



2022

ANNUAL REPORT



**Nebraska
Water Center**

Daugherty Water *for* Food Global Institute



The Nebraska Water Center

The Nebraska Water Center (NWC) was established by Congressional mandate as one of 54 state-based Water Resources Research Institutes in 1964. We coordinate research and programs that support the University of Nebraska as an international leader in water research, teaching, extension and outreach.

Our fundamental goals are to:

- 1 Coordinate a wide range of research impacting water issues
- 2 Foster a deeper understanding of water and its many beneficial uses
- 3 Help develop new water researchers
- 4 Train future water researchers and engineers
- 5 Extend research results to water professionals and the public through publications, seminars and conferences, electronic media, lectures and tours

NWC is part of the Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska and part of the University of Nebraska–Lincoln’s Institute of Agriculture and Natural Resources. Financial support for NWC and Water Sciences Laboratory comes from a combination of state, local and federal funding, as well as through partnerships with NGOs and industry.

For more information >>> watercenter.unl.edu



NWC 2022 SNAPSHOT



13

Undergraduate
Student
Interns



3

Postdoctoral
Researchers



\$3,576,281

in Grants to
Water Faculty
and Staff



25

Journal
Articles
Published



8,781

YouTube
Views



61

New
Facebook
Follows



23

Events
Hosted or
Co-Hosted



In 2022, the Water Sciences Laboratory experienced their most successful year yet.

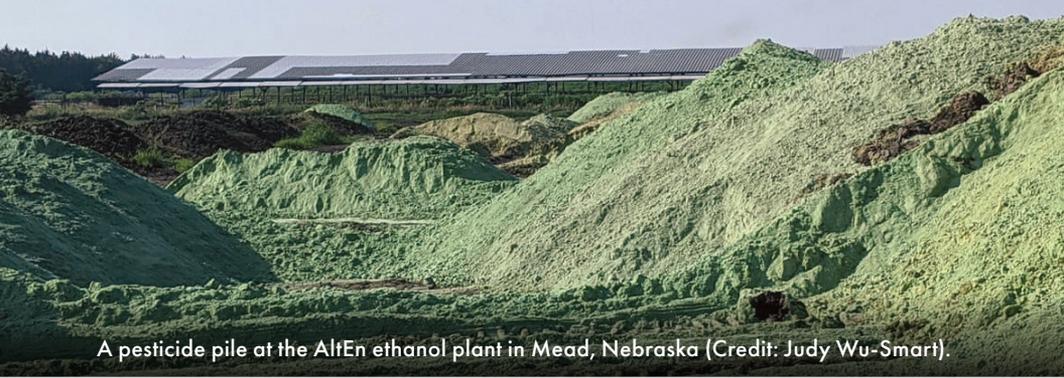
»» Water Sciences Lab Sees Rapid Growth in 2022

On the heels of a sharp decline in laboratory testing in 2020 and inconsistent growth in 2021, the Water Sciences Lab experienced more growth than ever before in 2022. Lab manager Victoria Dey shared her insights on the rollercoaster ride the lab has experienced in the last few years. “2019 was a really good year for us in terms of samples, projects, and revenue. We were on an upward trajectory and then, like many COVID affected businesses, the numbers fell off drastically in 2020 and 2021. In some aspects, 2021 was still low and was not ideal, but this year we’ll hit a record in terms of sample numbers and service revenue by the end of June.” So far, the lab has received almost twice as many samples in the first six months of 2022 than at the same point in 2020, with figures on track to exceed the peaks they experienced in 2019.

Finding the true cause of this unprecedented growth poses a challenging question. Dey attributes their success to several different avenues. She observed a noticeable uptick in sample submission in the fall of 2021 when researchers returned to universities, but the growth surpassed the expected figures if academic research was the only cause.

In addition to new lab equipment, the lab’s past successes are attributing to current and future growth. “There are more research publications out there that highlight the use of the laboratory,” Laboratory Director Dan Snow states, “so the more articles that get into the scientific literature the more people are aware of what we can do.” From academic journal articles to current events and other news articles, an increase of publications in the past few years has risen the profile of the lab for a wide variety of potential clients.

To learn more about the Water Sciences Laboratory
»» watercenter.unl.edu/water-sciences-laboratory2



A pesticide pile at the AltEn ethanol plant in Mead, Nebraska (Credit: Judy Wu-Smart).

»» WSL is Key to AltEn Contamination Monitoring

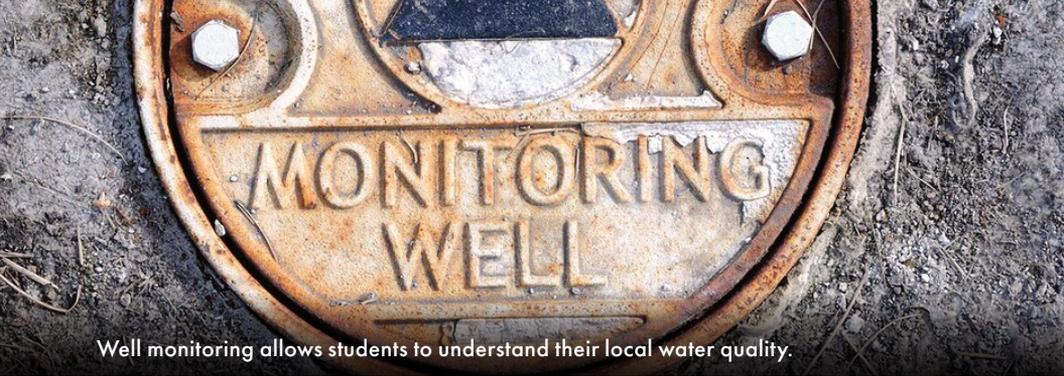
The Water Sciences Lab is essential to monitoring the impacts of the AltEn pesticide contamination, one of the worst environmental disasters in Nebraska. Located near Mead, Nebraska, the AltEn ethanol plant created innovative ways to generate ethanol from feedstocks consisting almost entirely of leftover seed corn treated with pesticides and fungicides. Treated seed is not unusual; but using it in large volumes to produce ethanol is. Over time, residents reported strong odors in the air, burning eyes and breathing difficulties. In early 2021, the State of Nebraska shut down the plant after numerous violations and a burst pipe spilled waste into a nearby watershed. Of specific concern are the neonicotinoid insecticides found on the treated seed. The toxicity of neonicotinoids has been established and current research focuses on the environmental and health threats left behind as the compounds break down.

The Water Sciences Laboratory first started testing samples for neonicotinoid insecticides for several clients and research projects about 15 years ago in response to increasing use of these chemicals in crop production. Over time, they expanded this analysis to include many fungicides and then most recently for degradation products of three of the most commonly used neonicotinoids (imidacloprid, thiamethoxam, and clothianidin). Shortly after they developed a combined method using a new high sensitivity triple quadrupole mass spectrometer, the AltEn incident became headline news.

The Water Sciences Lab is one of the only facilities in the U.S. that can offer such comprehensive methods for insecticide and fungicide residues in water, soil, and biological samples. The level of measurements would not be possible without their mass spectrometry technology and staff expertise.

The lab is continuing to collect and test air, dust, surface water, groundwater, soil and vadose zone samples from the areas that received wastewater and “wet cake” from the facility. This effort includes researchers from the U.S. Geological Survey, U.S. Environmental Protection Agency and all University of Nebraska campuses. This work will help to understand the magnitude and scale of the environmental occurrence of these chemicals, along with any associated ecological and human health effects from exposure.

For more information »» go.unl.edu/mead



Well monitoring allows students to understand their local water quality.

»» Know Your Well Project Enters Third Phase



From its inception in 2016, Know Your Well has brought citizen science into classrooms to increase groundwater testing throughout Nebraska and showcase the vulnerability of groundwater quality and importance of safe drinking water for rural residents and communities.

In the past six years, Know Your Well has been implemented in more than 28 school districts throughout the state. Participating schools receive educational materials, colorimetric testing kits, and training to conduct domestic well sampling and water testing. Participants collect split samples sent to the Water Science Laboratory for quality-assured testing and results are supplied to the well owner and participating schools. Students are encouraged to compare their test kit measurements with the laboratory tests and develop research projects about local well water quality. Many classes present their findings at science fairs, Nebraska Junior Academy of Science meetings, as well as city council and Natural Resource District board meetings.

Know Your Well is now entering its third stage, led by the Papio-Missouri River NRD with partnerships between the University of Nebraska at Kearney, the University of Nebraska–Lincoln, Chadron State College, the Nebraska Water Center and the Daugherty Water for Food Global Institute.

The latest grants provide funding to equip over 50 Nebraska schools with Know Your Well training, kits, and laboratory test results to highlight domestic well water quality through multiple NRDs.

Know Your Well is an educational gem for Nebraska’s natural resources and on the cutting edge of citizen science research. As more schools participate, the team has the opportunity to grow groundwater science literacy at the high school level and observe the impact student scientists have on local management practices and the adoption of conservation behaviors. Students are the decision-makers and stakeholders of tomorrow. By giving them the tools and agency to participate in water quality discussions now, they may become leaders in groundwater stewardship later in their professional and personal lives.

Learn more at »» knowyourwell.unl.edu



App development looks to improve data collection methods for Know Your Well students.

»» Computer Science Students Build New Platform for Know Your Well Data Collection

As Know Your Well (KYW) continues to grow and add more schools and student scientists, new funding provided by the Nebraska Environmental Trust has been dedicated to building a brand-new progressive web application (PWA) to improve the data collection process. A senior design team with UNL's School of Computer Science and Engineering (CSE) has been working with the KYW research team throughout the fall semester to design this custom system. The PWA allows schools to access their information on computers, tablets, and mobile devices regardless of differences in operating systems.

While still in its initial testing phase, this app is being designed to make gathering and reporting information easy and intuitive for school groups, whether it's their first time in the program or they've been participating since the beginning. Additionally, the app auto-captures GPS and time stamp data and will have the capacity to store it locally. This function is especially important as students often visit wells and record data in areas without mobile data coverage. As soon as the device reconnects to Wi-Fi, the stored information will be uploaded to the research database, ensuring accuracy and consistency of geospatial information.

The CSE senior design team is currently on schedule to release the app for program use towards the end of the spring semester in 2023.



The Water Sciences Laboratory is a leading expert in nitrate testing and is helping Nebraskans improve their nitrogen management.

»» Water Sciences Laboratory Helps Nebraska Tackle Nitrate

Around the world and across Nebraska, nitrogen fertilizer is regularly used to grow crops. Some of this nitrogen is converted to nitrate that can be easily lost from the root zone, contaminating ground and surface water. In addition to being harmful to human health, excess nitrate in drinking water is costly for small communities to treat. Sandy, irrigated soils in Nebraska are highly vulnerable to nitrate leaching, and few options exist for controlling nitrogen losses from these fields.

The Water Sciences Lab is on the front line of nitrate testing across the state, and for good reason. Staff expertise and a specialized set of equipment allow the lab to provide unique, premier testing for nitrate and other water quality concerns. Specifically, the lab has the capability to test stable isotopes of nitrate, a form of isotope “fingerprinting” to help researchers and natural resource managers assess the sources of nitrogen to local groundwater.

Nitrate is a long-running issue that will take time and patience to address. One of the most important steps in addressing nitrate contamination is collecting data that helps resource managers and landowners make informed decisions about their nitrogen application and use.

For more information on the Nebraska Water Center and Water Sciences Laboratory efforts to address nitrate and other contaminants in the state, visit »» watercenter.unl.edu/water-sciences-laboratory2.



The annual rural poll shows 66% of respondents worry about water quality impacting health.

»» Nebraska Rural Poll Includes Water Quality Questions

Safe, abundant drinking water is essential for Nebraska. NWC led the development of questions for the Nebraska Rural Poll — an annual survey of rural Nebraskans conducted by the University of Nebraska–Lincoln — to find out more about how rural Nebraskans feel about this critical issue.

The poll found two-thirds of respondents are concerned about contaminants in their water. In Nebraska, much of the health focus is on nitrate, a by-product of fertilizer used to grow crops like corn and soybeans. Only about half of respondents had tested their water and less than 2 in 10 treat their home tap water. These and other insights from the poll help inform future research and educational efforts, both for UNL faculty and partners across the state. For more information on the rural poll, visit »» ruralpoll.unl.edu.

The poll questions were the first action step of the Nebraska Nitrate Awareness Working Group. In January, NWC’s Crystal Powers convened a design kickoff workshop. The working groups are a part of a NWC and University Extension multi-year effort to build collaborations to address nitrate in Nebraska. The full strategy team has engaged over 100 participants representing 33 organizations to accomplish the goal that “all Nebraskans will have safe drinking water.” To learn more about the Nitrate Strategy working groups, visit »» go.unl.edu/nitrate_strategy.



USGS Small Grants support big ideas in water.

»» Current Projects

NWC awarded U.S. Geological Survey (USGS) 104b and 104g project funds to seven Nebraska research teams in 2022:

104b

- › *A Biological and Chemical Approach to Restoring Eutrophic Ponds in Nebraska.* Aaron Mittelstet, Steven Comfort. **\$25,000**
- › *Know Your Well - Northwest (2nd year funding).* Michael Leite, Daniel Snow. **\$7,000**
- › *Surface Water Antibiotic Exposure from Adjacent WWTPs, CAFOs, and Agricultural Fields.* Keeley MacNeill. **\$24,971**
- › *Isotope Equipment for Water Sciences Laboratory.* Trenton Franz, Daniel Snow. **\$25,000**

104g

- › *Linking the Riverine Microbiome and Process Rates to Ecosystem Function in two Nebraska River Systems.* Paul Ayayee, David Manning, Jessica Corman, David Rus, Mikaela Cherry. **\$224,151**
- › *Using a Coupled Surface Water/Groundwater Model Informed by Groundwater Age, Geophysics, and Vadose Zone Coring to Identify Type and Placement of Management Practices to Reduce Legacy Groundwater Nitrate Concentrations.* Aaron Mittelstet, Troy Gilmore, Dan Snow, Erin Haacker. **\$249,977**
- › *Nitrate Loading and Legacy Effects on Nitrogen and Carbon Cycling in Playa Wetlands of the High Plains.* John Hribljan, Paul Ayayee, Brian Tangen. **\$246,482**

For more information, visit »» go.unl.edu/NWCresearch.



In 2022, NWC researchers published 25 journal articles and received over \$3.5 million in grant funding.

»» Current Research

NWC has also been active in research focused on nitrate, improved modeling, and PFAS.

Nitrate

- › Relation to Fertilizer Management and Groundwater Nitrate Concentrations, Vadose Zone Nitrate Accumulation Upper Big Blue Natural Resources District. Vadose zone projects are also being done for the Lower Elkhorn NRD and Bazile Groundwater Management Areas.
- › Novel Approaches for Controlling Nitrate Leaching & Protecting Nebraska Ground Water, funded by Nebraska Environmental Trust.
- › Determination of effectiveness of the various agricultural best management practices (ABMPs) in reducing nitrate contamination of the vadose zone at a global scale.

Improved modeling

- › Development of Data Bases for Model Development and Field Testing of Crop Models in Mid-West Farms, in cooperation with the United States Department of Agriculture (USDA) Agricultural research Service Adaptive Cropping System Lab.
- › Improving soil-plant-atmospheric interaction simulation models, post-doctoral research in conjunction with USDA's Agricultural Research Service (ARS) in Maryland.

PFAS (forever chemicals)

- › Extraction, analysis, and occurrence of per- and polyfluoroalkyl substances (PFAS) in wastewater and after municipal biosolids lands application to determine agricultural loading.



Conference attendees enjoyed an evening on the Platte River at Nebraska Audubon's Rowe Sanctuary.

»» NWC Holds Platte River Basin Conference

From October 24 to October 26, the Nebraska Water Center hosted the 2022 Platte River Basin Conference in Kearney, Nebraska. 150 attendees from four states attended in-person, with an additional 30 virtual participants, representing academia, nonprofits, governmental agencies, industries, tribal nations, and more. Titled “Braided Paths: Science, Policy, and Culture,” this conference aimed to bring together the wide range of perspectives needed to find solutions to grand challenges throughout the Platte River Basin.

In an effort to broaden the perspectives and challenge the pre-existing assumptions of attendees, this conference provided a wide variety of programming and interactive experiences. Panel discussions featured perspectives on living and working in the Platte River Basin from tribal nations and farming families, as well as implications for future management of the Platte from regulators, researchers, and resource users and managers.

Over twenty breakout talks were presented, with topics including cranes and other wildlife, water science and engineering, social science and policy, and more. These presentations provided attendees with a wide range of research and applications for work within the Platte River Basin.

The Platte River Basin Conference also provided opportunities for diverse, interactive experiences. Conference attendees had the opportunity to attend a special screening of the film “Shells of Wisdom: Lessons from Ajijaak,” featuring a live Q & A with filmmaker Ginev Benton. Participants also headed out to Audubon Nebraska’s Rowe Sanctuary for an evening of food, fun, and photography lessons from artist Joshua Redwine and the Platte Basin Timelapse team.

The Platte River Basin Conference provided an opportunity for people with varying interests and backgrounds to come together to discuss their shared resources. By featuring a diverse selection of topics and speakers, participants left the conference with a greater appreciation of the river basin and a broader perspective on how we can work together towards solutions across the basin.

Videos of each session and other conference resources are available at
»» watercenter.unl.edu/2022-nebraska-water-conference.



As part of the 2022 Spring Seminar Series, Shane Doyle spoke on indigenous perspectives on the Missouri River.

»» Spring Seminar Series

The Nebraska Water Center (NWC), in partnership with the University of Nebraska–Lincoln’s School of Natural Resources, held its annual Spring Water Seminar Series once again in 2022. The 2022 Series highlighted hydrotourism — the significance that water holds in and around Nebraska and its ability to bring people from all walks of life together.

The 2022 seminars featured an extraordinary slate of specialists representing everything from city engineers to indigenous educational consultants to river outfitters. This diversity in fields and experience highlights how water means something different to every individual but is also something that unites us. Established in 1968, the series provides a forum to increase awareness and allow for meaningful conversation regarding these issues. The series is a cornerstone of NWC’s mission to help the University of Nebraska become an international leader in water research, teaching, extension and outreach.

The 2022 lectures included:

- › February 2 – Antelope Valley Project
- › February 16 – North Fork Development Project
- › March 2 – Hydrotourism and the Nebraska Outdoor Enthusiast
- › March 23 – Lake McConaughy Deep Dive
- › April 6 – Indigenous Perspectives on Missouri River
- › April 20 – Ecotourism and ecology along the Niobrara River

The 2023 Spring Seminar Series theme is “Hot Topics in Nebraska Water.” From water quality and health to social sciences and drought, each seminar will feature an expert presentation on an issue that is relevant to Nebraska today.

To view the 2023 Spring Seminar Series schedule and watch the sessions on Zoom, visit »» watercenter.unl.edu/spring-seminar-series.



NWC looks to the future through the Five-Year Review and the creation of the WICS Hub.

»» **Water Center Undergoes Five-Year Review**

As one of the many departments and centers within the University of Nebraska–Lincoln (UNL) Agricultural Research Division, the Nebraska Water Center undergoes a programmatic review every five years. The last review took place in the fall of 2017. In the fall of 2022, the Nebraska Water Center was reviewed internally by staff and externally by a review committee of Water Center Directors from across the U.S.

The purpose of this five-year review is to improve the program’s effectiveness and quality in alignment with the Institute of Agricultural Science and Natural Resources’ (IANR) strategic plans, Land-Grant mission, and the core values of both IANR and UNL.

NWC staff created the five-year review document in August and the review committee visited the Nebraska Water Center in November. IANR and the Nebraska Water Center director will receive recommendations from the review team in January and look forward to considering opportunities for future improvement of the Nebraska Water Center.

»» **Water & Integrated Cropping Systems Team Collaborates for Statewide Impact**

Addressing the challenges of food, energy, water, and social systems in Nebraska requires collaboration across disciplines. NWC has helped lead UNL’s IANR Water and Integrated Cropping Systems (WICS) team. The WICS team involves nearly 150 faculty from over a dozen IANR departments on campus and Extension facilities across the state, reaching all 93 Nebraska counties.

This fall the team identified four themes: Soil Health, Water Quantity and Quality, Digital Agriculture, and Integrated Cropping Systems. NWC’s Chittaranjan Ray and Crystal Powers are part of the WICS leadership team.

WICS will provide a baseline for IANR faculty to leverage their individual and collective knowledge, talents, and interests to drive impact for UNL’s land-grant mission: Research and Discovery, Teaching and Learning, Extension and Outreach.

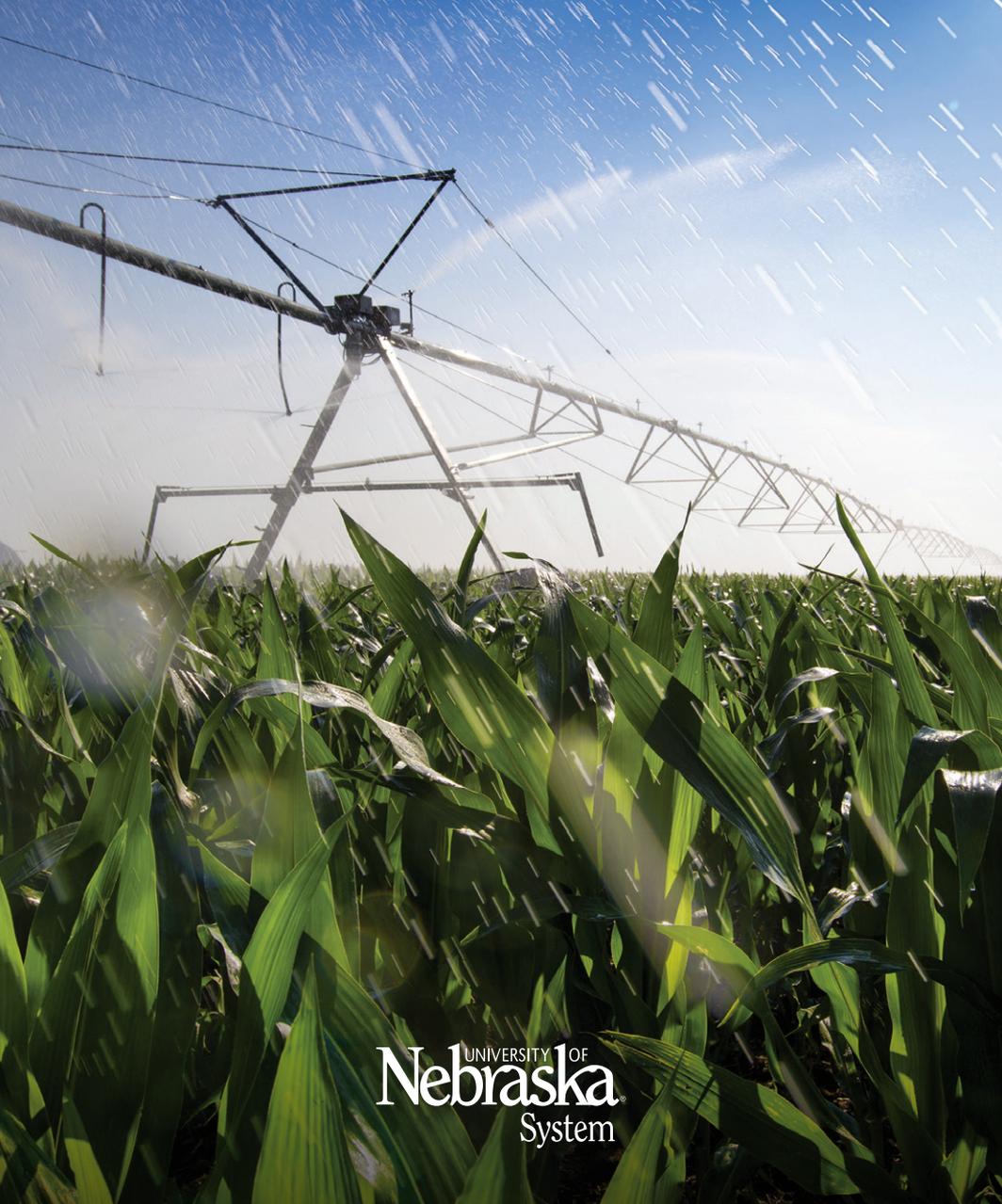
Learn more at »» wics.unl.edu



Our Impact

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System



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