Overview

The National Ecological Observatory Network (NEON) is a continental-scale ecological observatory designed to enable understanding of the impacts of climate change, land-use change and invasive species on ecology. NEON will gather instrumental and observational data over 30 years that will permit the study of ecological responses of the biosphere to environmental change and resulting feedbacks to the hydrosphere and atmosphere. NEON is the first large facility in the biological sciences to be supported through the National Science Foundation (NSF) Major Research Equipment and Facilities Construction program.

NEON's measurement systems will collect ecological and climatic data across the continental United States, including Alaska, Hawaii and Puerto Rico. NEON has partitioned the U.S. into 20 eco-climatic domains, which represent a range of soils, vegetation, landforms, and climates. NEON will collect physical, chemical and biological data at each of the 106 terrestrial and/or aquatic sites within these domains providing information on climate and atmospheric chemistry, soils, streams and ponds, and a variety of sentinel organisms that are sensitive to environmental change. The sites include 20 terrestrial and 20 aquatic core sites located in wildland areas that will remain in place for 30 years, along with 40 terrestrial and 16 aquatic relocatable sites that will move approximately every five to ten years.

NEON will employ distributed sensor networks, field samples and human observations, coordinated airborne observations, and field experiments to acquire ecological data. These data will be integrated and assembled via a coordinated cyberinfrastructure approach and will be made freely and openly available to researchers, educators, decision-makers and the public. The data are intended to be scaled from site to region, and in turn, to the continental level.

The NEON project considered the perspectives proposed in the National Science Foundation's Grand Challenge questions. As part of the NEON design, the site selection parameters in Yellowstone National Park (YNP) are fundamental in understanding the connectivity of the ecology among the NEON Domains--as well as the need to reveal immediate ecosystem responses to the stressors. Equally important will be NEON's ability to provide key, basic data to support local land use, conservation, preservation and policymaking.

Each domain will host a fully instrumented core site in a minimally managed “wildland” area slated to operate for the 30-year lifetime of NEON. In Yellowstone National Park (YNP), NEON has identified a location we hope to be use as the Domain 12 Core site. This proposed Core Site would be located in the Yellowstone Northern Range (Frog Rock) area. If approved, NEON plans to install tower related infrastructure including a soil array, instrument hut and associated paths at this location. There would also be an aquatic site in Blacktail Deer Creek. This proposal summarizes the operations activities for Aquatic and Terrestrial sampling, along with a map of the proposed location.

Site Infrastructure

At the proposed Yellowstone site, infrastructure includes paths, conduits, fencing, and equipment. A meteorological tower that is 59 feet tall would be built and used to mount sensors that measure a suite of atmospheric variables. An instrument hut would be built near the tower to house gas analyzer instruments and other equipment. The hut would also contain communications and control hardware that transmits data back to the NEON central repository. The tower would be constructed with minimal disturbance.

Throughout the Core site, there would be approximately 50-55 permanent TOS sampling plots that are identified for biological sampling, to include plots within the tower airshed and those distributed across major land cover types within sampling boundaries agreed to by YNP. Plot markers would be established in accordance with YNP policies and procedures.

Core sites must be located in wildland areas that are representative of pristine environments of each eco-climatic Domain. The proposed Yellowstone aquatic core sites would be instrumented with a suite of continuous water quality instruments at 2 locations within Blacktail Deer Creek (Sensor set 1 – S1 and Sensor set 2 – S2). These measurements include a multisonde with multiple water quality measurements (pH, conductivity, turbidity, fDOM), water level, water temperature, nitrate and in-stream photosynthetically active radiation (PAR). Further, a micromet station would be located in the riparian zone capturing near-stream measurements of net radiation, PAR, wind speed and direction, air temperature, and relative humidity. A suite of eight shallow groundwater wells would be located along the Aquatic stream reach and instrumented with water pressure (level), conductivity and temperature sensors. Placement of instruments would be site-specific, and all designs would need approval by YNP prior to placement.

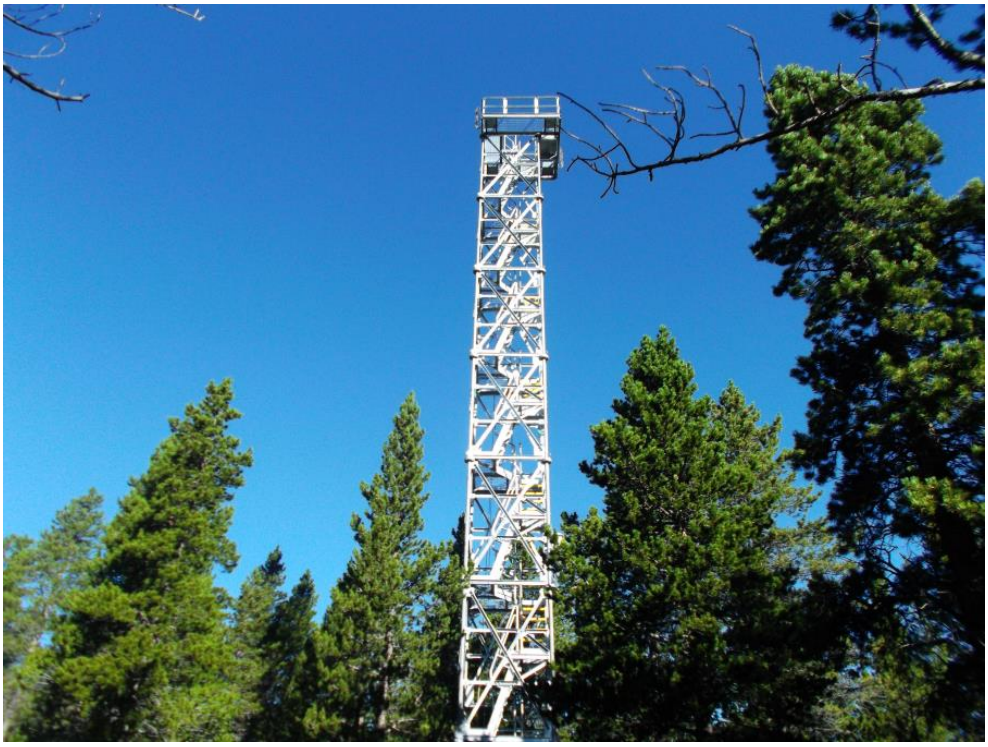

Figure 1. Comparable tower built in Rocky Mountain National Park

Observation Systems:

In an effort to link causes and consequences of change, multiple components of ecological systems would be observed:

• Remote sensing would measure structure and biogeochemical properties of vegetation.
• A flux tower and other automated sensors would measure components of the atmosphere (e.g. precipitation, temperature, radiation) and soil (e.g. respiration, soil moisture).
• Aquatic sensors and manual observations would measure chemical, physical, and biological components of streams, rivers, and lakes. All sensors would stream data through the portal to NEON headquarters.
• Field crews associated with the Terrestrial Observation System and Aquatic Observation System will collect data and samples to characterize organisms and biogeochemistry.

The Terrestrial Observation System (TOS) would collect data on biogeochemical cycles, infectious diseases, and a suite of focal taxa to characterize local patterns, dynamics, and linkages in terrestrial ecosystems. The selected taxa are designed to be widespread, capture a wide range of turnover time, and diverse evolution histories. Specifically, at the scale of the site, the TOS would collocate observations of:

•Plant biodiversity
•Plant biomass, leaf area, and chemical composition
•Plant phenology
•Bird composition and abundance
•Ground beetles abundance and diversity
•Mosquitos phenology, abundance, and pathogens
•Small mammals abundance, demography, and pathogens
•Tick-borne diseases
•Soil microbe abundance, diversity, and function
•Soils biogeochemistry

The Aquatic Observation System (AOS) would collect much similar data to the TOS data detailed above, only in the nearby stream named Blacktail Deer Creek. This data collection would include a diverse suite of observations related to biodiversity and invasive species, phenology, population dynamics, microbial diversity and function. Sentinel taxa encompassed in these observations include:

•Fish
•Riparian plants
•Aquatic macrophytes
•Algae
•Invertebrates
•Microbes

TOS/AOS protocols are designed to provide standardized data across the observatory, linkages among TOS/AOS protocols and between TOS/AOS and other NEON project areas, and where possible, complement other continental scale sampling efforts (e.g. Breeding Bird Survey, Forest Inventory Analysis).

NEON operations:

Each NEON site is managed by a Field Operations Manager, who has a supporting staff of 6 full-time-technicians and up to 25 seasonal technicians annually. Managers and full-time technicians are recruited during the construction phase. In operations, the Field Operations Manager will be the point-of-contact (POC) for each site's land-owner.

The Field Operations staff conduct TOS plot establishment and AOS site characterization field activities in collaboration with the relevant NEON science teams. The Field Operations staff receives training on the implementation of terrestrial and aquatics observation system protocols. The technicians receive training on the maintainability of instrument systems as part of integration and verification activities with Systems Engineering. The training includes safety procedures for NEON-specific procedures as well as general field safety practices.

Field Operations personnel conduct all field measurements and collections associated with the Aquatic Observation System (AOS) and Terrestrial Observation System (TOS) as well as maintaining sensors and infrastructure associated with the Terrestrial and Aquatic Instrument Systems (TIS and AIS). Detailed descriptions of protocols and measurement systems are provided below.
TIS maintenance is scheduled to be conducted 1-2 days each week by 2 technicians; AIS maintenance has a similar maintenance schedule of approximately 2 days every 2 weeks until ice forms on the stream.

AOS sampling is conducted within three 1-month periods by 2-4 technicians. For YNP these timeframes are anticipated to be May, mid-July to mid-August, and September.
TOS sampling is conducted from early spring through late fall. 2-4 technicians would conduct sampling on typical days, however up to 12 technicians may occasionally be required to sample multiple protocols on the same day.

Airborne Observation Platform (AOP) activities will include:

1. During operations, NEON will survey each of the NEON sites on an annual basis. The flight season will generally extend from March until October. The standard flight operations are divided into domains, with approximately two weeks allocated to each domain.
2. Flights are planned “campaign style” with domains surveyed one after another throughout the flight season using three aircraft. Flight altitude is 1000m (3280) mean AGL.
3. Airborne spectroscopy, and discreet and waveform LiDAR will be used to quantify plant species type and function, and vegetation structure and heterogeneity at the scale of individual shrubs and larger plants.
4. Color photography (25 cm resolution) will retrieve fine-scale information on land use, roads, impervious surfaces, and built structures.
5. The AOP is aircraft-mounted and operated instrumentation and would not result in any ground impacts to YNP. Flyovers would occur once a year. Preliminary flight paths have been established and would be reviewed and coordinated with staff at YNP and local air traffic control prior to any flights. If possible, AOP would like to deploy supporting field equipment (canvas tarps, GPS base station and sun photometer) at a single location designated by Park staff for the duration of the campaign (equipment to be deployed and packed up each day).

Conclusions

The Yellowstone Core site is critical to NEON establishing the continental network of sites proposed in the Greater Yellowstone Ecosystem. This site would provide data to the observatory and enable NEON to establish a network of sites throughout the all domains.

The above proposal represents the most up to date information NEON has compiled for the sites that are proposed on Yellowstone National Park in Northern Wyoming. Based on the current schedule, if this project is approved, construction is scheduled to begin summer 2015.

Please contact Sarah Eastin below with any questions or clarifications on this project proposal.

Sarah Eastin
Environmental Permitting Specialist
1685 38th St. Suite 100
Boulder CO 80301
seastin@neoninc.org
720.927.2609

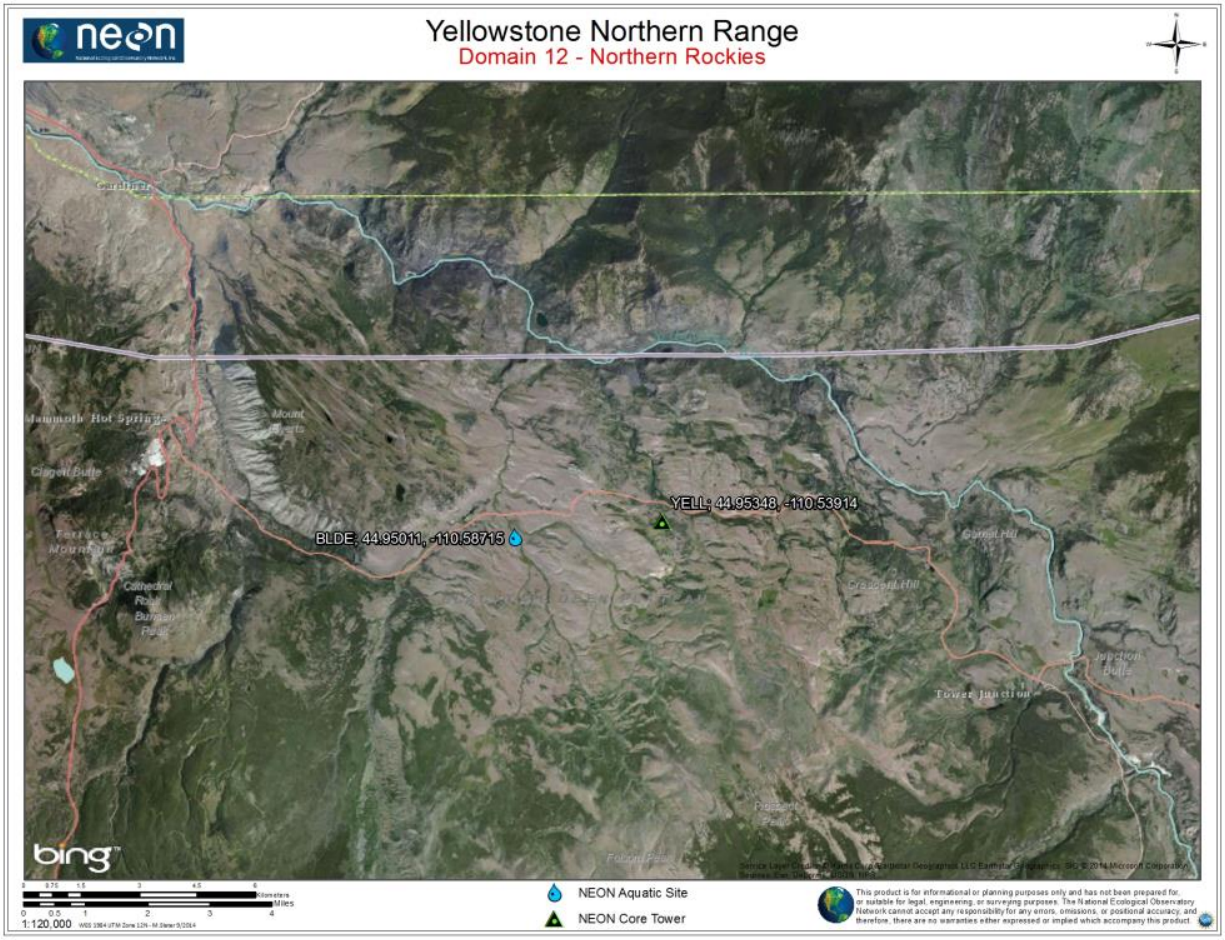

Figure 2. Overview of Proposed Tower Location and Aquatic Site