
Put a LID on Stream and Lake Pollution
Low Impact Development (LID) Provisions for Shoreland Zoning Ordinances
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Project Description. The purpose of this project is to develop model low-impact development (LID) ordinance provisions for Shoreland Zoning ordinances along with outreach about LID and the model to some towns in China Lake region and Belgrade Lakes region. The model LID ordinance provisions were prepared by Fred Snow, Community Planner at Kennebec Valley Council of Governments, which was under contract with Kennebec County Soil and Water Conservation District(KCSWCD) to undertake this project.

Acknowledgements. Appreciation extends to John Blais, PE, former Watershed Project Director at KCSWCD for review comments on the model LID ordinance provisions and to Jim Hart, PE, Director of Water Quality at Kennebec Water District and member of Board of Directors of China Lakes Regional Alliance for review comments on this presentation and for assistance concerning outreach. Thanks also extend to other collaborating stakeholders for their comments concerning the model and outreach planning and implementation.

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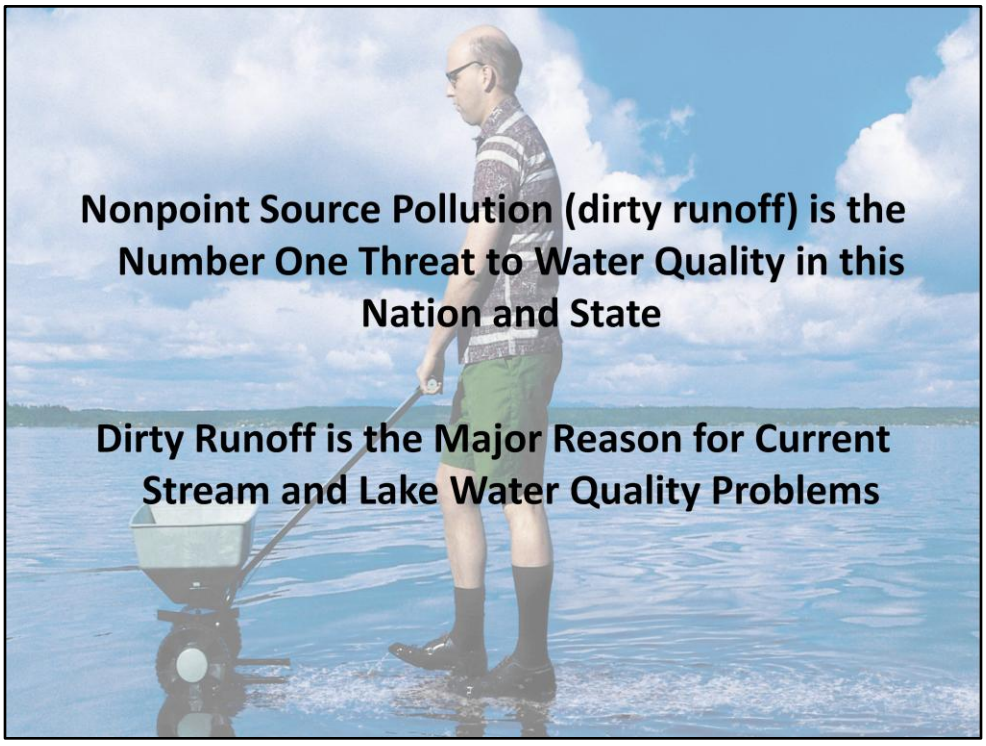
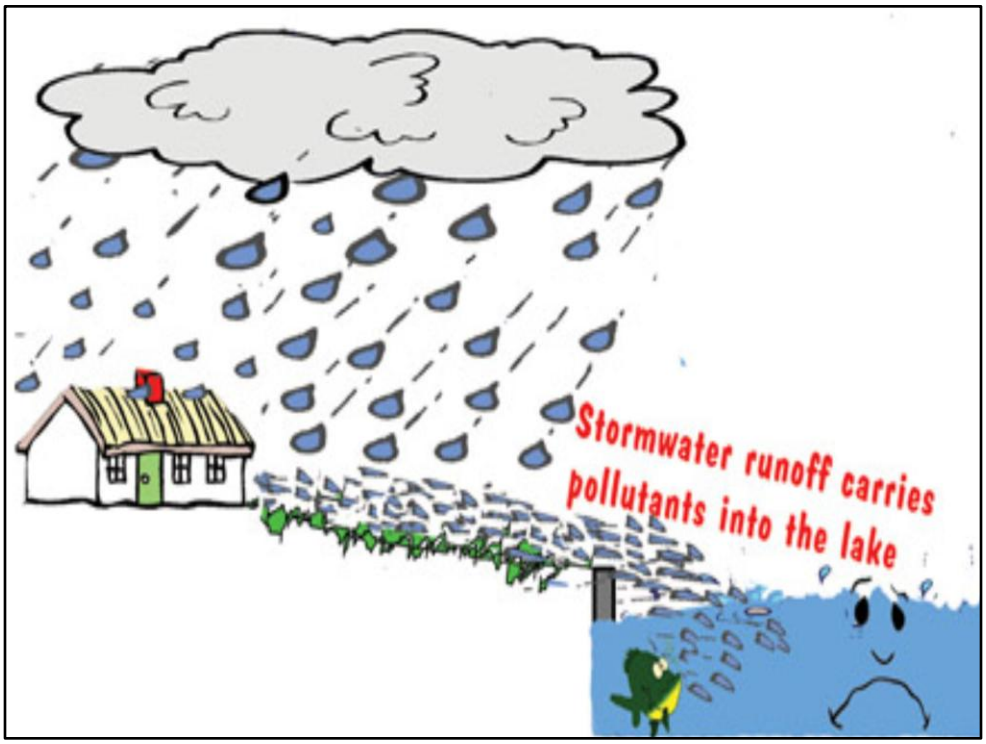
Maine is known for clear high quality lakes so What's the Problem?

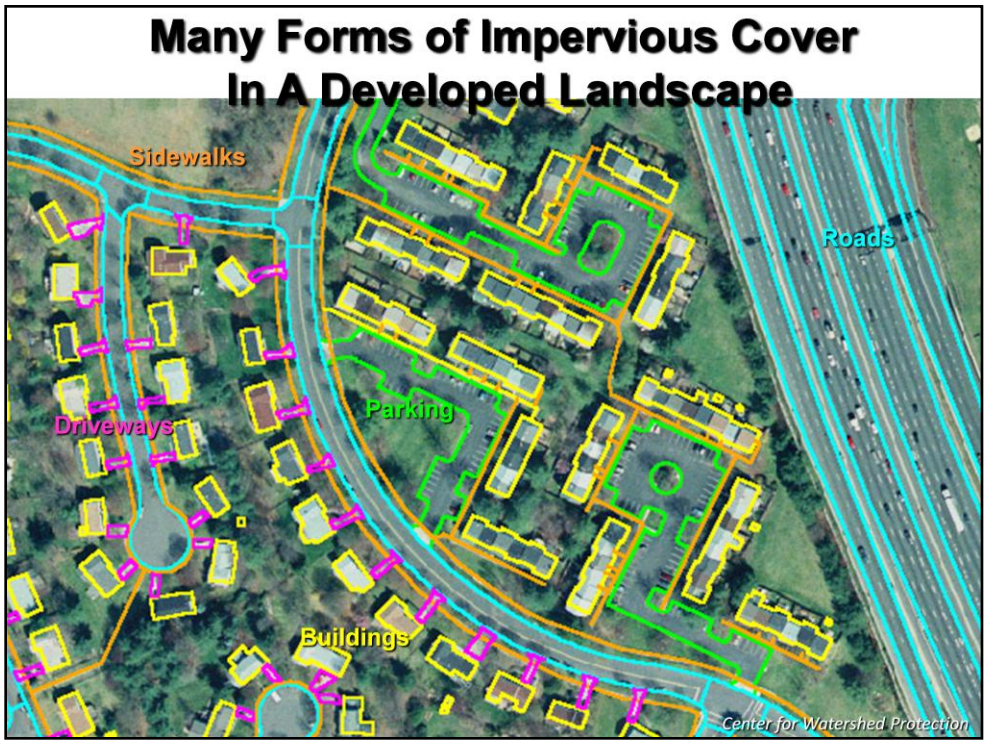


Well, 229 lakes are listed by DEP as lakes most at risk from new development and 38 of those lakes are listed by DEP as commonly having algae blooms.
According to EPA, DEP and other water quality experts … .
As the background picture indicates if you own property along a lake that includes for example a lawn sloping towards the lake when you fertilize your lawn it's often like you're fertilizing the lake because runoff can carry phosphorous and other fertilizer nutrients into the lake. And the property doesn't have to be on the lake but in the watershed of the lake with for example a lawn sloping towards a stream that flows into the lake.

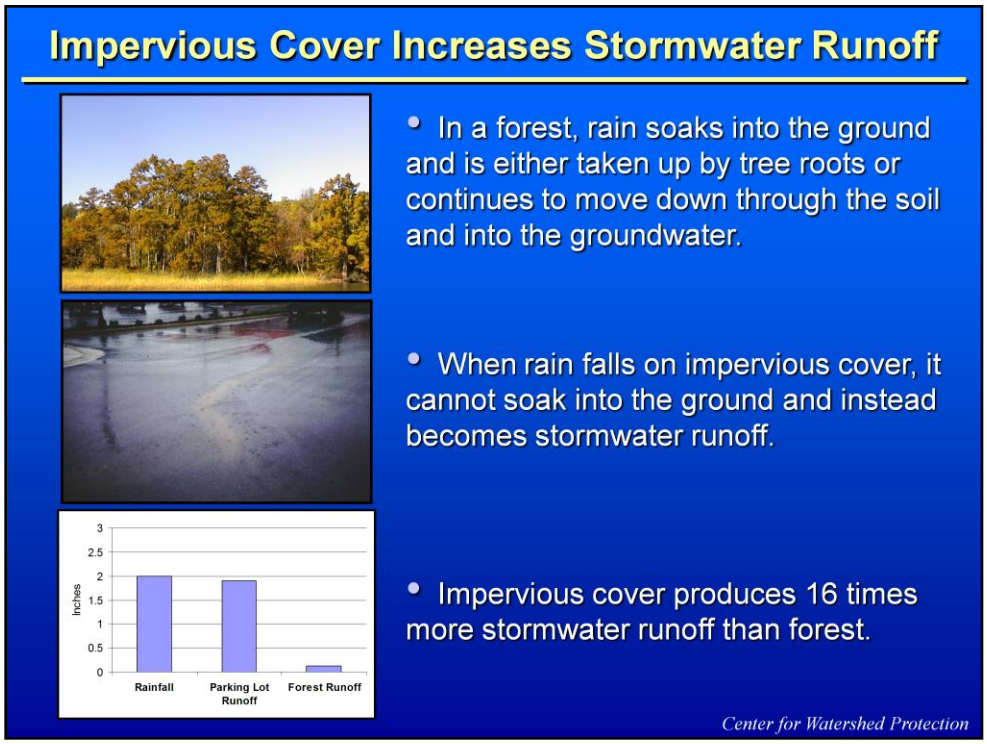


Though technically not impervious cover lawns act like an impervious surface allowing water to run over it rather than sinking into the ground. If pesticides, herbicides, or fertilizers are used on a lawn these are picked up and often carried into streams and lakes.

Why does this happen? Today's conventional development practices … .



There are many forms of impervious cover in a developed landscape. Development, such as a shopping center or a new house, produces impervious cover. Impervious cover is any surface in a watershed that does not allow water to soak into the ground. Forms of impervious cover include roads, parking lots, buildings, sidewalks, and driveways. As previously mentioned though technically not impervious cover lawns act like an impervious surface.



The quality of our streams and lakes is directly linked to land cover.

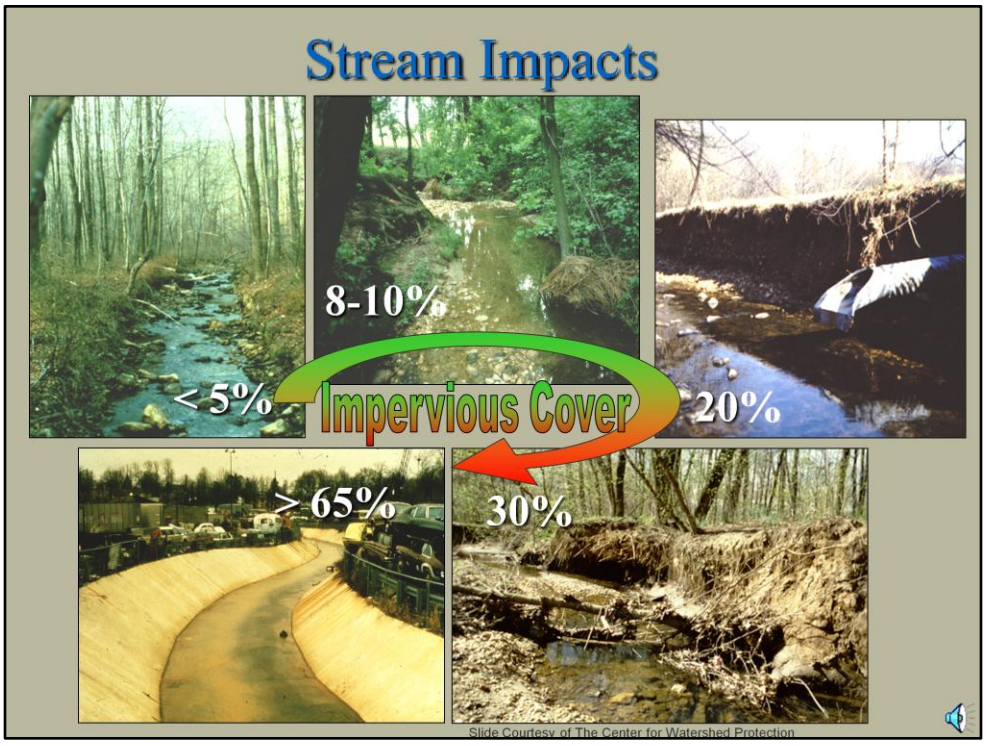
•In a forest, rain soaks into the ground where it is either taken up by tree roots or continues to move down through the soil and into the groundwater

•When rain falls on impervious cover, rain cannot soak into the ground and becomes stormwater runoff

•Impervious cover produces 16 times more stormwater runoff than forest. The chart illustrates, that if it were to rain 2 inches on a parking lot, 1.9 inches would become stormwater runoff. In a forest, only 0.12 inches would become stormwater runoff with the remainder soaking into the ground.

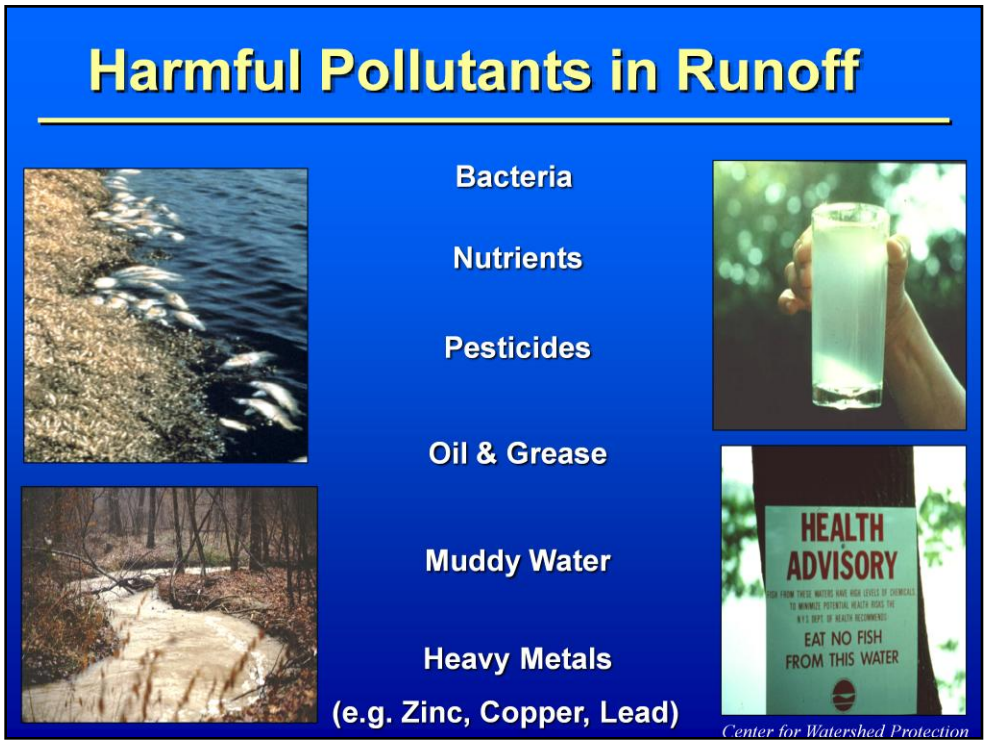
… .

While this flooded road doesn't appear to be much of a hazard drivers too often underestimate the hazard as they try to pass through a flooded road resulting in stalled out vehicles or worse.



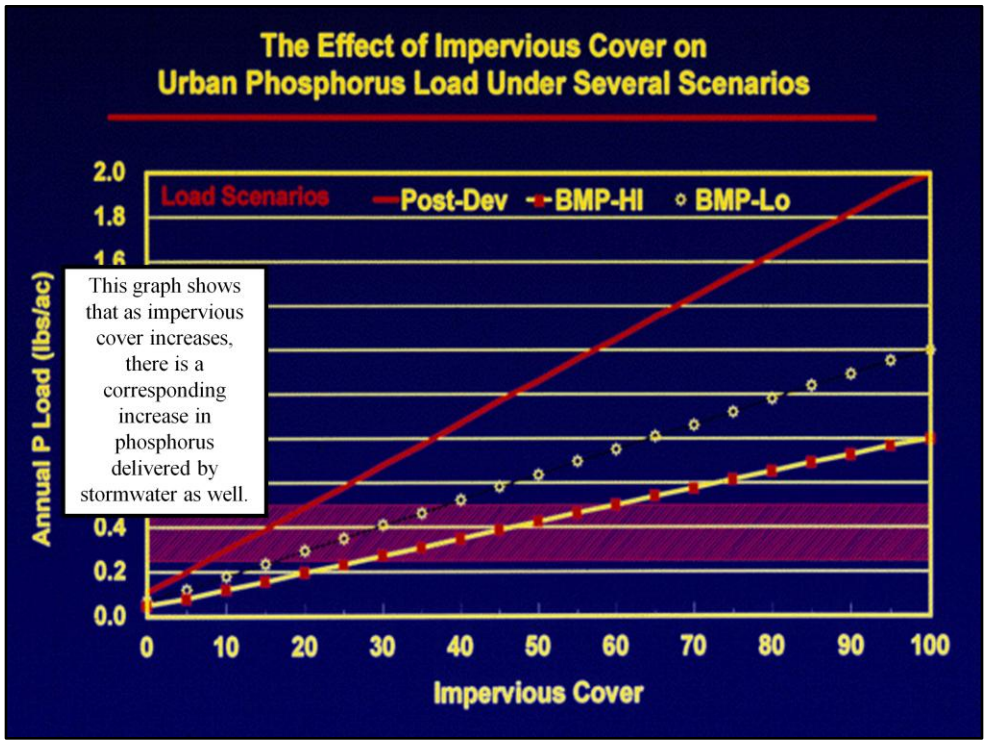
Impervious cover has an effect on streams which have an effect on any lakes they flow into. In watersheds with less than 5% impervious cover, streams are typically stable and pristine, maintaining good pool and riffle structure, a large, wetted perimeter during low flow, a good riparian canopy coverage. When impervious cover reaches 8 -10% in the watershed streams are characterized by various degrees of stream enlargement and widening, erosion, downcutting, and decreased channel stability. The 8 – 10% stream shown here has approximately doubled from its original predevelopment size and evidence of changes includes downcutting, exposed tree roots, and loss of the pool and riffle structure. Active erosion becomes much more evident at 20%.

Impervious cover influences water quality. Impervious surfaces collect many harmful pollutants. When it rains, these pollutants are washed away with the stormwater runoff and can end up in streams and lakes.

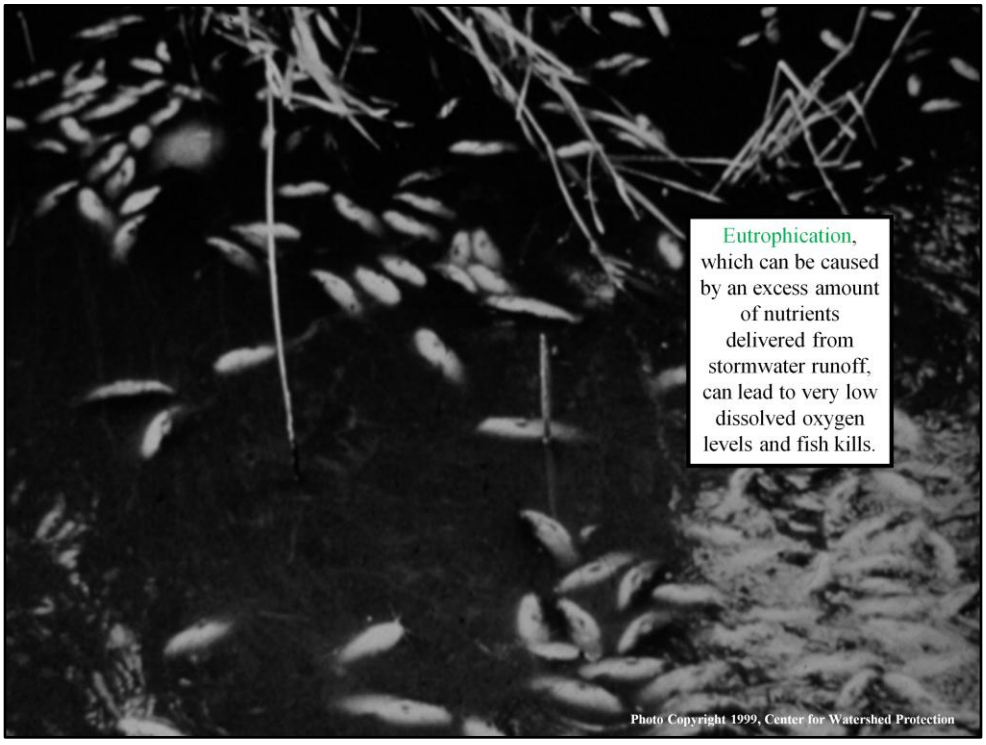


The different types of harmful pollutants found in stormwater runoff include the following:

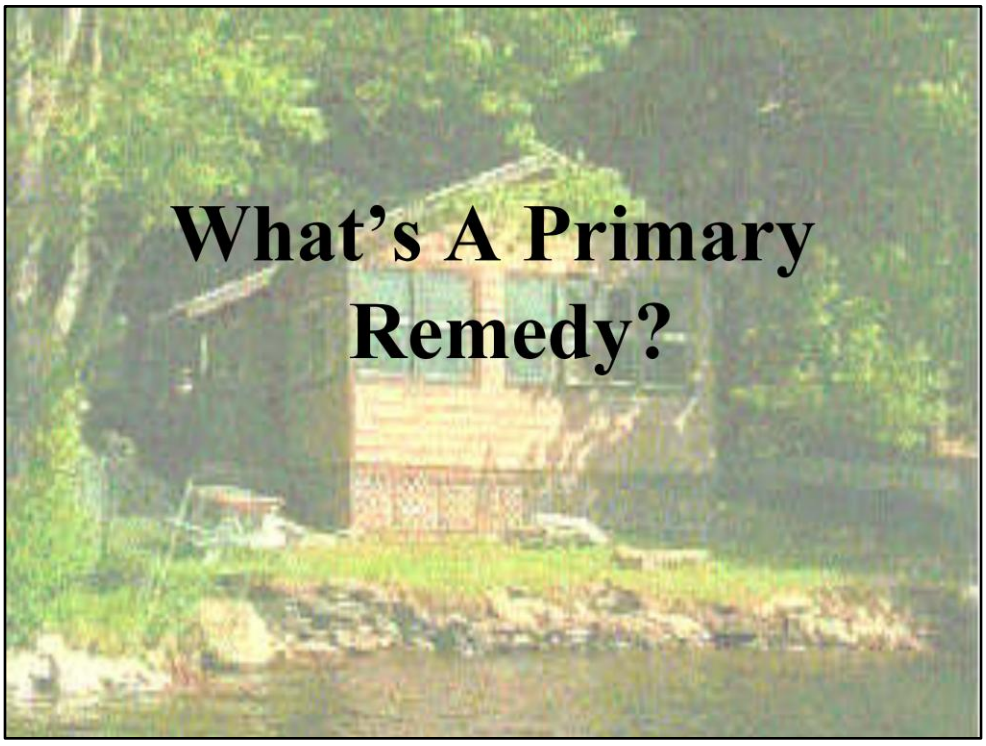
- Bacteria that can threaten our water supply or close beaches and shellfish beds
- Nutrients notably phosphorus that can cause algal blooms
- Pesticides, oil and grease, and anti-freeze that can be harmful or deadly to aquatic life
- Muddy water can block sunlight from reaching plants, clog waterways, and physically harm animals
- Heavy metals, such as zinc, copper, and lead, that can be toxic to organisms. Some heavy metals accumulate in organisms, causing them to be unsafe for human consumption.



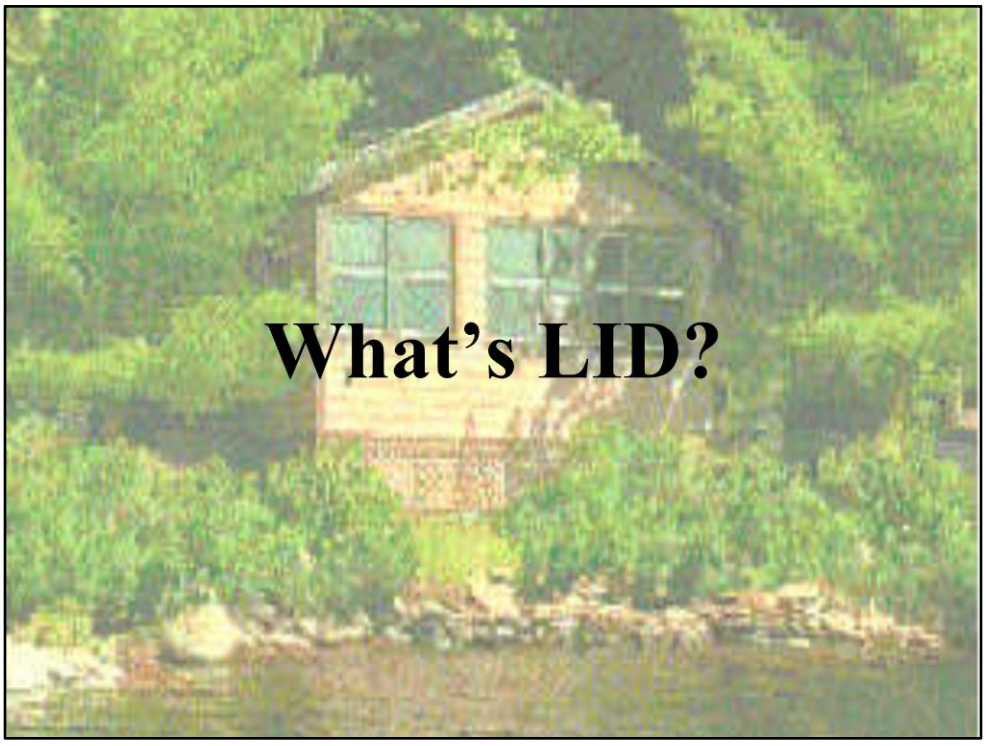
In most rural areas the primary pollutant of concern carried by run-off into our lakes is phosphorus. This graph shows that as impervious cover increases, there is a corresponding increase in phosphorus delivered by stormwater as well. The lines illustrate input load (in red) and two scenarios of the corresponding load using BMPs of different removal capability. Non-LID sediment ponds remove no more than 80% of phosphorous(P). LID systems can remove up to 94% of P (remaining 6% of P attributed to spring runoff and infrequent 25 year storms). At about 60% impervious cover, even with the best BMPs, the phosphorous load exceeds background levels.



Excess nutrients can create eutrophic conditions that can lead to uncontrolled algal growth that consumes oxygen in lakes and may create fish kills, odors, and other problems.


What's A Primary Remedy?


Reduce Runoff
Slow it Down
Spread it Out
Soak it In
LID


What's LID?

Low Impact Development (LID)

-- Keeps rainfall near where it falls

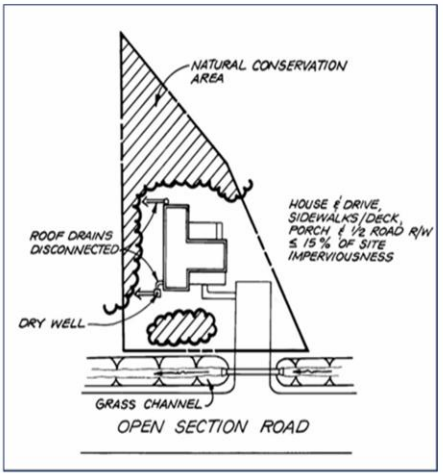
-- Limits areas of clearing and grading

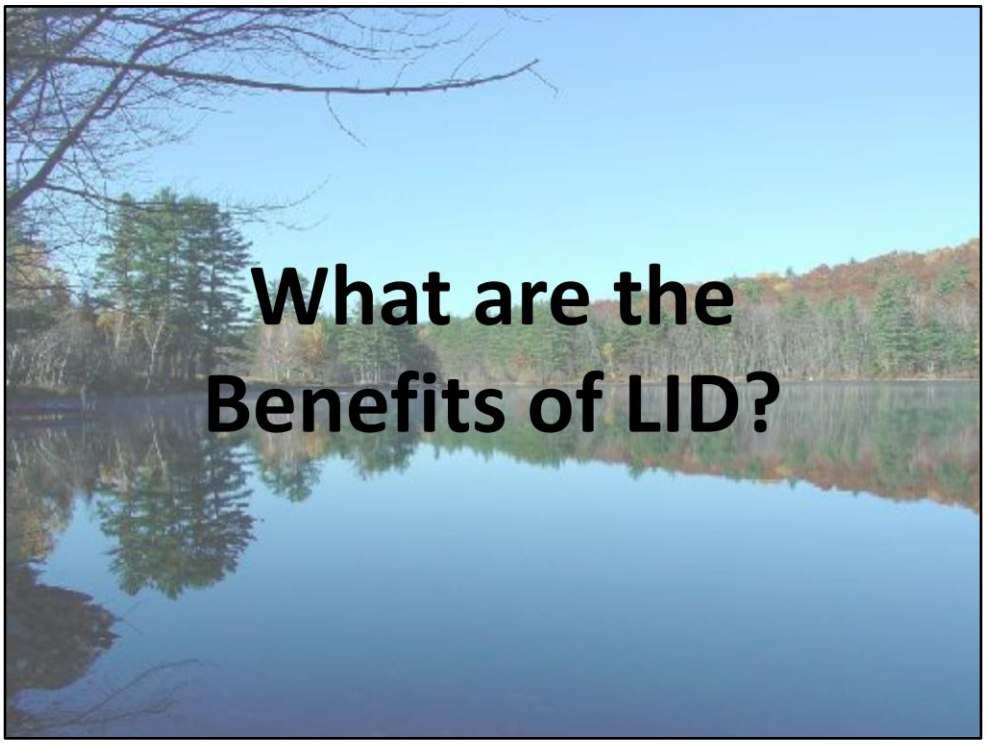
-- Minimizes impervious areas

… Is An Approach to Site Design and Stormwater Management that seeks to mimic the pre-development runoff characteristics on a development site.

LID Mimics Pre-Development Runoff

- By using several, **low-tech** systems that **fit in with site's** natural topography & drainage
- By **disconnecting** post-development drainage so runoff can **infiltrate** (soak) into the ground where it's **naturally treated near its source**





Now that we've gone over some basic principles of Low Impact Development, let's examine: what are the benefits?


LID Benefits
• Similar costs (often less sitework, grading & clearing)
• Optimizes infrastructure layout
• Increases flexibility – many design options
• Preserves natural green space. Protects wetlands and habitats.


LID Benefits
• More aesthetically pleasing and naturally attractive landscape
• Increased property values (e.g. a rain garden can be considered a landscape amenity)
• Less lawn, less mowing, less fertilizer


LID Benefits
Breaks up post-development drainage resulting in much greater overall control of runoff:
• During more frequent smaller storms and
• For the “first flush” of each storm when most of the pollution occurs

LID BENEFITS

Protects Water Quality

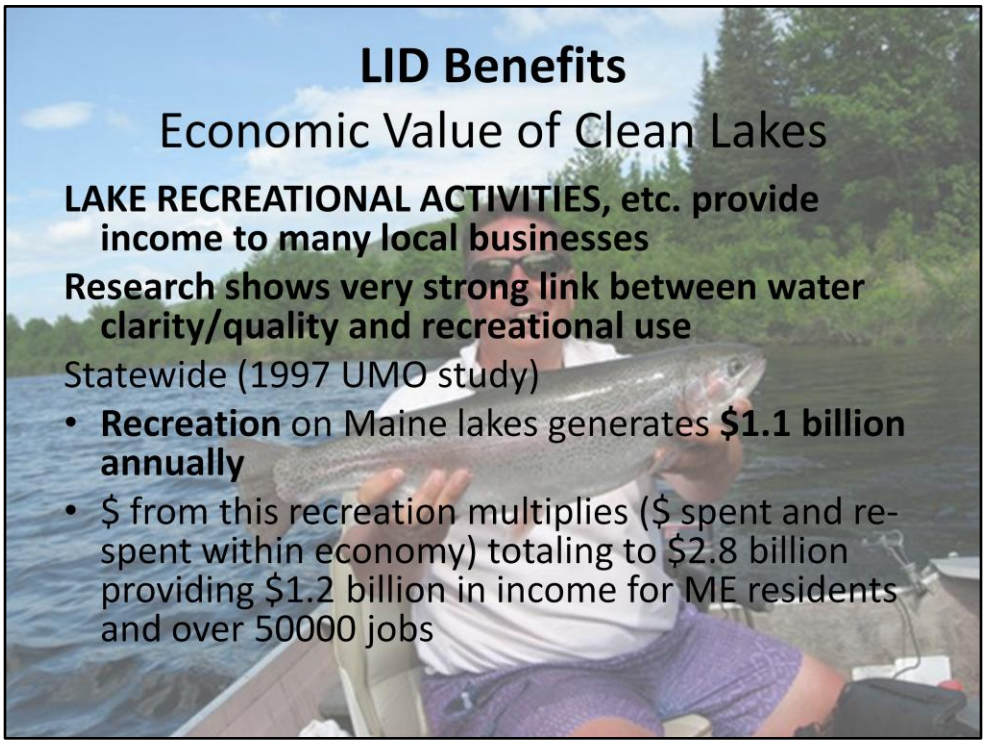
Most importantly LID protects the water quality of lakes and streams.

Over 600,000 Maine people, almost half the State's population get their drinking water from Maine lakes. LID protects drinking water from lakes by reducing sediment, nutrient, and toxic loads to water bodies.

There is considerable evidence to indicate that LID techniques also provide more effective water quality treatment for stormwater runoff. A "treatment train" approach that uses a number of techniques in series provides treatment through a variety of processes, including filtration, plant uptake, adsorption, and microbial activity. Contrast this with conventional systems such as ponds that rely on settling alone.

The emphasis on infiltration and the use of decentralized techniques also results in increased aquifer recharge. Many conventional systems are designed to provide recharge, but usually through a single infiltration basin that can cause groundwater mounding. A decentralized system distributes the infiltration throughout the site, which is more effective and which more accurately replicates natural systems.

Another important feature of the decentralized approach is that one or more of the individual structures can fail without compromising the overall integrity of the stormwater management system for the site.


LID Benefits
Economic Value of Clean Lakes
LAKE RECREATIONAL ACTIVITIES, etc. provide income to many local businesses
Research shows very strong link between water clarity/quality and recreational use
Statewide (1997 UMO study)
• Recreation on Maine lakes generates $1.1 billion annually
• $ from this recreation multiplies ($ spent and re-spent within economy) totaling to $2.8 billion providing $1.2 billion in income for ME residents and over 50000 jobs


LID Benefits
Economic Benefits of Clean Lakes
Drinking Water, Youth Camps, and Commercial Uses Generates $400 Million Annually in ME

… .

Tax revenue from lake front property can pay up to 74% of a community's education costs. These owners are often out of state residents.

LID Benefits
Municipal Fiscal Value of Clean Lakes

Research shows very strong link between lake clarity/quality and lake-front property values

China (UMO research, 1997)

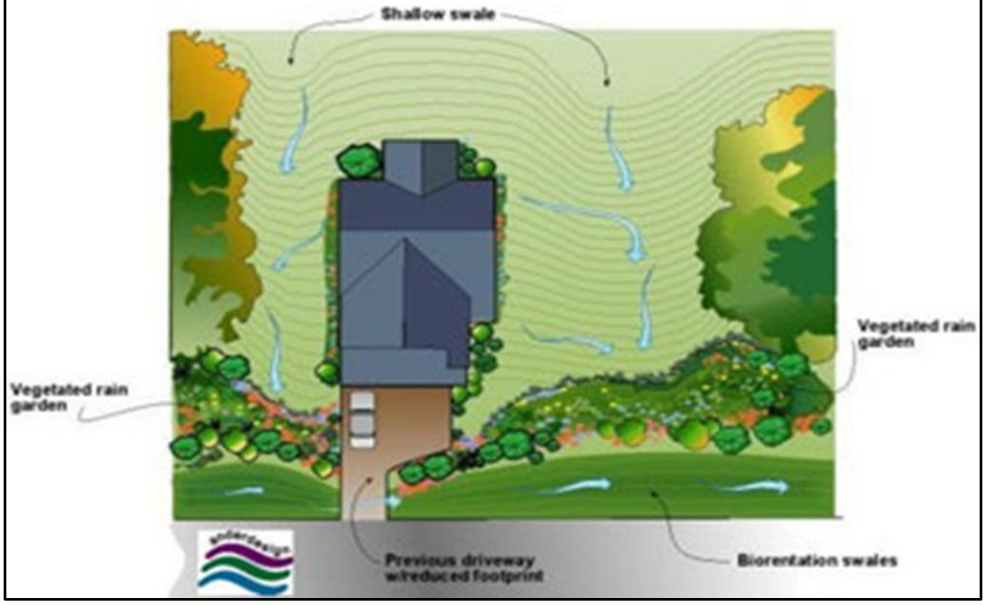
- 15% of average property value depended on water quality
- If water clarity declined by about 3 feet lake-front property value would drop $141 per frontage foot or $16,080,700

Belgrade (UMO research, 1997)

- 60% ($127 million) of total tax valuation ($211 million) is from lake-front property
- If water clarity declined by about 3 feet town would lose $10.5 million (5%) in total property value
- Result > 5% tax increase for non-shoreline owners; reduced property values and taxes for shoreline owners


LID Benefits
High Value of Clean Lakes
Community Actions to Protect Water Quality
Can Have a Significant Payoff by Maintaining
and Enhancing Future Tax Revenues,
Employment and Enjoyment of Lakes

What Does LID Look Like?



Rain Gardens

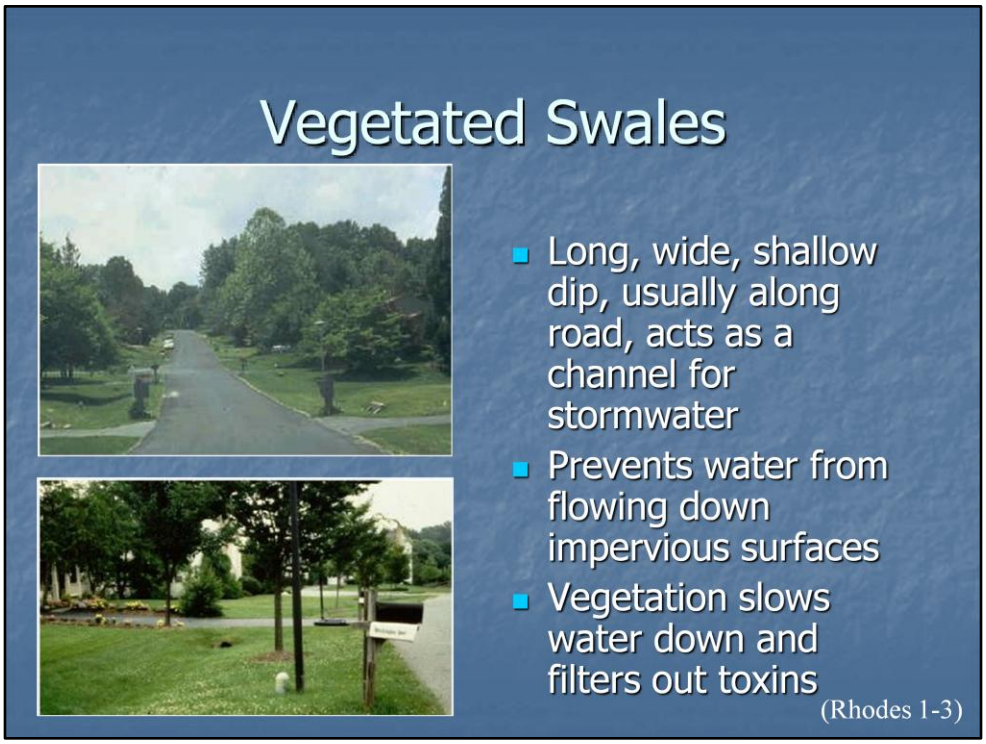
- Dish-shaped depression
- Gathers runoff
- Plants filter out pollutants
- Advantages:
  - Good for small lots
  - Can be low-cost, easy
  - Beautifies land
  - Significantly reduces runoff

(Picture source: “Rain Garden History,” Rain Gardens of West Michigan.)

Rain garden in subdivision cul de sac.

Rain garden near Cooperative Extension office building in Orono.

Another rain garden near Cooperative Extension office in Orono.



(Picture source: Rhodes' "Swale Stories," pages 1,3.)

Vegetated Buffers & Strips

- Absorbs energy of rainfall
- Trees, shrubs & ground cover hold soil, slow & cool runoff & remove pollutants
- Natural depressions & irregular ground surface traps runoff allowing it to soak in ground
- Screens development from the water while maintaining views for property owner

A good example of a vegetated buffer. Note irregular ground surface and that buffer allows a filtered view of the lake.

Rain Barrels & Cisterns

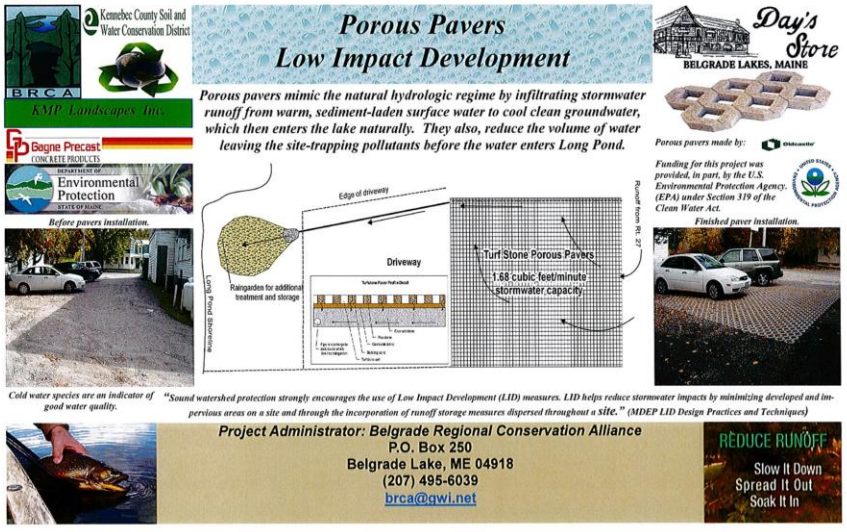
- Collect rainwater
- Use to water garden
- Install filter (more $) for household use
- Cut down on water bills
- Connect to downspout
- Mosquito-proof lid
- Angled runoff pipe
- Spigot
- 1” rain on 1,000 ft^2 roof = 600 gal water

Permeable Pavers

(James 2)

- Granular and porous or made of interlocking blocks
- Traps rainwater instead of acting as conduit
- Reduces runoff

Reduces runoff by slowing down the rate of water flow, or allowing water to evaporate and/or infiltrate to the soil below the pavement
(Picture source: James' "Green Roads," page 2.)



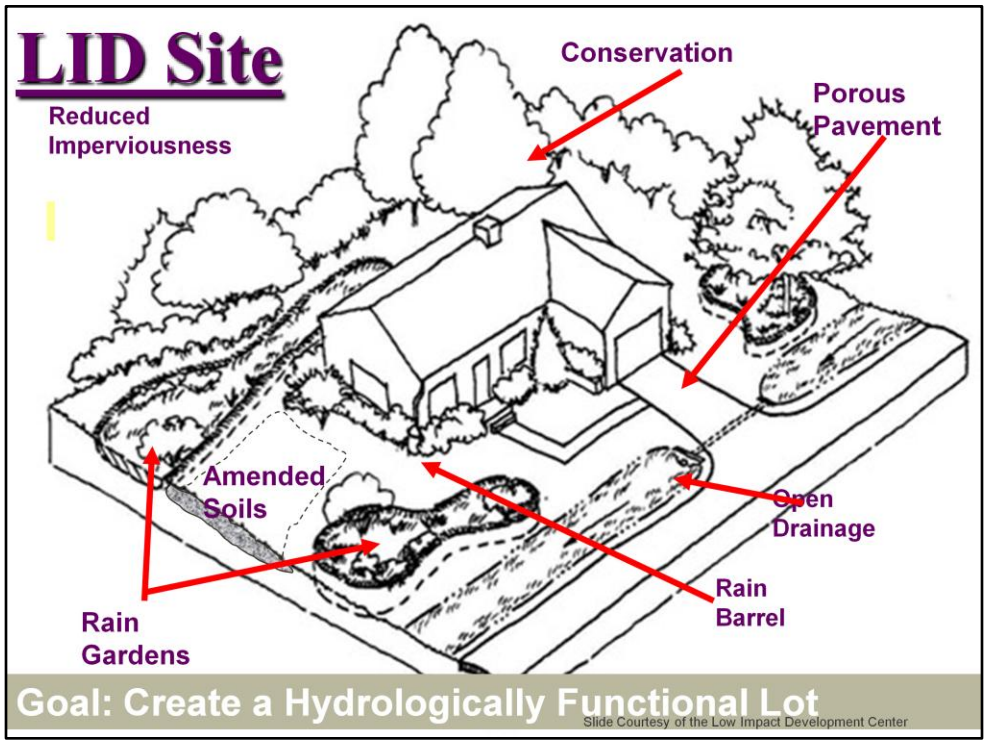
This shows design of porous pavers near Day's Store in Belgrade.

Here’s a close up view of permeable pavers near Day’s Store.

There is considerable evidence to indicate that LID techniques provide more effective water quality treatment for stormwater runoff. A “treatment train” approach that uses a number of techniques in series provides treatment through a variety of processes, including filtration, plant uptake, adsorption, and microbial activity. Contrast this with conventional systems such as ponds that rely on settling alone.

The emphasis on infiltration and the use of decentralized techniques also results in increased aquifer recharge. Many conventional systems are designed to provide recharge, but usually through a single infiltration basin that can cause groundwater mounding. A decentralized system distributes the infiltration throughout the site, which is more effective and which more accurately replicates natural systems.

Another important feature of the decentralized approach is that one or more of the individual structures can fail without compromising the overall integrity of the stormwater management system for the site.

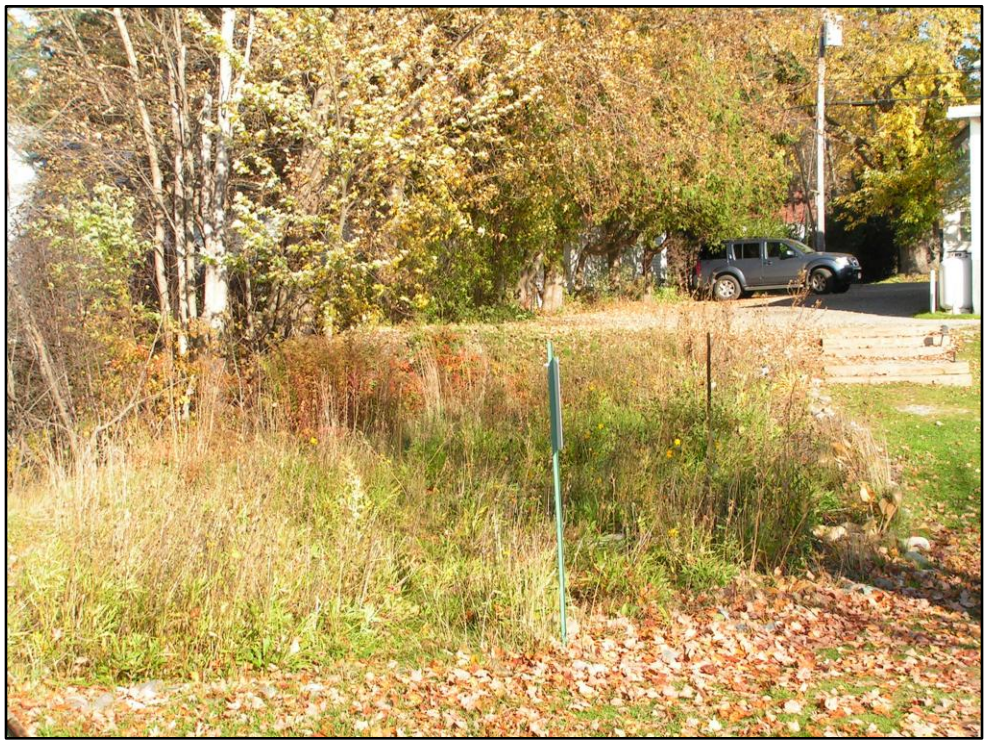


The most significant outcome is that application of Low Impact Development techniques can yield a hydrologically functional lot; that is, a piece of property where the flow of water after development is largely the same as it was before.

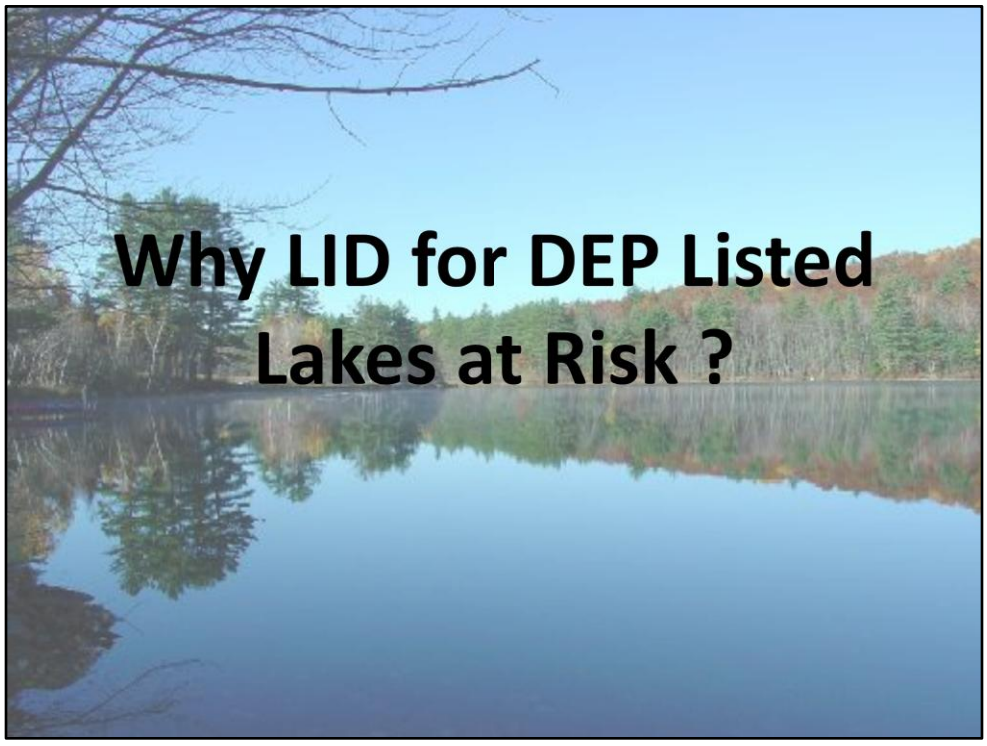
Here is another view of porous pavers at Day's Store in Belgrade.

Here’s another view of the porous pavers at Day’s Store.

Water from porous pavers at Day's Store moves down slope through a perforated drain pipe to stairs with crushed stone and drains to rain garden on left creating a "treatment train" of LID techniques.



Here's a view of the rain garden (late fall) downslope from the porous pavers at Day's Store. Long Pond shoreline is near the rain garden. Storm water is clean by the time it drains from rain garden.



A. Direct watershed of a lake most at risk from new development . A lake is considered most at risk from new development if it meets the criteria below. Lakes most at risk from new development are listed if it is

(1) A public water supply; or

(2) Identified by the department as being in violation of class GPA water quality standards or as particularly sensitive to eutrophication based on

(a) Current water quality,

(b) Potential for internal recycling of phosphorus,

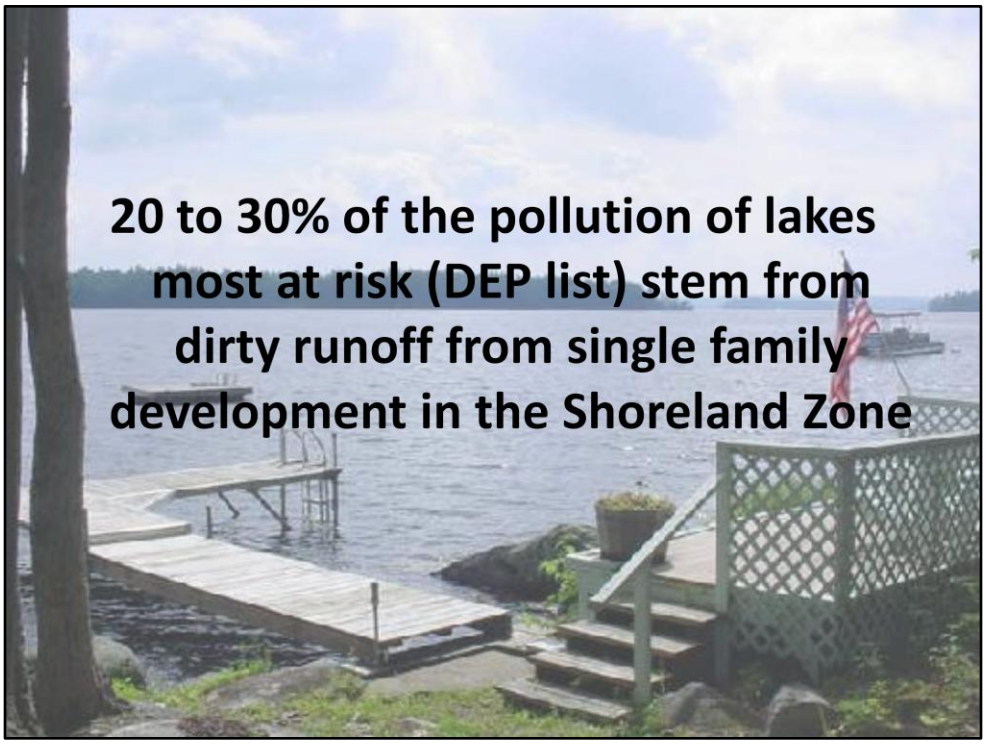
(c) Potential as a cold water fishery,

(d) Volume and flushing rate, or

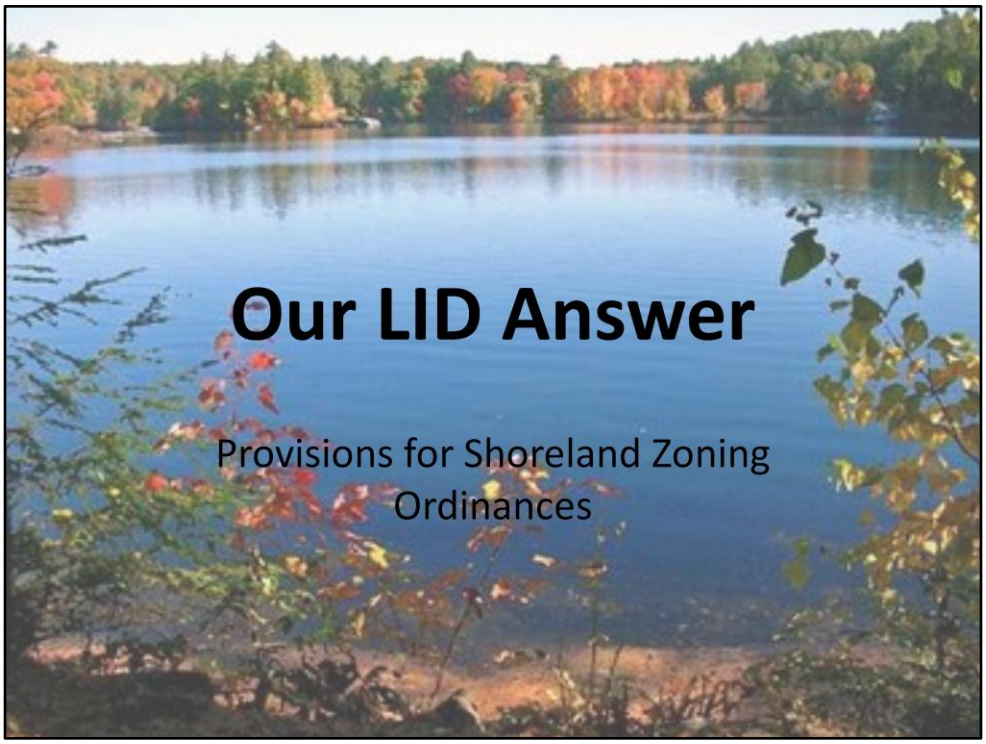
(e) Projected growth rate in the watershed.

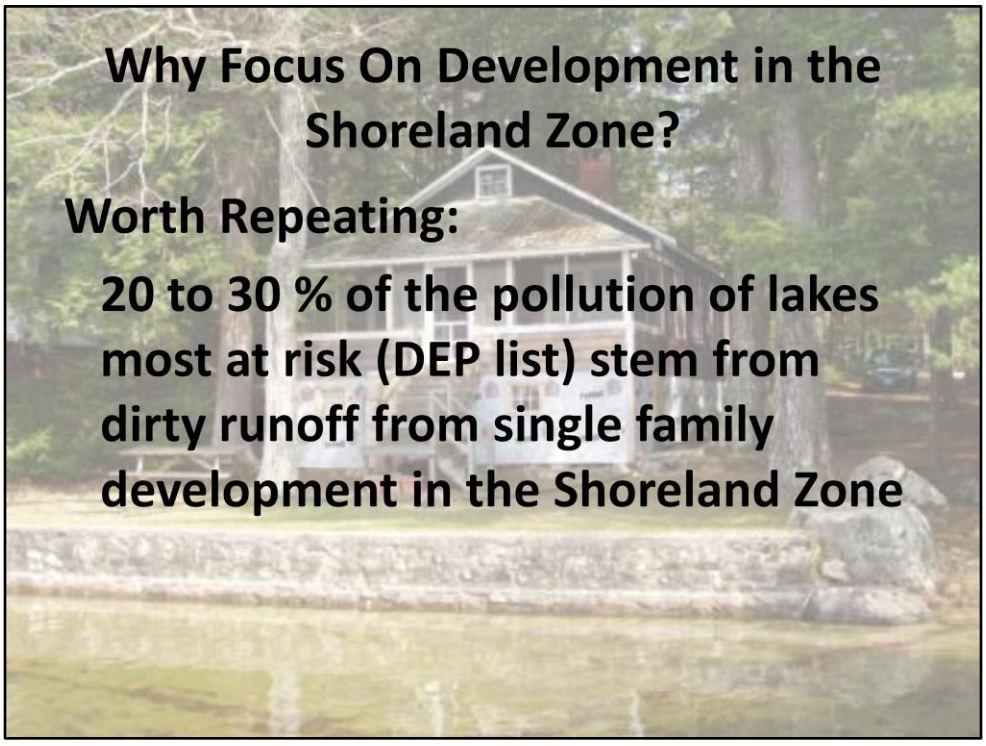
Severely blooming lakes are a subset of lakes most at risk. A severely blooming lake has a history of algal blooms, and the reduction of existing watershed phosphorus sources sufficient to eliminate those algal blooms is expected to be so difficult that the addition of new, incompletely mitigated development sources may prevent successful restoration of the lake.

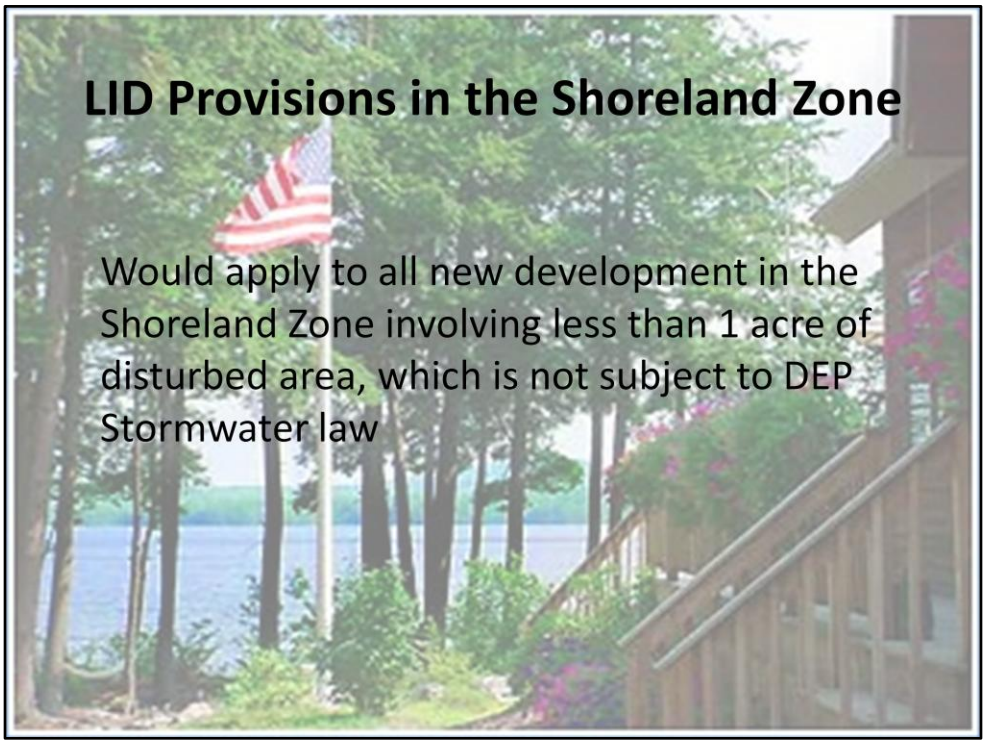
Many if not most lakes and great ponds in Maine are on this list.


20 to 30% of the pollution of lakes most at risk (DEP list) stem from dirty runoff from single family development in the Shoreland Zone


Local Ordinances Fall Short In Protecting Lake and Stream Water Quality(WQ)
• Shoreland Zoning (SZ)
➢ Important but without LID cannot protect WQ alone
➢ Many developed lakefront properties lack effective buffering downslope from primary structures
▪ Phosphorus(P) Control Ordinance
➢ Many towns have no P control ordinance
➢ Typically only applies to commercial or subdivision development
➢ China's P Control Ordinance
○ Applies to all new primary structures
○ Exempts additions to existing residences & accessory structures
Note: Most development in the SZ are additions & accessory structures. There are few developable lots in China that could accommodate a new primary structure.


Our LID Answer
Provisions for Shoreland Zoning Ordinances

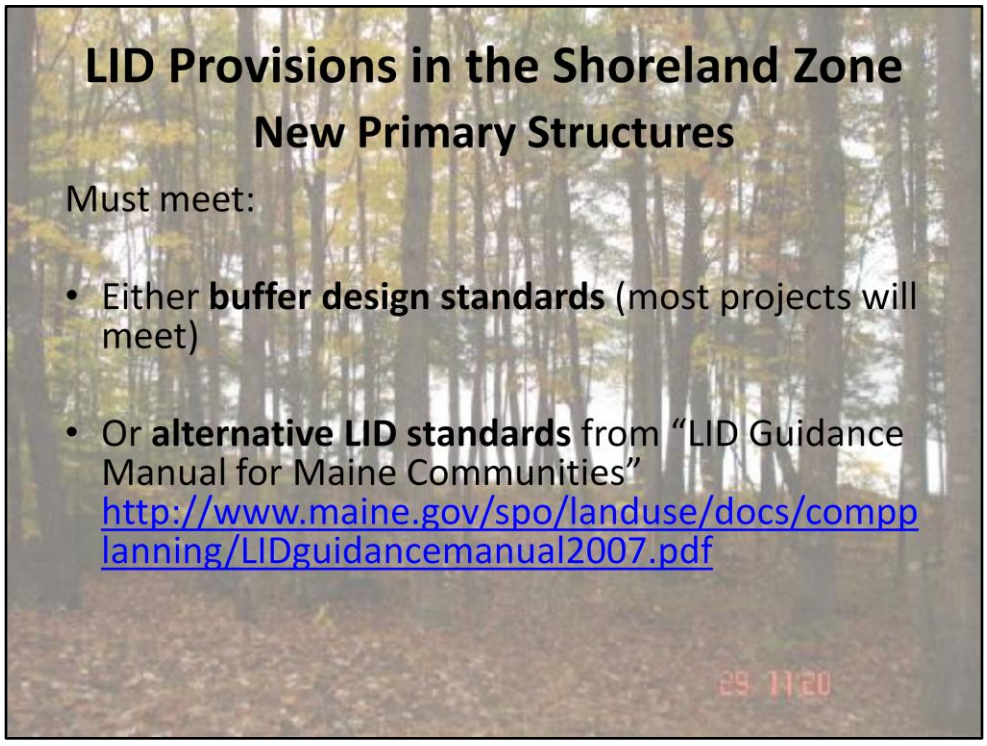

Why Focus On Development in the Shoreland Zone?
Worth Repeating:
20 to 30 % of the pollution of lakes most at risk (DEP list) stem from dirty runoff from single family development in the Shoreland Zone


LID Provisions in the Shoreland Zone
Would apply to all new development in the Shoreland Zone involving less than 1 acre of disturbed area, which is not subject to DEP Stormwater law

LID Provisions in the Shoreland Zone

Three Tiers of Regulation Based on Structure Type

- New Primary Structures
- New Additions to Primary Structures
- New or Additions to Decks and Accessory Structures


LID Provisions in the Shoreland Zone
New Primary Structures
Must meet:
• Either **buffer design standards** (most projects will meet)
• Or **alternative LID standards** from "LID Guidance Manual for Maine Communities" http://www.maine.gov/spo/landuse/docs/comppplanning/LIDguidancemanual2007.pdf

LID Provisions in the Shoreland Zone

Building Expansions of Existing Primary Structures

- 25’ wide or as wide as possible buffer area downslope of all development will be sufficient for most projects
- A few projects may require additional LID techniques so no net gain of dirty runoff exported from property

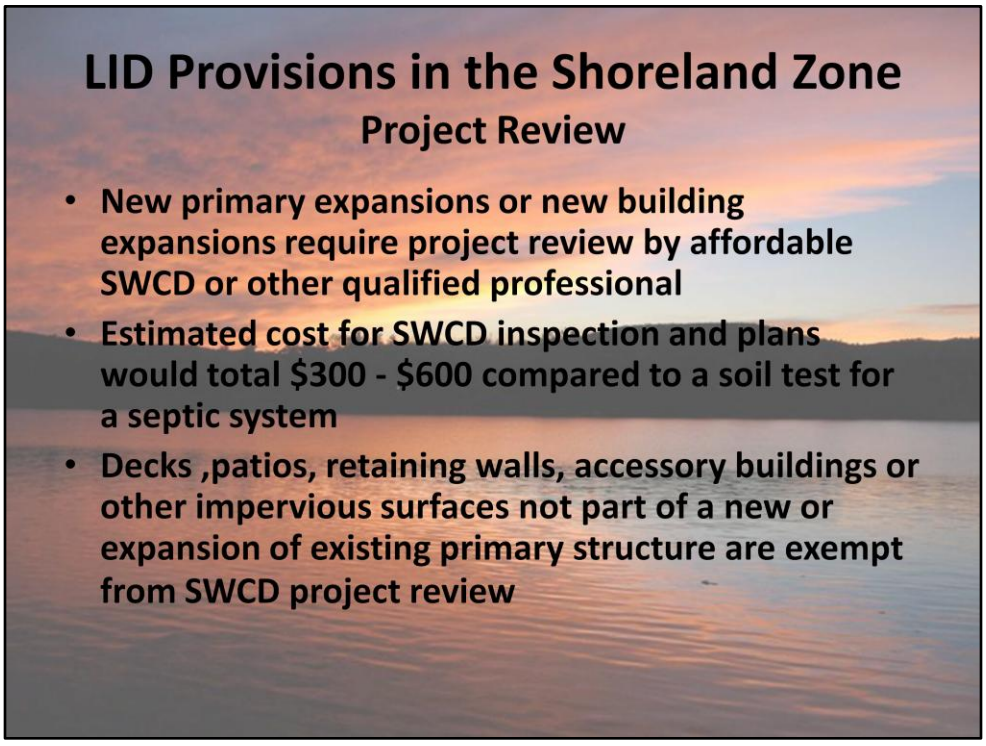
LID Provisions in the Shoreland Zone
New or Expansions of Decks or Accessory Structures

- **Decks, patios, retaining walls, accessory buildings or impervious surfaces** not part of a new development of a primary structure or expansion of an existing primary structure would only be subject to requirements in Appendix 1.
- **Decks** must allow rainfall to pass through and ground beneath must be pervious

LID Provisions in the Shoreland Zone

New or Expansions of Non-Primary Structures (cont)

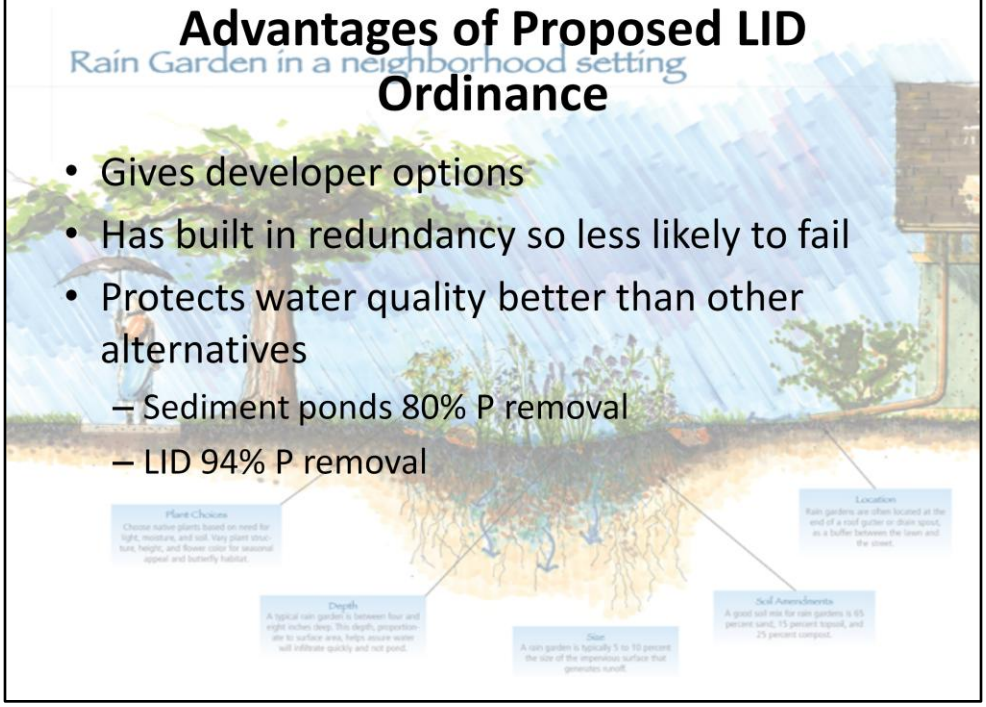
- **Patios** must permit infiltration.
- **Retaining walls** less than 24" high must not alter amount or direction of runoff flow and area behind the wall must be revegetated.
- **Accessory structures** must have a raised footing foundation with area under structure remaining ground surface. A drip edge is required.
- **Other impervious surfaces** (e.g. a driveway) must achieve no net gain in stormwater runoff.


LID Provisions in the Shoreland Zone
Project Review
• New primary expansions or new building expansions require project review by affordable SWCD or other qualified professional
• Estimated cost for SWCD inspection and plans would total $300 - $600 compared to a soil test for a septic system
• Decks ,patios, retaining walls, accessory buildings or other impervious surfaces not part of a new or expansion of existing primary structure are exempt from SWCD project review

Advantages of Proposed LID Ordinance

- Closes loophole of types of development not covered by existing ordinances
- Provides critical buffer design standards insuring effective performance
- Provides affordable solution provider SWCD minimizing engineering services
- Is development friendly in harmony with water quality

Advantages of Proposed LID Ordinance



- Gives developer options
- Has built in redundancy so less likely to fail
- Protects water quality better than other alternatives
  - Sediment ponds 80% P removal
  - LID 94% P removal