UNIVERSITY *of* NEW HAMPSHIRE
COOPERATIVE EXTENSION

Pesticide Management Guidelines for Groundwater Protection

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Section 1: Purpose Of Guidance

A. Introduction:

This document is a guide for all pesticide applicators in New Hampshire as guidance for managing pesticide use to prevent the contamination of groundwater. It is also a reference for towns, groups, organizations and individuals interested in pesticide management for ground-water protection and basic characteristics of pesticides and groundwater. This document is comparable in scope and content to a best management practice (BMP).

The New Hampshire Division of Pesticide Control initiated and developed this document in cooperation with the University of New Hampshire (UNH) Cooperative Extension as an outreach tool to add to the state's existing pesticide management policy.

In New Hampshire, as prompted by the state's pesticide law, the Pesticide Control Board has the responsibility and authority for adopting rules for pesticide use and the Division of Pesticide Control administers and enforces these rules. Call the Division at (603) 271-3550 with questions about pesticide pliciy or use.

UNH Cooperative Extension maintains a professional staff of research and educational specialists. Each county has a local extension educator available for information about agriculture, horticulture, natural resources, and the control of certain insects and diseases.

B. Purpose:

The use of pesticides is an important practice in most farming and many non-farming operations. This document encourages the use of pesticide management practices to prevent ground-water contamination and to introduce:

- ☐ the importance and existence of groundwater;
- ☐ characteristics of soil, surface water, geology, and human impacts relative to pesticides and ground-water quality; and
- ☐ pesticide management strategies to prevent ground-water contamination.

C. The Importance of Groundwater in New Hampshire:

Groundwater is an important source of drinking water, located virtually everywhere in the state. About sixty percent of all residents get their domestic water supply from groundwater. In the state's rural areas it is a source for over ninety percent of the drinking water supply. The overall trend for ground-water use is increasing and there is great concern for protecting this resource. Ground-water quality can also affect the environment, particularly surface water such as wetlands, lakes, ponds, rivers and streams.

D. Commitment to Protecting Groundwater in New Hampshire

The state's pesticide law recognizes the importance of pesticides as well as the importance of protecting the waters of the state. The "Groundwater Protection Act" targets the protection of New Hampshire groundwater as an existing or future source of drinking water. These two laws express the state's strong commitment to protect groundwater. Pesticide management practices can be used in achieving this goal.

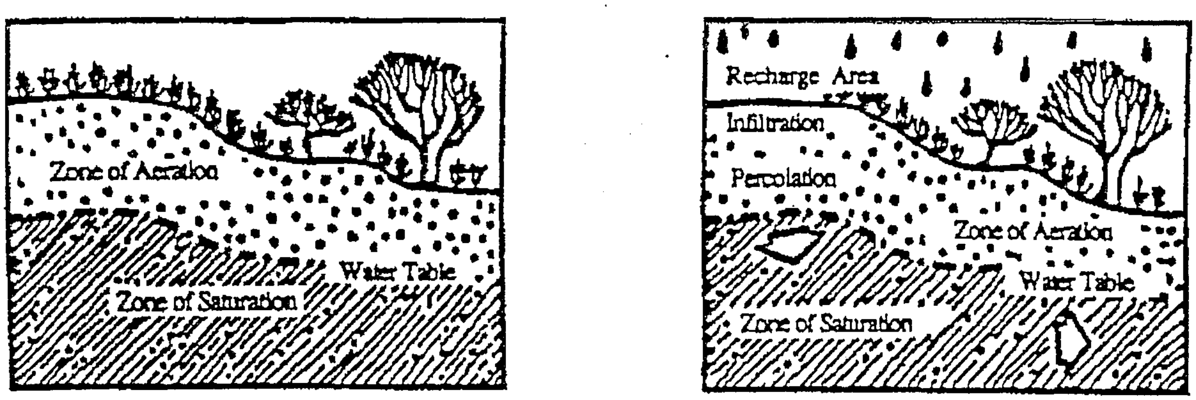
Important Reasons for Concern About Pesticide Management to Prevent Groundwater Contamination	
1	Pesticides have been detected in groundwater throughout New England and in other parts of the nation.
2	Once groundwater becomes contaminated, it is difficult and expensive to cleanup.
3	If we do not take voluntary steps to protect groundwater, there could be legislation to mandate what must be done.
4	Based on what has happened in other states, groundwater contamination may lead to liability suits.
5	Lending agencies and realtors now test groundwater for contamination before property is sold. If groundwater under an area is contaminated the sale of the property may be difficult.

Table 1

Section 2: GROUNDWATER

A. Groundwater

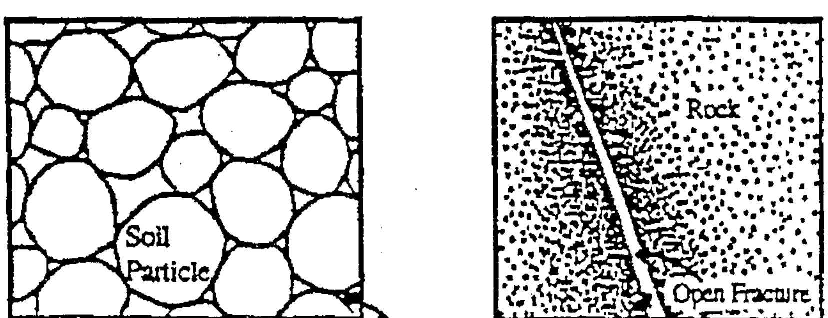
Groundwater is water below the water table and generally above impermeable bedrock. Its source is from precipitation that **infiltrates**, or moves into, the ground surface and **percolates**, or moves through, the soil, as shown in Figure 1. Areas on the land surface where water infiltrates into groundwater are **recharge areas** and areas where water accumulates under ground are **zones of saturation.**



Groundwater is found in the zone of saturation **Precipitation recharges groundwater**

Figure 1

Within the zone of saturation, groundwater is located in spaces between soil particles and in cracks or fractures in rocks and bedrock, as shown in Figure 2.



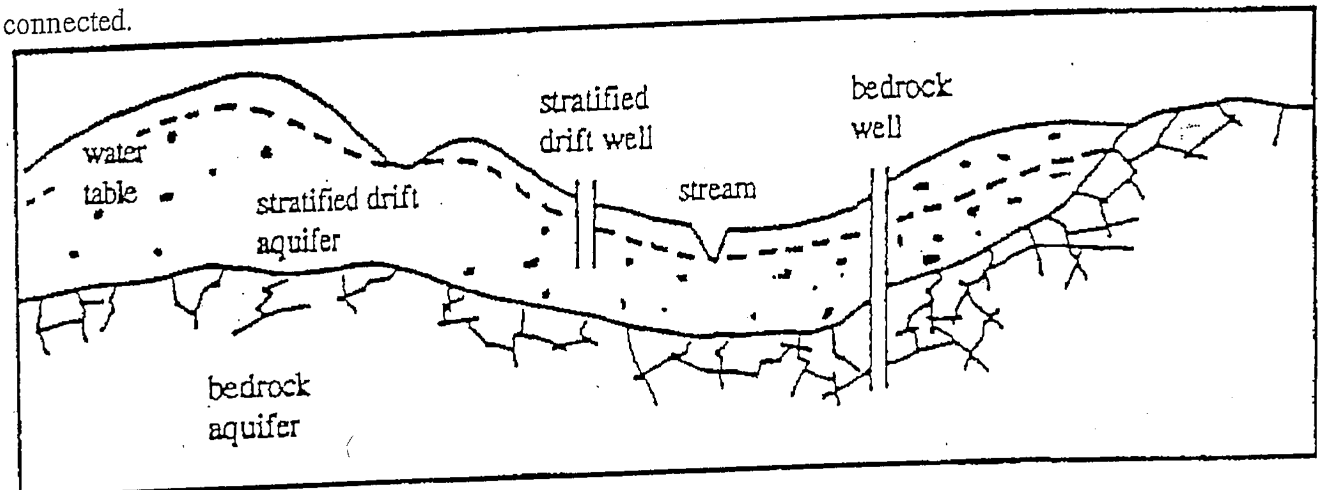
groundwater is stored here, in spaces and fractures

Figure 2

B. Aquifers

As water flows through the ground it may collect in soil spaces or bedrock fractures in quantities sufficient enough to yield water to a well. These areas are **aquifers** and in New Hampshire, they are found beneath virtually all the land surface in the state. The two most common aquifers in New Hampshire are **bedrock aquifers** and **stratified drift aquifers**, as shown in Figure 3. Bedrock is typically found a few inches to 150 feet below ground and often exposed above ground as outcrops. In New Hampshire, bedrock wells are generally placed at least 100 feet below ground with the average well at a median depth of 295 feet. Stratified drift aquifers are sand and gravel deposits typically found just beneath the land surface. On average they are 5 to 20 feet thick and rarely greater than 100 feet thick. It is these aquifers that tend to produce the largest volumes of water. Although there are some bedrock wells that produce enough volumes to serve large water systems, most municipal wells are in stratified drift aquifers. Other aquifer types in New Hampshire include glacial till aquifers found throughout the state, and marine clay confined sand/gravel and shore deposit aquifers, found in the southeastern portion of the state. Generally, these latter types can only provide enough volumes of water for single residential wells.

Although aquifers are talked about as separate units it is important to keep in mind they are often connected.



Two Major Types Of Aquifers In New Hampshire

Figure 3

C. Ground-water Vulnerability

Activities on the land surface can affect the water quality of aquifers. Precipitation, runoff, irrigation and surface water movement can all influence the movement of pesticides into groundwater. As water infiltrates the ground and percolates through the soil, it can carry pesticides into groundwater.

There are three major aspects that determine the vulnerability of groundwater to contamination from land use activities: 1) **Depth to Groundwater**, 2) **Geologic Conditions** and 3) **Weather Conditions.**

1) Depth to Groundwater: If the soil layer between the aquifer and land surface is shallow then the threat to ground-water quality is higher.
2) Geologic Conditions: Because of historic glacial activity many different geologic conditions exist in New Hampshire. Some may make the flow of a pesticide into groundwater easier than others. The geology of a site has a great influence on the possibility a pesticide will enter groundwater. Cracks or fractures in bedrock exposed at the surface offer routes for pesticides to flow into groundwater. The amount of gravel, rocks, cobbles and stones mixed with soil can also influence pesticide

movement. The type of soil, part of the geology, can determine the size and amount of spaces available for pesticides to enter the groundwater. Coarse textured soils such as sand and gravel are more likely to allow for the potential of transport. Therefore, understanding the geology of a site is helpful when making pesticide management decisions.

3) Weather Conditions: In general, pesticides have a greater potential of leaching during periods of increased precipitation, particularly rain. However, certain pesticide applications require large amounts of water. The use of certain fungicides used by fruit growers and certain insecticides used by lawn care applicators. It is recommended that best judgement be used based on daily, or even hourly, weather predictions.

D. Ground-water Flow

Groundwater moves, usually following the same direction as surface water. Flow is commonly from high elevations to low elevations where groundwater discharges into surface water sources such as streams, rivers, ponds, lakes and wetlands. However, pressure affects ground-water flow and may not follow the path governed by gravity. Also, deep groundwater can flow beneath surface waters, such as rivers, making flow predictions difficult. Geologic conditions where the groundwater occurs largely determine flow rates.

Because groundwater moves it can carry pesticides from one area to another. Contamination resulting from a discharge in one area may spread both vertically and laterally resulting in contamination far removed from the original source.

E. Sources Identifying Areas of Ground-water Vulnerability

The US Geologic Survey and NH Department of Environmental Services are now completing a study of New Hampshire stratified drift aquifers. From this study, maps and booklets will be available to use to determine the general direction of flow, aquifer location and general depth to the water table from the ground surface.

Section 3: Soils

A. Soils

New Hampshire soils are quite diverse and can differ from site to site. Soil characteristics play a large part in carrying pesticides into the groundwater. Soil type, its location, and exposure to pesticides are important factors when determining the chance a pesticide will move into groundwater.

B. Location

The type and location of soil, and its position with other soils and geology, can determine the chances pesticides will flow into groundwater. For example, a coarse soil, such as sand and gravel, provides an easier route for pesticide flow than a mixed soil of silt and clay. A thick clay layer, between groundwater and a top soil of coarse sand, may prevent a pesticide from entering groundwater. It is also important to note the manner in which the pesticide is applied can affect the possibility of a pesticide to enter groundwater. For example, a foliar application is less of a threat than a pesticide mixed with or placed directly onto exposed soil.

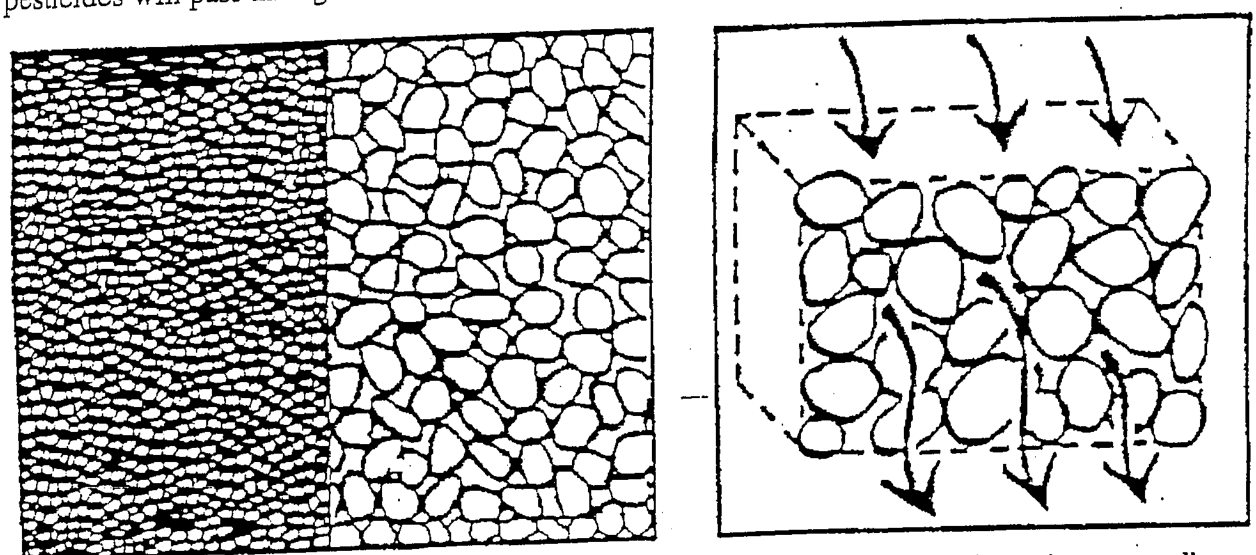
C. Soil Characteristics

There are four major soil characteristics that influence the soil's ability to transport a pesticide into groundwater - **texture**, **permeability**, **structure**, and **organic matter**. Understanding the soil characteristics of a site is useful in deciding pesticide use to prevent ground-water contamination.

1) <u>Texture:</u> Soil texture is determined by the relative proportions of **sand**, **silt** and **clay** the soil contains. Texture affects movement of water through soil and therefore movement of dissolved chemicals such as pesticides. Coarser, sandy soils allow chemicals to wash through to groundwater more readily than the heavier silt or clay loam soils. Soils with more clay and organic matter tend to hold water and dissolved chemicals longer. Accordingly, if such soil is above the water table, it reduces the potential for ground-water contamination. The ability of chemicals to wash through soils is termed **leaching** or **leachability**.

2) <u>Permeability:</u> Soil permeability is a measure of how fast water can move downward through a particular soil. Water moves quickly through soils with high permeability. Frequent irrigation may be necessary in high permeability soils but this also increases the likelihood of leaching. In highly permeable soils, the timing and methods of pesticide application need to be carefully determined to reduce leaching losses.

As Figure 4 shows, a coarse textured soil has larger pore spaces between soil particles and has a higher permeability than a clay textured soil, which has more pores but smaller spaces between particles. Water and pesticides will pass through a coarse textured soil faster than a clay textured soil.



fine (clay) course (sand) water flow through course soil

Figure 4

3) <u>Structure:</u> Structure refers to the way soil particles are added. For example, large pores called **macropores**, formed by plant roots, animal borings and cracks from freezing and thawing, can transmit water. This situation can exist in any soil type, including fine textured soils, allowing quick water transport.

4) <u>Organic Matter:</u> The organic matter of a soil can highly influence the fate of a pesticide. Typically, organic matter supports an active population of soil microorganisms, has a high water holding potential, and can adsorb (see page 13 for definition of adsorption) pesticides, allowing pesticides to degrade in the top layer of soil. Degradation of a pesticide in the top soil layer is important because if a pesticide gets below the root zone, the chance of it percolating into groundwater increases. This stems from soil conditions below the root zone, including a reduced number of microorganism populations, cooler soil temperatures, less light and less oxygen.

The greater the **organic matter content** results in more adsorption of a chemical and a greater water holding capacity of the soil. Increasing and maintaining an organic layer wherever possible can increase a buffer between pesticide application and groundwater.

The following table is a summary of ground-water contamination potential as influenced by water and soil characteristics:

Groundwater Contamniation Potential		
Soil Characteristics	**Low Risk**	**High Risk**
texture	fine clay	coarse sand
organic matter (OM)	high OM content	low OM content
macropores	few, small	many, large
depth of groundwater	deept (20 feet or more)	shallow (10 feet or less)
Water Volume		
rain/irrigation	small volumes at infrequent intervals	large volumes at frequent intervals

Table 1.

D. Soil Texture, Organic Matter and Chemical Analysis

Soil testing can be done by collecting samples and bringing them to a county office of UNH Cooperative Extension. UNH tests the samples. Every Extension office has sampling procedure information and may have soil test kits available on loan for field use. There are also private firms that test soil.

Soil analysis results include soil texture, soil pH, soil organic matter, and levels of various plant nutrients including calcium, magnesium, phosphorus and potassium. The UNH Cooperative Extension office can make recommendations based on the test results. There is a small fee for the testing by the university.

E. Determining Soil Type

A general description of soil types and their location is available from the US Soil Conservation Service (SCS) which provides states with soil information through a classification system. This system includes soil maps depicting general location and a description of the capabilities of various soil types. This information is available at SCS County Offices, UNH Cooperative Extension county offices and may also be on file at certain pubic libraries.

Using this general information along with the results of a soil test may provide guidance for pesticide management decisions.

Section 4: The Water Connection

Surface water and groundwater interconnect. Although it is more common in New Hampshire for groundwater to flow into surface water, in certain situations the reverse can be true. This is important to understand because a land use activity away from a surface water source, such as a lake, pond, river or stream, may be over a highly permeable soil and aquifer, which can send water and chemicals to a surface water body. Thus, activity in one area, over a ground-water source, may affect the quality of surface water in another area. Figure 5 gives a basic example of a ground-water flow system and how it connects with surface water.

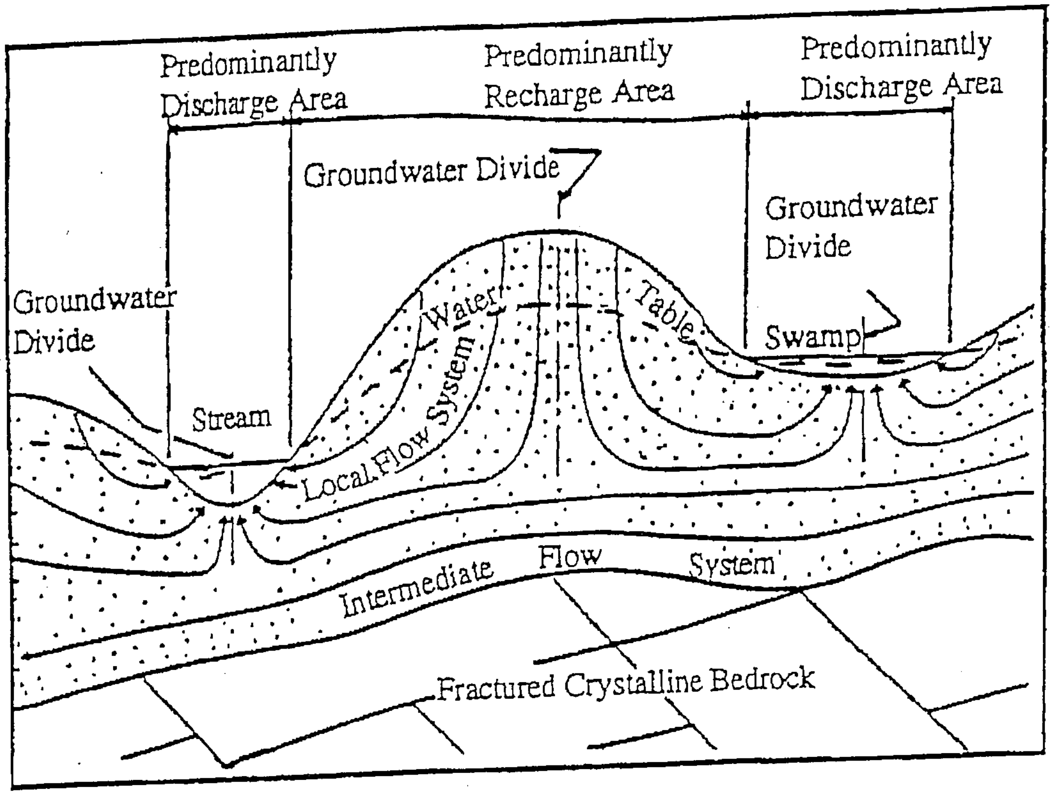


Figure 5

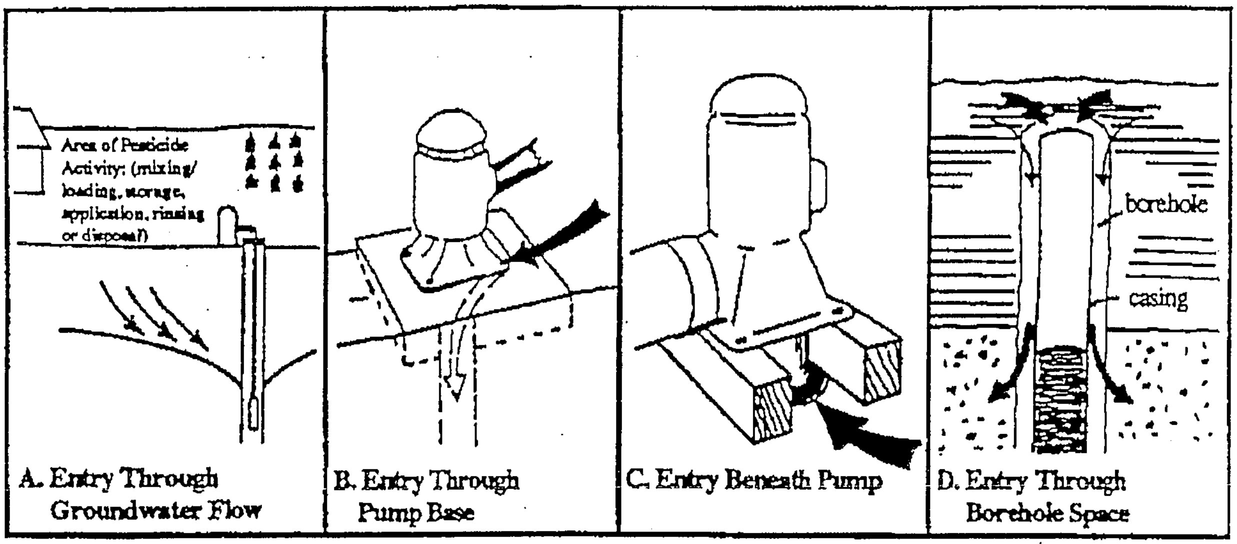
Section 5: Human Influence

Human activity such as removal or manipulation of soils, water and geology, the digging or drilling of wells, and other activities can greatly affect ground-water movement and quality.

A. Water Wells.

Water wells can serve as a direct route for chemicals to travel from the land surface into groundwater. Special care around wells can prevent this situation.

Figure 6 depicts several ways pesticides can enter groundwater through wells. As diagram A in Figure 6 shows, water in an area around a pumping well is drawn towards the well. This area is the contributing area of the well and pesticide usage in this area may result in pesticides entering groundwater, flowing with it to the well. Pumping not only influences the flow of water towards the well, but also the flow of chemicals that may be in the water. Wells located next to pesticide application sites should be inspected for proper construction and monitored periodically for pesticide contamination. Locate new wells away from pollution sources likely to contaminate the well. Proper seals between the pump and the pump bases (see diagram B in Figure 6) help prevent the entry of contaminants. Seals between the casing of the well and the wall of the hole (see diagrams C and D in Figure 6) can prevent water near the soil surface from entering the well and possibly contaminating the groundwater.



Avenues Of Entrance For Pesticide Entry To Wells

Figure 6

B. Soil Removal and Manipulation

The removal of soil can extract layers that may function as important pesticide degradation sites. For example, removing a top soil may rich in organic matter may expose a sandy soil, which increases aquifer vulnerability to pesticide use. Erosion produces the same result.

Ditches, trenches and quarries are places where pesticides may move easily into groundwater. Care is needed when pesticides are applied in these areas.

C. Specific Designation Areas

1) Wellhead Protection Areas (WHPA): WHPAs, defined as Class GAA groundwater by the Groundwater Protection Act, are areas delineated around public wells to prevent contamination. They vary in size and shape. For groundwater protection, pesticide applications within these areas should follow the utmost precautions. Label recommendations will often reference precautions for such areas and may state the required dose for certain soil types or areas due to location. Because these areas can vary from town to town, and even within a town, they may not be well-defined on the ground. Check the town's water or health department for help. The state's Groundwater Protection Bureau, part of the Department of Environmental Services, also records these areas and is another source of information to determine a WHPA.

   The administrative rules of the Pesticide Control Board prohibit pesticide applications within 400 feet of gravel packed wells used for public water supply or within 250 feet of other public wells unless approved by the Division of Pesticide Control.

2) Pesticide Management Area: A pesticide management area is an area where there has been contamination by a pesticide or a detection shows groundwater is under threat of contamination. The Division of Pesticide Control defines these areas. Use of pesticides within these areas may require a permit. Contact the Division for guidance before pesticide applications are made.

Section 6: Rules Relative to Surface and Ground Water Protection

There are policies about surface and ground water protection within the state's pesticide rules. The following describe the rules where certain surface and ground water contamination prevention are provided. For reference, citations from the Administrative Rules of the Pesticide Control Board, PES 100-900, are included with most of these descriptions. Pesticide applicators required to take examinations must know these rules, as well as other study materials, including a description of physical characteristics of groundwater occurrence, the importance of surface water and chemical characteristics of pesticides.

Examinations: An intention of the scope of examinations is to include information for proper pesticide management to avoid undesirable environmental results [PES 303.07(a)(3)].

Pesticide Labels: The use of pesticides must follow labelling instructions (PES 502.01), some of which include warnings or important use information to prevent surface and ground water contamination.

Distance from public wells: Pesticide use within **400 feet** of gravel packed wells used for public water supply or within **250 feet** of other public wells is prohibited unless use is approved by the Division of Pesticide Control (PES 502.07).

Application near public water supply: Any application near a public water supply shall be done so no pesticides drift or flow into the water supply (PES 502.05).

Special Permits: Pesticide use requiring a special permit must follow the conditions of the permit including those which concern surface and ground water protection. Special permits may require protective distances between wells and the area where pesticides are being applied, such as with certain aerial applications (PES 506.09). Pesticide applications within public water supply watersheds (PES 502.06) and for applications to control forest insects, mosquitoes or black flies in other watersheds or marshlands (502.04), require special permits.

Procedures for completing certain special permit applications, such as the request for use of pesticides in surface waters (PES 602), require listing the names and locations of public water supply wells, private water supply intakes [PES 602.01(a)(6)a.&b.] and nearest source of public water supplies [PES 602.01(a)(7)a.] near the area of proposed pesticide use. Along with the names and locations, a description of their relation to the proposed treatment area needs to be included. Identifying private and public water supply wells and intakes before pesticide use in surface water allows towns, residents and pesticide applicators to plan for surface and ground water protection.

There are conditions identified for granting special permits for pesticide applications to surface water within the rules (PES 603.03). They include a condition for granting special permits for pesticide treatment to surface waters within **75 feet** of dug or infiltration wells, or domestic drinking water intakes. They also include the requirement that the permittee obtain written permission for the treatment from all affected well owners [PES 603.03(b)(5)].

Public Control of Mosquitoes: Pesticides use for mosquito control by local government agencies is prohibited within **75 feet** of drinking water wells [PES 604.01(f)].

Chemigation: Operating pesticide chemicals through an irrigation system must follow the state plumbing code and rules of the Pesticide Control Board.

Anti-Siphon Devices: Pest control equipment using pesticides and drawing from surface water must have an anti-siphon device, approved by the division, to protect the water from back flow (PES 504.03).

Pesticide Storage: Pesticide storage must be **75 feet** away from drinking water wells. Bulk storage and certain pesticide dispensing areas must have secondary containment.

Section 7: Pesticides & Groundwater

Surface and groundwater contamination by pesticides in the United States is a serious concern. Surveys by various state and federal agencies have found contamination in many states. To maintain the good surface water and groundwater quality in New Hampshire, we must continue to be diligent and use practices which reduce risk of contamination.

The following chemicals have been reported in groundwater nationwide:

alachlor (Lasso)	DBCPA (& acid metabolites)	hexazinone (Velpar)
aldicarb (TemiK)	dicamba (Banvel)	lindane
arsenic	1,2-Dichloropropane	metolachlor (Bicep)
atrazine	dinoseb (Premerge)	methamidophos (Monitor)
bentazon	dyfonate	metribuzin (Sencor)
bromacil	endosulfan (Thiodan)	nitrate
carbofuran (Furadan)	ethylene dibromide (EDB)	oxamyl (Vydate)
chlorothalonil (Bravo)	ethylene thiorurea	picloram (Tordon)
cyanazine	*(breakdown of Maneb and Mancozeb)*	prometon (Pramitol)
DBCP	hexachlorobenzene	simazine (Princep)

Many of the pesticides listed here were found below established drinking water standards. As our ability to detect minute concentrations of pesticides improves and the frequency of monitoring increases, the list of detections will grow. Detecting a pesticide at low levels does not necessarily indicate a health risk.

Section 8: Pesticide Properties

The application rate, number of applications, pesticide and soil characteristics, and climate determine pesticide leaching and runoff.

A. Pesticide Properties:

1) **Solubility:** Pesticides highly soluble in water have a greater leaching potential. Water solubility greater than 30 parts per million (ppm) shows a high leaching potential.

2) **Adsorption:** Adsorption is the tendency of a chemical to attach itself to soil particles. Many organic chemicals are strongly attracted to soil particles. Fine particles, such as clay and organic matter, are especially important. Chemicals with the greatest attraction for soil particles are more likely to be "bound" to the soil and less likely to leach into groundwater.

3) **Volatility:** Highly volatile chemicals are lost to the atmosphere much like the evaporation of water. Sometimes highly volatile chemicals are less available to leach into the groundwater. However, if highly soluble in water, volatile chemicals can contaminate groundwater.

4) **Degradation:** Pesticides are degraded, or broken down into other chemicals by sunlight, microorganisms and other chemical processes. The time it takes for half the chemical to break down is called the half-life. The longer the half-life, the more likely a chemical will leach. Some factors which shorten the half-life include the presence of soil moisture, sunlight, microorganisms, neutral pH, and warm temperatures. Pesticides with a field dissipation half-life of greater than 30 days are potential leachers. The following table lists the approximate half-life of common pesticides. Under field conditions half-lives can vary greatly.

Pesticide Persistence

Non-Persistant (half-life of less than 30 days)	Moderately Persistent (half life of 30 to 99 days)	Persistent (half-life of 100 or more days)
Herbicides - generic name (trade name)		
Alachlor (Lasso) Acifluorfen (Blazer, Tackle) Bentazon (Basagran) Bifenox (Modown) Butylate (Sutan + Genate Plus) Chloramaben (Amiben) Cyanazine (Bladex) Dicamba (Banvel) Dinoseb (Premerge) EPTC (Eptam, Eradicane, Genep) Oryzalin (Surflan) Propachlor (Ramrod, Bexton) Tridiphane (Tandem) Vernolate (Vernam, Reward) 2,4-D	Atrazine (AAtrex) Chlorpropham (Furloe) Glyphosate (Roundup) Linuron (Lorox, Linex) Metolachlor (Dual) Metribuzin (Sencor, Lexone) Simazine (Princep, Aquazine) Trifluralin (Treflan) Tricloppyr (Garlon)	Paraquat (Paraquat, Granoxone) Picloram (Tordon) Terbacil (Sinbar)
Insecticides, Fungicides and Nematicides		
Anilazine (Dyrene) Bendiocarb (Turcam) Carbaryl (Sevin) Captan Fluvalinate (Mavrik) Iprodine (Chipco) Malathion Parathion (Niram, Parathion) Propiconazole (Banner) PCNB Trichlorfon (Dylox, Proxol) Triadimefon (Bayleton)	Aldicarb (Temik) Carbofuran (Furdan) Chlorpyrifos (Lorsban) Dalapon Diazinon (Specracide) Edrin Fonofos (Dyfonate) Chlorothalonil (Daconil) Metalaxyl (Subdue) Phorate (Thimet)	Benomyl (Tersan) Chlordane Fenarimol (Rubigan) Lindate (Isotox, Silvanol)

Table 2.

Based on the above characteristics, the following pesticides have been rated for their relative leaching potential. Be aware these ratings are estimates and do not necessarily reflect what happens under actual use. However, these estimates can serve as a guide in selecting pesticides.

Pesticide properties vary greatly, depending on formulation. Whenever possible, select pesticides and formulations which are less persistent and least likely to leach.

At present, the science for determining pesticide behavior in a field situation is limited. Ratings are based on the best available information and offered only as general guidelines. This is not an official list. Official lists of pesticides and pesticide restrictions that apply to New Hampshire are developed and maintained by the Pesticide Control Board.

Relative Leachability of Herbicides Commonly Used in New Hampshire

Common Name	Trade Name	Leachability Rating	Relative Surface Loss Potential
2,4-D Amine	2,4-D Amine	Medium	Low
2,4-D Amine Ester	2,4-D Ester	Medium	Medium
alachlor	Lasso, Alanox	Medium	Medium
atrazine	Attrex, Attranex, Bicep, Sutrazine	High	Medium
butylate	Sutan	Low	Medium
cyanazine	Bladex	Medium	Medium
dalapon	Dowpon, Dalapon	High	Low
dicamba	Benvel	High	Low
diquat	Diquat	Low	High
endothal	Aquathol, Accelerate	Medium	Low
EPTC	Eptam, Eradicane	Low	Medium
glyphosate	Roundup	Low	High
hexazinone	Velpar	High	Medium
linuron	Lorox, Hoe	Medium	High
metolachlor	Dual	High	Medium
metribuzin	Lexone, Sencor	High	Medium
napropamide	Devrinol	Medium	High
paraquat	Gramaxone, Paraquat Plus	Low	High
pendimethalin	Prowl	Low	High
picloram	Tordon, Grazon	High	Low
simazine	Princep, Simazine	High	Mediu,m
triclopyr	Garlon	Medium	High
trifluralin	Treflan, Triflurex	Low	High

Table 3.

Relative Leachability of Insecticides Commonly Used in NH

Common Name	Trade Name	Leachability Rating	Relative Surface Loss Potential
anilazine	Dyrene	Low	Low
benomyl	Benlate, Tersan 1991	Low	High
captan	Captan, Orthocide	Low	Low
chlorothalonil	Bravo, Daconil	Low	High
dichlone	Dichlone, Phygon	Low	?
dodine	Cyprex, Curitan	Low	High
fenarimol	Rubigan	High	High
iprodione	Chipco	Low	Medium
mancozeb	Mancozeb, Dithan M-45, Dikar, Manzate 200	Low	High
maneb	Maneb, Dithane M-22	Low	High
metalaxyl	Ridomil, Subdue	High	Medium
PCNB	Terraclor, Earthcide, Quintox	Low	High
propiconazole	Banner	Medium	High
triadimefon	Bayleton	Medium	Medium

Table 4.

Relative Leachability of Fungicides Commonly Used in NH

Common Name	Trade Names	Leachability Rating	Relative Surface Loss Potential
aldicarb	Temik	High	Low
azinphos-methyl	Guthion	Low	Medium
bendiocarb	Turcam	Low	Medium
carbaryl	Sevin	Low	Medium
carbofuran	Furdan	High	Low
chlorpyrifos	Dursban, Lorsban	Low	High
demeton	Systox	High	Medium
diazinon	Diazinon, Knox Out, Spectracide, Sarolex, DZN	Low	High
disulfoton	Di-Systox	Medium	Medium
esfenvalerate	Asana	Low	High
fluvalinate	Mavrik	Low	High
isazofos	Triumph	High	Medium
isofenphos	Oftanol	Medium	High
malathion	Malathion, Cythion	Low	Low
methamidophos	Monitor	Medium	Low
methomyl	Lannate, Nudrin	High	Medium
oxamyl	Vydate	Low	Low
oxdemeton-methyl	Metasystox-R	High	Low
permethrin	Ambush, Pounce	Low	High
phosmet	Imidan	Low	Medium
trichlorfon	Dylox, Proxol	High	Low

Table 5.

Section 9: MANAGEMENT PRACTICES

In addition to pesticide properties and soil characteristics, management practices can influence pesticide leaching and run off. Many practices are currently used to reduce the risk of groundwater contamination.

Management practices are grouped in the following categories:

A. Increased Efficacy and Safety of Pesticide Application Techniques

1) Timing of Application

Whenever possible, avoid preemergence herbicide applications before heavy rainfall.

For better weed control, apply postemergent herbicides after rainfall.

Proper timing of pesticides relative to the pest life cycle enhance control and reduce the number of applications.

With few exceptions, avoid pesticide applications under conditions of cold and hot air and soil temperatures.

2) **Direct Applications to the Target Site**

Modify equipment, such as adding shields to reduce drift.

Spot spray rather than broadcast spray if pests occur only in a few areas.

Use controlled droplet applications, electrostatic-sprayers, and band applications to reduce pesticide use and drift.

3) **Follow the Directions on the Pesticide Label**

Many pesticide labels contain use instructions or precautions designed to avoid ground-water contamination.

Use no more of the product than the label states. Higher dosage rates will not mean better control and deviation from label instructions is illegal.

4) **Maintain Records of Pesticide Use**

Maintain records by date of the identity and quantity of pesticides applied to each area. Records required by law are in the Administrative Rules of the Pesticide Control Board and outlined in detail in the UNH Cooperative Extension Pesticide Applicator Training Manual.

5) **Pesticide Application Equipment**

Calibrate and maintain equipment properly. Correctly calibrating application equipment before applying pesticides reduces your chances of applying too much.

Check your application equipment regularly for leaks, malfunctions and calibration.

Avoid spills and back-siphoning.

Avoid spills, especially near wells or other water sources. Prevent back siphoning of pesticide-contaminated water into the water source by keeping the end of the fill hose above the water level in the spray tank. Install a backflow device (such as an air gap or check valve) on the filling pipe to prevent backflow problems.

6) **Chemigation**

Careless use of chemigation has a greater potential to pollute water sources, over apply pesticides, and cause drift than ground applications of pesticides. Monitor chemigation carefully and use backflow prevention.

B. Soil and Water Conservation Practices

1) **Avoid Over Irrigation**

Avoid surface runoff that will move pesticides off-target.

2) **Time Irrigation**

Delay irrigation after a pesticide application, except as necessary to achieve pesticide control and compliance with the label.

3) **Increase Organic Matter on Coarse Textured Soils**

Animal manure and green manure cover crops bind pesticides and reduce the likelihood of leaching. Turf provides a natural filter to reduce the extent of ground-water contamination.

4) On slopes greater than 3%, pay particular attention to pesticide selection and application.

5) Consider the location of the pesticide application in relation to ground and surface water.

6) Use cover crops

Alternate pesticide use area with cover crops.

7) Use the following conservation techniques whenever possible:

Types Of Practice	Effect On Runoff Volume	Effect On Soil Erosion
Structural Practices		
Terraces		
level	-	-
graded	-	-
Subsurface drainage	0	0
Sediment ponds	0	0
Conservation tillage		
chisel plow	-	-
ridge-plant	-	-
no-till	-	-
minimum till (discing)	-	-
Contouring	-	-
Stripcropping	-	-
Grassed waterways	0	-
Diversions	0	-
Cover crops	-	-
Filter strips	0	0

Table 6

C. Use of IPM (Integrated Pest Management)

IPM is the integrating of pest control techniques in a manner which is economically and ecologically sound. For more information contact your UNH Cooperative Extension county office. Major components of an IPM system are:

1) Economic Threshold

Control pests when population levels and resulting damage justifies the cost. This population level is called the economic threshold.

2) Monitor and Identify Pests

Spray only when pest populations justify action.

Use pheromone, light traps or mechanical traps to monitor pests.

Scout fields often to determine where damage is likely to occur.

Identify pests correctly. Misdiagnosing pests results in unnecessary spraying.

3) **Cultural Controls**

Reduce pesticide problems by crop rotation and by proper timing of planting, fertilization and irrigation.

4) **Resistant Varieties**

Choose varieties less susceptible to pest damage, requiring fewer sprays.

5) **Biological Controls**

Introduce natural enemies.

Preserve predator habitats.

6) **Mechanical Barriers and Traps**

Plastic weed barriers

Row tunnels

Yellow sticky boards

7) **Use of "Trap" Crops**

"Trap" crops draw pests away from the marketable crops.

8) **Non-chemical Weed Control Technique**

Multivation

Rolling cultivators

Rotary hoes

Flame weeders

9) **Eliminate Pest Refuges**

10) **Select Pesticides Least Harmful to Non-Target Organisms and Least Likely to Contaminate Water**

D. Pesticide Storage and Rinsate Management

1) **Store pesticides safely. Refer to the Administrative Rules of the Pesticide Control Board and the University of New Hampshire Cooperative Extension Pesticide Applicator Training Manual for details.**

2) **Dispose of pesticides properly. Refer to the Administrative Rules of the Pesticide Control Board and the University of New Hampshire Cooperative Extension Pesticide Applicator Training Manual for details.**

3) **Do not dump rinsates. Spray adjacent fields if the crop is on the label or use rinsate as diluent if pesticides are compatible and have similar uses.**

4) When possible, build rinsate containment facility compatible with your management system. Consult with UNH Cooperative Extension or Soil Conservation Service for more information.

5) Buy only the amount of pesticide that can be used in one growing season.

6) Notify local fire department

   Location of storage facility.

   Copies of MSDS sheets.

   Contact your UNH Cooperative Extension county office for a copy of "How to Comply with SARA Title III."

7) Refer to the Administrative Rules of the Pesticide Control Board for pesticide management for groundwater protection, especially those described in Section 6 of this document, or contact the Division of Pesticide Control for state pesticide use policy, (603) 271-3550.

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