Trading to Improve Water Quality

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What We'll Cover

- What is trading?
- How does trading work?
  - Setting trading boundaries, defining credits, identifying buyers and sellers
- Project examples
- Where does trading work? For what pollutants?
- Benefits and challenges of trading

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What We'll Cover

- Key functions for all trading programs
  - CWA compliance, public information, connecting buyers/sellers
- Trading to reduce thermal load in the Tualatin River, Oregon
- Where is trading occurring now?
- What's next for trading
- Where to get more information

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What is “Trading”?

- Cap and trading
- Emissions trading
- Pollutant trading
- Effluent trading
- Offsets
- Mitigation

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Acid rain reductions XX tons over Y years at a cost savings of $$ vs. projected costs

What is Water Quality Trading (WQT)?

- Watershed management approach suited to particular water quality challenges
- Based in economic market principles
  - Sources facing higher pollutant control costs may purchase environmentally equivalent pollutant reductions from another source at lower cost
- Voluntary, but integrated and consistent with Clean Water Act regulations
  - An approach to meeting CWA goals, not an alternative to them

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Fix format on this slide

How Trading Works

- A 'cap' or limit is placed on the total amount of pollutant that can be released from all sources
  - Timeframe is established to meet cap
- Sources receive an allocation, i.e., authorization to release a given amount of pollutant
- Sources can meet their allocation by:
  - Making all necessary reductions on-site OR
  - Buying additional allocations - credits - from other sources that have reduced pollutants below their own allocation

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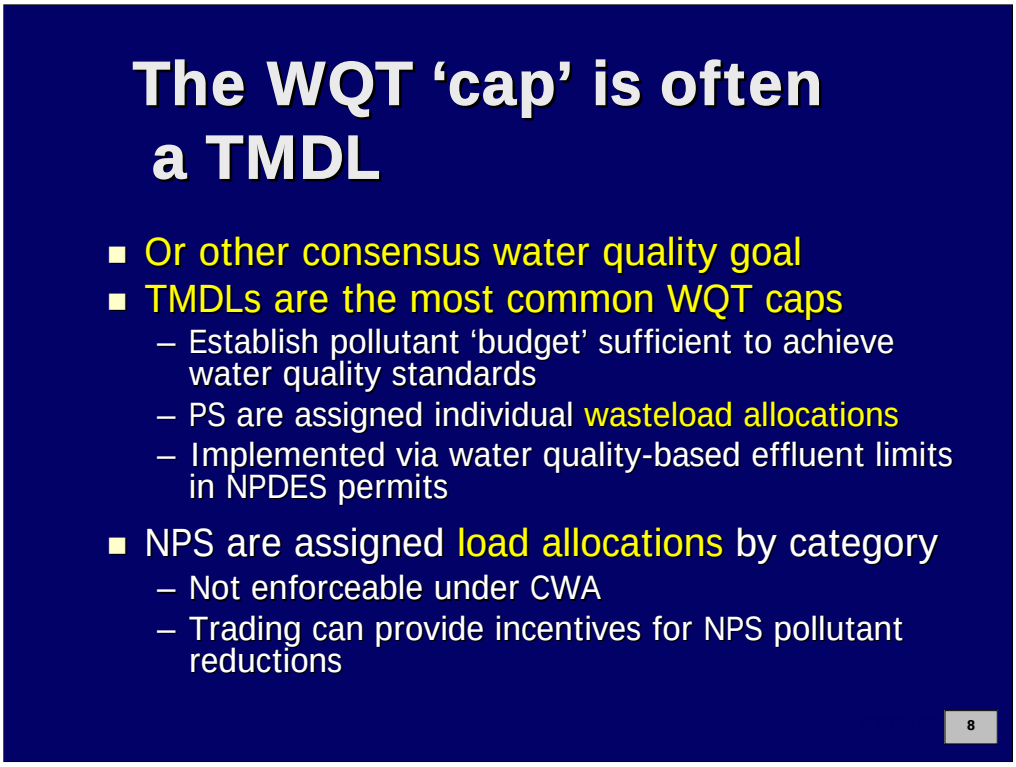
General description true for most types cap and trade programs;

Bullet 2: authorized amts consistent with meeting WQS

Sources that supply credits must reduce BELOW their allocation - important

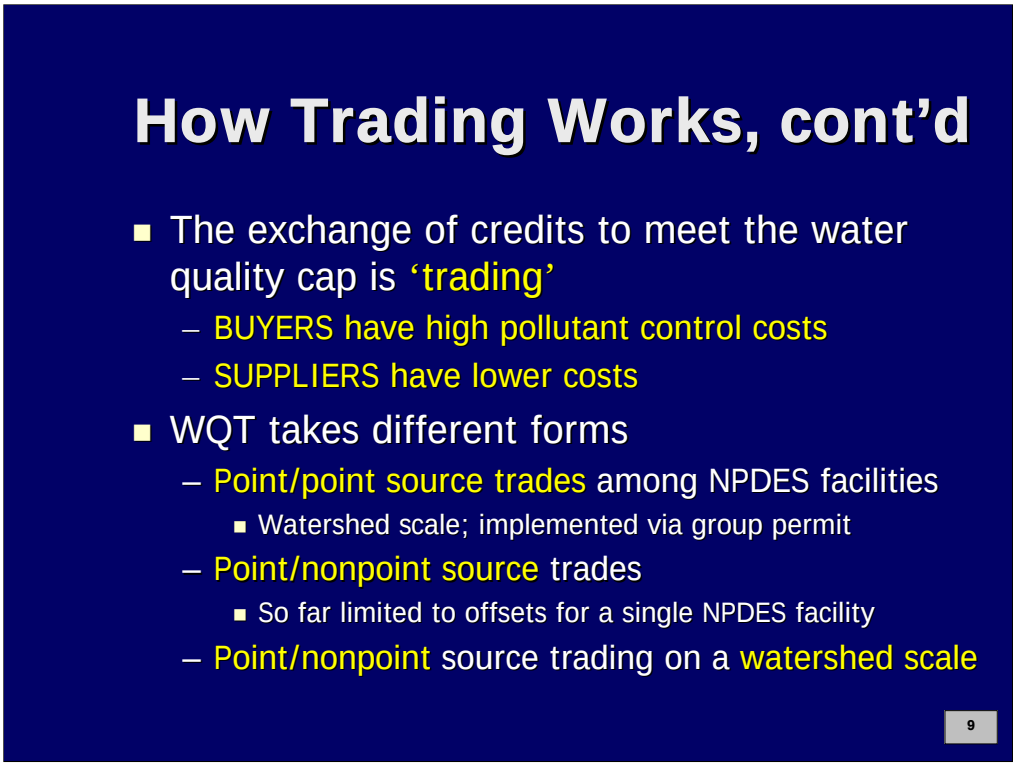


Say: Total Max. Daily Loads, TMDLs = to restore impaired waters to meet WQS

Can be other established/consensus WQ goal, e.g., Chesapeake Bay established loading caps by tributary consistent with WQS

EACH PS facility gets WQBEL derived from WLA

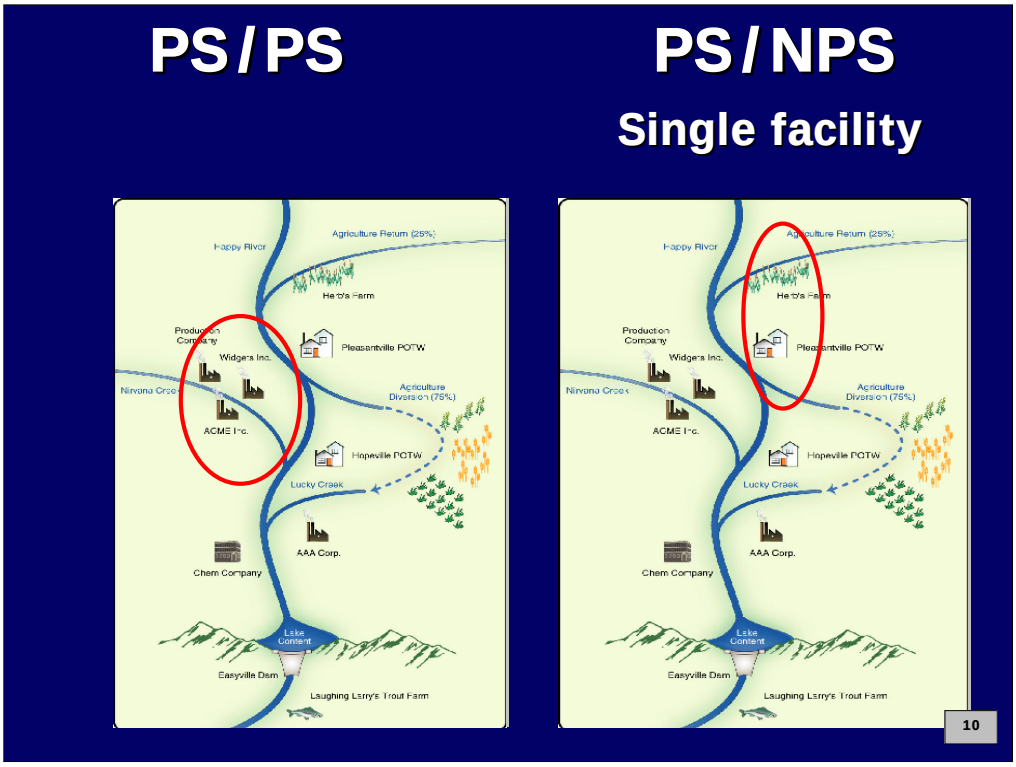
NPS group allocation by general source – all Ag, all forestry, etc. One reason PS/NPS trading more challenging to implement – more on that later. NPS not enforceable CWA, rely on voluntary EPA, state, USDA funding programs to achieve – one reason trading promising can be incentive for landowners, et al to install BMPs to achieve their LA then go beyond to generate credits for sale to NPS. Watershed scale PS/NPS trading programs could be significant way to achieve WQS in waters impaired by both PS and NPS



PS/PS A few well-established programs

PS/NPS offsets = one NPDES facility negotiates a trade to meet its permit requirements

PS/NPS on watershed scale, being explored in a number of watersheds – greater promise and challenges than other types of trading

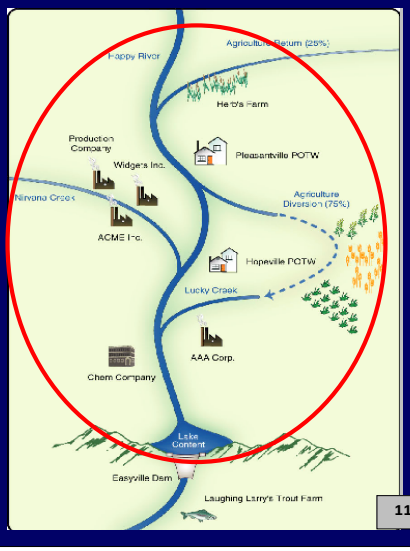


Happy River basin; TMDL = reduce P loadings to Lake Content. Array of PS and NPS

1. Cluster of PS on tributary – trading under group permit
2. Single PS, could purchase credits from upstream farm

Watershed Scale PS/NPS Trading

- Several programs under development
  - Passaic River, NJ
  - Cape Fear River, NC
  - Kalamazoo River, MI
  - Miami River, OH
  - others



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Would like to reverse text and picture

Many supported by EPA TWG


Questions?
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Example: Seasonal Hypoxia in Long Island Sound

- Excessive nutrient loadings contribute to hypoxic zone in Long Island Sound each summer
- To eliminate hypoxia, Connecticut TMDL calls for 64% nitrogen reduction among 79 wastewater treatment plants by 2014
- Challenging goal, potential price tag $1 billion

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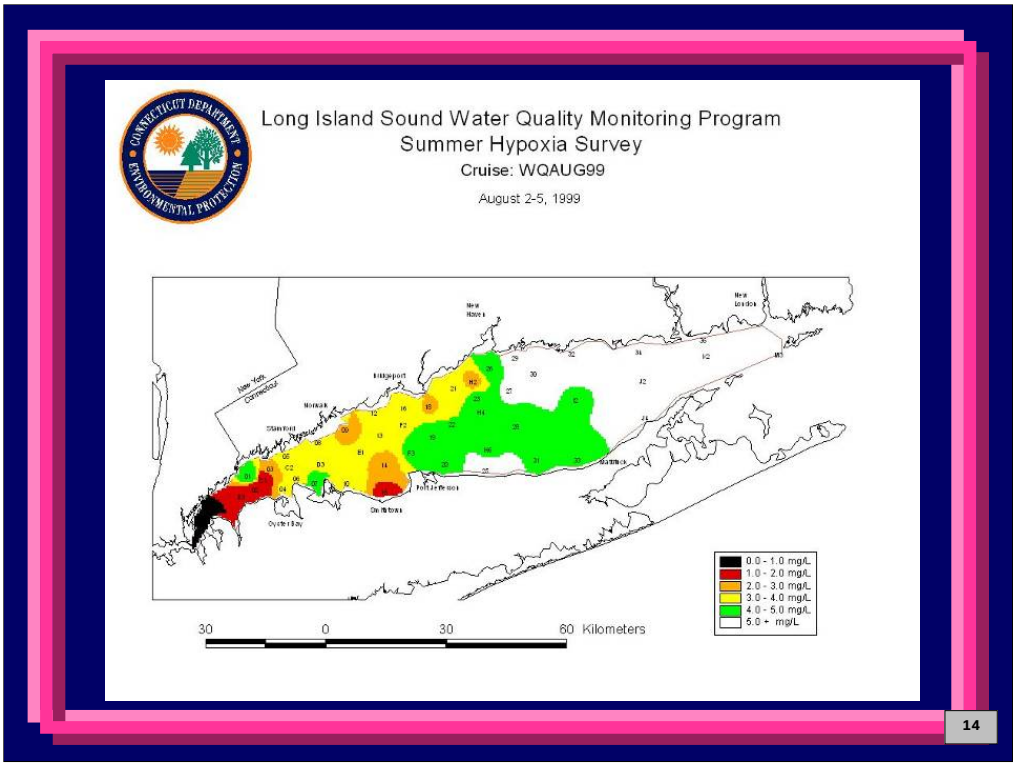
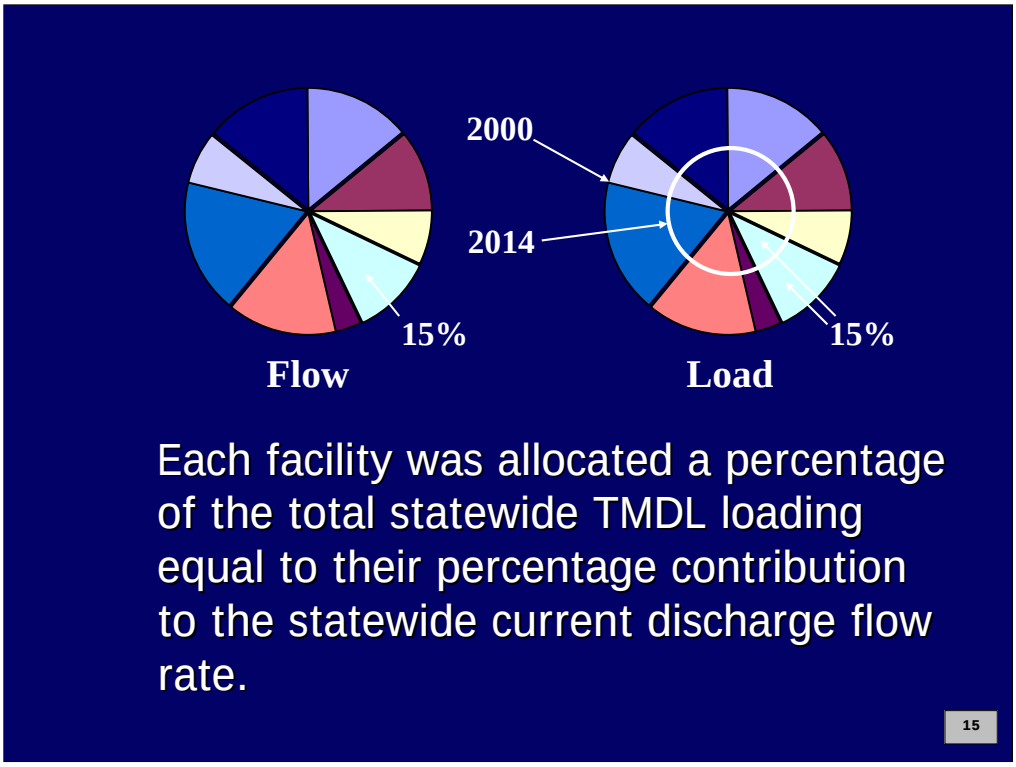


Acknowledge Gary Johnson, CT DEP for slides and info.



TMDL = from about 49,000 pounds per DAY to about 18,000 pounds/day TN

Nitrogen Cap and Trade: Long Island Sound

- CT established a Nitrogen Exchange allowing WWTPs to
  - reduce nitrogen *or*
  - buy nitrogen reductions from the Exchange *or*
  - over-control nitrogen and sell reductions
- 79 WWTPs covered by one NPDES permit
- Permit has aggregate cap that declines every two years to meet 2014 goal

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Permit and cap is for TN; individual permit limits for all other parameters including N compounds with acute effects, e.g., ammonia

Water Quality Equivalence

- WQT changes location of pollutant controls within a watershed
- Water quality equivalence considers that the impact of pollutant control at source A may differ from source B
- Ratios, based on pollutant fate and transport models, account for different WQ impacts

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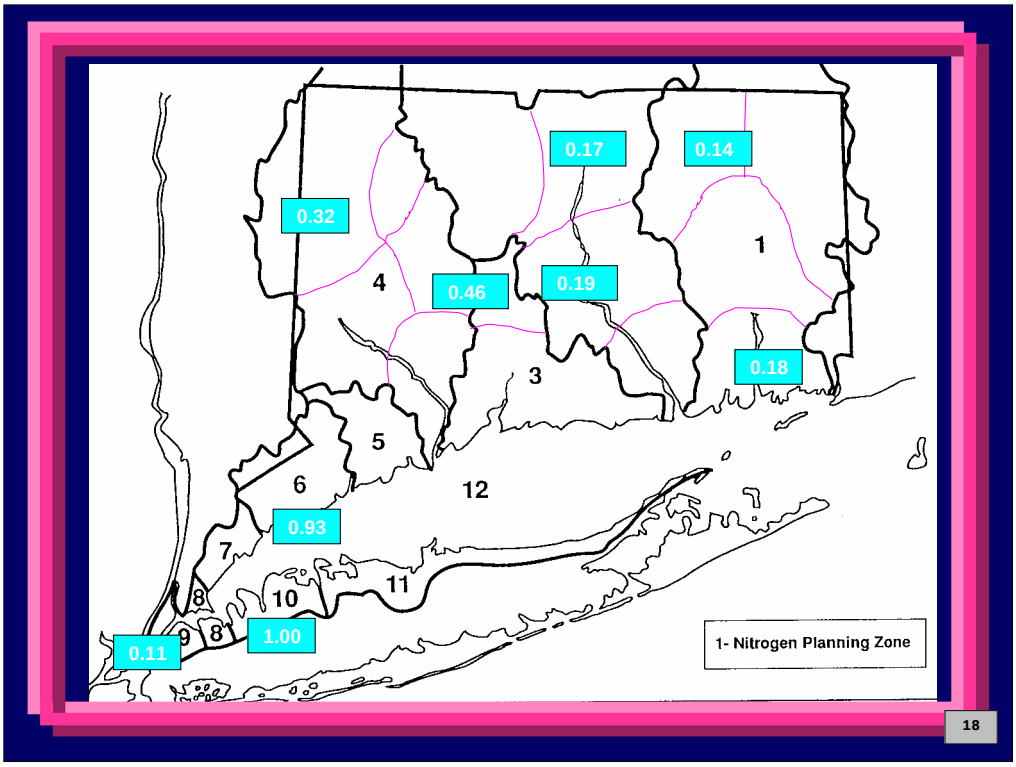
Water quality equivalence is particularly relevant for situations with a specific downstream monitoring point or point of concern (like a reservoir or estuary)



Connecticut and LI Sound General Permit example -

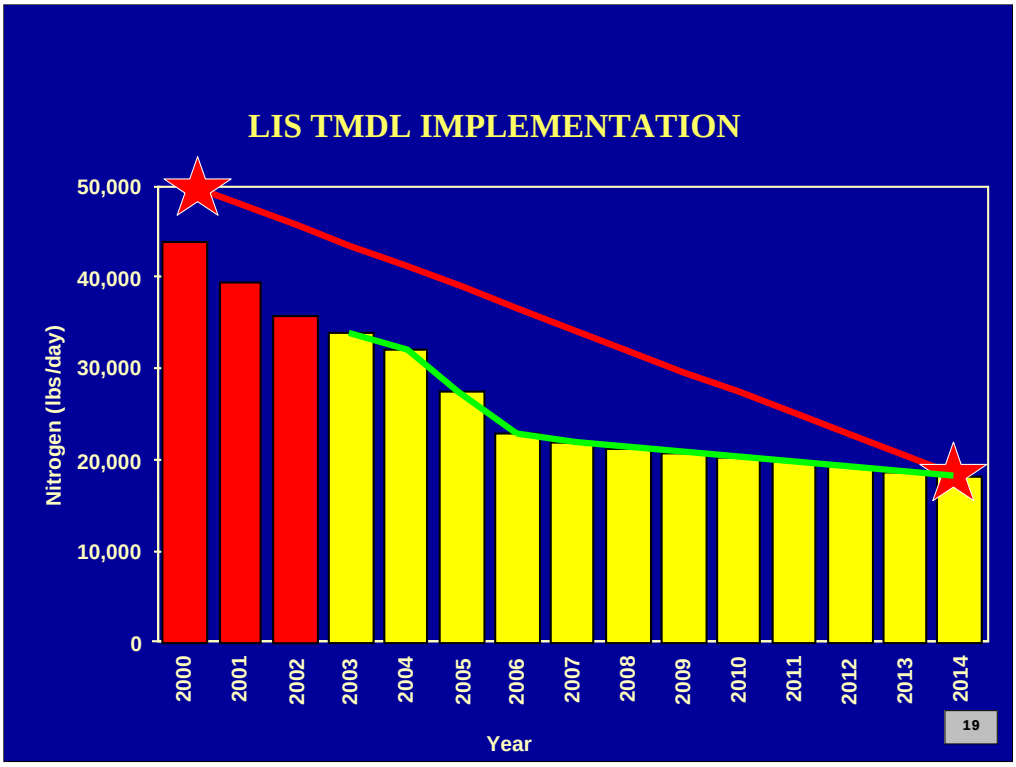
Facilities close by will have lower

Slide is animated to show map and then the way they set up contribution ratios based on which part of the state the discharge is from. Discharges from eastern and north eastern are given lower ratio than discharges from south west areas – this is based on relative impact driven by proximity to the area of impact. You will note that discharges that occur in the extreme south west area get a low ratio because of the flow into the Sound is not as heavy from that area.

In terms of trading, these relative contribution ratios are very important. For dischargers in the southwest part of CT, if they are able to accumulate one pound of credit, they can sell it for approximately the full one pound value. In the for north east area of the state, one pound of credit is only valued at about 0.14. So this has produced an incentive for dischargers in the southwest to invest in treatment and they have.

The TMDL had a 15 year schedule – current projections indicate that for the point source contributions, they may reach the needed reductions about 6 years ahead of schedule.

Program has been up and running for about 3-4 years now.



Expect to reach nitrogen goal 5 to 6 years earlier than more traditional allocation and save $200 million


Questions?
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Example:
South Nation River, Ontario

- Trading to reduce total phosphorus in NPS-dominated watershed

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Next example goes North to Canada. We have P/NPS trading in USA but not yet on watershed scale. This example 1) on a watershed scale and 2) employs a central 'bank' of NPS credits which could be a promising approach more generally.

Acknowledge Dennis O'Grady of SNC who provided these slides and leadership for the P reduction program

90% of P from NPS

South Nation Water Quality Challenge

- Phosphorus (P) degradation
  - Annual mean five times greater than water quality objective of .3 mg/l
- 18 wastewater treatment plants with several new or expanding facilities
- High treatment costs

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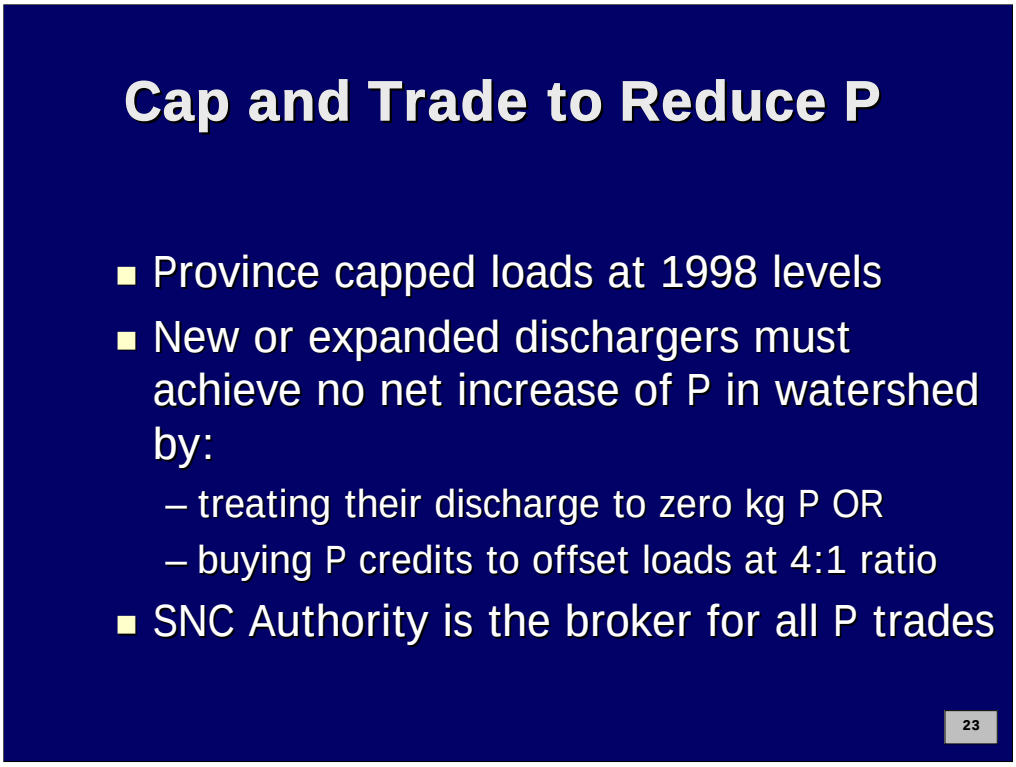
>$15M tertiary treatment per plant



Wastewater discharge must still meet Provincial treatment standards for all other parameters

Historical Clean Water Program

Since 1993, South Nation delivered 420 BMP projects worth over $5.4 million (> $1.6 million in grants)

Approx 350 are P reduction projects

Allowed cost/kg of P to be calculated

Verified amount of P that can be removed (> 9,166 kg annually)

Gave Province comfort level on P targets

Allowed TPM to proceed more quickly

How credits are generated

- Calculations developed for a set of BMPs
  - Manure storage
  - Milk-house washwater treatment
  - Barnyard runoff control
  - Limiting livestock access
  - Buffer strips
- Ratio of 4 to 1 applied
- Credits generated when project installed

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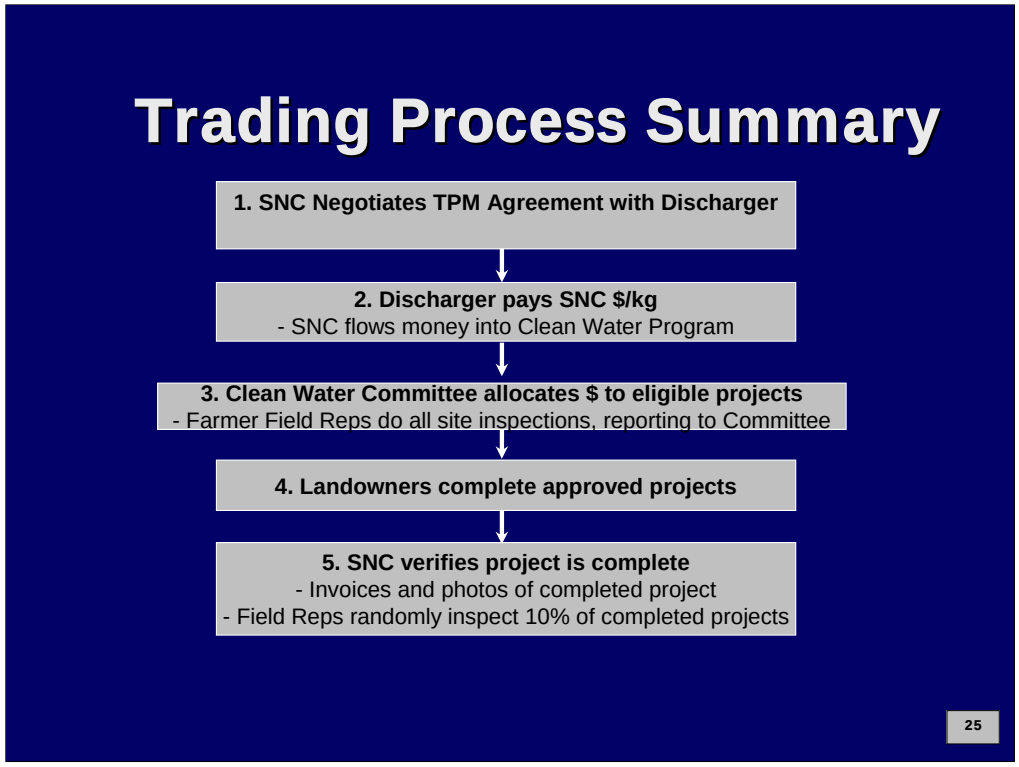
If manure lagoon trapped 100 pounds/day P, only 25 pounds per day available to PS dischargers for purchase

Results 2000-2004 = 6900 kg/yr P (15,000 pounds) reduced through dozens of projects



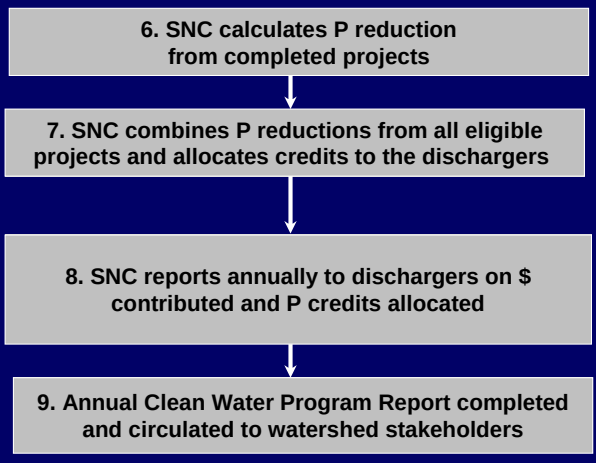
P credits are allocated based on targets for each discharger

Achieving P reduction targets varies from 1 to 5 years

List of projects that make up the “bank” of P credits is provided, individual projects and landowners are not specifically identified

this format adopted to address initial stakeholder concerns regarding landowner liability for performance of P reducing projects

Trading Process, cont'd



Monitoring

- 13 stations sampled monthly for surface water quality (April – Nov.)
- Historical data>40 years at some stations, provides baseline information to track P trends over time
- Monitoring provides data on WQ trends, not on individual BMPs

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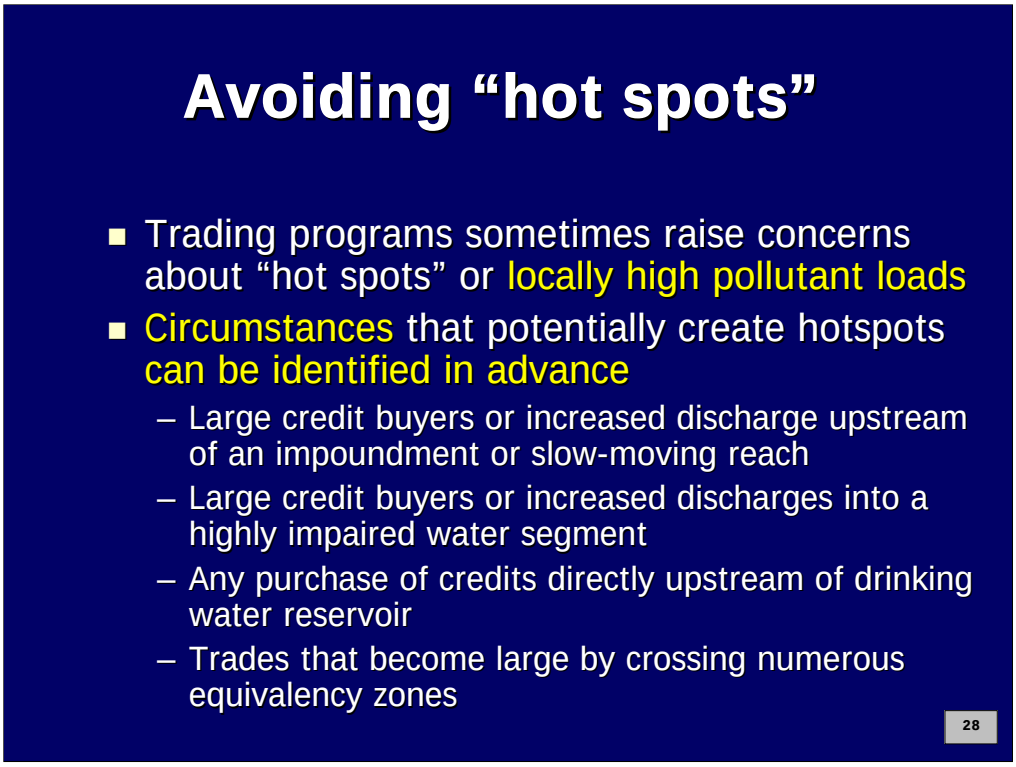

These circumstances can be anticipated and avoided through program design and implementation. Note that these factors don’t guarantee a hot spot will be created but should be carefully evaluated to determine whether a hot spot may be created and, if so, program designed and implemented to avoid that situation.

Avoiding "hot spots" through program design

- Trading program can and should be designed to avoid hot spots. Some approaches for doing so include:
  - For group permits, include individual permit limits for parameters affecting local water quality, e.g., ammonia nitrogen
  - Limit the number of credits used within an area
  - Limit the direction of trades, e.g., upstream versus downstream, or weight trades to favor a direction
  - Apply minimum reductions (before trading) on sources with high potential for creating local impacts

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Questions?
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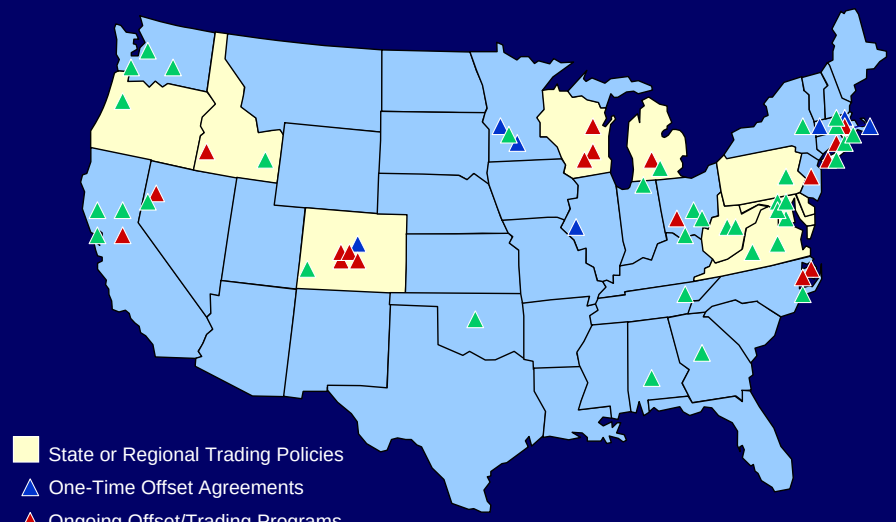
Water Quality Trading Activity



State or Regional Trading Policies
One-Time Offset Agreements
Ongoing Offset/Trading Programs
Other Projects and Recent Proposals

Source: Morgan and Wolverton (2005) and Breetz and Fisher-Vanden (2004)

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Why isn't there more trading?

Regulatory drivers essential yet lacking in many places

Biggest 'markets' expected for phosphorus, nitrogen but…many states have not adopted numeric water quality standards for nutrients

As more states adopt standards, water quality drivers will exist in more watersheds

Alternate driver of water quantity may emerge in some places

Trading is a significant shift in approach

requires education, time for scoping and assessment, infrastructure development, stakeholder engagement

A decision to proceed with WQT must be made watershed-by-watershed

Pollutant reductions made outside of a watershed will not help meet its water quality standards

Diversions, impoundments and other features significantly impact pollutant fate and transport

Analysis required to determine whether trading can succeed in a specific watershed, economically or environmentally

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Water Quality Trading in Oregon

Experiences to Date,
What's Next

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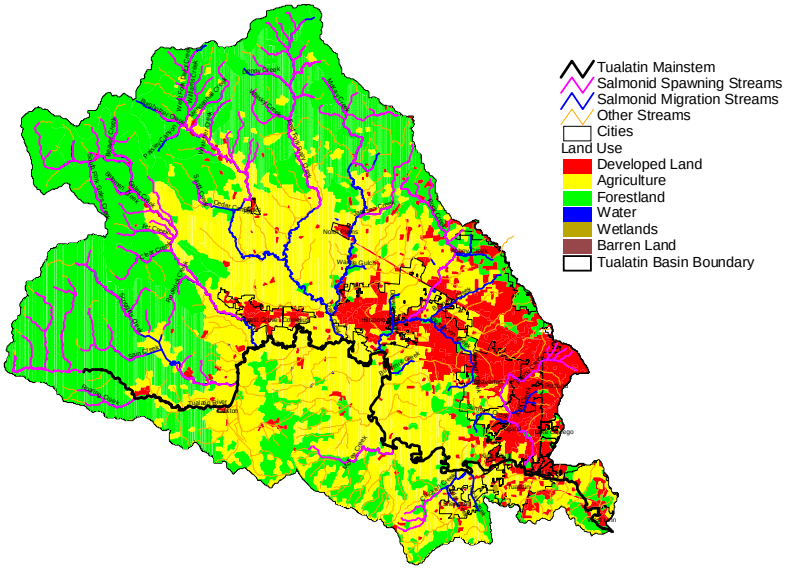
Perceptions of Trading

- Proponents: Trading is a way to bring free market efficiencies to reduce compliance costs
- Opponents: Trading is a way for polluters to get off the hook
- Alternate view: Trading can be a better way to protect the resource

Tualatin Basin: Salmonid Streams and Land Uses



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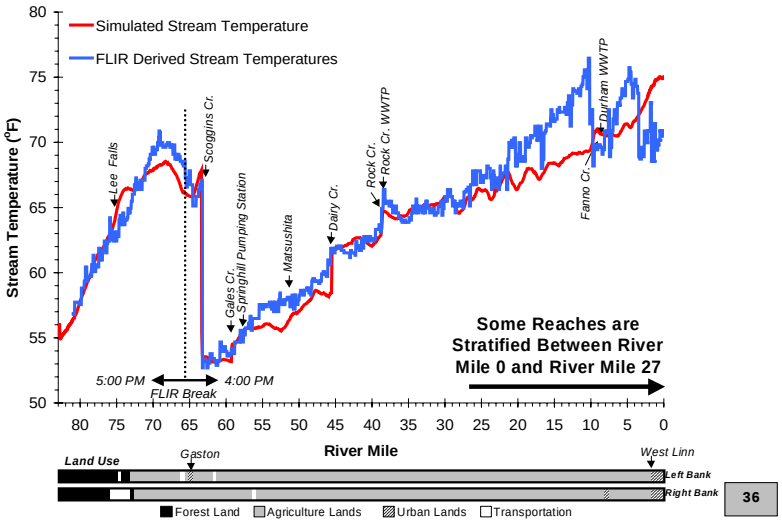
Tualatin River Temperature Profile (Observed and Predicted for 7/27/99)



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Trading Case Study: Clean Water Services

The following are allowed:

1. Temperature trading involving a combination of the following:

- Riparian shading
- Flow augmentation

2. "Bubble" permit limits for BOD and ammonia

- Limits allow interplant and intraplant trading of BOD and ammonia

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CWS Trade: Advantages

- Avoids the environmental downsides to refrigeration (high need for electricity).
- Riparian shading via native plants + flow aug. = greater environmental benefit.
- Much cheaper for the source.

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CWS Trade: A Side Benefit

We are getting good data on:

- What it takes to get riparian areas planted on agricultural land.
- What it takes/will take to keep it planted.

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How much will CWS have to do?

Flow augmentation:

- CWS is able to purchase about 30 cfs throughout the summer
- Impact established via modeling: about ½ excess heat load is offset

Riparian restoration:

- About 35 miles of stream to be planted

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How much… (cont'd)?

Riparian restoration:

- Impact quantified by measuring the amount of solar radiation that is blocked by shade-producing vegetation

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“Good” Riparian Area

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"Bad" Riparian Area

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How do they get so “bad”?

Streams are messy and unpredictable, they meander and flood.

So, people try to control them.

--Methods: removal of streamside vegetation, channel straightening, installation of dikes, levees and riprap.

And… impervious area happens.

As watersheds become increasingly built-up, peak flows increase.

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What happens when people try to control streams?

The Law of Unintended Consequences kicks in.

Some unintended consequences:

--Increased erosion rates.

--Streamside vegetation becomes dominated by nonnative invasives. Or riprap. Or concrete.

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Back to how much is enough…

The Basic Equation:

Length of Stream Required =

$$\frac{\text{Excess Heat Load (per day)}}{\text{(Reduced Solar Load x Stream Width)}}$$

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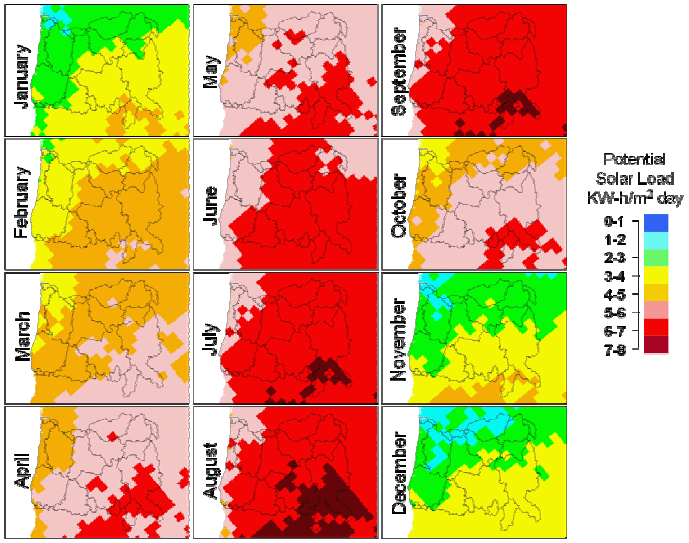
Daily Solar Loading Rates



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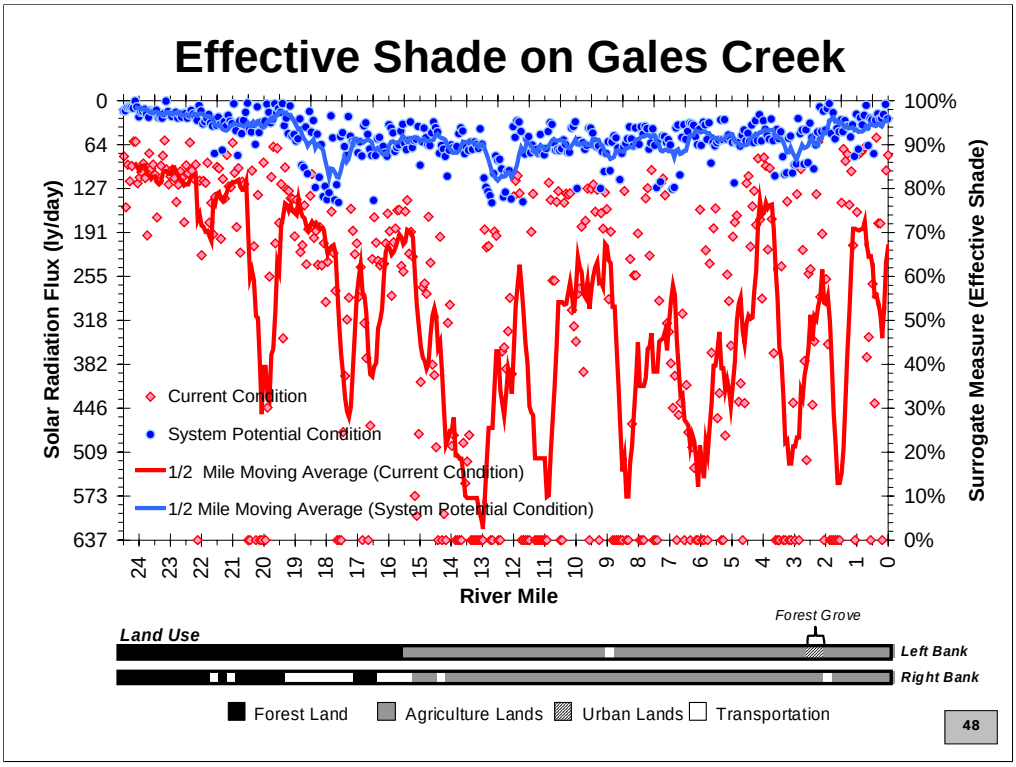
Effective Shade on Gales Creek
Solar Radiation Flux (ly/day)
0
64
127
191
255
318
382
446
509
573
637
Surrogate Measure (Effective Shade)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Current Condition
System Potential Condition
1/2 Mile Moving Average (Current Condition)
1/2 Mile Moving Average (System Potential Condition)
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
River Mile
Forest Grove
Land Use
Left Bank
Right Bank
Forest Land
Agriculture Lands
Urban Lands
Transportation
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Problems…

- Trees will take a long time to grow
- “You are giving CWS credit for something the farmers should already be doing”

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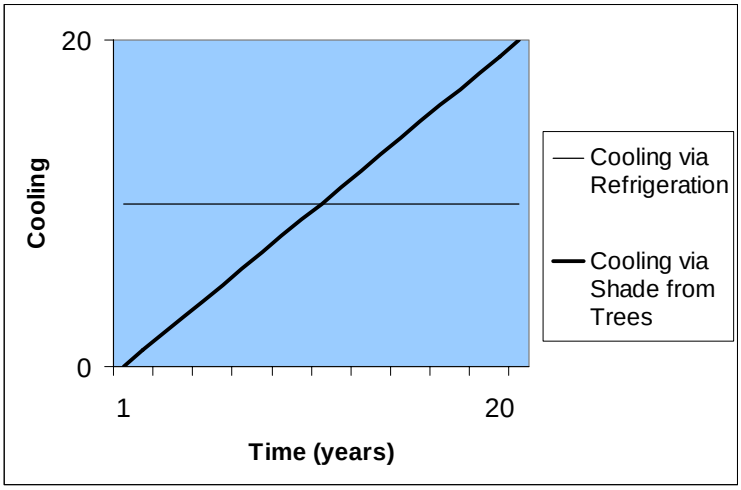
Compensating for Growth Rate of Trees



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The equation modified…

Length of Stream Required

$$= \frac{2 \times \text{Excess Heat Load}}{(\text{Reduced Daily Solar Load} \times \text{River Width})}$$

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Getting riparian areas planted…

- CWS has developed two incentive programs: “Enhanced CREP” and VEGBACC
- CWS has a contract with NRCS to enroll farmers
- There are 1900 farmers in the basin

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Alternative Approach

- City of Portland enters into non-binding agreements with (urban) landowners
- Landowner allows access, in exchange City installs plantings
- Homeowner gets free “naturescaping,” City has reduced admin. costs

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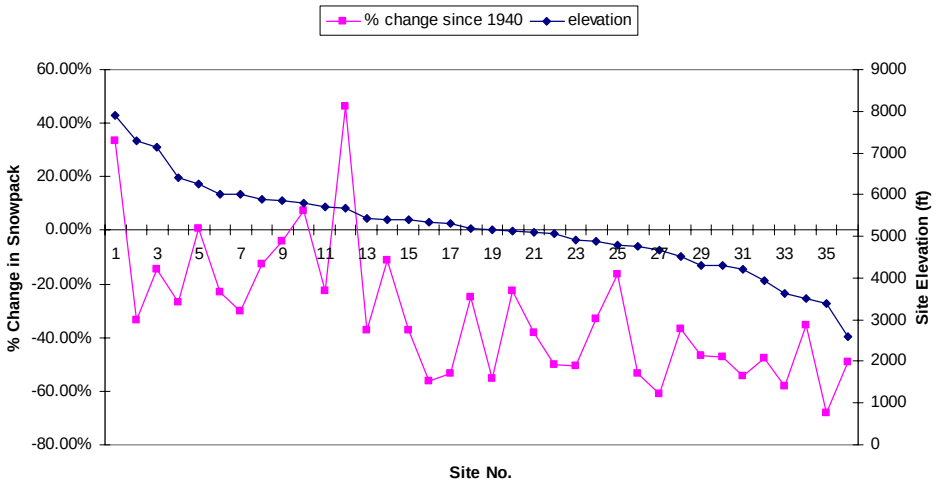
Establishing Compliance

Challenges:

- Stream temperature is highly variable
- Impact of restoration projects may not be readily measurable at outfall
- Possibility of natural disasters
- Impact of global warming

Evidence of Global Warming in Oregon:
% Change in Snow Pack Since 1940 at 36 Sites



Data courtesy of Philip W. Mote, JISAO/SMA Climate Impacts Group, University of Washington, Seattle, March 2003.

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Establishing Compliance

Compliance will be established as follows:

- First 5 years: adherence to planting plans
- After 5 years: plant survival rates and shade density measurements

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Status of CWS Trade

Goals for year 1 have been met, and 5 miles of stream have been planted.

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Clean Water Services Temperature Trade

- Motivation
- Benefits
- How to Quantify
- Compliance

Questions???

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What is next for trading?

The Willamette Partnership: an effort to expand trading to the entire Willamette basin.

Goal: to put together a “portfolio” of projects for sources to choose from to offset thermal and other impacts.

Some projects may involve hyporheic flow.

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What is hyporheic flow?

- Hyporheic flow refers to flow through the gravels below and at the margins of the river (the hyporheic zone).
- Cooling occurs via hyporheic flow.
- Estimate: hyporheic flows in the Willamette have been reduced by 80% due to bank hardening, loss of channel complexity.

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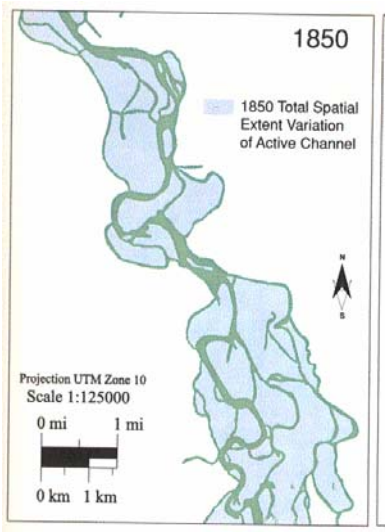
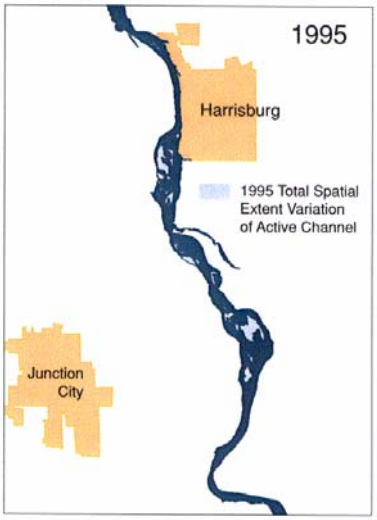
The Willamette River: Channel Simplification





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Achieving cooling via hyporheic flow…

Some approaches:

- Direct discharge of effluent to hyporheic gravels
- Re-creating side channels
- Floodplain restoration

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Hyporheic Flow Issues

Need to insure the following:

- Groundwater is not negatively impacted.
- Cooling is adequate.

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What is (probably) Not next for trading…

The following trading schemes have been proposed:

- Trading in the context of UAAs.
- Removal of contaminated sediments in lieu of better-than-background cleanup in uplands.

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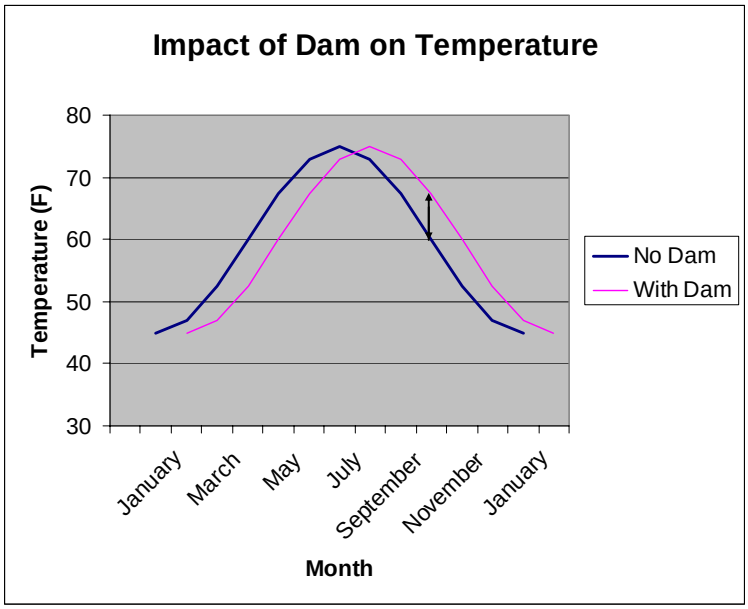

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When is trading Not likely to work?

Trading probably won't work if:

- Regulators, permitted sources and environmental groups do not trust each other.
- Parties do not feel a sense of urgency.

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Trading: Lessons Learned

Work with stakeholders to design trades.

Why? Because the CWA is silent on trading!

Where you don't have rules, you better have trust.

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What we heard from the stakeholders…

- Pursue trades involving shade.
- Limit duration of credit to 20 years.
- Compensate for the time it takes trees to grow.

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Lessons Learned (cont'd)

If stakeholders appreciate that trading can be a better way to protect the resource, they may accept:

- Longer timeframe for implementation
- Environmental benefit in a location other than at the outfall
- Uncertainty

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Last but not least…

- With trading available as a tool, we can ask “what is the best way to protect the resource?”
- Our perceptions of trading can limit the potential for trading.

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DEQ Webpage on Trading

- Q&A
- Trading Internal Management Directive
- Links to EPA trading policy, manuals on trading


Questions?
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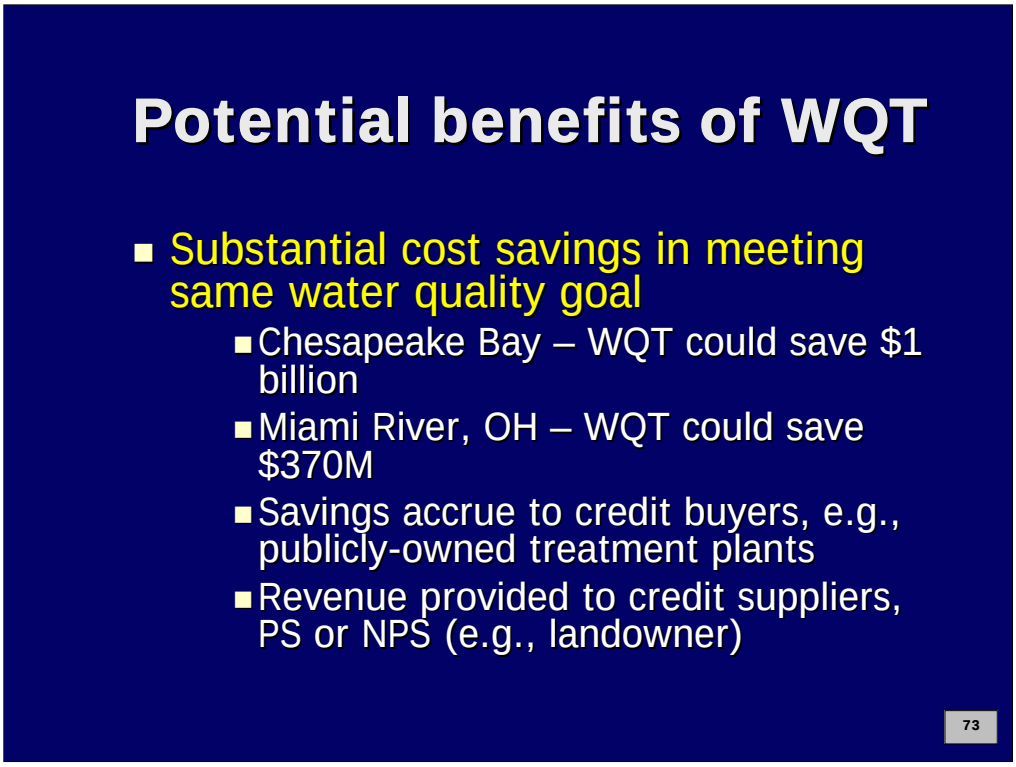

Where suited to the situation, WQT is a way to get more TMDLs, WQ goals implemented. With tight resources, cost savings can make the difference between implementation and no implementation.

In nutrient trading credit buyers will often be public agencies, e.g. POTW, thus savings accrue to the public.

Ches. Bay Finance Panel – if "fully leveraged" (PS and NPS) could save estimated $1 billion, or about of 7% of total cost for 300 WWTP to reach WQ goal (timeframe not specified but likely 7-15 years)

Miami River, OH, preliminary estimates for 315 WWTP to meet N,P criteria over 20-year period

These are preliminary estimates with many embedded assumptions – no one knows if they're accurate. But even if the order of magnitude is correct, there is a real opportunity.

Potential benefits of WQT

- For PS/NPS trading, environmental benefits in addition to improved WQ
  - Riparian improvement, reduced erosion
  - Co-control of multiple pollutants
  - Improved habitat, flood retention
  - Potentially, restoration of more wetlands

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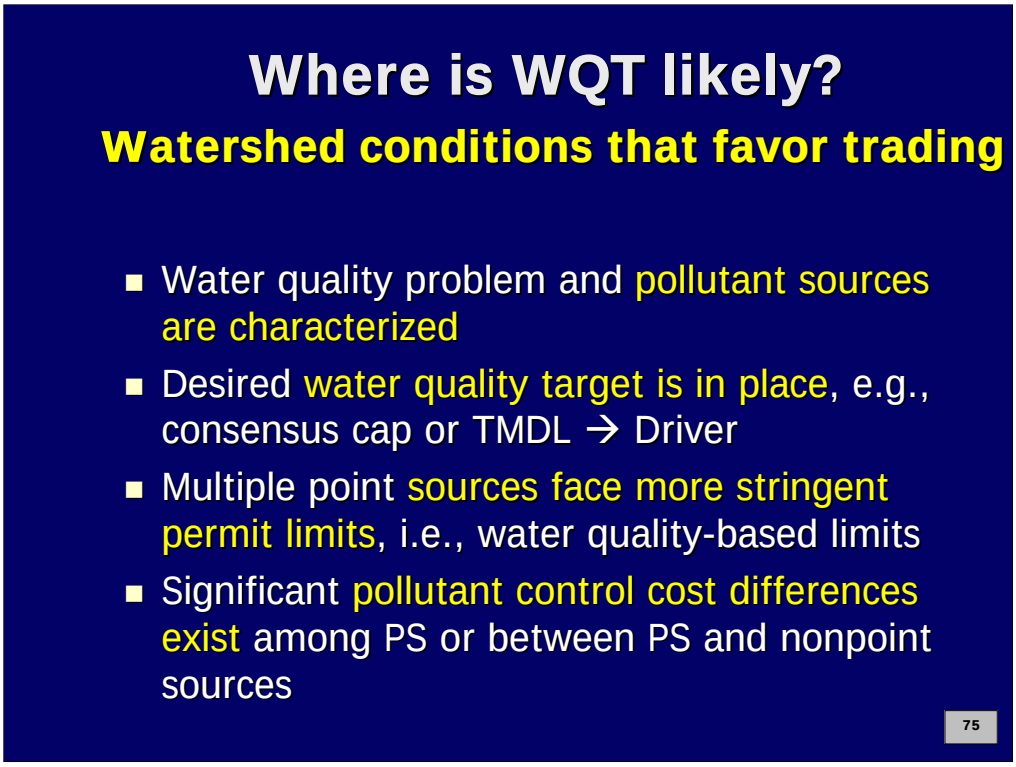
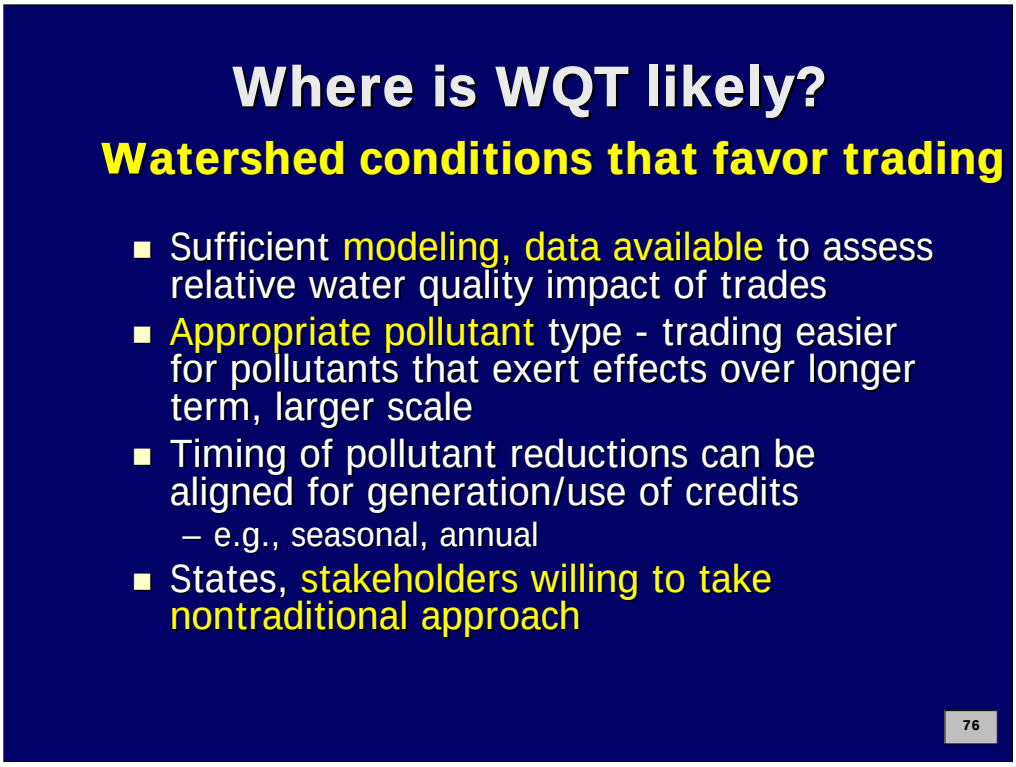


Large scale trading is generally viable only when these circumstances align

Can have single facility trades virtually anywhere, where one facility secures credits to meet its WQBEL. But for watershed-scale trading (multiple buyers & sellers) to be successful, experience shows that these factors need to be in place.

Many PS with high control costs make emergence of a 'market' for pollutant reductions more likely



Bullet 1 = WQ equivalence point. Trading moves location of poll. Control thus must be able to assess relative effect of poll. Reduction at diff. Locations in watershed.

WQT Assessment Handbook : Can WQT Advance Your Watershed's Goals?

- Help determine if a watershed has 'trading potential'
- Assess pollutant suitability
  - Pollutant type, timing of loads, WQ equivalence, alignment of credit supply/demand
- Identify potential buyers, sellers and analyze financial attractiveness
- Functions of WQT 'market'
- Engaging stakeholders

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Trading could help achieve WQ goals in numerous watersheds but limited impl. To date. Several reasons for this. One is: not always clear where trading is the right fit for WQ problem at hand. Based on their experience with several trading projects (or those that didn't emerge) EPA Region 10 developed WQTAssessment Handbook. We published national version a year ago to help stakeholders assess whether trading might be right tool for their watershed.

Much of info on equivalence, hot spots, identifying potential buyers and sellers, is covered in more detail in the Handbook

Identify potential credit users/buyers

Typically PS that face more stringent NPDES permit limits and have high control costs

Identify potential credit suppliers/sellers

PS with lower control costs than other PS

NPS with lower control costs

Requires preliminary control cost estimates for key PS and representative nonpoint sources

Key Functions
All WQT programs must:

- Assure CWA compliance
- Define trading area boundaries
- Define credits - exchangeable pollutant reductions
  - e.g., average pounds/day total phosphorus reduced during a one-year period
- Ensure accountability for pollutant reductions
- Ensure water quality equivalence and avoidance of hotspots
- Enable communication among credit buyers and sellers

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Key Functions
All WQT programs must:

- Track trades and progress towards WQ goals
- Manage risk among parties to trades
- Provide information to the public and other stakeholders

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Defining PS Credits

- Facilities may not trade to meet technology-based NPDES limits
- A facility may purchase credits to meet more stringent water quality-based limits
  - within limits needed to protect local water quality
- A facility can create credits to sell if its discharge is reduced below water quality-based limits
  - If limit=100, a reduction to 75 could generate 25 credits

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EPA Water Quality Trading Policy, 2003

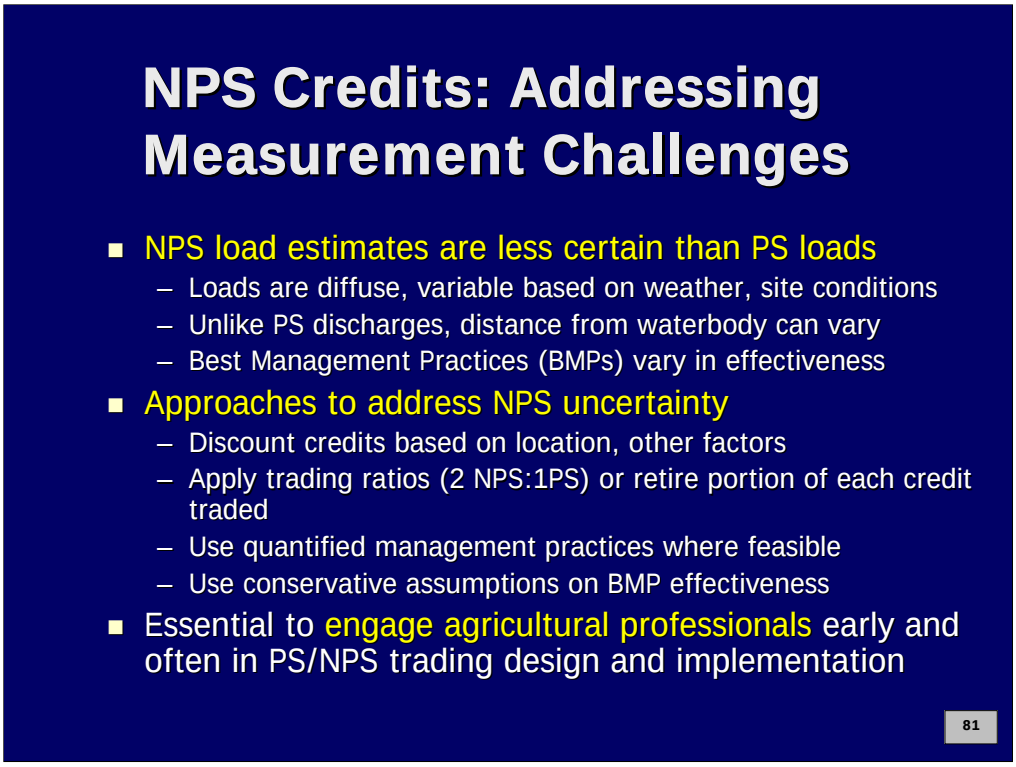
Another key issue which NPDES permit limits could be met through trading. PS may be subject two kinds of limits NPDES permits

-technology-based effluent limits all must meet; developed for their industrial category by pollutant; many of these in place for decades

-water quality-based effluent limits – more stringent, included in permits where waterway impaired for pollutant and PS is causing or contributing to impairment, whether or not TMDL for that water

May trade for latter but not technology standards – statutory minimums.

"Credits" created when discharge below WQBEL. Another facility can purchase credits to meet WQBEL; however may not do so if discharge threatens local WQ.

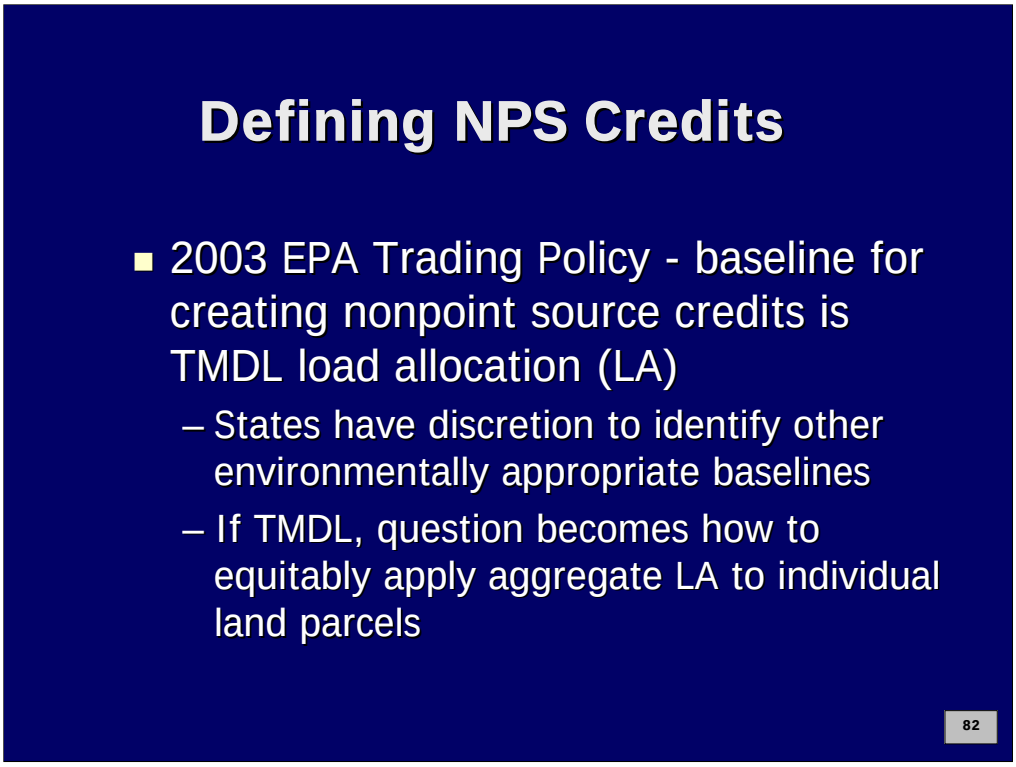


Measurements or BPJ used to establish ratios: Alton, IL BPJ 2:1 sediment offset

Lower Boise: identified 8-9 practices for which reliable data available; if these practices used

Reduce need for discounting by using demonstrated values or conservative assumptions

States, others developing trading programs that involve NPS – essential to bring Ag experts in early for technical and implementation credibility and expertise



Defining NPS credits trickier

Defining NPS Credits – An Approach

Estimating P credits - Lower Boise, ID program

- Identify eligible BMPs and efficiencies
- Estimate current P load of land parcel using soil slope and loss factors
- Estimate P reductions achieved with BMPs including uncertainty factor
- From total P reduction achieved, deduct contribution to TMDL LA or other WQ goal
- What remains are marketable 'credits'
  - which may be further discounted for location or to offset PS/NPS uncertainty

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Questions?
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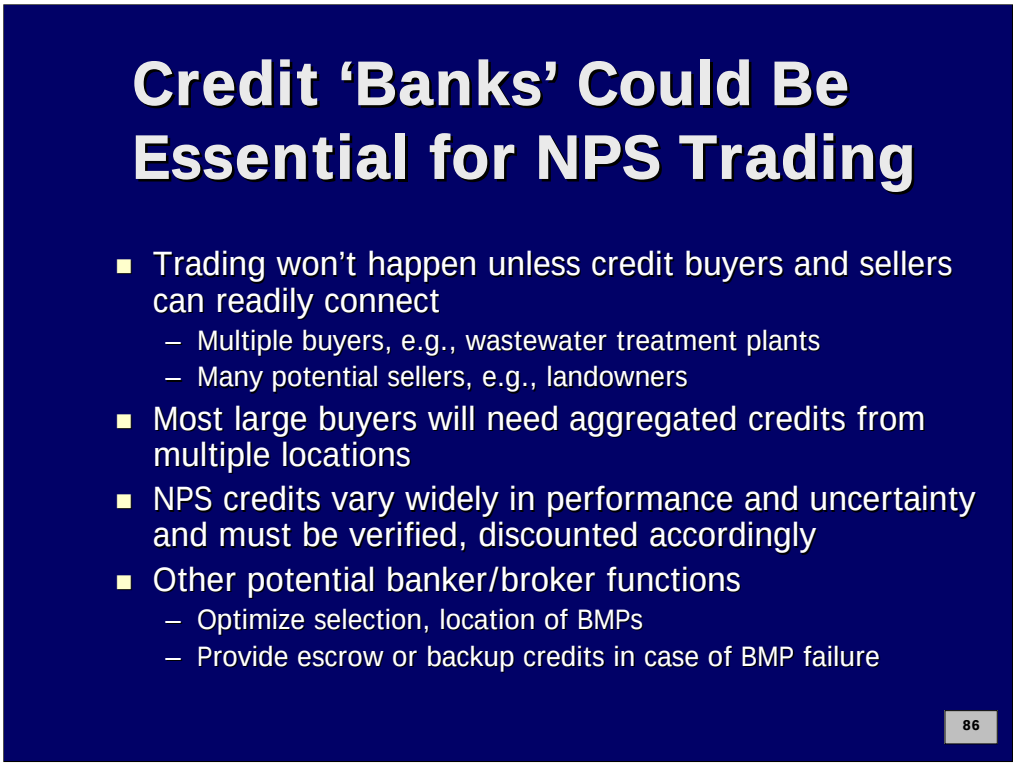
And uncertain about size and number of markets. But if it's going to happen we need to start in earnest to address a number of challenges.

Technical and implementation challenges NPS trading. Not subject of this talk but don't want to minimize. Still need i.d. analytical methods and approaches to reliable NPS measurements.



Trading among PS is straightforward and partners can generally find one another.

For PS/NPS trading, however, banker/brokers could be essential to its success. Unlikely to be large "single user" banks for NPS credits, where the buyer provides his own credits. In part b/c buyers generally won't be state agencies (DOT) but will be large municipalities

In large watersheds, could be dozens of buyers; hundreds of sellers. POTWs and landowners don't have a history of working together, may distrust. Landowners want arms-length (or more) from gov't activities and are too busy, not necessarily qualified to assess credits, discount, market and sell.

Likely need for credit aggregation and 'insurance' that individual landowners unlikely to provide.

Other functions could be added, e.g., preferring measurable BMPs which result in higher-value (less discounted) credits; focusing BMPs in watershed areas that maximize their effectiveness in treating pollutants.

Possible PS-NPS Framework

NPS Credit Broker

Works with landowner, or purchases land, to generate nutrient reduction credits

Nutrient reduction

Manure management

Riparian buffers

Aggregates credits and sells to credit bank or directly to buyers

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In closing…

- Like other watershed decisions, trading program design and implementation can occur at regional, state and local levels
- Effective engagement of watershed stakeholders can greatly influence the success and outcomes of trading programs

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Questions?
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