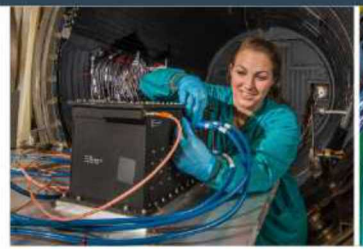
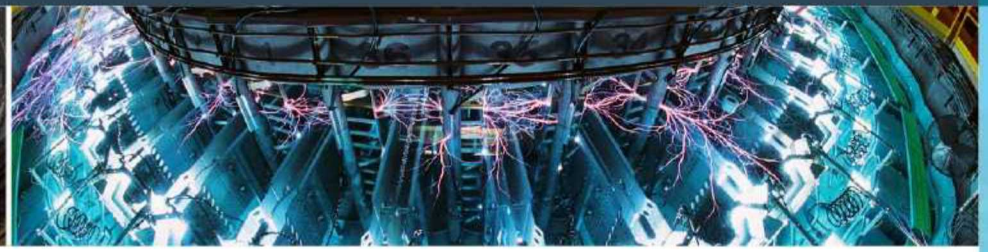
SAND2020-6856C

# Importance of Plant-Level Characteristics for Assessment of Water-Related Threats to Electric Power Sector





PRESENTED BY

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Sandia National Laboratories

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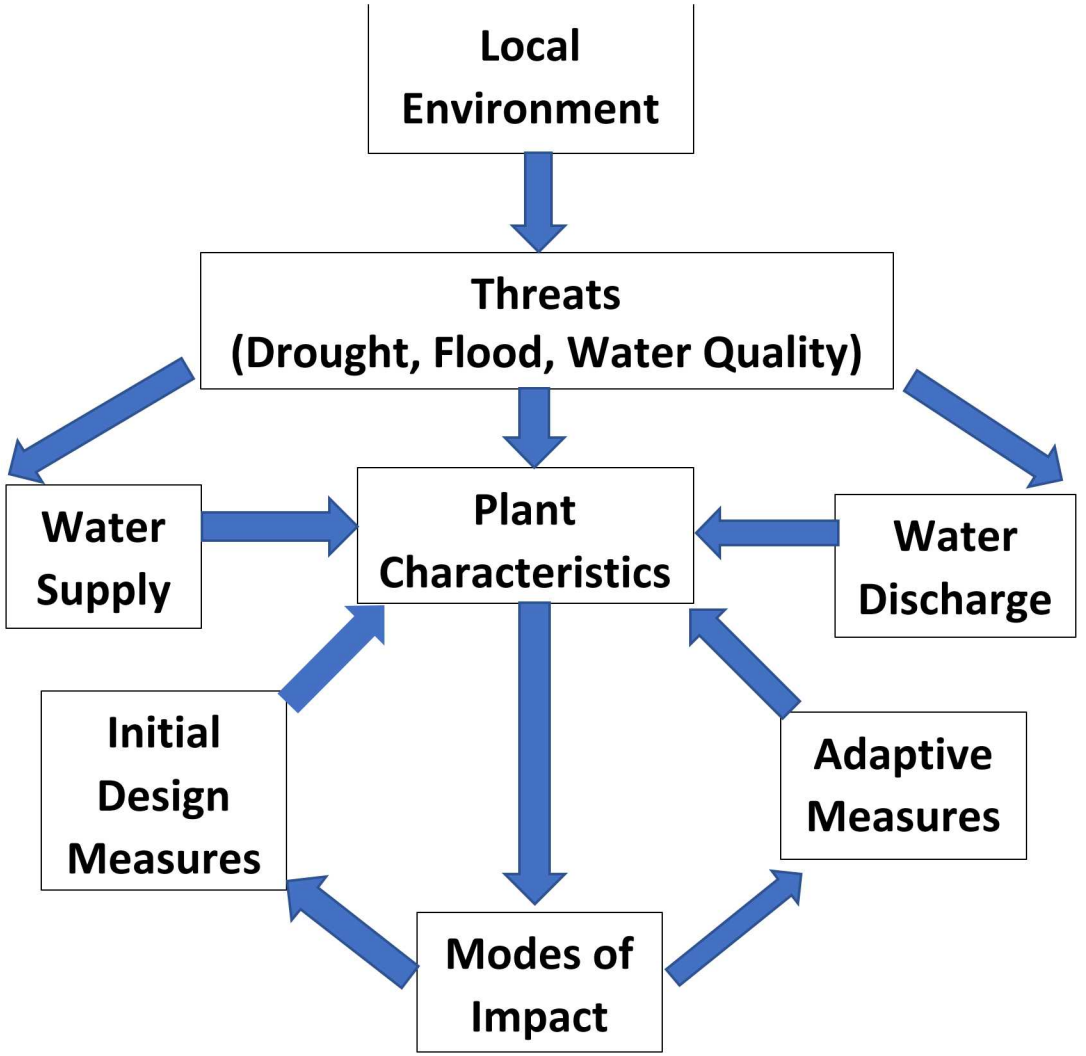
# Problem

- Thermoelectric power generation is threatened by disruption to water supply (quantity and quality).
- Threat assessments attempt to project how this threat is evolving with changing climate, technology, and resource demand.
- Current assessments fail to consider critical plant-level data:
  - Unique modes of impact due to drought, flood, and water quality; and
  - Local mitigation measures employed.

# Objective

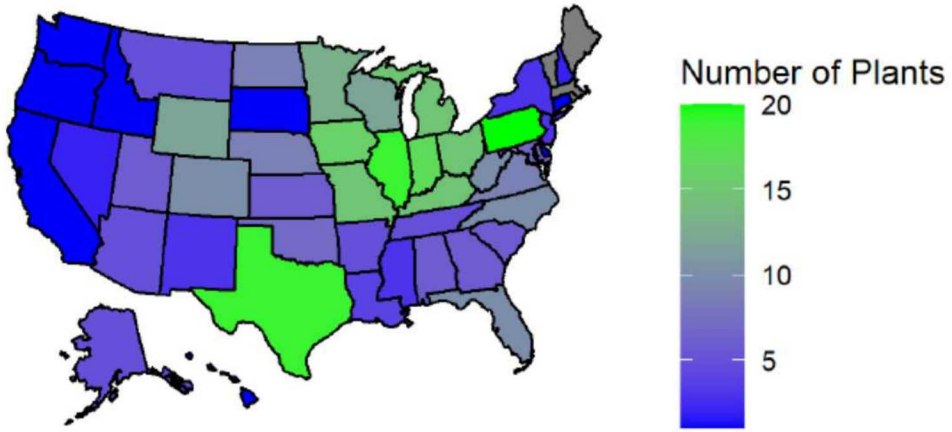
Conduct plant-level survey to determine:

- Specific modes through which extreme conditions impact power plant operations, and
- Specific measures implemented by owners/operators to mitigate water-related threats.



# Questionnaire

- Contacted power plant operators.
- Semi-structure interview process conducted by phone.
- Approximately 30 questions.
- Limited to coal-fired generation.




Coal-Fired Plants Operating in U.S.

## Water-Related Threat Questions

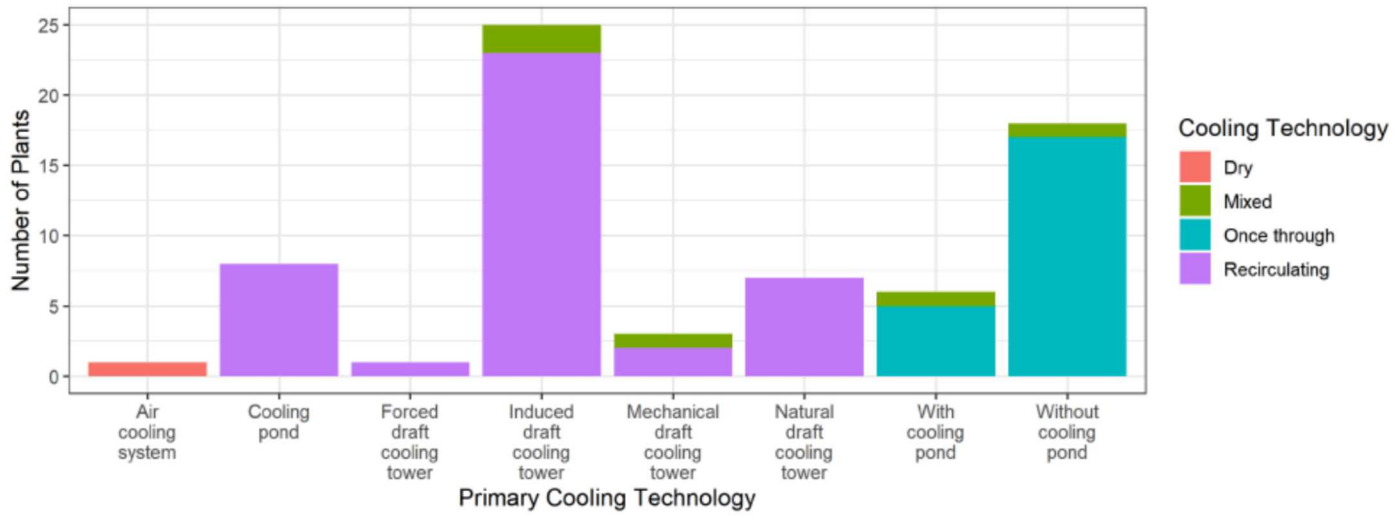
| | | | | |
|---|---|---|---|---|
| **Fuel** | Coal | Coal | Coal | Coal |
| **Number of Units** | 5 | 2 | 2 | 4 |
| **Generation Capacity (MW)** | 1140 | 376 | 2240 | 2090 |
| **Location (lat/lon; state)** | | | | |
| **Water Source (type, %)** | Surface water (100%) | Surface water (100%) | Surface water (100%) | Surface water (100%) |
| **Water Source (name)** | | | | |
| **Annual Water Withdrawal (MGD)** | | | | 1162.9 |
| **Water Permitting Requirements (State-level, municipality, other provider?)** | State Water Reporting (Use) | In the Southeast, don't have concerns about water rights. Access is | State Water Reporting (Use) | State Water Reporting (Use) |
| **Drought-related Constraints? (env flow, river operations, other users, power plant efficiency; gw: drawdowns) Frequency?** | | | | |
| **Flood-related constraints? Frequency?** | No b/c of reservoir upstream | | No b/c of reservoir upstream | No b/c of reservoir upstream |
| **Water quality-related Constraints? (thermal, biological, salinity, etc.)** | None | | No issues present | None |
| **Peaking vs constant load considerations?** | Peaking plant | | Baseload plant | Baseload plant |
| **Mitigation Strategies** | Reservoir operations protocols manage water supply and coordinate withdrawals between neighboring power plants (coordinated with water supply extremes) | | Added supplemental water supply with intake on Dan River | Reservoir operations protocols manage water supply and coordinate withdrawals between neighboring power plants (coordinated with water supply extremes) |
| **Cooling Technology** | Once-through | Recirculating pond | Once-through | Once-through |
| **Any Storage/Cooling Ponds on-site?** | No | Yes | No | No |
| **Discharge Permitting Requirements (State-level; temps, etc.)** | State NPDES (State has been more aggressive in terms of water regulations: so putting treatment technologies on all coal plants.) | State NPDES (State has been more aggressive in terms of water regulations: so putting treatment technologies on all coal plants.) | State NPDES (State has been more aggressive in terms of water regulations: so putting treatment technologies on all coal plants.) | State NPDES (State has been more aggressive in terms of water regulations: so putting treatment technologies on all coal plants.) |
| **Drought-related Constraints? (env flow, river operations, other users, power plant efficiency; gw: drawdowns)? Frequency of issues?** | N/A | | N/A | N/A |
| **Flood-related constraints? Frequency?** | N/A | | N/A | N/A |
| **Water quality-related Constraints? (thermal, biological, salinity, etc.) Frequency of issues?** | Thermal limits exists but has not caused any problems. With ash pond closed and ww system upgraded, selenium issue has also been addressed. | | Was a problem in the 1980s (standards issues) - discharge of coal pond goes to River while discharge of cooling intake to nearby creek. Can adjust discharges as needed to account for low flows. | Summer, there's always a competition for cool water between McGuire and Marshall - for both thermal limits and fisheries (used to stock striped bass but now hybrid striped bass). Group looks at that balancing specifically. Most of the time they make it work. Rarely derate. |
| **Peaking vs constant load considerations?** | N/A | | N/A | N/A |
| **Mitigation Strategies** | N/A | | N/A | Monitor thermal conditions and coordinate discharge with neighboring plants. |
| **How does coal ash management influence water operations at the site?** | Bottom ash (recycled water). Everything else in dry. Inactive ash pond. | | Bottom ash (recycled water). Everything else in dry. Inactive ash pond. | Bottom ash (recycled water). Everything else in dry. Inactive ash pond. |
| **Other** | | | | None |
| **Metadata** | | | | |
| **Availability** | | | | |
| **Discharge** | | | | |
| **Miscellaneous** | | | | |

# Respondents

- *Identification of plant-level contacts was difficult—successful for only 33% of plants (based on capacity)*

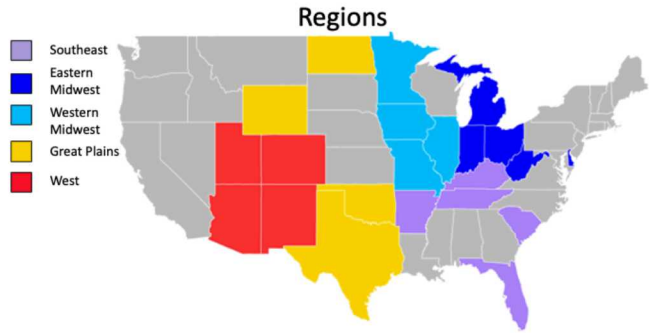
| | Total | Interviewed | Interviewed (% of Total) |
|---|---|---|---|
| Utilities | 220 | 32 | 14.5 |
| Plants | 353 | 69 | 19.6 |
| States with Coal Plants | 46 | 23 | 50.0 |
| Plant Capacity (GW) | 279.5 | 91.9 | 33.0 |

- *Covered broad range of geographies, plant characteristics, water sources, and water discharge practices.*



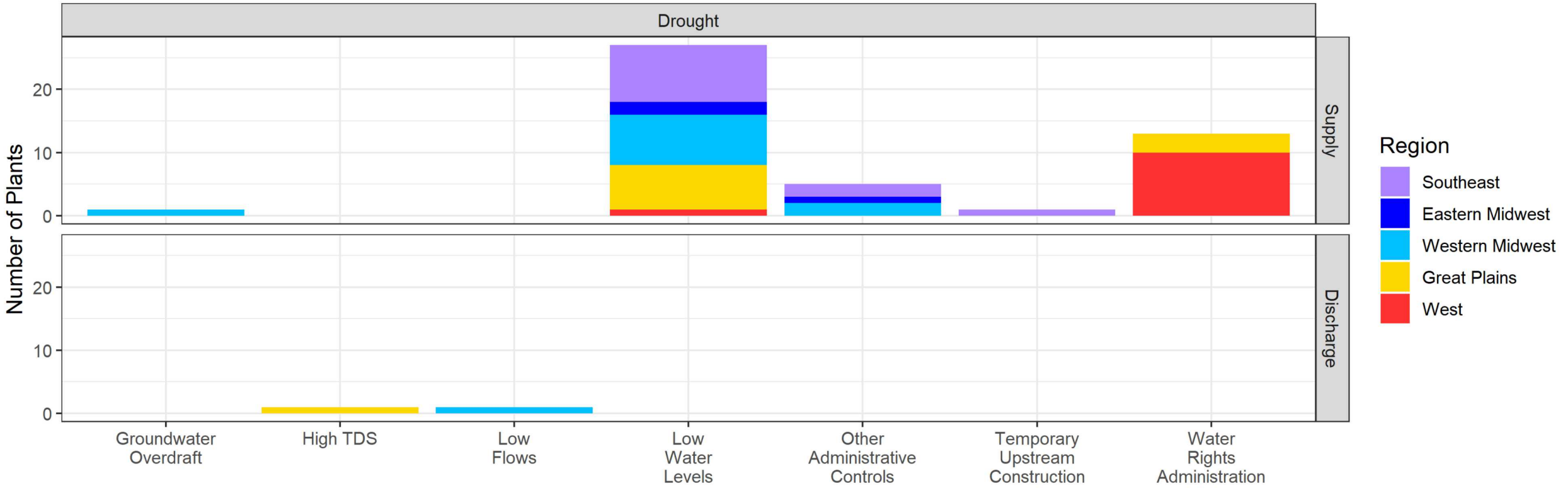
# Results: Water Supply

## Institutional Controls on Water Supply by Region

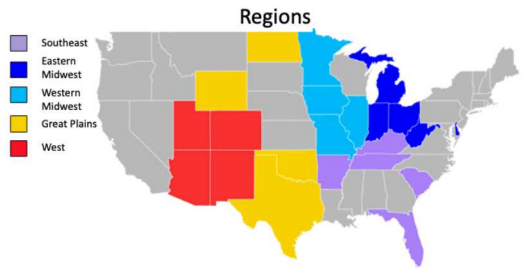



# Results: Drought

## Modes of Impact that Drought has on Water Supply and Discharge

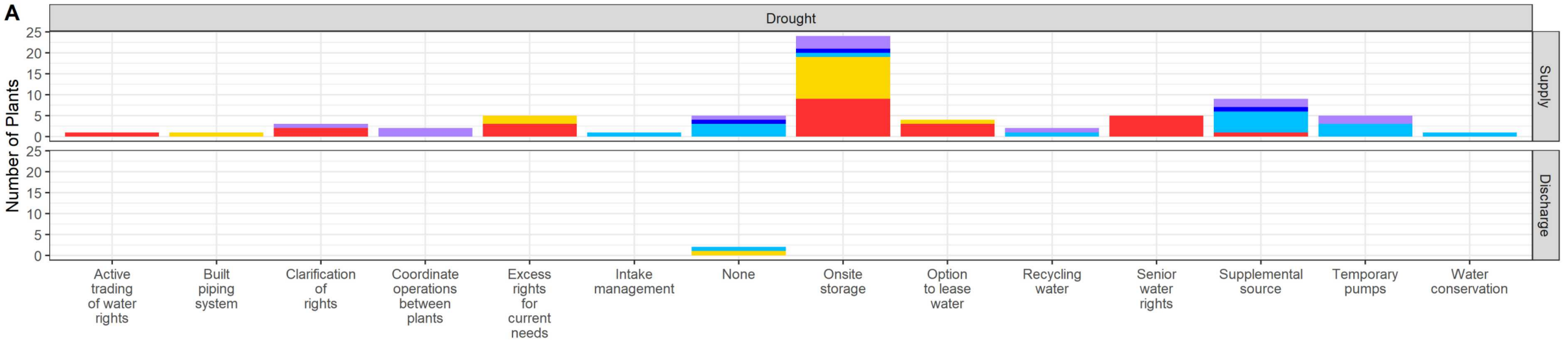



- 49 plants reported drought related threats
- 5 modes of impact on supply
- 2 modes of impact on discharge

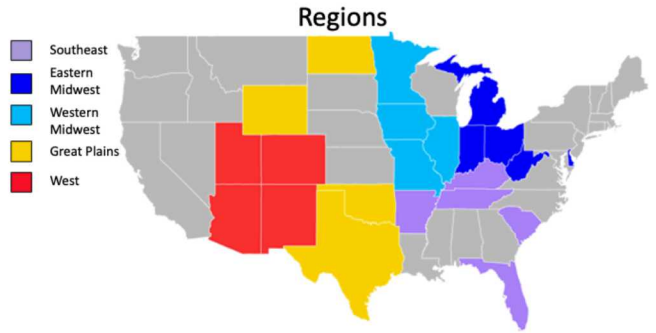


# Results: Drought

## Mitigation Measures taken to Manage the Impact of Drought on Water Supply and Discharge

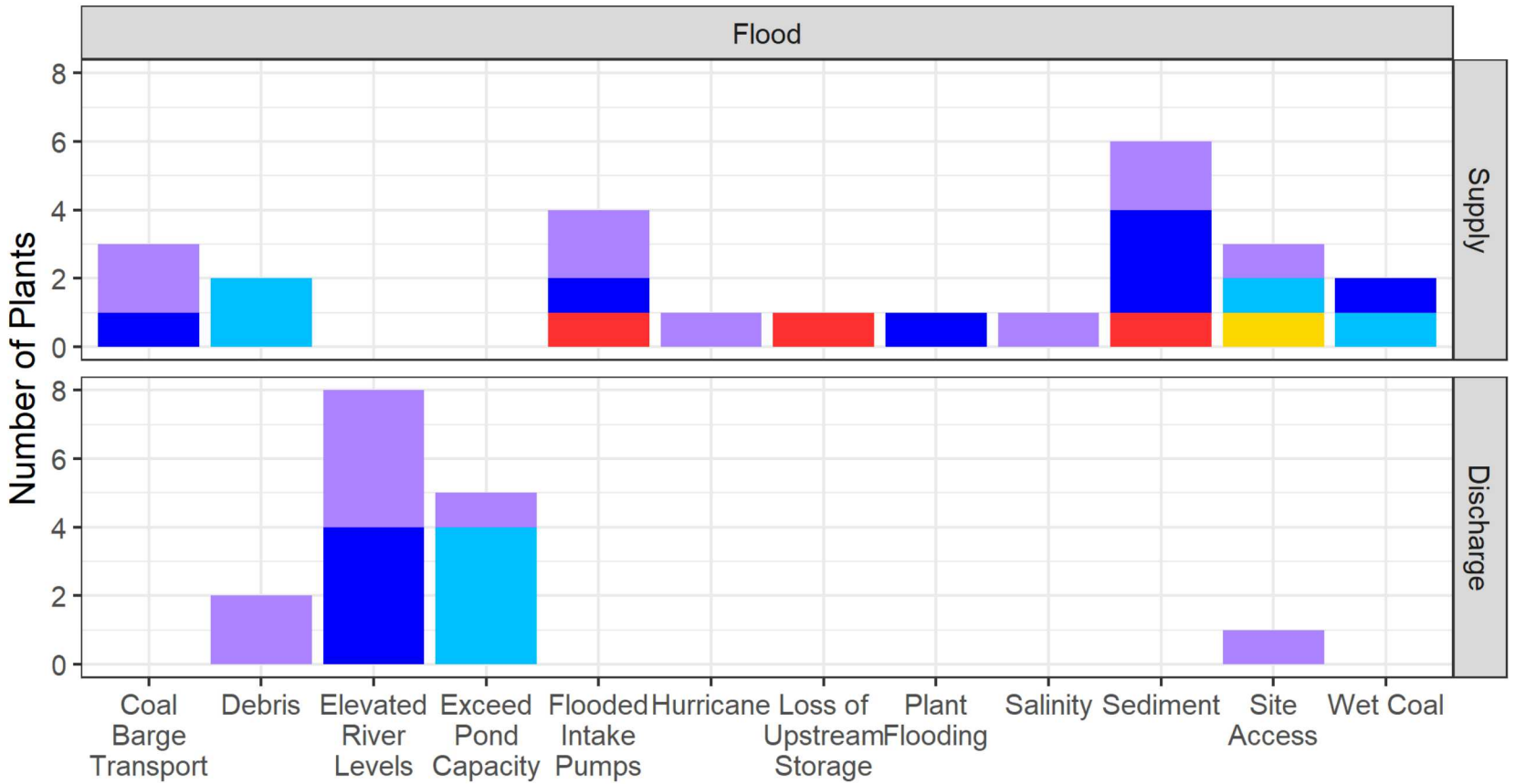



- In only 7 cases was no action taken
- 13 measures taken to manage supply
- Discharge-related drought impacts are usually not managed

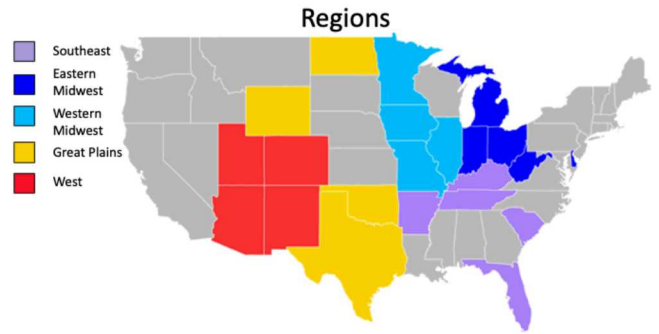


# Results: Flood

## Modes of Impact that Flood has on Water Supply and Discharge

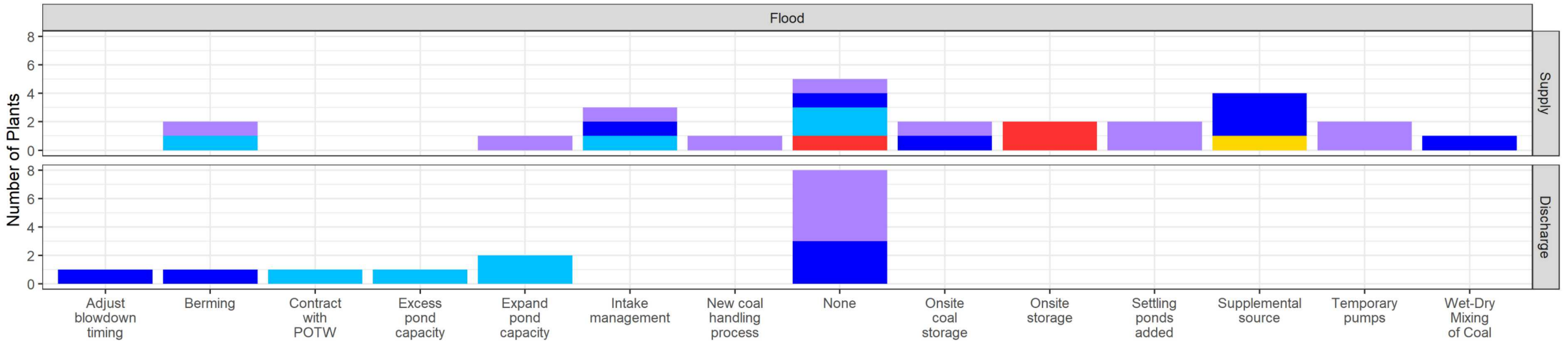



- 32 plants reported flood related threats
- 10 modes of impact on supply
- 4 modes of impact on discharge

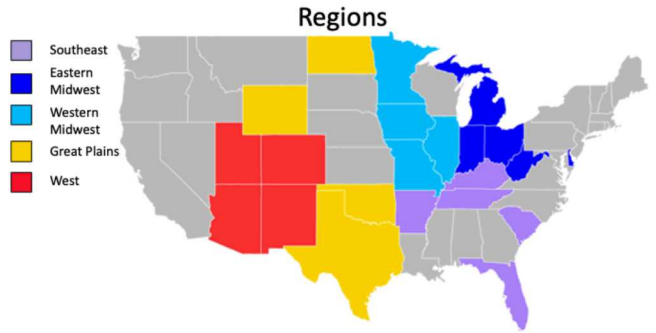


# Results: Flood

## Mitigation Measures taken to Manage the Impact of Flood on Water Supply and Discharge

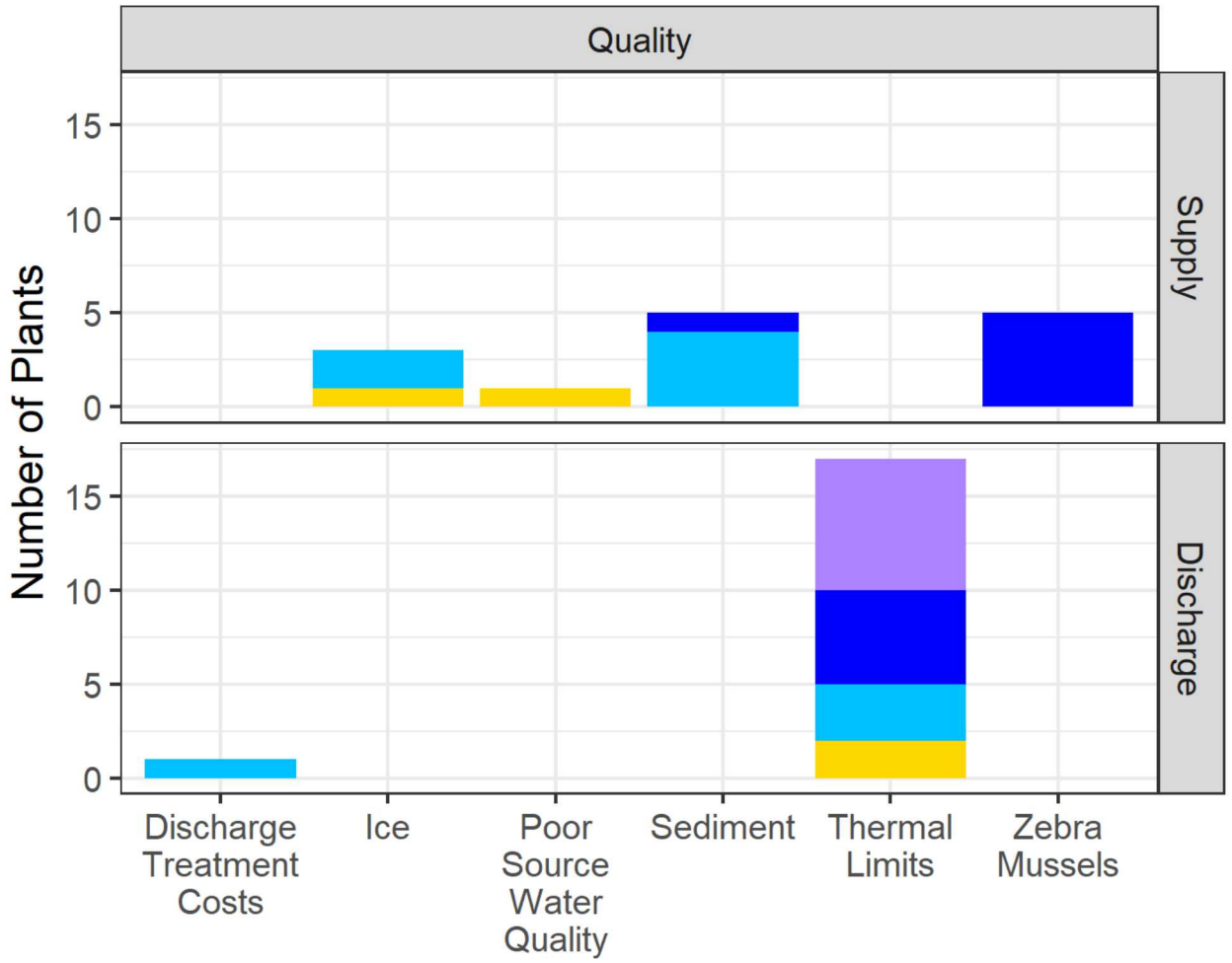



- In 13 cases no action was taken
- 10 measures taken to manage supply
- 5 measures taken to manage discharge

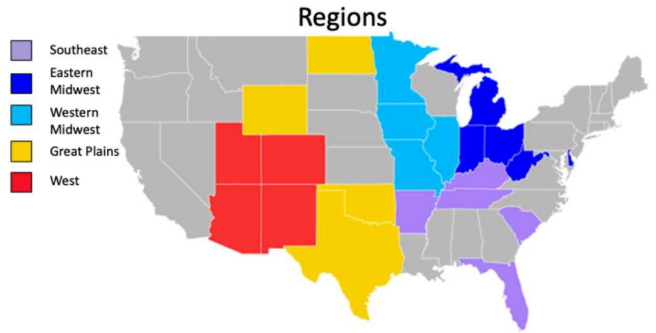


# Results: Water Quality

## Modes of Impact that Water Quality has on Water Supply and Discharge

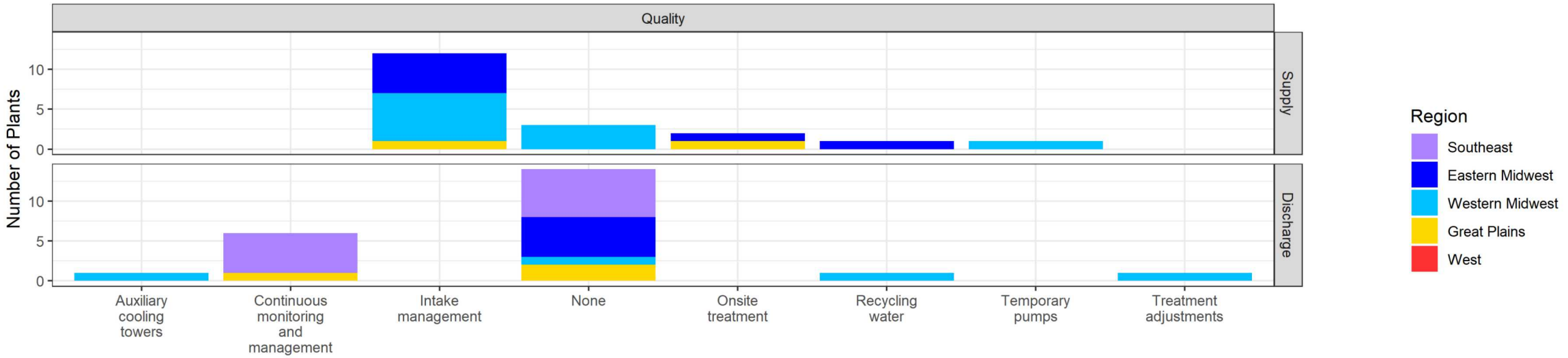



- 32 plants reported water quality related threats
- 4 modes of impact on supply
- 2 modes of impact on discharge

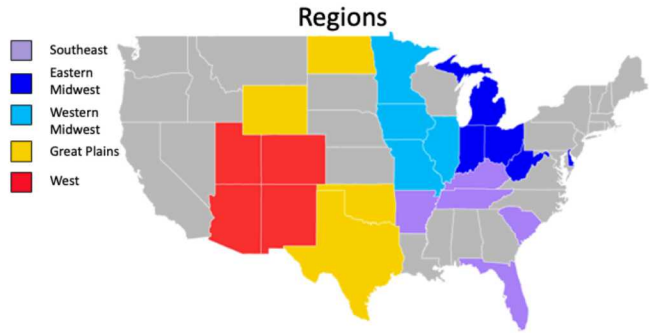


# Results: Water Quality

## Mitigation Measures taken to Manage the Impact of Water Quality on Water Supply and Discharge




- In 17 cases no action was taken
- 4 measures taken to manage supply
- 4 measures taken to manage discharge



# Take Aways

- Key information missing from the open literature:
  - Unique threats posed to plants due to their location and design (***25 unique modes***), and
  - Physical and managerial measures taken to mitigate threats (***115 measures across 69 plants***).
- Each plant is largely unique; however, some broad trends exist relating threats and actions taken.
- Value of such information:
  - Reduce misclassification of actual threat, and
  - Lower overestimation of impact without regard to mitigative measures taken.