# Natural Resource Damages Assessment and Restoration:

# Oil & Hazardous Materials Releases to Groundwater

Karen I. Pelto

Massachusetts Department of Environmental Protection

April 26, 2018

# Natural Resources Held in Trust for the Public by the Commonwealth

**Resources include:**

Biota (fish and wildlife)

Surface Water

**Groundwater**

Air

Soils and Sediment

**Services provided by Natural Resources include:**

Fishing, hunting and shellfishing

Habitat for wildlife

Recreation

Spiritual or cultural use

**Water supply**

# When oil spills or releases of hazardous materials, cleanup and assessment occur

## Cleanup

Determine nature and extent of contamination

Evaluate, select and take actions to eliminate or reduce risks to human health and the environment

## Damages Assessment

Determine type and extent of injuries to natural resources

Evaluate, select and take actions to restore natural resources that compensates the public for injuries

# Natural Resource Damages Authority and Trustees

| **Massachusetts General Laws:** | **Federal Laws:** |
|---|---|
| • Chapter 21E, sections 5A and 11A<br>• Chapter 21A section 2A | • Superfund (CERCLA)<br>• Oil Pollution Act of 1990 |

| **State Trustee:** | **Federal Trustees:** |
|---|---|
| • Secretary of Energy and Environmental Affairs<br>• MassDEP delegated authority to administer NRD Program | • National Oceanic and Atmospheric Administration<br>• U.S. Fish and Wildlife Service<br>• Federally recognized Tribes |

# Over $76 million in Natural Resource Damages settlements in Massachusetts

New Bedford Harbor $20 M

GE/Housatonic $15 M

Fireworks (Tronox) $6.8 M

Bouchard B-120 $19.3 M

IndustriPlex $4.3 M

**Nyanza $3.1 M**

**Sutton Brook Disposal Area $1.65 M**

**Textron/MMR $1.3 M**

**Charles George $1.2 M**

**Blackburn & Union $1 M**

Rubchinuk $747,000

Holyoke Coal Tar $500,000

Global/Irving $312,500

Island End $300,000

Reed & Barton $236,447

Framingham GM $157,425

PSC Palmer $157,000

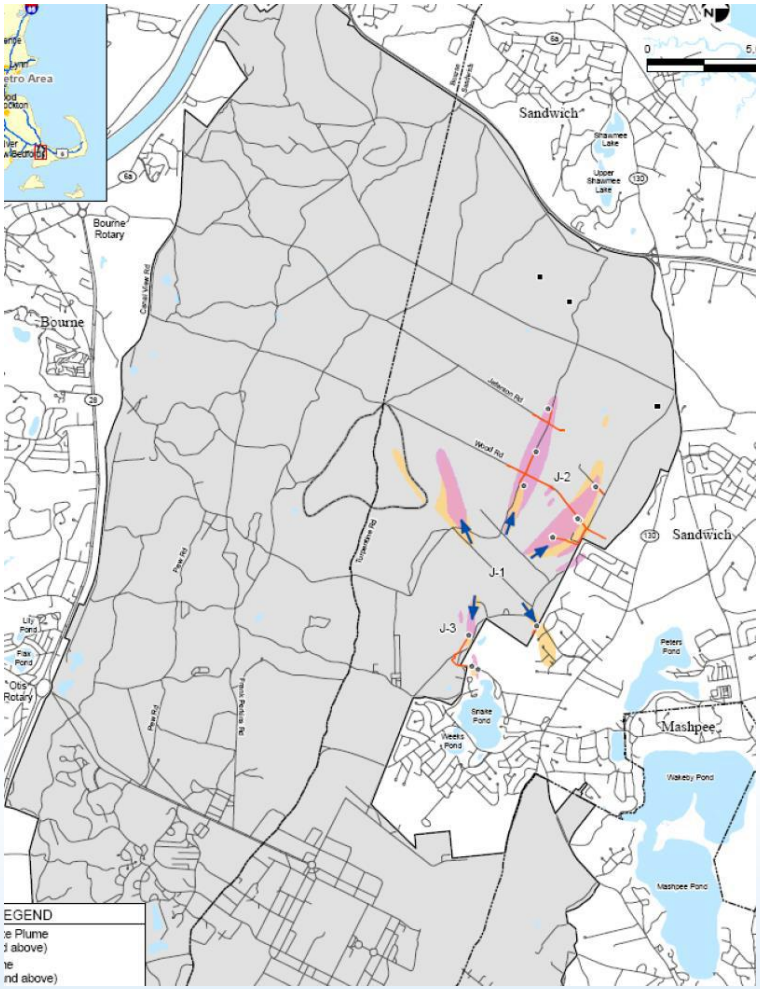
Posavina $155,000

JP Noonan $55,100

Colrain Acid Spill $30,000

Hallmark/Mystic $26,801

# Example of Natural Resource Injury and Restoration: Textron/MMR 21E & CERCLA



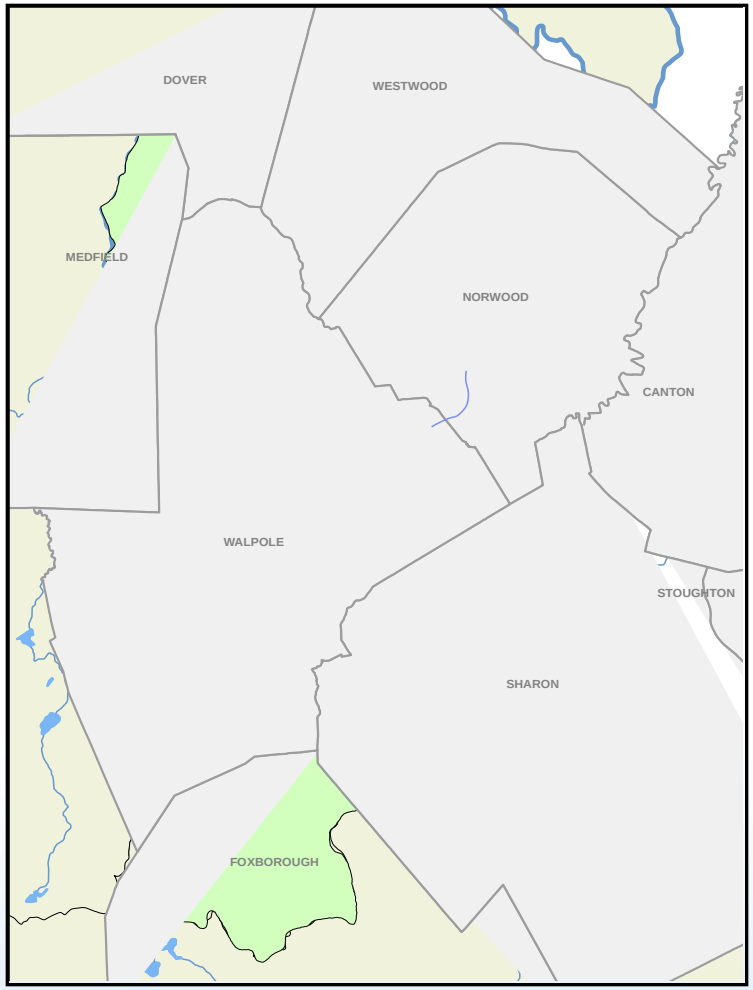

- Exceedance of MA drinking water or other standards is considered an injury to groundwater
- Munitions testing within J ranges
- Sagamore Lens within Sole Source Aquifer
- Wellhead protection areas
- Groundwater contaminated with perchlorate

MassDEP

# Example of Natural Resource Injury and Restoration: Textron/MMR


- $259,200 to purchase 13.7 acres in Mashpee
- $61,200 to purchase 5.3 acres in Sandwich
- $442,700 for Phases I, II, and III of Sandwich's Comprehensive Water Resources Management Plan
- $371,800 for Upper Cape Regional Water Supply Cooperative Sagamore Lens Sustainable Management Plan

# Example of Natural Resource Injury and Restoration: Blackburn & Union NPL




- Head of the Neponset River Sole Source Aquifer
- Groundwater contaminated with VOCs, SVOCs, metals

# Example of Natural Resource Injury and Restoration: Blackburn & Union

Groundwater Recharge

- Protect the quality of current and potential drinking water supplies through aquifer land conservation
- Reduce losses of clean water to aquifers (reduce infiltration and inflow to a sewer system)
- Provide quality recharge to aquifers, (capture, store and infiltrate stormwater that would otherwise be discharged directly to a stream via an existing storm drain system)

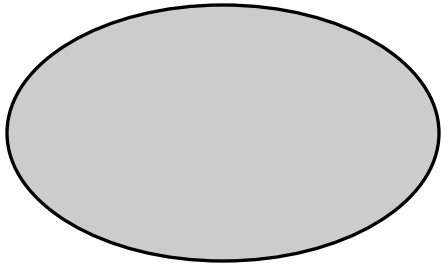
Demand Management

- Implement measures to conserve water (water audits, leak detection surveys and repair)
- Reduce impacts of drought conditions on aquifers and ecosystems

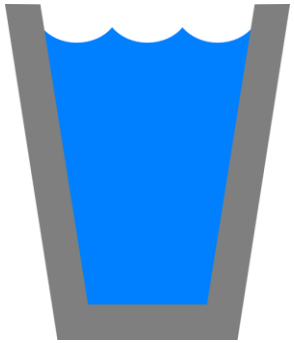
Integrated Management

- Integrate planning and management of current and potential drinking water supplies and wastewater treatment

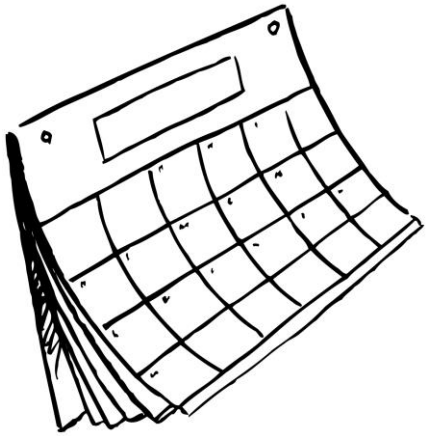
# Schematic of MA Groundwater Method



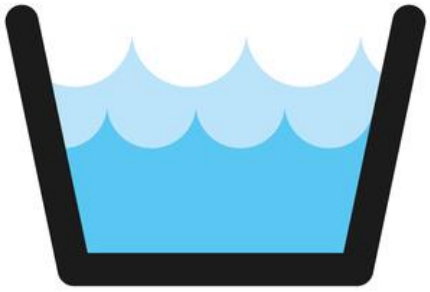
Area



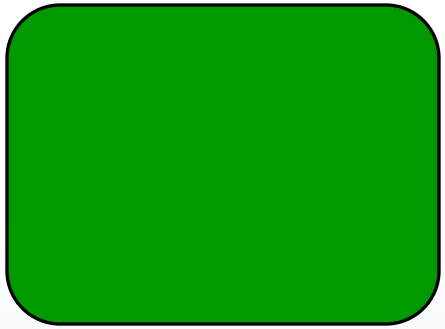
Volume



Time



Total Volume



Area

Theoretical Well (gallons per minute)

Annual Replacement Volume

IEc

# Standard Groundwater NRDA Methodology & Review of Historical Release Data

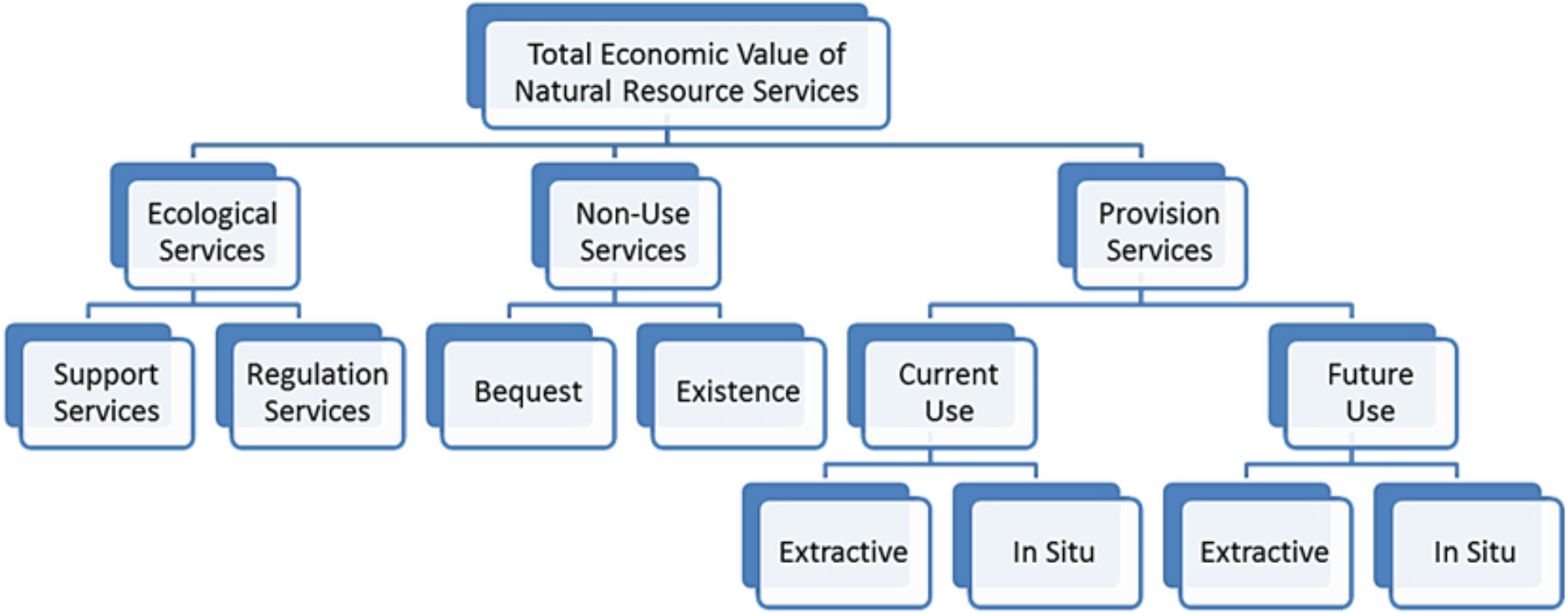
Scott Friedman & Sophie Swetz
Industrial Economics, Incorporated
www.indecon.com

25 April 2018

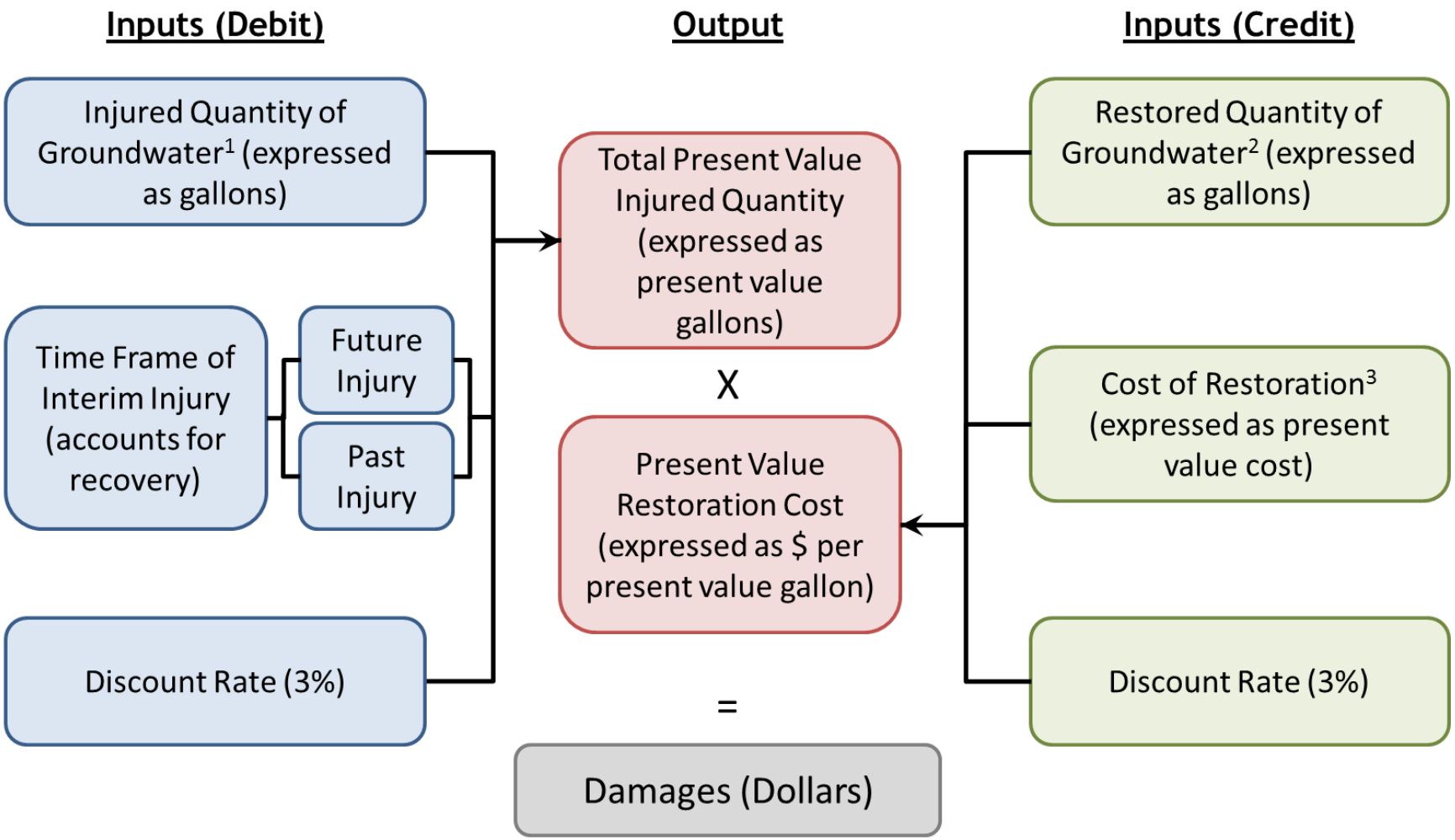
# Draft Results

| Description (n = 5) | Min | Max |
|---|---|---|
| Acres of Groundwater Contamination | 1 | 2 |
| Timeframe of Contamination (years) | 2 | 25 |
| Present value quantity of injured groundwater (gallons) | 2,172,976 | 21,896,323 |
| Hypothetical well pumping rate (gpd) | 178 | 1,798 |
| Required compensatory recharge protection area (acres) | 0 | 1.38 |
| Land acquisition cost ($) | $990 | $33,857 |
| Compensatory Restoration cost ($) | $0 | $32,379 |

# Groundwater Services



# Resource Equivalency Analysis




[1] Quantity of injured groundwater is based on spatial extent of the plume and the recharge rate.
[2] Quantity of restored groundwater is derived from the restoration of recharge.
[3] Cost of restoration is based on the costs of restoration alternatives that protect or enhance recharge.

# Resource Equivalency Analysis - Debit

| Input | Potential Source/Notes |
|---|---|
| Injury Determination | Contamination above a threshold |
| Injury Start Year | Year contamination was first identified |
| Current Year | Year in which the assessment occurs |
| Injury End Year | Year of temporary/permanent solution or year of predicted permanent solution |
| Baseline | Conditions but for the contamination |
| Discount Rate | 3% (standard NRDA practice) |
| Recharge Rate (ft/year) | USGS estimates or fraction of precipitation rate |
| Change in Area of Contamination | Constant in Area of contamination for the purposes of this method |
| Area of contamination (acres) | Surface area of contaminated groundwater |

# Resource Equivalency Analysis - Credit

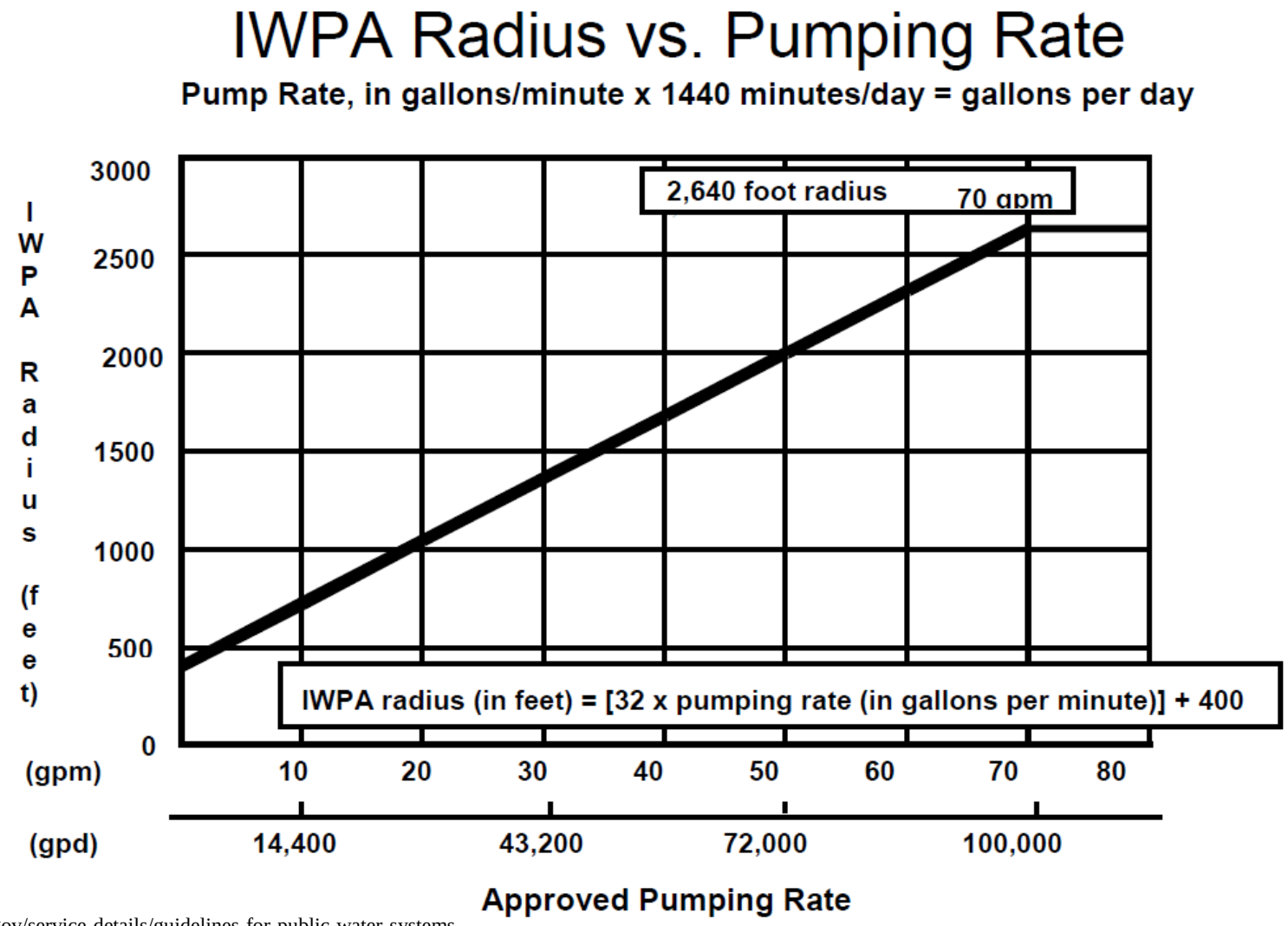
| Input | Source/Notes |
|---|---|
| Restoration Start Year | Year of assessment |
| Current Year | Year in which the assessment occurs |
| Restoration End Year | In perpetuity |
| Discount Rate | 3% (standard NRDA practice) |
| Pumping Rate | gpd or gpm of annual replacement volume |
| Required Land Protection Area | Land required to protect the annualized replacement volume by treating that volume as if it were the approved pumping rate |
| Zone I | Protective radii for all other Public Water System wells, Wellfields, and infiltration galleries are determined by the following equation: Zone I radius in feet = (150 x log of pumping rate in gpd) - 350. |
| Cost of Land ($/Acre) | Assessor data, transaction data, reimbursable state-owned land valuations |

# Draft Approach – Debit: Total PV

$$PV = \sum_{i=1}^{n} Y_i \quad \text{Annual Injured Volume (g)} \quad * \quad ((1+3\%)^{(\text{current year} - \text{year n})})$$

| Year | Unavailable Volume | Present Value Volume |
|---|---|---|
| 2000 | 1,076,230 | 1,832,209 |
| 2001 | 1,076,230 | 1,778,844 |
| 2002 | 1,076,230 | 1,727,033 |
| 2003 | 1,076,230 | 1,676,731 |
| 2004 | 1,076,230 | 1,627,894 |
| 2005 | 1,076,230 | 1,580,480 |
| 2006 | 1,076,230 | 1,534,446 |
| 2007 | 1,076,230 | 1,489,754 |
| 2008 | 1,076,230 | 1,446,363 |
| 2009 | 1,076,230 | 1,404,236 |
| 2010 | 1,076,230 | 1,363,336 |
| 2011 | 1,076,230 | 1,323,627 |
| 2012 | 1,076,230 | 1,285,075 |
| 2013 | 1,076,230 | 1,247,645 |
| 2014 | 1,076,230 | 1,211,306 |
| 2015 | 1,076,230 | 1,176,025 |
| 2016 | 1,076,230 | 1,141,772 |
| 2017 | 1,076,230 | 1,108,517 |
| 2018 | 1,076,230 | 1,076,230 |

# Draft Approach – Credit: Recharge Protection




https://www.mass.gov/service-details/guidelines-for-public-water-systems

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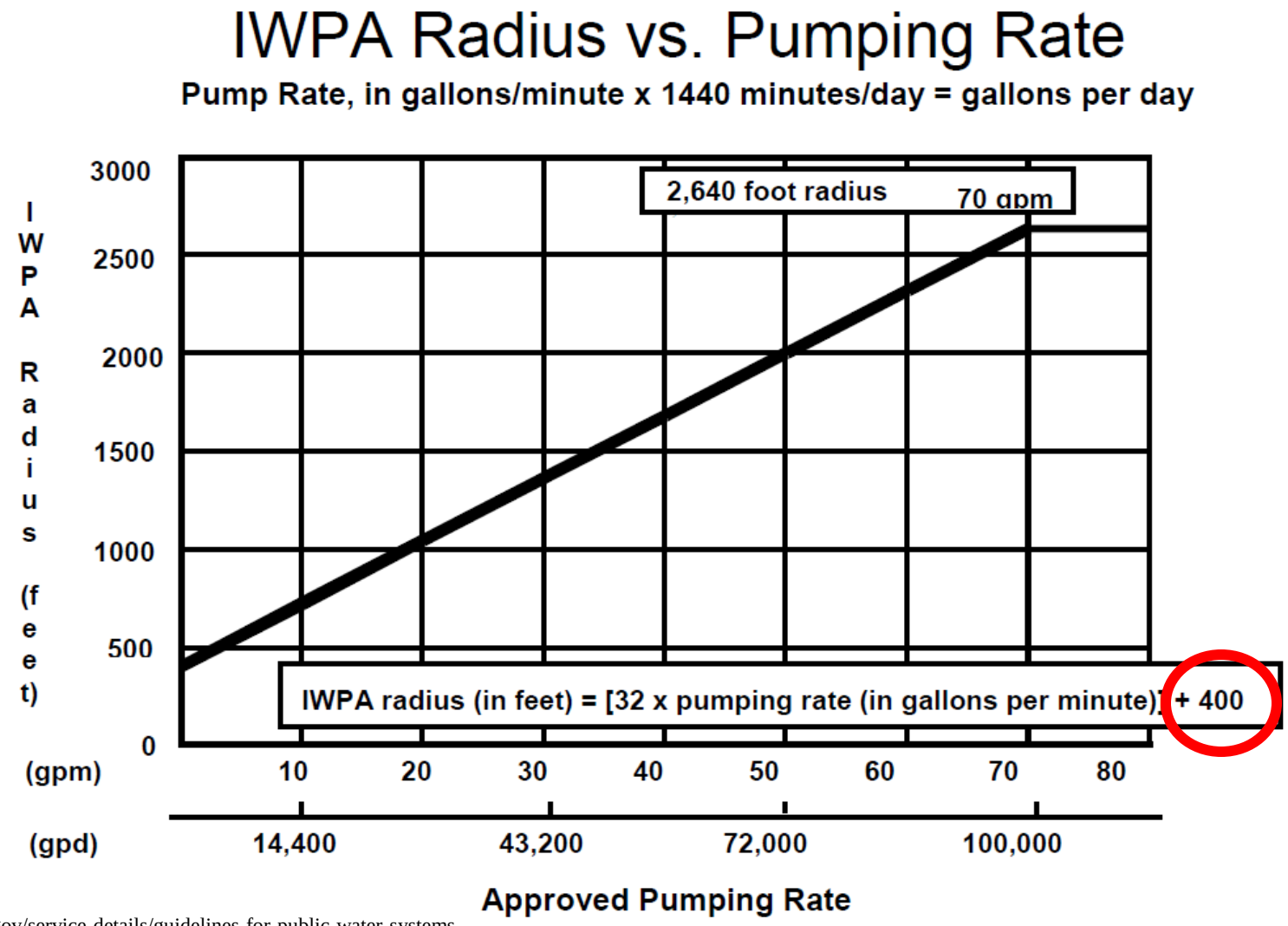


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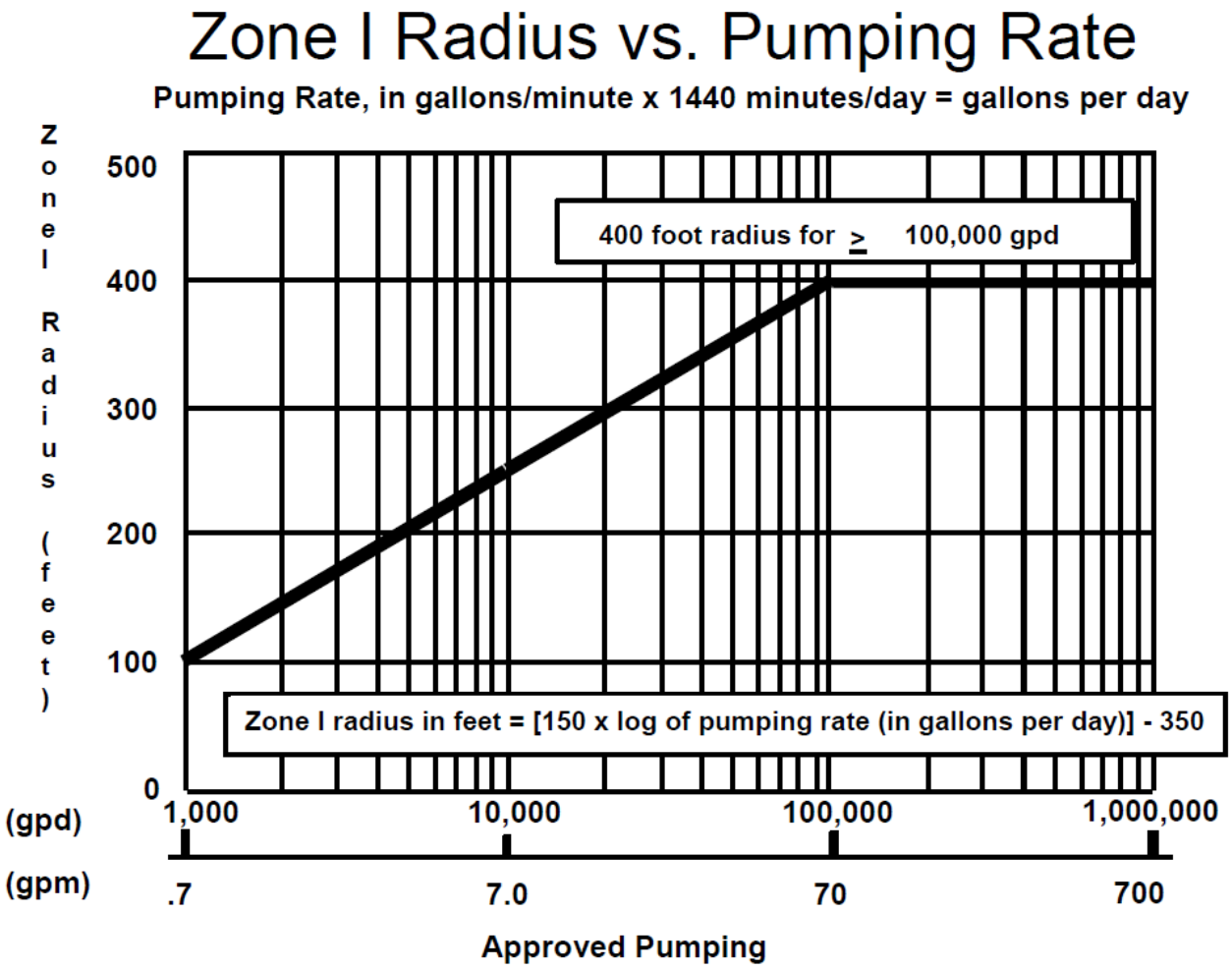


**A minimum Zone I radius of 100 feet** shall be applied to all groundwater sources with Approved Yields of 1,000 gallons per day or less.

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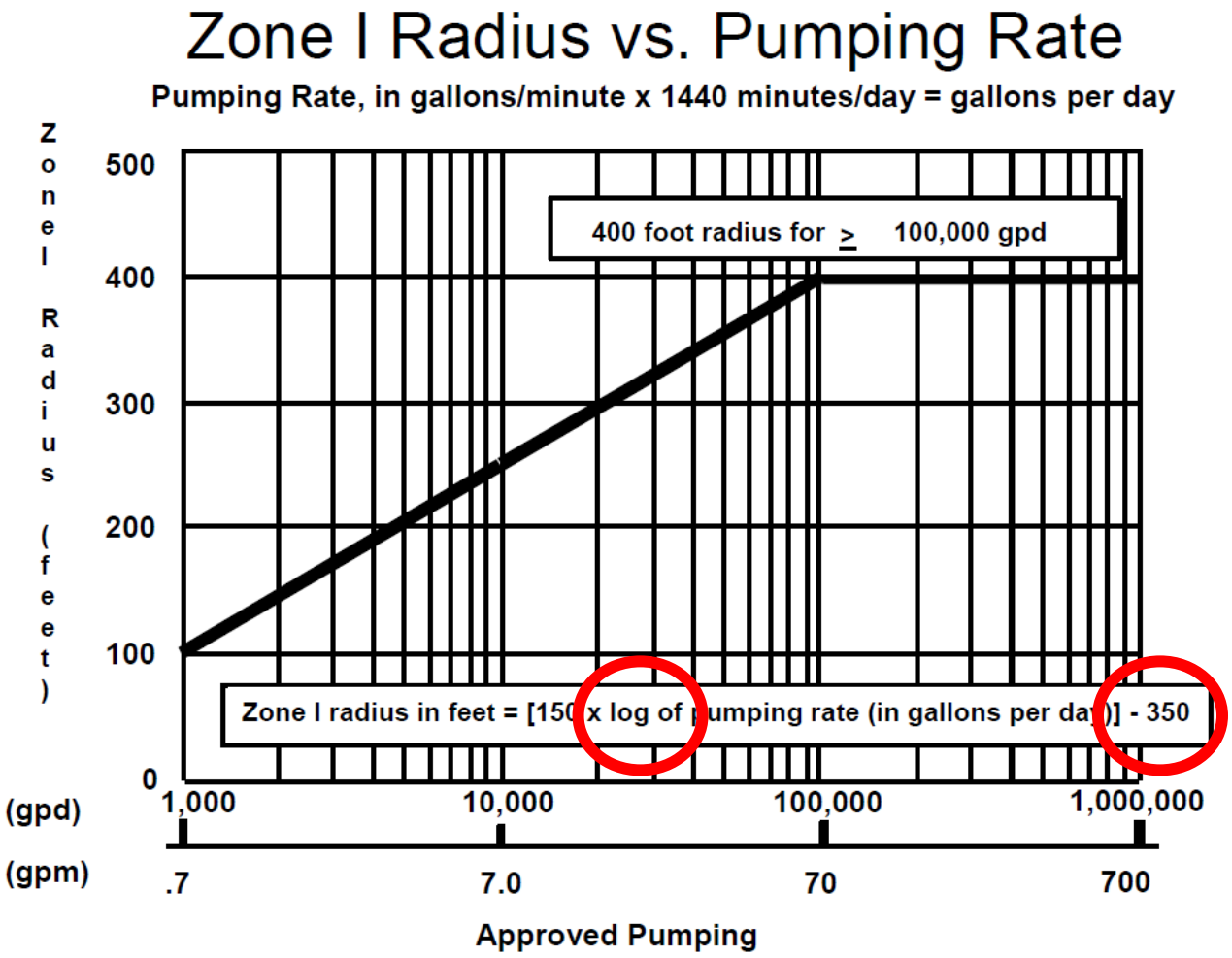


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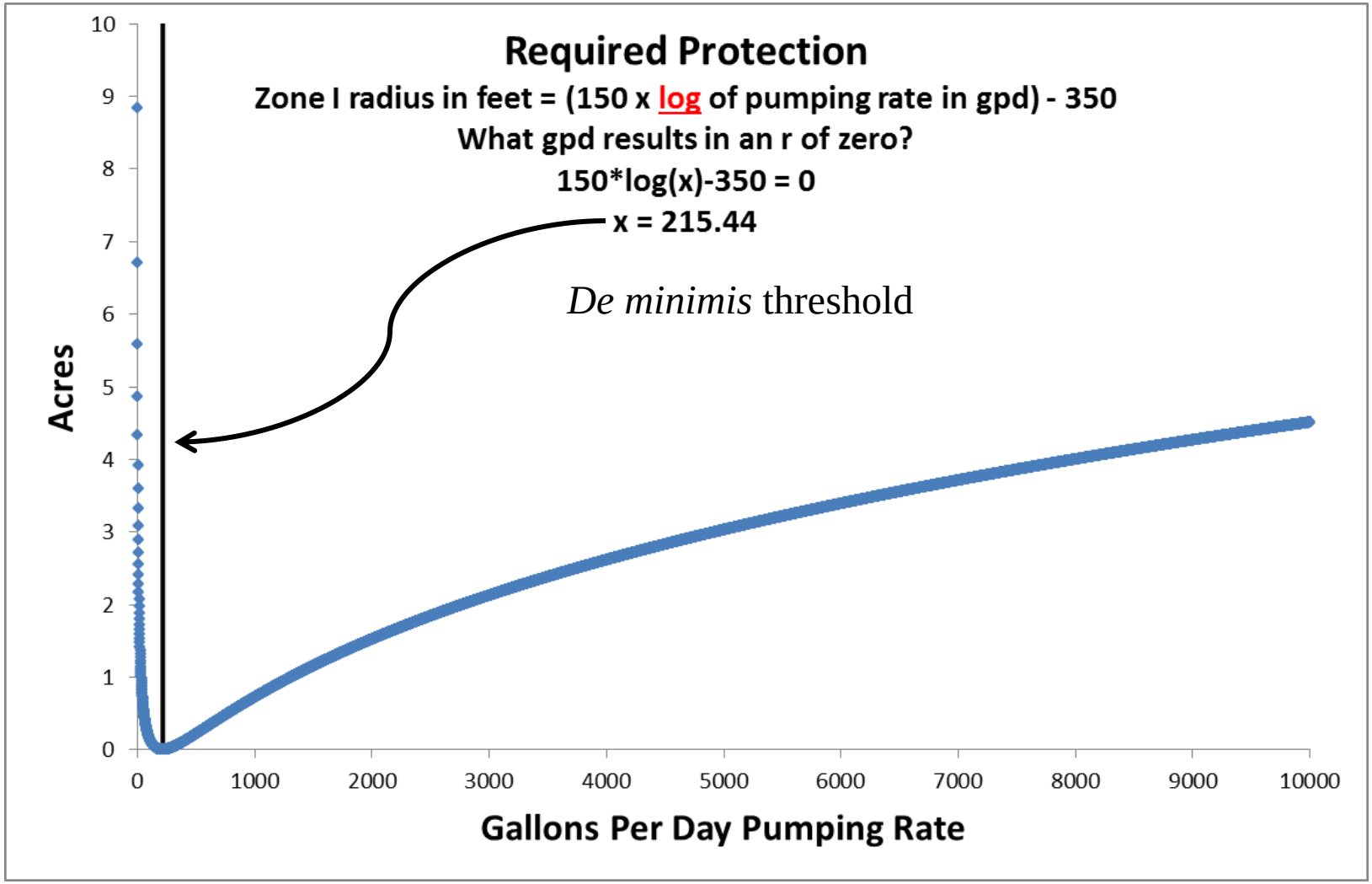

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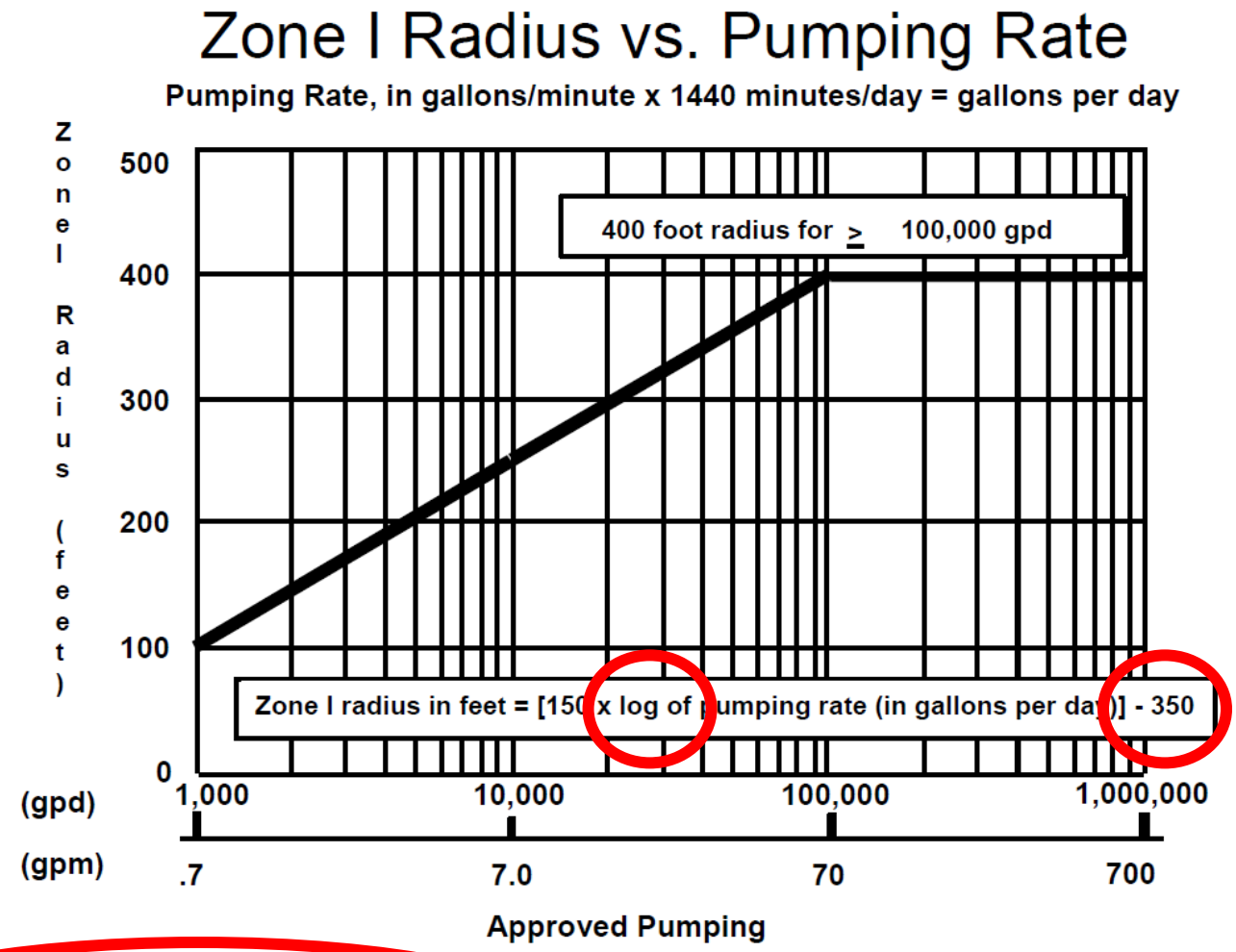


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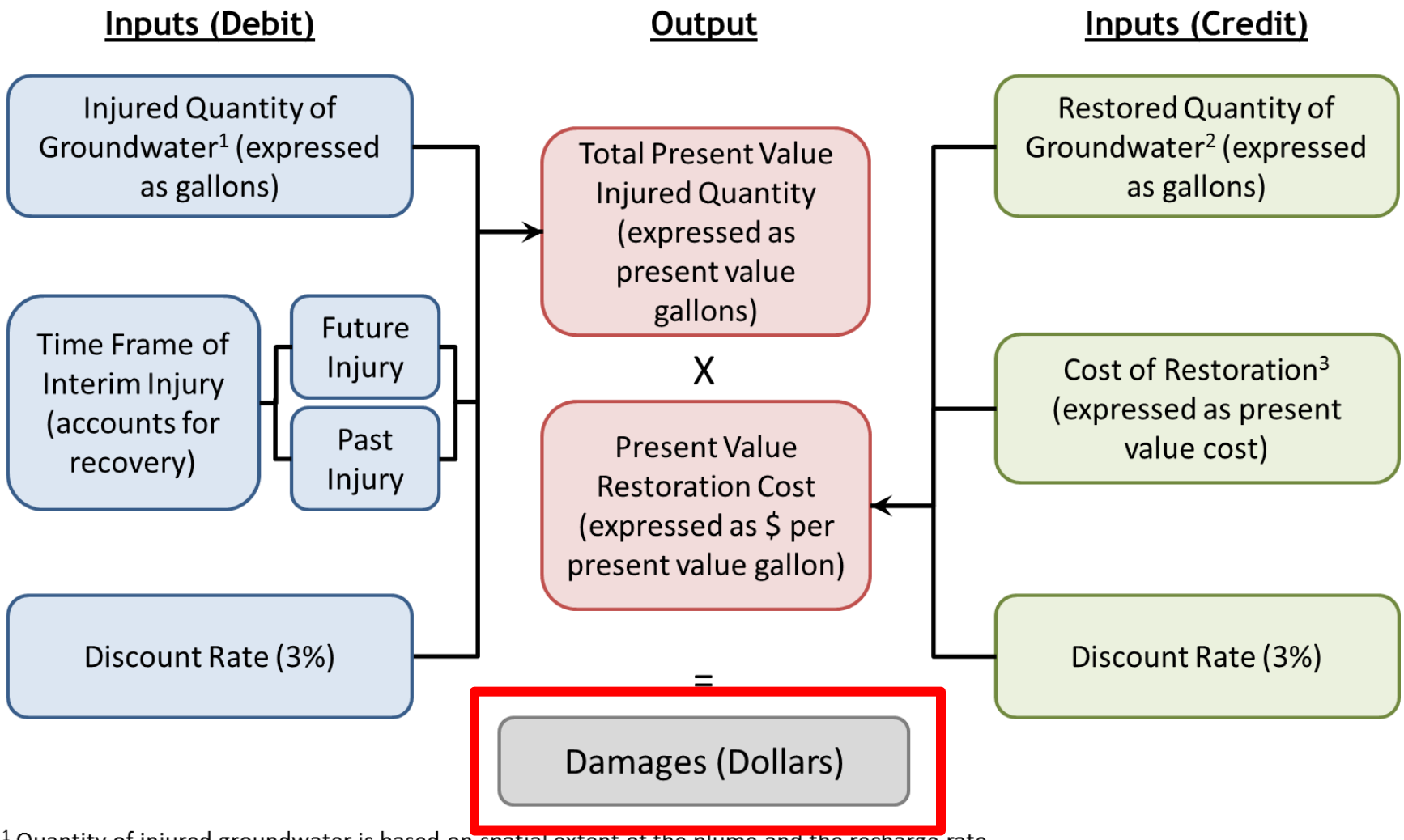


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# Draft Approach – Output: Summary

$$\text{Annual Injured Volume (g)} = \text{Area of GW Contamination (Acres)} * \text{43,560 ft}^2\text{ per acre} * \text{Recharge Rate (ft)} * \text{7.48 g per ft}^3$$

$$\text{Restoration (gpd)} = \frac{3\% * \left\{ \sum_{i=1}^{n} Y_i \text{ Annual Injured Volume (g)} * ((1+3\%)^{(\text{current year} - \text{year n})}) \right\}}{365.25 \text{ days}}$$

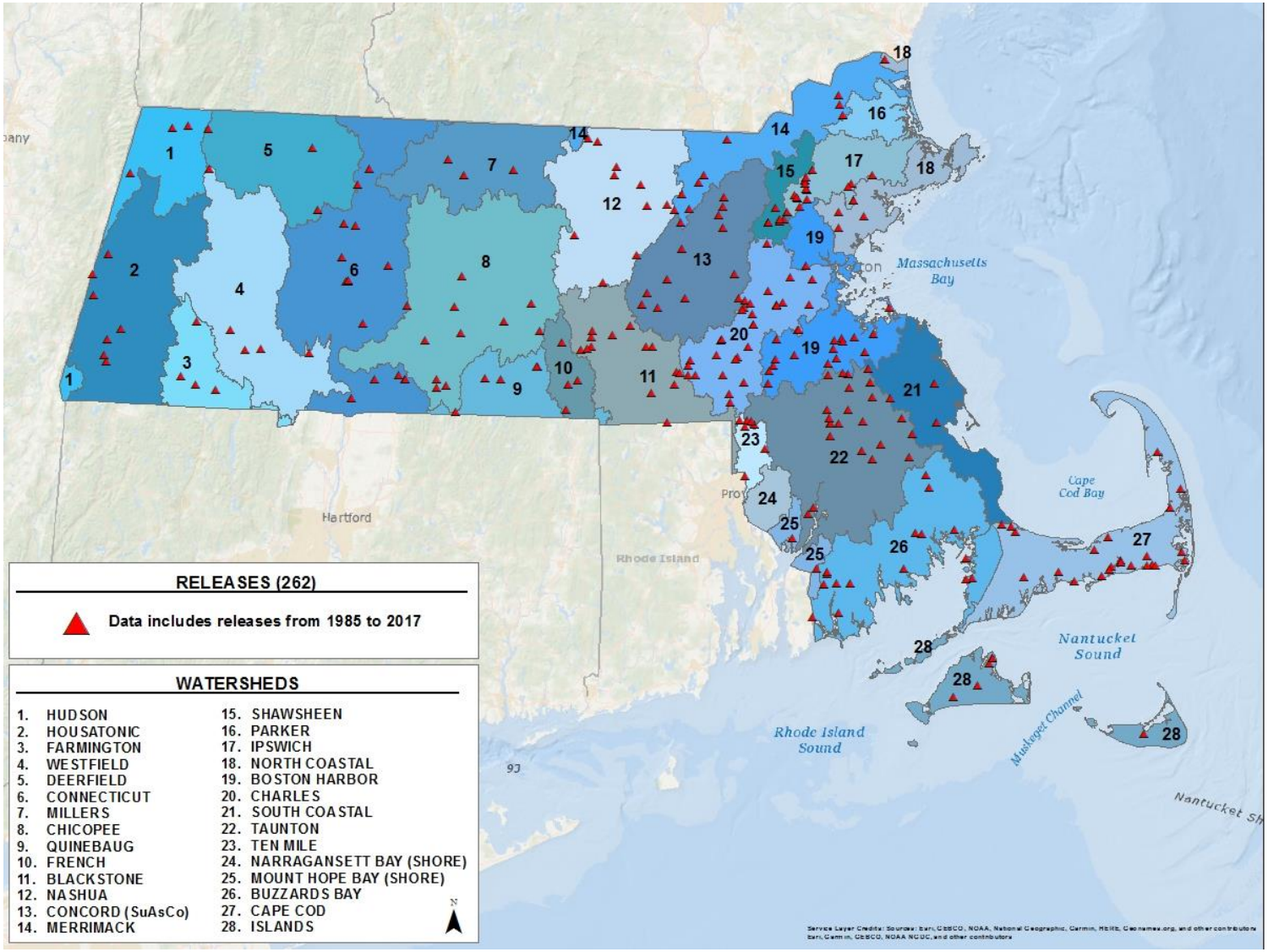
$$Required\ Restoration\ (acres) = \pi\ * ((150 * \log(restoration\ (gpd)) - 350)^2)$$

$$Damages\ (\$) = Required\ Restoration\ (acres) * acquisition\ \$/acre$$

# *De minimis* and Maximum Considerations

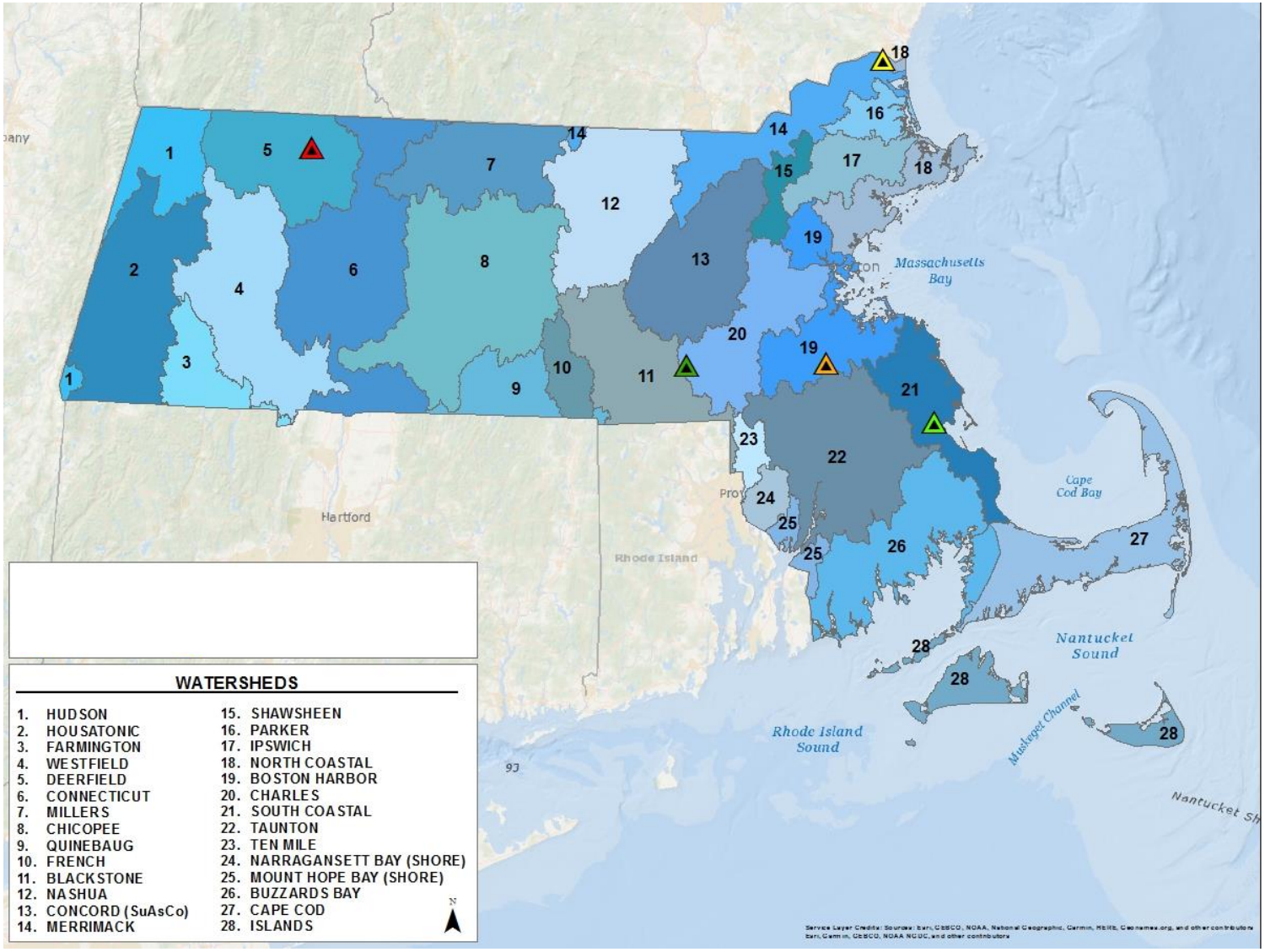
- Area of contamination
  - Minimum – 0.75 acres
  - Maximum - none
- Gallons per day pumping rate for restoration
  - Minimum – 215.44
  - Maximum - none
- Timeframe (end year – start year)
  - Minimum – one year
  - Maximum - none

# Historical Releases (all releases)




Data provided by MassDEP

# Historical Releases (n=5 for back testing)

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# Historical Releases (n=5 for back testing)

| RTN | 3 | 4 | 2 | 4 | 1 | Units |
|---|---|---|---|---|---|---|
| Inputs | Value | Value | Value | Value | Value | |
| Area of groundwater contamination | 1.86 | 1.50 | 2.00 | 1.00 | 2.00 | acres |
| Start of injury | 2000 | 2000 | 2012 | 1990 | 1997 | year |
| Start Year of Remediation | 2001 | 2005 | 2012 | 1995 | 2003 | year |
| End of injury | 2015 | 2015 | 2014 | 2015 | 2014 | year |
| Recharge | 1.78 | 1.88 | 1.88 | 2.25 | 1.78 | feet |
| Current Year | 2018 | 2018 | 2018 | 2018 | 2018 | year |
| Minimum acquisition size | 1 | 1 | 1 | 1 | 1 | acres |
| Discount rate | 3% | 3% | 3% | 3% | 3% | % |
| Watershed | North Coastal | Boston Harbor | Charles | South Coastal | Deerfield | NA |
| Watershed | Watershed Specific | Watershed Specific | Watershed Specific | Watershed Specific | Watershed Specific | State wide or Watershed Specfic |
| Land acquisition inflation adjustment | 100% | 100% | 100% | 100% | 100% | % |
| Program Management Costs | 10% | 10% | 10% | 10% | 10% | % |
| De minimis area of contamination | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | acres |
| De minimis gpd | 215.44 | 215.44 | 215.44 | 215.44 | 215.44 | gallons per day |
| De minimis timeframe of contamination | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | years |

**Data provided by MassDEP**

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| | Zone I Radius Pumping Rate | | | | | |
| Results | Value | Value | Value | Value | Value | Units |
| Area of groundwater contamination | 81,022 | 65,340 | 87,120 | 43,560 | 87,120 | square feet |
| Starting annual volume of groundwater contamination | 1,076,230 | 916,394 | 1,225,116 | 733,115 | 1,159,951 | gallons |
| Present value quantity of injured groundwater | 13,627,828 | 14,150,226 | 2,172,976 | 20,635,308 | 21,896,323 | gallons |
| Annual Replacement Volume | 408,835 | 424,507 | 65,189 | 619,059 | 656,890 | gallons per year |
| Hypothetical well pumping rate (gpm) | 0.8 | 0.8 | 0.1 | 1.2 | 1.2 | gallons per minute |
| Hypothetical well pumping rate (gpd) | 1,119 | 1,162 | 178 | 1,695 | 1,798 | gallons per day |
| Required compensatory recharge protection area | 0.83 | 0.87 | 0.00 | 1.30 | 1.38 | acres |
| Land acquisition cost | $ 24,901 | $ 33,857 | $ 23,457 | $ 6,393 | $ 990 | dollars per acre |
| Compensatory restoration costs | $22,763 | $32,379 | $0 | $9,157 | $1,501 | dollars |

Data provided by MassDEP

| RTN | 3 | 4 |
|---|---|---|
| **Inputs** | **Value** | **Value** |
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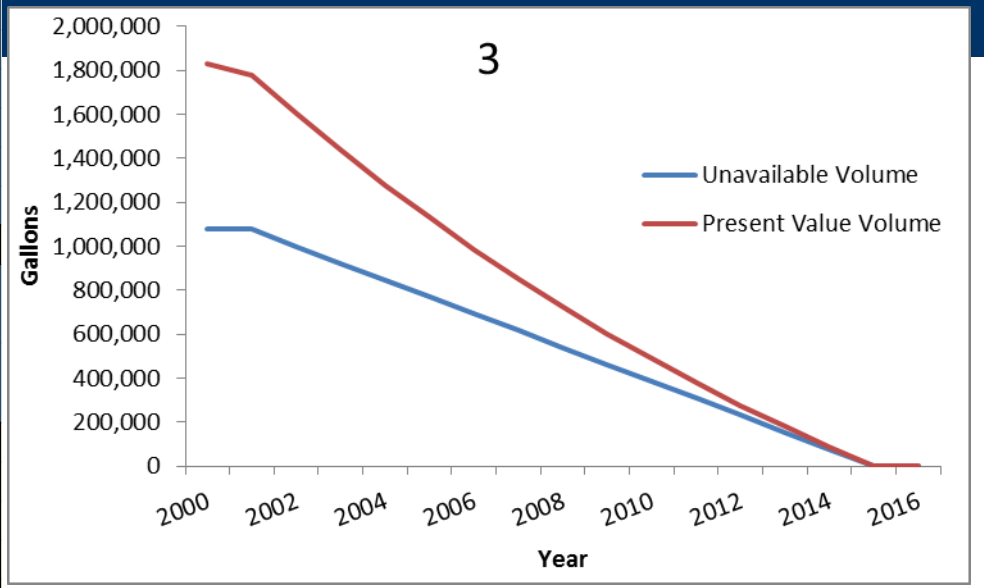


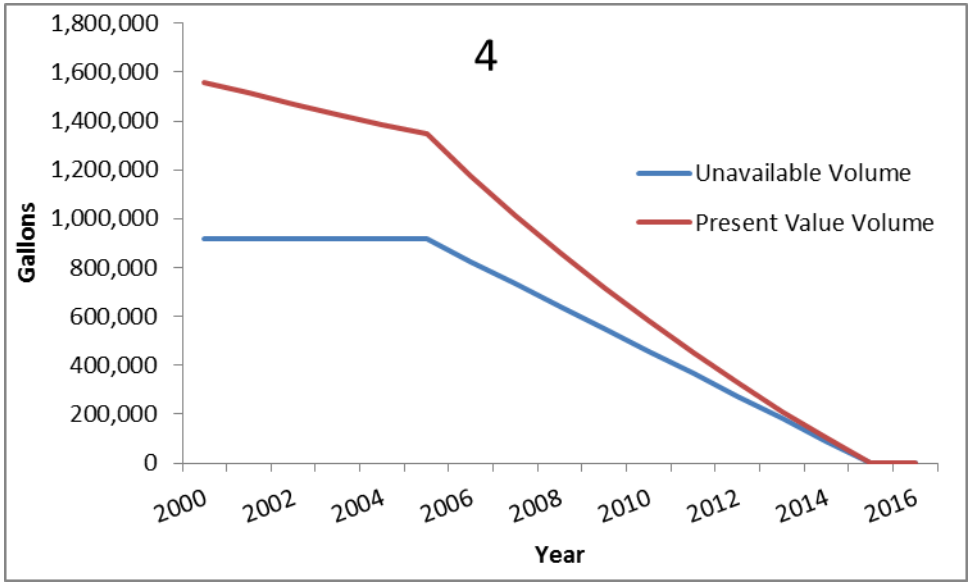


Data provided by MassDEP

IEc

# Questions?


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