
# Occurrence Analysis for Potential Source Waters for the Fourth Six-Year Review of National Primary Drinking Water Regulations

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# Disclaimer

This report is in support of the revise/take no action decisions for EPA's Fourth Six-Year Review of Existing Drinking Water Standards Federal Register Notice. This report is intended to provide technical background for the fourth Six-Year Review.

This document is not a regulation itself and it does not substitute for the Safe Drinking Water Act (SDWA) or EPA's regulations. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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# Abbreviations and Acronyms

| | |
|---|---|
| AA | activated alumina |
| ATSDR | Agency for Toxic Substances & Disease Registry |
| BAT | best available technology |
| CF | coagulation filtration |
| DBP | disinfection byproduct |
| EDR | electrodialysis reversal |
| EPA | U.S. Environmental Protection Agency |
| GAC | granular activated carbon |
| GW | ground water |
| IX | ion exchange |
| LS | lime softening |
| MCL | maximum contaminant level |
| MCLG | maximum contaminant level goal |
| MSBA | multi-stage bubbling aeration |
| NAICS | North American Industry Classification System |
| NAWQA | National Water-Quality Assessment |
| NCFAP | National Center for Food and Agricultural Policy |
| ND | no data reported |
| NPDWR | National Primary Drinking Water Regulation |
| OPP | U.S. Environmental Protection Agency, Office of Pesticide Programs |
| OX | oxidation |
| PAC | powdered activated carbon |
| PDP | Pesticide Data Program |
| POU | point-of-use |
| PTA | packed tower aeration |
| RO | reverse osmosis |
| SDWA | Safe Drinking Water Act |
| SW | surface water |
| SYR | Six-Year Review |
| SYR 1 | First Six-Year Review |
| SYR 2 | Second Six-Year Review |
| SYR 3 | Third Six-Year Review |
| SYR 4 | Fourth Six-Year Review |
| TRI | Toxics Release Inventory |
| USDA | U.S. Department of Agriculture |
| USGS | U.S. Geological Survey |

# Executive Summary

The U.S. Environmental Protection Agency (EPA) has completed its fourth Six-Year Review (SYR 4) of national primary drinking water regulations (NPDWRs). The 1996 Safe Drinking Water Act (SDWA) Amendments require EPA to periodically review existing NPDWRs. Section 1412(b)(9) of SDWA reads:

> ...[t]he Administrator shall, not less than every 6 years, review and revise, as appropriate, each primary drinking water regulation promulgated under this title. Any revision of a national primary drinking water regulation shall be promulgated in accordance with this section, except that each revision shall maintain, or provide for greater, protection of the health of persons.

The primary goal of the Six-Year Review (SYR) process is to identify NPDWRs for possible regulatory revision. Although the statute does not define when a revision is "appropriate," as a general benchmark, EPA considered a possible revision to be "appropriate" if, at a minimum, it presents a meaningful opportunity to:

- improve the level of public health protection, and/or
- achieve cost savings while maintaining or improving the level of public health protection.

For SYR 4, EPA obtained and evaluated new information that could affect a NPDWR, including information on finished water occurrence (USEPA, 2024b), analytical feasibility (USEPA, 2024a), and health effects (USEPA, 2024c). EPA identified new health effects assessments that indicate the possibility to raise maximum contaminant level goal (MCLG) values for several regulated contaminants. Consequently, EPA reviewed data on contaminant occurrence in source water to determine if there is a meaningful opportunity to achieve cost savings while maintaining or improving the level of public health protection. This document describes this review.

**Exhibit ES-1** shows the current MCLG values for contaminants for which new health effects assessments indicate a potential MCLG that is higher than the MCLG in the NPDWR. The new health effects information results in a wide range of potential MCLG increases. The lowest relative increase is 2 times the current MCLG for both diquat and picloram. The highest relative increase is 150 times the current MCLG for the upper bound potential MCLG for lindane.

The exhibit also shows the current maximum contaminant level (MCL) values, most of which equal the MCLG values. The potential MCLG value for each contaminant is higher than the corresponding current MCL value. Thus, a revision to the MCLG for a contaminant would affect the MCL, which could reduce costs for drinking water systems that control the contaminant to meet the MCL.

**Exhibit ES-1. Current MCLG/MCL Values and Potential MCLG Values**

| Contaminant | Current MCLG/MCL (mg/L) | Potential MCLG (mg/L) |
|---|---|---|
| Alachlor[a] | zero (MCLG)<br>0.002 (MCL) | 0.03 |
| Atrazine | 0.003 | 0.4 |
| Barium | 2 | 6 |
| Beryllium | 0.004 | 0.01 |
| 1,2-Dichlorobenzene | 0.6 | 2 |
| 1,4-Dichlorobenzene | 0.075 | 0.4 |
| 1,1-Dichloroethylene[a] | 0.007 | 0.3 |
| 2,4-Dichlorophenoxyacetic acid (2,4-D)[a] | 0.07 | 1 |
| Diquat[a] | 0.02 | 0.03 |
| Glyphosate[a] | 0.7 | 6 |
| Lindane (gamma-Hexachlorocyclohexane)[a] | 0.0002 | 0.009 |
| Picloram[a] | 0.5 | 1 |
| Simazine | 0.004 | 0.4 |
| 1,1,1-Trichloroethane[a] | 0.2 | 10 |

Source: USEPA, 2024c

a. Although new health effects information indicated a possibility to increase MCLG during a prior SYR, EPA decided not to revise the NPDWR because the revision was a low priority.

The potential for and magnitude of cost savings related to MCL changes depend on four factors:

- The magnitude of increase in the MCL;
- The concentration of the contaminant in the source water, relative to the current MCL and the potential MCLG;
- The presence of co-occurring contaminants treated with the same technology and the relative importance to the design and operation of the treatment technology; and
- The specific treatment technology currently employed.

EPA's analysis of the potential for cost savings was constrained to readily available data. The data available to characterize contaminant occurrence was especially limited because there is no comprehensive dataset that characterizes source water quality for drinking water systems. Data from the National Water-Quality Assessment (NAWQA) program conducted by the U.S. Geological Survey (USGS) and U.S. Department of Agriculture (USDA) Pesticide Data Program (PDP) water monitoring survey provide useful insights into potential contaminant occurrence in source water. However, these data are not based on random or representative sampling events and, therefore, cannot be used directly to derive quantitative estimates of national occurrence in drinking water sources.

Nevertheless, the available data indicate relatively infrequent contaminant occurrence in potential source waters at the levels of interest. The NAWQA data, which provide the most extensive coverage of potential source waters, indicate that most of the contaminants are found in concentrations that exceed the potential MCLG values. Three contaminants – 2,4-D, glyphosate and picloram – are not found at levels above either the current MCLG or the potential MCLG values in either dataset. Diquat, which is not included in any of these datasets, potentially occurs infrequently in source water given less frequent use compared to the other pesticides in

the table (alachlor, atrazine, glyphosate, lindane, picloram, and simazine) and that it tends to dissipate quickly from surface water (SW) and be immobile in soils.

Without national estimates of contaminant occurrence in drinking water sources, EPA cannot estimate how many systems currently treat for the contaminants listed in **Exhibit 1-1**. EPA also does not have national data regarding the treatment technologies being utilized to control these contaminants. Use of some technologies would result in higher operational cost savings from reduced use; however, co-occurrence considerations for all the best available technologies (BAT) could diminish the ability to alter treatment for higher potential MCLGs.

Despite the possibility for changes in MCLG values that range from 2 to 133 times higher than current MCLs, the available occurrence data for potential drinking water sources indicate relatively low contaminant occurrence in the concentration ranges of interest. Therefore, EPA cannot conclude that there is a meaningful opportunity for system cost savings.

# 1. Introduction

The U.S. Environmental Protection Agency (EPA) has completed its fourth Six-Year Review (SYR 4) of national primary drinking water regulations (NPDWRs). The 1996 Safe Drinking Water Act (SDWA) Amendments require EPA to periodically review existing NPDWRs. Section 1412(b)(9) of SDWA reads:

> ...[t]he Administrator shall, not less than every 6 years, review and revise, as appropriate, each primary drinking water regulation promulgated under this title. Any revision of a national primary drinking water regulation shall be promulgated in accordance with this section, except that each revision shall maintain, or provide for greater, protection of the health of persons.

The primary goal of the Six-Year Review (SYR) process is to identify NPDWRs for possible regulatory revision. Although the statute does not define when a revision is "appropriate," as a general benchmark, EPA considered a possible revision to be "appropriate" if, at a minimum, it presents a meaningful opportunity to:

- improve the level of public health protection, and/or
- achieve cost savings while maintaining or improving the level of public health protection.

For SYR 4, EPA implemented the protocol that it developed for the first Six-Year Review (SYR 1) (USEPA, 2003), including minor revisions developed during the second review process (SYR 2) (USEPA, 2009). EPA obtained and evaluated new information that could affect a NPDWR, including information on finished water occurrence (USEPA, 2024b), analytical feasibility (USEPA, 2024a), and health effects (USEPA, 2024c). EPA identified new health effects assessments that indicate the possibility to raise maximum contaminant level goal (MCLG) values for several regulated contaminants. An MCLG is a concentration at which there is no known health risk. Consequently, EPA reviewed data on contaminant occurrence in source water to determine whether there is a meaningful opportunity to achieve cost savings while maintaining the level of public health protection. This document describes this review.

**Exhibit 1-1** shows the current MCLG values for contaminants for which new health effects assessments indicate a potential MCLG that is higher than the MCLG in the NPDWR. The new health effects information results in a wide range of potential MCLG increases. The lowest relative increase is 2 times the current MCLG for diquat. The highest relative increase is 133 times the current MCLG for atrazine.

**Exhibit 1-1** also shows the current maximum contaminant level (MCL) values, most of which equal current MCLG values. The MCL values are the regulatory standards that limit contaminant concentrations in water distributed by regulated public water systems. The potential MCLG value for each contaminant is greater than the corresponding MCL value. Thus, a revision to the MCLG for each contaminant would need to be accompanied by an increase in the corresponding MCL. Increasing the regulatory limit could result in reduced treatment costs for drinking water systems that control the contaminant to meet the current MCL while providing the same level of health protection.

**Exhibit 1-1. Current and Potential MCLG Values**

| Contaminant (Chemical Abstracts Service Registry Number®) | Current MCLG (mg/L) | Current MCL (mg/L) | Potential MCLG (mg/L) |
|---|---|---|---|
| Alachlor[a] (15972-60-8) | zero | 0.002 | 0.03 |
| Atrazine (1912-24-9) | 0.003 | 0.003 | 0.4 |
| Barium (7440-39-3) | 2 | 2 | 6 |
| Beryllium[a] (7440-41-7) | 0.004 | 0.004 | 0.01 |
| 1,2-Dichlorobenzene (95-50-1) | 0.6 | 0.6 | 2 |
| 1,4-Dichlorobenzene (106-46-7) | 0.075 | 0.075 | 0.4 |
| 1,1-Dichloroethylene[a] (75-35-4) | 0.007 | 0.007 | 0.3 |
| 2,4-Dichlorophenoxyacetic acid (2,4-D) [a] (94-75-7) | 0.07 | 0.07 | 1 |
| Diquat[a] (85-00-7) | 0.02 | 0.02 | 0.03 |
| Glyphosate[a] (1071-83-6) | 0.7 | 0.7 | 6 |
| Lindane (gamma-Hexachlorocyclohexane) [a] (58-89-9) | 0.0002 | 0.0002 | 0.009 |
| Picloram[a] (1918-02-1) | 0.5 | 0.5 | 1 |
| Simazine (122-34-9) | 0.004 | 0.004 | 0.4 |
| 1,1,1-Trichloroethane[a] (71-55-6) | 0.2 | 0.2 | 10 |

Source: USEPA, 2024c

a. Although new health effects information indicated potential to increase MCLG during prior SYR cycles, EPA decided not to revise the NPDWR because the revision was a low priority.

In making its recommendation to revise or take no action regarding an MCLG, EPA needs to determine whether there is a meaningful opportunity for cost savings while maintaining the same level of protection. This report provides the information EPA reviewed to make this determination.

During the first three SYR cycles, EPA made a recommendation not to revise several NPDWRs for which an increase in MCLG was possible, including several under consideration again during the current review. EPA's past recommendations were based on its determination that the potential for cost savings was low. As a result, EPA classified the MCLG revisions as a low priority activity because of competing workload priorities, administrative costs associated with rulemaking, and the burden on States and the regulated community to implement any regulatory change that resulted.

This technical support document addresses the potential for cost savings, which depends on the potential cost savings impact at the system level and the number of systems affected. Section 2 provides a discussion of the factors affecting the potential for cost savings for each contaminant of interest. Section 3 discusses the sources of these contaminants and current usage of some of the contaminants. Section 4 summarizes water quality data that is readily available to characterize contaminant occurrence. Section 5 provides a summary of information regarding whether possible changes to the MCLGs constitute a meaningful opportunity to reduce costs while maintaining health protection. USEPA (2024b) provides occurrence analysis information for other contaminants included in SYR 4.

# 2. Cost Savings

MCLG revisions alone do not produce cost savings. The potential for cost savings comes from subsequent revisions to the MCL values, which could affect treatment activities at regulated public water systems. The magnitude of these cost savings depends on four factors:

- The magnitude of increase in the MCL;
- The concentration of the contaminant in the source water, relative to the current MCL and the potential MCLG;
- The presence of co-occurring contaminants treated with the same technology and the relative importance to the design and operation of the treatment technology; and
- The specific treatment technology currently employed.

The following sections address each of these factors.

## 2.1 Magnitude of Possible MCL Increase

In general, the potential for cost savings increases as the magnitude of the MCLG/MCL change increases. A larger MCL increase has the potential to affect a greater number of systems and to result in more substantial changes in treatment operations. **Exhibit 2-1** presents the magnitude of possible change for the contaminants of interest.

**Exhibit 2-1. Magnitude of Possible MCL Increase**

| Contaminant | Multiple of Current MCL |
|---|---|
| Alachlor | 15 |
| Atrazine | 133 |
| Barium | 3 |
| Beryllium | 3 |
| 1,2-Dichlorobenzene | 3 |
| 1,4-Dichlorobenzene | 5 |
| 1,1-Dichloroethylene | 43 |
| 2,4-D | 14 |
| Diquat | 2 |
| Glyphosate | 9 |
| Lindane (gamma-Hexachlorocyclohexane) | 45 |
| Picloram | 2 |
| Simazine | 100 |
| 1,1,1-Trichloroethane | 50 |

Note: Rounded to integer values.

Based solely on multiples of the current MCLs, the potential for cost savings appears lower for barium, beryllium, 1,2-dichlorobenezene, 1,4-dichlorobenzene, diquat, glyphosate, and picloram than for alachlor, atrazine, 1,1-dichloroethylene, 2,4-D, lindane, simazine, and 1,1,1-trichloroethane.

## 2.2 Source Water Occurrence

If an MCL increases, there are two potential scenarios that could result in treatment cost savings:

- Treatment is no longer required because the source water concentration is less than the potential higher MCL; and
- Less treatment is required even though the source water concentration is greater than the higher potential MCL.

The potential cost savings under the first scenario are greater than under the second, because a system could cease treatment for the contaminant altogether. There is no comprehensive database of source water quality for public water systems. Therefore, EPA reviewed available data on contaminant releases and ambient water quality to characterize source water occurrence. Section 3 provides contaminant release data from EPA's Toxics Release Inventory (TRI) and pesticide application rate estimates produced by the U.S. Geological Survey (USGS). Section 4 contains occurrence data summaries from two source water quality monitoring programs the National Water-Quality Assessment (NAWQA) program conducted by the USGS and the Pesticide Data Program (PDP) conducted by the U.S. Department of Agriculture (USDA).

## 2.3 Co-Occurring Contaminants

The presence of co-occurring contaminants is a potential limiting factor on the cost savings that can be achieved given an MCL increase. Co-occurring contaminants are relevant when the same treatment process that removes the target contaminant also removes one or more co-occurring contaminants. Potential cost savings depend on the relative importance of each contaminant to the design and operation of the process. If the target contaminant controls treatment operation decisions, then there may be a greater opportunity for cost savings. On the other hand, if a co-occurring contaminant controls treatment operation decisions, then it may not be possible to adjust operations and lower costs.

For example, a system with coagulation/filtration to remove turbidity, followed by granular activated carbon (GAC) to remove lindane, could realize a cost savings with an increase in the lindane MCL if the GAC system can be adjusted. If, however, the GAC process also removes other regulated organic contaminants, the operation may not be able to be adjusted despite a change in the lindane MCL.

## 2.4 Treatment Technology

**Exhibit 2-2** summarizes the best available technologies (BAT) and small system compliance technologies for each of the contaminants. Although systems are not required to use a BAT to meet an MCL, the list of technologies provides insights to the potential for treatment changes.

One potential operational change that is highly dependent on the magnitude of the MCL increase is the degree of blending used by a system. Some systems treat only a portion of the source water to a level well below the MCL and then blend the treated water with untreated water, resulting in blended water with contaminant concentrations below the MCL. An MCL increase could result in a system reducing the quantity of water being treated and increasing the quantity of untreated water in its blending operation. This change could result in reduced operating costs such as labor

costs for operating the treatment system and, potentially, reduced energy costs for pumping water through the treatment process.

The potential for cost savings for operating expenses such as chemical use, energy use, and media replacement vary by treatment technology. Some technologies, once in place, are more amenable to operational changes than others. The following sections provide discussions of the factors affecting the potential cost savings for each technology in **Exhibit 2-2**.

**Exhibit 2-2. Summary of Treatment Technologies**

| Contaminant | Best Available Treatment (BAT) | Small System Compliance Technologies |
|---|---|---|
| Alachlor | GAC | GAC, POU GAC, PAC |
| Atrazine | GAC | GAC, POU GAC, PAC |
| Barium | IX, LS, RO, EDR | CF, IX, LS, RO, EDR, POU IX, POU RO |
| Beryllium | AA, CF, IX, LS, RO | AA, CF, IX, LS, RO, POU IX, POU RO |
| 1,2-Dichlorobenzene | PTA, GAC | PTA, GAC, MSBA, Aeration (diffused, tray, shallow tray) |
| 1,4-Dichlorobenzene | PTA, GAC | PTA, GAC, MSBA, Aeration (diffused, tray, shallow tray) |
| 1,1-Dichloroethylene | PTA, GAC | PTA, GAC, MSBA, Aeration (diffused, tray, shallow tray) |
| 2,4-D | GAC | GAC, POU GAC, PAC |
| Diquat | GAC | GAC, POU GAC, PAC |
| Glyphosate | OX | OX |
| Lindane (gamma-Hexachlorocyclohexane) | GAC | GAC, POU GAC, PAC |
| Picloram | GAC | GAC, POU GAC, PAC |
| Simazine | GAC | GAC, POU GAC, PAC |
| 1,1,1-Trichloroethane | PTA, GAC | PTA, GAC, MSBA, Aeration (diffused, tray, shallow tray, spray) |

Sources: 40 CFR 141.61 and 141.62, USEPA 1998.
AA = Activated Alumina; CF = Coagulation/Filtration; EDR = Electrodialysis [Reversal]; GAC = Granular Activated Carbon; IX = Ion Exchange; LS = Lime Softening; MSBA = Multi-Stage Bubble Aeration; OX = Oxidation (Chlorine or Ozone); PAC = Powdered Activated Carbon; POU = point-of-use; PTA = Packed Tower Aeration; RO = Reverse Osmosis

### 2.4.1 Ion Exchange

Increasing the MCL for a target contaminant in an ion exchange (IX) system could allow for greater run times before regeneration or replacement of the IX resin. This longer run length would mean a reduction in regeneration chemical use, with associated cost savings, or a reduction in the cost of replacement resin/media and disposal costs. Alternatively, by changing bed depth, a system can reduce the quantity of resin or media present, with similar cost savings. Therefore, these cost savings could be large relative to the total operating cost of the technology, particularly if the magnitude of the MCL change is large.

Also, IX systems are more likely than other systems to be operated for the removal of a single contaminant. This circumstance is particularly true of systems with contaminant-specific resins. Thus, co-occurring contaminants may be less of a concern for some systems using this technology. Even when operated to remove multiple contaminants, this technology is amenable to changes in the resin used. If the MCL for one contaminant increases such that it is no longer a concern, the system can switch to a contaminant-specific resin (e.g., resin designed for arsenic removal) that is more efficient for removal of a co-occurring contaminant, with potential cost savings.

### 2.4.2 Activated Alumina

Increasing the MCL for a target contaminant in an activated alumina (AA) system could allow for greater run times before media replacement or regeneration. This longer run length would mean a reduction in regeneration chemical use, with associated cost savings, or a reduction in the cost of replacement media and disposal costs.

Also, AA systems are more likely than other systems to be operated for the removal of a single contaminant. Thus, co-occurring contaminants may be less of a concern for some systems using this technology.

### 2.4.3 Coagulation/Filtration

Coagulation/filtration (CF) treatment systems are most commonly used to treat surface water (SW) to remove pathogens. Therefore, the process modifications for change in the beryllium MCL are unlikely to occur.

### 2.4.4 Granular Activated Carbon

Like IX, with an increased MCL, granular activated carbon (GAC) systems may be able to be adjusted to extend the run length before regeneration or replacement of the GAC media or decrease the bed depth to reduce the GAC quantity. Cost savings could be large relative to the total operating cost of the technology, particularly if the magnitude of the MCL change is large.

Unlike IX, however, GAC removes a wide spectrum of organic compounds including disinfection byproduct (DBP) precursors and is more likely to be used for the removal of multiple contaminants. Thus, co-occurring contaminants may limit or eliminate the potential for cost savings, depending on which contaminants have the greatest influence on GAC operation. Also, although not all GAC media are the same, there is less potential for a change in GAC media to result in significant cost savings.

### 2.4.5 Powdered Activated Carbon

This treatment involves adding powered activated carbon (PAC) to adsorb one or more target contaminants prior to carbon removal via filtration. The treatment can be used, as needed, for intermittent contaminant spikes such as seasonal pesticide usage. An increase in the MCL for a contaminant treated using PAC could result in cost savings if the change affects the frequency or quantity of carbon addition. PAC may remove co-occurring organic contaminants. Therefore, the potential for cost savings depends on the presence of co-occurring contaminants.

### 2.4.6 Point-of-Use

Point-of-use (POU) devices are plumbed-in filters or pour-through pitches that treat water at a single tap. The potential for cost savings is most likely limited to MCL changes that would remove the need to continue device usage. The savings would be the avoided costs of purchasing replacement filters and/or replacement devices.

### 2.4.7 Packed Tower Aeration

An increased MCL could allow packed tower aeration (PTA) systems treating for 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethylene, or 1,1,1-trichloroethane to reduce the air-to-water ratio, resulting in reduced energy cost for blowers. Blower energy costs,

however, make up a small portion of total operating costs. Thus, the cost savings could be small relative to the total operating cost of the technology.

Also, like GAC, PTA can remove a wide range of contaminants, specifically volatile contaminants, and is more likely to be used for the removal of multiple contaminants. Thus, co-occurring contaminants may eliminate the potential for cost savings or limit the savings to the extent 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethylene, or 1,1,1-trichloroethane treatment controls the air-to-water ratio.

### 2.4.8 Multi-Stage Bubble Aeration

Multi-stage bubble aeration (MSBA) injects bubbles of air into water as it flows through shallow, compartmentalized basins. By increasing the surface area of water exposed to air, aeration removes volatile organic compounds. A higher MCL could result in a lower air-to-water ratio, reducing energy costs for blowers. Because the process can simultaneously remove multiple volatile contaminants, the potential for cost savings depends on the presence of co-occurring contaminants.

### 2.4.9 Oxidation

With an increased MCL, systems using oxidation (OX) to treat for glyphosate could reduce the dose of chlorine or ozone, resulting in reduced chemical cost. Chlorination and ozonation, however, typically are installed for the primary purpose of disinfecting drinking water. In other words, there would almost always be potential for a biological contaminant (i.e., bacteria, viruses, and parasites) in these systems, and glyphosate treatment would be a secondary benefit of the system. Cost savings in these systems would be limited to the extent glyphosate treatment controls the chemical dose. Although chemical costs make up a large portion of operating cost for these technologies, the ability to reduce these costs significantly would likely be small because of disinfection needs. It is unlikely that systems would be able to cease oxidation treatment because of an increase in the glyphosate MCL, given the underlying need for disinfection.

### 2.4.10 Lime Softening

An increased MCL may allow lime softening (LS) systems to reduce the dose of treatment chemicals (coagulant or lime), resulting in reduced cost. Like OX, however, LS systems also are typically installed for another primary purpose (e.g., solids and/or hardness removal). The treatment of the target contaminant would likely be a secondary benefit of the system. Cost savings would be limited to the extent that the MCL increase controls the coagulant or lime dose. Although chemical costs make up a moderate portion of operating cost for this technology, the ability to reduce these costs significantly would likely be small because of treatment needs for other contaminants. It is unlikely systems would be able to cease LS treatment, given the need to continue removal of solids and/or hardness.

### 2.4.11 Reverse Osmosis and Electrodialysis

Reverse osmosis (RO) and electrodialysis generally achieve a very high removal rate for a wide variety of contaminants. Although some operational adjustments may be possible (e.g., changes in blending ratios), these changes would not have a dramatic effect on operating costs unless there are no co-occurring contaminants. These technologies are very likely to be used for

removal of multiple contaminants, thereby limiting the potential for cost savings due to an MCL change for one contaminant.

# 3. Contaminant Characteristics and Sources

Toxic pollutants can be introduced to SW through natural sources as well as human activities. **Exhibit 3-1** provides a summary of the uses and potential sources for the contaminants of interest.

**Exhibit 3-1. Potential Sources and Environmental Fate of the Contaminants**

| Contaminant | Sources of Potential Release to the Environment | Description/Uses | Environmental Fate and Transport |
|---|---|---|---|
| Alachlor | Agricultural runoff. | Herbicide used for weed control among corn, soybeans, sorghum, peanuts, and beans. | Low absorption to soil; soluble and highly mobile in water; leaches to ground water (GW). |
| Atrazine | Agricultural runoff. | Herbicide used for weed control among corn, sugarcane, and sorghum. Former uses in Hawaii, Alaska, and U.S. territories and on evergreen trees and roadside areas were voluntarily withdrawn in 2020. | Moderately soluble in water; tends to persist in GW and SW with slow or no biodegradation; moderate adsorption to sediments; atmospheric release during use will lead to redeposition although vapor-phase atrazine may undergo photochemical degradation. |
| Barium | Industrial waste; drilling waste ground application, offshore drilling wastewater; copper smelting; erosion of natural deposits. | Naturally occurring metal; used in oil and gas drilling mud, jet fuel, pesticides, paint, bricks, ceramics, glass, and rubber. | Leaching and erosion of natural deposits into GW; atmospheric deposition; precipitate out of aquatic media as insoluble salt; adsorb to suspended solids in SW; not mobile in soil systems. |
| Beryllium | Wastewater discharge from industry and electric utilities, deposition of atmospheric beryllium, and weathering of rocks and soils. | Metal commonly converted into alloys; used in making electrical and electronic parts, construction materials for machinery, molds for plastics, automobiles, sports equipment, vehicles, and dental bridges. | Does not degrade in the environment; carried to rivers by deposition or land erosion; low mobility in sediment. |
| 1,2-Dichlorobenzene | Atmospheric emissions, industrial wastewater discharge during its production and use; by-product of 1,4-dichlorobenzene production; waste disposal in landfills. | Industrial chemical used to make herbicides. | Volatilizes to the atmosphere from soil and water; slightly water soluble; sorbs moderately to soils and sediments. |
| 1,4-Dichlorobenzene | Atmospheric emissions and deposition; waste disposal in landfills; sewage sludge application to agricultural soils; municipal wastewater. | Industrial chemical used to make deodorant blocks used in garbage cans and restrooms, and control odor in animal-holding facilities. Also used as a fumigant for control of moths, molds, and mildews, and as an insecticide. | Highly volatile from water and soil; if released to GW, may be transported through the ground to SW; sorbs moderately to soils and sediments. |

| Contaminant | Sources of Potential Release to the Environment | Description/Uses | Environmental Fate and Transport |
|---|---|---|---|
| 1,1-Dichloroethylene | Atmospheric emissions or wastewater discharge from manufacturing plants. | Industrial chemical used in making adhesives, synthetic fibers, refrigerants, food packaging, and coating resins. | Hydrophobic; highly volatile; if spilled on land, may leach to GW. |
| 2,4-D | Runoff from agricultural, forest, aquatic, and residential application. | Herbicide used for control of broadleaf weeds among fruit and vegetable crops, forestry, right-of-way, aquatic, and residential applications. | Intermediately to very mobile in soil; leaches to GW. |
| Diquat | Agricultural runoff; manufacturing wastewater discharges. | Herbicide used to control plant growth in aquatic environments and as agricultural and residential herbicide. | Permanently adsorbs to soil; rapidly adheres to sediments when released to water; immobile. |
| Glyphosate | Direct discharge during application; manufacturing wastewater discharges. | Herbicide used on food and non-food field crops as well as a plant growth regulator. | Strongly adsorbs to soil, immobile; unlikely to leach to GW; likely to adhere to sediments when released to SW by aquatic use and erosion. |
| Lindane (gamma-Hexachlorocyclohexane) | Agricultural runoff; atmospheric emissions; rain and snow deposition. | Insecticide used to treat a variety of crop seeds until 2011. | Volatile; sorbs to soil, leaching to GW (soluble in water at 7 mg/L). |
| Picloram | Runoff from agricultural, forest, and rights-of-way application. | Herbicide used to control feed crop pastures, nonfood crops (rights-of-way), and in forestry. | Highly soluble and mobile in water; leaches to GW, no degradation. |
| Simazine | Agricultural and stormwater runoff. | Herbicide used for weed control among fruits, berries, vegetables, ornamental nursery plants, forestry, and golf courses. Former uses in Hawaii, Alaska, and U.S. territories and for some types of plants were voluntarily withdrawn in 2020. | Moderately soluble and persistent in water with slow or no biodegradation; relatively quick degradation on soil under direct sunlight; low adsorption to soils; low volatility. |
| 1,1,1-Trichloroethane | Atmospheric emissions or wastewater discharge from manufacturing plants, discharge or leaching from landfills. | Industrial chemical used as a solvent and in production of hydrofluorocarbons. | Highly volatile; sorbs to soil, may leach to GW; atmospheric deposition; moderate solubility. |

Source: ATSDR 2002, 2003, 2006a, 2006b, 2007; USEPA, 1993, 1995a, 1995b, 2002, 2005, 2006a, 2006b, 2006c, 2007, 2020a, and 2020b

## 3.1 Toxic Release Inventory Data

EPA collected reported state level releases and disposal data for the pollutants of concern from its TRI from 2007 through 2019. TRI data for 1,2-dichlorobenzene and 1,4-dichlorobenzene were available from 2009 to 2020. These data identify states that are most likely to have anthropogenic sources of the contaminants of interest that are reported to the TRI, which

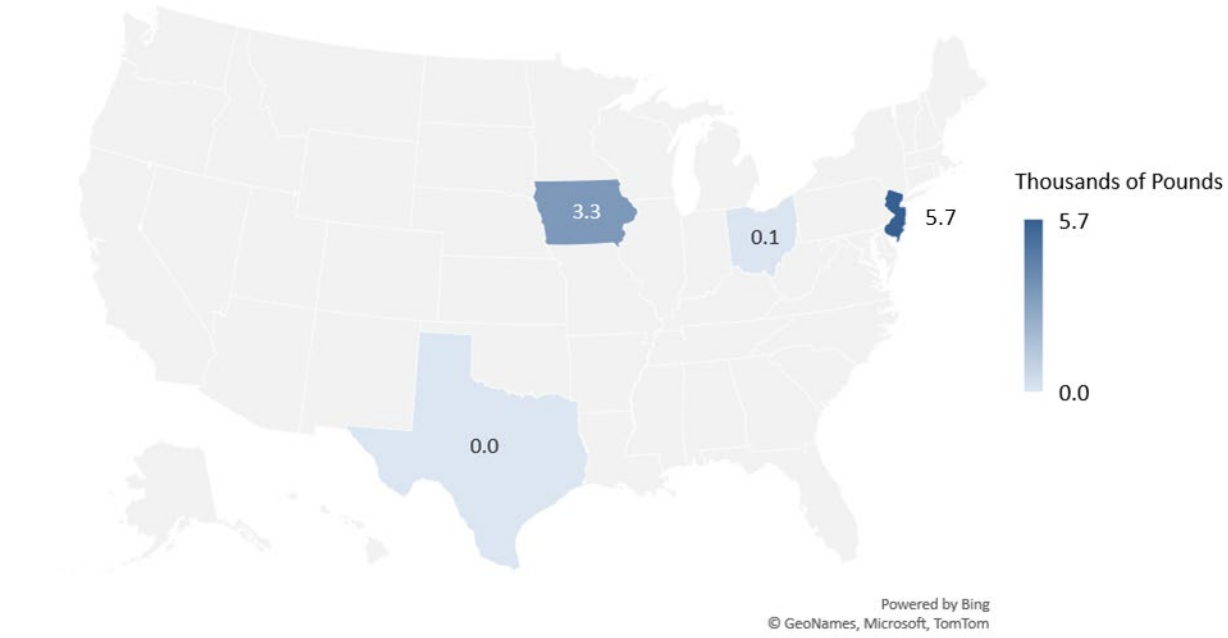
excludes agricultural applications of pesticides. TRI does not have release or disposal data for 1,1-dichloroethane, diquat, or glyphosate.

The following sections provide TRI release summaries by contaminant. They include three types of exhibits: maps indicating the total releases/disposal over the time period by state; bar charts indicating the total annual releases across all states; and pie charts showing the percentage of on-site disposal/releases by environmental media and total off-site disposal/releases.

### 3.1.1 Alachlor

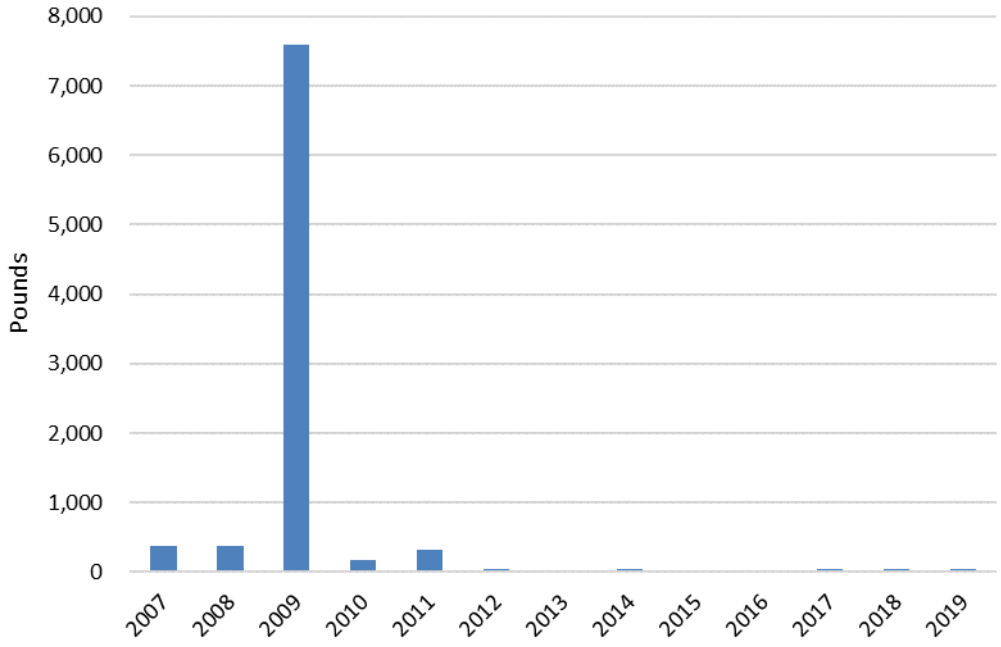
Alachlor releases occurred only in Iowa, Ohio, Texas, and New Jersey from 2007 to 2019 (**Exhibit 3-2)**. Most of the releases occurred in 2009 (**Exhibit 3-3**), which coincides with a large water release in New Jersey. Because of that 2009 release, water releases accounted for 54% of the releases over time, followed by off-site (21%), air (15%), and land (10%) releases (**Exhibit 3-4**).

**Exhibit 3-2. Nationally Reported Disposal or Release of Alachlor (2007–2019; thousands of pounds)**



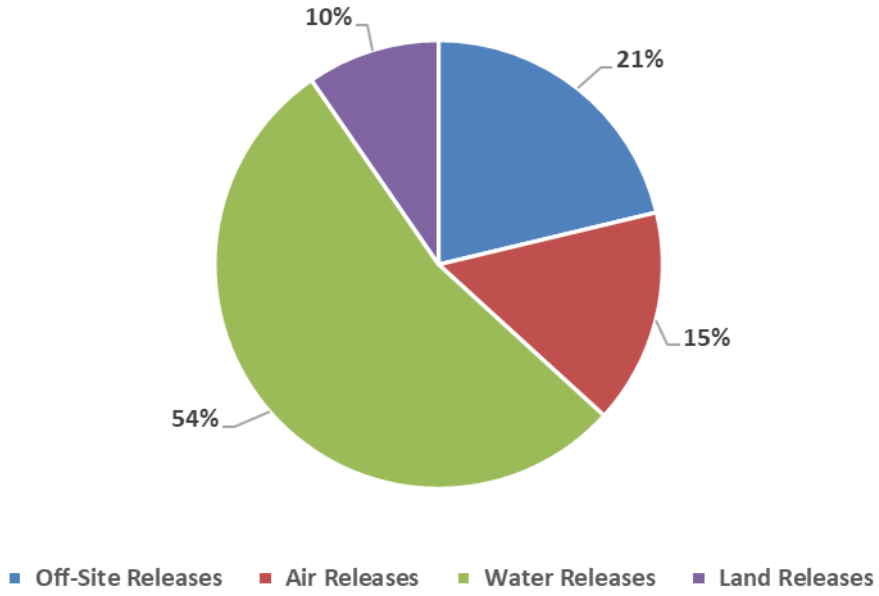

Source: USEPA, 2020c

**Exhibit 3-3. Reported Disposal or Release of Alachlor by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-4. Reported Disposal or Release of Alachlor by Media (2007–2019; percent)**

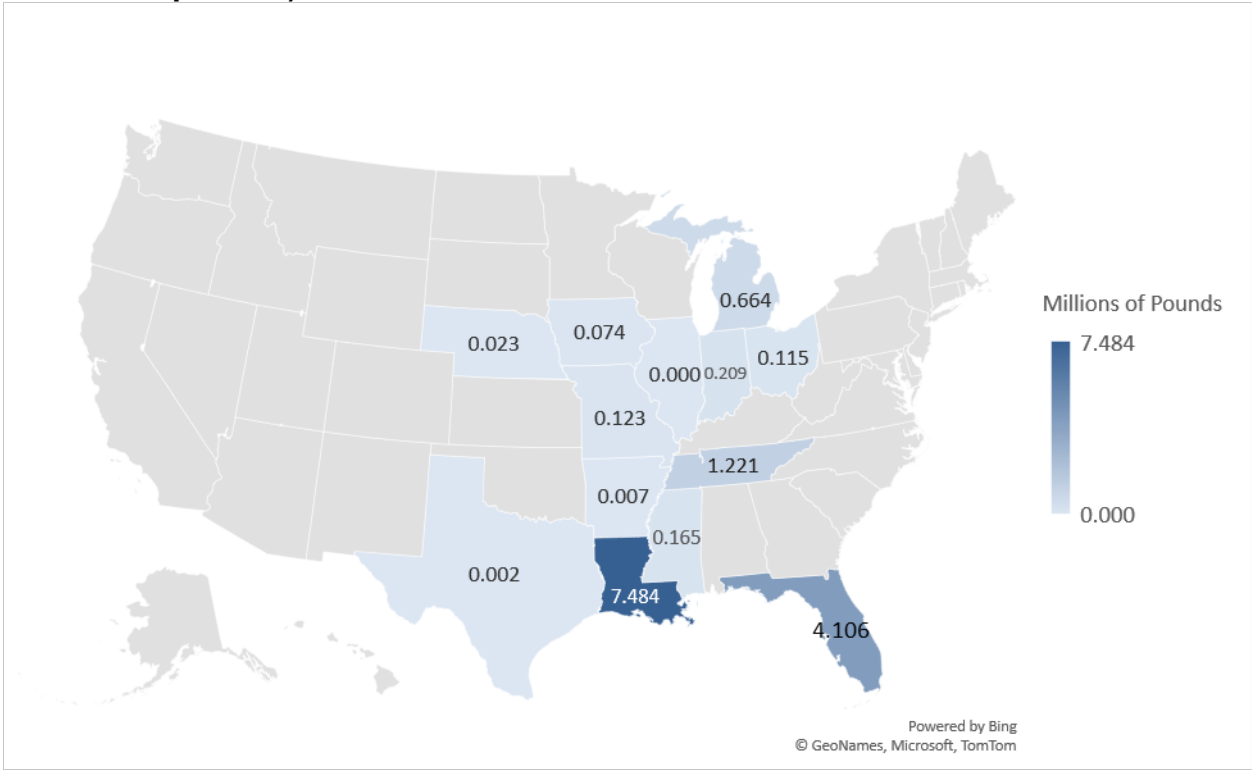



Source: USEPA, 2020c

### 3.1.2 Atrazine

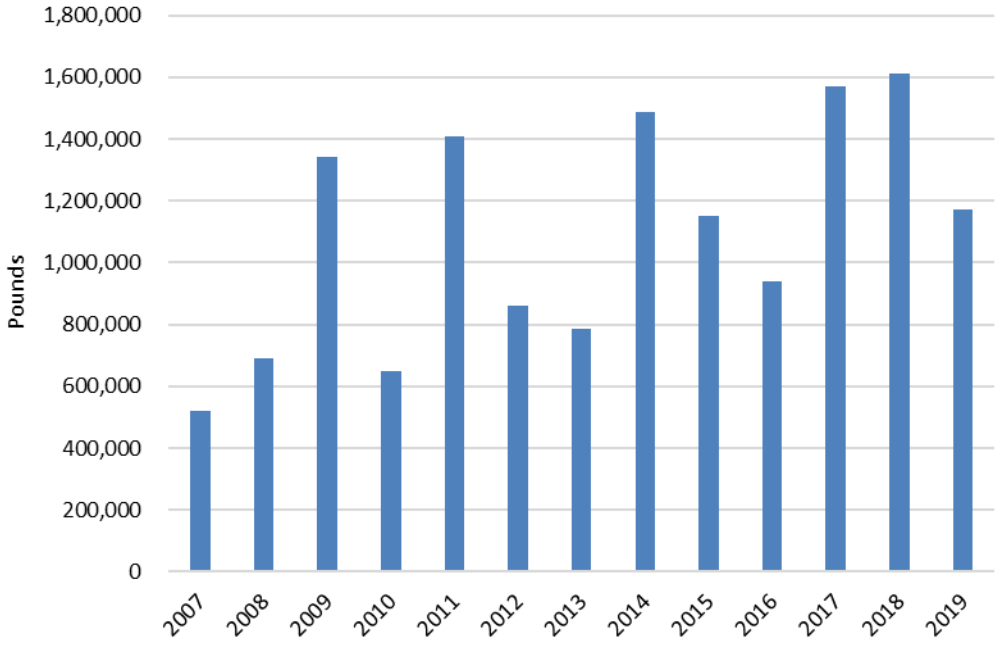
From 2007 to 2019, atrazine releases occurred throughout the Midwest and in several states bordering the Gulf of Mexico (**Exhibit 3-5)**. Louisiana and Florida account for most of those releases. The years when releases exceed a million pounds coincide with large land releases in Louisiana (**Exhibit 3-6**). Land releases and off-site disposal accounted for 51% and 46% of releases, respectively (**Exhibit 3-7**).

**Exhibit 3-5. Nationally Reported Disposal or Release of Atrazine (2007–2019; millions of pounds)**



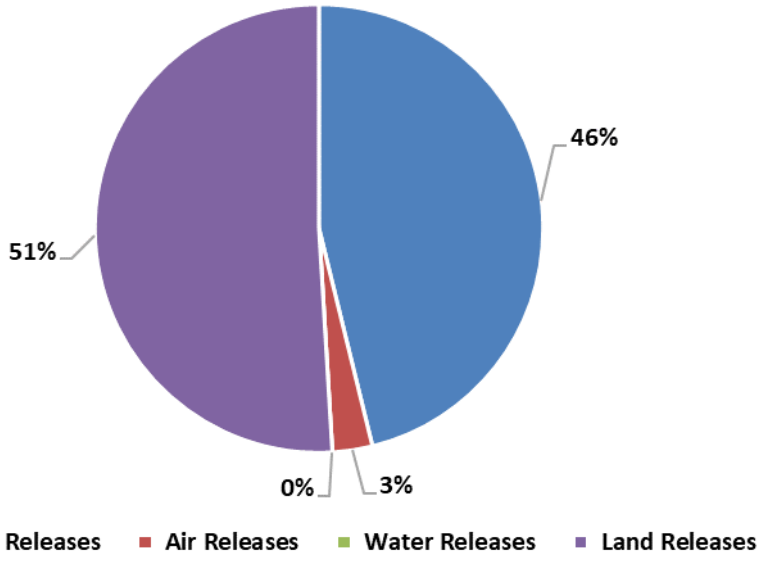

Source: USEPA, 2020c

**Exhibit 3-6. Reported Disposal or Release of Atrazine by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-7. Reported Disposal or Release of Atrazine by Media (2007–2019; percent)**

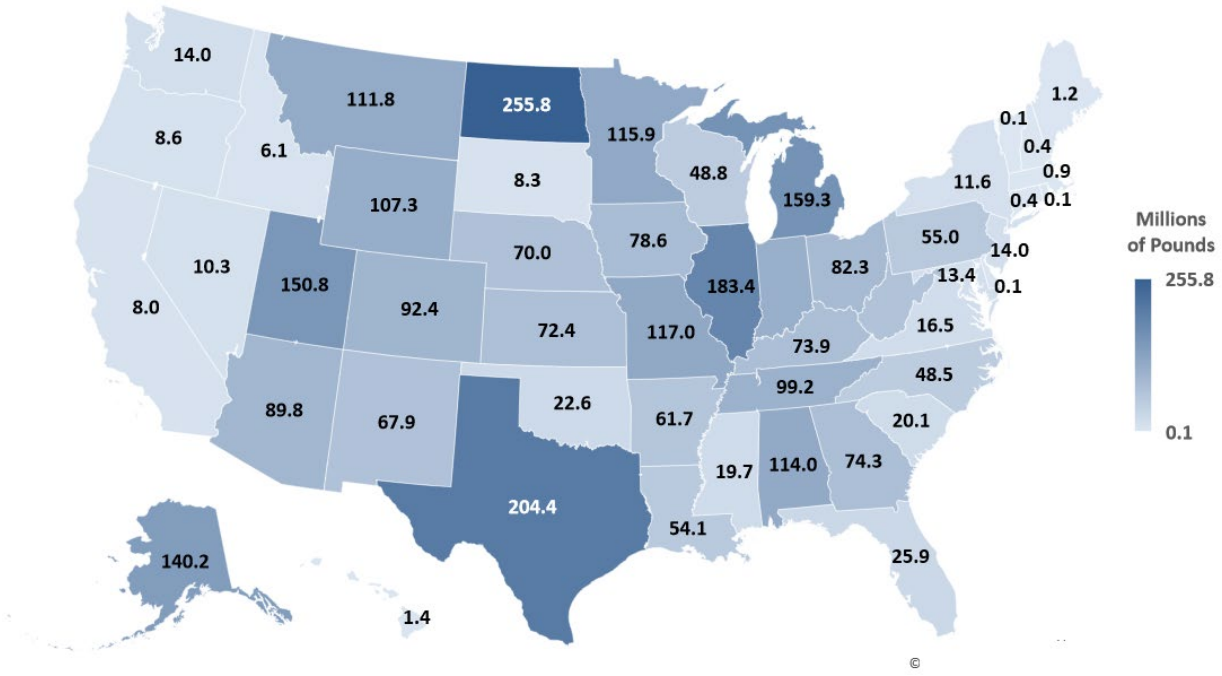



Source: USEPA, 2020c

### 3.1.3 Barium and Barium Compounds

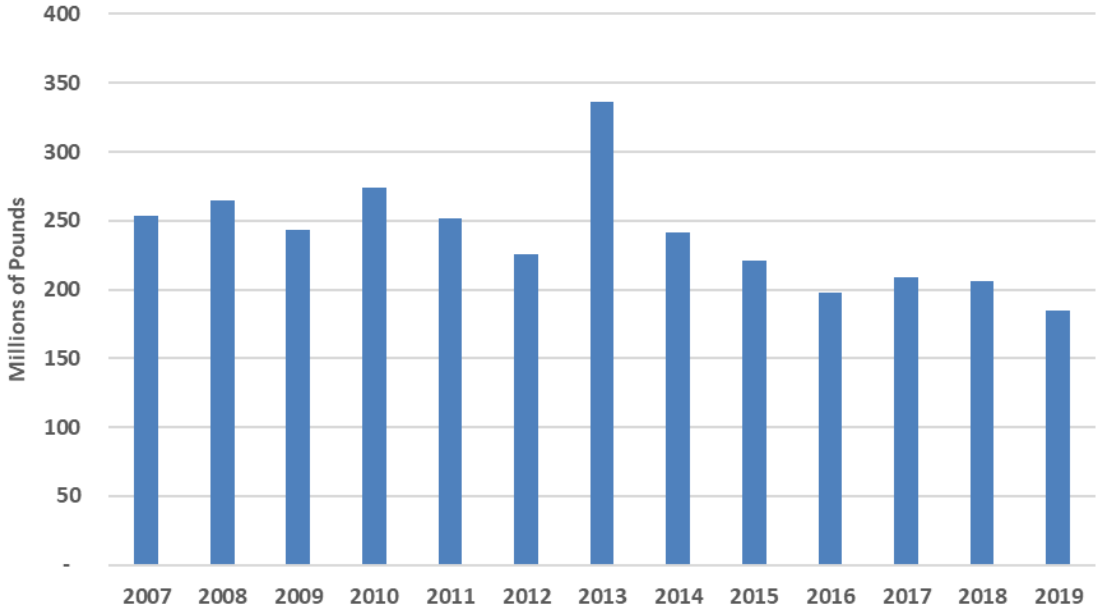
Although releases or disposal of barium and barium compounds occurred in every state, North Dakota, followed by Texas, Illinois, and Michigan reported the highest release and disposal quantities (**Exhibit 3-8).** There was a slight downward trend from 2007 to 2019, reaching approximately 184 million pounds, the lowest reported releases during the period (**Exhibit 3-9**). Land releases account for 79% of releases, followed by off-site releases (20%) (**Exhibit 3-10**).

**Exhibit 3-8. Nationally Reported Disposal or Release of Barium and Barium Compounds (2007–2019; millions of pounds)**



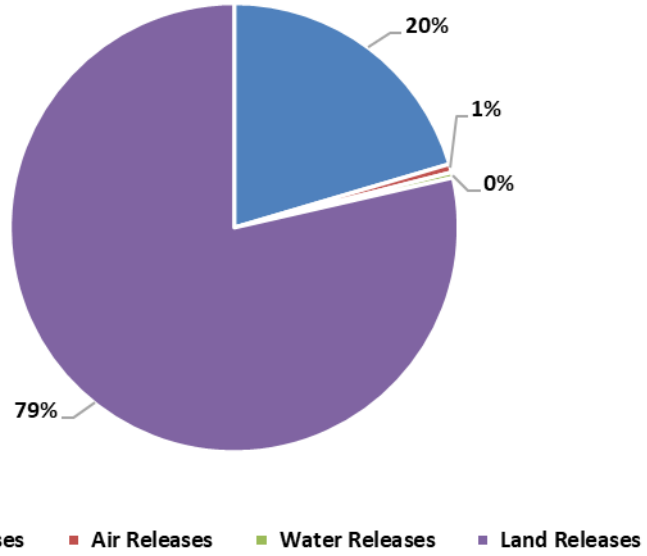

Source: USEPA, 2020c
Note: Releases of 2.9 million pounds in Puerto Rico not shown.

**Exhibit 3-9. Reported Disposal or Release of Barium and Barium Compounds by Year (2007–2019; millions of pounds)**




Source: USEPA, 2020c

**Exhibit 3-10. Reported Disposal or Release of Barium and Barium Compounds by Media (2007–2019; percent)**

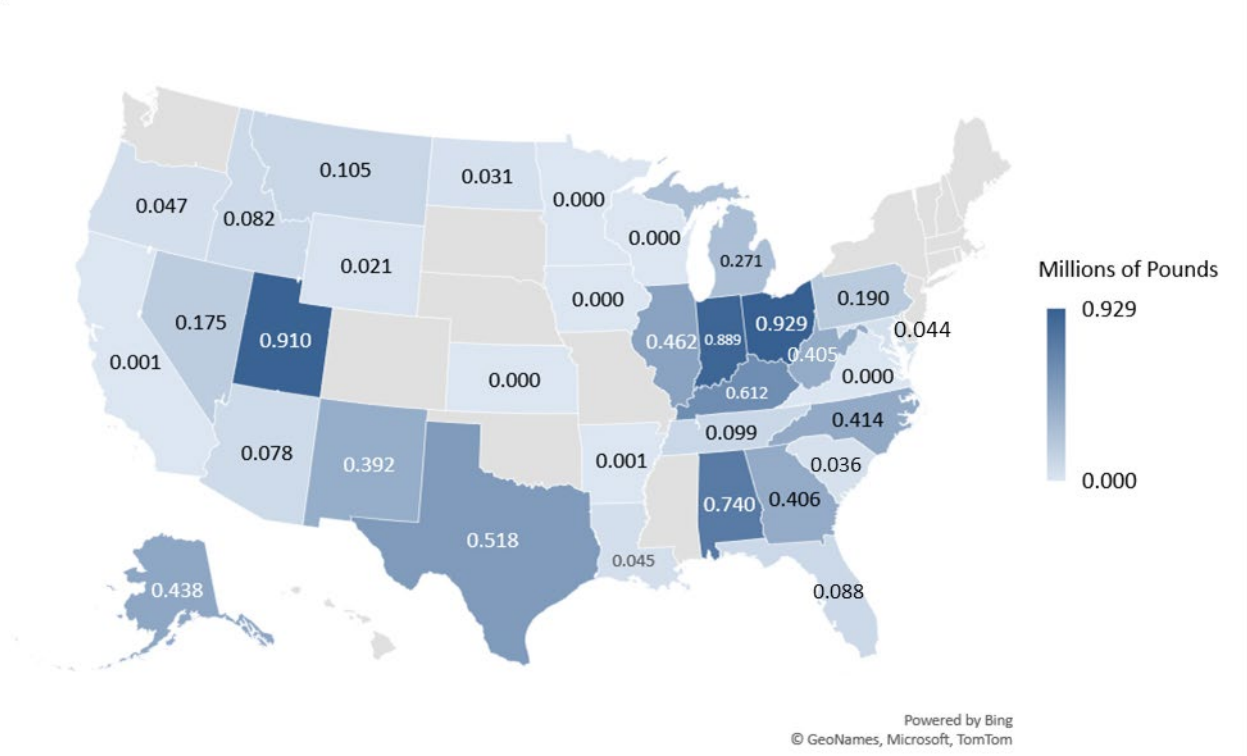



Source: USEPA, 2020c

### 3.1.4 Beryllium and Beryllium Compounds

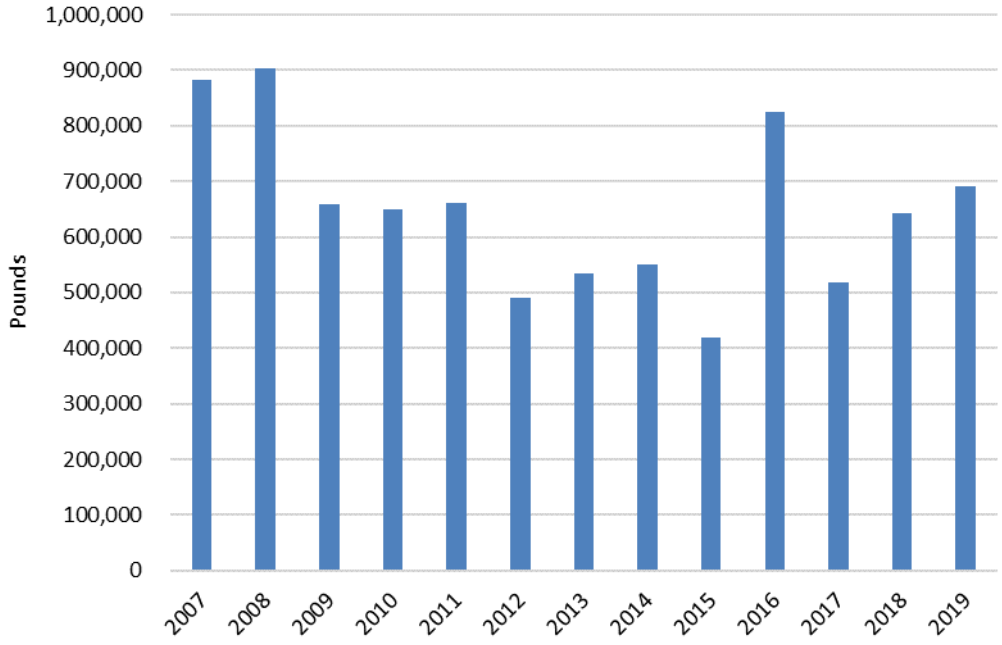
Releases and disposals of beryllium and beryllium compounds occurred in most states. Ohio, Utah, and Indiana reported the highest release and disposal rates across the country **(Exhibit 3-11)**. Beryllium and beryllium compound releases and disposals generally followed a downward trend from 2007 to 2015 but have recently trended upward since 2015 (**Exhibit 3-12**). On-site land releases/disposal account for 85% of reported releases (**Exhibit 3-13**).

**Exhibit 3-11. Nationally Reported Disposal or Release of Beryllium and Beryllium Compounds (2007–2019; millions of pounds)**



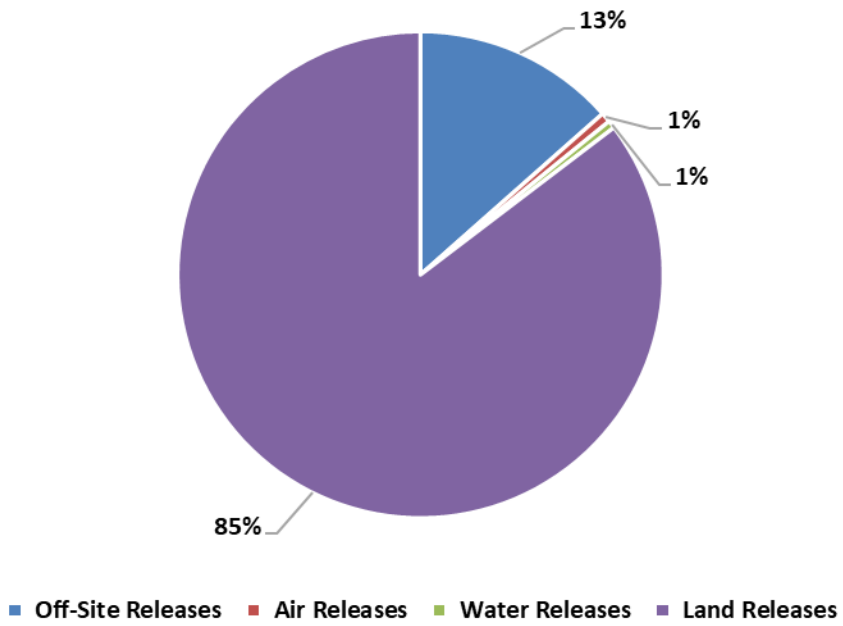

Source: USEPA, 2020c

**Exhibit 3-12. Reported Disposal or Release of Beryllium and Beryllium Compounds by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-13. Reported Disposal or Release of Beryllium and Beryllium Compounds by Media (2007–2019; percent)**

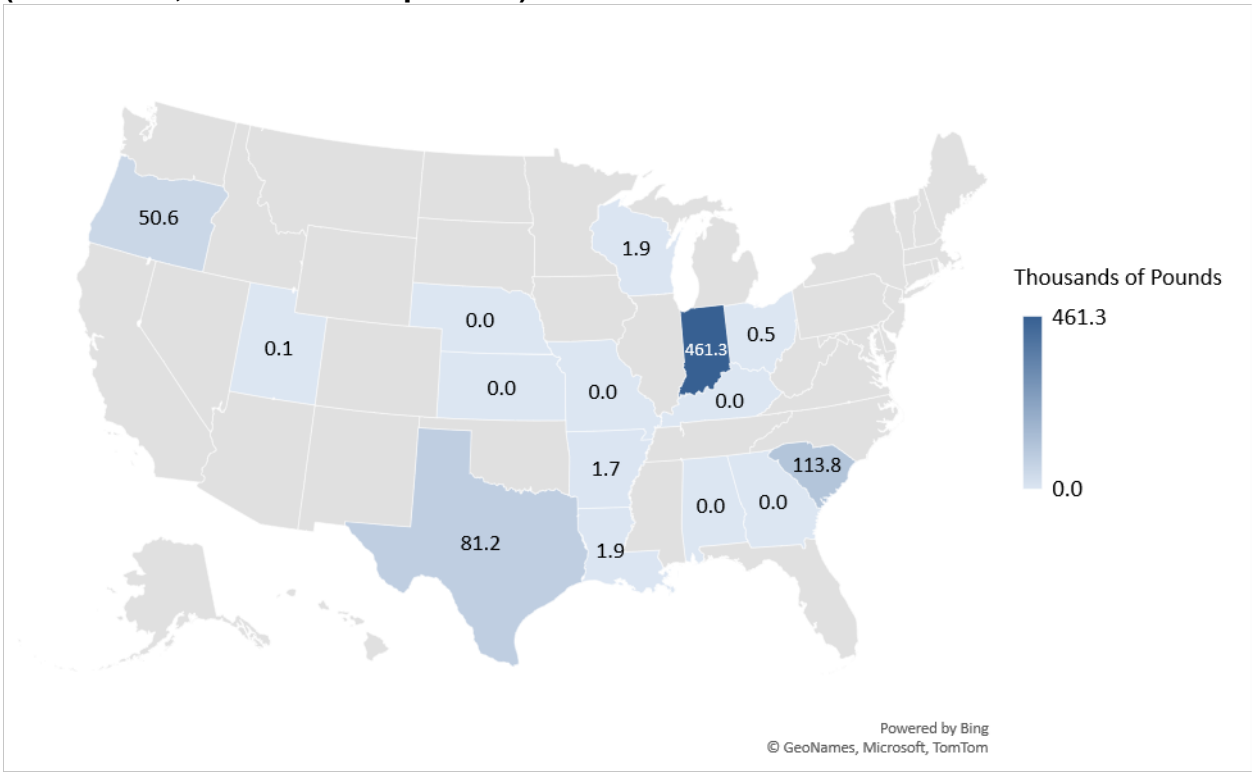



Source: USEPA, 2020c

### 3.1.5 1,2-Dichlorobenzene

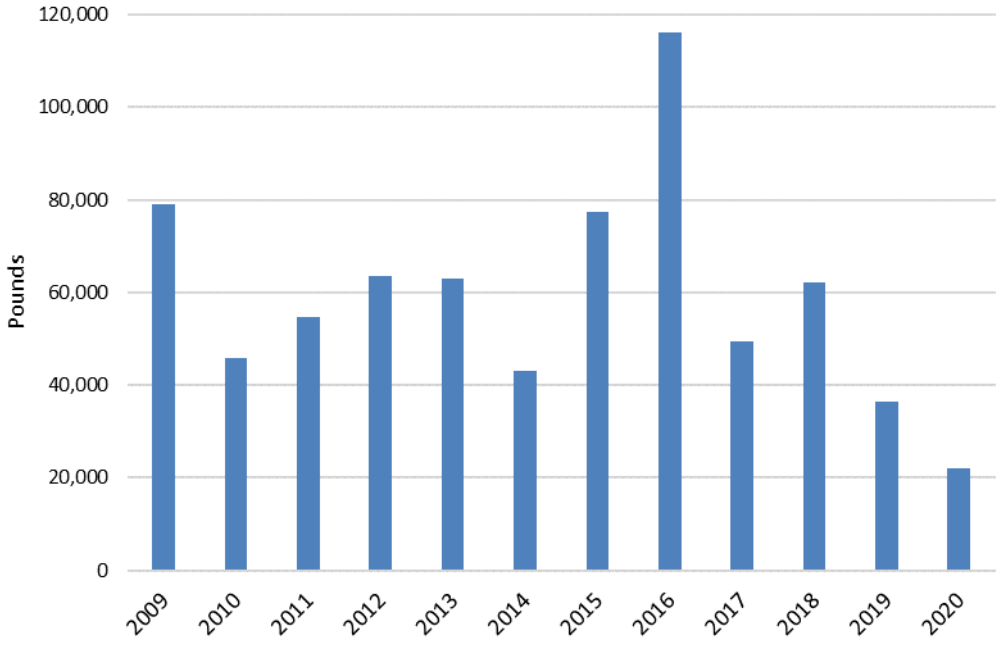
**Exhibit 3-14** shows that the greatest release and disposal of 1,2-dichlorobenzene occurred in Indiana followed by South Carolina. From 2009 to 2018, total reported releases and disposal fluctuated, peaking in 2016 at nearly 120,000 pounds primarily because of a large air release in Georgia (**Exhibit 3-15**). Since 2018, reported releases and disposals of 1,2-dichlorobenzene have declined steadily to approximately 22,000 pounds in 2020. Air releases accounted for 81% of the releases (**Exhibit 3-16**).

**Exhibit 3-14. Nationally Reported Disposal or Release of 1,2-Dichlorobenzene (2009–2020; thousands of pounds)**



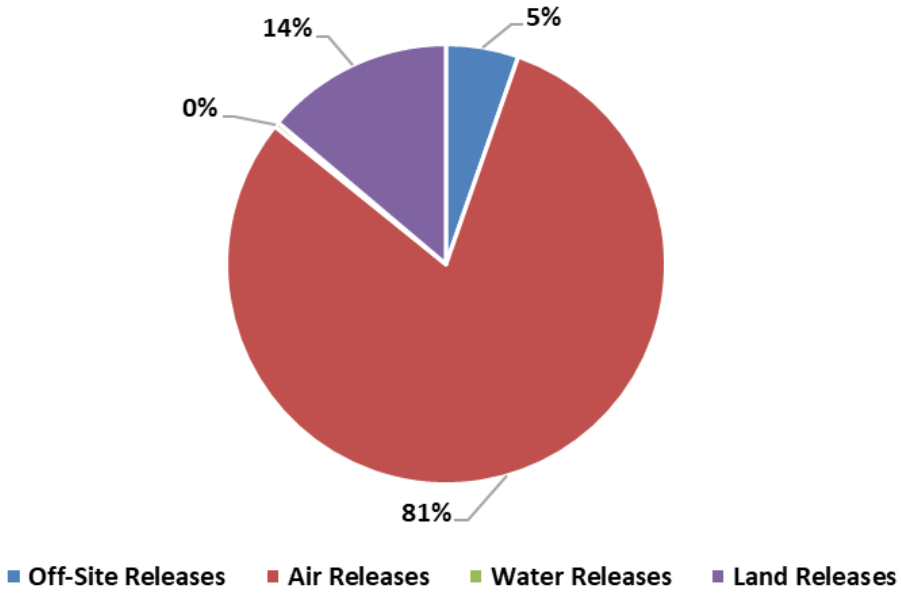

Source: USEPA, 2020c

**Exhibit 3-15. Reported Disposal or Release of 1,2-Dichlorobenzene by Year (2009–2020; pounds)**




Source: USEPA, 2020c

**Exhibit 3-16. Reported Disposal or Release of 1,2-Dichlorobenzene by Media (2009–2020; percent)**

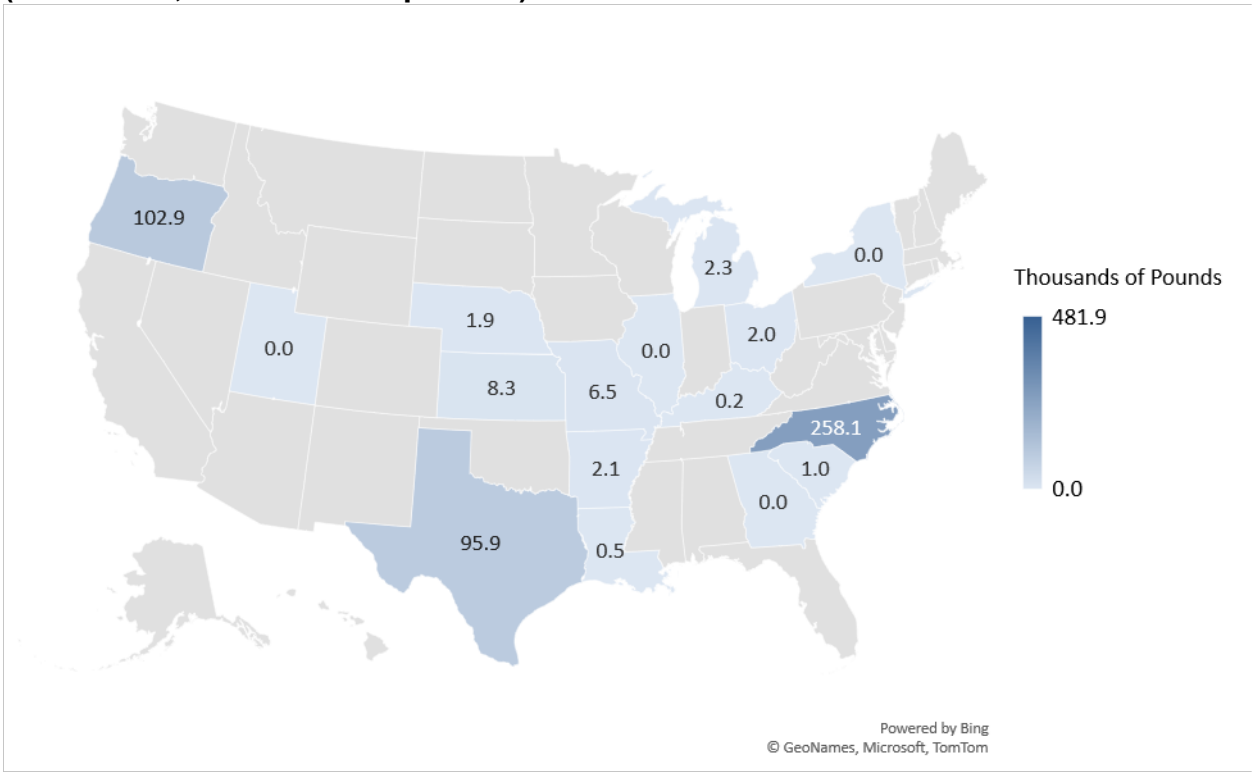



Source: USEPA, 2020c

### 3.1.6 1,4-Dichlorobenzene

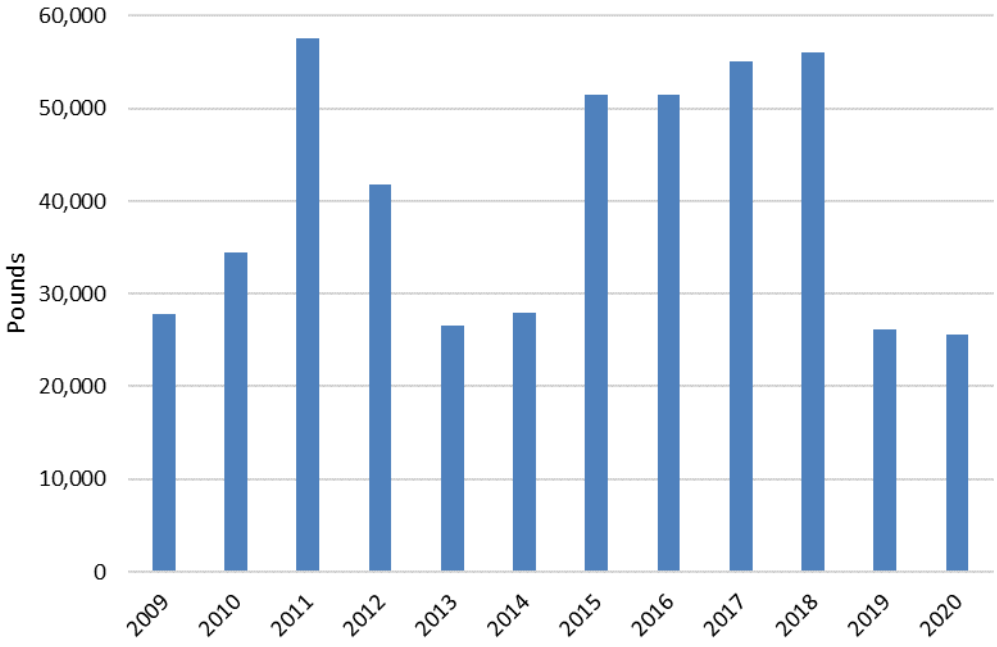
**Exhibit 3-17** shows that North Carolina reported the greatest release and disposal of 258,000 pounds (54%) followed by Oregon, (21%) and Texas (20%). 1,4-dichlorobenzene releases and disposals fluctuated from 2009 to 2020 (**Exhibit 3-18**), peaking in 2011 at approximately 60,000 pounds primarily because of a large air release in North Carolina. Reported releases and disposals of 1,4-dichlorobenzene have declined to approximately 25,000 pounds since 2018 **(Exhibit 3-19**).

**Exhibit 3-17. Nationally Reported Disposal or Release of 1,4-Dichlorobenzene (2009–2020; thousands of pounds)**



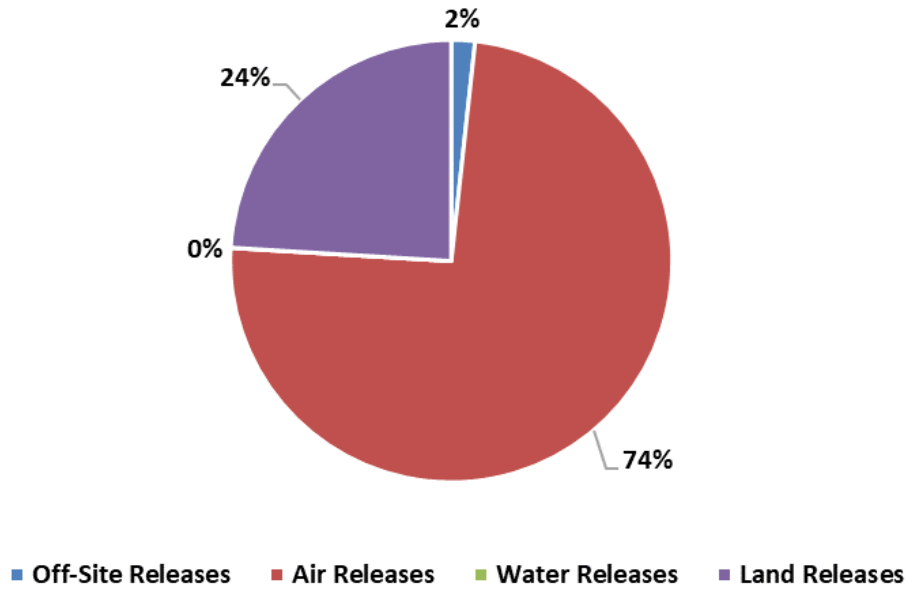

Source: USEPA, 2020c

**Exhibit 3-18. Reported Disposal or Release of 1,4-Dichlorobenzene by Year (2009–2020; pounds)**




Source: USEPA, 2020c

**Exhibit 3-19. Reported Disposal or Release of 1,4-Dichlorobenzene by Media (2009–2020; percent)**

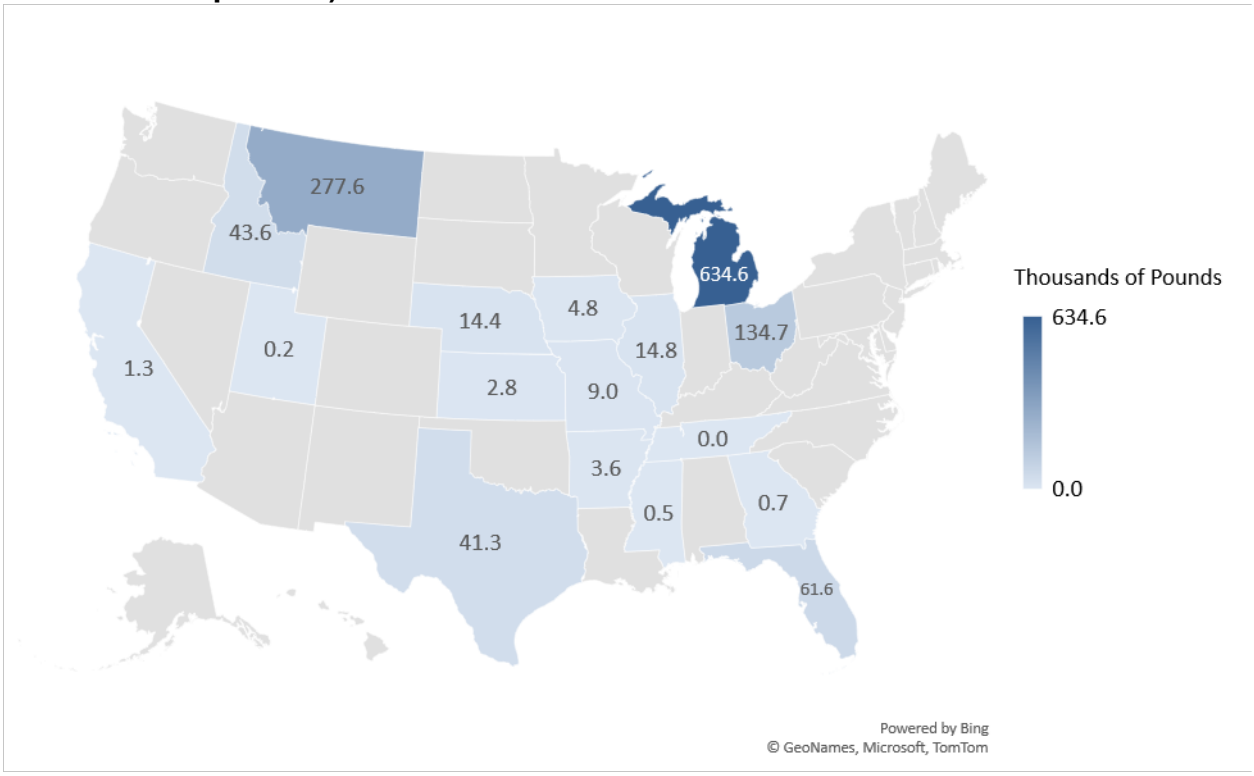



Source: USEPA, 2020c

### 3.1.7 2,4-D

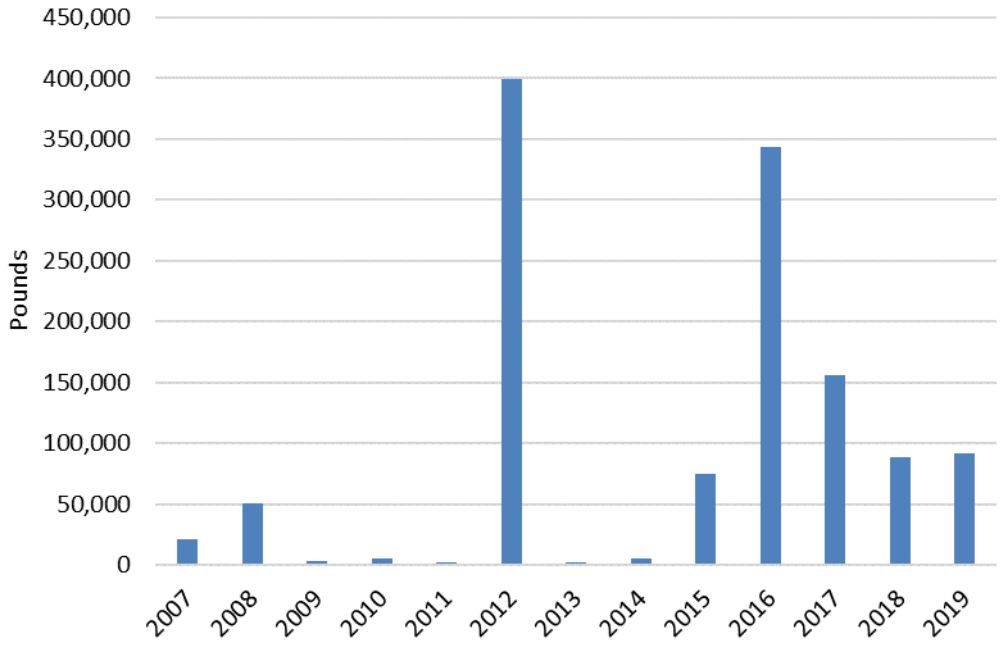
**Exhibit 3-20** shows that the greatest release and disposal of 2,4-D occurred in Michigan followed by Montana and Ohio. From 2007 to 2019, total reported releases and disposal fluctuated, peaking in 2012 at almost 400,000 pounds primarily because of a large off-site release in Montana (**Exhibit 3-21**). In 2016, a large land release or disposal quantities in Michigan account for the second peak. Because of additional large land releases or disposal in Michigan from 2015 through 2019, the majority of 2,4-D was released to land (72%) or disposed off-site (27%) (**Exhibit 3-22**).

**Exhibit 3-20. Nationally Reported Disposal or Release of 2,4-D (2007–2019; thousands of pounds)**



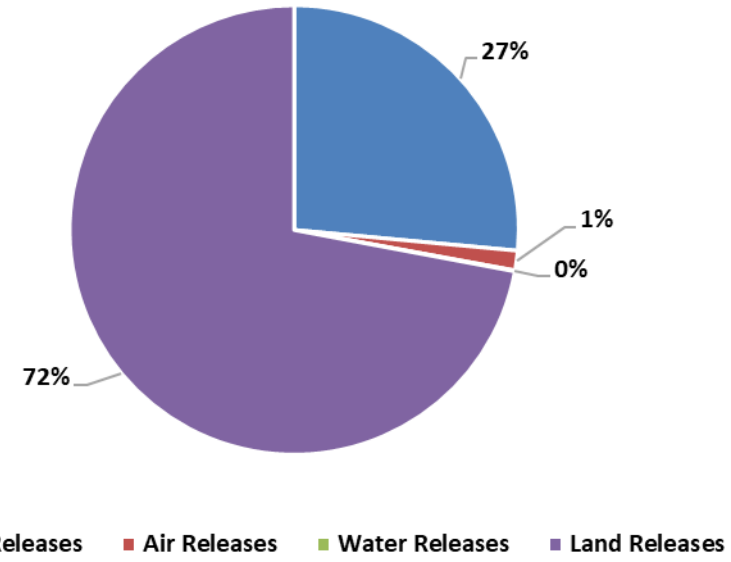

Source: USEPA, 2020c

**Exhibit 3-21. Reported Disposal or Release of 2,4-D by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-22. Reported Disposal or Release of 2,4-D by Media (2007–2019; percent)**

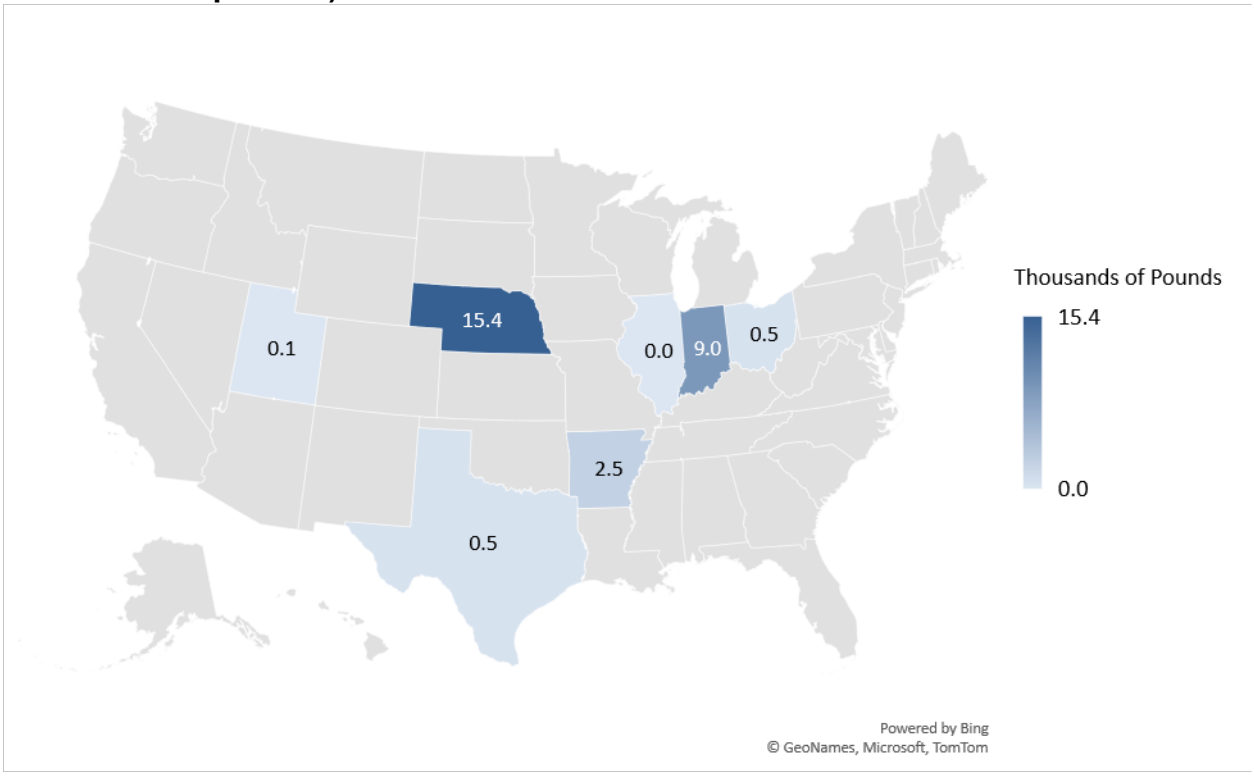



Source: USEPA, 2020c

### 3.1.8 Lindane

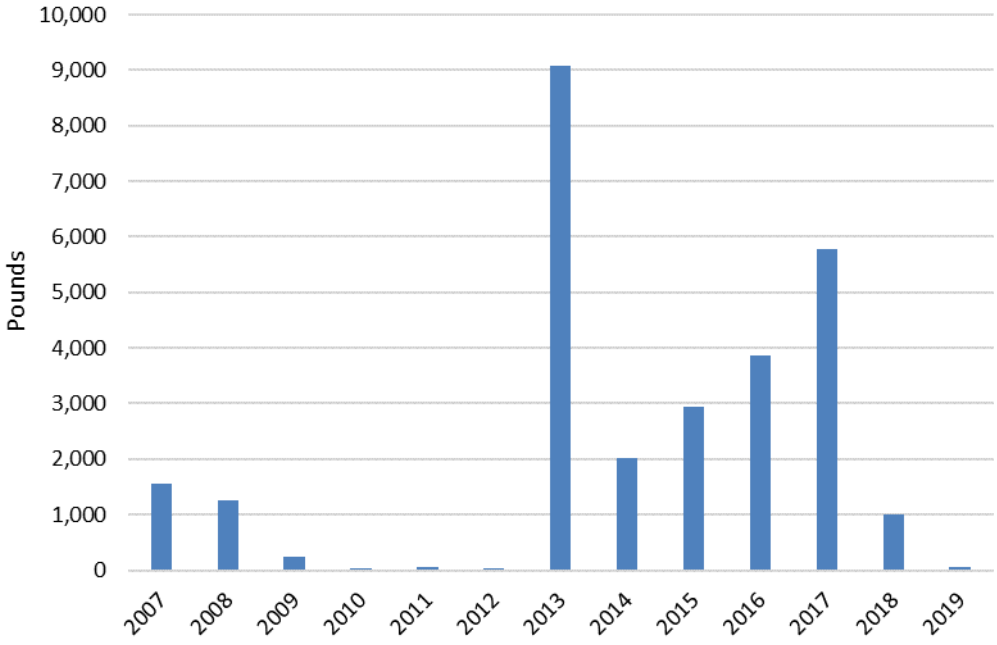
Seven states reported releases and disposal of lindane; Nebraska had the highest total release and disposal quantity for the 2007-2019 reporting period (**Exhibit 3-23)**. Annual release and disposal quantities of lindane were less than 2,000 pounds from 2007 through 2012, then the quantity peaked at more 9,000 pounds in 2013 because of a large off-site release or disposal in Indiana (**Exhibit 3-24)**. This release and large off-site releases or disposals in Nebraska from 2014 to 2017 led to the majority of lindane being disposed off-site (97%) (**Exhibit 3-25**).

**Exhibit 3-23. Nationally Reported Disposal or Release of Lindane (2007–2019; thousands of pounds)**



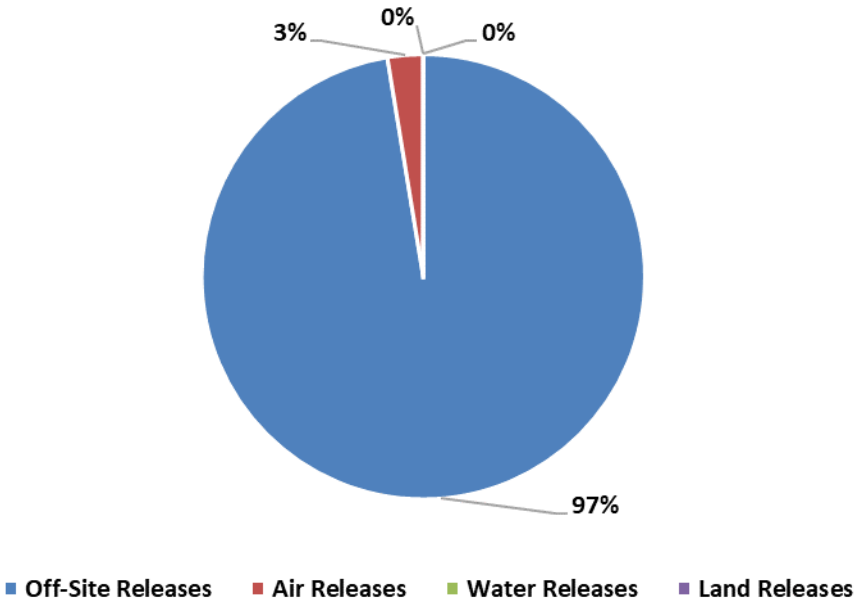

Source: USEPA, 2020c

**Exhibit 3-24. Reported Disposal or Release of Lindane by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-25. Reported Disposal or Release of Lindane by Media (2007–2019; percent)**

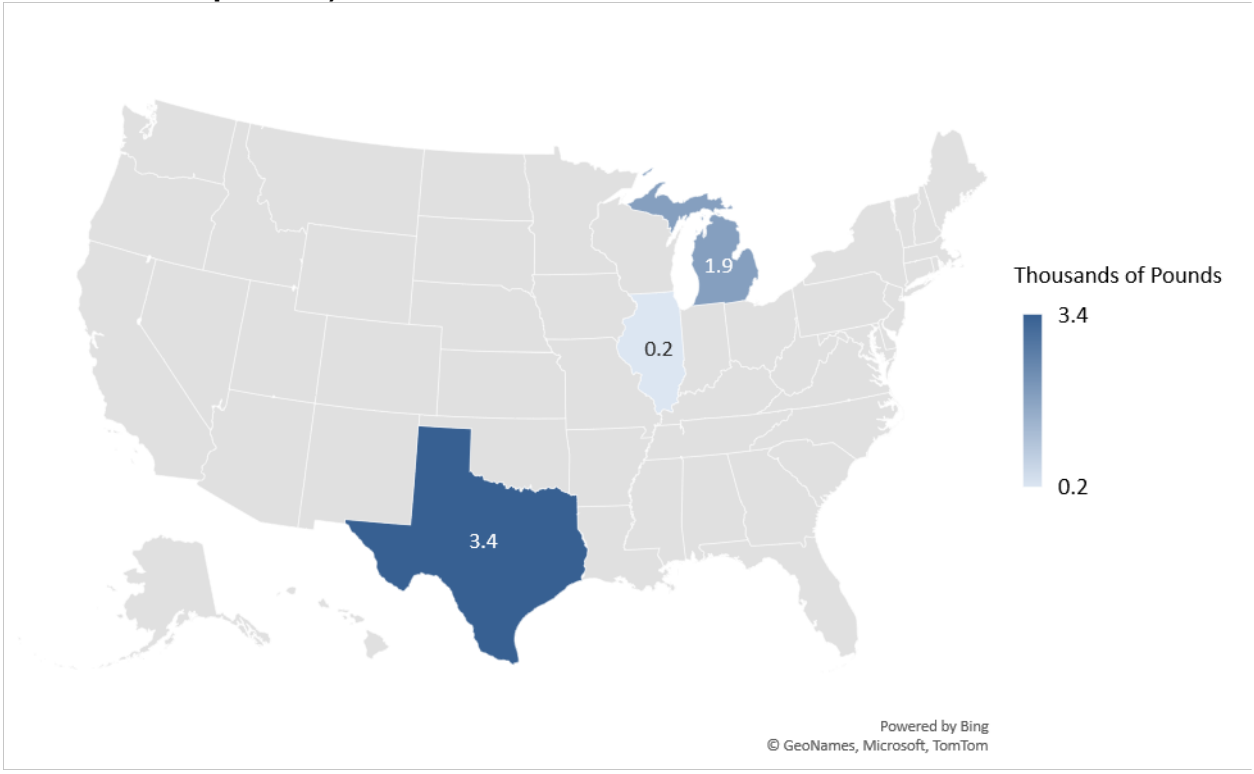



Source: USEPA, 2020c

### 3.1.9 Picloram

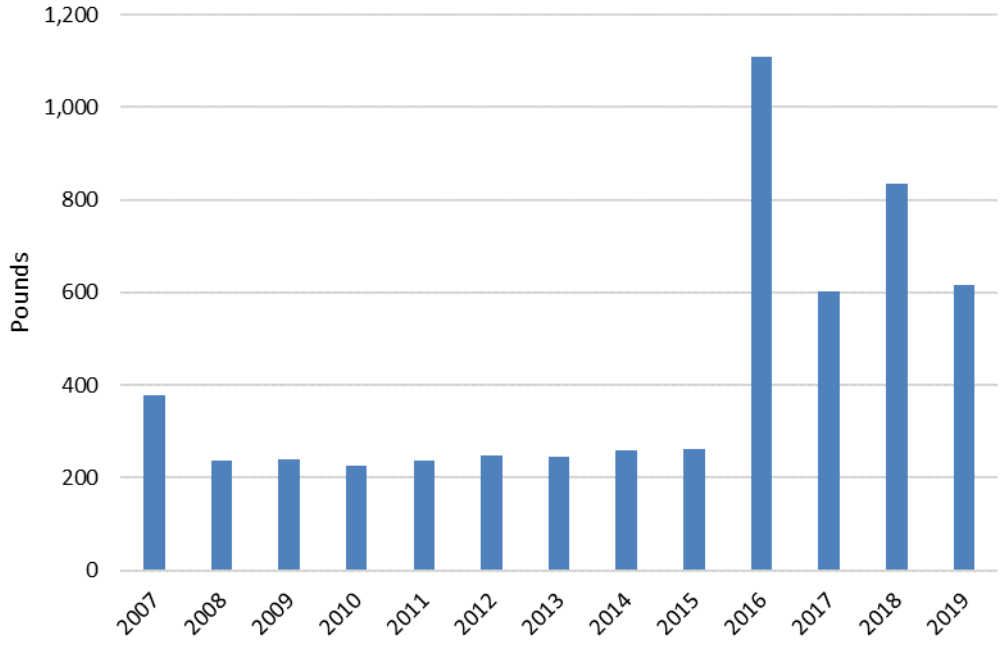
Only three states—Texas, Michigan, and Illinois—had reported releases and disposal of picloram (**Exhibit 3-26**). From 2008 to 2015, releases remained relatively constant; from 2016 to 2019, releases increased by more than a factor of two (**Exhibit 3-27)**. Air releases account for approximately 69% of the total releases reported followed by water (15%) and off-site disposal (15%) (**Exhibit 3-28**).

**Exhibit 3-26. Nationally Reported Disposal or Release of Picloram (2007–2019; thousands of pounds)**



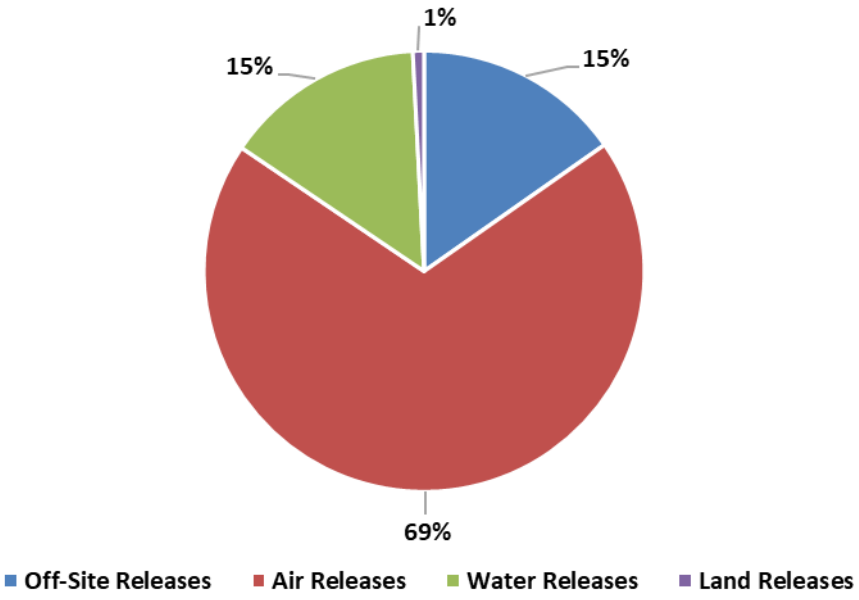

Source: USEPA, 2020c

**Exhibit 3-27. Reported Disposal or Release of Picloram by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-28. Reported Disposal or Release of Picloram by Media (2007–2019; percent)**

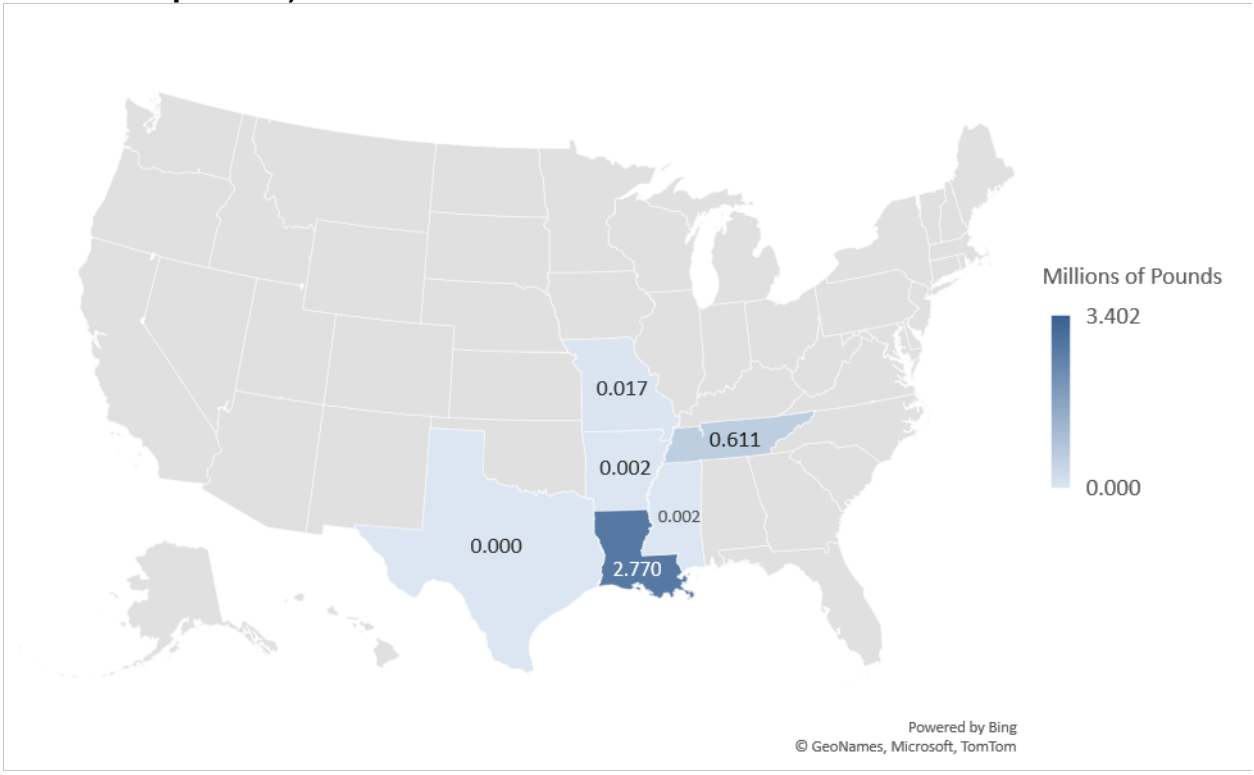



Source: USEPA, 2020

### 3.1.10 Simazine

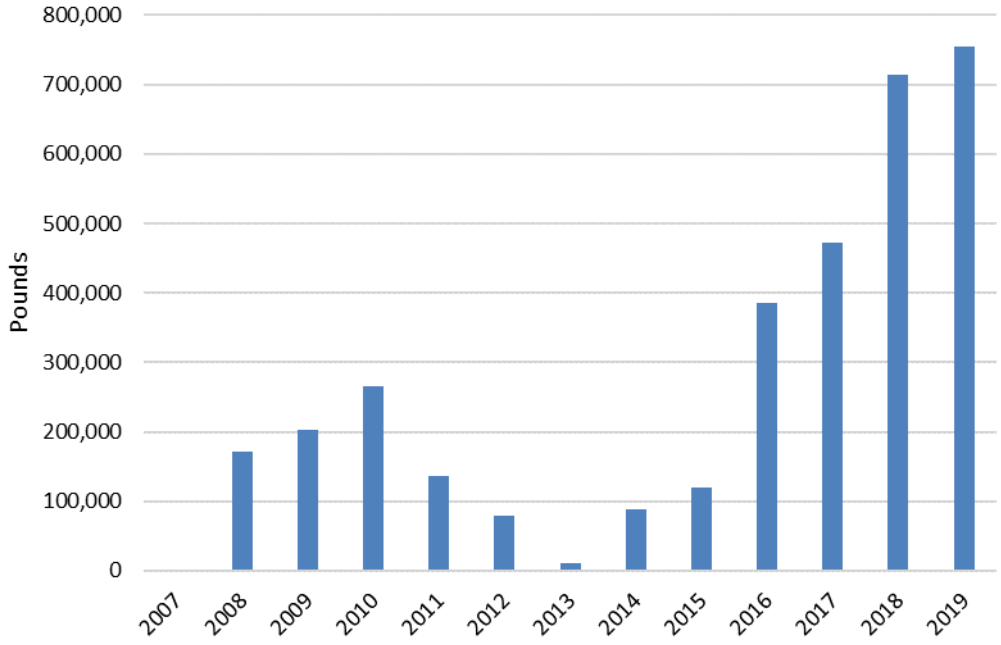
Simazine releases occurred in six states from 2007 to 2019 (**Exhibit 3-29**). Louisiana accounted for most of the releases, followed by Tennessee, which measured nearly an order of magnitude less (**Exhibit 3-30)**. Releases on land accounted for about 60% and off-site disposals accounted for about 39% of the releases (**Exhibit 3-31**).

**Exhibit 3-29. Nationally Reported Disposal or Releases of Simazine (2007–2019; millions of pounds)**



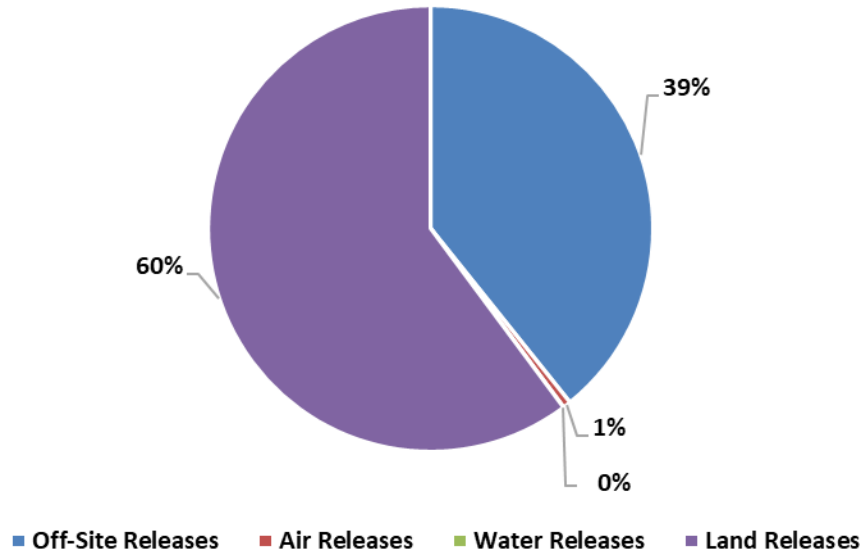

Source: USEPA, 2020c

**Exhibit 3-30. Reported Disposal or Release of Simazine by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-31. Reported Disposal or Release of Simazine by Media (2007–2019; percent)**

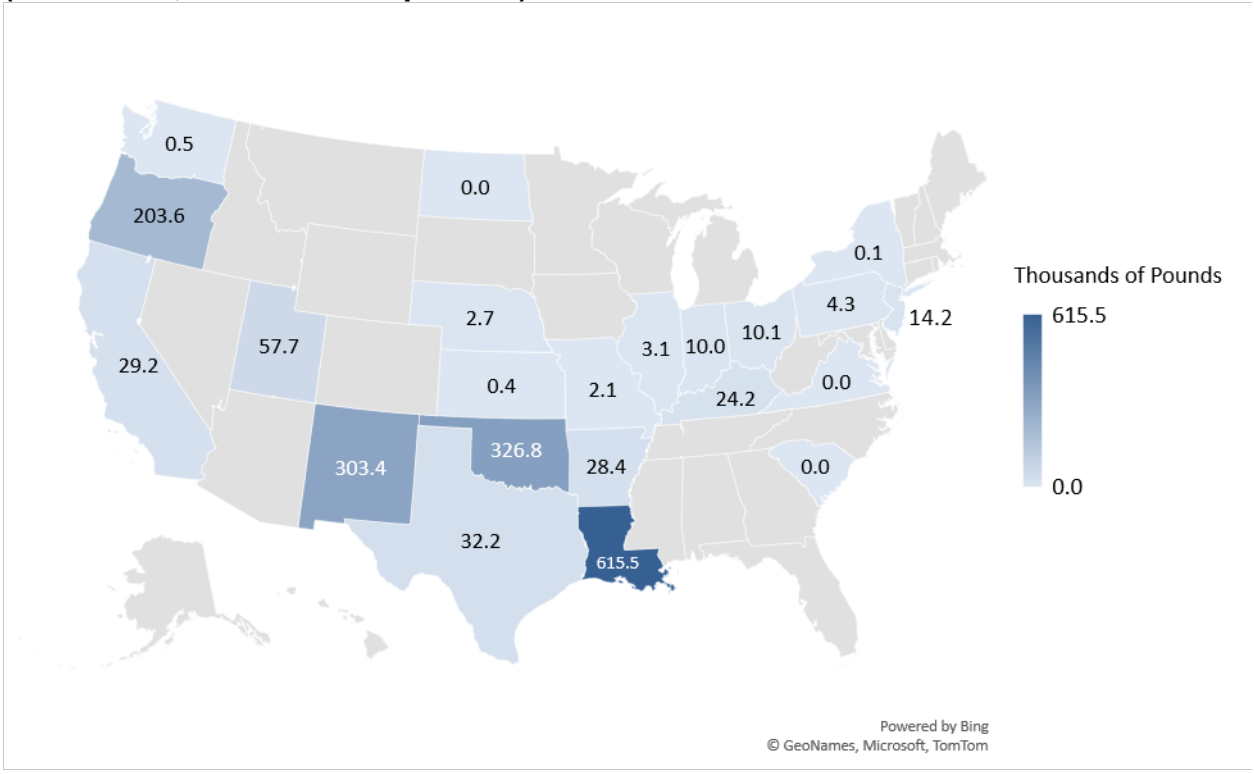



Source: USEPA, 2020c

### 3.1.11 1,1,1-Trichloroethane

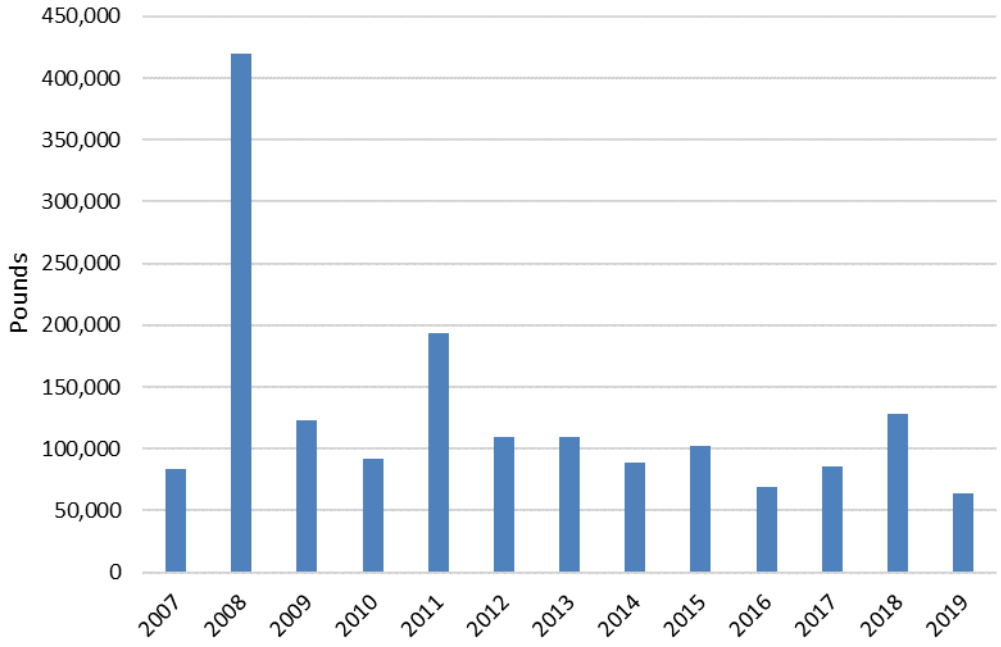
**Exhibit 3-32** shows that Louisiana reported the greatest release and disposal of approximately 616,000 pounds (37%) followed by New Mexico (20%), and Oklahoma (18%). Reported releases and disposal of 1,1,1-trichloroethane were approximately 60,000 pounds in 2019 (**Exhibit 3-33**). In Louisiana, all releases and disposal came from the chemical sector (NAICS 325), and most was released into the air (**Exhibit 3-34**; USEPA, 2020c).

**Exhibit 3-32. Reported Disposal or Releases of 1,1,1-Trichloroethane by State (2007–2019; thousands of pounds)**



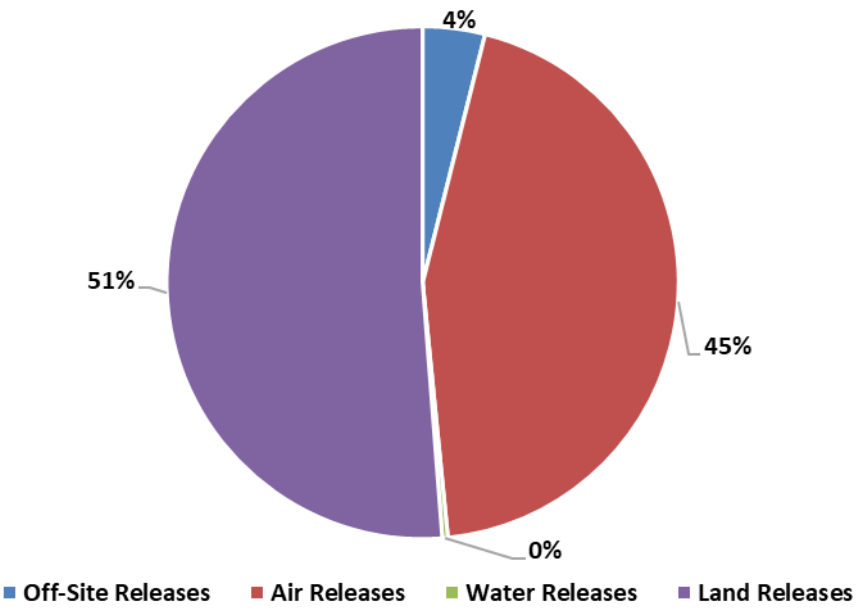

Source: USEPA, 2020c

**Exhibit 3-33. Reported Disposal or Releases of 1,1,1-Trichloroethane by Year (2007–2019; pounds)**




Source: USEPA, 2020c

**Exhibit 3-34. Reported Disposal or Release of 1,1,1-Trichloroethane by Media (2007–2019; percent)**




Source: USEPA, 2020c

## 3.2 Pesticide Usage Estimates

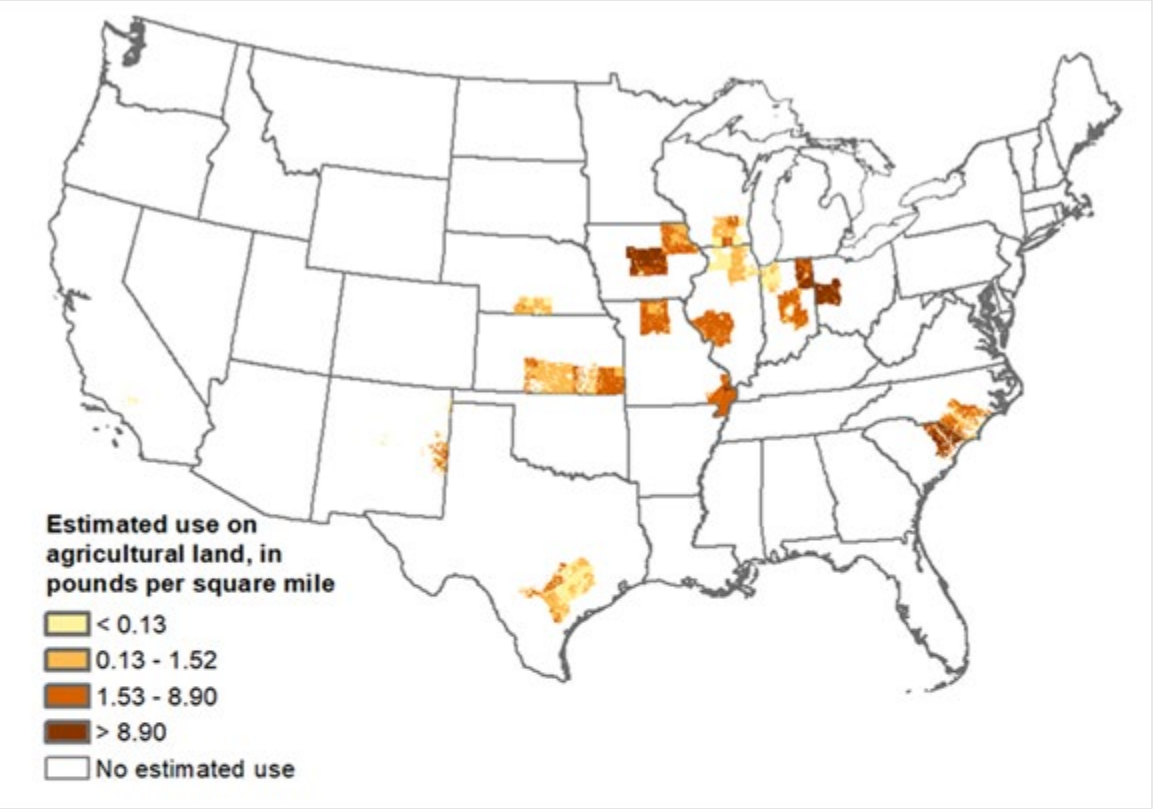
A second source of environmental release information is the USGS estimates of pesticide use. The USGS estimates annual pesticide use at the county level based on crop-specific usage rates (pounds per acre) obtained via survey and county-level crop production data obtained from USDA (Baker and Stone, 2015). The usage rates reflect practices at a sample of farms in each of 15 USDA Crop Reporting Districts. Whenever the sample usage rate was zero, USDA used two extrapolation approaches to generate upper and lower bounds the uncertainty estimates. The "low" estimate reflects a usage rate of zero and the "high" estimate reflects usage rates in adjacent Crop Reporting Districts.

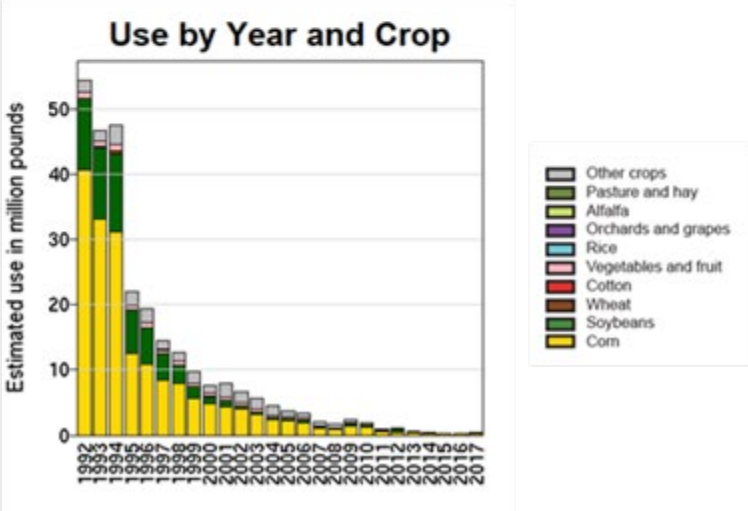
Estimates compiled for 2017 include several of the contaminants in this report: alachlor, atrazine, 2,4-D, diquat, glyphosate, lindane, picloram and simazine. The following figures come from the USGS online data analysis tool, which generates application rate maps and annual national usage charts by pesticide for both the low and high estimate scenarios.

### 3.2.1 Alachlor

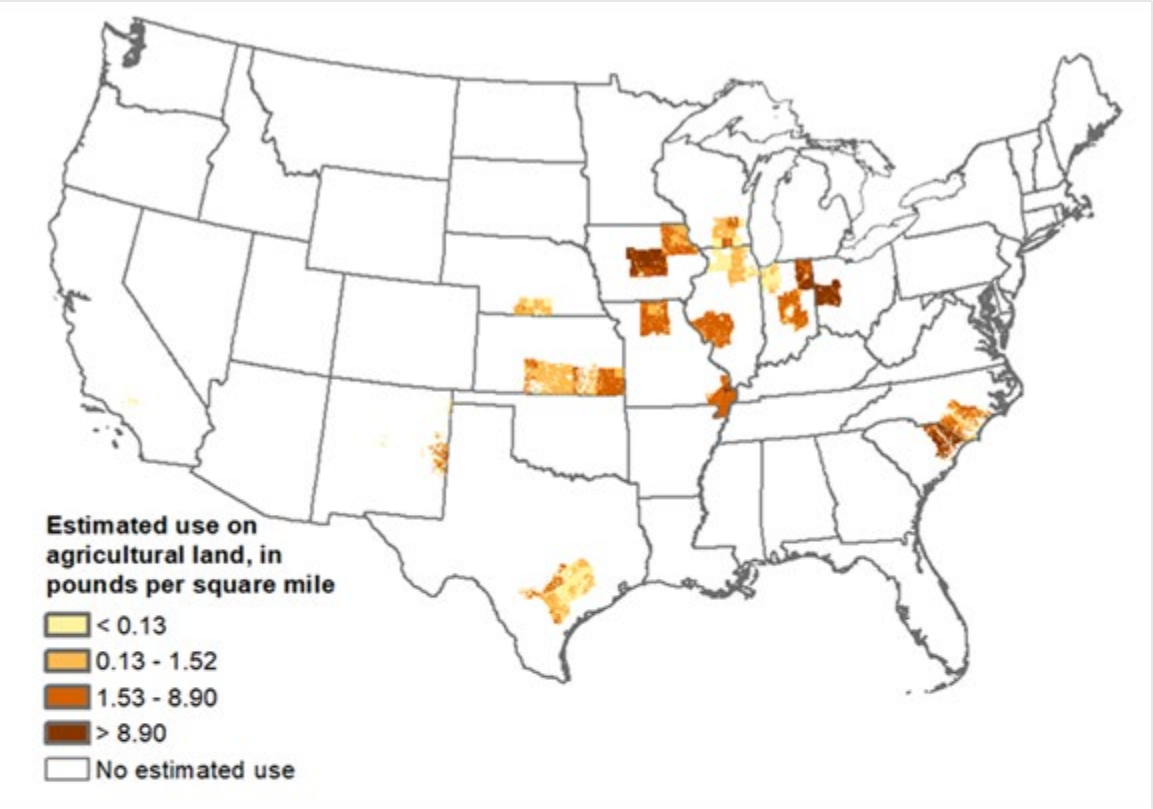
**Exhibit 3-35** and **Exhibit 3-36** show that the alachlor application rates are highest in the Midwest, with primary application to corn and soybean crops. Annual usage rates have declined substantially from more than 50 million pounds in 1992 to less than 5 million pounds in 2017.

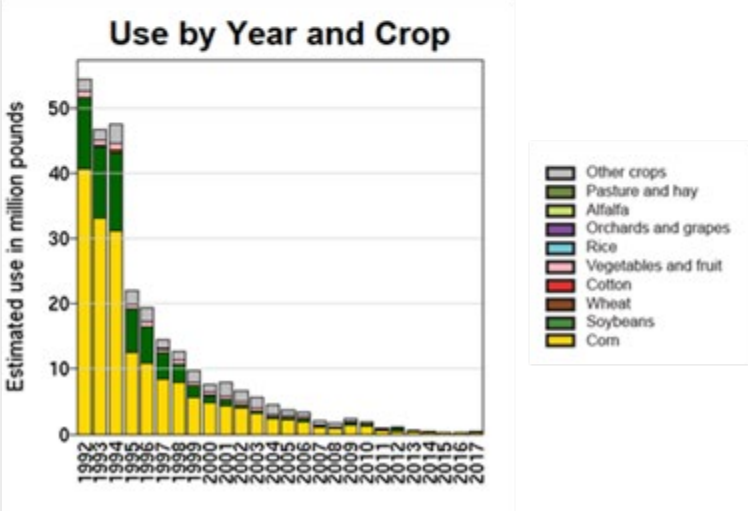
**Exhibit 3-35. Lower Bound Estimated Agricultural Use of Alachlor, 2017**



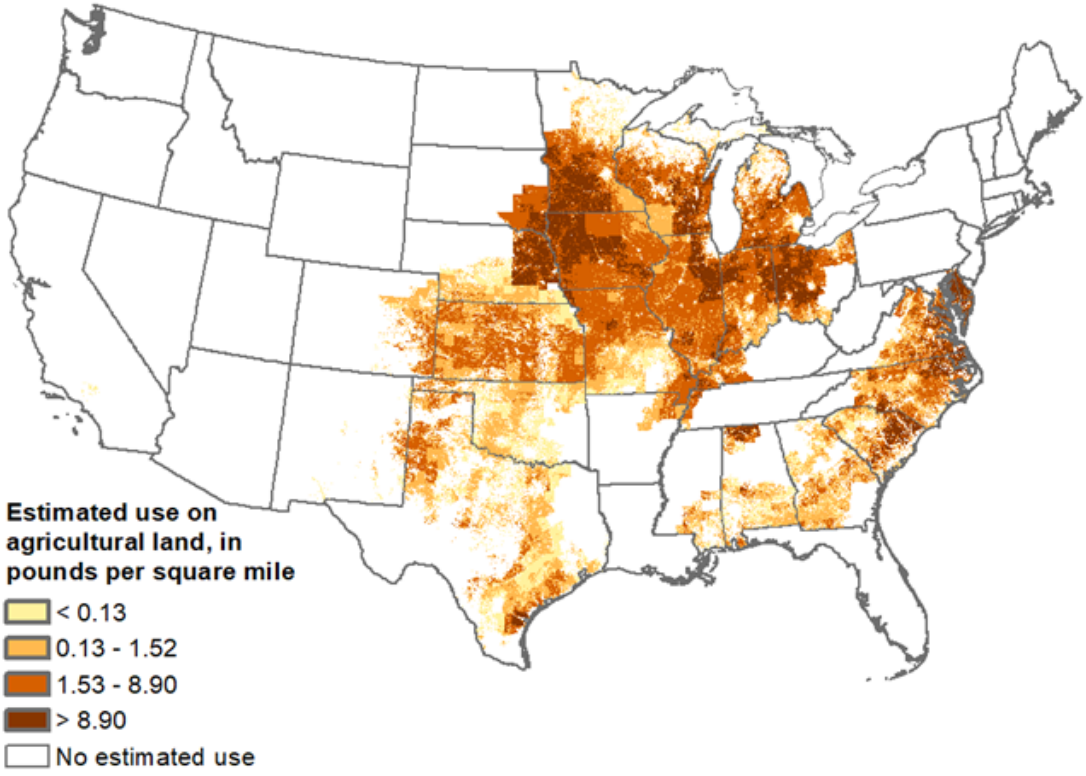



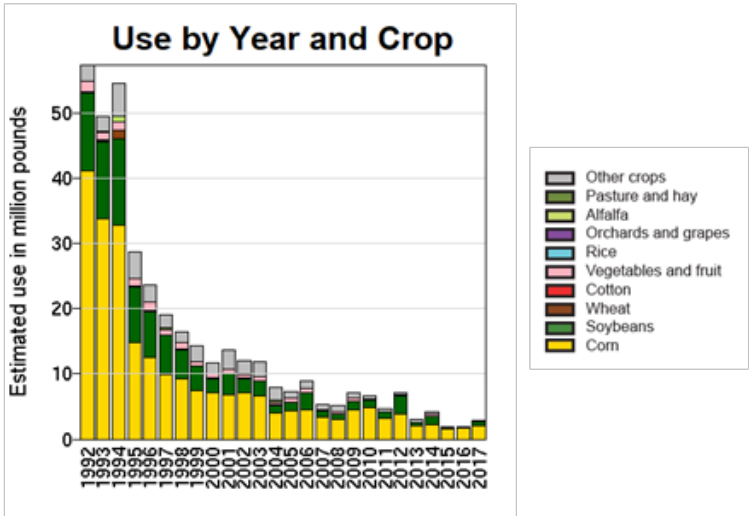

Source: USGS, 2020a


Estimated use on agricultural land, in pounds per square mile
< 0.13
0.13 - 1.52
1.53 - 8.90
> 8.90
No estimated use


Use by Year and Crop
Estimated use in million pounds
0
10
20
30
40
50
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Other crops
Pasture and hay
Alfalfa
Orchards and grapes
Rice
Vegetables and fruit
Cotton
Wheat
Soybeans
Corn

## Exhibit 3-36. Upper Bound Estimated Agricultural Use of Alachlor, 2017



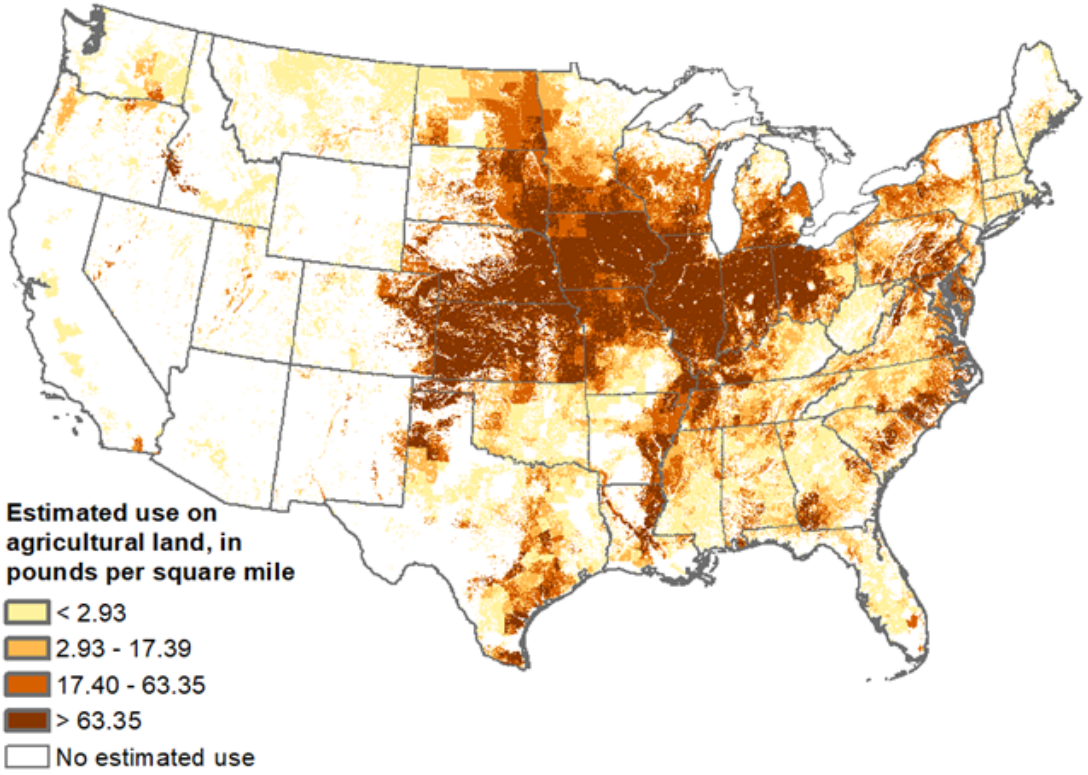



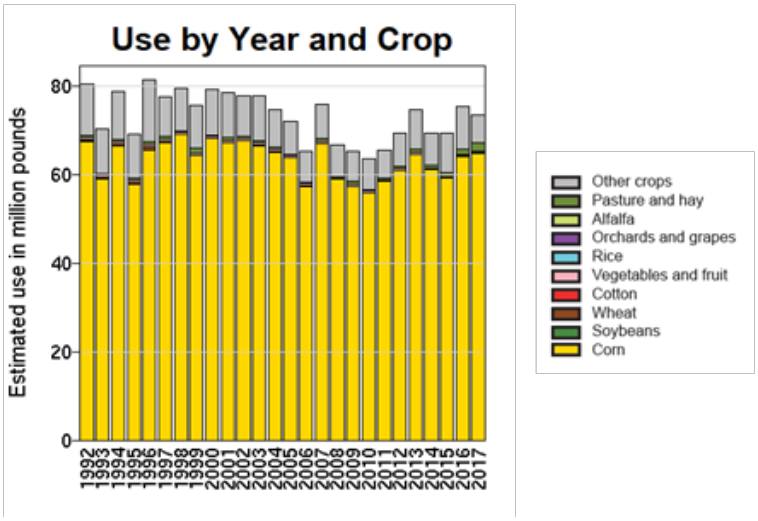

Source: USGS, 2020a

### 3.2.2 Atrazine

**Exhibit 3-37** and **Exhibit 3-38** show that the atrazine application rates are highest in the Midwest, with primary application to corn and other crops. Annual usage rates have averaged approximately 70 million pounds from 1992 through 2017.

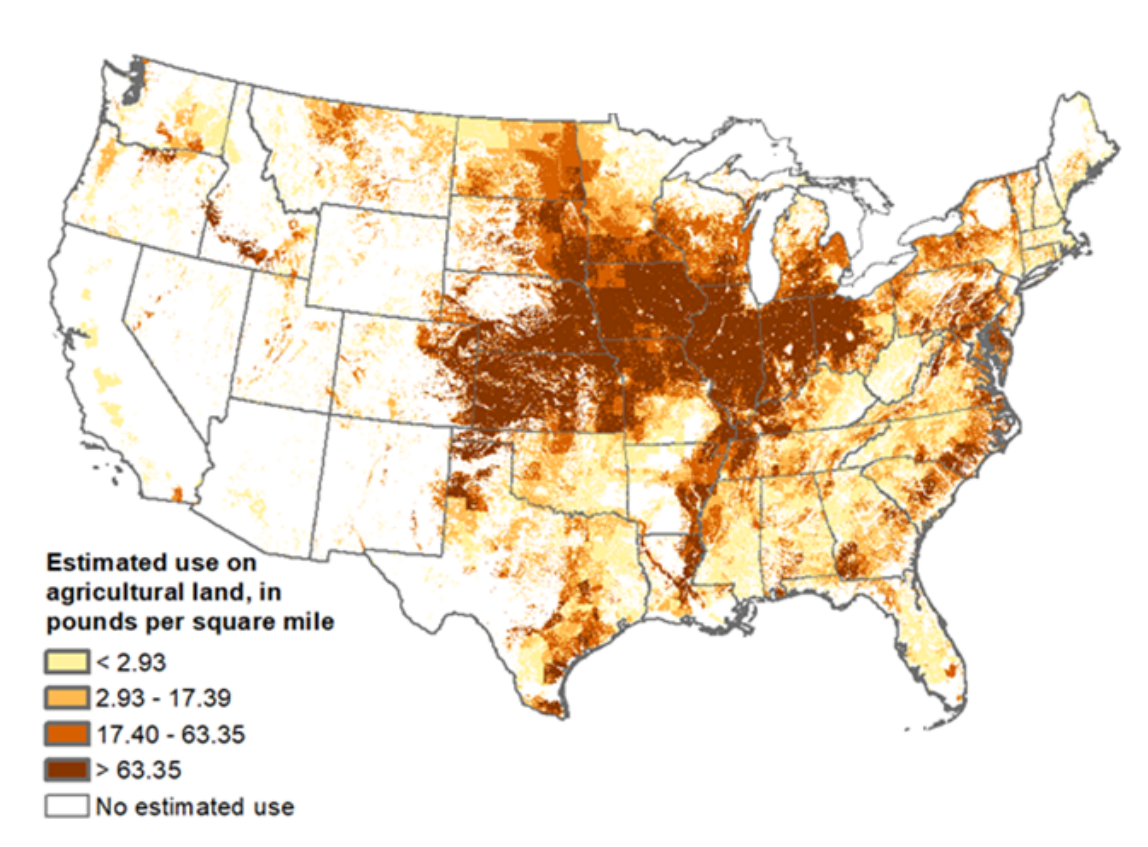
**Exhibit 3-37. Lower Bound Estimated Agricultural Use of Atrazine, 2017**

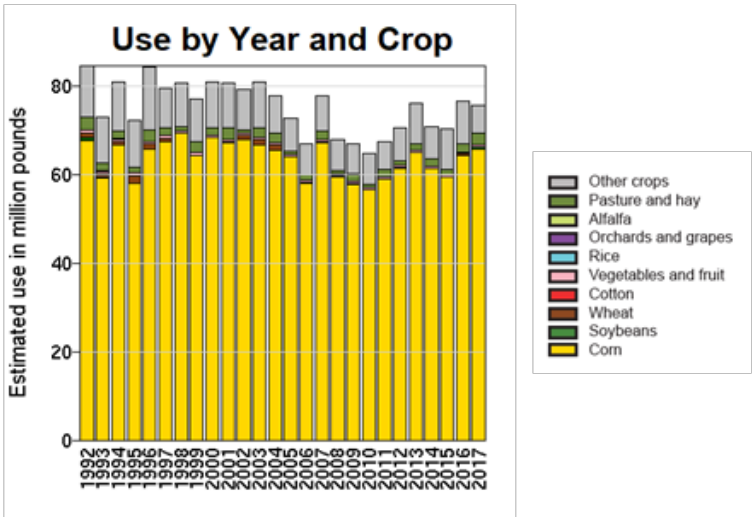



Source: USGS, 2020a

## Exhibit 3-38. Upper Bound Estimated Agricultural Use of Atrazine, 2017



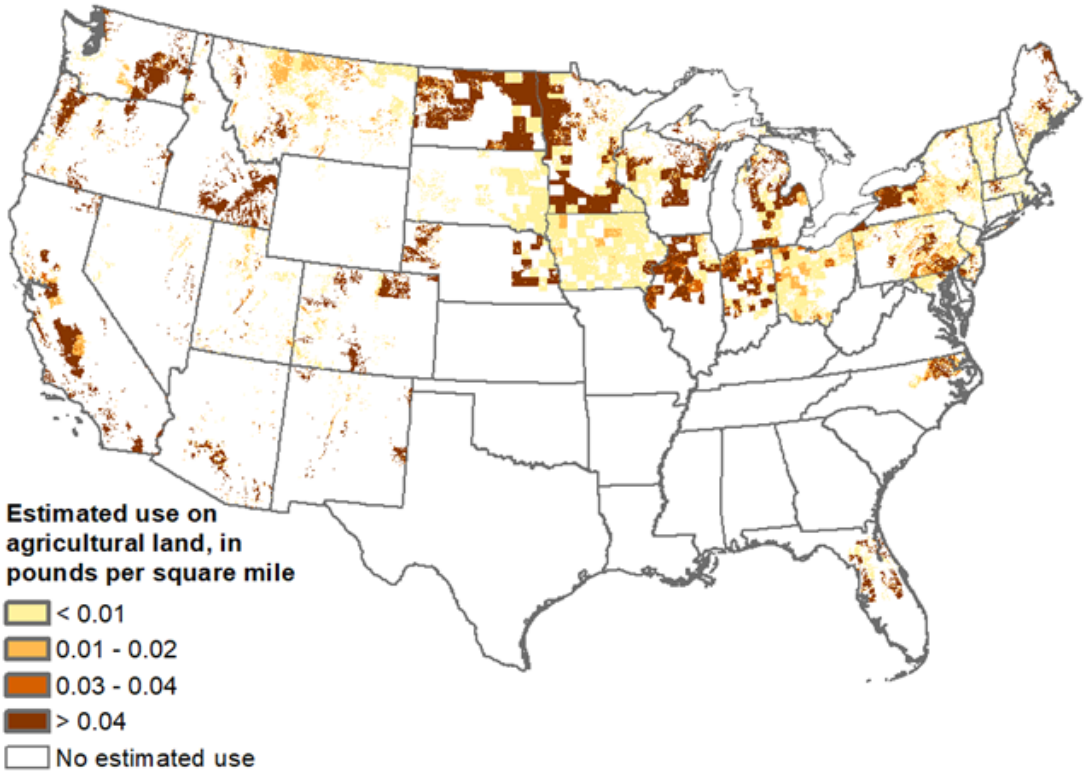



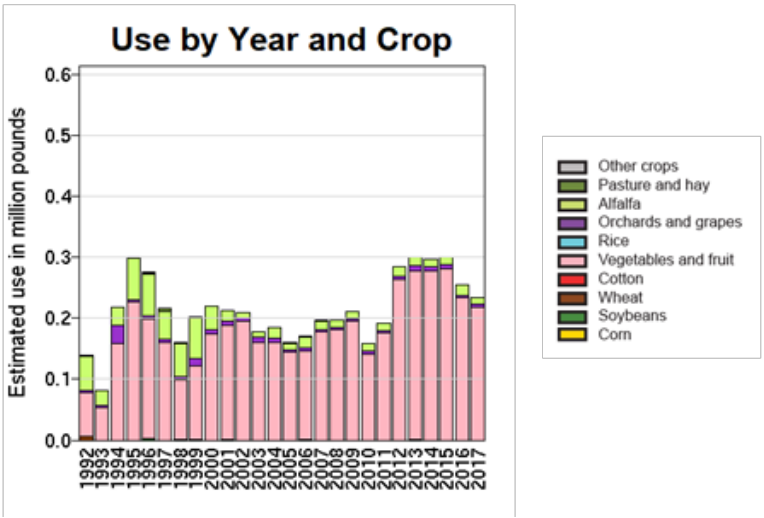

Source: USGS, 2020a

### 3.2.3 Diquat

**Exhibit 3-39** and **Exhibit 3-40** show diquat application rates primarily in the Northern latitudes, especially in the Great Lakes states. The pesticide is primarily applied to vegetables and fruit. Uncertainty regarding diquat application rates for alfalfa predominate differences between the low and high use estimates. Annual usage rates are around 0.2 million pounds for the last decade.

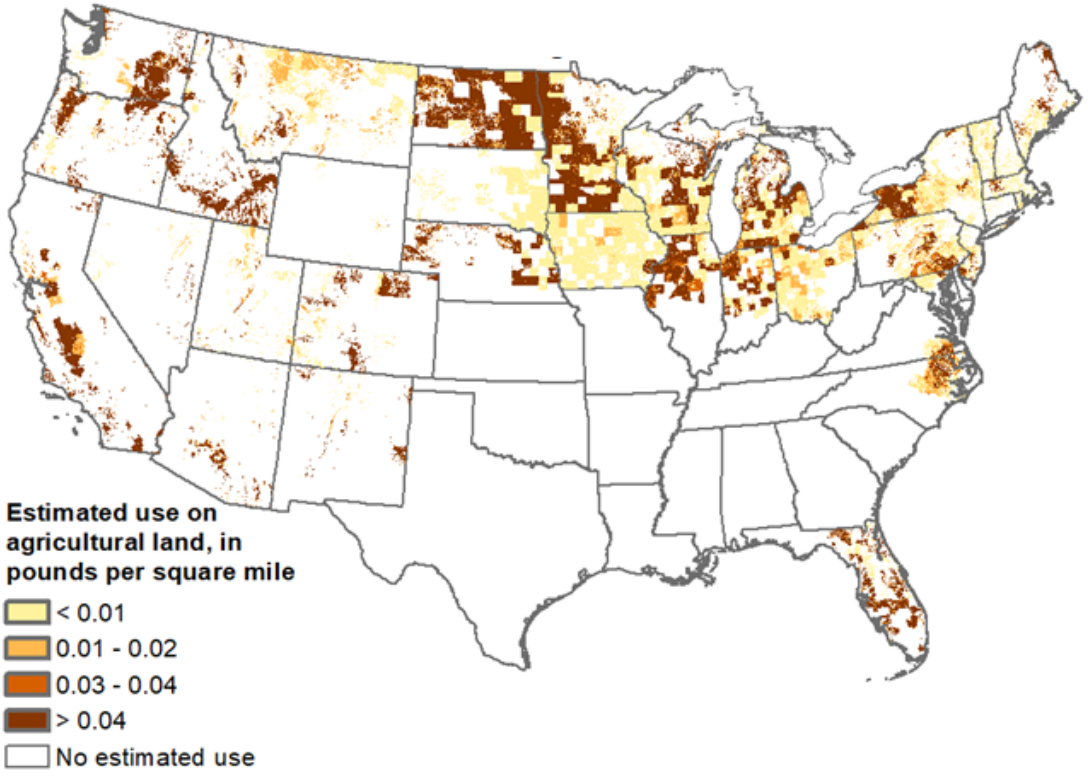
**Exhibit 3-39. Lower Bound Estimated Agricultural Use of Diquat, 2017**

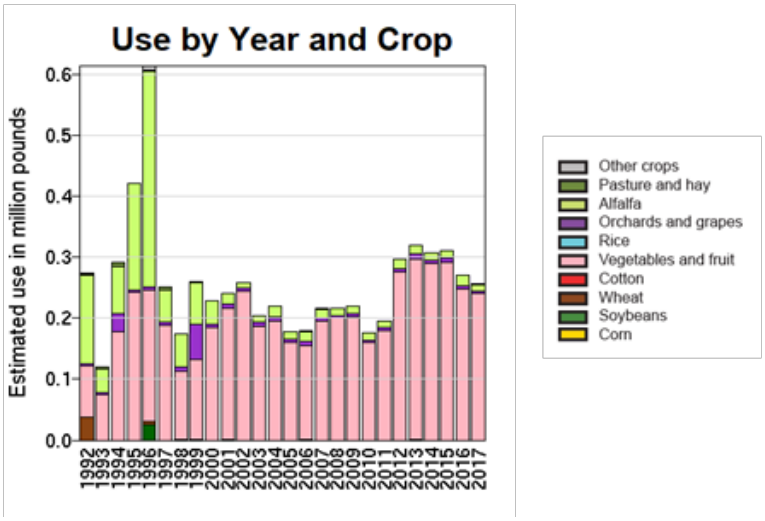



Source: USGS, 2020a

## Exhibit 3-40. Upper Bound Estimated Agricultural Use of Diquat, 2017



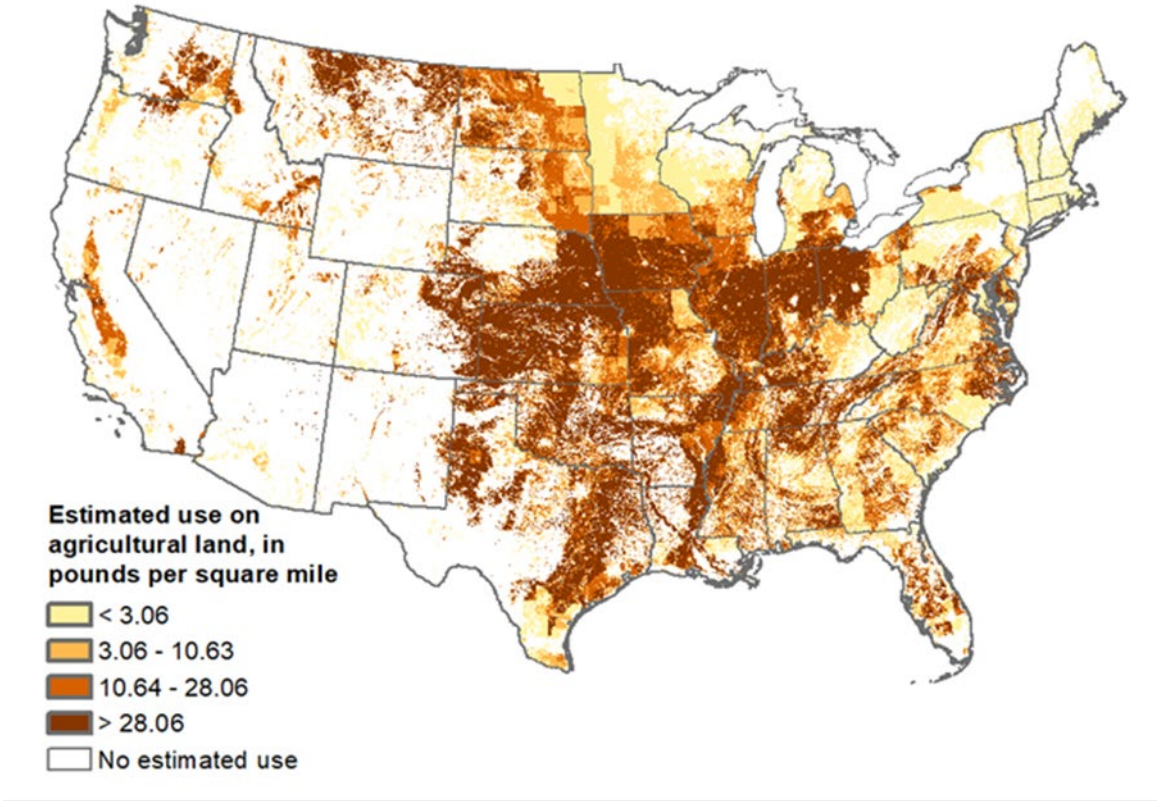



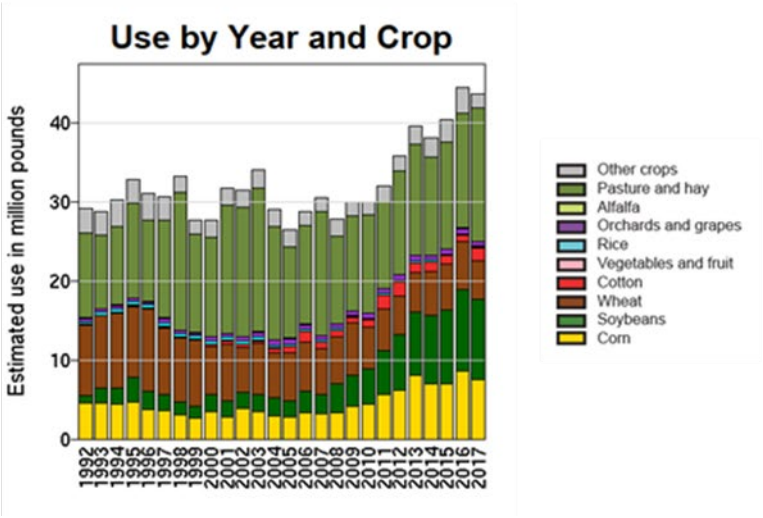

Source: USGS, 2020a

### 3.2.4 2,4-D

**Exhibit 3-41** and **Exhibit 3-42** show widespread 2,4-D application rates primarily in the Midwest, South, and Southeastern regions, with primary application to pasture and row crops (corn, soybeans, wheat). Annual usage rates range from 30 to 50 million pounds throughout 2012 to 2017.

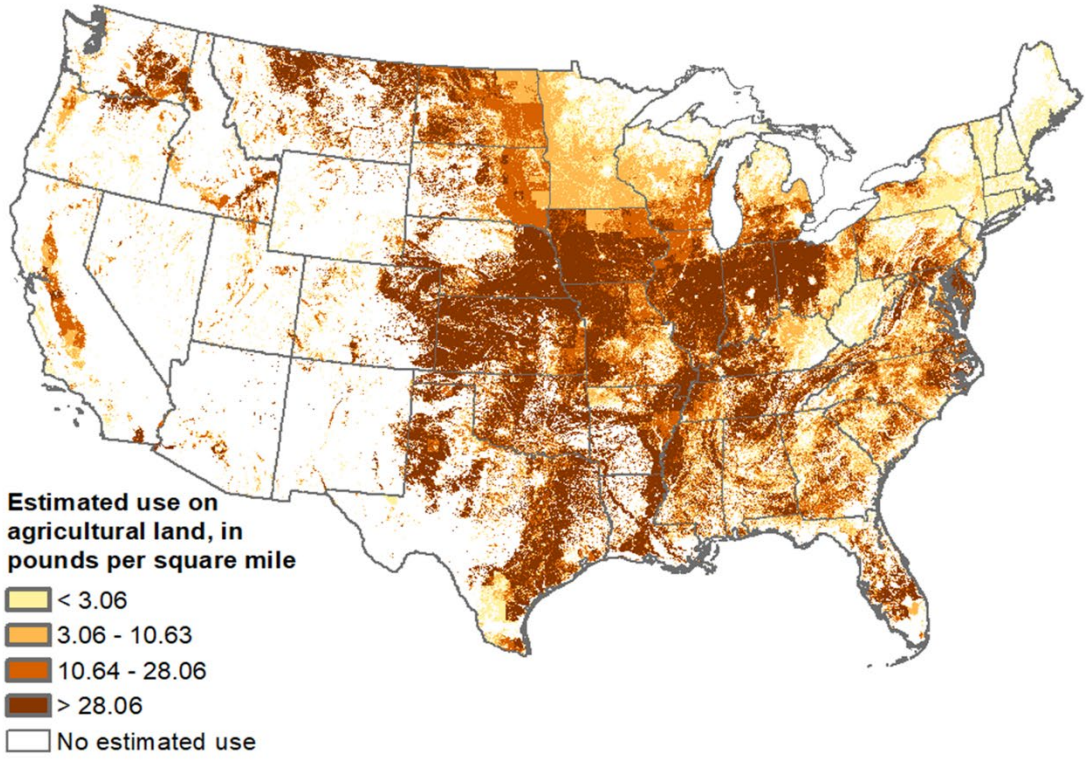
**Exhibit 3-41. Lower Bound Estimated Agricultural Use of 2,4-D, 2017**

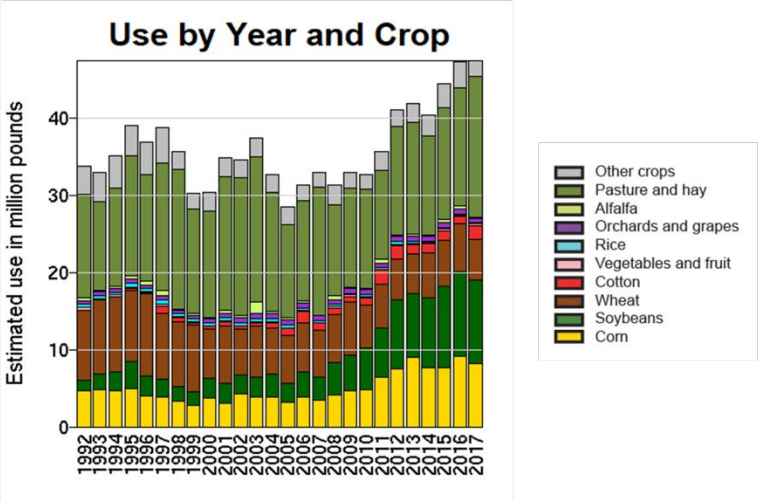



Source: USGS, 2020a

## Exhibit 3-42. Upper Bound Estimated Agricultural Use of 2,4-D, 2017



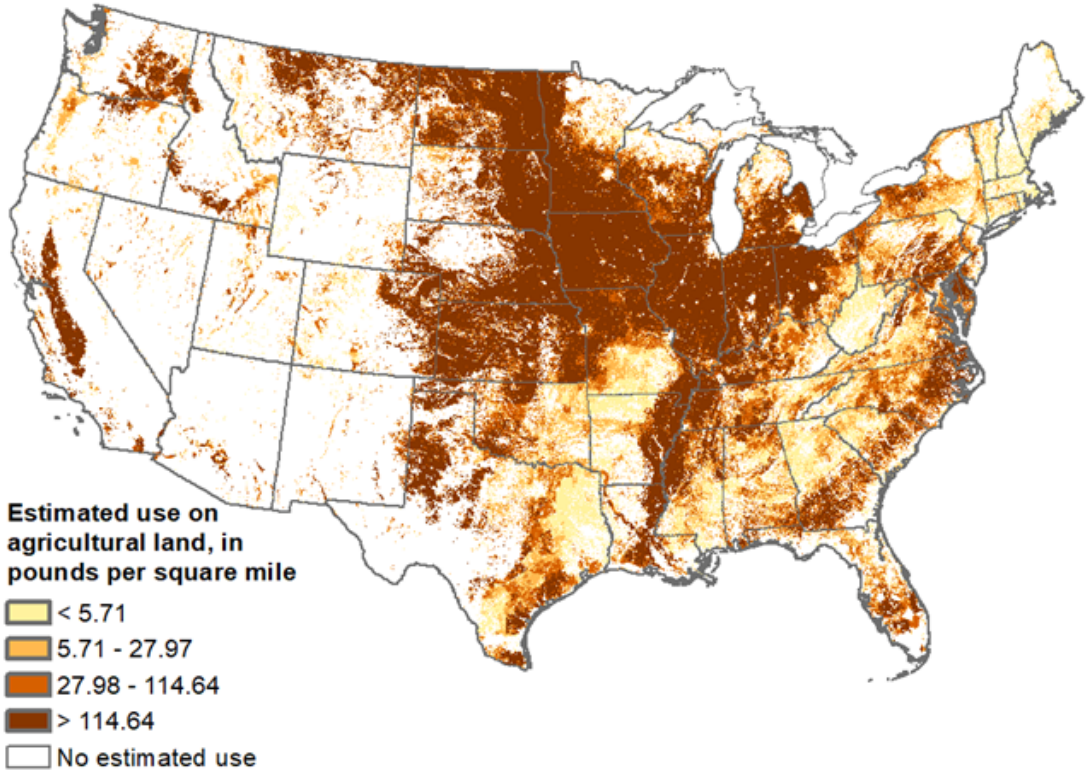



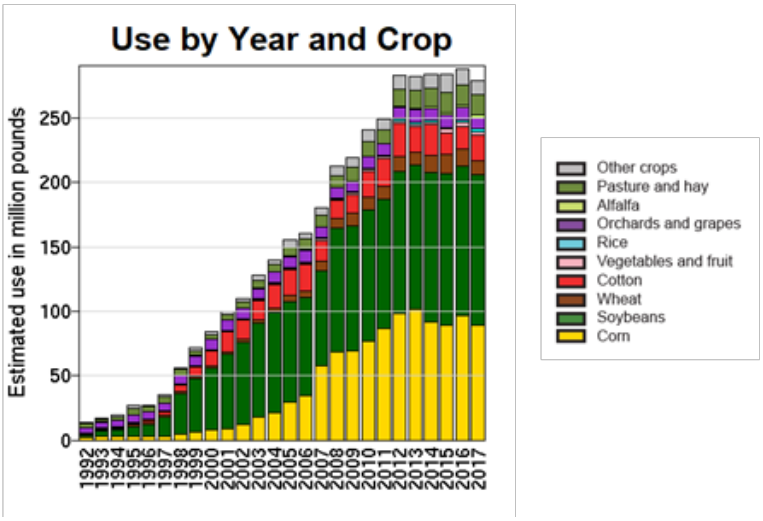

Source: USGS, 2020a

### 3.2.5 Glyphosate

**Exhibit 3-43** and **Exhibit 3-44** show extensive glyphosate application in the Midwest and areas of high application rates along the South Atlantic coastal region and the South. Applications to corn and soybeans dominate use. Annual usage rates have increased rapidly from 50 million pounds in 1998 to almost 300 million pounds in 2017.

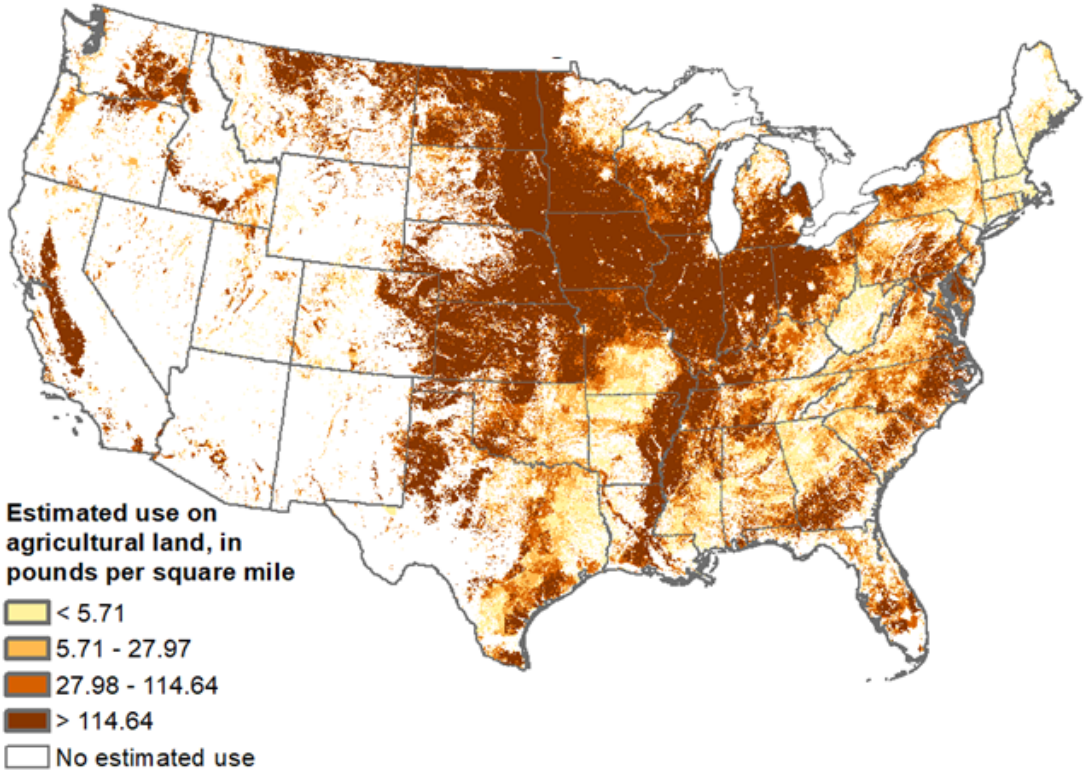
**Exhibit 3-43. Lower Bound Estimated Agricultural Use of Glyphosate, 2017**

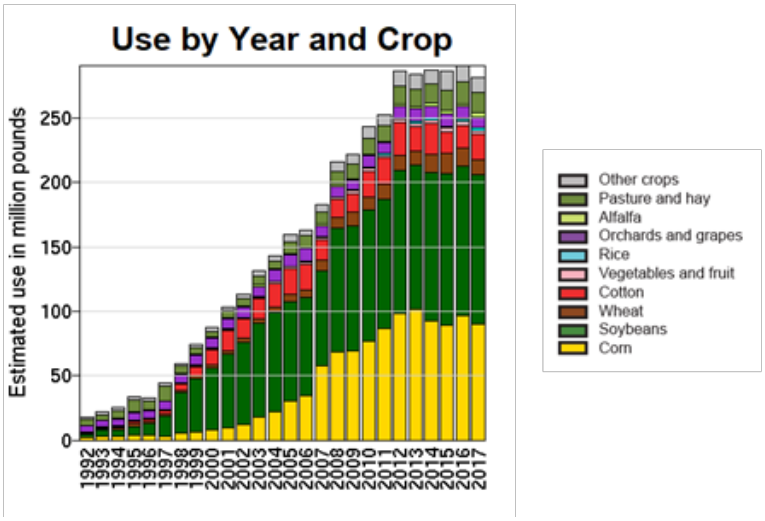



Source: USGS, 2020a

## Exhibit 3-44. Upper Bound Estimated Agricultural Use of Glyphosate, 2017



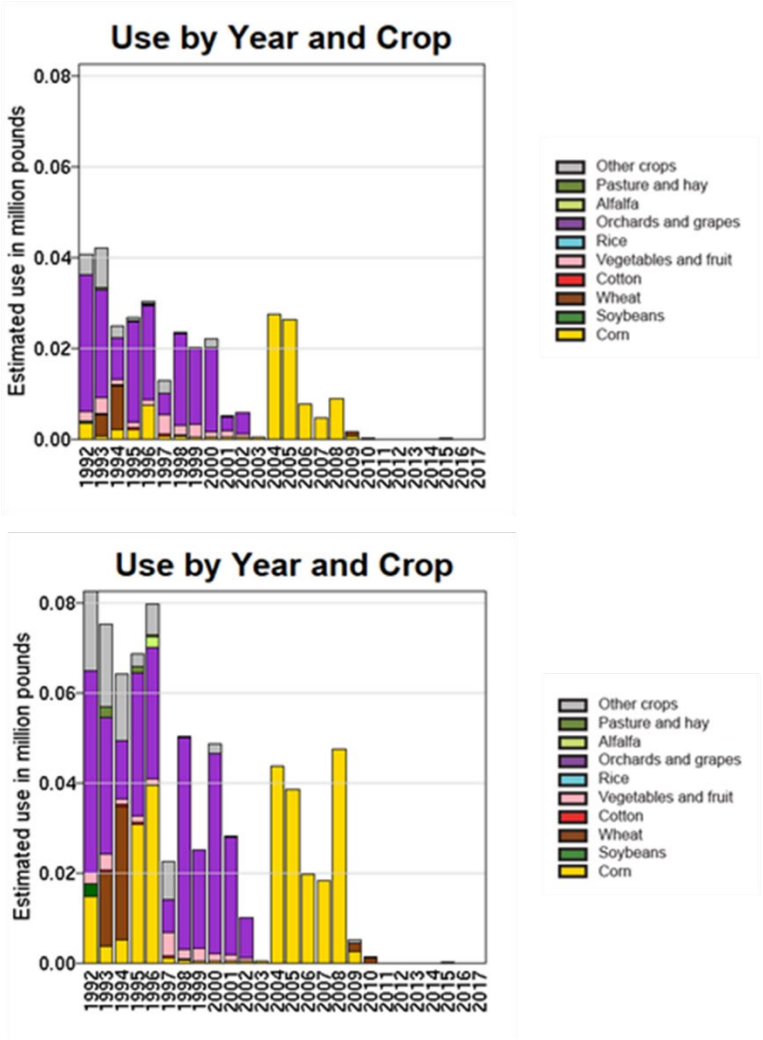




Source: USGS, 2020a

### 3.2.6 Lindane

**Exhibit 3-45** shows that lindane use ended in 2011, therefore there is no usage rate application map for 2017. Prior to 2004, lindane applications to orchards and grapes dominated, particularly in the upper bound estimates. From 2004 to 2010, application was primarily to corn and wheat.

**Exhibit 3-45. Lower and Upper Bound Estimated Agricultural Use of Lindane by Year and Crop**

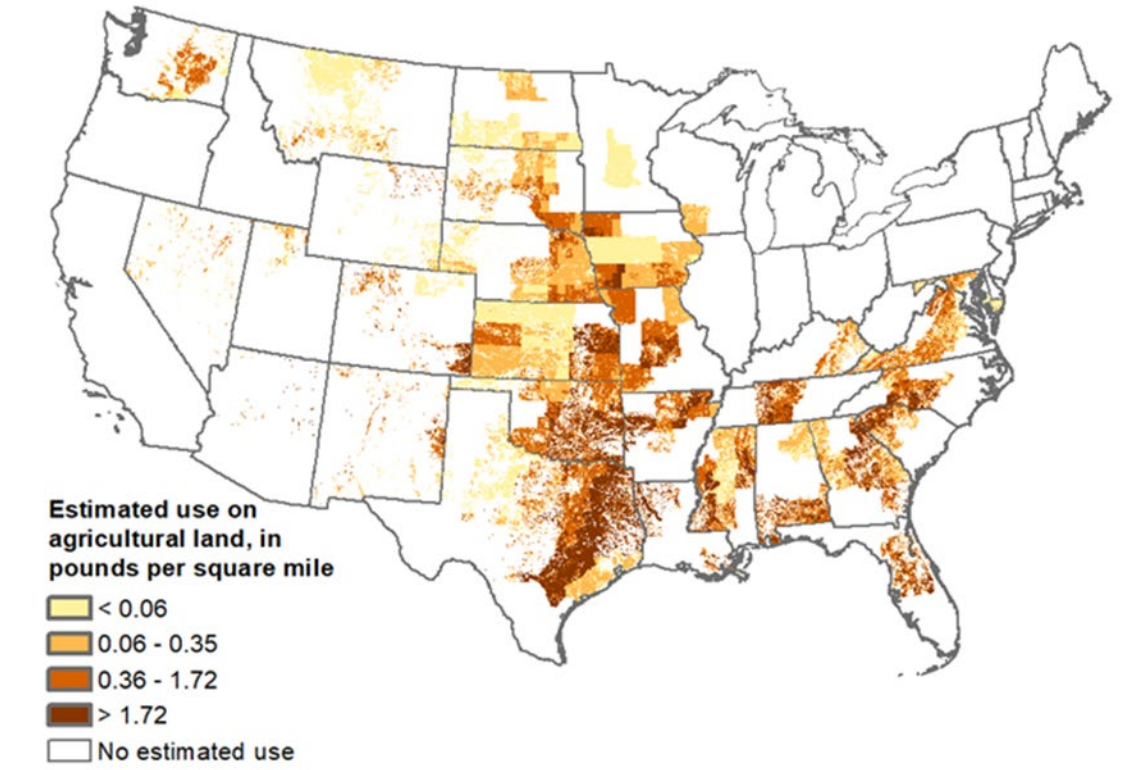


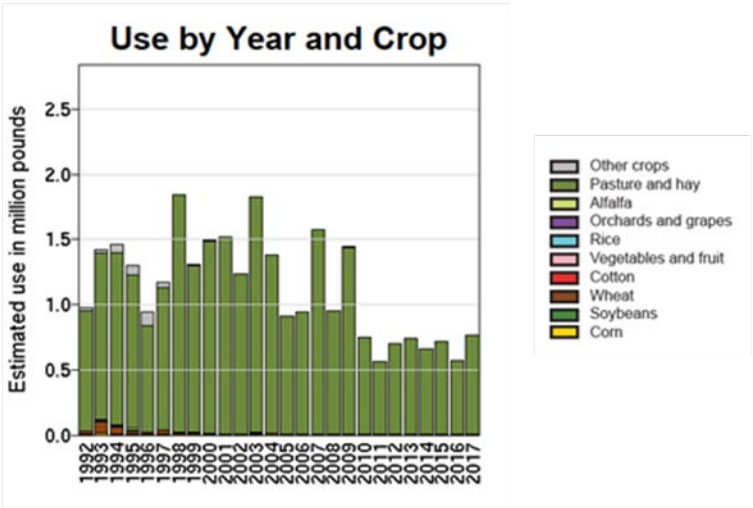

Source: USGS, 2020a

### 3.2.7 Picloram

**Exhibit 3-46** and **Exhibit 3-47** show picloram application primarily in the Great Plains states and the Southern and Southeastern states. Picloram is primarily applied to pasture. Annual usage rates are somewhat lower since 2010, but generally range from 1 to 2 million pounds in the low estimates.

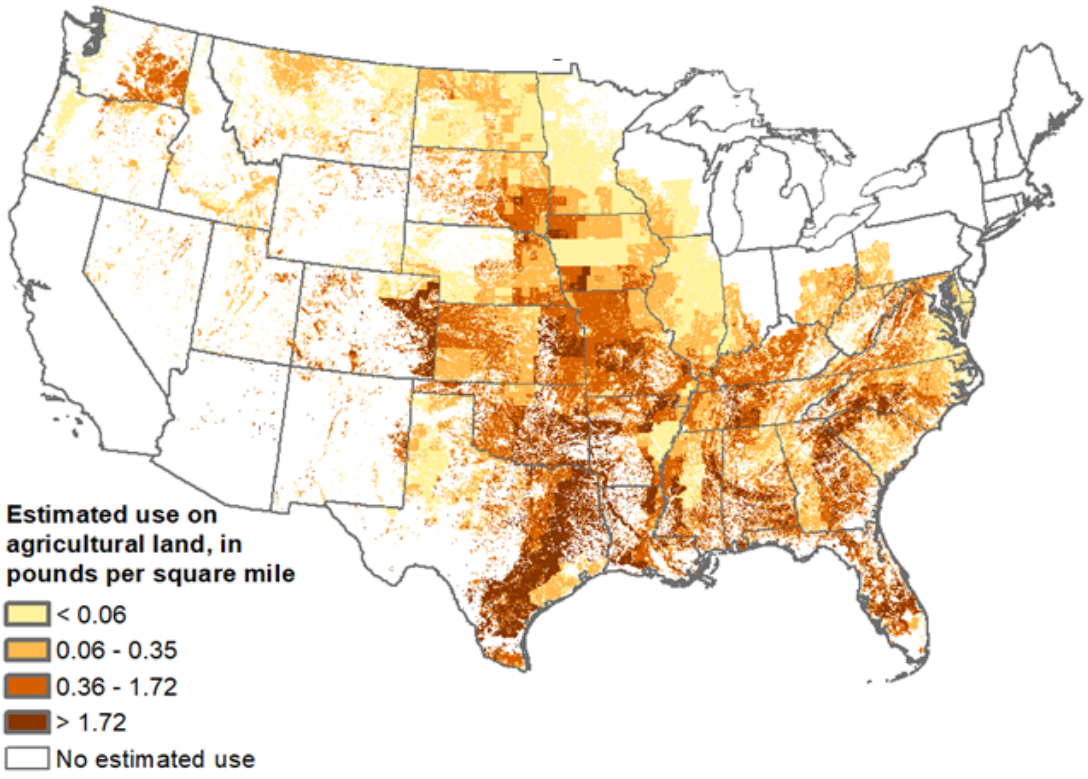
**Exhibit 3-46. Lower Bound Estimated Agricultural Use of Picloram, 2017**

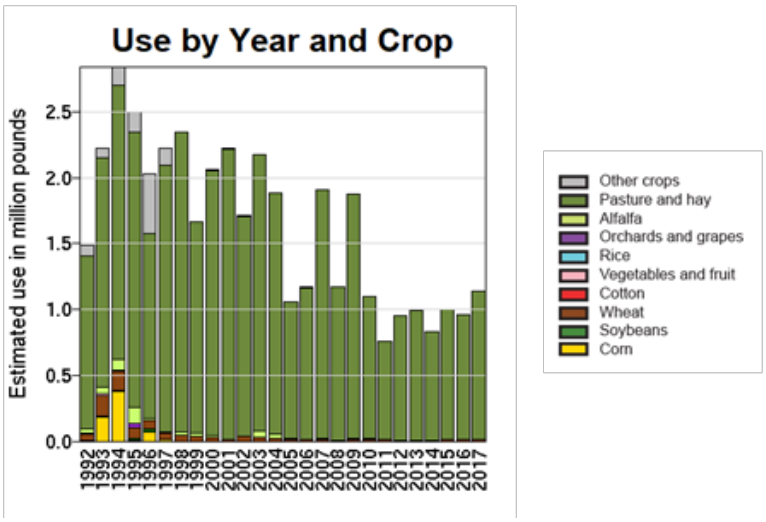



Source: USGS, 2020a

## Exhibit 3-47. Upper Bound Estimated Agricultural Use of Picloram, 2017



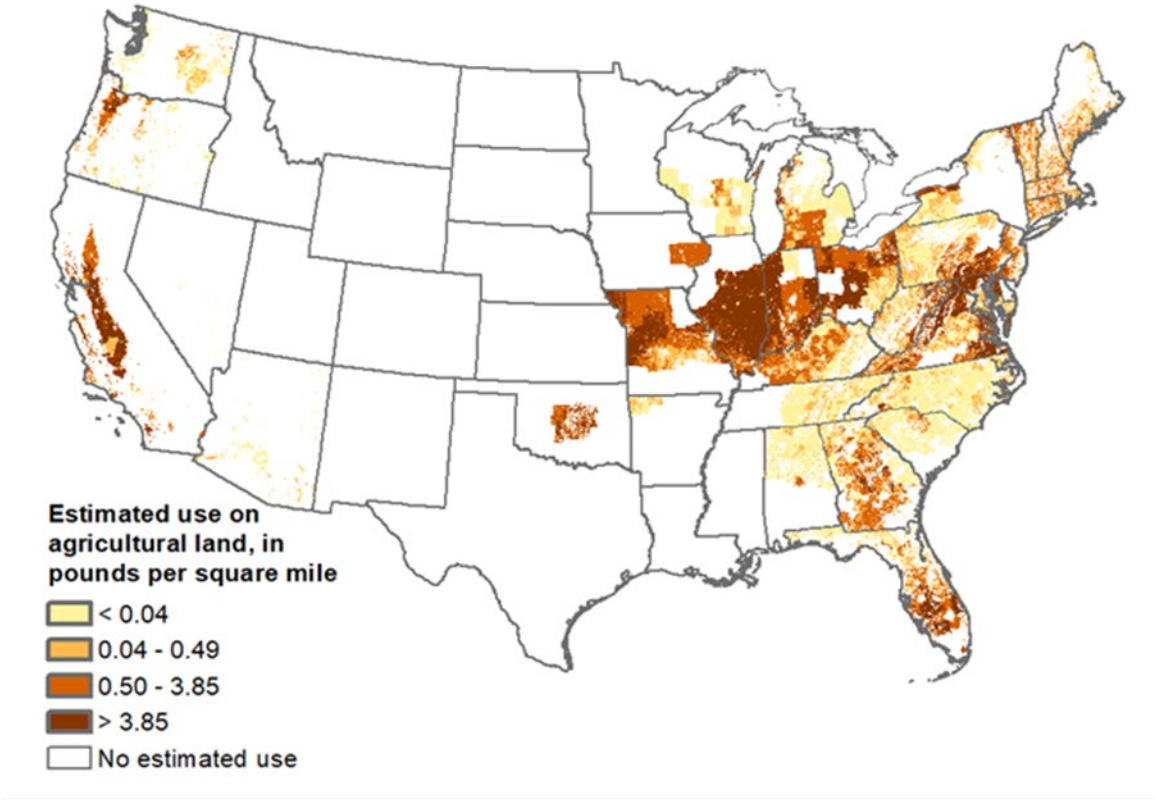



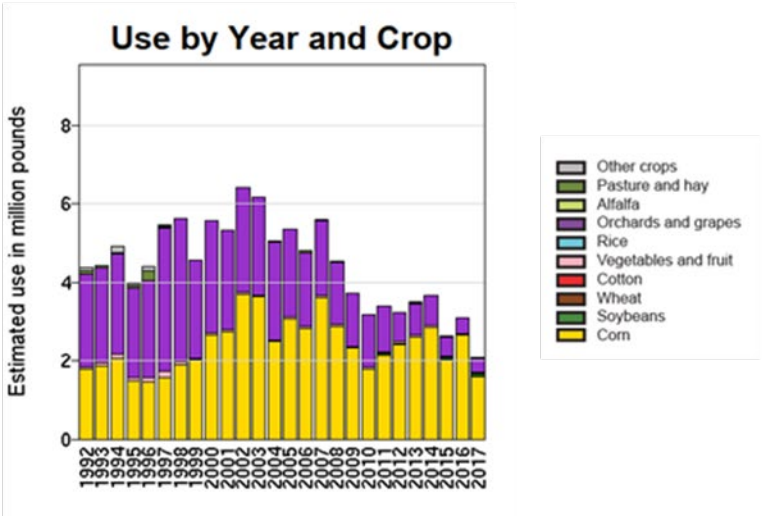

Source: USGS, 2020a

### 3.2.8 Simazine

**Exhibit 3-48** and **Exhibit 3-49** show simazine application primarily in the Midwest states and throughout the Atlantic coastal states. Simazine is primarily applied to corn as well as orchards and grapes. Annual usage rates are somewhat lower since 2009, but generally average about 4 million pounds from 1992-2017.

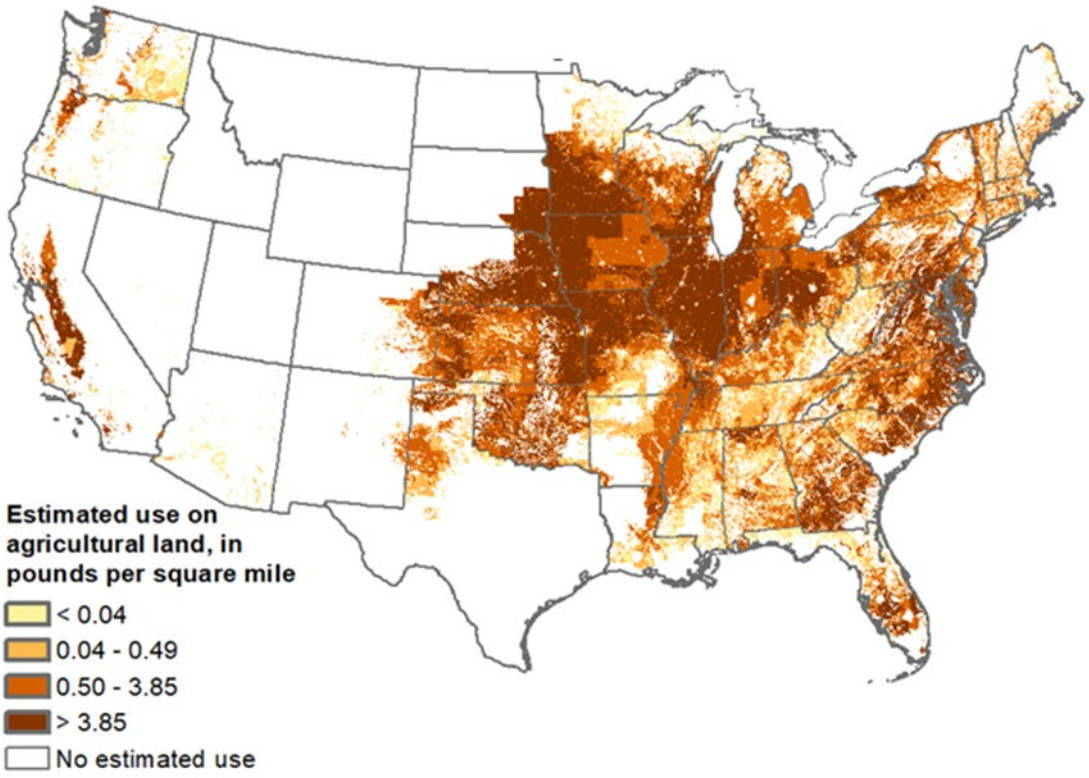
**Exhibit 3-48. Lower Bound Estimated Agricultural Use of Simazine, 2017**

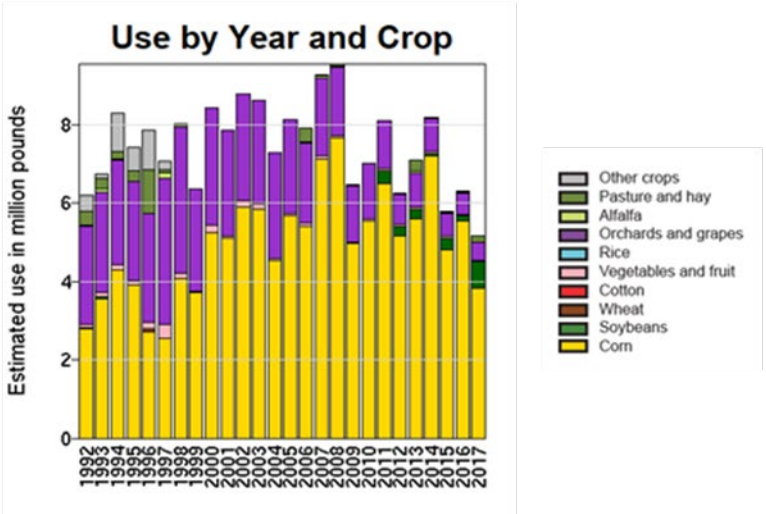



Source: USGS, 2020a

## Exhibit 3-49. Upper Bound Estimated Agricultural Use of Simazine, 2017




Source: USGS, 2020a

# 4. Contaminant Occurrence Data Sources

EPA obtained data from two sources that provide information on contaminant occurrence in source water: USGS' NAWQA Program and USDA's Pesticide Data Program (PDP) water monitoring survey. This section provides background information on these three sources as well as occurrence summary data for the contaminants of interest.

## 4.1 NAWQA

In 1991, USGS implemented the NAWQA Program, in part, to characterize the condition of streams, rivers, and ground water (GW) in the U.S. For the NAWQA Program, the USGS conducted interdisciplinary assessments, including water chemistry, hydrology, land use, stream habitat, and aquatic life, and established a baseline understanding of water-quality conditions in 51 of the Nation's river basins and aquifers, referred to as Study Units (USGS, 2006). **Exhibit 4-1** depicts these study units.

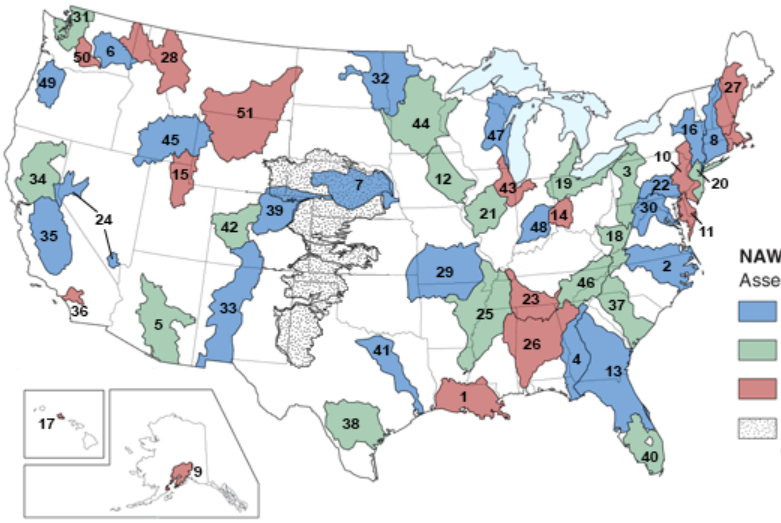
USGS selected these Study Units to reflect important hydrologic and ecological resources; critical sources of contaminants, including agricultural, urban, and natural sources; and a high percentage of population served by municipal water supply and irrigated agriculture. These areas account for more than 70% of total water use (excluding thermoelectric and hydropower) and more than 50% of the supply of drinking water (Gilliom et al., 2006).

The Study-Unit design used a rotational sampling scheme with sampling intensity varying year to year at the different sites. During the first decade, 20 investigations began in 1991; 16 in 1994; and 15 in 1997. During the period 2001-2012, rotational monitoring continued in 42 of the 51 Study Units. For the third decade, from 2013 through 2023, USGS adopted a new strategic Science Plan with a modified monitoring design to support a wide range of research and water quality assessment and forecasting needs (USGS, 2013). **Exhibit 4-2** shows the 100 streams and river monitored annually as feasible. **Exhibit 4-3** identifies the 79 GW well networks in 20 principal aquifers to be sampled at a rate of 7 to 8 networks per year.

USGS makes NAWQA data available through a link to "Field/Lab samples" on the web interface for the National Water Information System (USGS, 2021). EPA downloaded and reviewed the available SW and GW sampling data for the contaminants of interest for data completeness and modified some fields to ensure data consistency (e.g., transforming results reported in milligrams per liter or nanograms per liter to micrograms per liter).

For the contaminant-specific occurrence summaries reported below, EPA identified the total number of locations where contaminant-specific sampling occurred and the subset of locations for which at least one sample resulted in contaminant detection. EPA also estimated the number of locations where the maximum reported concentration exceeded the current MCL and the potential MCLG. Because EPA used maximum concentration values for each location, the location estimates represent upper bounds on contaminant occurrence in the NAWQA database.

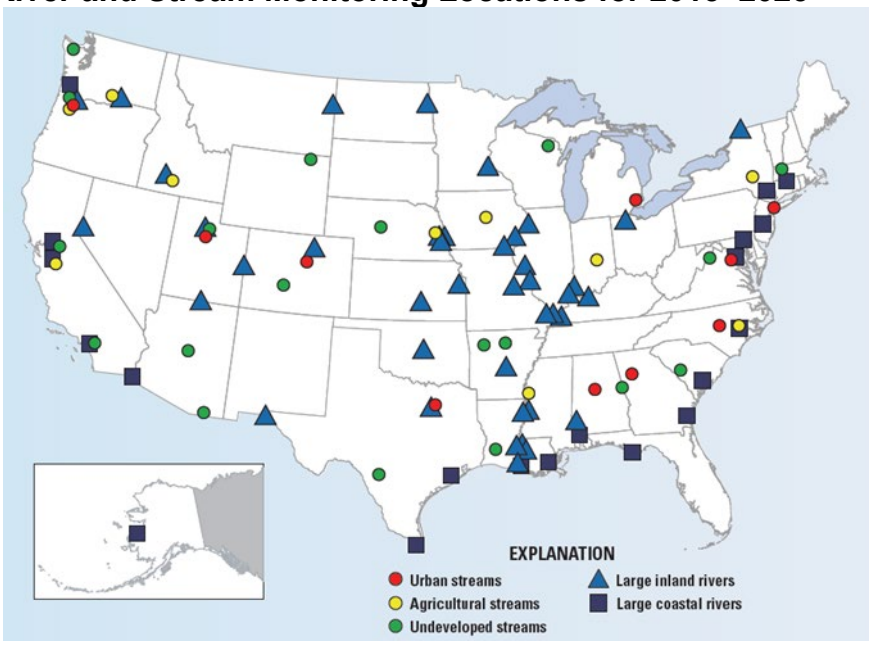
## Exhibit 4-1. NAWQA Study Units




1 Acadian–Pontchartrain Drainages
2 Albemarle–Pamlico Drainage Basin
3 Allegheny and Monongahela River Basins
4 Apalachicola–Chattahoochee–Flint River Basin
5 Central Arizona Basins
6 Central Columbia Plateau
7 Central Nebraska Basins
8 Connecticut, Housatonic, and Thames River Basins
9 Cook Inlet Basin
10 Delaware River Basin
11 Delmarva Peninsula
12 Eastern Iowa Basins
13 Georgia–Florida Coastal Plain
14 Great and Little Miami River Basins
15 Great Salt Lake Basins
16 Hudson River Basin
17 Island of Oahu
18 Kanawha–New River Basins
19 Lake Erie–Lake Saint Clair Drainages
20 Long Island–New Jersey Coastal Drainages
21 Lower Illinois River Basin
22 Lower Susquehanna River Basin
23 Lower Tennessee River Basin
24 Las Vegas Valley Area and the Carson and Truckee River Basins
25 Mississippi Embayment
26 Mobile River Basin
27 New England Coastal Basins
28 Northern Rockies Intermontane Basins
29 Ozark Plateaus
30 Potomac River Basin
31 Puget Sound Basin
32 Red River of the North Basin
33 Rio Grande Valley
34 Sacramento River Basin
35 San Joaquin–Tulare Basins
36 Santa Ana Basin
37 Santee River Basin and Coastal Drainages
38 South-Central Texas
39 South Platte River Basin
40 Southern Florida
41 Trinity River Basin
42 Upper Colorado River Basin
43 Upper Illinois River Basin
44 Upper Mississippi River Basin
45 Upper Snake River Basin
46 Upper Tennessee River Basin
47 Western Lake Michigan Drainages
48 White River Basin
49 Willamette Basin
50 Yakima River Basin
51 Yellowstone River Basin

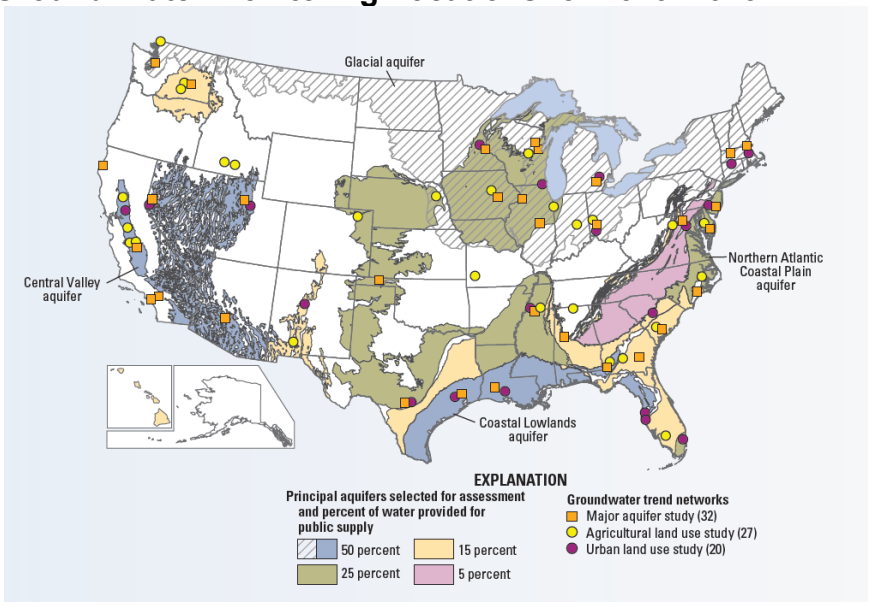
Source: USGS, No date.

**Exhibit 4-2. River and Stream Monitoring Locations for 2013–2023**




Source: USGS, 2013

**Exhibit 4-3. Ground Water Monitoring Locations for 2013–2023**




Source: USGS, 2013

## 4.2 PDP

The USDA established the PDP in 1991 to collect data pertaining to pesticide residues in food consumed by infants and children. In 1996, Congress expanded the program to include pesticide residues in drinking water. Implementation of this portion of the program began in 2001 and ended in 2013 (USDA, 2014).

The USDA collects and publishes annual databases. Each database contains:

- residual concentrations of more than 300 pesticides in drinking water, raw food, and processed food
- results from consumables originating in 43 countries, 50 states, Washington D.C., and Puerto Rico

The drinking water data in the PDP provide information to support the Food Quality Protection Act authorized in 1996 by Congress. When data collection began in 2001, USDA (2014) limited sampling to treated water at community water systems in New York and California. In 2002, monitoring efforts expanded to include five additional systems in Colorado, Kansas, and Texas; these locations were eliminated after 2003. The study expanded again in 2004 to include systems in Michigan, North Carolina, Ohio, Oregon, Pennsylvania, and Washington.

Although the USDA collects both raw water and treated water samples, the data reported below reflects only the raw water samples, which are better indicators of source water quality. The treated water samples reflect the effects of water treatment on contaminant removal. For the years 2009 through 2013, the PDP data also include a few samples taken from source waters of schools and day care centers. Because these facilities may be classified as non-transient, non-community water systems that are subject to most of the same drinking water standards as a municipal system, EPA included those samples in the occurrence estimates below. Note that data for beryllium, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethylene, diquat, glyphosate, and 1,1,1-trichloroethane are not available in the PDP.

## 4.3 Contaminant Occurrence

The following sections discuss the occurrence of contaminants of interest, and present summary data from the NAWQA and PDP databases. Each summary table juxtaposes the occurrence data with the current MCL value and one or more potential MCLG values that are based on new health risk information. EPA also developed maps that plot the NAWQA data to demonstrate the spatial extent of the sampling locations and occurrence results.

EPA did not identify any readily available water quality data for diquat. Therefore, EPA obtained available information on diquat use and environmental fate and transport to characterize potential source water occurrence.

### 4.3.1 Alachlor

**Exhibit 4-4** provides comparisons of the maximum alachlor concentrations found at locations in the NAWQA database with the current MCL (which is greater than the MCLG of zero) and the potential MCLG value. The results have been disaggregated by SW and GW sampling, which shows that detections occur more frequently in SW than in GW. The maximum concentrations at less than 1% of NAWQA sampling locations exceed the current MCL and the maximum concentrations at only five locations exceed the potential MCLG. **Exhibit 4-5** presents a spatial representation of the NAWQA data. **Exhibit 4-6** shows alachlor raw water concentrations from the PDP database. None of the samples contained alachlor concentrations that exceeded either the current MCL or potential MCLG. Together, data from these sources indicate minimal occurrence of this contaminant above the current MCL and the higher potential MCLG value.

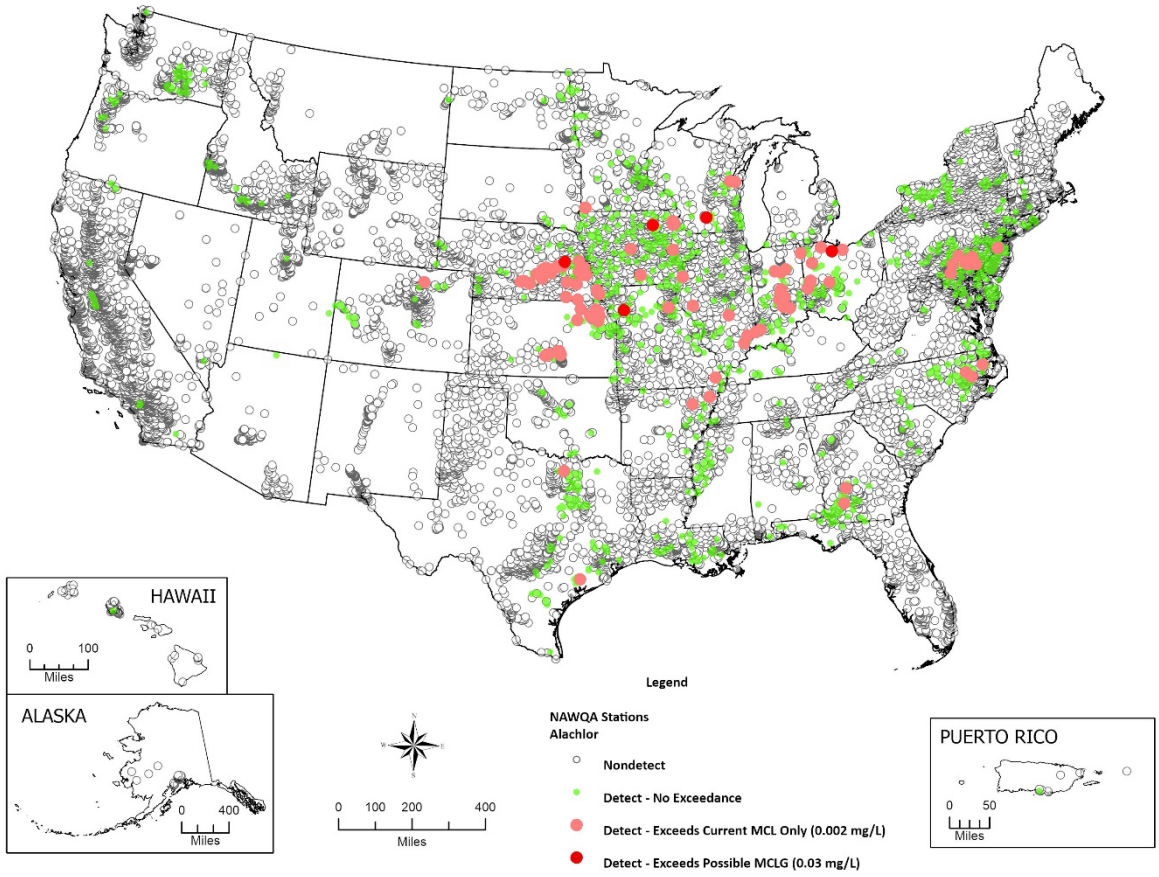
## Exhibit 4-4. Alachlor Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 5,669 (100%) | 18,251 (100%) | 23,920 (100%) |
| Locations where all samples are nondetects [a] | 4,439 (78.3%) | 17,837 (97.7%) | 22,276 (93.1%) |
| Locations where at least one detection occurs | 1,230 (21.7%) | 414 (2.3%) | 1,644 (6.9%) |
| Maximum concentration exceeds current MCL (0.002 mg/L) | 91 (1.6%) | 26 (0.1%) | 117 (0.5%) |
| Maximum concentration exceeds potential MCLG (0.03 mg/L) | 3 (0.1%) | 2 (<0.1%) | 5 (<0.1%) |

Source: USGS, 2021 (data from 1991 to 2021; detection and exceedance estimates based on maximum sample values at each location).

a. The detection limits range from 0.000002 to 0.002 mg/L. Excludes 19 nondetects with reporting limits greater than 0.002 mg/L. Of these, 1 limit (0.038 mg/L) is greater than 0.03 mg/L.

## Exhibit 4-5. Alachlor NAWQA Occurrence (1991–2021)




Source: USGS, 2021

**Exhibit 4-6. Summary of Alachlor Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)**

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2,806 | 1,830 |
| Samples with detected quantity [a] | 13 | 9 |
| Maximum concentration exceeds current MCL (0.002 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (0.03 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 1.3 X $10^{-5}$ mg/L to 7.5 X $10^{-5}$ mg/L. Detection limits range from 7.8 X $10^{-6}$ mg/L to 4.5 X $10^{-5}$ mg/L.

### 4.3.2 Atrazine

**Exhibit 4-7** provides comparisons of the maximum atrazine concentrations found at locations in the NAWQA database with the current MCL (which is greater than the MCLG of zero) and the potential MCLG value. The maximum concentrations at 1.9% of NAWQA sampling locations exceed the current MCL and the maximum concentration at three locations exceed the potential MCLG. **Exhibit 4-8** presents a spatial representation of the NAWQA data. **Exhibit 4-9** shows atrazine raw water concentrations from the PDP database. None of the samples contained atrazine concentrations that exceeded either the current MCL or potential MCLG. Together, the data sources indicate minimal occurrence of this contaminant above the current MCL and the higher potential MCLG value.

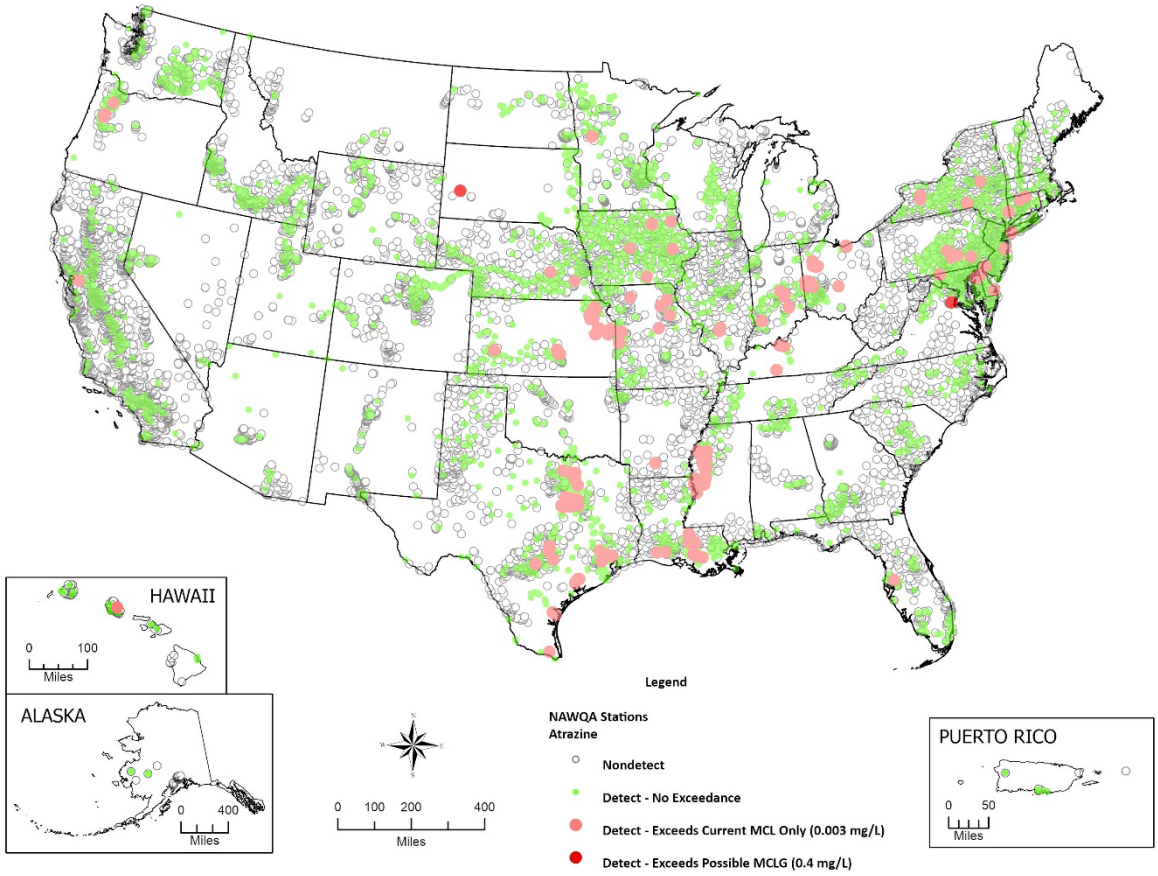
**Exhibit 4-7. Atrazine Occurrence in NAWQA: Number and Percent of Locations by Water Type**

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 6,511 (100%) | 18,682 (100%) | 25,193 (100%) |
| Locations where all samples are nondetects [a] | 2,047 (31.4%) | 14,485 (77.5%) | 16,532 (65.6%) |
| At least one detection | 4,464 (68.6%) | 4,197 (22.5%) | 8,661 (34.4%) |
| Maximum concentration exceeds current MCL (0.003 mg/L) | 446 (6.8%) | 36 (0.2%) | 482 (1.9%) |
| Maximum concentration exceeds potential MCLG (0.4 mg/L) | 3 (<0.1%) | 0 (0%) | 3 (<0.1%) |

Source: USGS, 2021 (national data from 1991 to 2020; estimates based on maximum sample values at each location).

a. The detection limits range from 0.000001 to 0.0026 mg/L. Excludes 68 nondetects with reporting limits greater than 0.003 mg/L, none of which are greater than 0.4 mg/L.

**Exhibit 4-8. Atrazine NAWQA Occurrence (1991–2020)**




Source: USGS, 2021

**Exhibit 4-9. Summary of Atrazine Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)**

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2,810 | 1,830 |
| Samples with detected quantity [a] | 2,254 | 324 |
| Maximum concentration exceeds current MCL (0.003 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (0.4 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 1.1 X $10^{-6}$ mg/L to 1.2 X $10^{-2}$ mg/L. Detection limits range from 6.6 X $10^{-7}$ mg/L to 2.5 X $10^{-5}$ mg/L.

## 4.3.3 Barium

**Exhibit 4-10** provides a comparison of maximum barium concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-11** presents a spatial representation of the NAWQA data. These data indicate that less than 0.5% of the total sampling locations for this contaminant have maximum concentrations between the current

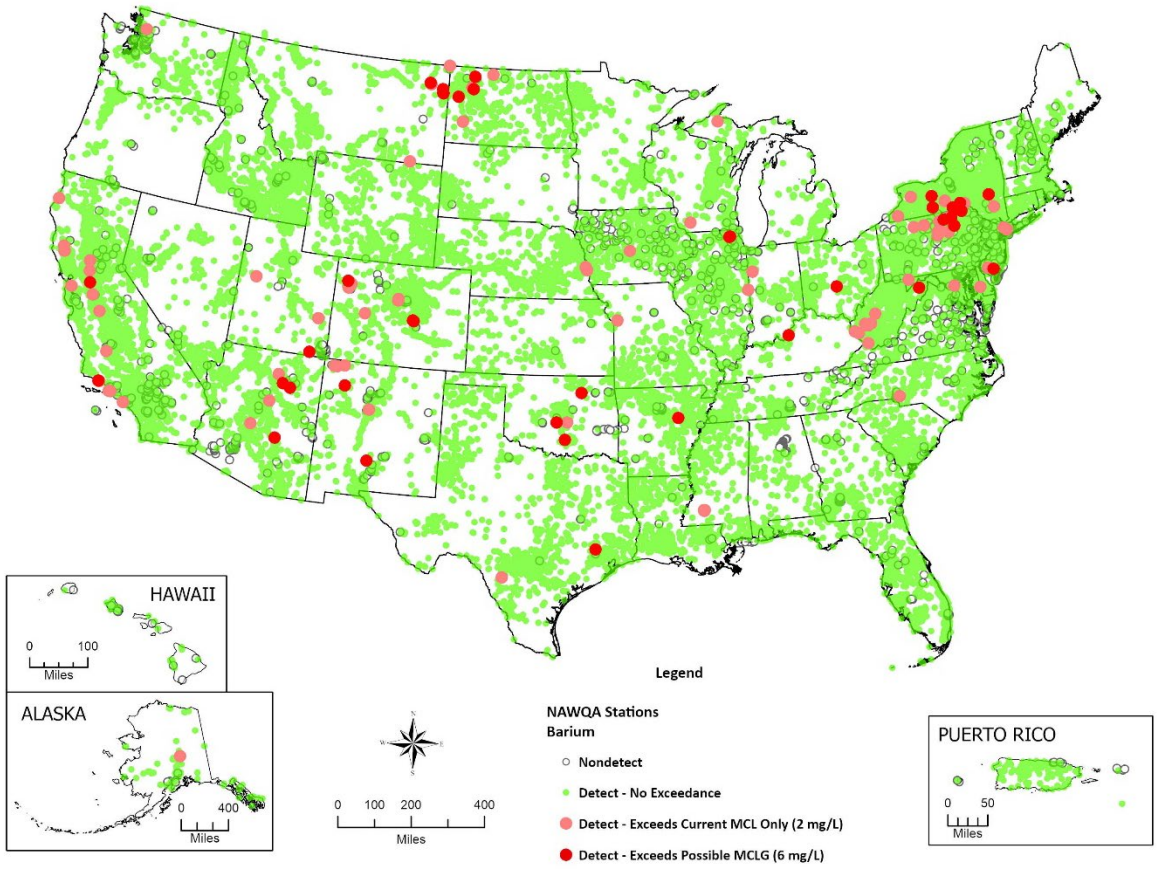
MCLG and the potential MCLG value. Although barium occurs in detected quantities at most of the NAWQA sampling locations, less than 0.5% of sampling locations in NAWQA report maximum concentrations above the current MCLG.

### Exhibit 4-10. Barium Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 7,203 (100%) | 30,194 (100%) | 37,397 (100%) |
| All samples are nondetects[1] | 311 (4.3%) | 1,340 (4.4%) | 1,651 (4.4%) |
| At least one detection | 6,892 (95.7%) | 28,854 (95.6%) | 35,746 (95.6%) |
| Exceeds current MCL (2.0 mg/L) | 28 (0.4%) | 113 (0.4%) | 141 (0.4%) |
| Exceeds potential MCLG (6.0 mg/L) | 8 (0.1%) | 32 (2.4%) | 40 (0.1%) |

Source USGS, 2021 (data from 1991 to 2021; detection and exceedance estimates based on maximum sample values at each location).
1. The detection limits range from 0.00002 to 0.004 mg/L; the mode is 0.001 mg/L.

### Exhibit 4-11. Barium NAWQA Occurrence (1991–2020)




Source: USGS, 2021

### 4.3.4 Beryllium

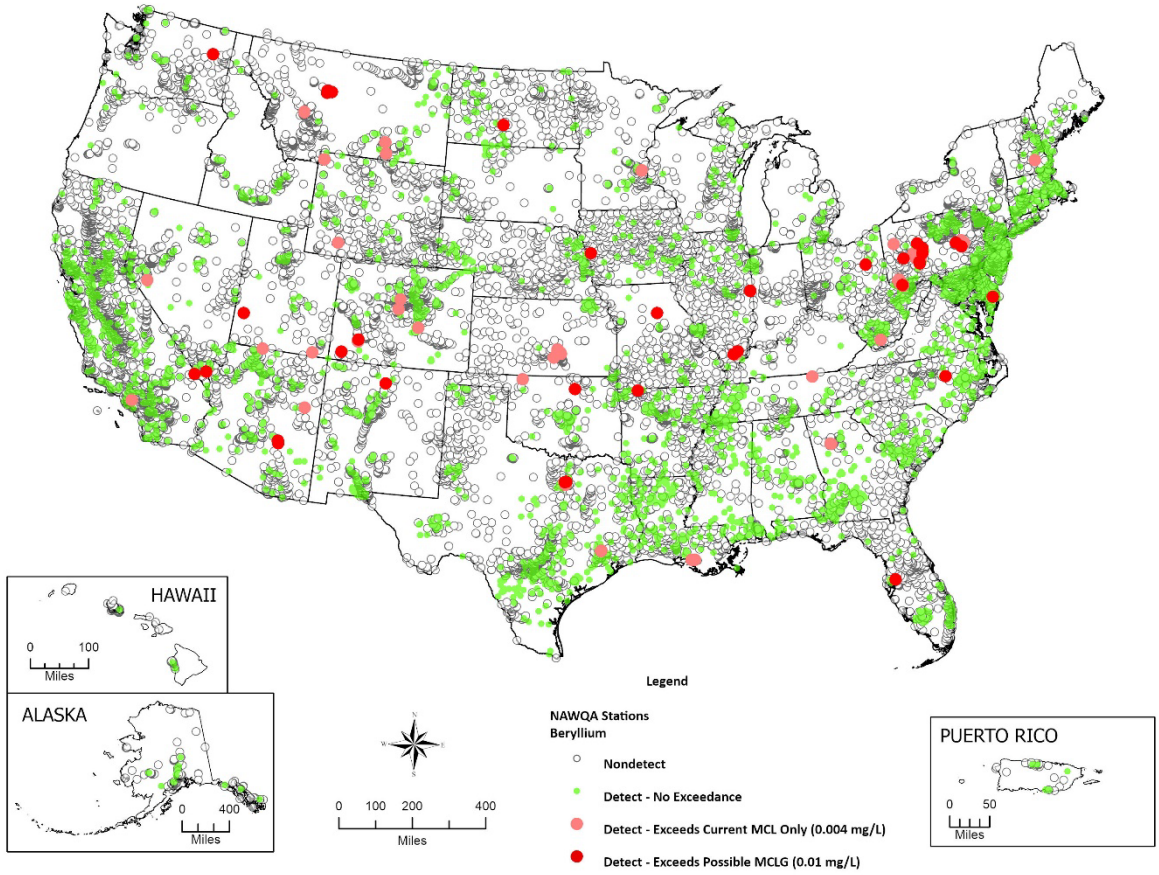
**Exhibit 4-12** provides comparisons of maximum beryllium concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-13** presents a spatial representation of the NAWQA data. These data indicate that less than 0.5% of NAWQA locations have maximum concentrations between the current MCLG and the potential MCLG.

**Exhibit 4-12. Beryllium Occurrence in NAWQA: Number and Percent of Locations by Water Type**

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 4,541 (100%) | 20,901 (100%) | 25,442 (100%) |
| All samples are nondetects [a] | 3,704 (81.6%) | 17,449 (83.5%) | 21,153 (83.1%) |
| At least one detection | 837 (18.4%) | 3,452 (16.5%) | 4,289 (16.9%) |
| Maximum concentration exceeds current MCL (0.004 mg/L) | 70 (1.5%) | 82 (0.4%) | 152 (0.6%) |
| Maximum concentration exceeds potential MCLG (0.01 mg/L) | 34 (0.7%) | 44 (0.2%) | 78 (0.3%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits for the results shown range from 0.0000007 to 0.004 mg/L. Excludes 6,121 nondetects with reporting limits greater than 0.004 mg/L. Of these, 55 are greater than 0.01 mg/L, ranging from 0.011 mg/L to 12 mg/L.

**Exhibit 4-13. Beryllium NAWQA Occurrence (1991–2021)**




Source: USGS, 2021

### 4.3.5 Diquat

Water quality results for diquat were not available in NAWQA. To characterize potential source water occurrence, EPA obtained pesticide application estimates because the primary uses of diquat are as an algaecide, defoliant, desiccant, and herbicide (USEPA, 1995a).

As **Exhibit 3-39** and **Exhibit 3-40** above show, the annual diquat application to crops is generally about 0.2 million pounds. These estimates do not include non-agricultural applications, however. National non-crop usage data are not available. During the third review cycle (SYR 3), EPA obtained data from California showing that non-crop applications (e.g., right-of-way and aquatic herbicide) accounted for 73% of statewide use in 2012 (USEPA, 2015). Thus, non-crop use was approximately three times higher than crop use.

Of the pesticides included in this document, only lindane has lower national usage rates than diquat. **Exhibit 4-14** provides national crop use estimates for diquat and the other pesticides included in this report that were developed by USGS. These data suggest that even if the actual national use of diquat is several times greater than the crop use estimate indicates, the usage rate for diquat would be one of the lowest in terms of pounds applied.

**Exhibit 4-14. National Pesticide Use for Crops (2010–2017, millions of pounds)**

| Pesticide | Low | High |
|---|---|---|
| 2,4-D | 304 | 331 |
| Alachlor | 6 | 32 |
| Atrazine | 561 | 572 |
| Diquat | 2 | 2 |
| Glyphosate | 2,191 | 2,212 |
| Lindane | <1 | <1 |
| Picloram | 5 | 8 |
| Simazine | 25 | 54 |

Source: USGS, 2020b

USEPA (1995a) notes that although diquat is persistent (i.e., it does not hydrolyze and is resistant to degradation), it becomes immobile when it adsorbs to soil particles and, therefore, is unlikely to contaminate GW. Furthermore, diquat dissipates quickly from SW because it adsorbs to soil sediments, vegetation, and organic matter; the estimated half-life in SW is 1 to 2 days, based on a study of two ponds in Florida (USEPA, 1995a). These factors suggest the possibility of low occurrence in drinking water sources.

### 4.3.6 1,2-Dichlorobenzene

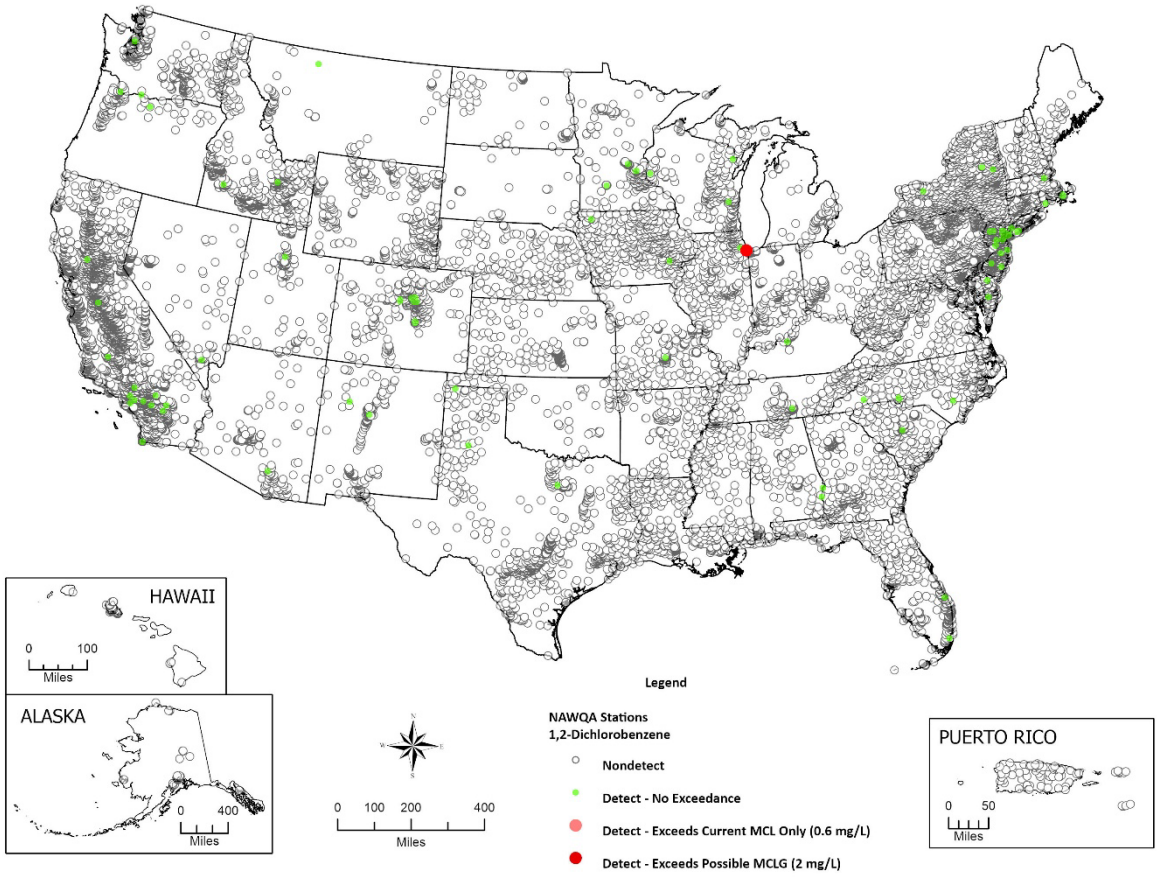
**Exhibit 4-15** provides a comparison of maximum 1,2-dichlorobenzene concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-16** presents a spatial representation of the NAWQA data. These data indicate that less than 0.1% of NAWQA locations have maximum concentrations above the current MCL value and only one location has a maximum concentration above the higher potential MCLG value.

**Exhibit 4-15. 1,2-Dichlorobenzene Occurrence in NAWQA: Number and Percent of Locations by Water Type**

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 1,797 (100%) | 17,998 (100%) | 19,795 (100%) |
| All samples are nondetects [a] | 1,762 (98.1%) | 17,937 (99.7%) | 19,699 (99.5%) |
| At least one detection | 35 (1.9%) | 61 (0.3%) | 96 (0.5%) |
| Maximum concentration exceeds current MCL (0.6 mg/L) | 0 (0%) | 1 (<0.1%) | 1 (<0.1%) |
| Maximum concentration exceeds potential MCLG (2 mg/L) | 0 (0%) | 1 (<0.1%) | 1 (<0.1%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits range from 0.00000275 to 0.5 mg/L. Excludes 35 nondetects with reporting limits greater than 0.6 mg/L. Of these, 3 are greater than 2 mg/L, ranging from 2.5 mg/L to 5 mg/L.

**Exhibit 4-16. 1,2-Dichlorobenzene NAWQA Occurrence (1991–2021)**




Source: USGS, 2021

## 4.3.7 1,4-Dichlorobenzene

**Exhibit 4-17** provides a summary of 1,4-dichlorobenzene occurrence at NAWQA monitoring locations including a comparison of maximum 1,4-dichlorobenzene concentrations with the current MCL and potential MCLG values. **Exhibit** 4-18 presents a spatial representation of the

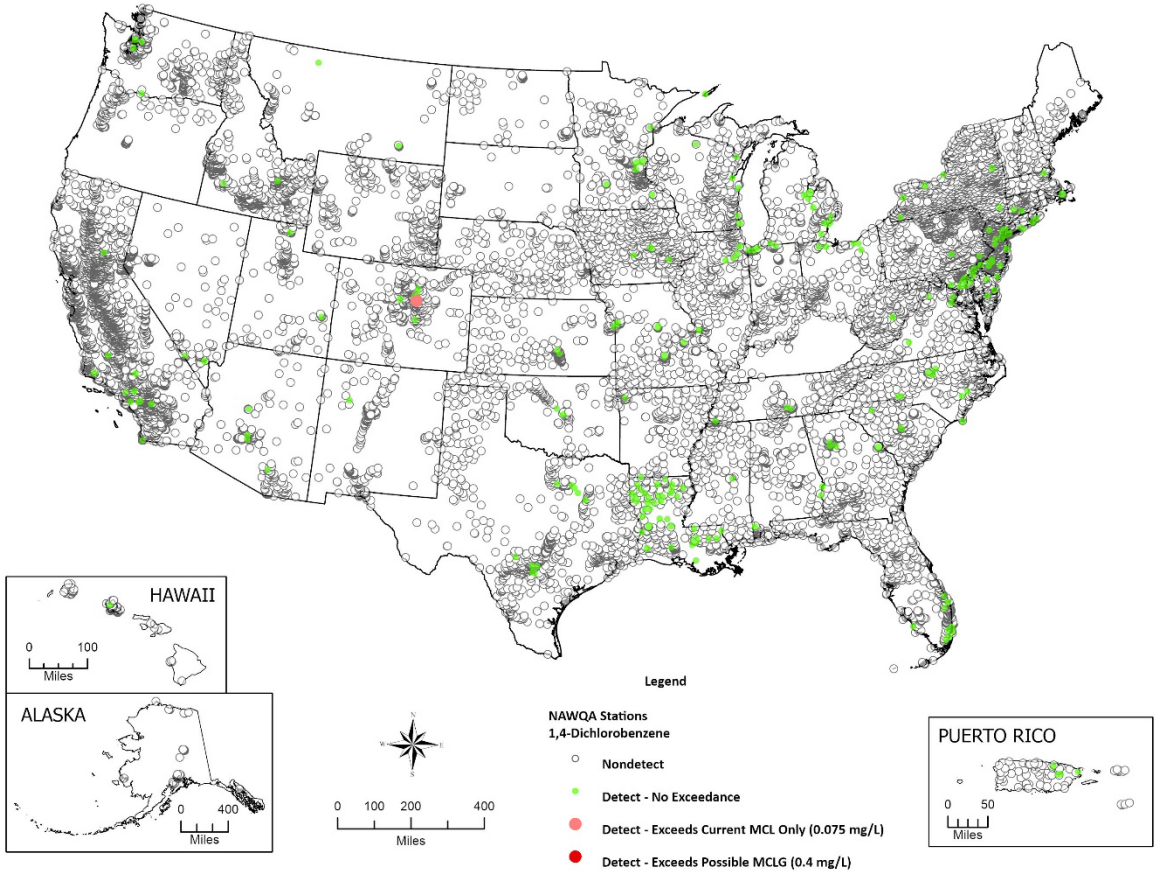
NAWQA data. These data indicate that less than 0.1% of NAWQA locations have maximum concentrations above the current MCL value and only one location has a maximum concentration above the higher potential MCLG value.

### Exhibit 4-17. 1,4-Dichlorobenzene Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 3,474 (100%) | 20,653 (100%) | 24,127 (100%) |
| All samples are nondetects [a] | 3,307 (95.2%) | 20,477 (99.1%) | 23,784 (98.6%) |
| At least one detection | 167 (4.8%) | 176 (0.9%) | 343 (1.4%) |
| Maximum concentration exceeds current MCL (0.075 mg/L) | 1 (<0.1%) | 0 (0%) | 1 (<0.1%) |
| Maximum concentration exceeds potential MCLG (0.4 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits range from 0.00000279 to 0.071 mg/L. Excludes 152 nondetects with reporting limits greater than 0.075 mg/L. Of these, 40 are greater than 0.4 mg/L, ranging from 0.5 mg/L to 5 mg/L.

### Exhibit 4-18. 1,4-Dichlorobenzene NAWQA Occurrence (1991–2021)




Source: USGS, 2021

### 4.3.8 1,1-Dichloroethylene

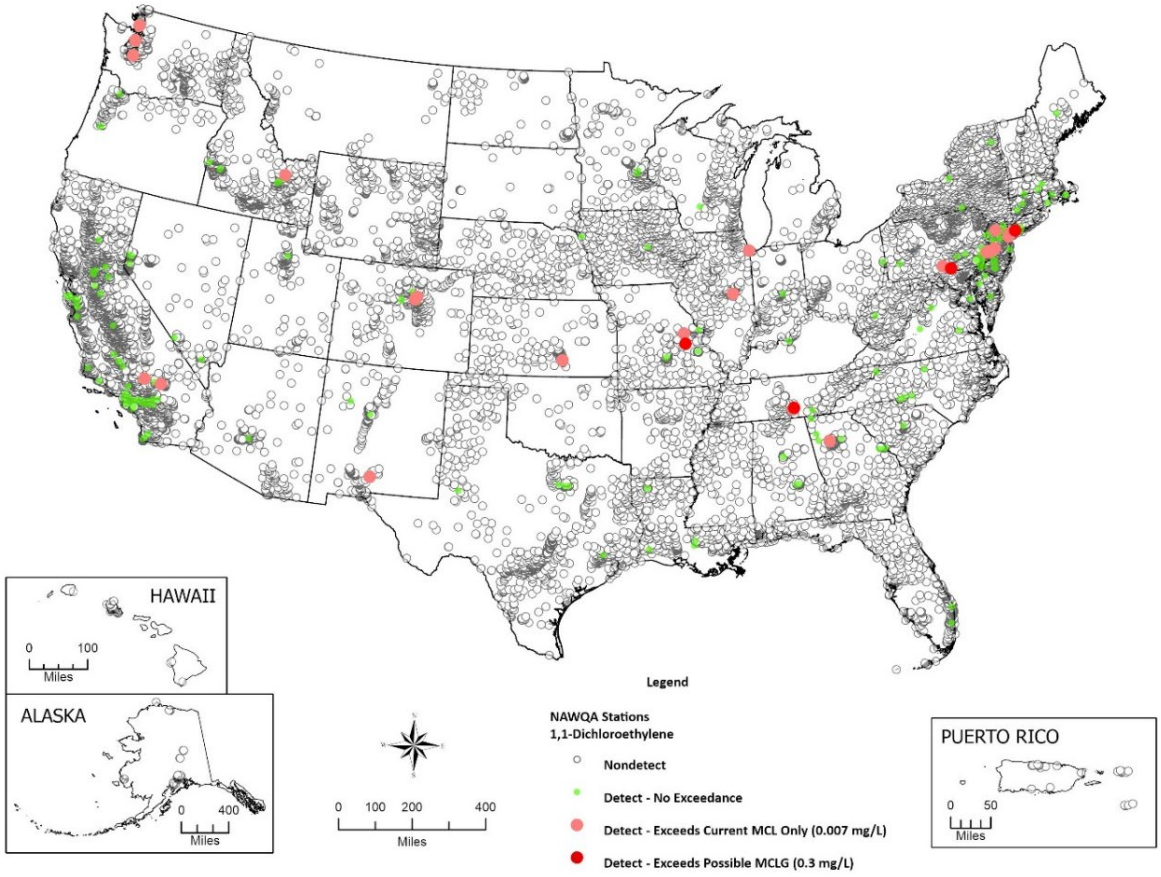
**Exhibit 4-19** provides a comparison of maximum 1,1-dichloroethylene concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. These data indicate that less than 0.4% of NAWQA locations have maximum concentrations between the current MCLG and the higher potential MCLG values. **Exhibit 4-20** presents a spatial representation of the NAWQA data.

**Exhibit 4-19. 1,1-Dichloroethylene Occurrence in NAWQA: Number and Percent of Locations by Water Type**

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 1,571 (100%) | 19,369 (100%) | 20,940 (100%) |
| All samples are nondetects [a] | 1,536 (97.8%) | 18,868 (97.4%) | 20,404 (97.4%) |
| At least one detection | 35 (2.2%) | 501 (2.6%) | 536 (2.6%) |
| Maximum concentration exceeds current MCL (0.007 mg/L) | 4 (0.3%) | 76 (0.4%) | 80 (0.4%) |
| Maximum concentration exceeds potential MCLG (0.3 mg/L) | 0 (0%) | 4 (<0.1%) | 4 (<0.1%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits range from 0.00002 to 0.007 mg/L. Excludes 501 nondetects with reporting limits greater than 0.007 mg/L. Of these, 41 are greater than 0.3 mg/L, ranging from 0.5 mg/L to 5 mg/L.

**Exhibit 4-20. 1,1-Dichloroethylene NAWQA Occurrence (1991–2021)**




Source: USGS, 2021

## 4.3.9 2,4-D

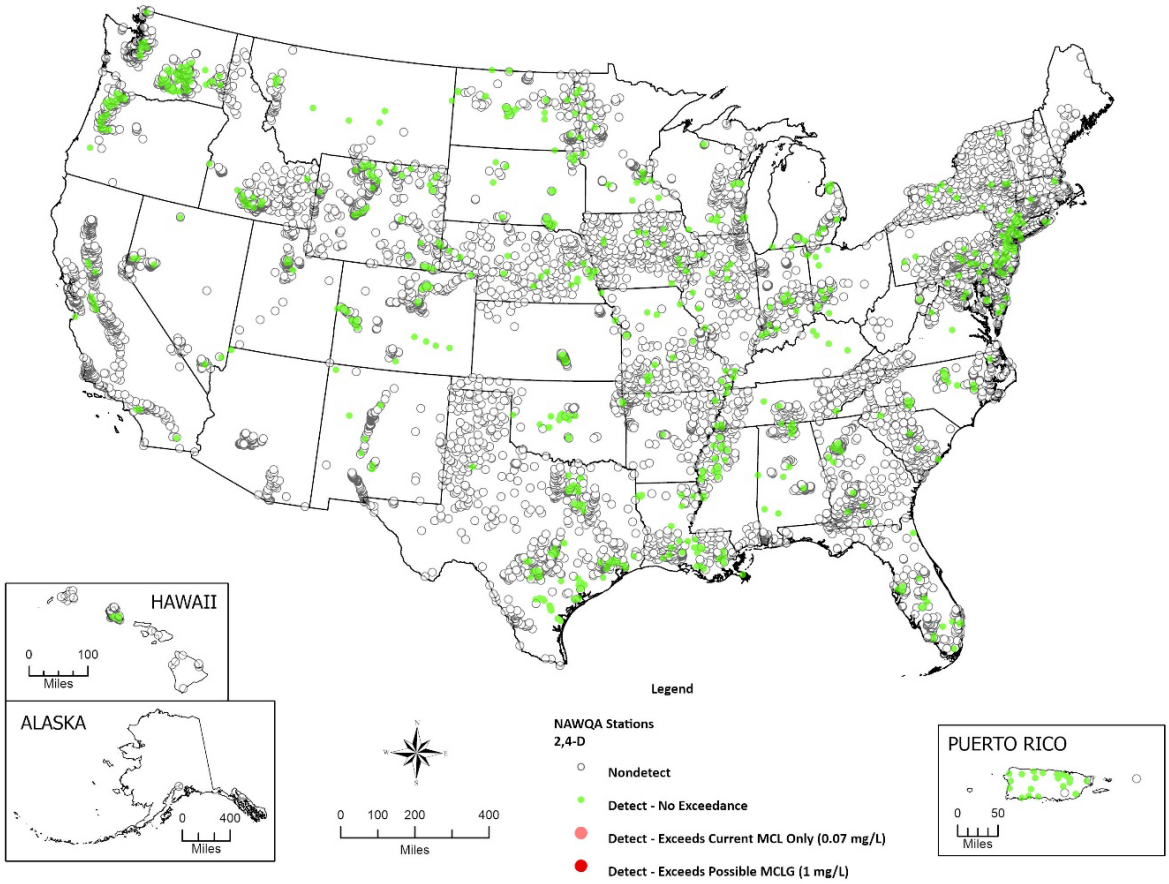
**Exhibit 4-21** provides comparisons of maximum 2,4-D concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-22** presents a spatial representation of the NAWQA data. The NAWQA data indicate that no sampling locations for this contaminant had a maximum concentration between the current MCL and the potential MCLG values. **Exhibit 4-23** shows 2,4-D raw water concentrations from the PDP database. Data from both sources indicate no occurrence of this contaminant above the current MCLG and the higher potential MCLG value.

## Exhibit 4-21. 2,4-D Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 2,569 (100%) | 8,958 (100%) | 11,527 (100%) |
| All samples are nondetects[a] | 1,756 (68.4%) | 8,894 (99.3%) | 10,650 (92.4%) |
| At least one detection | 813 (31.6%) | 64 (0.7%) | 877 (7.6%) |
| Maximum concentration exceeds current MCL (0.07 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |
| Maximum concentration exceeds potential MCLG (1 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2020; estimates based on maximum sample values at each location).
a. The detection limits range from 0.000007 to 0.0078 mg.

## Exhibit 4-22. 2,4-D NAWQA Occurrence (1991–2020)




Source: USGS, 2021

### Exhibit 4-23. Summary of 2,4-D Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2,802 | 1,835 |
| Samples with detected quantity [a] | 1,858 | 196 |
| Maximum concentration exceeds current MCL (0.07 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (1 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 1.1 X $10^{-6}$ mg/L to 3.5 X $10^{-3}$ mg/L. Detection limits range from 6.5 X $10^{-7}$ mg/L to 2.6 X $10^{-4}$ mg/L.

## 4.3.10 Glyphosate

**Exhibit 4-24** provides a summary of glyphosate occurrence at NAWQA monitoring locations including a comparison of maximum glyphosate concentrations with the current MCL and potential MCLG values. **Exhibit 4-25** presents a spatial representation of the NAWQA data. Although these data are sparse, they indicate that none of the sampling locations for this contaminant have maximum concentrations above the current MCL.

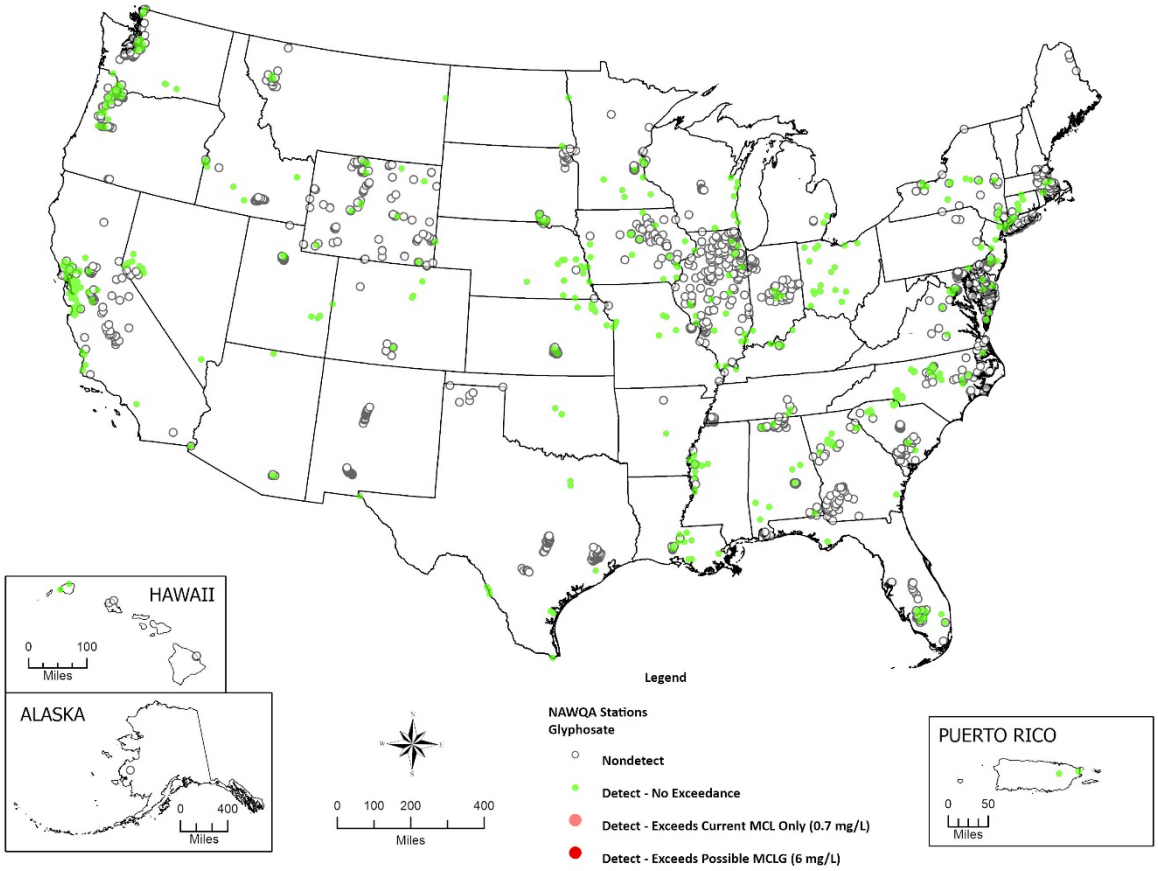
### Exhibit 4-24. Glyphosate Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 806 (100%) | 1,355 (100%) | 2,161 (100%) |
| All samples are nondetects [a] | 326 (40.4%) | 1,291 (95.3%) | 1,617 (74.8%) |
| At least one detection | 480 (59.6%) | 64 (4.7%) | 544 (25.2%) |
| Maximum concentration exceeds current MCL (0.7 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |
| Maximum concentration exceeds potential MCLG (6 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).

a. The detection limits range from 0.00002 to 0.025 mg/L.

**Exhibit 4-25. Glyphosate NAWQA Occurrence (1991–2021)**




Source: USGS, 2021

## 4.3.11 Lindane

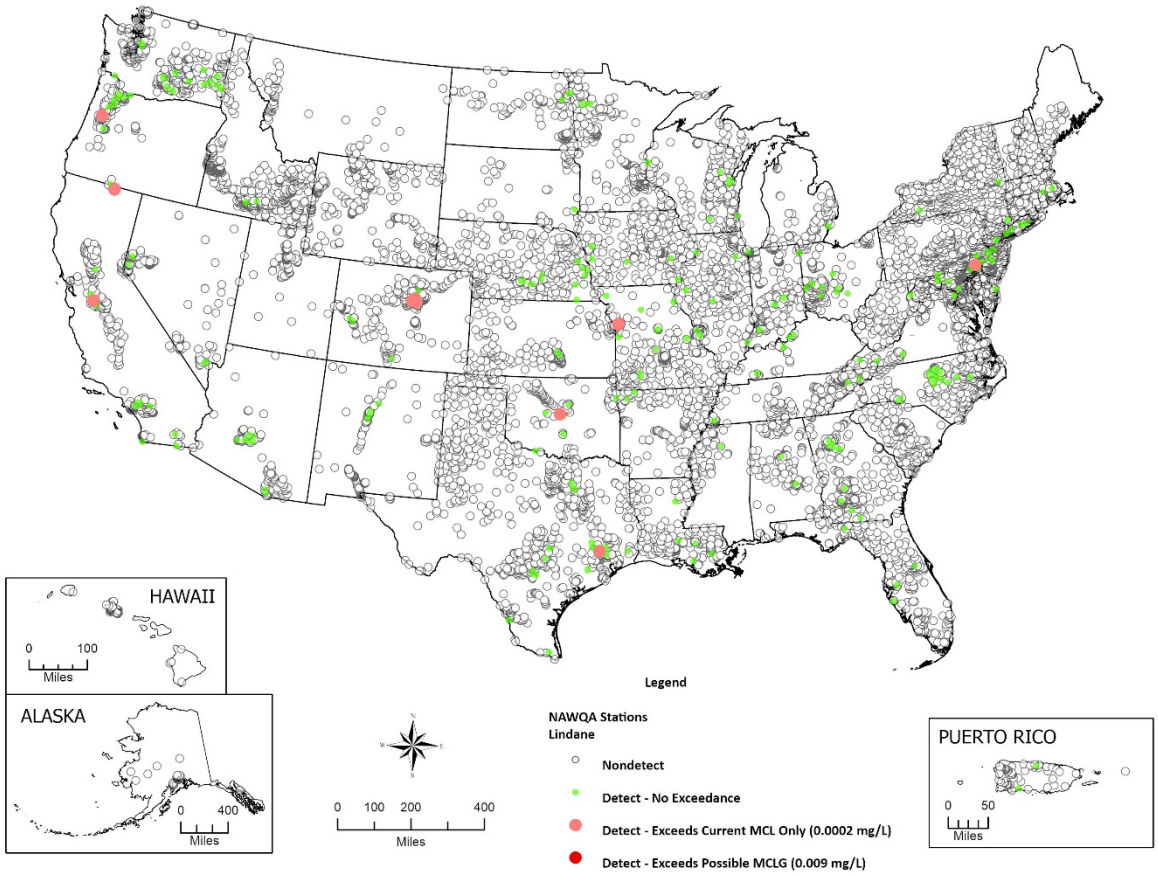
**Exhibit 4-26** provides a comparison of maximum lindane concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-27** presents a spatial representation of the NAWQA data. These data indicate that less than 0.1% of NAWQA locations have maximum concentrations above the current MCL value and no locations have maximum concentrations above the higher potential MCLG value.

## Exhibit 4-26. Lindane Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 4,879 (100%) | 11,900 (100%) | 16,779 (100%) |
| All samples are nondetects [a] | 4,597 (94.2%) | 11,862 (99.7%) | 16,459 (98.1%) |
| At least one detection | 282 (5.8%) | 38 (0.3%) | 320 (1.9%) |
| Maximum concentration exceeds current MCL (0.0002 mg/L) | 10 (0.2%) | 1 (<0.1%) | 11 (<0.1%) |
| Maximum concentration exceeds potential MCLG (0.009 mg/L) | 0 (0%) | 0 (0.) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits range from 0.0000006 to 0.0002 mg/L. Excludes 33 nondetects with reporting limits greater than 0.2 mg/L. Of these, 7 are greater than 0.009 mg/L, ranging from 1 mg/L to 3 mg/L.

## Exhibit 4-27. Lindane NAWQA Occurrence (1991–2021)




Source: USGS, 2021

**Exhibit 4-28** shows lindane raw water concentrations from the PDP database. Data from both sources indicate almost no occurrence of this contaminant above the current MCL value and no occurrence above the higher potential MCLG value.

### Exhibit 4-28. Summary of Lindane Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2739 | 401 |
| Samples with detected quantity [a] | 3 | 0 |
| Maximum concentration exceeds current MCL (0.0002 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (0.009 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 3.3 X $10^{-5}$ mg/L to 1.0 X $10^{-4}$ mg/L. Detection limits range from 1.0 X $10^{-5}$ mg/L to 6.6 X $10^{-5}$ mg/L.

## 4.3.12 Picloram

**Exhibit 4-29** provides a comparison of maximum picloram concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-30** presents a spatial representation of the NAWQA data. **Exhibit 4-31** shows picloram raw water concentrations from the PDP database. Data from both sources indicate no occurrence of this contaminant above the current MCL and the higher potential MCLG values.

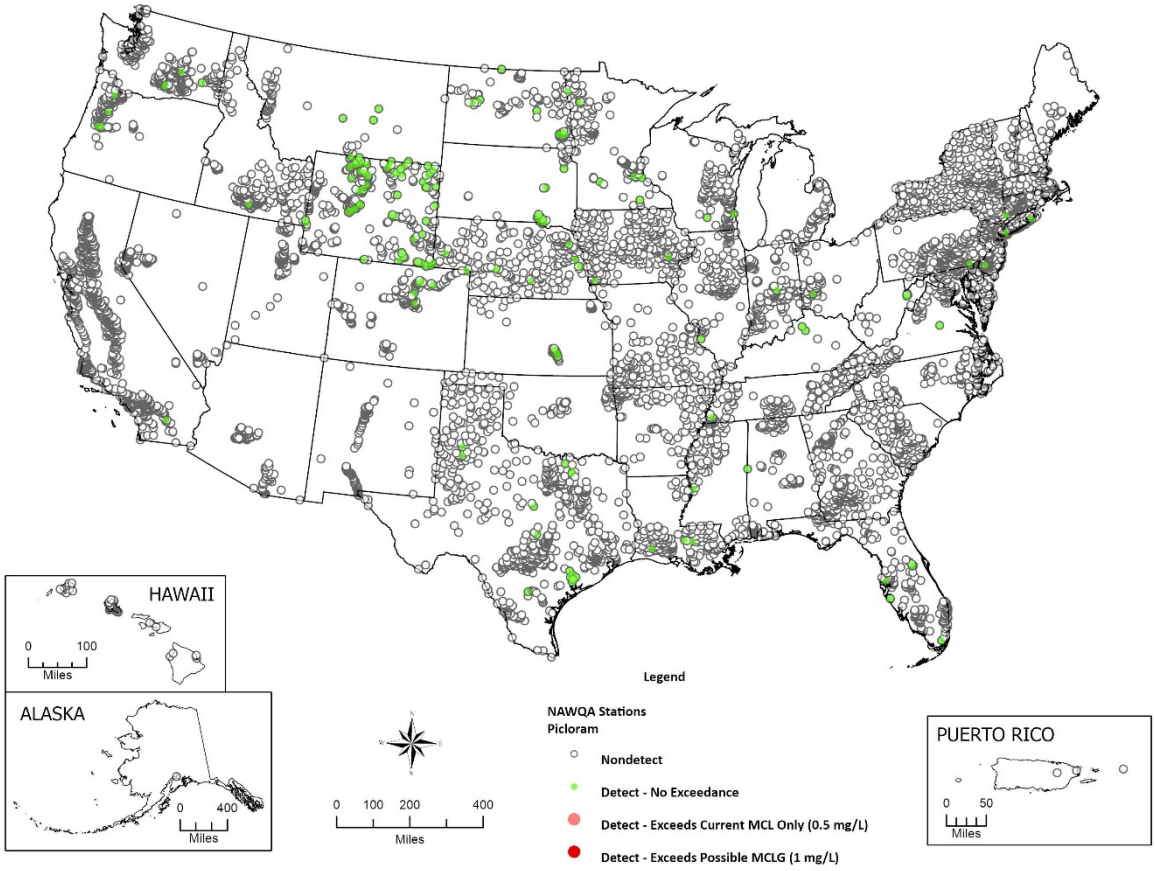
### Exhibit 4-29. Picloram Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 2,356 (100%) | 8,855 (100%) | 11,211 (100%) |
| All samples are nondetects [a] | 2,251 (95.5%) | 8,775 (99.1%) | 11,026 (98.3%) |
| At least one detection | 105 (4.5%) | 80 (0.9%) | 185 (1.7%) |
| Maximum concentration exceeds current MCL (0.5 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |
| Maximum concentration exceeds potential MCLG (1 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2020; estimates based on maximum sample values at each location).

a. The detection limits range from 0.00001 to 0.008 mg/L.

**Exhibit 4-30. Picloram NAWQA Occurrence (1991–2020)**




Source: USGS, 2021

**Exhibit 4-31. Summary of Picloram Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)**

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2,802 | 1,835 |
| Samples with detected quantity [a] | 21 | 11 |
| Maximum concentration exceeds current MCL (0.5 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (1 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 3.7 X $10^{-5}$ mg/L to 8.9 X $10^{-5}$ mg/L. Detection limits range from 1.0 X $10^{-5}$ mg/L to 4.4 X $10^{-3}$ mg/L.

## 4.3.13 Simazine

**Exhibit 4-32** provides comparisons of the maximum simazine concentrations found at locations in the NAWQA database with the current MCL and the potential MCLG value. The maximum concentrations at 0.3% of NAWQA sampling locations exceed the current MCL and no locations have maximum concentrations above the higher potential MCLG value. **Exhibit 4-33** presents a spatial representation of the NAWQA data. **Exhibit 4-34** shows simazine raw water

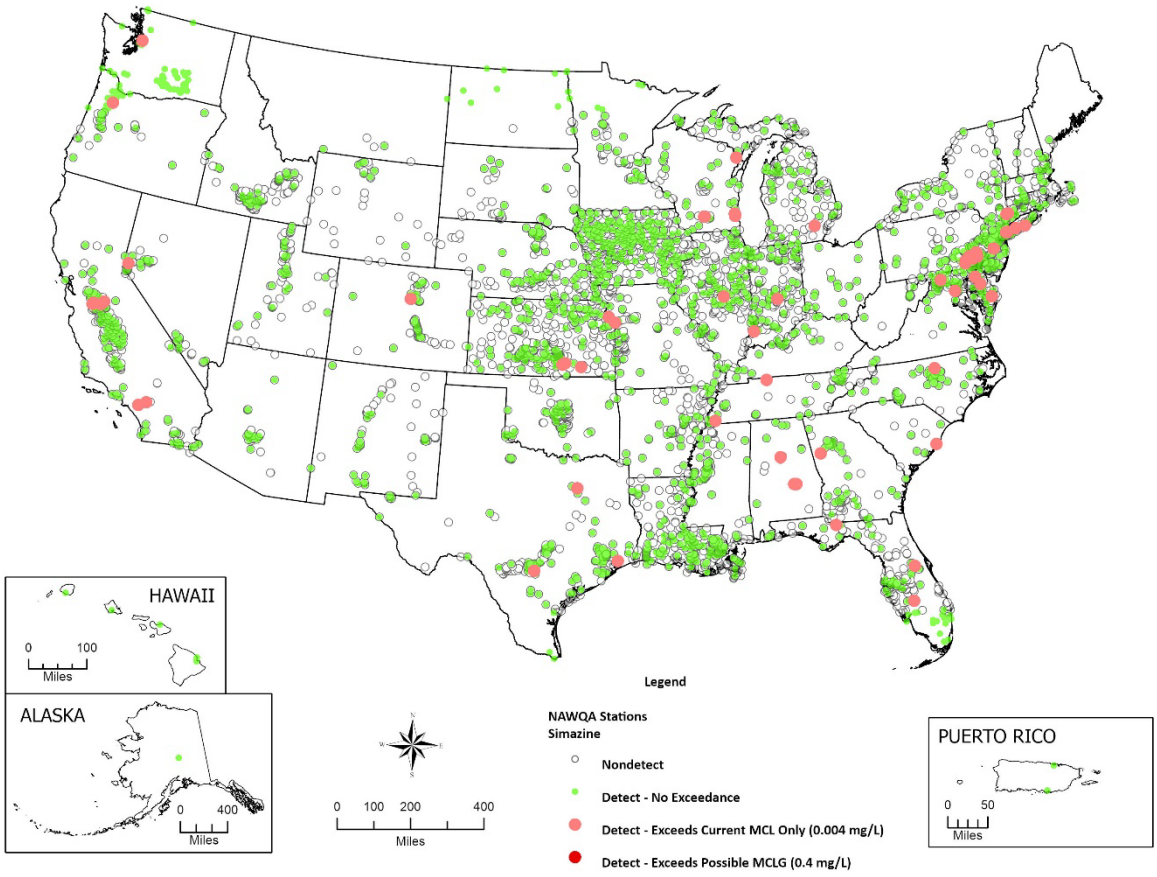
concentrations from the PDP database. None of the samples contained simazine concentrations that exceeded either the current MCL or potential MCLG. Together, data from these sources indicate minimal occurrence of this contaminant above the current MCL and the higher potential MCLG value.

### Exhibit 4-32. Simazine Occurrence in NAWQA: Number and Percent of Locations by Water Type

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 7,233 (100%) | 16,086 (100%) | 23,319 (100%) |
| Locations where all samples are nondetects [a] | 4,910 (67.9%) | 13,985 (86.9%) | 18,895 (81%) |
| At least one detection | 2,323 (32.1%) | 2,101 (13.1%) | 4,424 (19%) |
| Maximum concentration exceeds current MCL (0.004 mg/L) | 51 (0.7%) | 17 (0.1%) | 68 (0.3%) |
| Maximum concentration exceeds potential MCLG (0.4 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).
a. The detection limits range from 0.000002 to 0.002 mg/L. Excludes 49 nondetects with reporting limits greater than 0.004 mg/L, none of which are greater than 0.4 mg/L.

### Exhibit 4-33. Simazine NAWQA Occurrence (1991–2021)




Source: USGS, 2021

**Exhibit 4-34. Summary of Simazine Occurrence for Water Samples in USDA Agricultural Marketing Service PDP (2004–2013)**

| Occurrence Result | Surface Water Samples | Ground Water Samples |
|---|---|---|
| Total Samples | 2,810 | 1,830 |
| Samples with detected quantity [a] | 1,481 | 54 |
| Maximum concentration exceeds current MCL (0.004 mg/L) | 0 | 0 |
| Maximum concentration exceeds potential MCLG (0.4 mg/L) | 0 | 0 |

Source: USDA, no date.

a. Detected quantities range from 8.3 X $10^{-5}$ mg/L to 9.3 X $10^{-5}$ mg/L. Detection limits range from 7.1 X $10^{-7}$ mg/L to 5.0 X $10^{-5}$ mg/L.

## 4.3.14 1,1,1-Trichloroethane

**Exhibit 4-35** provides a comparison of maximum 1,1,1-trichloroethane concentrations for locations in the NAWQA database with the current MCL and potential MCLG values. **Exhibit 4-36** presents a spatial representation of the NAWQA data. The NAWQA data indicate that less than 0.1% of the sampling locations for this contaminant have maximum concentrations between the current MCL and the potential MCLG values.

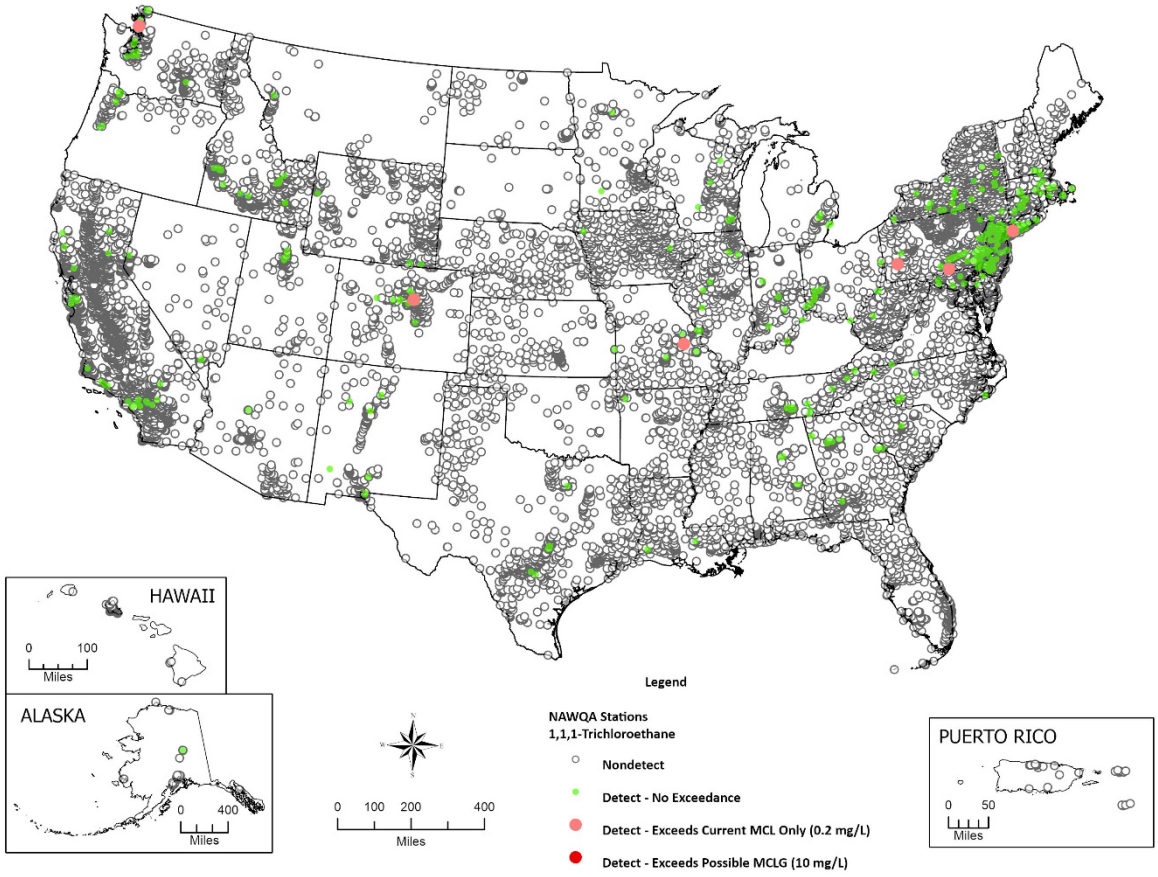
**Exhibit 4-35. 1,1,1-Trichloroethane Occurrence in NAWQA: Number and Percent of Locations by Water Type**

| Occurrence Result | Surface Water | Ground Water | Total |
|---|---|---|---|
| Total locations | 1,747 (100%) | 19,608 (100%) | 21,355 (100%) |
| All samples are nondetects [a] | 1,653 (94.6%) | 18,944 (96.6%) | 20,597 (96.5%) |
| At least one detection | 94 (5.4%) | 664 (3.4%) | 758 (3.5%) |
| Maximum concentration exceeds current MCL (0.2 mg/L) | 1 (0.1%) | 9 (<0.1%) | 10 (<0.1%) |
| Maximum concentration exceeds potential MCLG (10 mg/L) | 0 (0%) | 0 (0%) | 0 (0%) |

Source: USGS, 2021 (national data from 1991 to 2021; estimates based on maximum sample values at each location).

a. The detection limits range from 0.00002 to 0.2 mg/L.

## Exhibit 4-36. 1,1,1-Trichloroethane NAWQA Occurrence (1991–2021)




Source: USGS, 2021

# 5. Conclusions

In its SYR 4, EPA identified the potential to increase the MCLG for several contaminants based on new health effects information available after rule promulgation. A potential MCLG increase and accompanying MCL increase raises the possibility of cost savings to systems treating for the contaminant. The potential for cost savings is system-specific and depends on various factors including the magnitude of the MCL increase, the concentration of a contaminant in source water, the specific treatment technology in use, and the extent to which co-occurring contaminants can affect decisions to change treatment operation. **Exhibit 5-1** and **Exhibit 5-2** present a summary of this information.

The new health effects information results in a wide range of potential MCL increases (see **Exhibit 5-1**). The lowest relative increase is 2 times the current MCL for both diquat and picloram. The highest relative increase is 133 times the current MCL for atrazine.

### Exhibit 5-1. Summary of Potential for Cost Savings Based on Source Water Occurrence Concentrations

| Contaminant | Magnitude of MCLG Increase [a] | NAWQA % Exceed Current MCL | PDP % Exceed Current MCL | NAWQA % Exceed Potential MCLG | PDP % Exceed Potential MCLG |
|---|---|---|---|---|---|
| Alachlor | 15 | 0.5% | 0% | <0.1% | 0% |
| Atrazine | 133 | 1.9% | 0% | <0.1% | 0% |
| Barium | 3 | 0.4% | -- | 0.1% | -- |
| Beryllium | 3 | 0.6% | -- | 0.3% | -- |
| 1,2-Dichlorobenzene | 3 | <0.1% | -- | <0.1% | -- |
| 1,4-Dichlorobenzene | 5 | <0.1% | -- | 0% | -- |
| 1,1-Dichloroethylene | 43 | 0.4% | -- | <0.1% | -- |
| 2,4-D | 14 | 0% | -- | 0% | -- |
| Diquat | 2 | -- | -- | -- | -- |
| Glyphosate | 9 | 0% | -- | 0% | -- |
| Lindane | 45 | <0.1% | 0% | 0% | 0% |
| Picloram | 2 | 0% | 0% | 0% | 0% |
| Simazine | 100 | 0.3% | 0% | 0% | 0% |
| 1,1,1-Trichloroethane | 50 | <0.1% | -- | 0% | -- |

--: No data were available.

a. Number indicates times higher the potential MCLG is than the current MCL. For example, the potential MCLG for alachlor (0.03 mg/L) is 15 times higher than the current MCL (0.002 mg/L).

EPA's analysis of the potential for cost savings was constrained to readily available data. The data available to characterize contaminant occurrence was especially limited because there is no comprehensive dataset that characterizes source water quality for drinking water systems. The TRI release data indicate relatively widespread releases for barium, beryllium, and 1,1-dichloroethylene, but sparse releases of the other contaminants. The USGS pesticide use maps show widespread applications of atrazine, 2,4-D, glyphosate, and picloram, more limited applications of alachlor and diquat, and no application of lindane since 2011. Despite these environmental release patterns, water quality data from the NAWQA Program and PDP indicate minimal occurrence above current MCLG or MCL values. EPA notes that these monitoring

datasets are not based on random or representative sampling events. Furthermore, the datasets include samples from water resources that are not drinking water sources. Therefore, these datasets cannot be used directly to derive quantitative estimates of national occurrence in drinking water sources.

Nevertheless, the summary of the available data in **Exhibit 5-1** shows relatively infrequent contaminant occurrence in potential source waters at the levels of interest. The NAWQA data indicate that the following occur at concentrations that exceed current MCL values: alachlor; atrazine; barium, beryllium; 1,2-dichlorobenzene; 1,4-dichlorobenzene; 1,1-dichlorethylene; lindane; simazine; and 1,1,1-trichloroethane. Only alachlor, atrazine, barium, beryllium, 1,2-dichlorobenzene; 1,4-dichlorobenzene,1,1-dichloroethylene, and lindane occur in concentrations that exceed the potential MCLG values, and these exceedances are rare. Three contaminants – 2,4-D, glyphosate and picloram– are not found at levels above either the current MCLG or the potential MCLG. Diquat, which is not included in the either the NAWQA or PDP datasets, may occur infrequently in source water given less frequent use compared to the other pesticides in the table based on usage patterns (alachlor, atrazine, glyphosate, lindane, picloram, and simazine) and the tendency of diquat to dissipate quickly from surface water and be immobile in soils.

**Exhibit 5-2. Summary of Potential for Cost Savings Based on Treatment Technology**

| Cost Savings Potential | BAT | Contaminant | Co-occurring Contaminants Limit Savings? |
|---|---|---|---|
| High | GAC | 1,2-Dichlorobenzene<br>1,4-Dichlorobenzene<br>1,1-Dichloroethylene<br>1,1,1-Trichloroethane<br>2,4-D<br>Alachlor<br>Atrazine<br>Diquat<br>Lindane<br>Picloram<br>Simazine | Yes |
| High | IX | Barium<br>Beryllium | Yes |
| High | AA | Beryllium | Yes |
| Moderate | LS | Barium<br>Beryllium | Yes |
| Moderate | CF | Beryllium | Yes |
| Low | PTA | 1,2-Dichlorobenzene<br>1,4-Dichlorobenzene<br>1,1-Dichloroethylene<br>1,1,1-Trichloroethane | Yes |
| Low | EDR | Barium<br>Beryllium | Yes |
| Low | RO | Barium<br>Beryllium | Yes |
| Low | OX | Glyphosate | Yes |

AA = Activated Alumina; CF = Coagulation/Filtration; EDR = Electrodialysis [Reversal]; GAC = Granular Activated Carbon; IX = Ion Exchange; LS = Lime Softening; MSBA = Multi-Stage Bubble Aeration; OX = Oxidation (Chlorine or Ozone); PAC = Powdered Activated Carbon; POU = point-of-use; PTA = Packed Tower Aeration; RO = Reverse Osmosis

As **Exhibit 5-2** shows, there is higher potential for operational cost savings for some BAT; however, co-occurrence considerations for all BAT could diminish the potential to alter treatment for higher potential MCLGs. Without national estimates of contaminant occurrence in drinking water sources, EPA cannot determine how many systems currently treat for the contaminants listed in Exhibit 5-2. EPA also does not have national data regarding the treatment technologies being utilized by drinking water systems to control these contaminants.

Despite the possibility for changes in MCLG values that range from 2 to 133 times higher than current MCLs, the available occurrence data for potential drinking water sources indicate relatively low contaminant occurrence in the concentration ranges of interest. Therefore, EPA cannot conclude that there is a meaningful opportunity for system cost savings.

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