MDAR Programs and Activities related to Water Conservation and Water Quality Protection

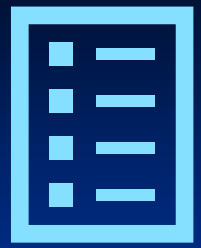
Hotze Wijnja, Ph.D.

Massachusetts Department of Agricultural Resources

Agriculture and Water

- Quantitative Aspects:
  - Water Management Related
    - Water Conservation
    - Drought Management/Mitigation
    - Drainage and Flood Control
- Qualitative Aspects:
  - Pesticides and Water Quality
  - Plant Nutrients (Fertilizers)

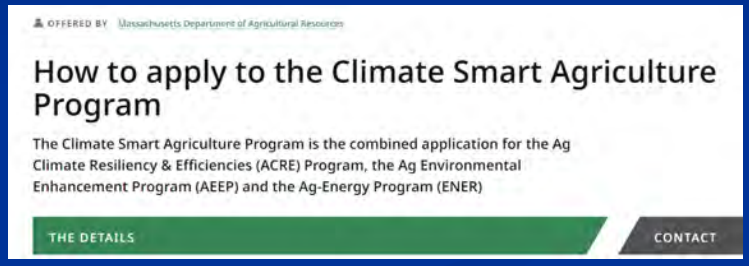
Outline



- Programs related to Water Conservation, Drought Mitigation and Soil Health
- Pesticides and Water Quality
  - Pesticide Registration: Water Related Assessments
    - Drinking water exposure, Human Health Risk Assessment
    - Water and Ecological Risk Assessments
  - MA Regulation of Pesticides: Public Water Supplies
  - Pesticide Monitoring Studies
  - Mosquito Control and Surface Water Protection
- Plant Nutrient Regulations

MDAR Grant Programs

- The Climate Smart Agriculture Program (“CSAP”) combines MDAR’s water, energy, and climate grants into one application.
  - Agricultural Climate Resiliency & Efficiencies (“ACRE”) Grant
    - 2022: 20 projects, total $500k
  - Agricultural Environmental Enhancement Program Grant (“AEEP”)
    - 2022: 11 projects, total $350k
  - Ag-Energy Program Grant (“ENER”)
- By bringing the three grants under one program, MDAR seeks to simplify the application process.



CSAP Grant Program

- Provide financial incentives to allow agricultural operations to proactively address risks and strengthen their economic and environmental resiliency
  - Safeguard natural resources, mitigate climate change impacts
    - Improving soil health,
    - Ensuring efficient use of water,
    - Preventing impacts on water quality,
    - Reducing greenhouse gas (“GHG”) emissions,
    - Enhance carbon sequestration

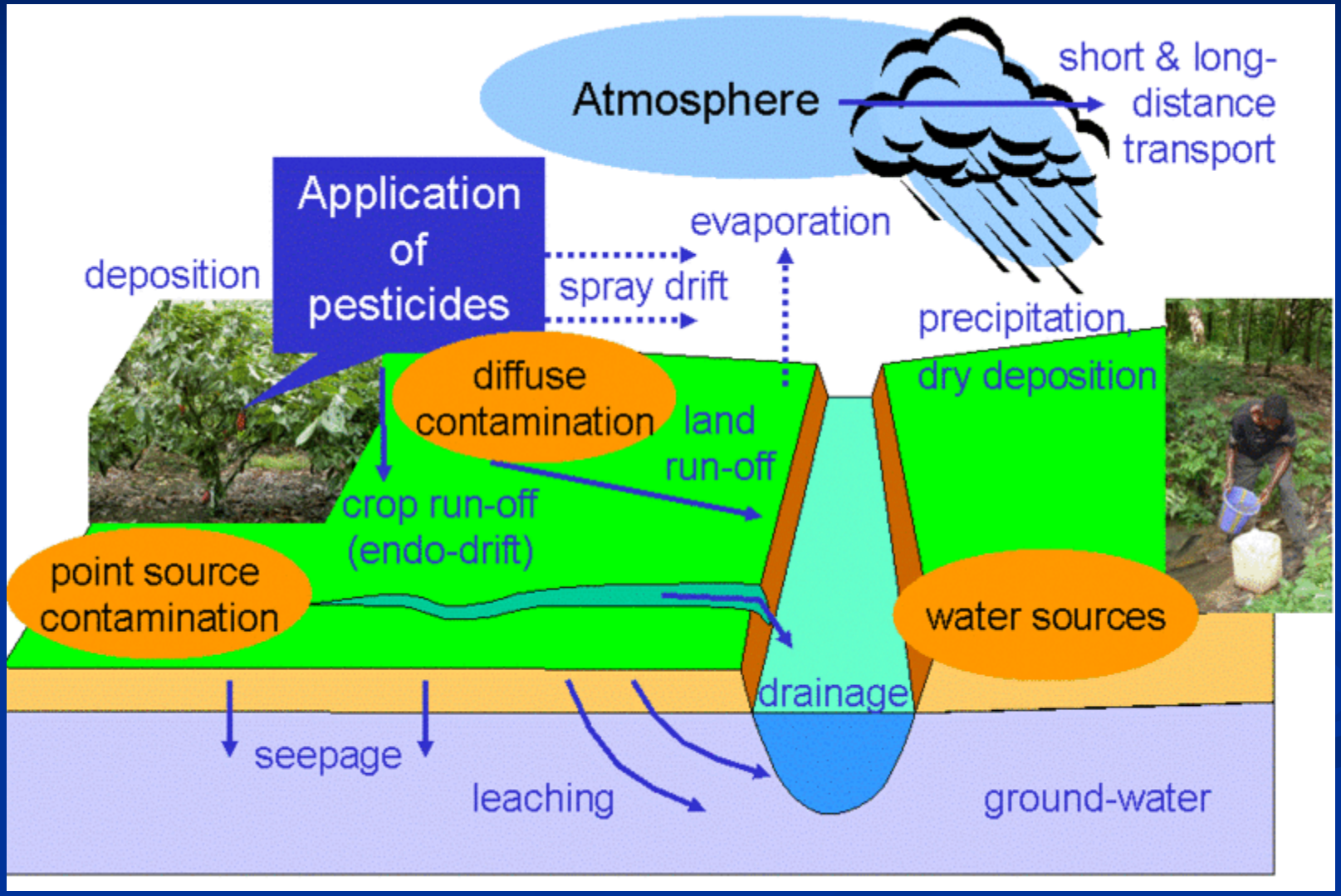
EEA Grant Program

- Food Security Infrastructure Grant Program
  - EEA program had a drought mitigation priority in their last RFR (closed in March)
  - Includes support of projects that intend to increase long-term resilience to drought or extreme weather events including:
    - Improvement of access to wells and surface
    - Water efficiency-related projects, such as drip irrigation

Farmer Consultant Program

- Massachusetts Coordinated Soil Health Program
  - American Farmland Trust in collaboration with the MDAR, NOFA/Mass, and UMass Amherst
  - Facilitate practices to improve soil health as part of effort to improve resiliency to climate change and farm viability.
  - Soil health improvement has also water conservation benefits.

Pesticides and Water



Pesticide Regulation and Water Quality

Health & Environment ▾ Pest Control ▾ Pesticide Products ▾ Pesticide Incidents ▾

Water and Pesticides

Clean waters provide healthy ecosystems for wildlife, plants and people. Inland fresh water is the source for 70% of U.S. **drinking water** supply, so protecting that supply from unnecessary contamination is important. Multiple federal and state agencies, including the EPA, work together to **regulate pesticides** and protect our

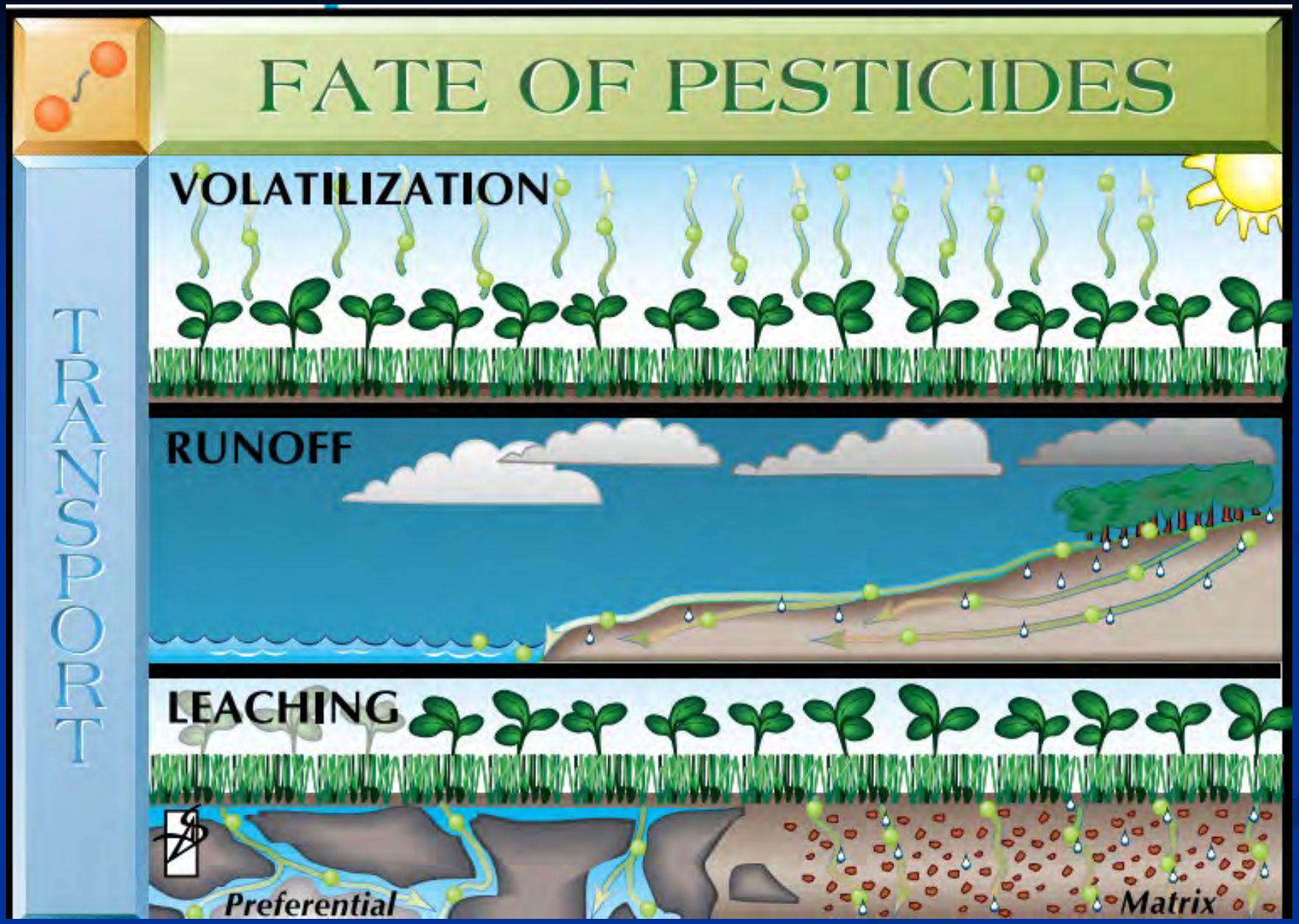
Addressing Potential Risks Associated with Use of Pesticides

- Minimize risks:
  - Characterization of pesticide ingredients
  - Risk Assessments
  - Regulatory Requirements
  - Education/Outreach
  - Practices to minimize impacts from pesticides

Pesticides in the Environment

- Potential for pesticides to affect the environment and human health
  - Pesticide Characteristics
  - Movement in the Environment
  - Persistence and Degradation

- Some pesticide products are restricted due to higher concerns for risks to humans and environment
  - Groundwater Protection List
  - Other (state) restricted pesticides


FATE OF PESTICIDES
TRANSPORT
VOLATILIZATION
RUNOFF
LEACHING
Preferential
Matrix

Pesticide Registration

- Federal level: EPA Registration
  - Foundation of Pesticide Regulation
  - Registration requirements
  - Comprehensive review and evaluation of studies
  - Exposure and Risk Assessments
  - Risk-Benefit Evaluation
  - Registration and Issuing of Pesticide Product Label
  - Registration review on 15-year cycle

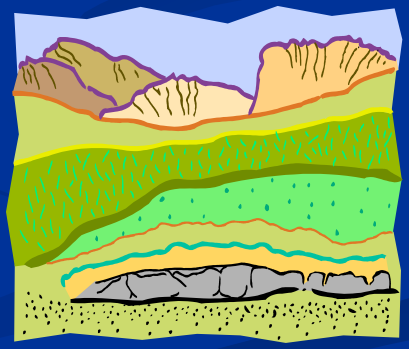
- State Level: Pesticide Board Subcommittee
  - Review for registration in MA
  - State specific aspects and reviews

Federal Level: Registration Process at EPA

- Scientific, legal, and administrative procedures
- Examination of ingredients, use pattern, storage and disposal practices
- Evaluation of a wide variety of potential human health and environmental effects
- EPA requires more than 100 scientific studies done according to strict EPA guidelines

Environmental Fate Studies and Assessments

- Degradation studies
  - Hydrolysis
  - Photolysis (water, soil, air)
- Metabolism studies (biodegradation)
  - Aerobic/Anaerobic (soil/water)
- Mobility studies
  - Leaching; adsorption/desorption
- Volatility
- Field dissipation (terrestrial, aquatic)
- Ground and surface water exposure



Adsorption interactions of organic compound with natural solids

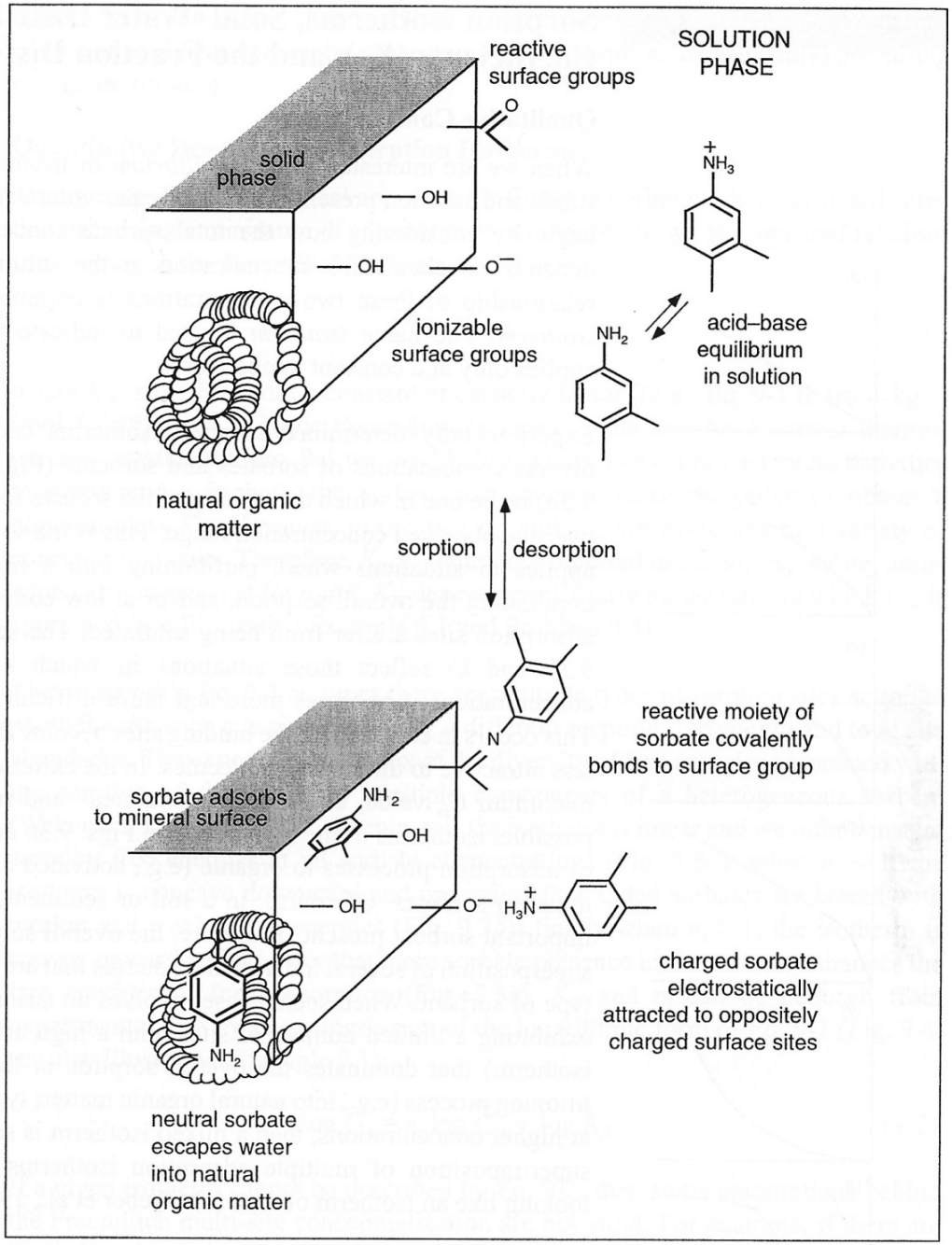


Figure 9.2 Some sorbent–sorbate interactions possibly controlling the association of a chemical, (3,4-dimethylaniline) with natural solids.

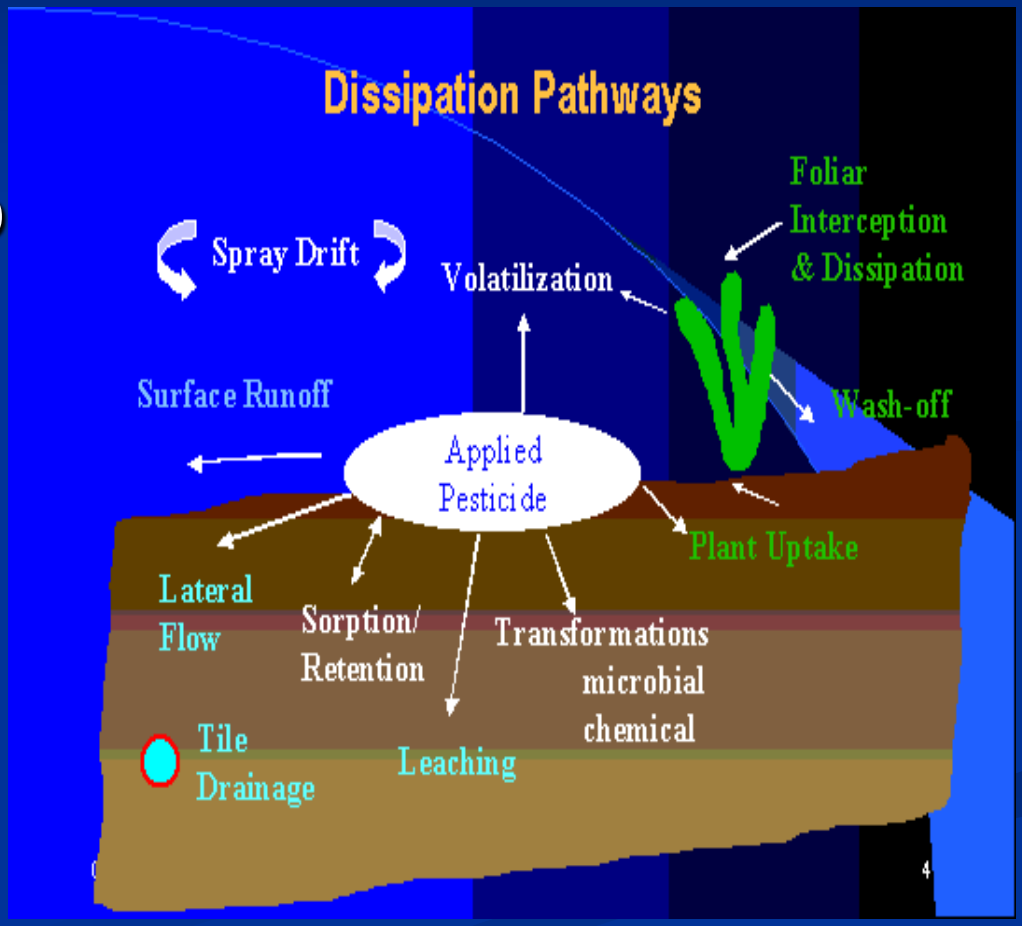
Addressing Environmental Concerns

- Know the chemical characteristics of pesticides
  - How pesticides behave in the Environment
- Understand the ways pesticides move during and after application
- Know the processes by which pesticides degrade in the environment

Addressing Environmental Concerns

- Know how the characteristics and processes add up to an overall environmental fate and impacts

- Groundwater and surface water exposure



Water Exposure Pathways
Spray Drift

- Movement of airborne pesticide droplets from the target area or vapor drift

- Check the label for precautions
  - mandatory no-spray buffers
  - spray droplet size requirements
  - wind speed restrictions
  - application volume requirements
  - warnings for sensitive crop or sites

Product Label Language: Controlling Spray Drift

Controlling Spray Drift

Variable Winds. DO NOT apply in variable wind conditions.

Wind Direction. Wind direction (e.g. away from nontarget areas) must be based on the average direction (not instantaneous).

Wind Speed. Drift potential increases at wind speeds of less than 3 mph (due to inversion potential) or more than 10 mph. However, many factors, including droplet size, canopy, and equipment specifications determine drift potential at any given wind speed. **DO NOT** apply when winds are greater than 15 mph.

Inversion Restriction. DO NOT make applications during temperature inversions. Drift potential is high during temperature inversions. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain close to the ground and move laterally in a concentrated cloud. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light-to-no wind.

Sensitive Areas. To ensure the protection of threatened or endangered species, it is important to maintain spray drift loadings below levels of concern for any area adjacent to the application site that is not excluded as possible habitat for these organisms. The following restrictions apply:

- **Buffer distance** - 15 feet
- **Release height** - 20 inches
- **Droplet size** - A combination of spray nozzles and appropriate pressure must be selected to provide ASABE standard S571.1 droplet size category of fine ($DV_{0.5}$ of ≥ 180 microns) or coarser than fine.
- **Maximum wind speed** - 15 mph

Water Exposure Pathways Runoff into Water

- Pesticides move in water over soil

- Residues may enter ditches, streams, rivers, ponds, and lakes

- Exposure tosurface water used for drinking and livestock water, irrigation, etc

Label Language: Runoff

ENVIRONMENTAL HAZARDS

For terrestrial uses: Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

Ground Water Advisory: This chemical has properties and characteristics associated with chemicals detected in ground water. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow.

Surface Water Advisory: This product may impact surface water quality due to runoff of rain water. This is especially true for poorly draining soils and soils with shallow ground water. This product is classified as having a high potential for reaching surface water via runoff for several months or more after application. A level, well-maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential loading of fenpyrazamine. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

Water Exposure Pathways: Leaching into Groundwater

- Water-soluble pesticides more susceptible
- Pesticides with low adsorption affinity are susceptible
- Pesticides that are also persistent are even more susceptible
- Soil properties
- Groundwater depth

Label Language: Addressing Leaching

Environmental Hazards

This pesticide is toxic to marine/estuarine invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff may be hazardous to terrestrial and aquatic plants in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

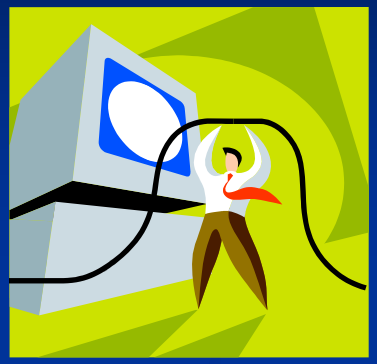
Groundwater advisories: This chemical is known to leach through soil into groundwater under certain conditions as a result of label use. Use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Do not use on coarse soils classified as sand, which have less than 1% organic matter.

Ground Water Exposure Assessments

- Part of Environmental Fate and Exposure Assessments by EPA
- Potential Groundwater Exposure is assessed
  - Water exposure models are used to estimate worst-case scenarios
  - If needed, special leaching studies will be required
  - Groundwater exposure level is used in drinking water and dietary assessments
- Based on assessments, groundwater-specific label statements may be required

Modeling of Pesticide Fate and Water Exposure



- Computer models allow the consideration of various environmental fate processes simultaneously

- Simulate the individual processes and combine them to an overall environmental fate and water exposure level (surface water and ground water)

Pesticide Root Zone Model – Ground Water

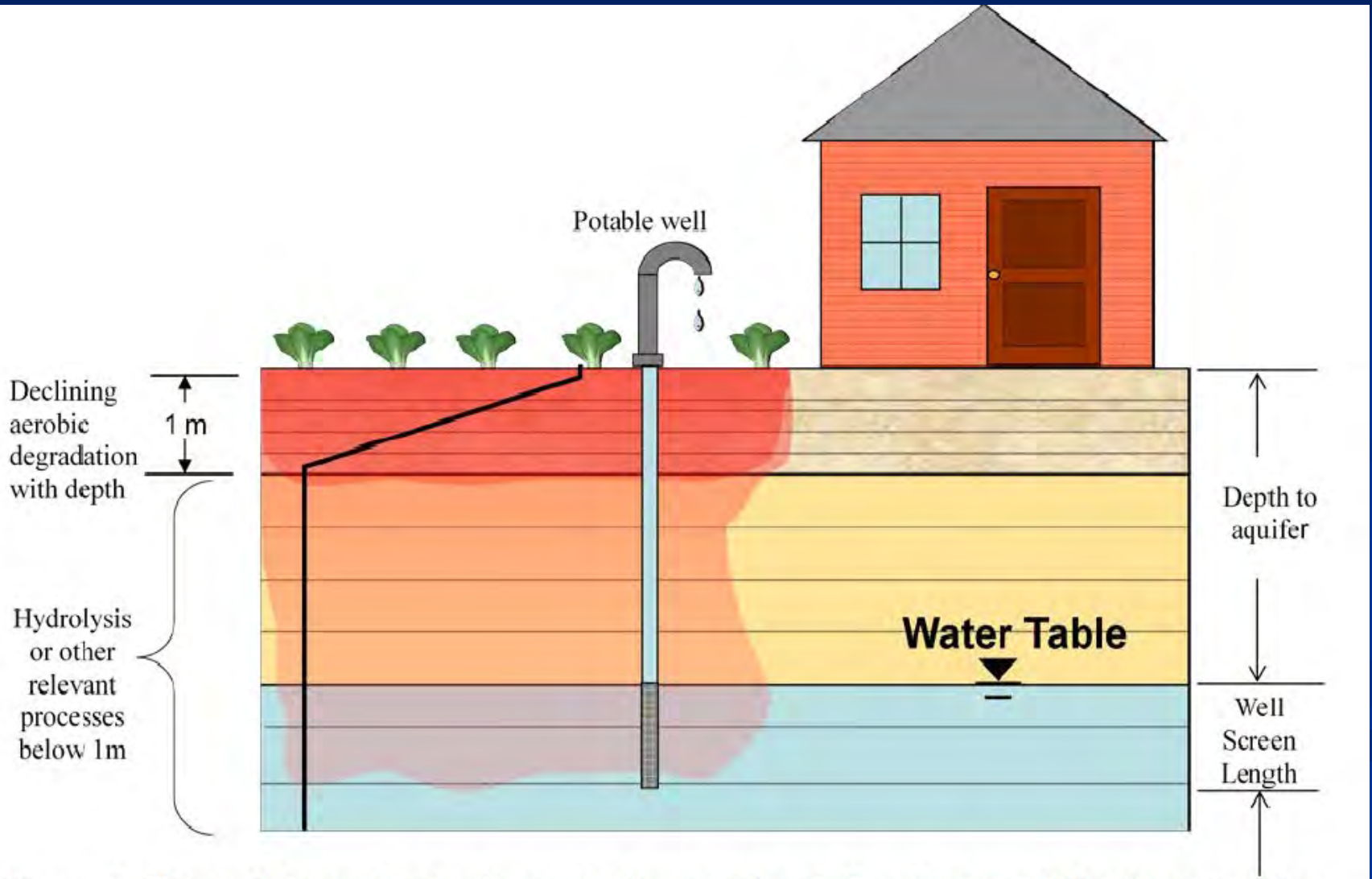
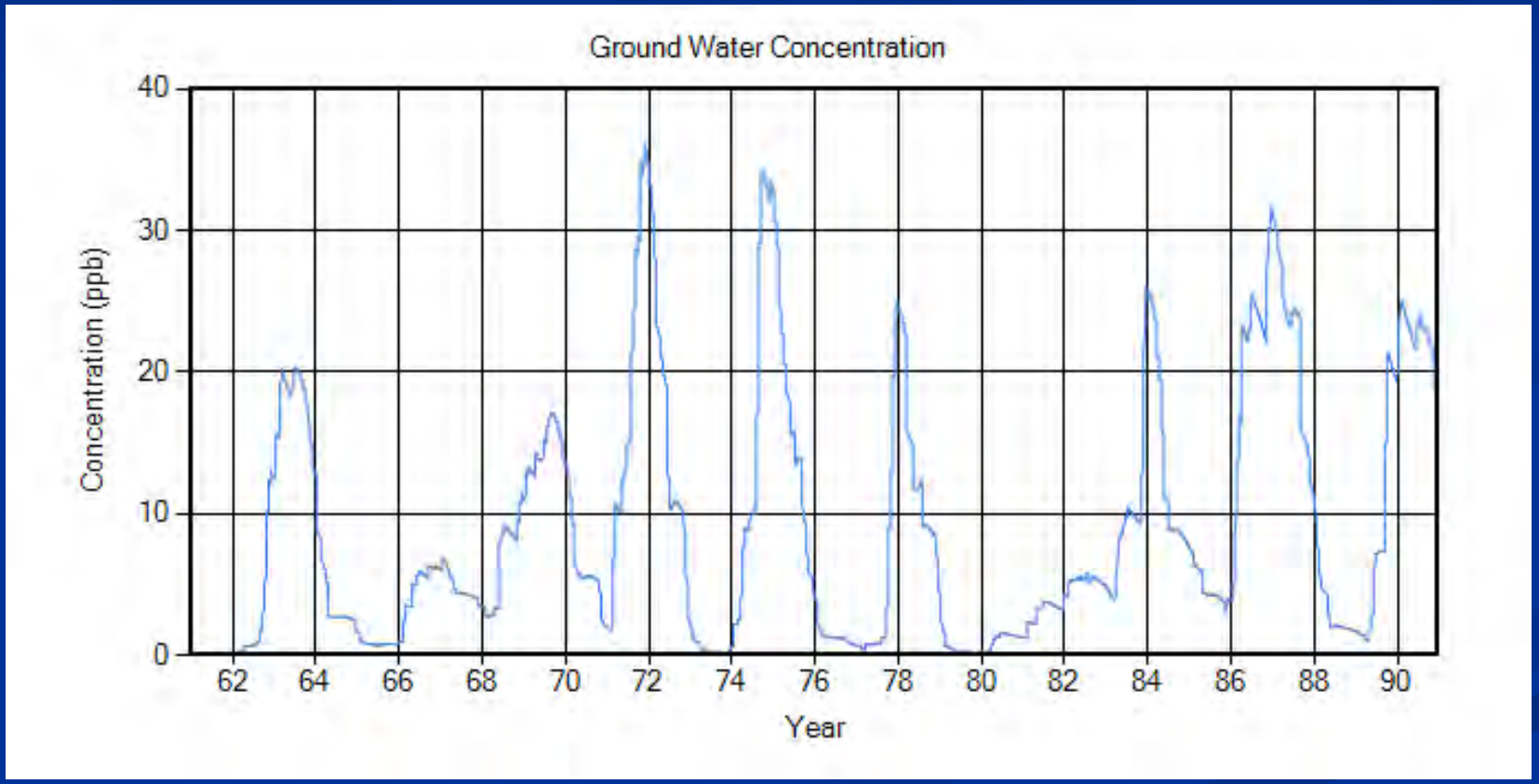


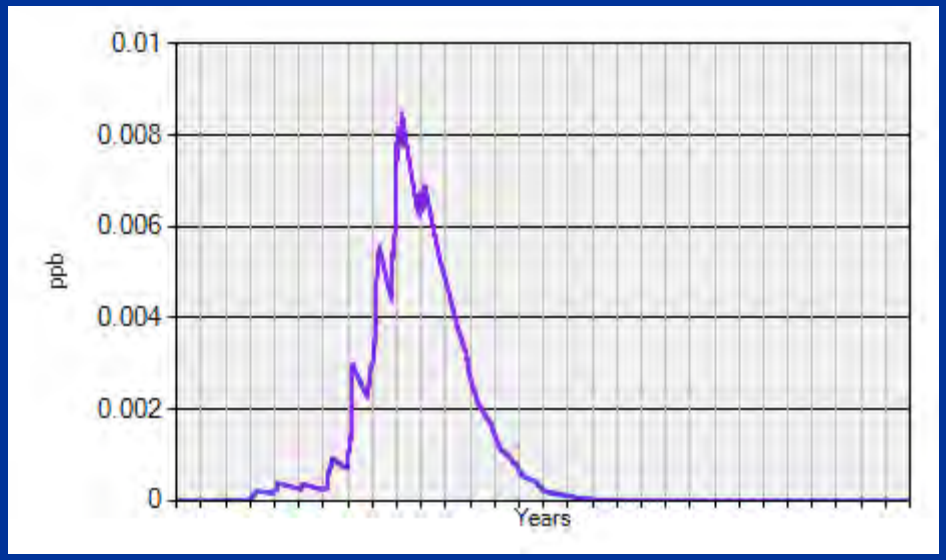
Figure 1. General Groundwater Scenario Concept for Estimating Pesticide Concentrations

Modeling Example: Atrazine in PA Corn Scenario: Groundwater



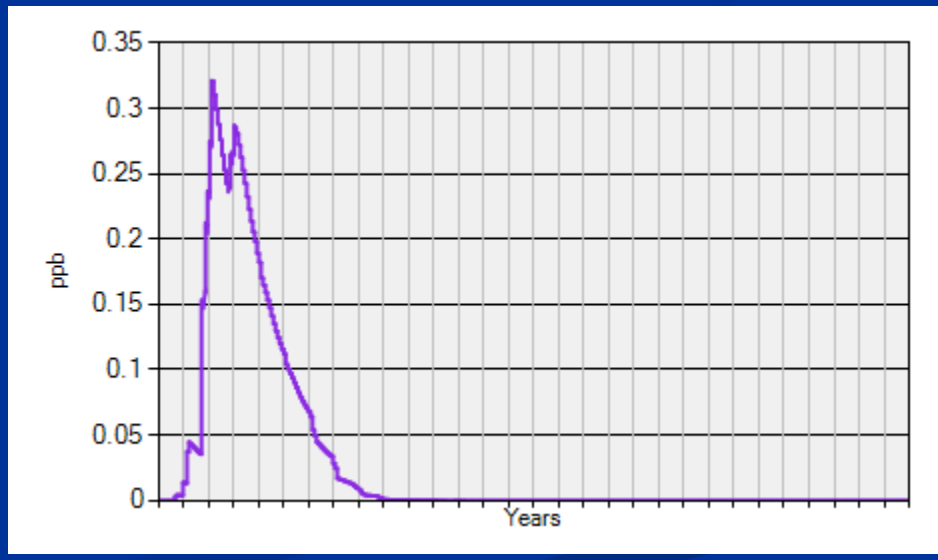
Modeling Results for Metsulfuron in Cape Cod Soil

- GW Depth of 10 m



30 Years

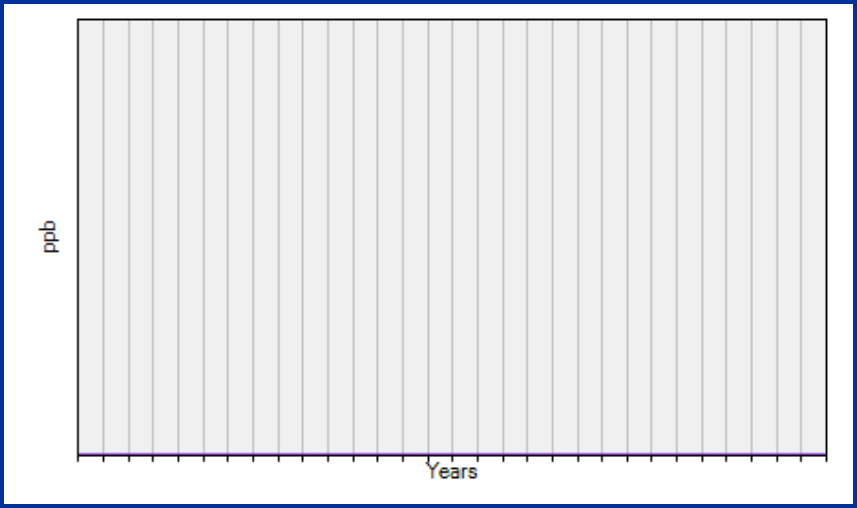
- GW Depth of 3 m



30 Years

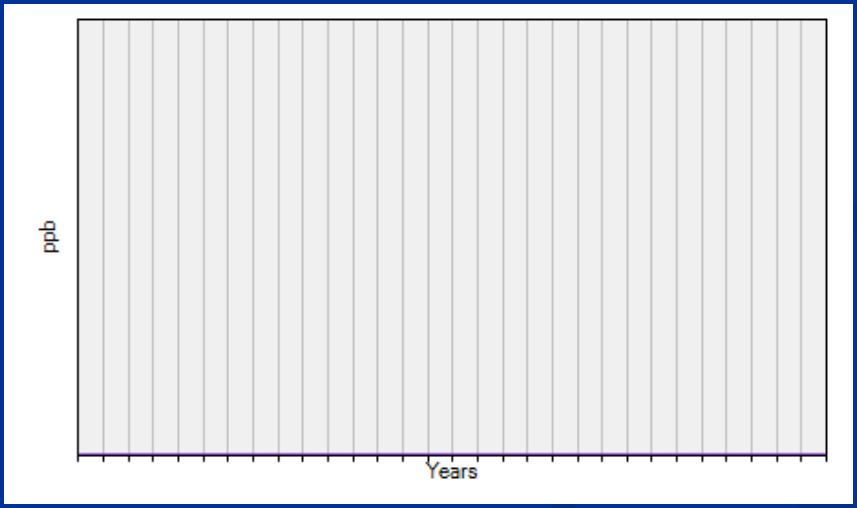
Modeling Results for Glyphosate in Cape Cod Soil

GW Depth of 10 m:



30 Years

GW Depth of 3 m

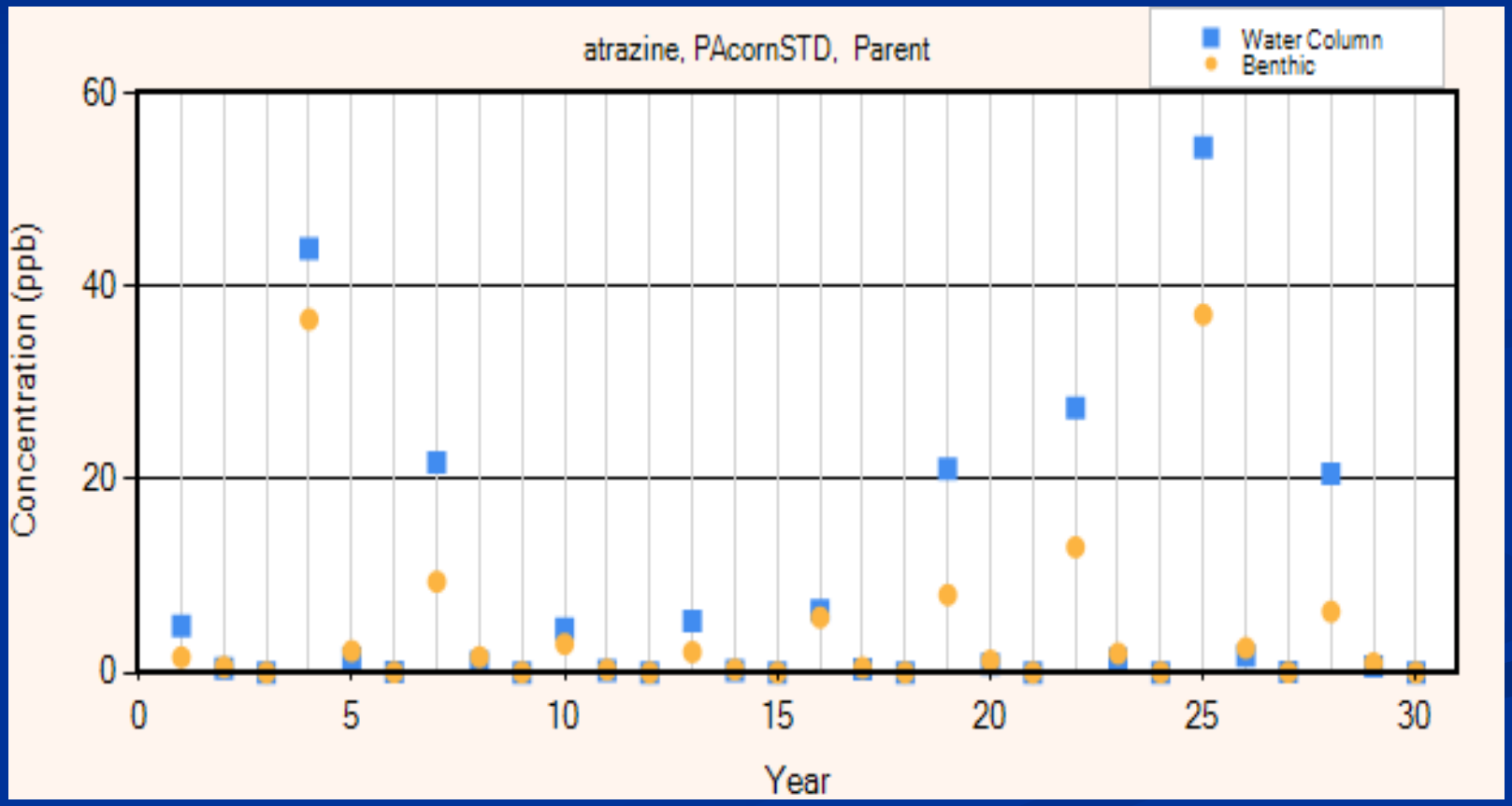


30 Years

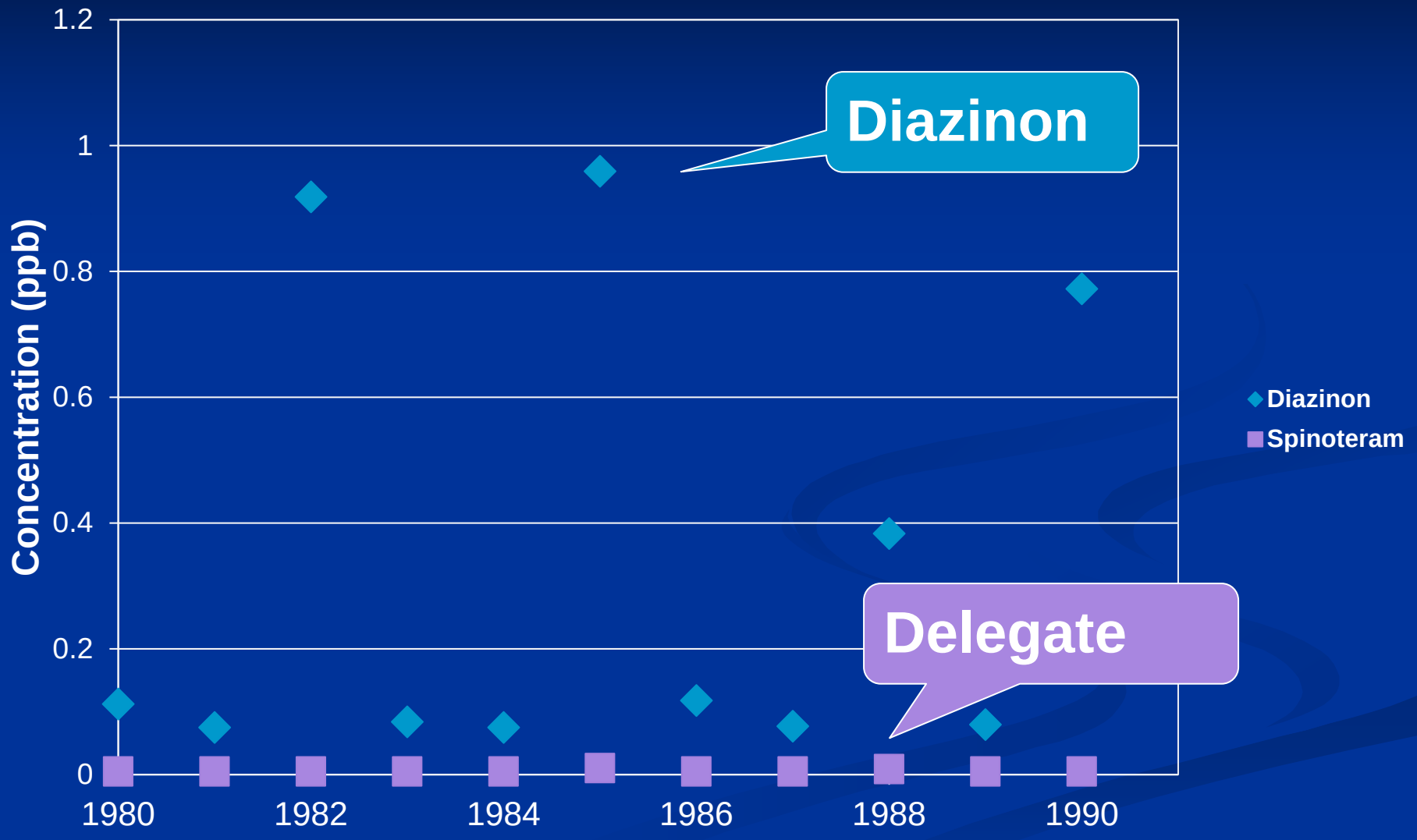
Surface Water Modeling

Eco Scenario

Atrazine on Corn Scenario: Surface Water Reservoir



Simulated Surface Water Concentrations, Cranberry Scenario



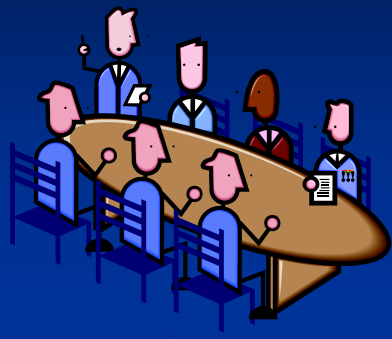
Use of Modeling Tools

- Modeling tools can provide refined assessment about pesticide fate
  - Used by regulators and scientists to evaluate different scenarios
  - Support assessments for pesticide registration and evaluation

Pesticide Registration and Groundwater Protection Aspects at the State Level

- Pesticide Registration
- Public Water Supply Protection Regulations
- Best Practices
- Monitoring studies

MA Pesticide Board Subcommittee



- Entity that registers pesticides in MA
- Five members from the Pesticide Board
  - Director of Food Protection Program, DPH – Chairperson
  - Commissioner of MDAR or designee
  - Commissioner of DPH or designee
  - Commissioner of DCR or designee
  - Commercial Applicator

Subcommittee Registration Classification

- Subcommittee determines potential to cause unreasonable adverse effects when used as labeled

- Classification of registration
  - Refuse to register
  - Register – unclassified/ General Use
  - Register and classify for Restricted Use (e.g. classification as a potential groundwater contaminant)
  - Register for Special Local Need

Groundwater Protection List Criteria

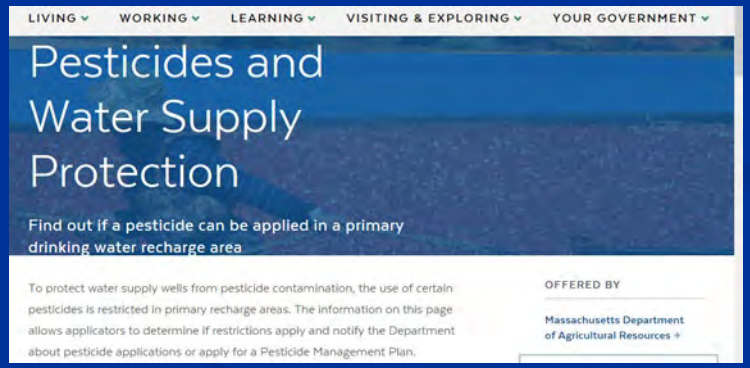
- Leaching Potential
  - Water solubility greater than 3 ppm, or
  - Organic matter-Water Partitioning less than 1900, or
  - Soil-water partitioning constant less than 20, or
  - Soil half-life greater than 7 days

AND

- Toxicological Concern
  - Maximum contaminant level less than 20 ppb, or
  - Known or probably human carcinogen

Groundwater Protection Program

- Regulation: 333 CMR 12.00:
- ***Protection of Groundwater Sources of Public Drinking Water Supplies from Non-Point Source Pesticide Contamination***



- Applies to products with active ingredients on Groundwater Protection List

MA Groundwater Protection List

Groundwater Protection List

List of pesticide active ingredients that could affect groundwater

The Groundwater Protection List refers to a list of pesticide active ingredients that could potentially impact groundwater due to their chemical characteristics and toxicological profile.

Search for registered products in Massachusetts

Active Ingredients by Category

Herbicides	Insecticides	Fungicides
• Acetochlor*	• Aldicarb	• Chlorothalonil
• Acifluoren	• Carbofuran	• Cyflufenamid
• Alachlor	• Dinotefuran	• Cyproconazole
• Aldicarb	• Disulfoton	• Folpet
• Atrazine	• Fenamiphos	• Kresoxim-Methyl
• Bentazon	• Fonofos	• Triticonazole

Pesticide Education Related to Groundwater Protection

- Best practices to minimize potential pesticide exposure
  - Including site assessment, product selection, proper calibration, label instructions and precautions

- Guidance on how to comply with Water Supply Protection Regulations

Pesticides and Water Supply Protection | Mass.gov

(https://www.mass.gov/pesticides-and-water-supply-protection)

What would you like to do?

Top tasks

- How do I Comply with Groundwater Protection Regulations? →
- Is Pesticide on the Groundwater Protection List? →

All other tasks

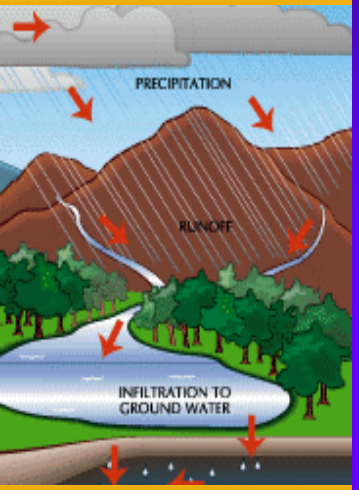
- Are you in Compliance with Groundwater Protection Regulations? →
- Submit a Pesticide Management Plan →
- Notify Use of Pesticide on Groundwater Protection List →

Scenario Evaluation

- Are you using a product on the Groundwater Protection List ?
- Are you in a regulated primary recharge area ?
- How do you ensure that you are in compliance with the regulations ?

Groundwater Protection List

- Pesticides identified as Potential Groundwater Contaminant
  - Leaching potential & toxicological concerns
- All restricted use products:
  - Only available to licensed professionals
- If possible, avoid use of listed pesticides in regulated recharge areas (Zone II's)
  - In specific situation, use of product will be allowed



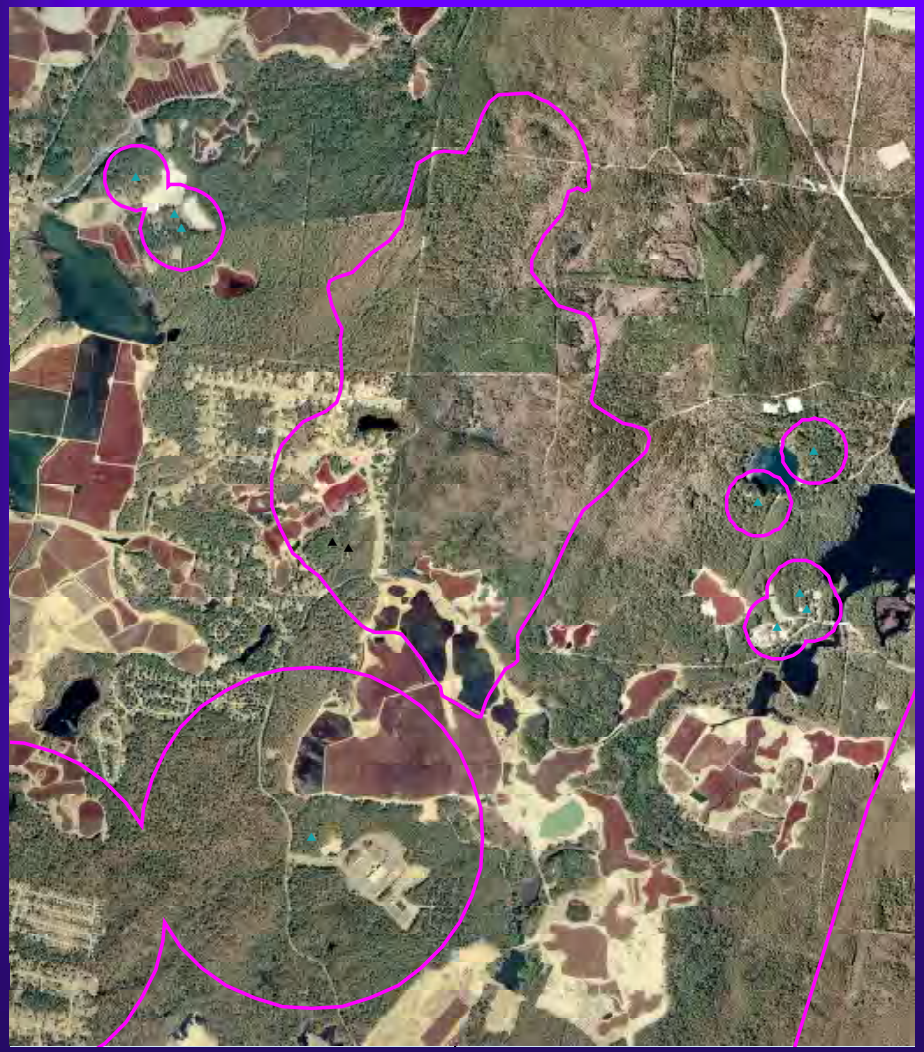
Primary Recharge Areas

Are you using a product on the Groundwater Protection List ?

Are you in a regulated Primary Recharge Area?

Are you applying to an area with greater than or less than 50% foliar cover ?

Regulated Recharge Areas



ZONE II

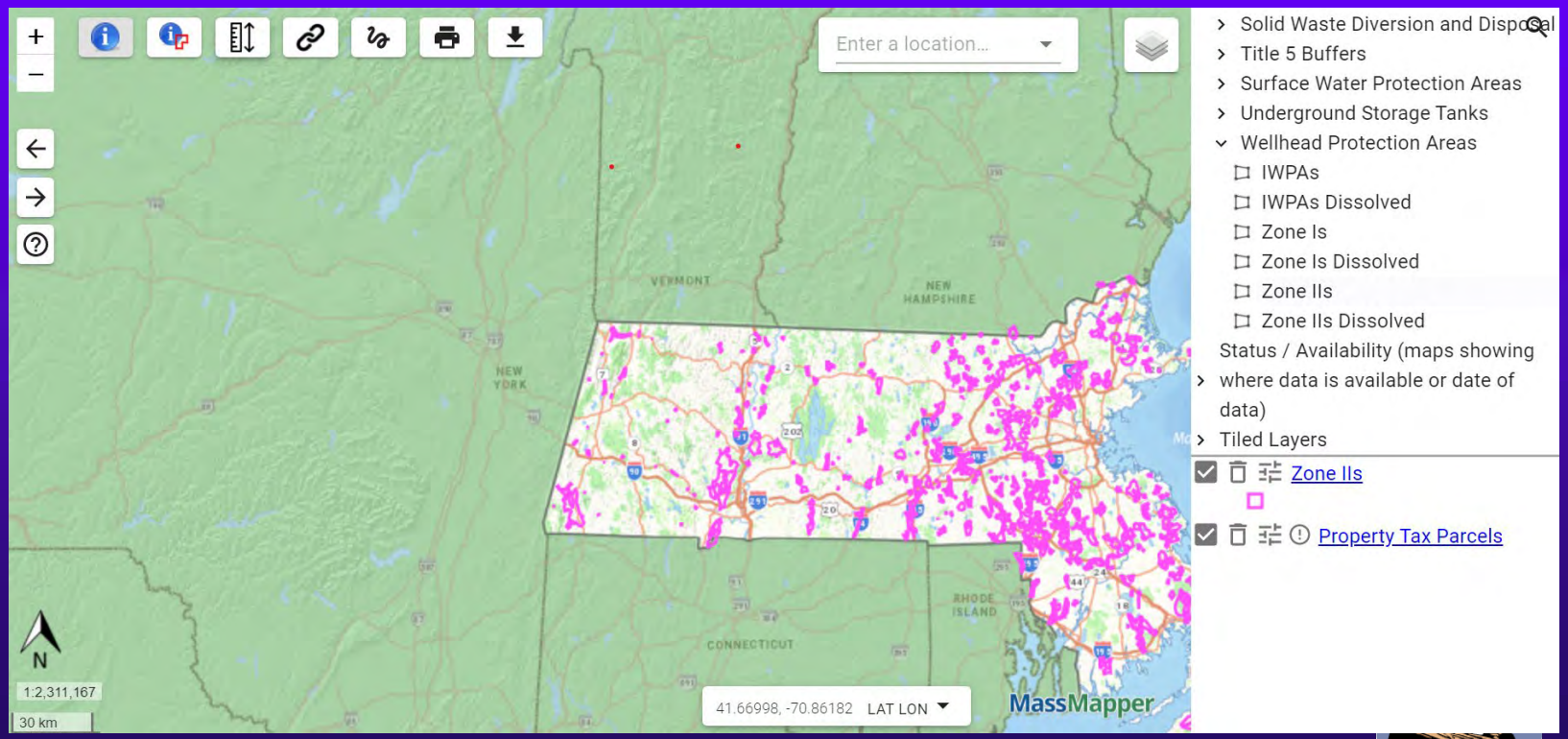
- 100,000 gpd
- scientific delineation

IWPA

- Interim Wellhead Protection Area
- 0.5 mile radius

MassGIS Online Mapping Info Viewer

- MassMapper

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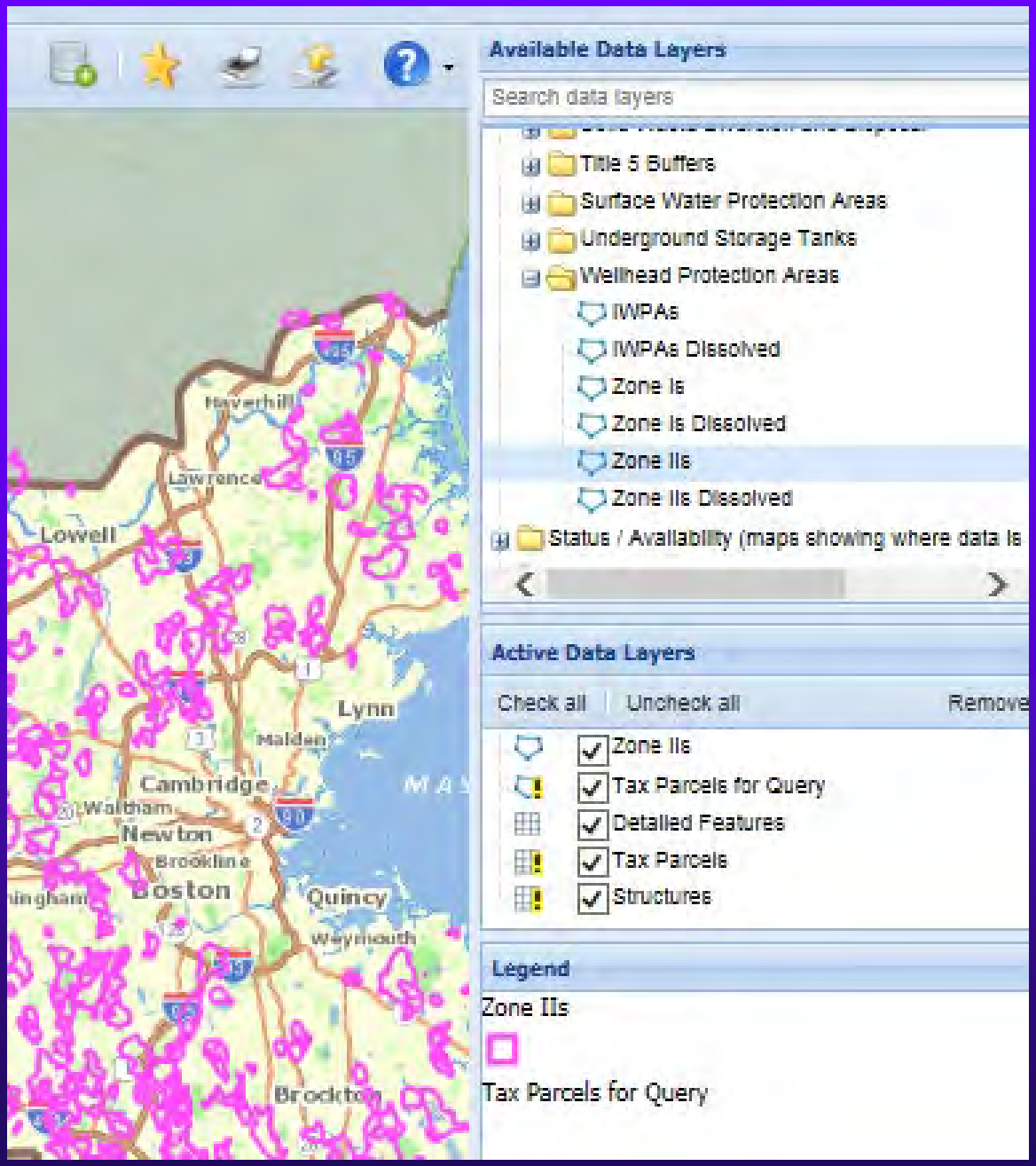
Available Data Layers
Search data layers
Title 5 Buffers
Surface Water Protection Areas
Underground Storage Tanks
Wellhead Protection Areas
IWPAs
IWPAs Dissolved
Zone Is
Zone Is Dissolved
Zone IIs
Zone IIs Dissolved
Status / Availability (maps showing where data is
Active Data Layers
Check all
Uncheck all
Remove
Zone IIs
Tax Parcels for Query
Detailed Features
Tax Parcels
Structures
Legend
Zone IIs
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Haverhill
Lawrence
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Cambridge
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Newton
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Weymouth
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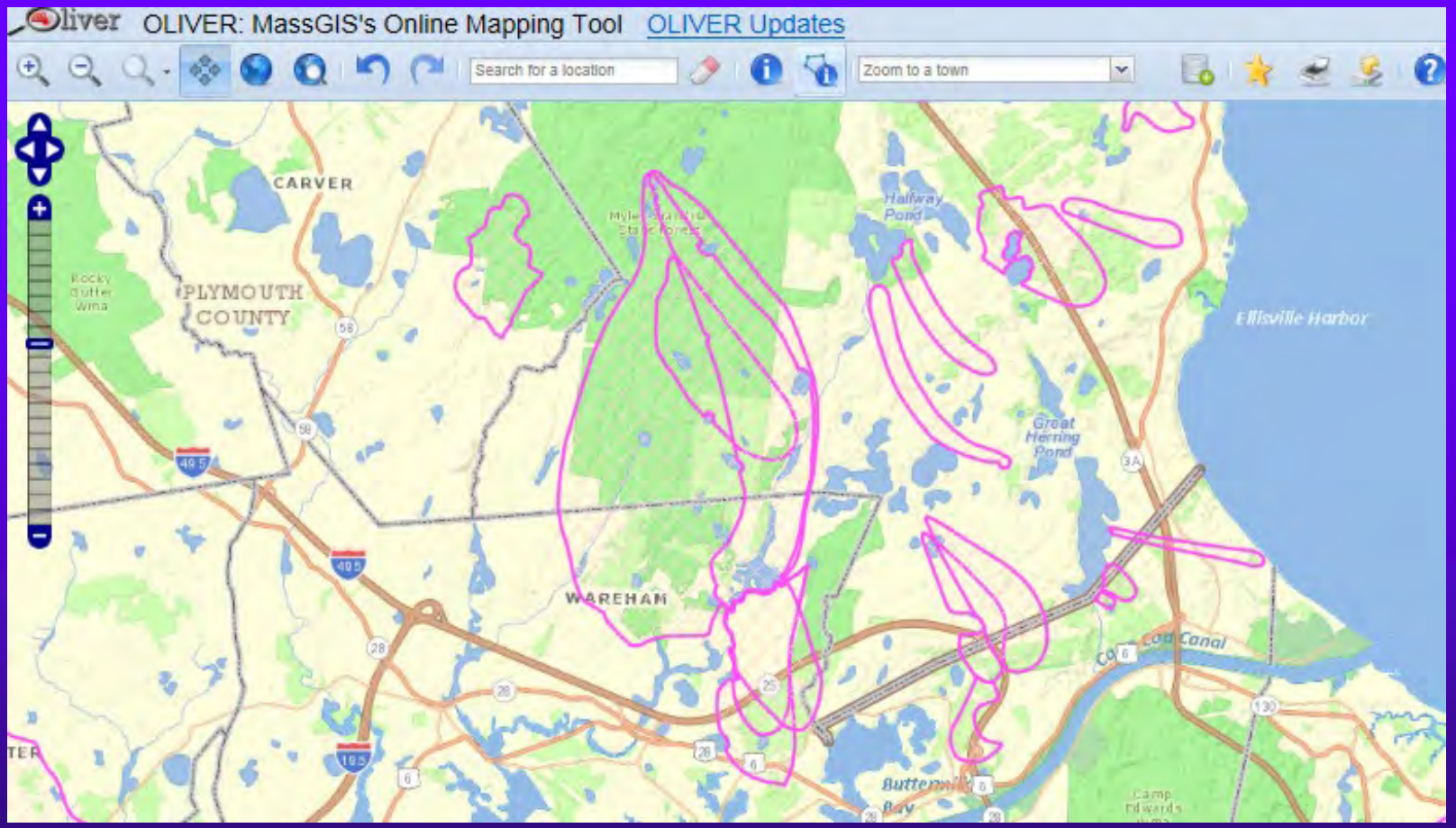

OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
Zoom to a town
CARVER
PLYMOUTH COUNTY
WAREHAM
Halfway Pond
Great Herring Pond
Ellisville Harbor
Cape Cod Canal
Buttermilk Bay
Camp Edwards
Rocky Gutter Wma

Review for Pesticide Applicators

- Are you using a product on the Groundwater Protection List ?
- Are you in a regulated primary recharge area ?
- What do you do next ?
  - Contact UMass Extension specialist for no-viable alternative assessment
  - In certain situations, application of listed pesticide may be allowed and MDAR must be notified.

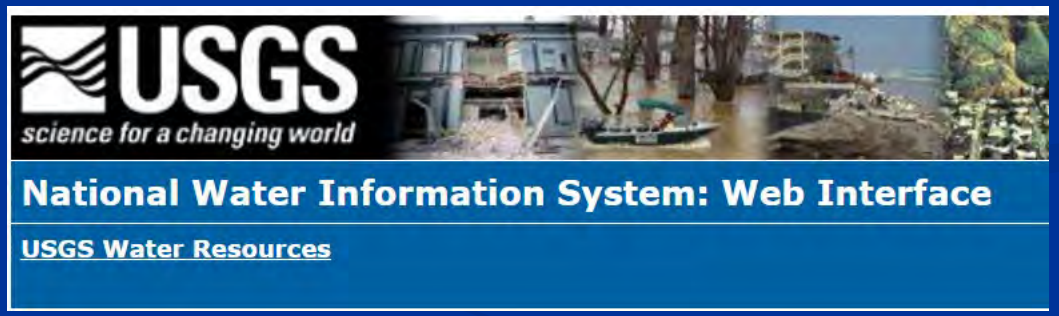
Aquatic Herbicides

- List of Aquatic Herbicides available for permitted use in MA (Aquatic Herbicide Active Ingredients | Mass.gov)
- Joint review by MassDEP and MDAR
- Permitting by MassDEP

Monitoring of Pesticide Residues in Water Resources

- Monitoring studies to determine the occurrence of pesticides in water resources

- USGS studies



- MDAR studies

Changes in Pesticide Occurrence in Suburban Surface Waters in Massachusetts, USA, 1999–2010

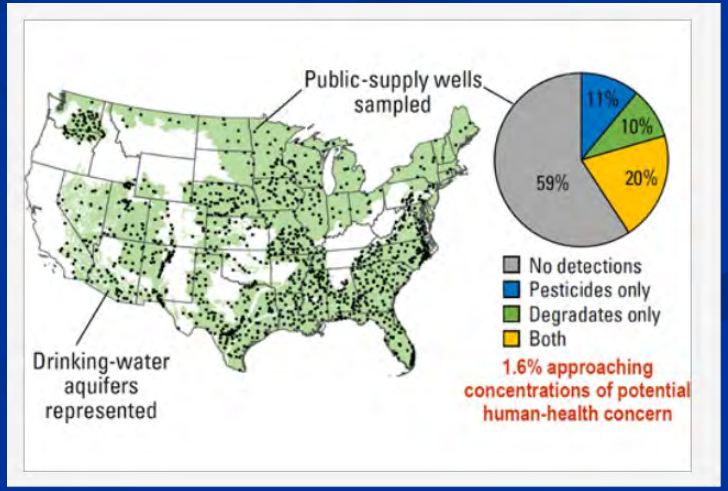
USGS Study on Pesticides Detected in Groundwater

Pesticides and Pesticide Degradates in Groundwater Used for Public Supply across the United States: Occurrence and Human-Health Context

Laura M. Bexfield*, Kenneth Belitz, Bruce D. Lindsey, Patricia L. Toccalino, and Lisa H. Nowell

Cite this: *Environ. Sci. Technol.* 2021, 55, 1, 362–372
Publication Date: December 14, 2020
https://doi.org/10.1021/acs.est.0c05793

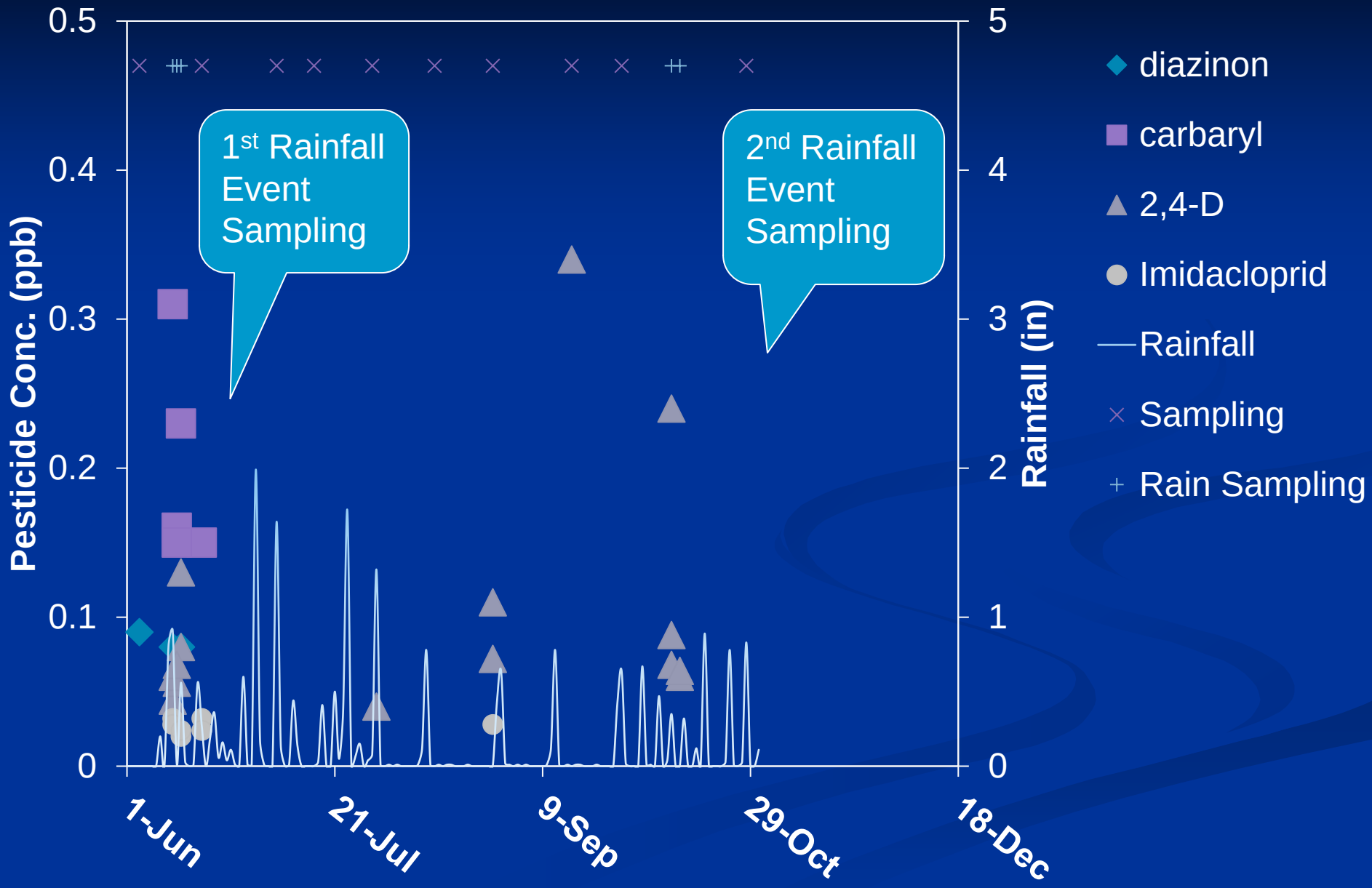
- Atrazine, hexazinone, prometon, tebuthiuron, four atrazine degradates, and one metolachlor degradate were each detected in >5% of wells.
- Although pesticide compounds occurred frequently, concentrations were low



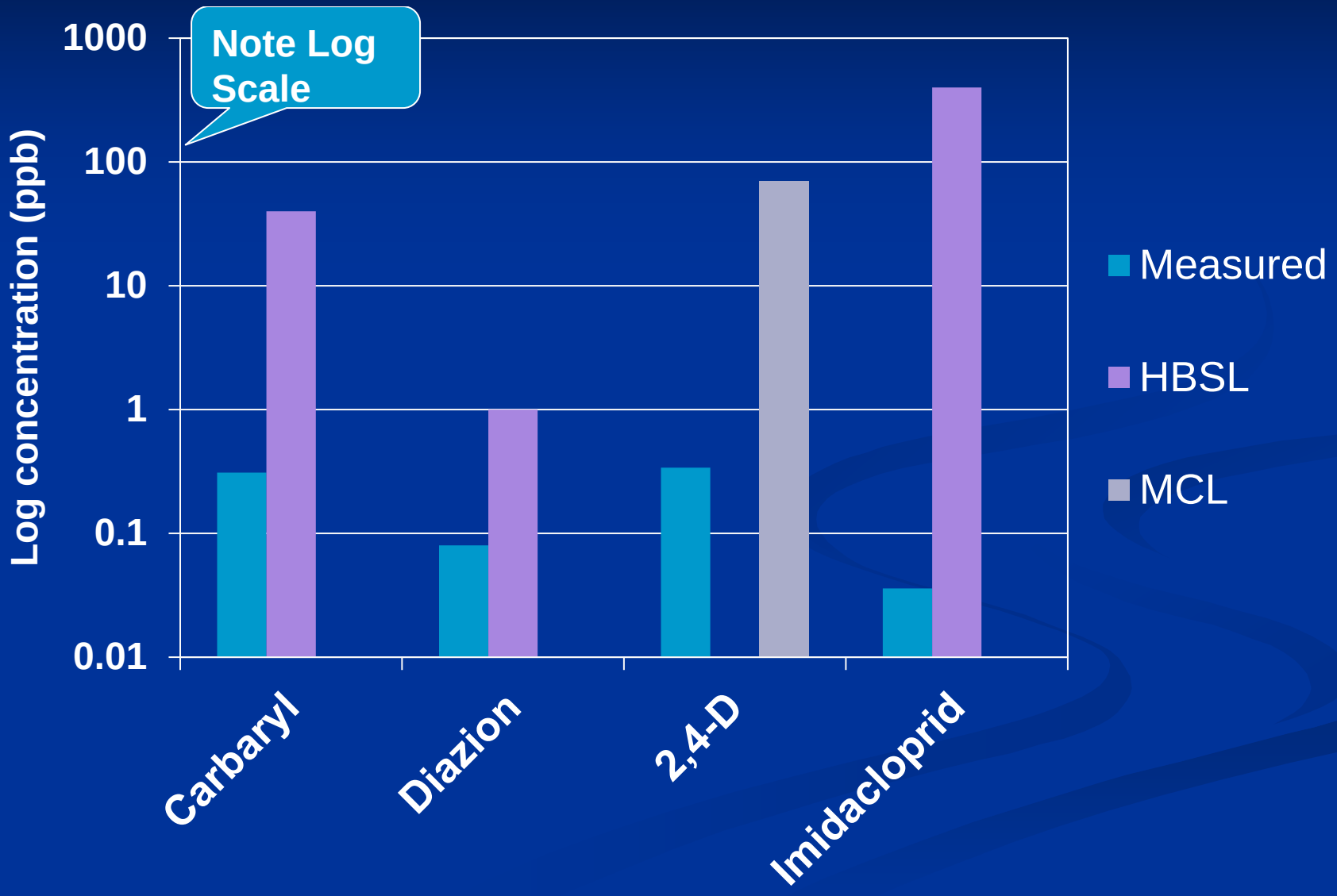
MDAR Study of Pesticides in Suburban Waters 2010

- Monitor occurrence of pesticides in pond and river
- Study Areas:
  - Spy Pond in Arlington
  - Aberjona River Winchester and Woburn
- 2009-2010
  - Bi-weekly and two rain events

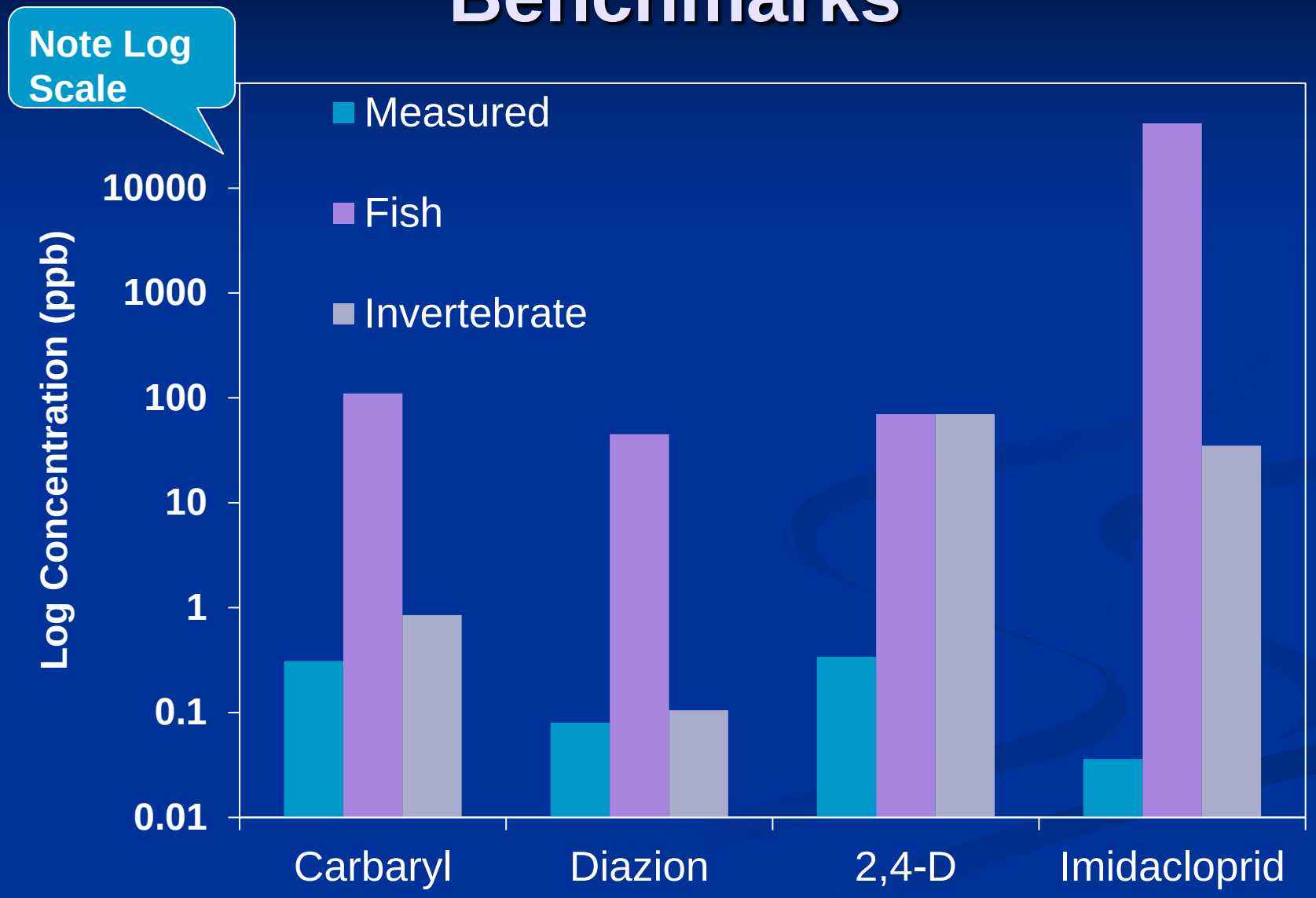
Pesticides detected in the Aberjona River



Comparison with Health-Based Standards



Comparison with Aquatic Life Benchmarks



Changes in Pesticide Occurrence in Suburban Surface Waters in Massachusetts, USA, 1999–2010

Hotze Wijnja, Jeffery J. Doherty & Saida A. Safie

Bulletin of Environmental Contamination and Toxicology

ISSN 0007-4861

Bull Environ Contam Toxicol
DOI 10.1007/s00128-014-1251-4

MDAR Monitoring: Pesticides in Cranberry Bog Systems

- Monitoring for pesticides on Groundwater Protection List
- Targeted monitoring based on Notifications
- 2018: Three bog systems; Sampling of bog ditches

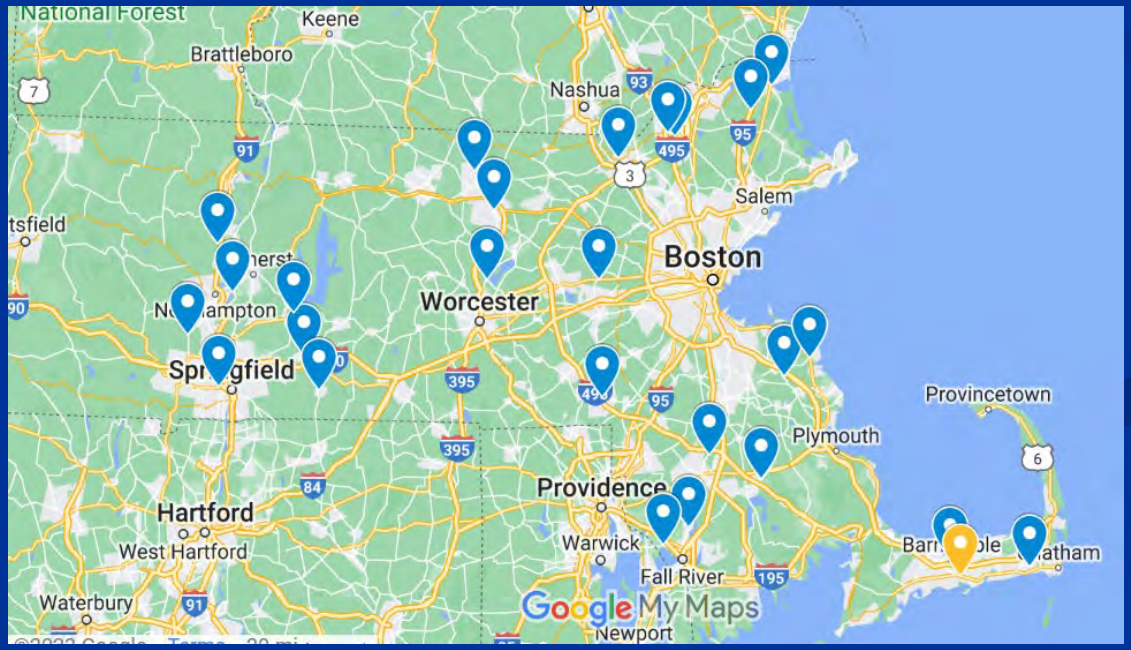
Pesticide	Highest Detection (ppb)	Human Health Standard (ppb)
Chlorothalonil	0.022	500
Methoxyfenozide	3.54	600
Thiamethoxam	0.044	77

MDAR: Cape Cod Monitoring Study

- Pesticide residues in Public Water Supply Wells (September 2018 – July 2021)
- Target analytes were a selection of rights-of-way herbicides and turf & landscape pesticides
- Few detections of turf & landscape pesticides
  - Imidacloprid and 2,4-D
  - Measured concentrations (less than 1 ppb) were below level of concern for drinking water

Glyphosate Monitoring Study

- Assess the occurrence of Glyphosate herbicide residues in public water supplies
- Started in November of 2022
- Monthly sampling for one year



Mosquito Control

- Insecticides and Water Quality Protection

- Efforts to ensure water quality protection include:
  - Products used are reviewed and evaluated for water quality impacts
  - Exclusion areas, including public water supplies
  - Buffers/Setbacks for applications near sensitive areas
  - Water quality monitoring following aerial spraying

Plant Nutrient Regulations and Water Quality

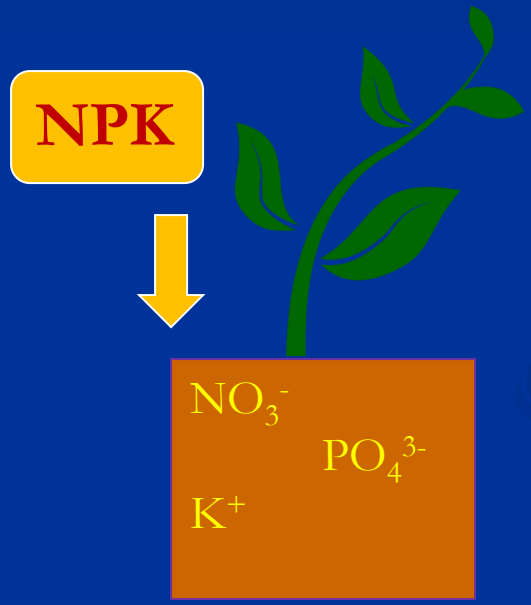
- State-Wide (MDAR)
  - Massachusetts state-wide plant nutrient regulations (330 CMR 31.00): Establishes standards for application of plant nutrients to agricultural land and non-agricultural turf and lawns
- Cape Cod
  - Several municipalities, under the purview of the Cape Cod Commission, have ordinances regarding the application of fertilizer
- Islands:
  - Municipal fertilizer application regulations

Plant Nutrients

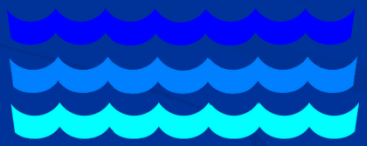
- Non-Mineral Nutrients are:
  - Hydrogen (H), oxygen (O), & carbon (C) (obtained through air/water)
- Macro elements:
  - Primary nutrients are nitrogen (N), phosphorus (P), and potassium (K).
  - Secondary nutrients are calcium (Ca), magnesium (Mg), and sulfur (S).
- Micronutrients are:
  - Boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese (Mn), molybdenum (Mo) and zinc (Zn).

Application of Plant Nutrients

- Maintain Landscapes
- Achieve Crop Production Goals



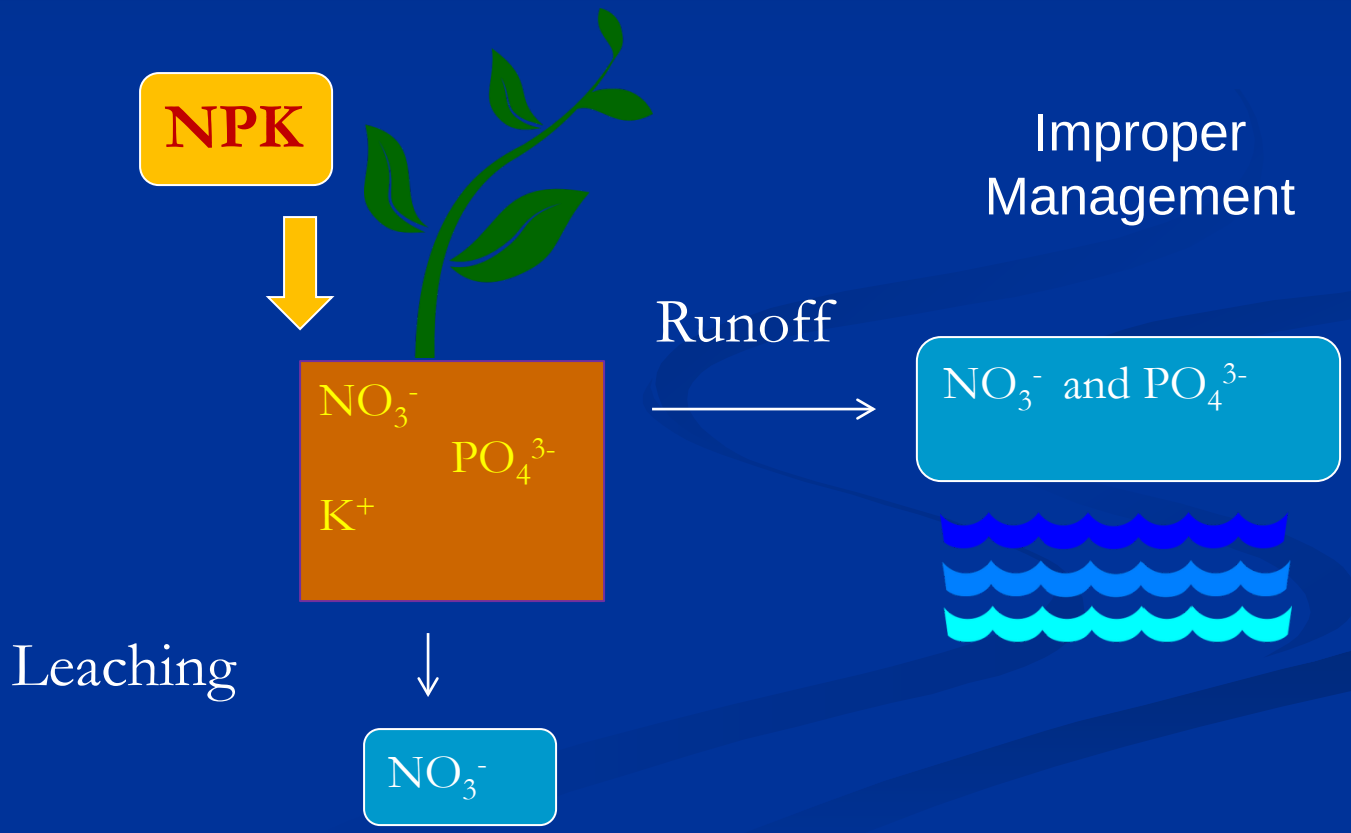
Proper Management



Healthy Land – Healthy Water

Application of Plant Nutrients

- Maintain Landscapes
- Achieve Crop Production Goals

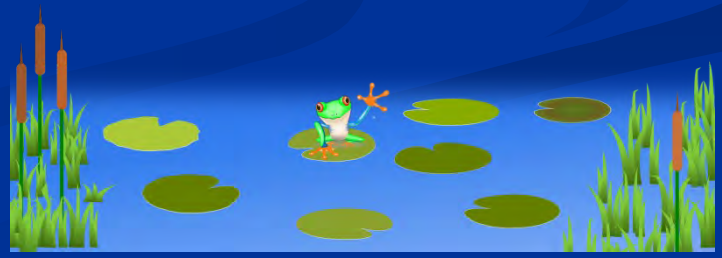


Poor Land Management – Water Quality Issues

Purpose of the Plant Nutrient Regulations (330 CMR 31)

- Ensure that plant nutrients are applied in an effective manner to provide sufficient nutrients for maintaining healthy agricultural land and turf & lawn.

- Minimize impacts of plant nutrients on surface and ground water resources to protect human health and the environment.



What do the Regulations Require for Agricultural Land?

- Many requirements are based on UMass Guidelines for Nutrient Management Practices

UMass Extension Nutrient Management

- General requirements include:
  - Follow UMass guidelines for nutrient management
  - Not to apply plant nutrients to surface water
  - Not to apply to saturated soils or soils that are frequently flooded
  - Not to apply to frozen or snow-covered soils
  - Application setbacks from sensitive areas

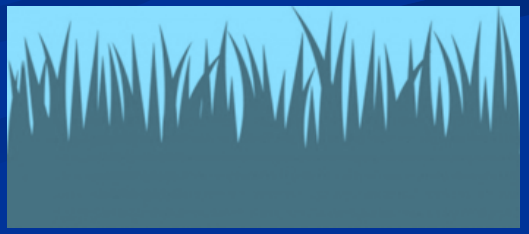
Agricultural Land Requirements

- Nutrient Management Plan Requirements
- Criteria for plan maintenance and updates,
- Criteria for soil, plant tissue, and agricultural byproduct testing

Requirements for Turf & Lawns

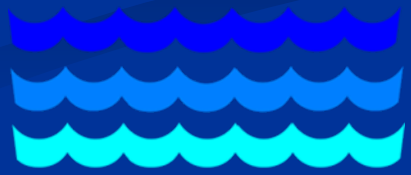
Note: The regulations do NOT cover plant nutrient applications to vegetable gardens, trees, and ornamentals!

- Specific restrictions for Phosphorus-containing fertilizer: may **only** be applied when:
  - a soil test indicates that it is needed; or
  - when a lawn is being established, patched or renovated.



Regulations for Turf & Lawns

- No Applications of plant nutrients shall be made:
  - to frozen and/or snow-covered soil;
  - to saturated soil, or soils that are frequently flooded;
  - to sidewalks or other impervious surfaces; remove any applied material from these areas
  - Setbacks from surface water and drinking water supplies



Regulations for Turf and Lawns

- Requirements for organic plant nutrient materials:
  - Account for P and N applied with organic sources
  - Exempt from this requirement is a single annual application of organic material (up to 0.25 lbs of Phosphate per 1000 square feet)
- Applies also to applications by homeowners
- Record keeping requirements for professionals

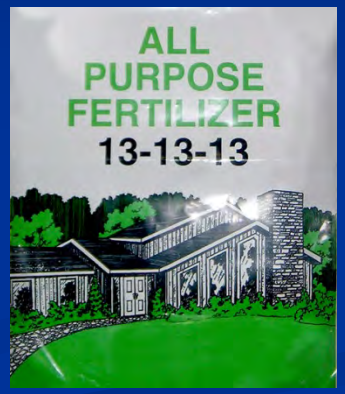
Healthy Turf – Healthy Water

Test your Soil

Apply Plant Nutrients based on test results and BMPs

Retailer Requirements

- Retailers of phosphorus-containing lawn fertilizers:
  - Segregate phosphorus-containing fertilizer from phosphorus-free fertilizer lawn fertilizers
  - Post sign to inform the consumer about phosphorus-containing fertilizer restrictions (see next slide)



Healthy Lawns – Healthy Water

Use Zero-Phosphorus Lawn Fertilizer! It's the Law!

Phosphorus runoff poses a threat to water quality. Therefore, under Massachusetts Law, phosphorus-containing fertilizer may only be applied to lawn or non-agricultural turf when:

- a soil test indicates that additional phosphorus is needed for the growth of that lawn or non-agricultural turf; or
- is used for newly established lawn or non-agricultural turf during the first growing season.

Most lawns in Massachusetts do not need additional phosphorus for healthy growth.

Look for the "Zero" to Protect Our Waters

Check the fertilizer bag for a set of three numbers representing the percentage of nitrogen (N), phosphorus (P) and potassium (K).

Buy the bag with a "0" in the middle: Zero Phosphorus

MDAR
MASSACHUSETTS DEPARTMENT


THANK YOU

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