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Sustainable Phosphorus Removal

kemira

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SUSTAINABLE CHEMICAL PHOSPHORUS REMOVAL

You Will Learn About

→ Consequences of Phosphorus in the Environment

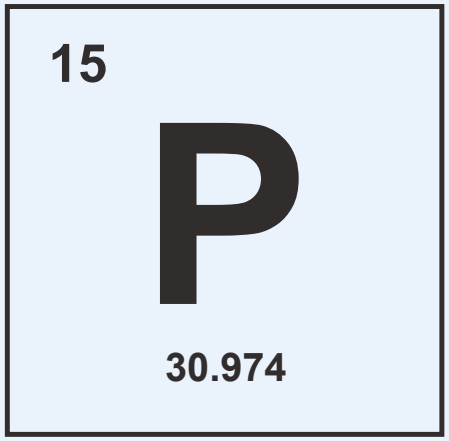
→ Regulatory Pressures to Control Phosphorus

→ Sustainable Management of Phosphorus Discharges

What is Phosphorus?

Phosphorous

- Naturally occurring element found in mineral deposits as an inorganic trivalent phosphate ion $(PO_4)^{3-}$
- Essential to <u>all life</u> on earth
- Biological Phosphorous
  - → Adenosine triphosphate (ATP)
  - → Deoxyribonucleic acid (DNA)
  - → Phospholipids (cell membranes)
  - → Mineral component of bones & teeth



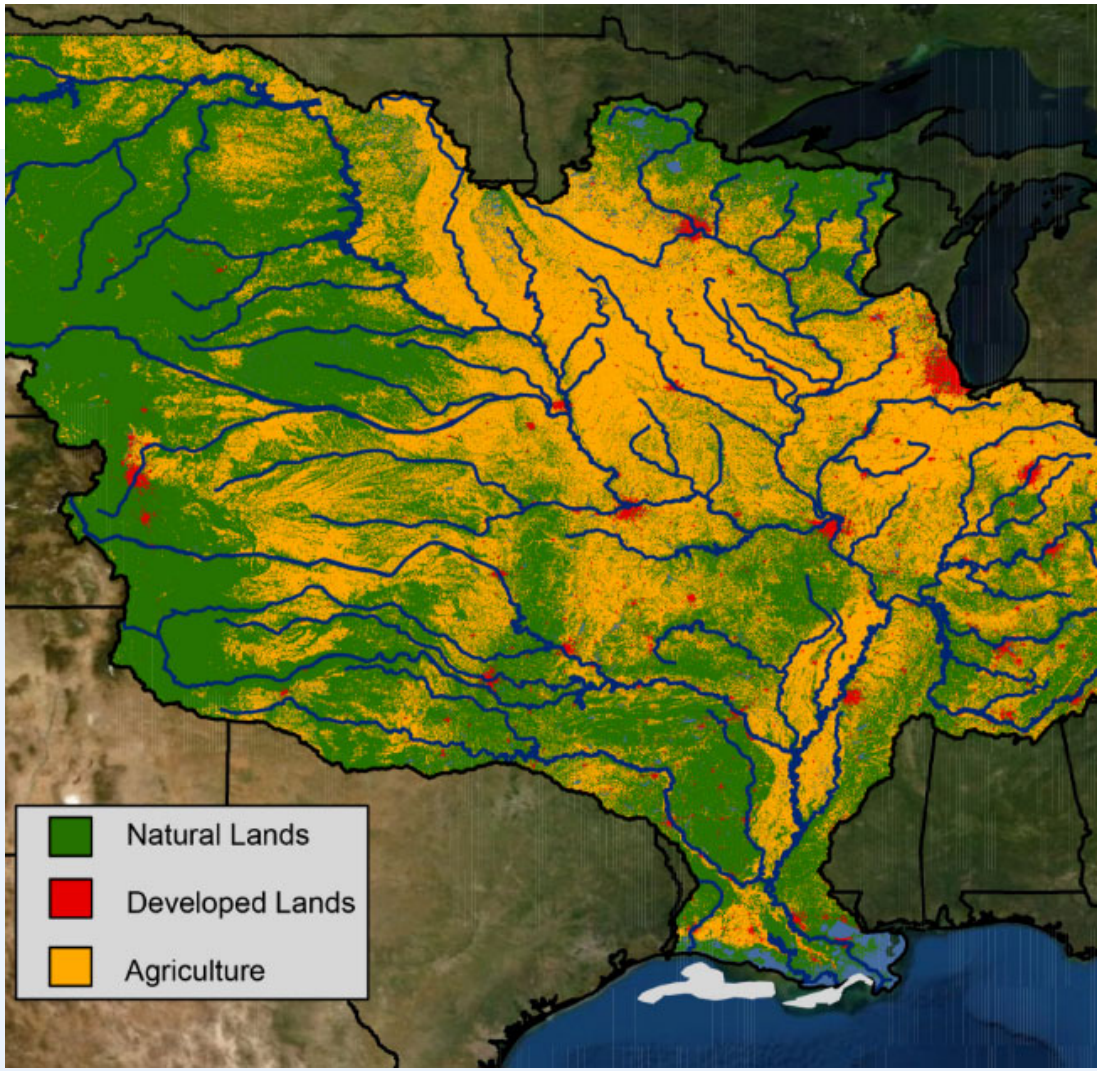
The Impact of Excess Phosphorus

Excessive Phosphorous

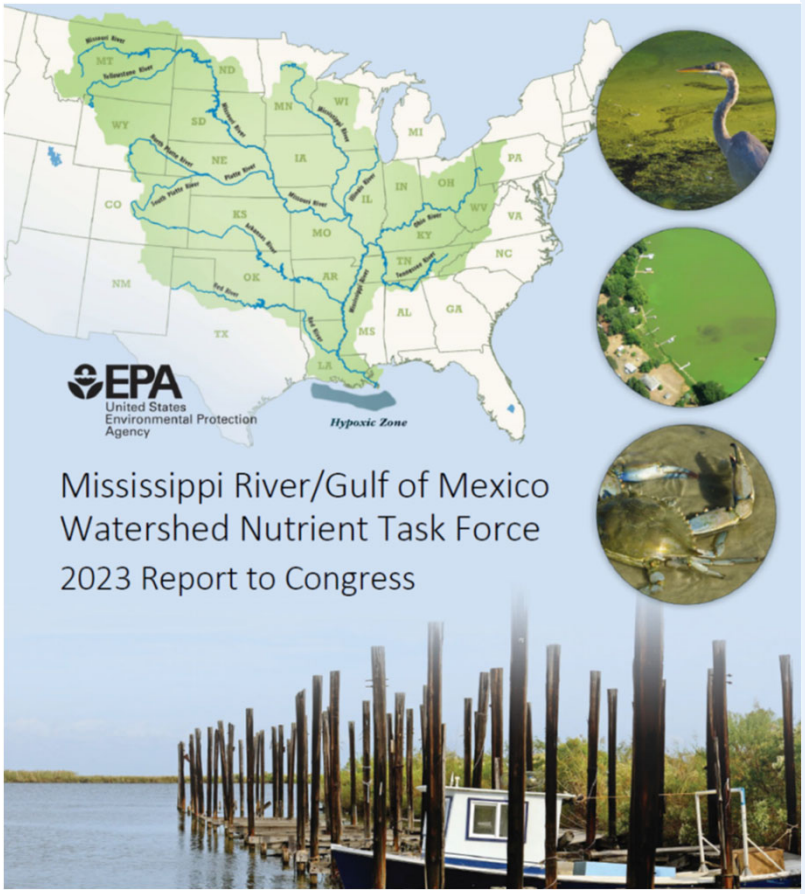
Sources:
→ Agricultural Fertilizers
→ Municipal Wastewater

Unintended Impacts:
→ Toxic harmful algae blooms (HAB)
→ Algae w/excessive biomass
→ Water taste & odor problems
→ Dissolved oxygen(DO) depletion/ hypoxic zones

- < 5 mg/L DO - stressful to fish
- < 3 mg/L DO - no fish
- < 1 mg/L DO - no life



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics. AeroGRID, IGN, and the GIS User Community (Image credit: USGS)



https://www.epa.gov/ms-htf/reports-point-source-progress-hypoxia-task-force-states

Hypoxia Example

Tributaries to Mississippi/Atchafalaya River Basin (MARB)

Encompasses watersheds with significant contributions of nitrogen & phosphorus to the surface waters of the MARB

Gulf of Mexico hypoxic (dead) zone is the largest in the USA

→ 2017 it covered 8,494 square miles

→ area contains ~ half of the nation's coastal wetlands

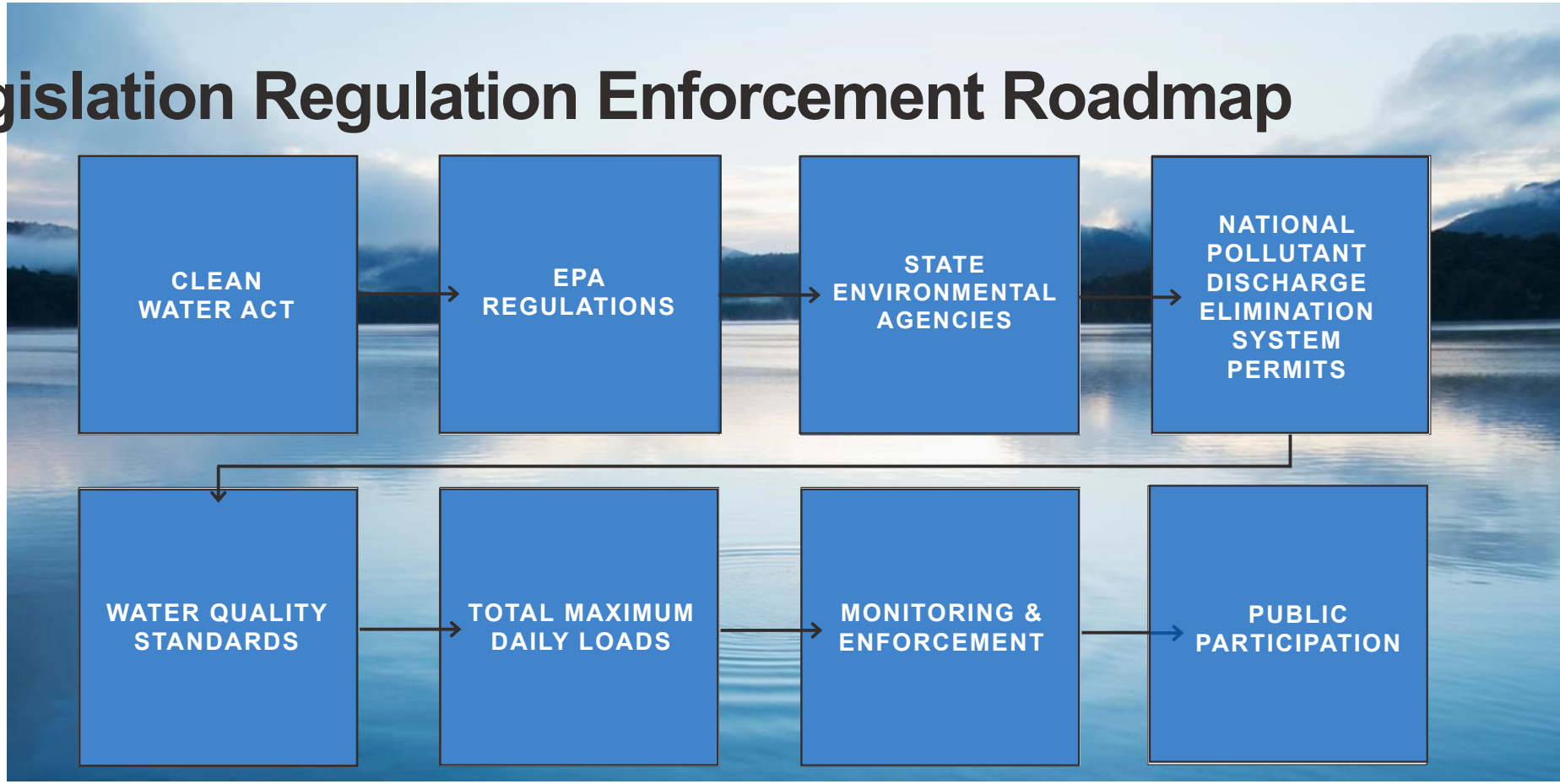
→ Supports fisheries generating $1 billion/year

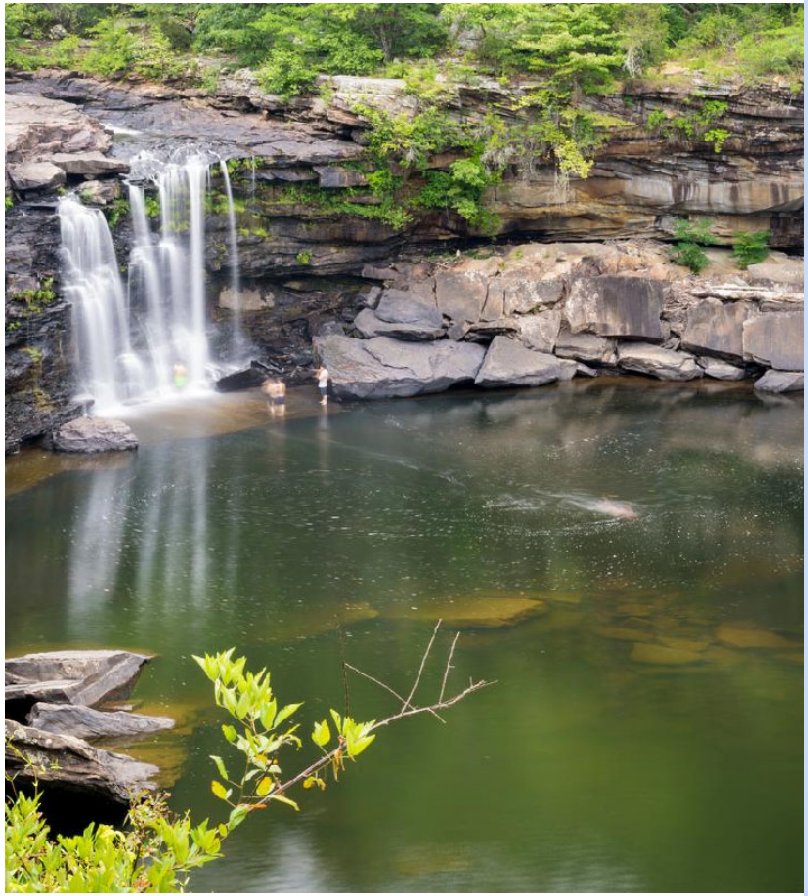
Chesapeake Bay – also a major dead zone

→ Each summer > 40% of area and 5% of volume

Phosphorus Limits

Legislation Regulation Enforcement Roadmap





DESIGNATED USES

National Water Quality Criteria

Numerical limits on toxic chemicals, nutrients, bacteria, heavy metals & other contaminants

→ Drinking water

→ Fishing

→ Recreational water

→ Habitat preservation & endangered species protection

Impaired Water - if contaminants exceed water quality standards for a designated use

Phosphorus Limits Example

State of Illinois

- → Current Statewide effluent standard for total phosphorus "Total P" limit = 1.0 mg/L
- → May be higher or lower in a specific permit
- → Future effluent limit of 0.5 mg/L Total Phosphorus applicable January 1st, 2030,
- → Exceptions apply, consult with local EPA office or regulatory consultant for site specific requirements

Phosphorus in Wastewater

Phosphorous Removal

Two removal methods:

→ **Biological treatment**

→ **Chemical precipitation**

- Iron-based removal

Iron-based Phosphorous Removal

Total-Phosphorous - removed by physical removal & chemical precipitation

Total P = Insoluble + Soluble fractions

Insoluble:
Organically bound particulate phosphorous → physical removal

Soluble (phosphate):
Inorganic ortho phosphate + polyphosphate → chemical precipitation

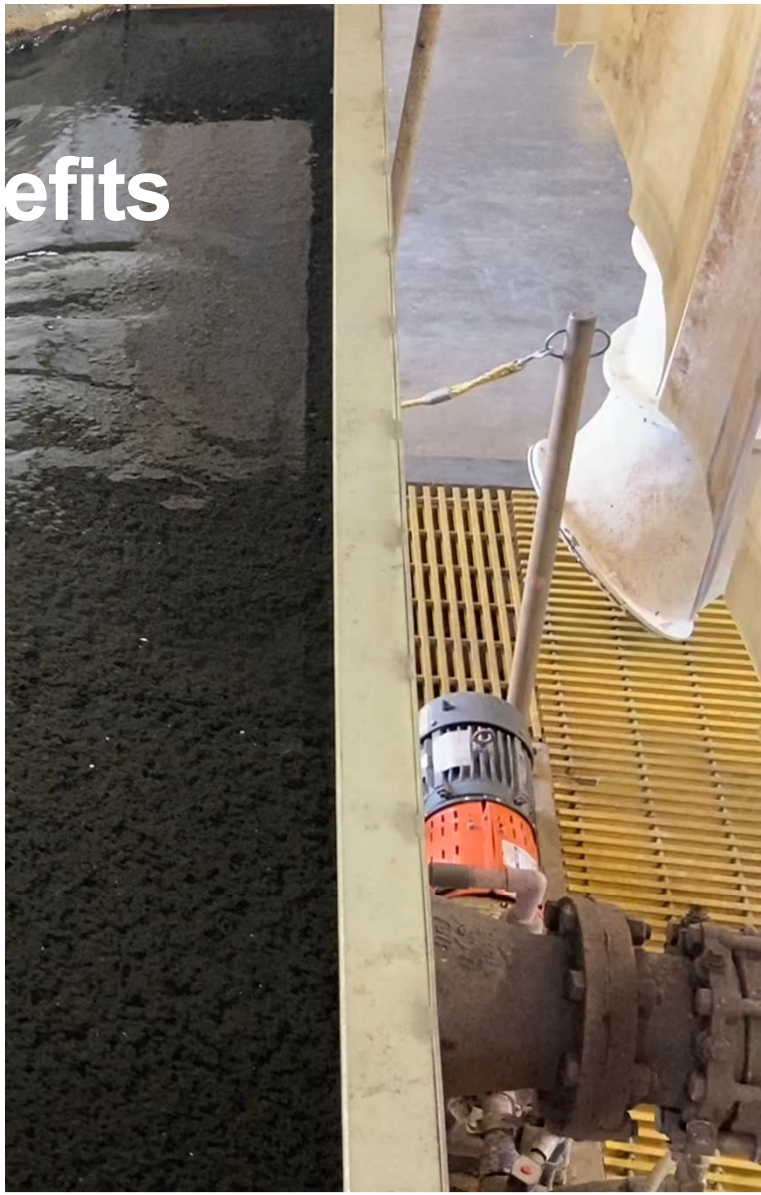
COAGULANT ADDITION POINTS & DOSING

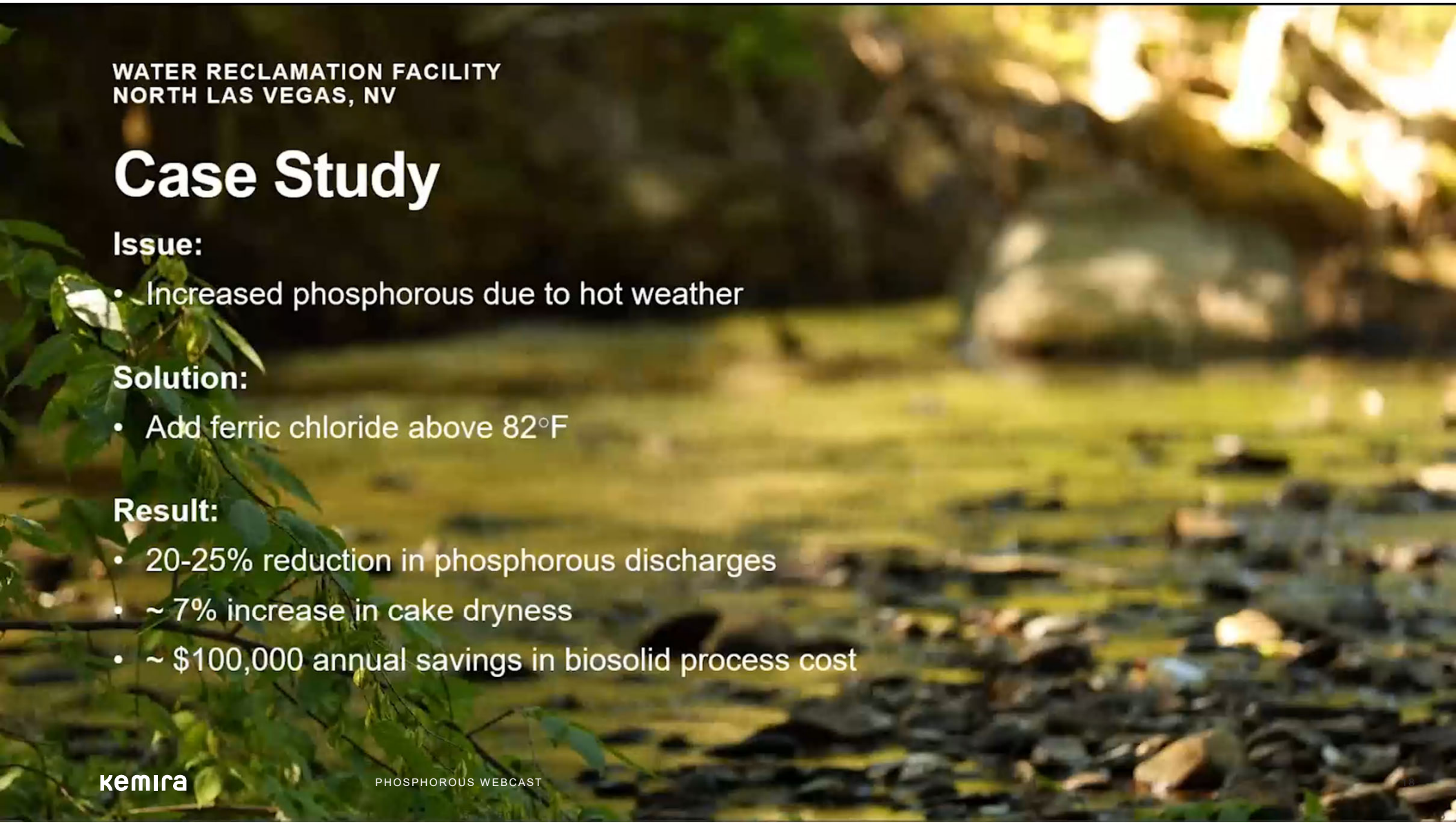
Iron-based Phosphorous Removal

PHOSPHOROUS REMOVAL USI

Sustainable B efits

- → **Reduction of H_2S gas**
  - Odor & corrosion con
    increased equipment
- → **Struvite control**
- → **Dryer cake solids**
  - Less solid transport;
    in CO_2 emissions
- → **Cost savings**
  - Reduced solid dispos
  - Reduced chemical tr
    - → Reduction in dewatering





WATER RECLAMATION FACILITY
NORTH LAS VEGAS, NV

Case Study

Issue:

- Increased phosphorous due to hot weather

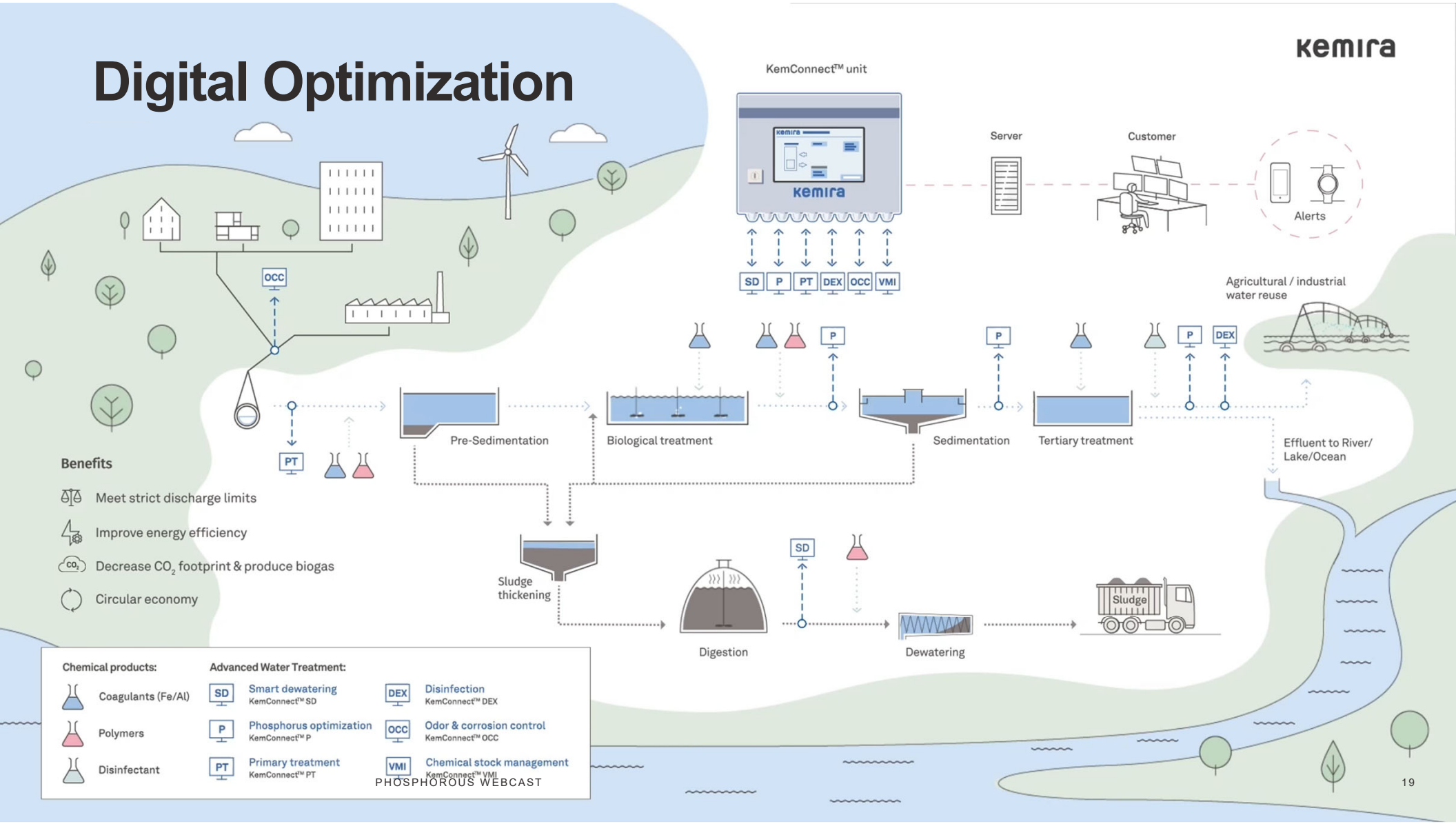
Solution:

- Add ferric chloride above 82°F

Result:

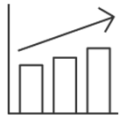
- 20-25% reduction in phosphorous discharges
- ~ 7% increase in cake dryness
- ~ $100,000 annual savings in biosolid process cost

Digital Optimization



CONCLUSION

Benefits of Iron Coagulants for Phosphorous Removal

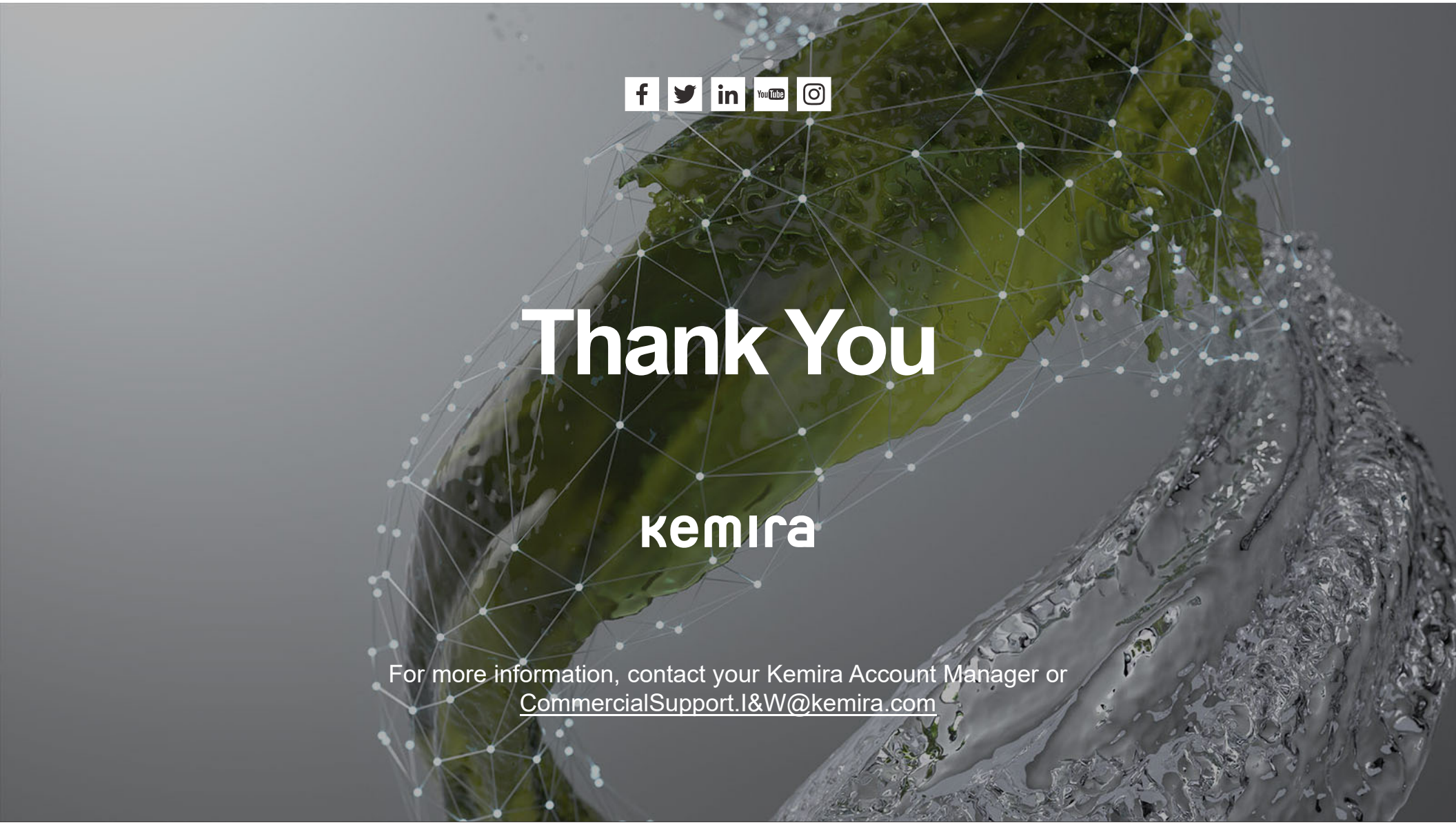


IMPROVED WATER QUALITY

PHOSPHOROUS DISCHARGE LIMIT COMPLIANCE

COST SAVINGS

SUSTAINABLE DOWN-STREAM BENEFITS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