Potential Natural Vegetation (PNV)

Presented to the North Fork Coeur d'Alene River Watershed Advisory Group

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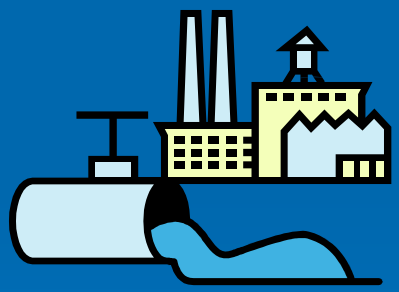
Temperature

- Elevated temperatures increase stress on the aquatic community
  - Reduced cutthroat trout populations
  - Shift in macroinvertebrate community

Temperature

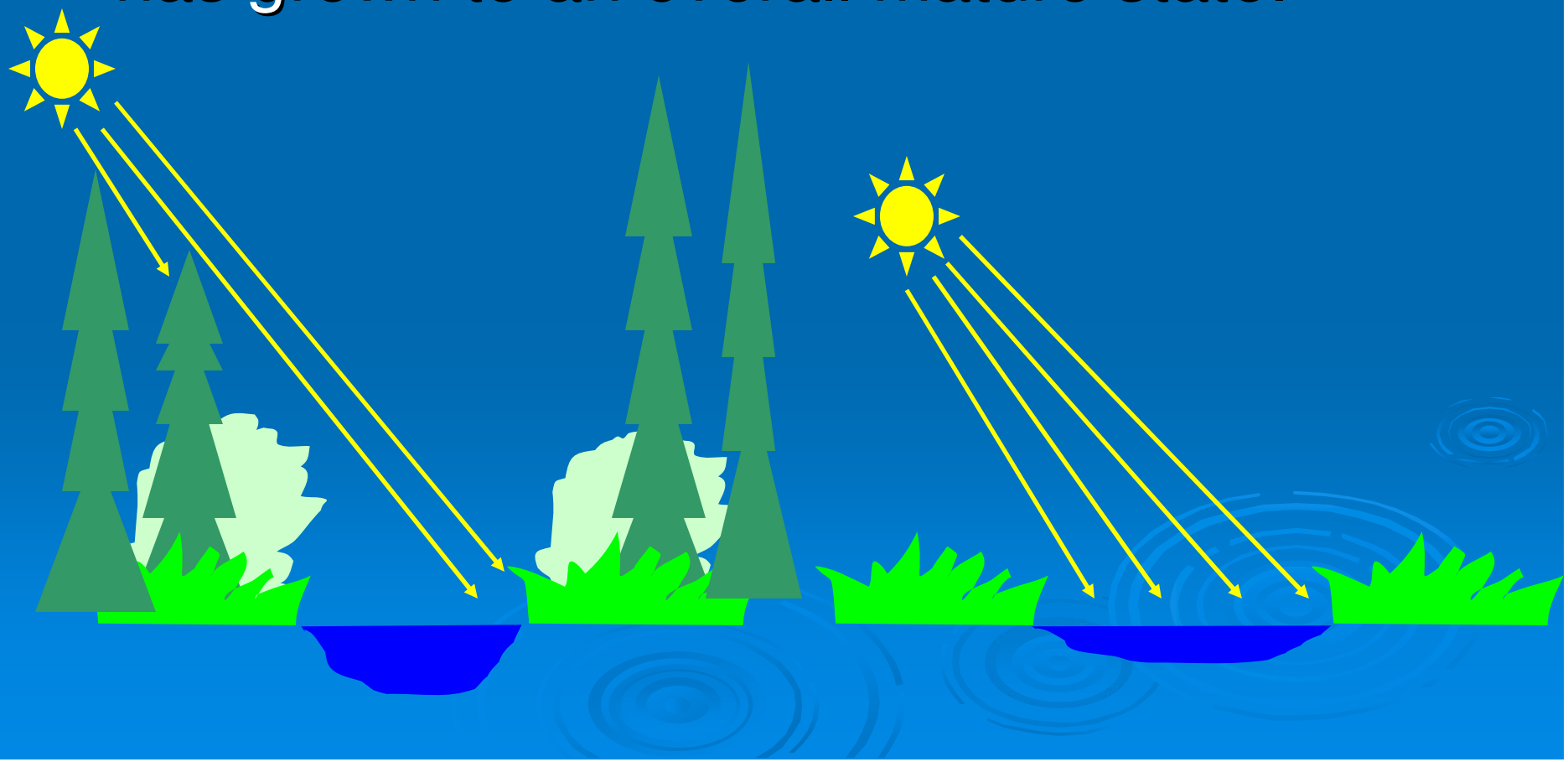
- Factors contributing to elevated stream temperature
  - Ground water
  - Point source dischargers
  - Geo-thermal inputs
  - Air temperature
  - Solar loading



- Of these factors reductions in solar loads (increases in shade) is the most manageable

What is Potential Natural Vegetation?

- PNV is that riparian plant community that has grown to an overall mature state.



What is Potential Natural Vegetation?

- Why use shade?
  - Most controllable
  - Easily measured
  - Thermal inputs most likely cause of increased water temperature
  - Other possible sources not seen in watershed

Modeling Shade Steps

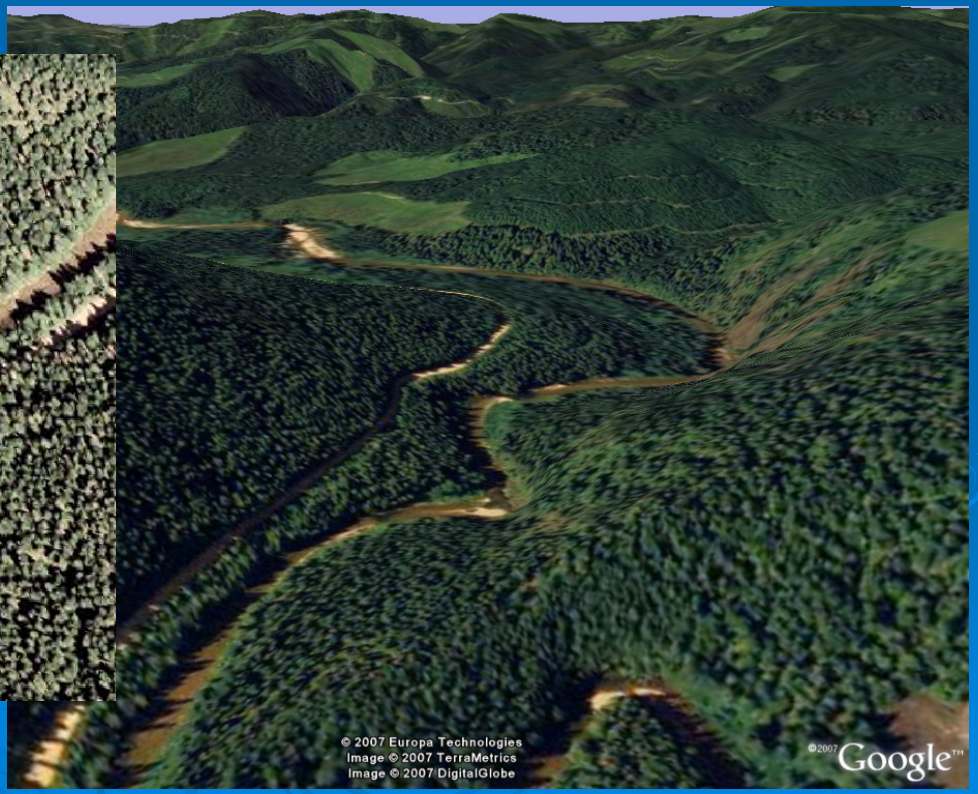
1. Determine existing shade
2. Validate existing shade estimates
3. Choose regional PNV shade curve
4. Calculate stream surface area
    1. Existing and Potential
5. Determine existing load and potential load, difference = TMDL

Step 1

Estimating Existing Shade

Estimating Existing Shade

- Satellite interpretation
- Topographic influences



Estimating Existing Shade

Estimating Existing Shade

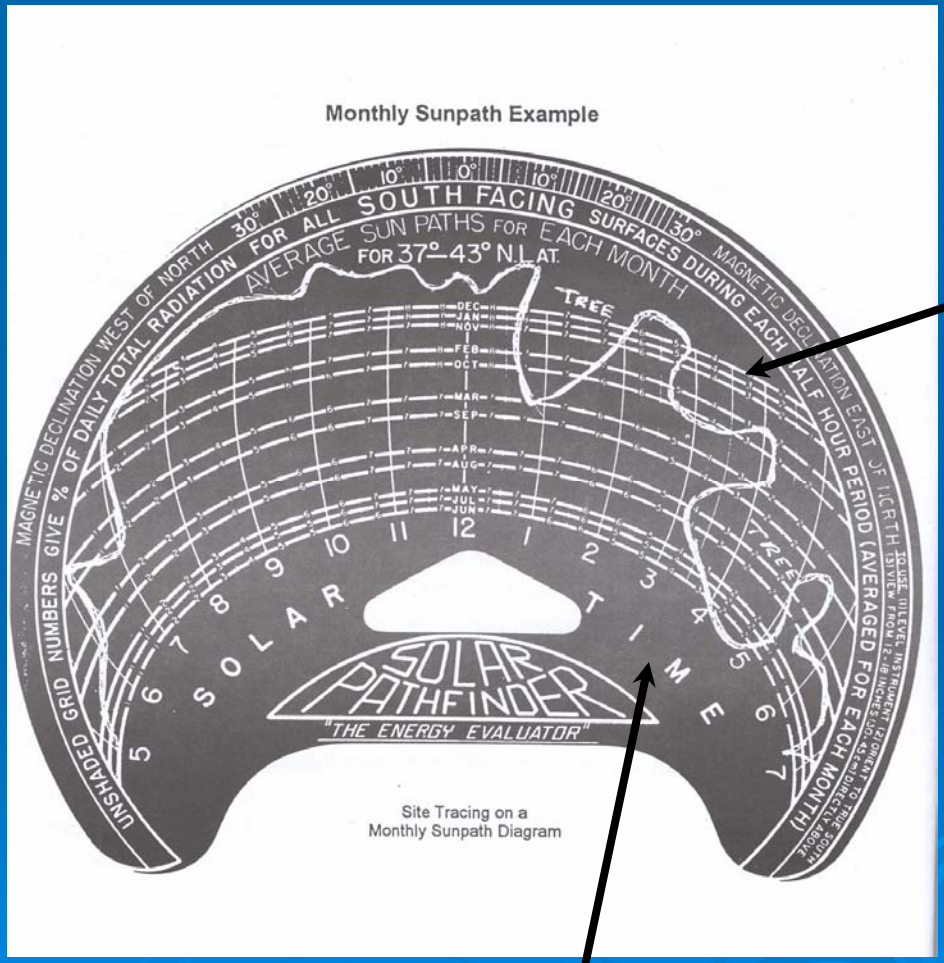
10%

Step 2

Validating Existing Shade Estimates

Validating Existing Shade Estimates

Validating Existing Shade Estimates



Shaded Area

Unshaded Area

Validating Existing Shade Estimates

Validating Existing Shade Estimates

Step 3

Choosing a representable PNV shade curve

Vegetation Community Composition

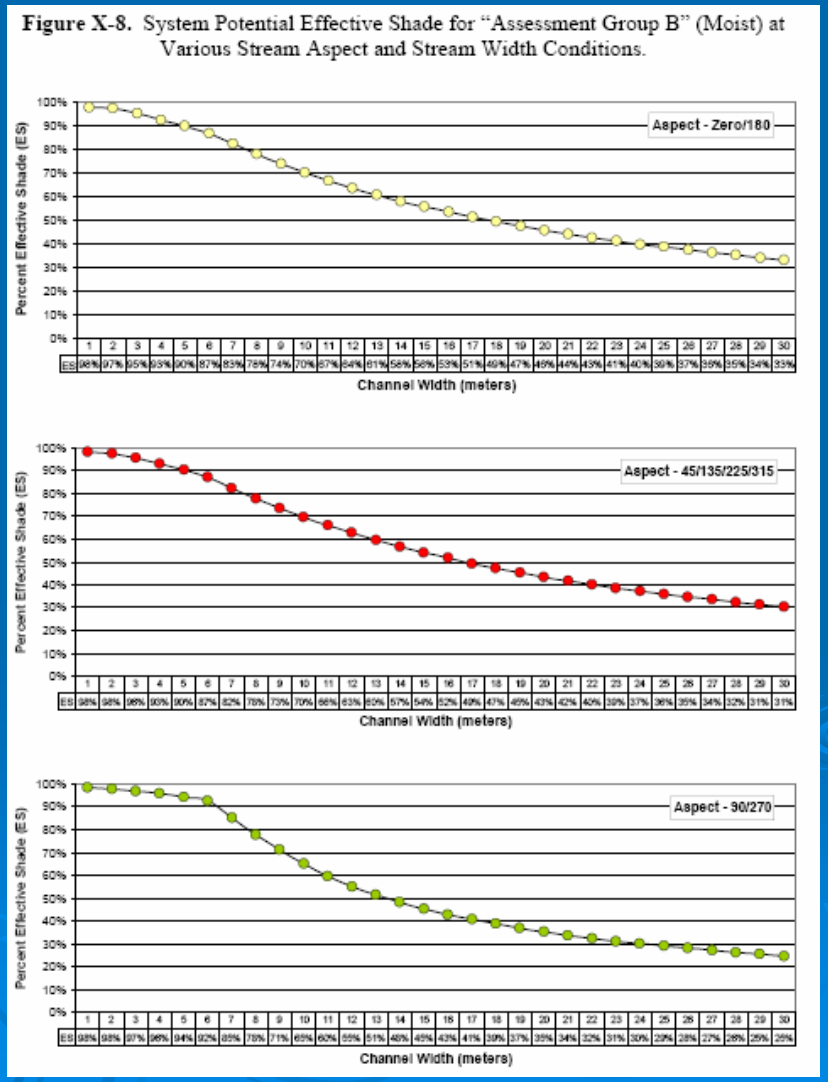
- Five vegetation subgroups categorized in subbasin
  - Conifer Forest
  - Conifer / Shrub
  - Conifer meadow
  - Forest opening >100 meters
  - Grass meadow near lower reach floodplain

Conifer Forest – Group B

- Moist forest consisting of Western Red Cedar and Western Hemlock

Conifer	1m	2m	3m	4m	5m	6m	7m	8m	9m
Group B - VRUs 4,5,6	98	98	96	94	91	89	83	78	73
Target (%)	**98**	**98**	**96**	**94**	**91**	**89**	**83**	**78**	**73**

Conifer	10m	11m	12m	13m	14m	15m	20m	24m	25m
Group B - VRUs 4,5,6	68	64	61	57	54	52	41	37	35
Target (%)	**68**	**64**	**61**	**57**	**54**	**52**	**41**	**37**	**35**



Conifer Forest/Shrub – Group B & Non-forest Group 1

- Group B - Moist forest consisting of Western Red Cedar and Western Hemlock
- Non-forest 1 – black cottonwood, rocky mountain maple, and alder

Conifer/Shrub	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m	14m	15m
Group B - VRUs 4,5,6	98	98	96	94	91	89	83	78	73	68	64	61	57	54	52
Group 1 - Hardwoods	98	94	86	78	72	65	60	55	52	48	45	41	39	37	35
Average	98	96	91	86	81.5	77	71.5	66.5	62.5	58	54.5	51	48	45.5	43.5
Target (%)	**98**	**96**	**91**	**86**	**82**	**77**	**72**	**67**	**63**	**58**	**55**	**51**	**48**	**46**	**44**

Conifer/Shrub	16m	17m	18m	19m	20m	21m	22m	23m	24m	25m	26m	27m	28m	29m	30m
Group B - VRUs 4,5,6	49	47	45	43	41	40	38	37	36	35	33	32	31	30	30
Group 1 - Hardwoods	33	32	30	29	28	27	26	25	24	24	23	22	21	21	20
Average	41	39.5	37.5	36	34.5	33.5	32	31	30	29.5	28	27	26	25.5	25
Target (%)	**41**	**40**	**38**	**36**	**35**	**34**	**32**	**31**	**30**	**30**	**28**	**27**	**26**	**26**	**25**

Conifer/Shrub	31m	32m	33m	34m	35m	38m	41m	44m	46m	47m	48m	49m	50m	51m	52m	59m
Group B - VRUs 4,5,6	29	29	28	28	27	26	24	23	22	22	21	21	21	21	20	19
Group 1 - Hardwoods	19	18	18	18	17	16	15	14	14	14	13	13	13	13	12	11
Average	24	23.5	23	23	22	21	19.5	18.5	18	18	17	17	17	17	16	15
Target (%)	**24**	**24**	**23**	**23**	**22**	**21**	**20**	**19**	**18**	**18**	**17**	**17**	**17**	**17**	**16**	**15**

Conifer Meadow – Grass & Group B

- Grass – Tufted hairgrass
- Group B – Moist forest consisting of Western Red Cedar and Western Hemlock

Conifer Meadow	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m
Group B - VRUs 4,5,6	98	98	96	94	91	89	83	78	73	68	64	61
Tufted Hairgrass (IDEQ, 2002)	43	30	17	15	12	10	9	8	7	6	6	5
Average	70.5	64	56.5	54.5	51.5	49.5	46	43	40	37	35	33
Target (%)	**71**	**64**	**57**	**55**	**52**	**50**	**46**	**43**	**40**	**37**	**35**	**33**

Conifer Meadow	13m	14m	15m	16m	17m	18m	19m	20m	21m	23m	26m	27m
Group B - VRUs 4,5,6	57	54	52	49	47	45	43	41	40	37	33	32
Tufted Hairgrass (IDEQ, 2002)	5	4	4	3	3	3	2	2	2	1	1	1
Average	31	29	28	26	25	24	22.5	21.5	21	19	17	16.5
Target (%)	**31**	**29**	**28**	**26**	**25**	**24**	**23**	**22**	**21**	**19**	**17**	**17**

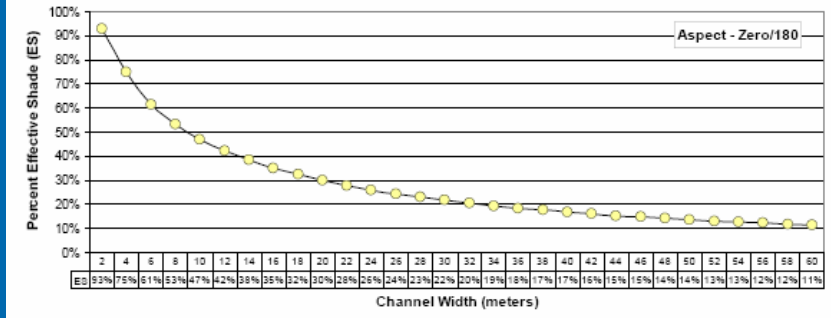
Forest Opening >100 meters – Non-Forest Group 1

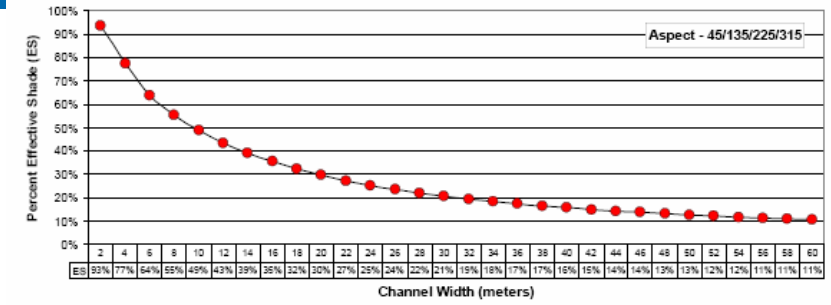
- Non-Forest Group 1 – black cottonwood, rocky mountain maple, and alder

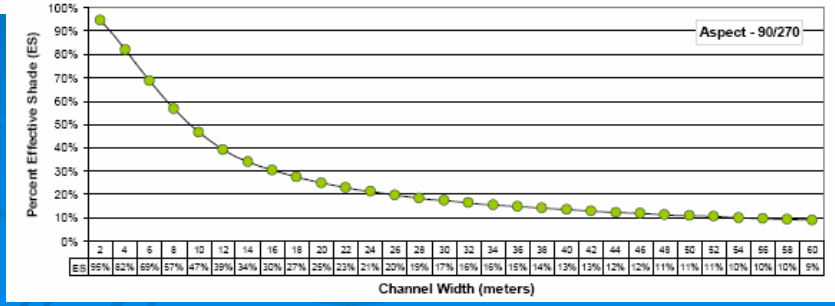
Shrub Meadow	1m	2m	3m	4m	5m
Group 1 - Hardwoods	98	94	86	78	72
Target (%)	**98**	**94**	**86**	**78**	**72**

6m	7m	8m	9m	10m	11m	12m	16m
65	60	55	52	48	45	41	33
65	**60**	**55**	**52**	**48**	**45**	**41**	**33**

Figure X-16. System Potential Effective Shade for "Non-Forest" Assessment Group 1 at Various Stream Aspect and Stream Width Conditions.







Grass Meadow – Non-Forest Group 1 & Tufted Hairgrass

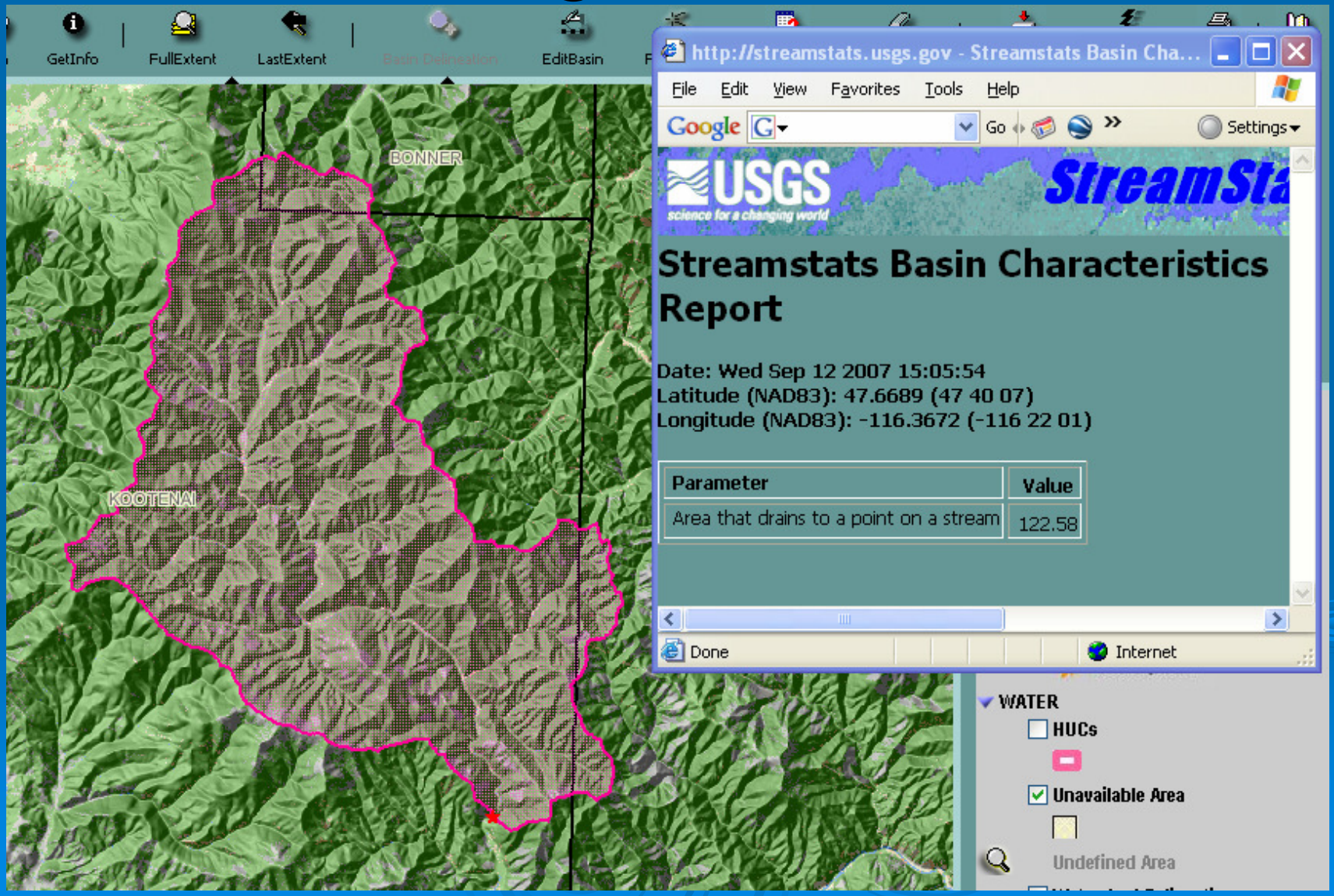
- Areas occupying floodplains in lower reaches
  - Non-Forest Group 1 - black cottonwood, rocky mountain maple, and alder
  - Tufted Hairgrass

Grass Meadow	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	14m	17m	23m
Group 1 - Hardwoods	98	94	86	78	72	65	60	55	52	48	45	41	37	32	25
Tufted Hairgrass (IDEQ, 2002)	43	30	17	15	12	10	9	8	7	6	6	5	4	3	1
Average	70.5	62	51.5	46.5	42	37.5	34.5	31.5	29.5	27	25.5	23	20.5	17.5	13
Target (%)	**71**	**62**	**52**	**47**	**42**	**38**	**35**	**32**	**30**	**27**	**26**	**23**	**21**	**18**	**13**

Step 4

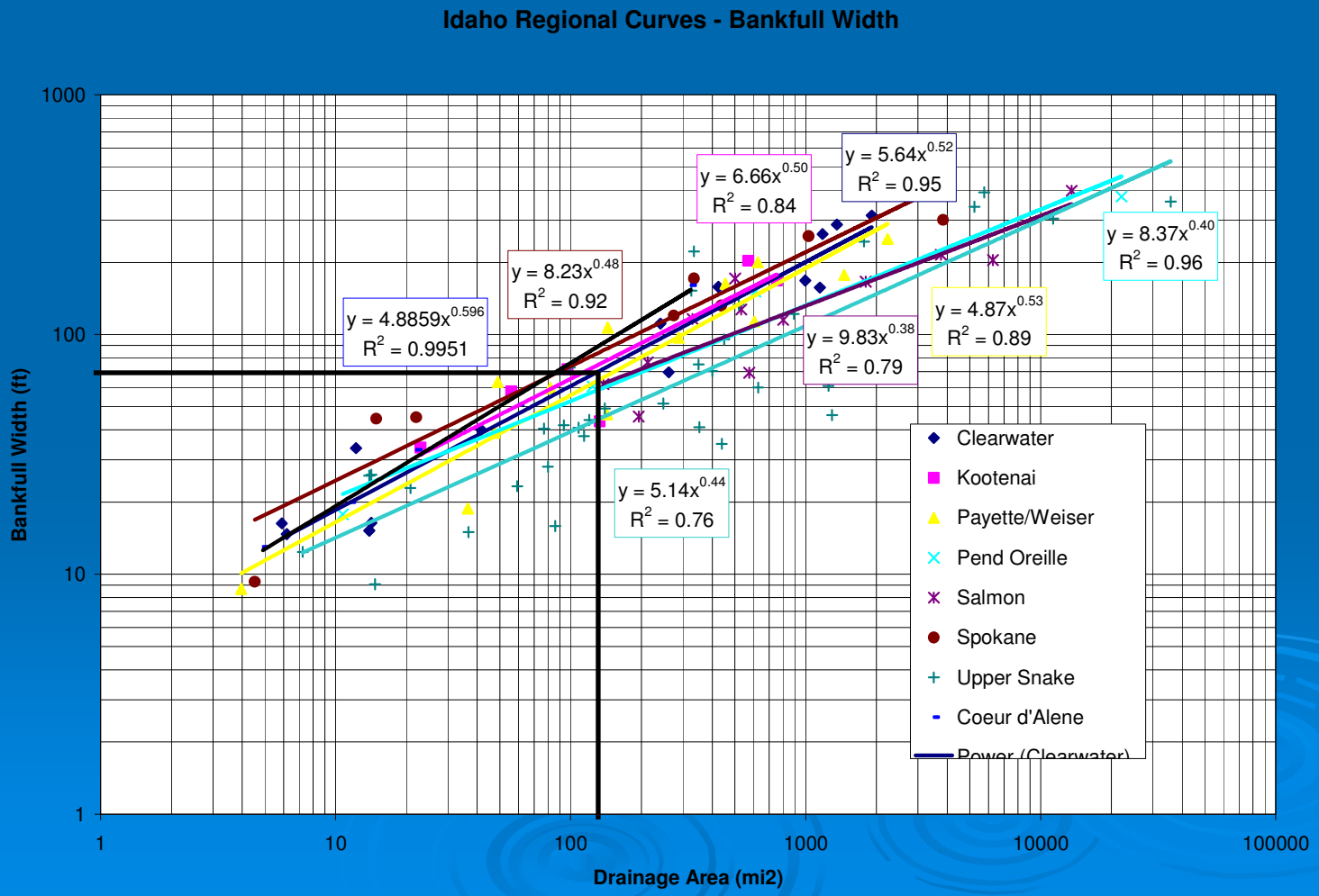
Determining Stream Surface Area

Determining Bankfull Width



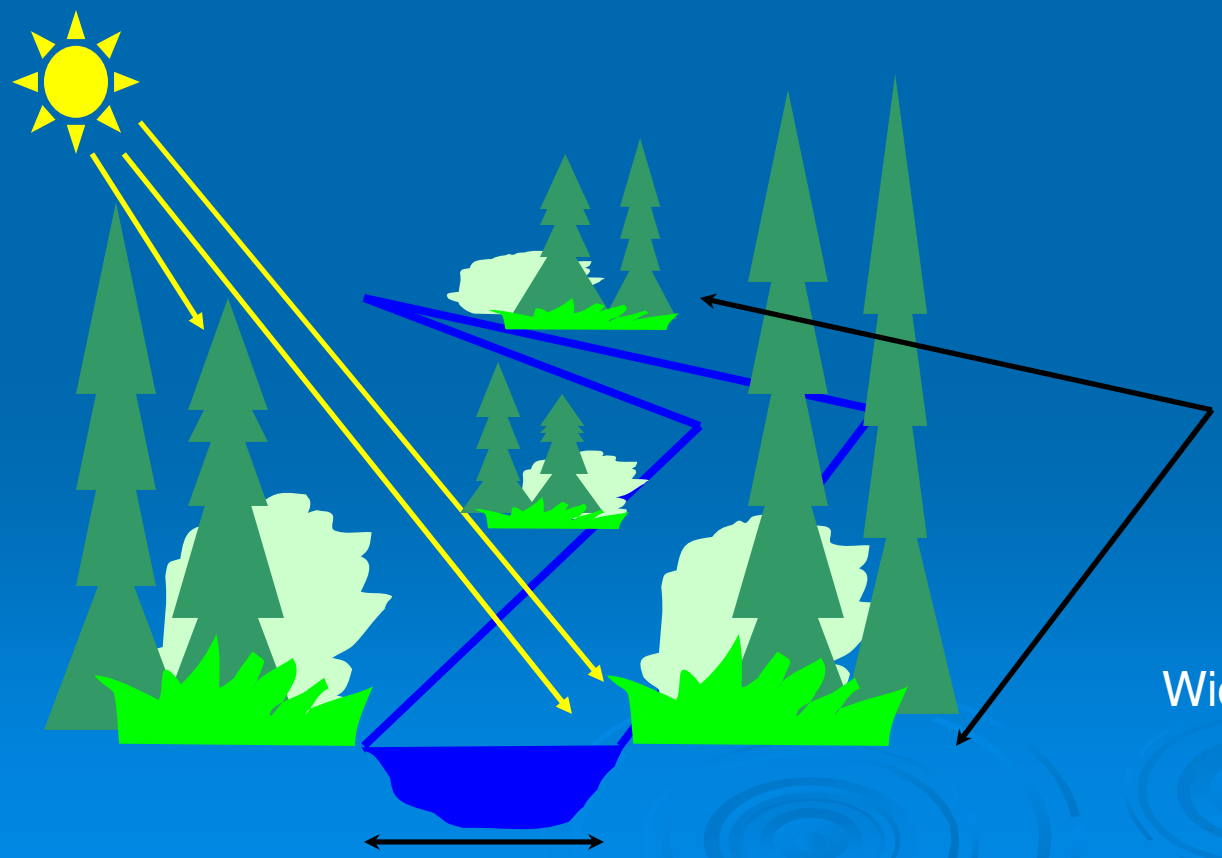
Determining Bankfull Width

- Bankfull width (x) Reach length



Determining Stream Surface Area

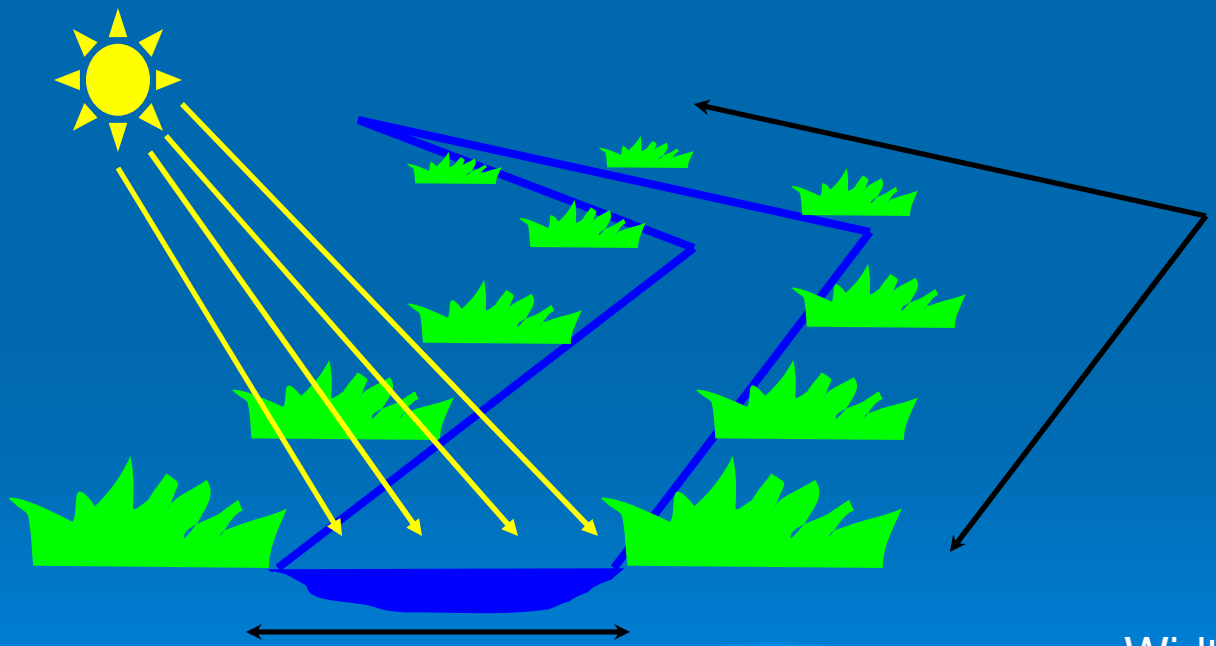
- Bankfull width X Length of Stream Reach



Width X Length = Area

Determining Stream Surface Area

- Bankfull width X Length of Stream Reach



Width X Length = Area

Step 5

Calculating Existing and Potential Solar Loads

Developing Solar Load

- Solar radiation data collected from Natural Renewable Energy Lab (NREL)
  - Spokane, WA and Kalispell, MT
- Existing solar load
  - Area X NREL solar radiation data
- Potential solar load
  - Area X NREL solar radiation data

Developing Solar Load

Table 28 (cont). Existing and Potential Solar Loads for North Fork Coeur d'Alene River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	NF Coeur d'Alene River
490	0.1	4.95	0.41	3.245	-1.71	18	16	8820	43659	7840	25440.8	-18218.2	conifer/shrub
180	0	5.5	0.41	3.245	-2.26	18	16	3240	17820	2880	9345.6	-8474.4	
530	0.1	4.95	0.41	3.245	-1.71	19	16	10070	49846.5	8480	27517.6	-22328.9	
390	0	5.5	0.41	3.245	-2.26	19	16	7410	40755	6240	20248.8	-20506.2	
360	0.1	4.95	0.4	3.3	-1.65	19	17	6840	33858	6120	20196	-13662	
270	0	5.5	0.4	3.3	-2.20	19	17	5130	28215	4590	15147	-13068	
180	0.1	4.95	0.4	3.3	-1.65	19	17	3420	16929	3060	10098	-6831	
830	0	5.5	0.4	3.3	-2.20	20	17	16600	91300	14110	46563	-44737	

Existing Shade

Potential Shade

Existing Solar Load

Potential Solar Load

Existing – Potential = TMDL

or solar reduction needed

From this …

to this