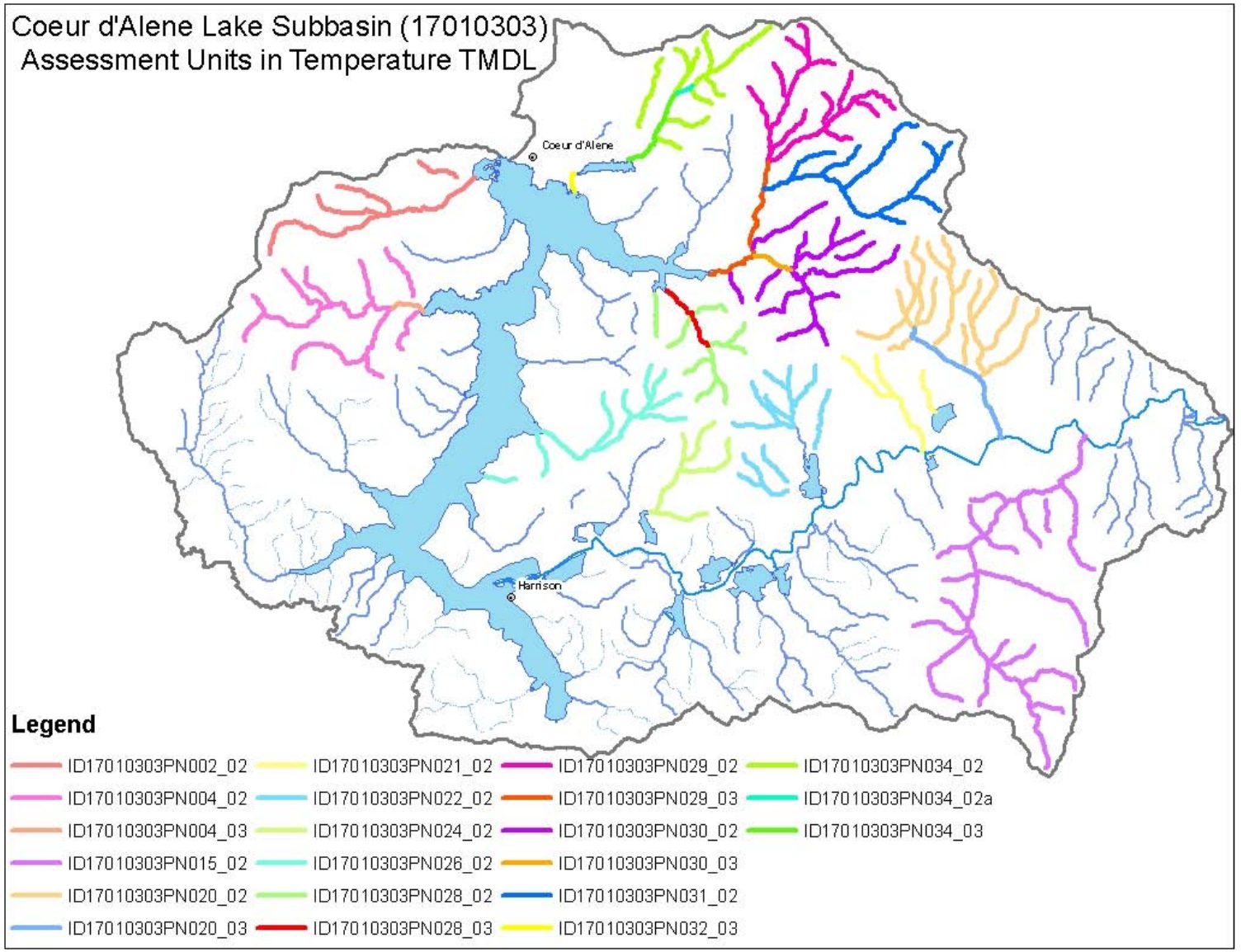
Potential Natural Vegetation

- Expected natural plant community with some natural level of age class distribution.
- Provides the expected effective shade (along with topography)
- Produces natural stream temperatures (assuming no point sources, dams, etc.)
- Equates to natural background conditions in Idaho WQS

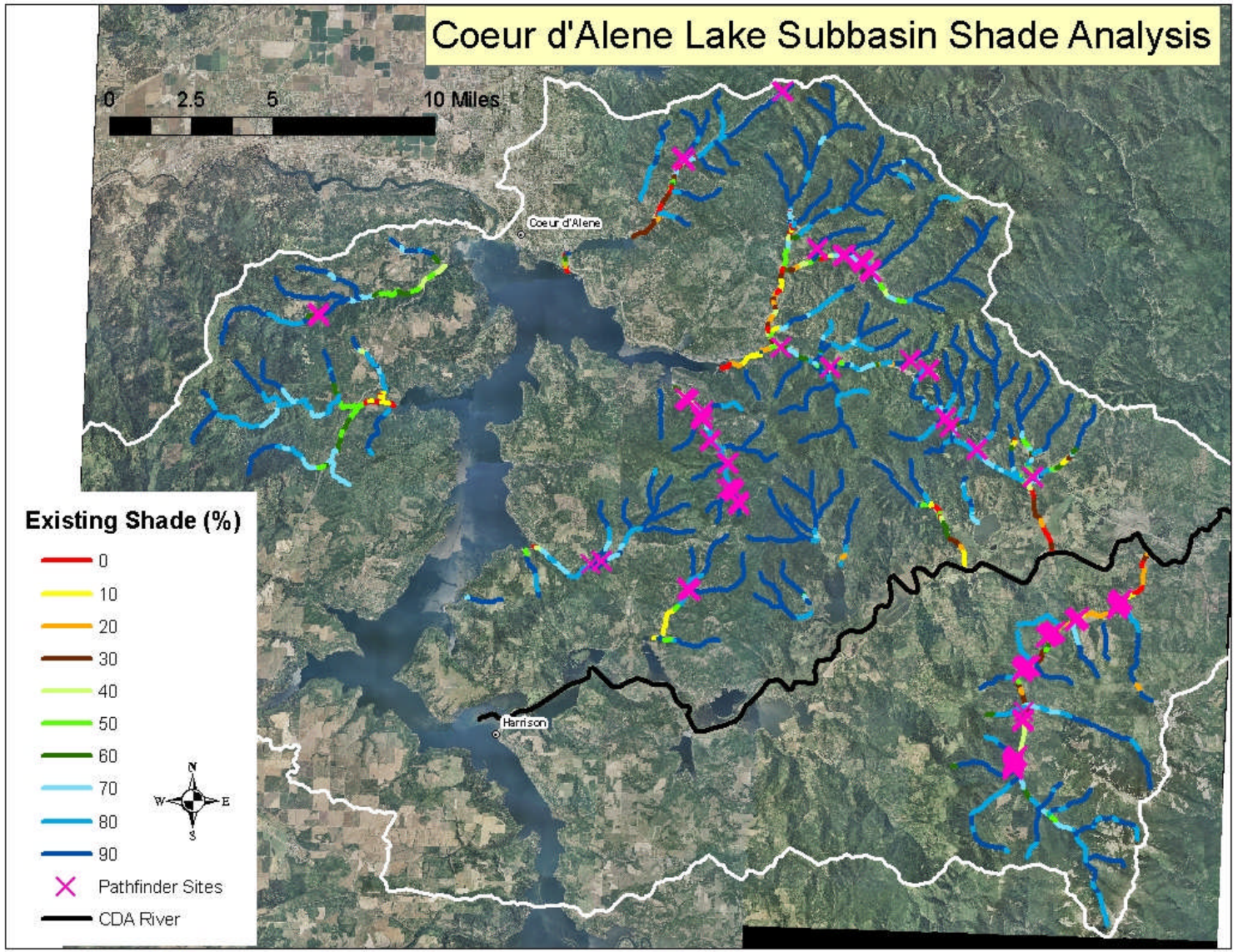
Temperature TMDL

- Loading Capacity = Solar Load under PNV
  aka potential (target) effective shade
- Existing Load = Solar Load under current
  (existing) effective shade
- Load Reduction = PNV Load – Existing Load

AU in Temperature TMDL



Existing Effective Shade

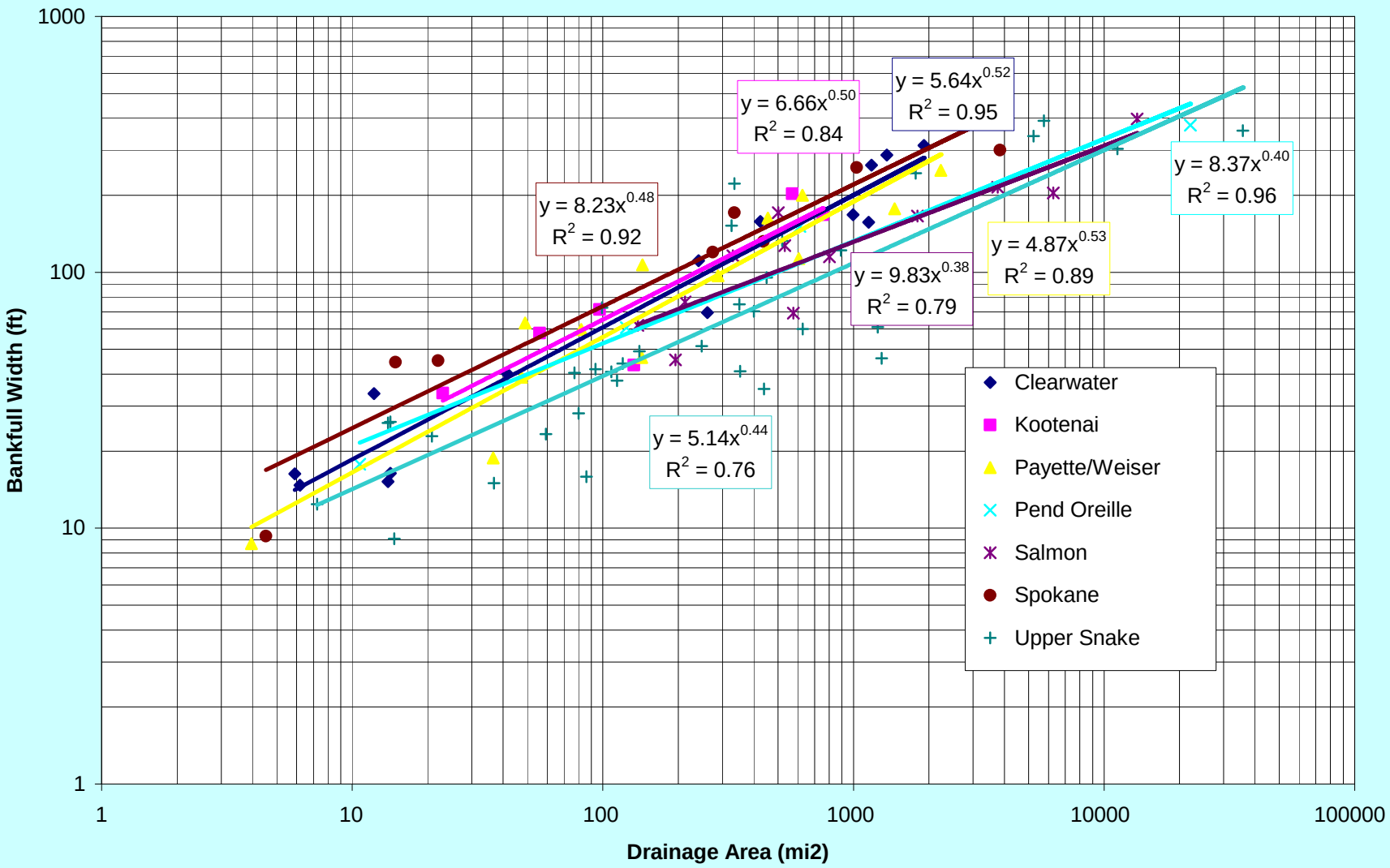


Existing Effective Shade Field Verification

60

Field Verification

aerial class	pathfinder actual	pathfinder class	delta		Sites
80	87.3	80	0		fernan #1
90	87.3	80	10		fernan #1
50	76.6	70	-20		fernan #2
60	86.5	80	-20		fernan #3
90	86.5	80	10		fernan #3
90	91	90	0		searchlight
90	93	90	0		cedar #1
80	67.8	60	20		cedar #2
80	63.5	60	20		cedar #3
10	80.5	80	-70		4th july #2
80	80.1	80	0		4th july #3
30	82.9	80	-50		fern
70	58.4	50	20		curran
90	89.2	80	10		beauty #1
90	92.9	90	0		beauty #3
80	89.6	90	-10		carlin
90	95.3	90	0		carlin trib
80	88.1	80	0		blue lake
90	92.5	90	0		cottonwood
90	92.8	90	0		cougar
			-4	average	
			22.34	std dev	
			9.79	95%CI	


Idaho Regional Curves - Bankfull Width
Bankfull Width (ft)
Drainage Area (mi2)
1000
100
10
1
1
10
100
1000
10000
100000
y = 8.23x^0.48
R^2 = 0.92
y = 6.66x^0.50
R^2 = 0.84
y = 5.64x^0.52
R^2 = 0.95
y = 8.37x^0.40
R^2 = 0.96
y = 4.87x^0.53
R^2 = 0.89
y = 9.83x^0.38
R^2 = 0.79
y = 5.14x^0.44
R^2 = 0.76
Clearwater
Kootenai
Payette/Weiser
Pend Oreille
Salmon
Spokane
Upper Snake

Bankfull Width Estimation

Location	area (sq mi)	Clearwater (m)	CDA USFS (m)	USFS power (m)	CDA WPN (m)	Average existing (m)
Phantom Creek @ mouth	1.79	2	5	2	4	
Blue Grouse Creek @ mouth	1.23	2	5	2	3	
Holliday Creek @ mouth	0.37	1	5	1	2	
Onawa Creek @ mouth	0.68	1	5	1	2	
Rutherford Gulch @ mouth	3.27	3	5	3	5	
Cedar Creek @ mouth	15.85	7	7	7	9	4.4
Cedar Creek bl Alder Creek	14.55	7	7	7	9	
Cedar Creek ab SF Cedar Creek	3.17	3	5	3	5	3.2
un-named tributary to Cedar Creek	0.75	1	5	1	3	
SF Cedar Creek @ mouth	6.73	5	6	5	6	
SF Cedar Creek bl 2nd tributary	4.31	4	6	4	5	
SF Cedar Creek bl 1st tributary	2.6	3	5	3	4	
1st tributary to SF Cedar Creek	1.41	2	5	2	3	
2nd tributary to SF Cedar Creek	0.5	1	5	1	2	
3rd tributary to SF Cedar Creek	1.93	2	5	2	4	
Alder Creek @ mouth	4.36	4	6	4	5	
Alder Creek ab 1st fork	1.33	2	5	2	3	
1st fork to Alder Creek	1.47	2	5	2	3	
Chinese Gulch @ mouth	0.33	1	5	1	2	
Un-named stream south of Wolf Lodge Creek	0.8	2	5	1	3	
Marie Creek @ mouth	17.9	8	7	8	9	6.4
Marie Creek bl Skitwish Creek	13.5	7	7	7	8	8
Marie Creek ab Skitwish Creek	9.19	5	6	5	7	8
Latour Creek @ mouth	52.2	13	11	14	15	
Latour Creek ab Little Baldy Creek	46.4	13	11	13	14	12.5
Latour Creek ab Baldy Creek	25.1	9	8	10	11	8
Latour Creek ab Butler Creek	14.6	7	7	7	9	7.9
Larch Creek @ mouth	0.77	2	5	1	3	1.7

Potential or Target Shade

Shade Calculator

(Shade.xls, WA DOE)

Shade Duration & Shade Quality

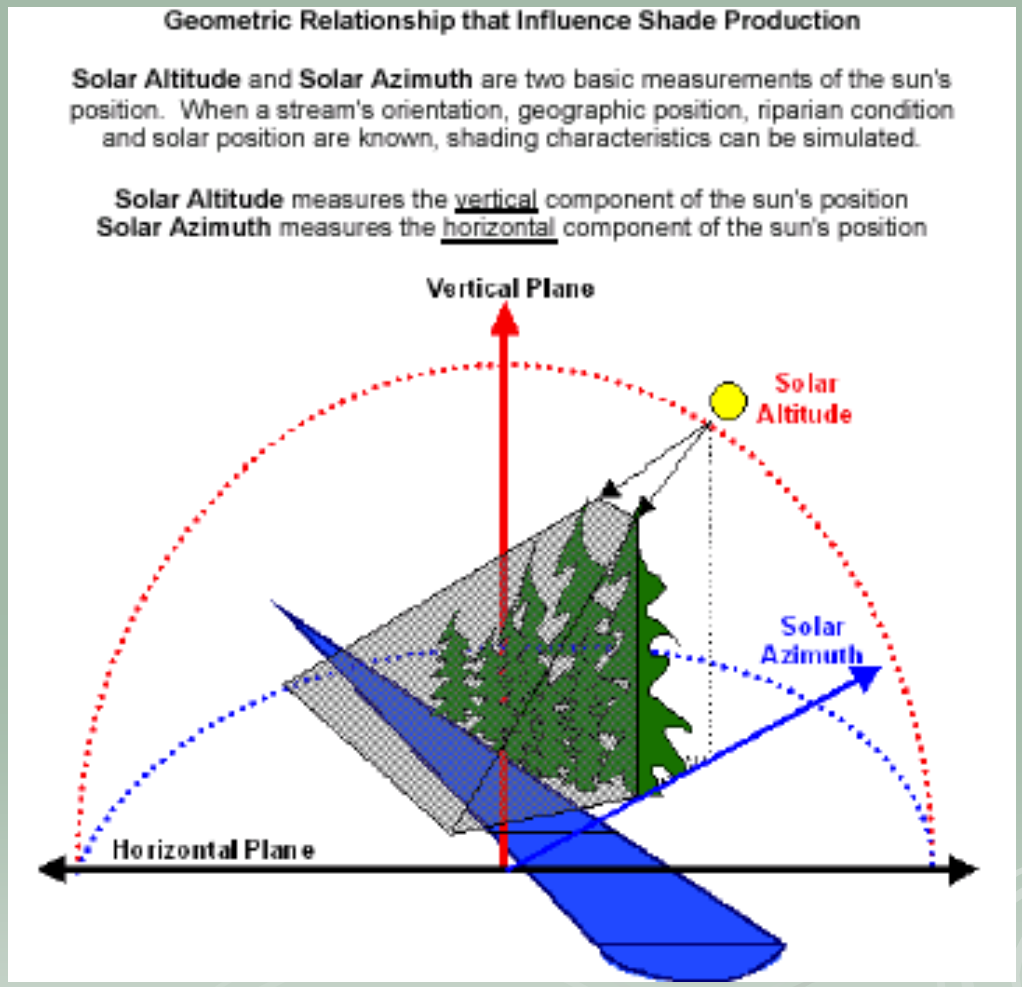


Table 1. VRU/HTG Assessment Groups in the Pend Oreille Basin (KPIZ 2003)

Assessment Group	Description
Group A: VRU 1/HTG 1 (Warm/Dry), VRU 2/HTG 2 (Moderately Warm/Dry), and VRU 3/HTG 3 (Moderately Warm/ Moderately Dry).	This group contains the more warm and dry habitat types with VRU 1 being the warmest and driest to the more moderate conditions of VRU 3. These sites include warm, dry grasslands to moderately cool and dry upland sites. The dry, lower elevation open ridges are composed of mixed Douglas-fir and ponderosa pine in well-stocked and fairly open-grown conditions. Moderately moist, upland sites and dense draws also include larch and lodgepole pine, with lesser amounts of ponderosa pine. Tree regeneration occurs in patches and is largely absent in the understory, particularly in the driest sites. Annual precipitation ranges from 14" to 30", about 75% of that falling as rain. While the growing season is fairly long, high solar input and moderately shallow soils often result in soils that dry out early in the growing season, which results in low to moderate site productivity.
Group B: VRU 4/HTG 4 (Moderately Warm/Moist), VRU 5/HTG 5 (Moderately Cool/Moist), and VRU 6/HTG 6 (Moderately Cool/Wet).	This group occupies most of the moist sites along benches and stream bottoms. The moderating effects of the inland maritime climate ecologically influence this group. This group includes the more moderate sites of VRU 4 and scattered riparian and wet sites of VRU 6. This group is widespread throughout the forest and has the most biological productivity. Precipitation is moderate to high ranging from 30" to 55" per year.
Group C: VRU 7/HTG 7 (Cool/Moist) and VRU 8/HTG 8 (Cool/Wet).	This group occurs in the moist, lower subalpine forest setting and is common on northwest to east facing slopes, riparian and poorly drained subalpine sites, and moist frost pockets. This landscape is typically bordered by warmer sites (Group B) and cool, drier subalpine sites (Group D). This group includes characteristics of each. Average precipitation is estimated between 35" and 55" per year, less than half as rain. Vegetative productivity is moderate to high as a result of the high moisture-holding capacity and nutrient productivity of loess deposits, adequate precipitation, and a good growing season.
Group D: VRU 9/HTG 9 (Cool/ Moderately Dry), HTG 10 (Cold/Moderately Dry) and HTG 11 (Cold).	This group is typified by cool and moderately dry conditions with moderate solar input. The climate is characterized by a short growing season with early summer frosts. Annual precipitation ranges from 35"-70", mostly in the form of snow. Due to generally shallow soils (low water holding capacity), slope position, and aspect, soil moisture is often limited during late summer months. It is generally found on rolling, ridges and upper reaches of convex mountain slopes.

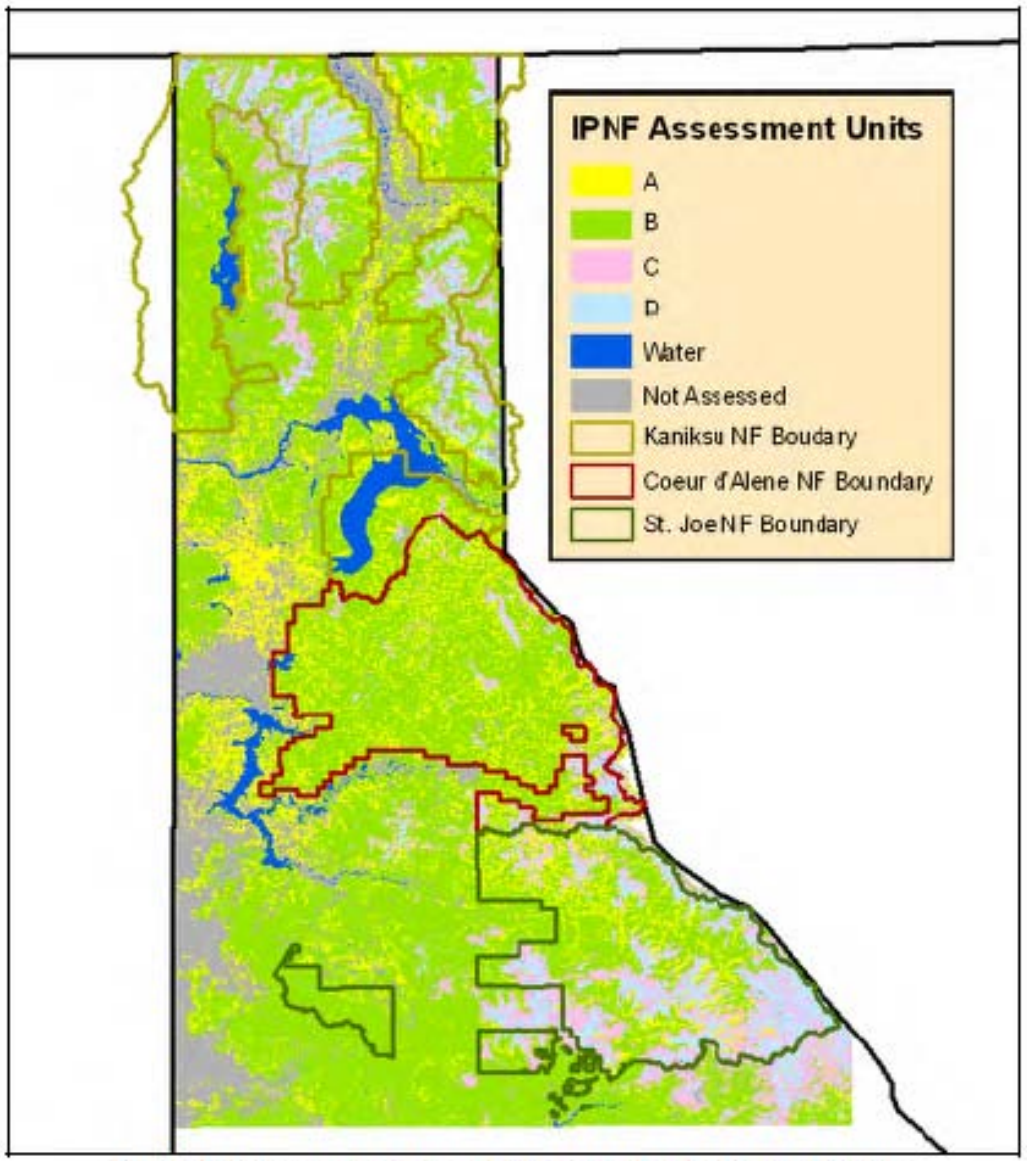
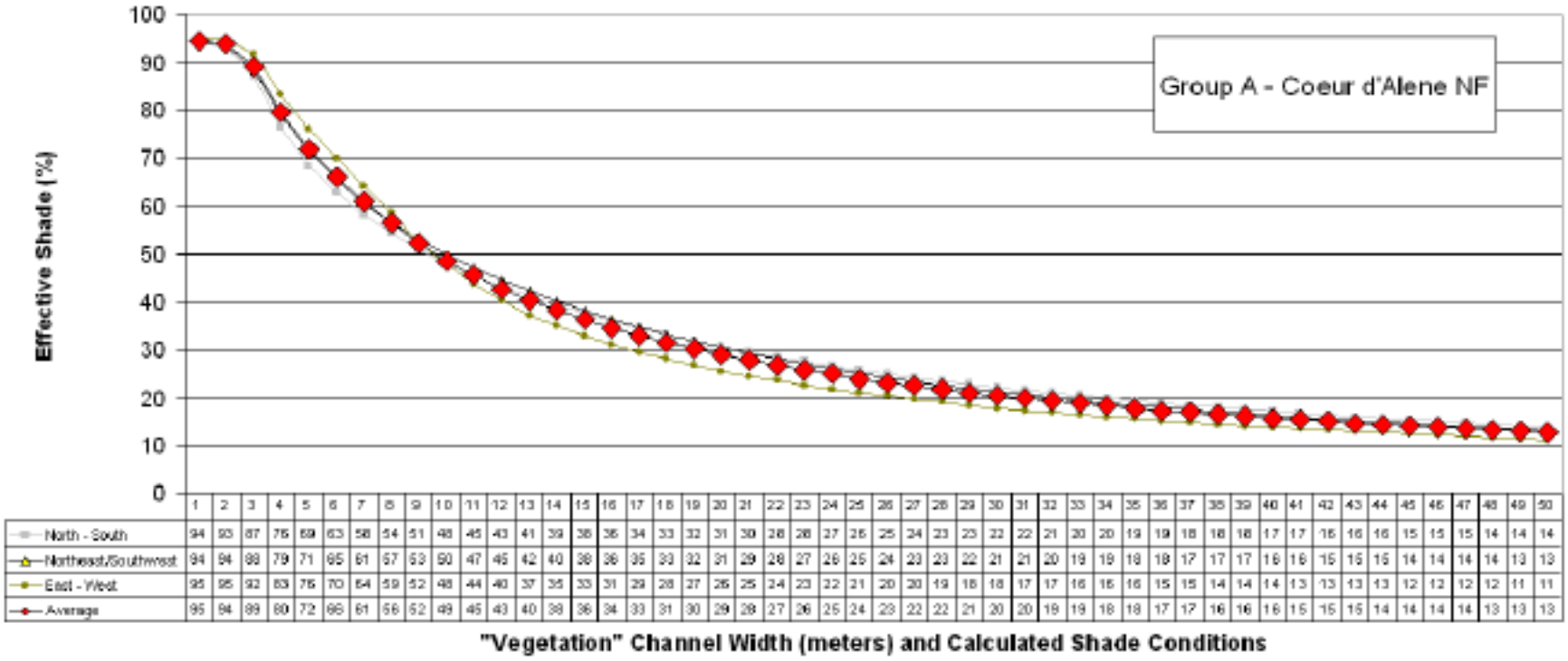


Figure 1. Assessment Groups in the Idaho Panhandle National Forests.

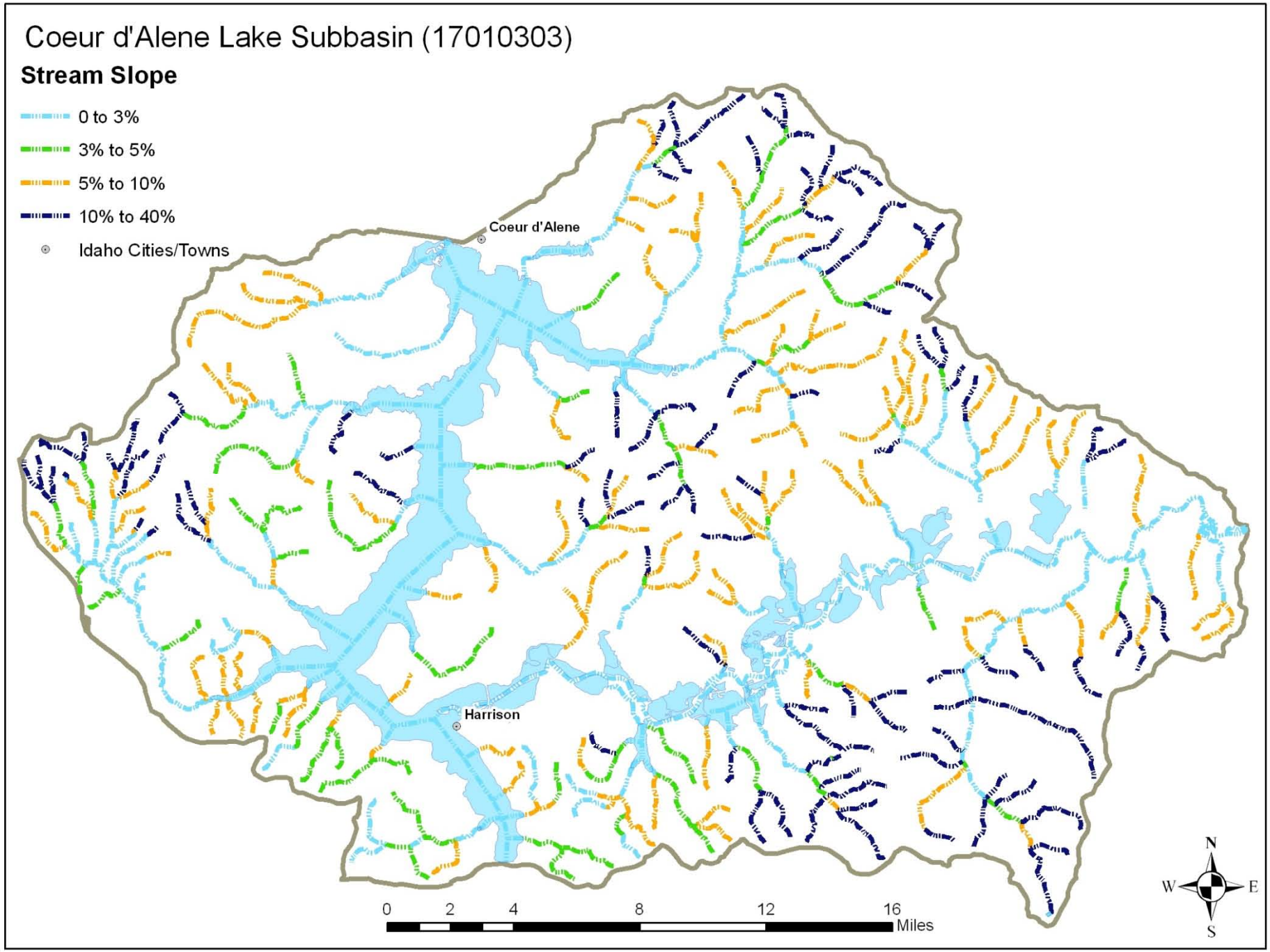
Shade Curve

Figure A.1-1 (Continued). System Potential Effective Shade at Various Stream Aspect and Stream Width Conditions.
Warm/Dry (Group A) – Coeur d'Alene National Forest (IPNF)



	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	39	40	41	42	43	44	45	46	47	48	49	50
North - South	94	93	87	76	69	63	58	54	51	48	45	43	41	39	38	36	34	33	32	31	30	28	28	27	26	25	24	23	23	22	22	21	20	20	19	19	18	18	18	17	17	16	16	16	15	15	15	14	14	14
Northeast/Southwest	94	94	88	79	71	65	61	57	53	50	47	45	42	40	38	36	35	33	32	31	29	28	27	26	25	24	23	23	22	21	21	20	19	19	18	18	17	17	17	16	16	15	15	15	14	14	14	14	13	13
East - West	95	95	92	83	76	70	64	59	52	48	44	40	37	35	33	31	29	28	27	26	25	24	23	22	21	20	20	19	18	18	17	17	16	16	16	15	15	14	14	14	13	13	13	13	12	12	12	12	11	11
Average	95	94	89	80	72	66	61	56	52	49	45	43	40	38	36	34	33	31	30	29	28	27	26	25	24	23	22	22	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13	13	13

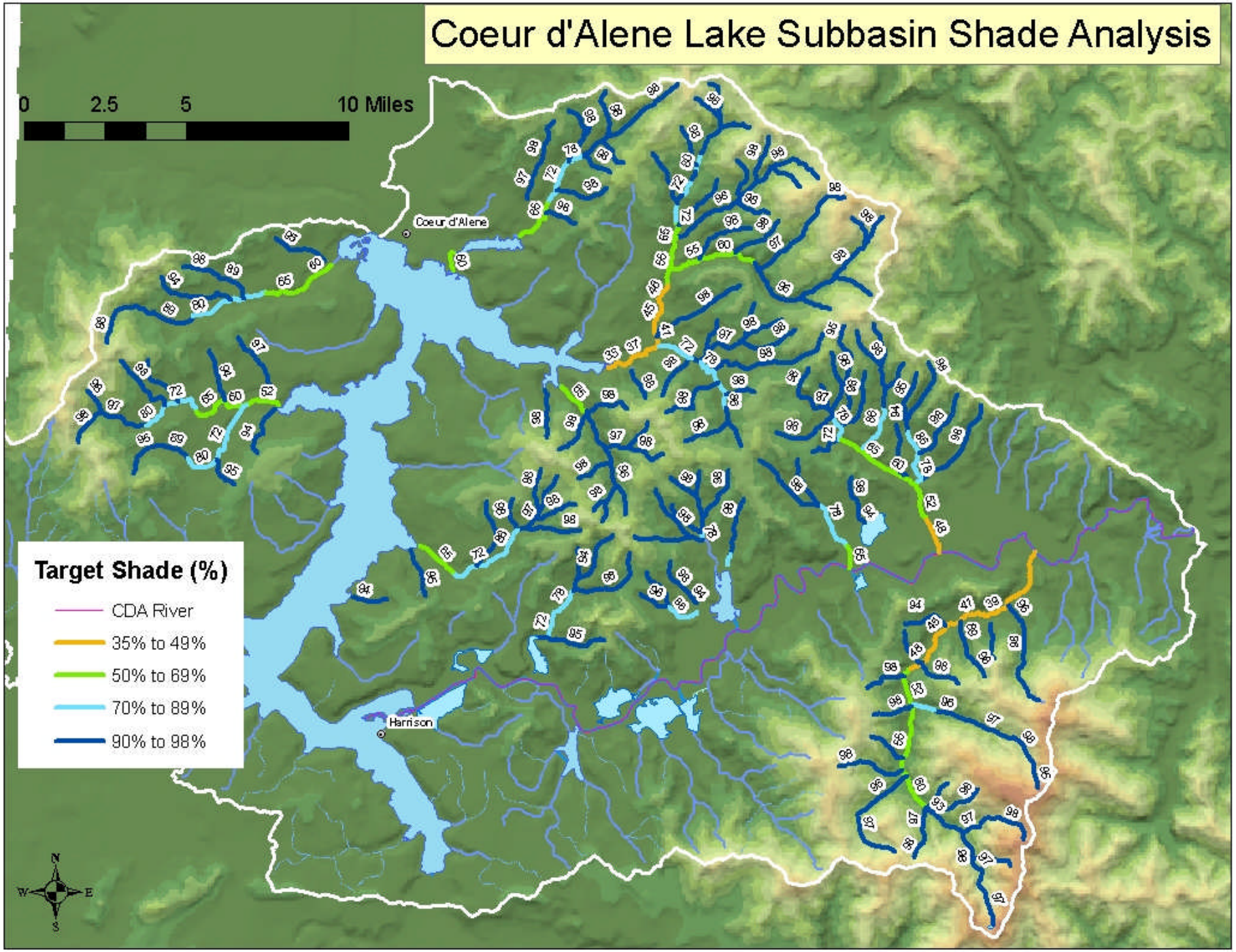
"Vegetation" Channel Width (meters) and Calculated Shade Conditions


Coeur d'Alene Lake Subbasin (17010303)
Stream Slope
0 to 3%
3% to 5%
5% to 10%
10% to 40%
Idaho Cities/Towns
Coeur d'Alene
Harrison
0
2
4
8
12
16
Miles
N
W
E
S

Hardwoods Shade Curve

Group 1 Nonforest - Hardwoods	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m
0/180 aspect		93		75		61		53		47	
45/135/225/315 aspect		93		77		64		55		49	
90/270 aspect		95		82		69		57		47	
Target (%)	**97**	**94**	**86**	**78**	**71**	**65**	**60**	**55**	**52**	**48**	**45**

Group 1 Nonforest - Hardwoods	12m	13m	14m	15m	16m	17m	18m	19m	20m	21m	22m
0/180 aspect	42		38		35		32		30		28
45/135/225/315 aspect	43		39		35		32		30		27
90/270 aspect	39		34		30		27		25		23
Target (%)	**41**	**39**	**37**	**35**	**33**	**32**	**30**	**29**	**28**	**27**	**26**

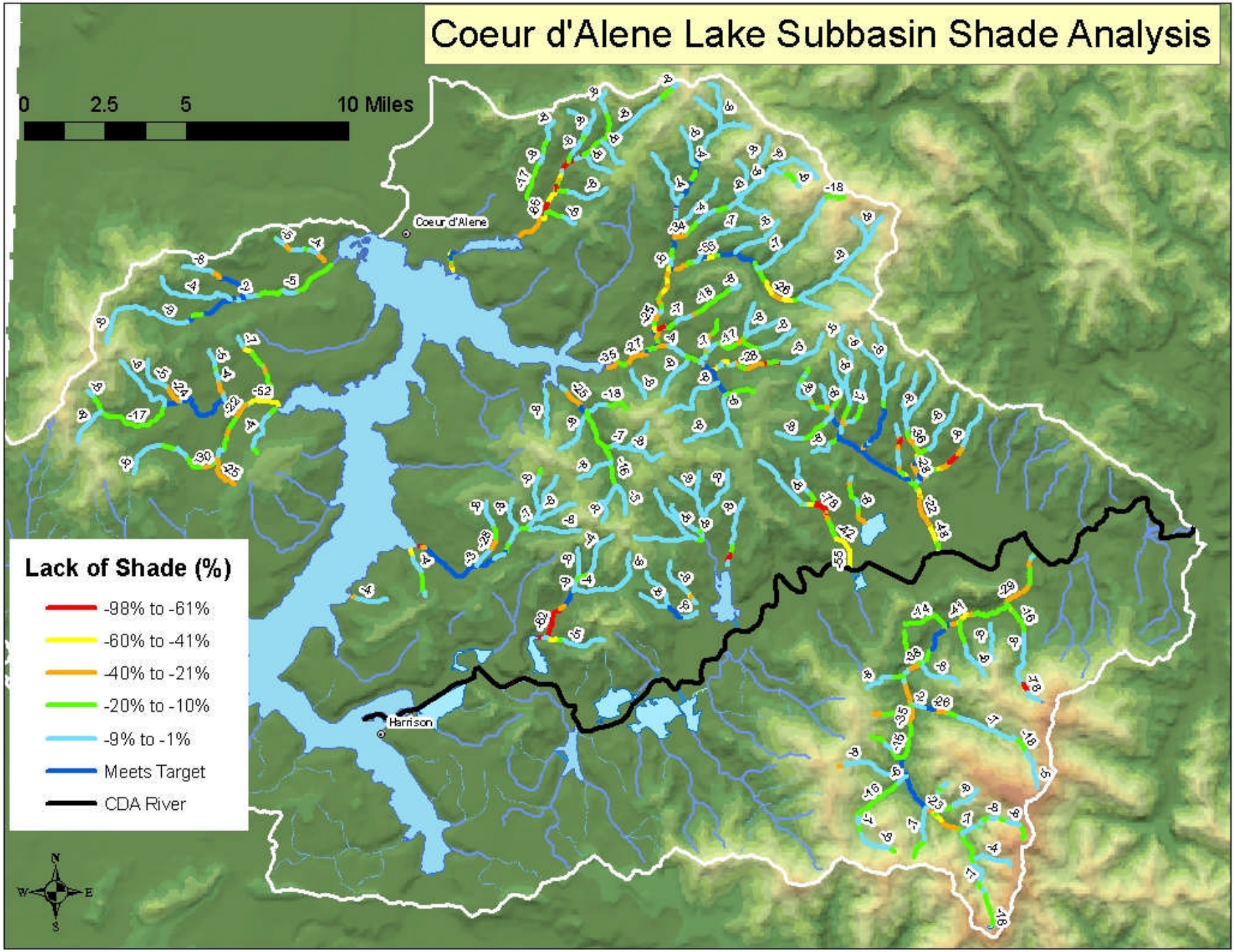

Coeur d'Alene Lake Subbasin Shade Analysis
0
2.5
5
10 Miles
Coeur d'Alene
Harrison
Target Shade (%)
CDA River
35% to 49%
50% to 69%
70% to 89%
90% to 98%
N
W
E
S

Carlin Creek Loading Table

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
026_02	Pleasant Creek	1	2000	Forest	98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
026_02	Pleasant Creek	2	440	Group B	97%	0.17	3	1,000	200	90%	0.55	3	1,000	600	400	-7%
026_02	Pleasant Creek	3	630		97%	0.17	3	2,000	300	90%	0.55	3	2,000	1,000	700	-7%
026_02	Pleasant Creek	4	520		96%	0.22	4	2,000	400	80%	1.10	4	2,000	2,000	2,000	-16%
026_02	1st to Pleasant	1	240		98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
026_02	1st to Pleasant	2	1900		98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
026_02	No Creek	1	2200		98%	0.11	2	4,000	400	90%	0.55	2	4,000	2,000	2,000	-8%
026_02	Carrill Creek	1	2700		98%	0.11	2	5,000	600	90%	0.55	2	5,000	3,000	2,000	-8%
026_02	trib to Carlin Cr	1	1500		98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
026_02	trib to Carlin Cr	2	510		98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
026_02	trib to Carlin Cr	3	610		98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
026_02	trib to Carlin Cr	4	1200		98%	0.11	2	2,000	200	95%	0.28	2	2,000	600	400	-3%
026_02	Carlin Creek	1	1700		98%	0.11	2	3,000	300	90%	0.55	2	3,000	2,000	2,000	-8%
026_02	Carlin Creek	2	850	Nonforest	86%	0.77	3	3,000	2,000	80%	1.10	3	3,000	3,000	1,000	-6%
026_02	Carlin Creek	3	440	Group 1	86%	0.77	3	1,000	800	70%	1.65	3	1,000	2,000	1,000	-16%
026_02	Carlin Creek	4	110		78%	1.21	4	400	500	90%	0.55	4	400	200	(300)	0%
026_02	Carlin Creek	5	600		78%	1.21	4	2,000	2,000	70%	1.65	4	2,000	3,000	1,000	-8%
026_02	Carlin Creek	6	950		72%	1.54	5	5,000	8,000	90%	0.55	5	5,000	3,000	(5,000)	0%
026_02	Carlin Creek	7	1500		72%	1.54	5	8,000	10,000	80%	1.10	5	8,000	9,000	(1,000)	0%
026_02	Carlin Creek	8	820		65%	1.93	6	5,000	10,000	70%	1.65	6	5,000	8,000	(2,000)	0%
026_02	Carlin Creek	9	440		65%	1.93	6	3,000	6,000	80%	1.10	6	3,000	3,000	(3,000)	0%
026_02	Carlin Creek	10	600		65%	1.93	6	4,000	8,000	70%	1.65	6	4,000	7,000	(1,000)	0%
026_02	Carlin Creek	11	210		65%	1.93	6	1,000	2,000	40%	3.30	6	1,000	3,000	1,000	-25%
026_02	Carlin Creek	12	120		65%	1.93	6	700	1,000	0%	5.50	6	700	4,000	3,000	-65%
026_02	un-named (S of	1	290	Group B	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
026_02	un-named (S of	2	340		98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
026_02	un-named (S of	3	460	Group A	95%	0.28	1	500	100	80%	1.10	1	500	600	500	-15%
026_02	un-named (S of	4	1100		94%	0.33	2	2,000	700	90%	0.55	2	2,000	1,000	300	-4%
026_02	un-named (S of	5	260		94%	0.33	2	500	200	50%	2.75	2	500	1,000	800	-44%
026_02	Hungry Hollow	1	1700		94%	0.33	2	3,000	1,000	90%	0.55	2	3,000	2,000	1,000	-4%
026_02	Hungry Hollow	2	110		94%	0.33	2	200	70	70%	1.65	2	200	300	200	-24%
							Totals		56,000					69,000	14,000	

Fernan Creek Load Table

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
034_02a	Fernan Creek	1	230	Group B	97%	0.17	3	700	100	80%	1.10	3	700	800	700	-17%
034_02a	Fernan Creek	2	150	Nonforest	78%	1.21	4	600	700	60%	2.20	4	600	1,000	300	-18%
034_02a	Fernan Creek	3	90	Group 1	78%	1.21	4	400	500	0%	5.50	4	400	2,000	2,000	-78%
034_02a	Fernan Creek	4	280		78%	1.21	4	1,000	1,000	70%	1.65	4	1,000	2,000	1,000	-8%
034_02a	Fernan Creek	5	200		78%	1.21	4	800	1,000	77%	1.27	4	800	1,000	0	-1%
034_02a	Fernan Creek	6	90		78%	1.21	4	400	500	0%	5.50	4	400	2,000	2,000	-78%
034_02a	Fernan Creek	7	120		78%	1.21	4	500	600	10%	4.95	4	500	2,000	1,000	-68%
034_03	Fernan Creek	1	310		72%	1.54	5	2,000	3,000	0%	5.50	5	2,000	10,000	7,000	-72%
034_03	Fernan Creek	2	50		72%	1.54	5	300	500	50%	2.75	5	300	800	300	-22%
034_03	Fernan Creek	3	110		72%	1.54	5	600	900	0%	5.50	5	600	3,000	2,000	-72%
034_03	Fernan Creek	4	240		72%	1.54	5	1,000	2,000	70%	1.65	5	1,000	2,000	0	-2%
034_03	Fernan Creek	5	260		72%	1.54	5	1,000	2,000	30%	3.85	5	1,000	4,000	2,000	-42%
034_03	Fernan Creek	6	200		72%	1.54	5	1,000	2,000	50%	2.75	5	1,000	3,000	1,000	-22%
034_03	Fernan Creek	7	140		72%	1.54	5	700	1,000	60%	2.20	5	700	2,000	1,000	-12%
034_03	Fernan Creek	8	80		72%	1.54	5	400	600	0%	5.50	5	400	2,000	1,000	-72%
034_03	Fernan Creek	9	160		72%	1.54	5	800	1,000	50%	2.75	5	800	2,000	1,000	-22%
034_03	Fernan Creek	10	770		72%	1.54	5	4,000	6,000	30%	3.85	5	4,000	20,000	10,000	-42%
034_03	Fernan Creek	11	700		65%	1.93	6	4,000	8,000	0%	5.50	6	4,000	20,000	10,000	-65%
034_03	Fernan Creek	12	140		65%	1.93	6	800	2,000	20%	4.40	6	800	4,000	2,000	-45%
034_03	Fernan Creek	13	210		65%	1.93	6	1,000	2,000	10%	4.95	6	1,000	5,000	3,000	-55%
034_03	Fernan Creek	14	1440		65%	1.93	6	9,000	20,000	30%	3.85	6	9,000	30,000	10,000	-35%
032_03	Fernan Creek	1	60		60%	2.20	7	400	900	90%	0.55	7	400	200	(700)	0%
032_03	Fernan Creek	2	40		60%	2.20	7	300	700	0%	5.50	12	500	3,000	2,000	-60%
032_03	Fernan Creek	3	50		60%	2.20	7	400	900	90%	0.55	7	400	200	(700)	0%
032_03	Fernan Creek	4	200		60%	2.20	7	1,000	2,000	0%	5.50	40	8,000	40,000	40,000	-60%
032_03	Fernan Creek	5	90		60%	2.20	7	600	1,000	60%	2.20	2	200	400	(600)	0%
032_03	Fernan Creek	6	100		60%	2.20	7	700	2,000	20%	4.40	3	300	1,000	(1,000)	-40%
032_03	Fernan Creek	7	110		60%	2.20	7	800	2,000	50%	2.75	4	400	1,000	(1,000)	-10%
032_03	Fernan Creek	8	170		60%	2.20	7	1,000	2,000	20%	4.40	5	900	4,000	2,000	-40%
032_03	Fernan Creek	9	250		60%	2.20	7	2,000	4,000	0%	5.50	7	2,000	10,000	6,000	-60%
							Totals		71,000					180,000	100,000	


Coeur d'Alene Lake Subbasin Shade Analysis
0
2.5
5
10 Miles
Coeur d'Alene
Harrison
Lack of Shade (%)
-98% to -61%
-60% to -41%
-40% to -21%
-20% to -10%
-9% to -1%
Meets Target
CDA River
N
W
E
S

Implementation

- Prioritize with Lack of Shade.
- Field Verification – nature of problem and pathfinder shade.
- Problem identification – beaver ponds, subtending water, plant community, channel width, disturbance (natural vs. human-caused).
- Real problems for rehabilitation.

Impalpable Challenges

- Lakes, Reservoirs, beaver ponds, etc.
- Agricultural diversion & return.
- Point sources.
- Ground water influences

From this …

to this