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An Economic Approach to Estimating the Effectiveness of Forestry BMPs

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- Background and Justification
  - Evidence-based BMPs?
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Water and Property Rights

- Private owners do not **own the water** that flows through their lands
- This is a trust resource
- Downstream riparians have a **right to clean water**
- Owners do not have the right to put sediment or slush into the streams
- BMPs intended to reduce **externalities** of forest operations

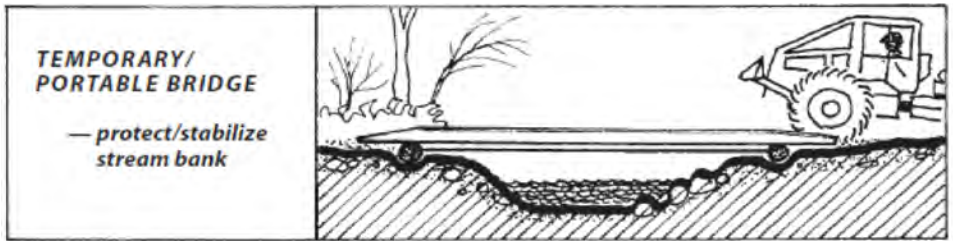
Maine's Forest Economy

- 17.6 MM acres of forest land
- 100,000 + forest owners
- 32,000 miles of permanent & perennial streams
- 5,400 logging jobs/year
- 400,000 acres harvested each year
- 12.8 MM Tons harvested/year

Source: MFPC (2016)

Policy side

- Forestry identified as a contributor of nonpoint source pollution
- The 1972 Clean Water Act requires all forested states to have a forest water quality protection program based on acceptable BMPs.
- BMPs introduced as suggested guidelines/techniques to help protect water quality and habitat integrity
- In many states, BMPs are the basis for a voluntary program that relies on logger and forest landowner education, while some states make them mandatory or include them as part of a broader state forest practices law.
- Extensive research confirmed its effectiveness, often 70% or more



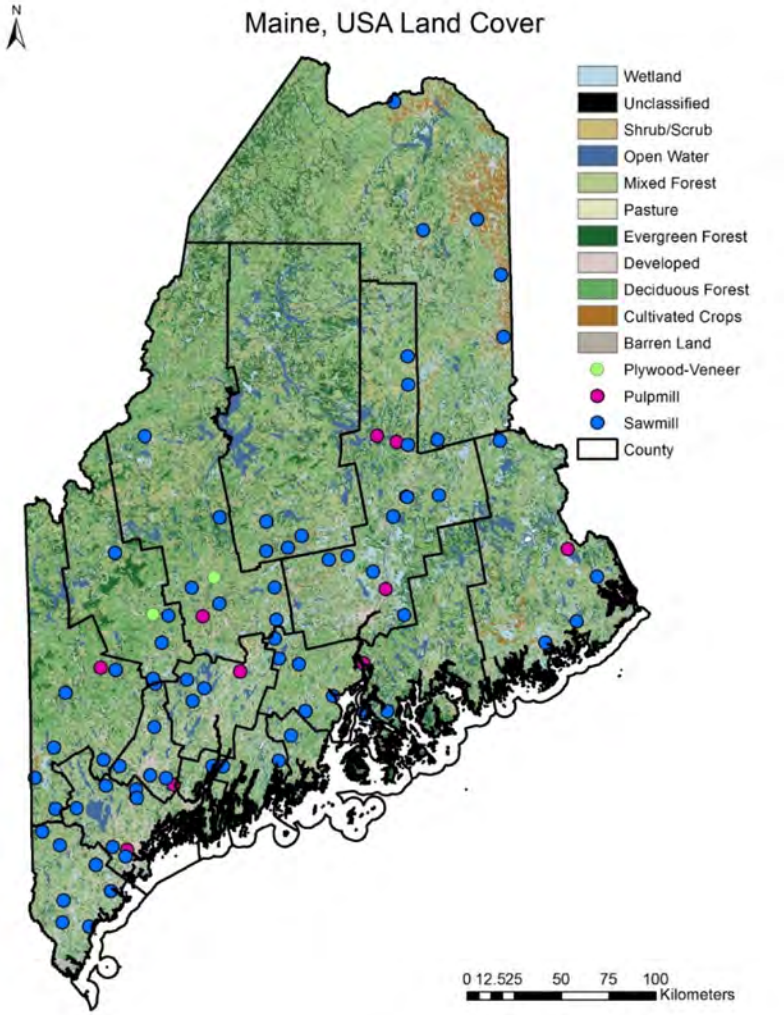
Maine Forestry BMPs

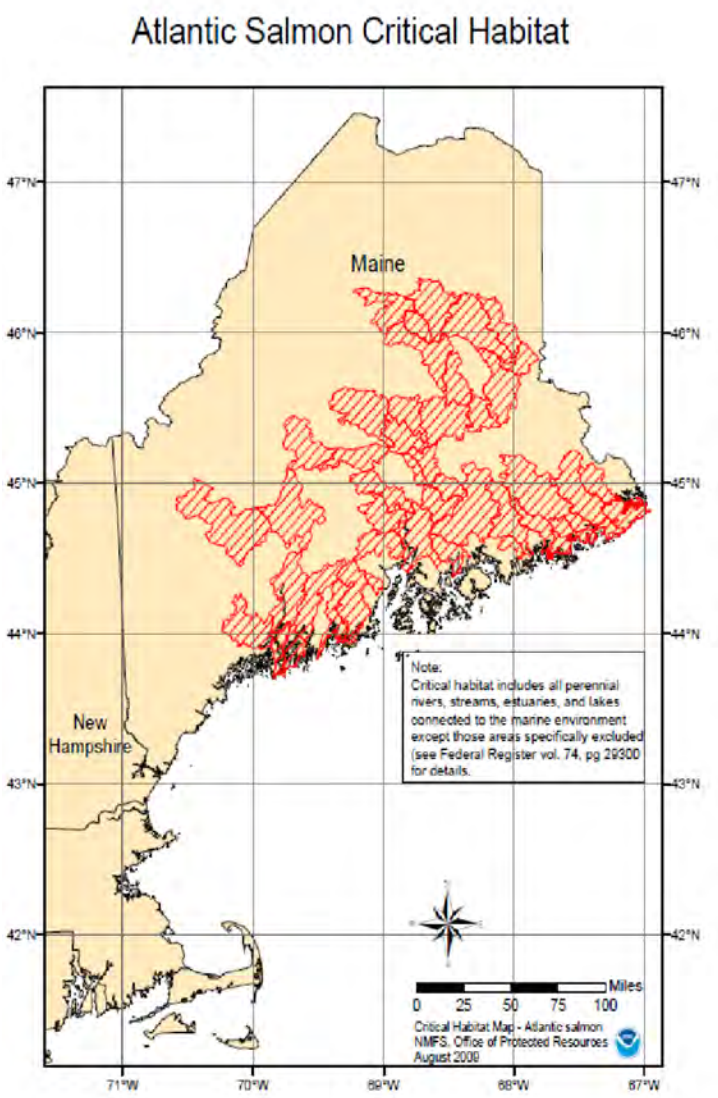
- Maine Forest Service promotes voluntary implementation of BMPs, stating:
  - It is often more effective, cheaper, and easier to prevent pollution than to fix problems after they occur.
  - When you understand the principles behind BMP techniques, you will be able to anticipate and prevent problems before they end up costing you time and money.

Then and now

Multiple Water Values

- Shifting from recreation to multiple values
- Last bastion of native brook trout
- Opportunity to restore Atlantic salmon?
- Recognition of ecological/fishery role of diadromous spp.


Maine, USA Land Cover
N
Wetland
Unclassified
Shrub/Scrub
Open Water
Mixed Forest
Pasture
Evergreen Forest
Developed
Deciduous Forest
Cultivated Crops
Barren Land
Plywood-Veneer
Pulpmill
Sawmill
County
0 12.525 50 75 100
Kilometers

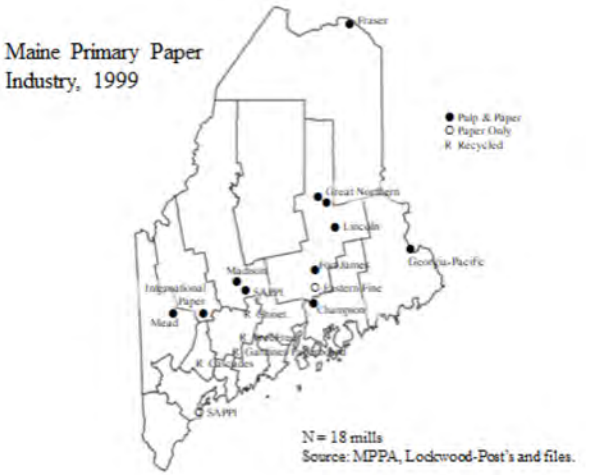

Atlantic Salmon Critical Habitat
Maine
New Hampshire
47°N
46°N
45°N
44°N
43°N
42°N
71°W
70°W
69°W
68°W
67°W
Note:
Critical habitat includes all perennial rivers, streams, estuaries, and lakes connected to the marine environment except those areas specifically excluded (see Federal Register vol. 74, pg 29300 for details.
Miles
0 25 50 75 100
Critical Habitat Map - Atlantic salmon
NMFS, Office of Protected Resources
August 2009

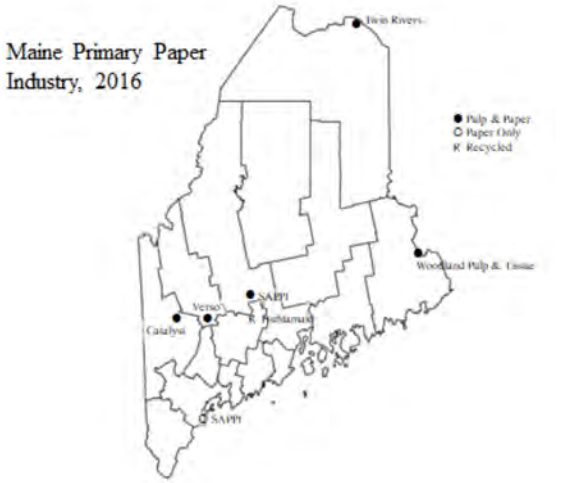
Challenges

- Roads, culverts and bridges are old and stressed by changes in climate
- Some are washing out or overdue for replacement
- Short time horizon of some owners
- Many owners have camp lots on leases; roads are usually poor

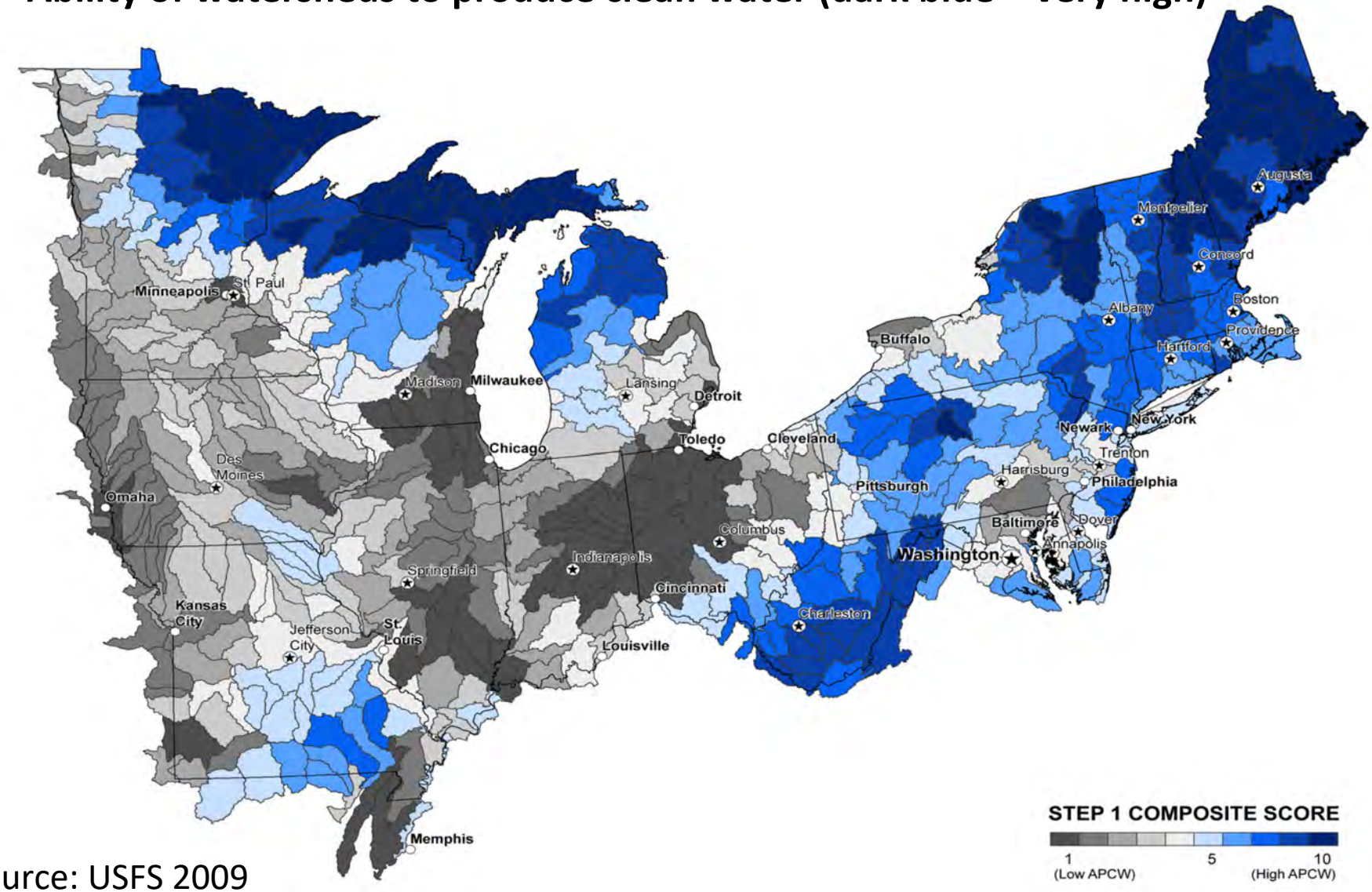
Challenges

- Currently, wood markets down and landowner returns weak
- Deteriorating roads – truck speeds declining; damage to vehicles; lost bridges; longer hauls
  - All add to higher delivered wood costs
- Yet expectations for improved water quality continue (required by law)



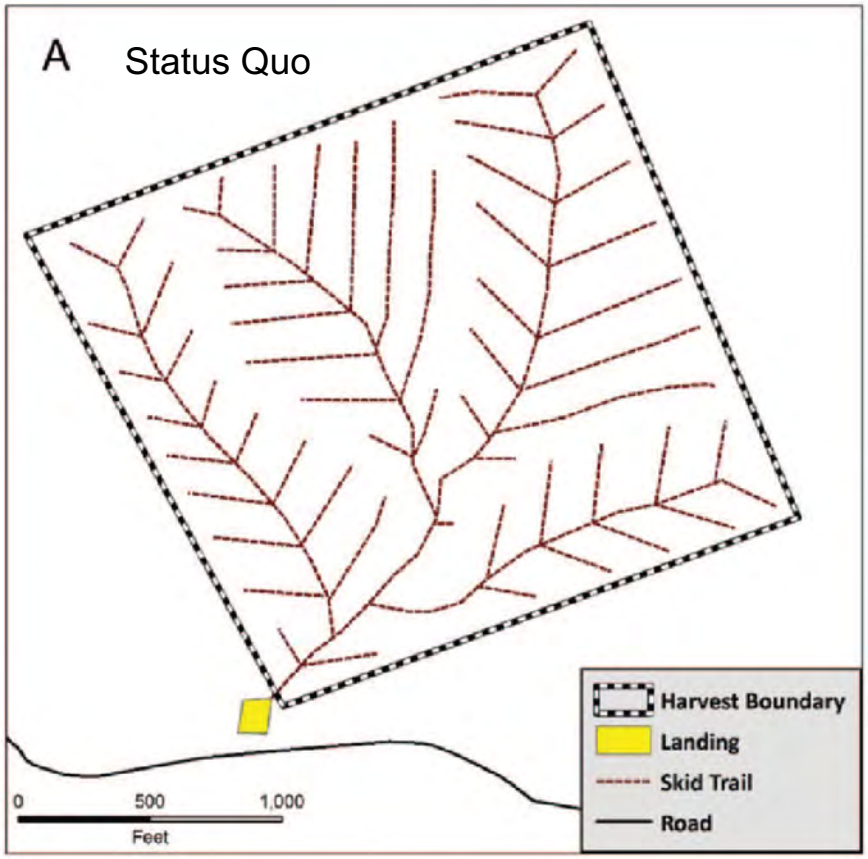


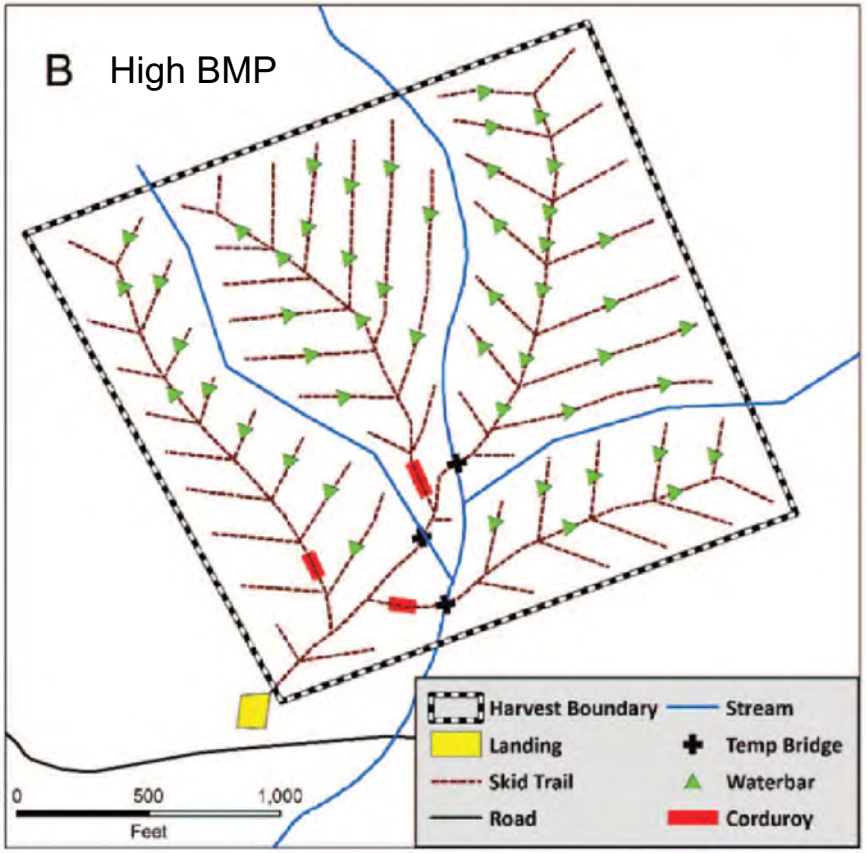
Ability of watersheds to produce clean water (dark blue = very high)



Source: USFS 2009

Costing out BMPs





What is cost of going from A to B, and how effective is it?

Source: Kelly et al (JoF, 2017)

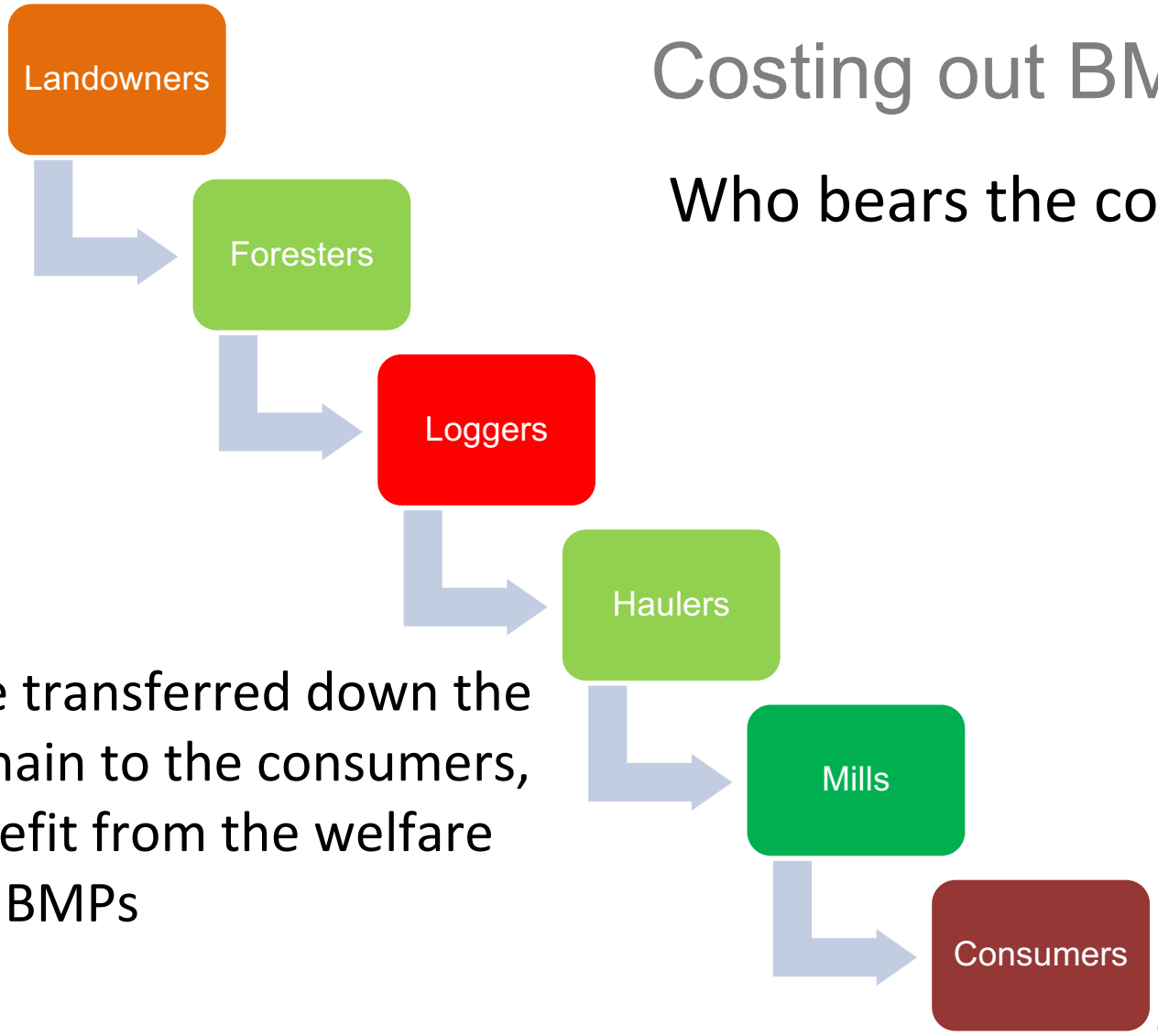
Costing out BMPs

Components of BMP costs

- **Labor**: road-building, engineers, extra hours
- **Capital equipment**: culverts, water bars, bridges
- **Machine Time**: level of effort and type
- **Opportunity cost**: lost area to harvest, time, planning

Costing out BMPs

Who bears the costs?



Costs are transferred down the supply chain to the consumers, who benefit from the welfare effect of BMPs

Source: Sun (2006)

Costing out BMPs Literature

- Ellefson and Miles (1985) found that estimated BMP costs in the Midwest could amount to more than half of the net returns on national forest timber sales.
- Henly et al. (1988) found that government costs to implement forest practice rules ranged from as little as $100,000 per year in Idaho and Nevada to more than $4 million annually in California.
- Lickwar et al. (1992) estimated Southeast average costs of $12.45 per acre, $2.34 per MBF, or 2.87% of gross stumpage values based on 1987 BMPs and prices.
- Woodman and Cubbage (1994) estimated Georgia average BMP costs of $24.33 per acre or $3.02 per MBF for forest industry lands and $41.65 per acre or $5.39 per MBF for NIPF lands.
- For Virginia, Shaffer et al. (1998) estimated median BMP costs of $18.90 per acre
- Sun (2006) estimated that the largest losses in welfare are perceived by consumers, followed by loggers and landowners

Costing out BMPs

- BMP costs ranged from $0 to $62/ac, based on results from eight case studies and a survey of 112 loggers.
- The case studies showed a reduction in harvest productivity due to BMPs from 0 to 9%
- Estimates similar to other (limited) studies:
  - US South: $26/ac
  - Virginia: $12-75/ac
  - Minnesota: 1-9% increase in logging cost

Source: Kelly et al (JoF, 2017)

Costing out BMPs (2017 dollars)

BMP	Cost	Unit
Pre-harvest planning	$2,050-5,259	$/ac
Temporary Bridge	$1,125*	$/bridge
Water bars	$11,903-$19,929	$/water bar installed
Culvert	$3,901-$8,176	$/culvert installed
SMZ	$2,147	$/SMZ
Seeding and mulching	18,880-$26,109	$/landing

Source: Cubbage (2004) & *Shaffer et al (FPS, 1998)

Effectiveness research

- Cristan et. al. (2016) conduct a very extensive review of the literature by region, with 20 studies focusing on the Northern United States and their major conclusion is the water quality is protected when BMPs are properly applied
- Wilkerson et al. (2004) found that streams without buffers had the highest increase in weekly maximum temperatures (this goes back to buffers services, including shade)

Effectiveness research

- Edwards & Williard (2010) found that BMPs reduce sediments from 53 to 94% and nutrients such as nitrogen by 60-80% and phosphorus by 85-86%

- Schuler & Briggs (2000) found strong relationship between BMP application and prevention of sediment movement

- Anderson & Lockaby (2011) argue there is a research gap in some of these topics and suggest approaches to bridge it

Implementation data (Maine-specific)

- 85% of sites: BMPs applied appropriately on crossing and approaches, or were avoided if possible
- BMPs were not applied on 4% of stream crossings and approaches
- 92% of tests: found no sediment entered a waterbody
- 98% of sites: no evidence of chemical spills
- 96% of sites: no haul road or landing in the waterbody buffer/filter strip
- Wetlands were either avoided or effective BMPs were used to cross

Source: MFS (2016)

How Maine Compares (implementation %)

	AL	FL	ME	MI	MO	NC	OH	SC	VT	VA	WI	Mean
Timber harvest	98	99	**90**	*	99	*	85	94	*	*	97	94.6
Forest roads	93	99	**89**	91	97	84	83	98	94	85	70	89.4
Skid trails	*	100	**89**	87	99	82	73	*	84	90	88	88
Log landings	*	100	**97**	99	100	*	81	*	70	94	*	91.6
Stream crossings	96	98	**81**	86	94	72	78	81	68	92	*	84.6
SMZs *	97	98	**93**	94	97	91	81	92	86	92	89	91.8

*Stream Management Zone

Source: Cristan et al (2017)

General Conclusions

- BMPs appear to be highly effective (70%+) if correctly implemented
- Recent studies found high implementation rates (85%+)
- Limited studies on regional/state BMP costs
  - Range from 1.2% to over 26% loss in net revenue
- Does the result justify the cost?
- Should we be more stringent from a regulatory perspective?
- More extreme weather + deteriorating markets and infrastructure → more cost and effort required in future?

Paths forward

- Perform local study to quantify local costs
- Assess equipment and methods carefully
- Onsite field work, time studies, current data
- Examine silviculture methods for connections to costs
- Improve roadbuilding techniques
- Bridges & culverts
  - Designs & technologies
  - Durability & its tradeoffs
- Better assessment of BMPs costs and effectiveness requires more data

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Questions?