

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
<i>NEON Doc. #:</i> NEON.DOC.004312	<i>Author:</i> D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	<i>Revision:</i> D

NEON SITE RESEARCH COORDINATION GUIDELINES

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Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	12/10/2010	NEON.SYS.000280.CRE	Initial release
B	09/23/2011	ECO-00276	Update to new document numbers and template
C	06/23/2014	ECO-01688	Updated to incorporate more recent NEON Science, EHS and FOPS needs
D	08/25/2016	ECO-04100	Updated to remove STREON, change number of core and relocatable site, update sample plot numbers.

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
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TABLE OF CONTENTS

1 DESCRIPTION.....1

1.1 Introduction 1

1.2 Purpose 1

1.3 Scope and Limitations 1

2 RELATED DOCUMENTS AND ACRONYMS2

2.1 Applicable Documents 2

2.2 Reference Documents..... 2

2.3 External References 2

3 DEFINITIONS.....3

4 NEON MEASUREMENT TYPES.....3

4.1 Terrestrial Instrument System (TIS) 3

4.2 Terrestrial Observation System (TOS)..... 3

4.3 Aquatic Observation and Instrument Systems (AOS/AIS)..... 5

5 RESEARCH AROUND NEON LOCATIONS7

6 LAND MANAGEMENT8

7 RECOMMENDED EXCLUSIONS NEAR NEON LOCATIONS8

7.1 Tower Location 9

7.1.1 Flux Scale..... 9

7.1.2 Microclimate Scale 11

7.1.3 Soil Scale..... 12

7.2 Terrestrial Sampling Locations..... 12

7.2.1 Tower Plots 13

7.2.2 Distributed and Gradient Plots (Including Tick Plots) 13

7.2.3 Small Mammal Grids 14

7.2.4 Bird Grids..... 14

7.3 Aquatic Locations..... 15

7.3.1 Aquatic Streams 15

7.3.2 Aquatic Lakes and Ponds..... 16

7.3.3 Groundwater Wells..... 18

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
<i>NEON Doc. #:</i> NEON.DOC.004312	<i>Author:</i> D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	<i>Revision:</i> D

8 CONTACTS.....18

APPENDIX A NEON SITE RESEARCH COORDINATION FLOWCHARTS19

LIST OF TABLES AND FIGURES

Figure 1. Concept drawing showing the different scales of TIS measurement 3

Figure 2. Conceptual depiction of tower, instrument hut, boardwalks, and biological sampling 3

Figure 3. Generalized TOS sampling design showing locations of terrestrial plots and transects. 4

Figure 4. Generalized aquatic sampling scheme for a wadeable stream site denoting the location of instrumental infrastructure and observational sampling stations. 6

Figure 5. Generalized aquatic sampling scheme for a lake site denoting the location of instrumental infrastructure. 7

Figure 6. Schematic of the 90%, 80%, and 50% source areas around the tower as well as the prevailing wind flux footprint 10

Figure 7. The three different use conditions around the tower infrastructure, (a) the 80 percent source area footprint under daytime convective conditions, (b) the distance (5L) away an obstacle has to be from the footprint, and (c) the 100% stable source. 11

Figure 8. Conceptual illustration of the exclusion area around sensor infrastructure in streams and lakes as a function of flow and predominant wind direction. 16

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

1 DESCRIPTION

1.1 Introduction

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 plans to gather ecological and climatic data over 30 years within 20 eco-climatic domains across the continental United States, Alaska, Hawaii and Puerto Rico; including 81 terrestrial and aquatic sites.

NEON sites comprise 20 terrestrial and 19 aquatic core sites located in wildland areas that will remain in place for 30 years, along with 27 terrestrial and 15 aquatic relocatable sites that will move approximately every five to ten years. Relocatable sites are established in response to priority science questions identified by the scientific community (RD [03]).

NEON’s co-located physical, chemical and biological measurements and observations are acquired via distributed sensor networks, field samples and human observations, and coordinated airborne observations. The intent is to facilitate the study of ecological responses of the biosphere to environmental change and resulting feedbacks to the hydrosphere and atmosphere. NEON data and data products will have maximum long term value if additional observations and experiments can be carried out by other researchers in the same general area while maintaining consistency in NEON’s data collection methods and the environmental integrity of NEON sites.

Note that researchers are responsible for obtaining any site host permits and agreements necessary for access and to perform research at a NEON site. Contact the NEON Project for more information – RequestNEONResources@battelleecology.org

1.2 Purpose

The purpose of this document is to establish a set of guidelines for coordination of field research activities in the vicinity of NEON measurement and sampling infrastructure. The intent is to ensure the integrity of NEON’s instrumental and observational systems and associated data and data products over the 30-year life of the observatory, while also encouraging research by independent scientists.

1.3 Scope and Limitations

These guidelines apply across all of NEON’s 20 domains to any research, scientific observation or related activity in the vicinity of NEON instrumental or observational locations that could potentially have a measurable impact on NEON measurement and observation systems – i.e., the Terrestrial Instrument System (TIS), Terrestrial Observation System (TOS), Aquatic Instrument System (AIS), and Aquatic Observation System (AOS) (AD [01]).

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

As it will be difficult to anticipate all the circumstances and proposed research efforts that may arise in and around a NEON site, site specific adaptations likely will be necessary. Close coordination between NEON, the site host and research investigators will be necessary to ensure the continued success of on-going and future proposed research efforts at the site.

This document is not intended to replace existing land use agreement. Rather, it is to be used as a guide in conjunction with any existing site agreements. All activities will be approved under the terms and conditions of any land use agreements that are in effect. And as noted above, researchers are responsible for obtaining any permits and agreements necessary for site access and use.

These guidelines also are not intended to alter land management practices at NEON sites. Given that the purpose of these guidelines is to maintain the integrity of the NEON science theme designated for a particular site, these land management practices are expected to continue over the life of the NEON site.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

AD [01]	NEON.DOC.000001	NEON Observatory Design (NOD)
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2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]	NEON.DOC.001478	Plan for Selection of Future Relocatable Sites
RD[04]	NEON.DOC.001304	Plan for Evaluating, and Approving PI Requests to Access NEON Biological Sampling Infrastructure Including Field Samples
RD[05]	NEON.DOC.001484	NEON Field and Lab Procedure and Protocol: Areas of Mutual Representativeness and Exclusion around Terrestrial Infrastructure Measurements

2.3 External References

External references contain information pertinent to this document, but are not NEON configuration-controlled. Examples include manuals, brochures, technical notes, and external websites.

ER [01]	Kormann, R. and F. X. Meixner. 2001. An Analytical Footprint Model for Non-Neutral Stratification. <i>Boundary-Layer Meteorology</i> 99: 207–224.
ER [02]	Schmid, H.P. 1997. Experimental design for flux measurements: matching the scales of

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

observations and fluxes. *Agricultural and Forest Meteorology* 87: 179–200.

3 DEFINITIONS

In this document, the term ‘location’ is used in the general sense to refer to an area where NEON will collect soil, water and biological samples, or where instruments are placed. NEON facilities at these locations include:

- **Tower Locations:** Tower, instrument hut, soil arrays, tower plots and access routes.
- **Terrestrial Sampling Locations:** All distributed and gradient plots.
- **Aquatic Sampling Locations:** Aquatic instrumental and observational locations, and groundwater wells.

4 NEON MEASUREMENT TYPES

4.1 Terrestrial Instrument System (TIS)

The TIS uses automated *in situ* sensors to provide fixed, representative measurements of physical and chemical climate drivers, ecosystem responses and feedback mechanisms across the soil-plant-atmosphere continuum at all 20 NEON core and 27 relocatable sites. Measurements include a variety of biophysical and biogeochemical variables (i.e., temperature, humidity, wind, precipitation, radiation, carbon dioxide, ozone, and reactive nitrogen), and ecosystem functioning

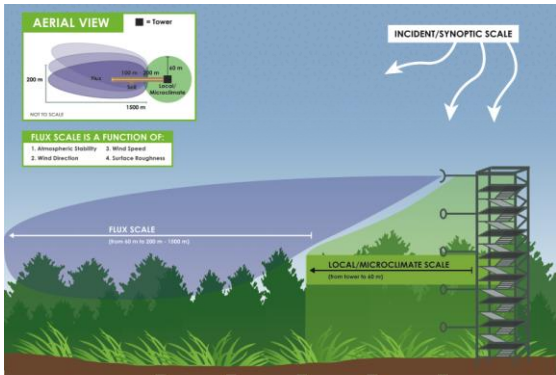


Figure 1. Concept drawing showing the different scales of TIS measurement



Figure 2. Conceptual depiction of tower, instrument hut, boardwalks, and biological sampling

in terms of carbon, water and energy fluxes. The TIS continuously measures these quantities at different local scales including incident, micro-climate and dynamic flux source areas with tower-mounted instrumentation. It also takes similar measurements at the stand-level in soils adjacent to the tower. The tower infrastructure, instrument hut and soil array are notionally illustrated in Figures 1 and 2. For more detailed description of these scales, please refer to the NEON Observatory Design Document (AD [01]). Tower plots, associated with the TOS, are located within the tower footprint – i.e., flux scale (see next section).

4.2 Terrestrial Observation System (TOS)

The TOS samples and makes observations of organisms and soils to identify and quantify indicators of change in terrestrial ecosystems, including species abundance, diversity, infectious diseases,

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

biogeochemistry and phenology. These activities are focused on plants, soils, microbes, birds, small mammals, ticks, mosquitos and ground beetles, and take place at all terrestrial core and relocatable sites. There are three types of TOS plots.

- Tower Plots:** Between 4 and 30 sampling plots are placed within the 90% flux area of the primary and secondary (if applicable) airsheds of each NEON tower using a stratified random design. Measurements include above and below-ground plant productivity, phenology, soil biogeochemistry and soil microbial community diversity and function. Additionally, individual plants are marked for phenological measurements along a fixed, square ‘loop’ transect within the tower airshed. These plots provide a direct link between NEON’s Terrestrial Observation System and Terrestrial Instrument System platforms.

- Distributed Plots:** There are between 20 and 50 sampling plots distributed in a stratified random manner across each core and relocatable site, depending on the size and diversity of major cover types. These plots are sampled for plant diversity, productivity and biogeochemistry; soil microbes and biogeochemistry; ground beetles, mosquitoes, birds, small mammals, and ticks.¹ While sampling for many components is collocated within a plot to the extent possible, most sampling protocols are followed in a smaller subset of plots. In addition, birds, small mammals, mosquitos, and ticks are sampled in plots without other sampling due to logistical constraints and the need to minimize sampling impacts.

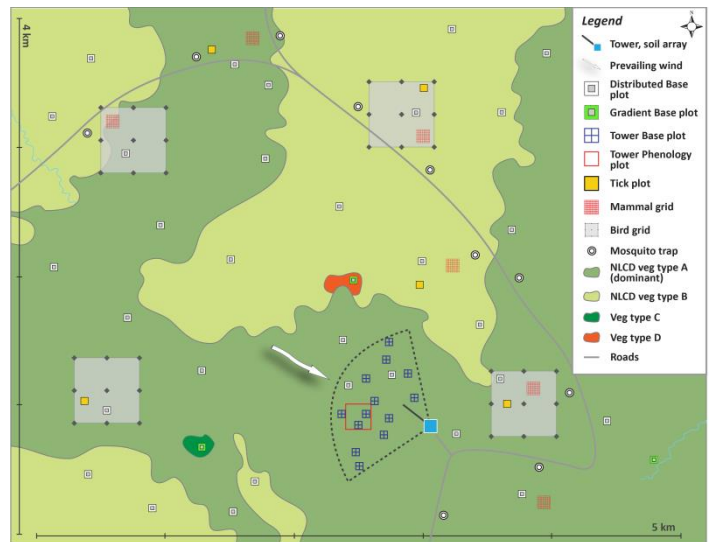


Figure 3. Generalized TOS sampling design showing locations of terrestrial plots and transects.

- Bird and Small Mammal Grids:** Small mammals are sampled on three to eight trapping grids in association with a sub-set of the *Distributed Plots*. Birds are monitored using point-counts at 5 – 15 nine-point grids also placed in association with *Distributed Plots* where possible.
- Tick Plots:** Tick sampling involves the collection of ticks using drag sampling on 6 plots on the site. Plots are placed near a subset of distributed plots where no other sampling will occur in order to minimize the impact of technician activity on tick-capture rates.

¹ At some sites, the NEON site boundaries follow ownership boundaries. At others, particularly larger sites, boundaries have been drawn to constrain the sampling area.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

- **Mosquito Plots:** Due to the frequency of sampling, mosquito sampling occurs at 10 plots located within 30m of a road.

Figure 3 schematically illustrates the placement of terrestrial observational sampling plots.

- **Gradient Plots:** Additional Gradient Plots will be established at sites as needed in order to capture major topographical, vegetation, or hydrologic gradients to improve scalability between terrestrial and aquatic biogeochemical measurements and TOS and AOP data. These plots may include subplots for sampling plant biodiversity, soil and plant biogeochemistry and soil microbes.

NEON encourages the use of terrestrial sampling locations as controls for other experiments and research activities, subject to the guidelines presented below. Sampling within these plots may be permissible under the assignable assets program (see RD [04]).

4.3 Aquatic Observation and Instrument Systems (AOS/AIS)

The aquatic component of NEON samples organisms and performs field observations to identify and quantify indicators of change in stream, river and shallow lake ecosystems. Data will be gathered via *in situ* sensors (AIS) and analyses performed on samples collected through manual field collections (AOS). These activities will take place across the observatory network at 34 aquatic sites. NEON will utilize a maximum of 1 km of a stream reach (Fig. 4) or an entire lake (Fig. 5), plus a 15 m buffer zone from each streambank or lake edge. All instrumentation is located and measurements are made within these buffers, as illustrated in Figures 4 and 5.

The aquatic suite consists of chemical measurements of surface and shallow ground water (e.g., dissolved oxygen, pH, conductivity, DOM, chlorophyll and nutrient levels) physical measurements (e.g. lake and stream morphology, water and air temperature, wind speed and direction) and the diversity and distribution of algae, microbes, aquatic plants, invertebrates and fish.

Streams (wadeable):

The aquatic instrument infrastructure (AIS) is located within the 1 km stream reach. The instrument infrastructure consists of two sensor sets (S1 and S2) that are installed between 200 and 500 m apart depending on the average water travel time. Further infrastructure consists of a meteorological station located in the riparian zone and a suite of up to eight instrumented groundwater wells located within the 200 m permitted boundary. All observational sampling (AOS) takes place within the 1 km stream reach (Figure 4).

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

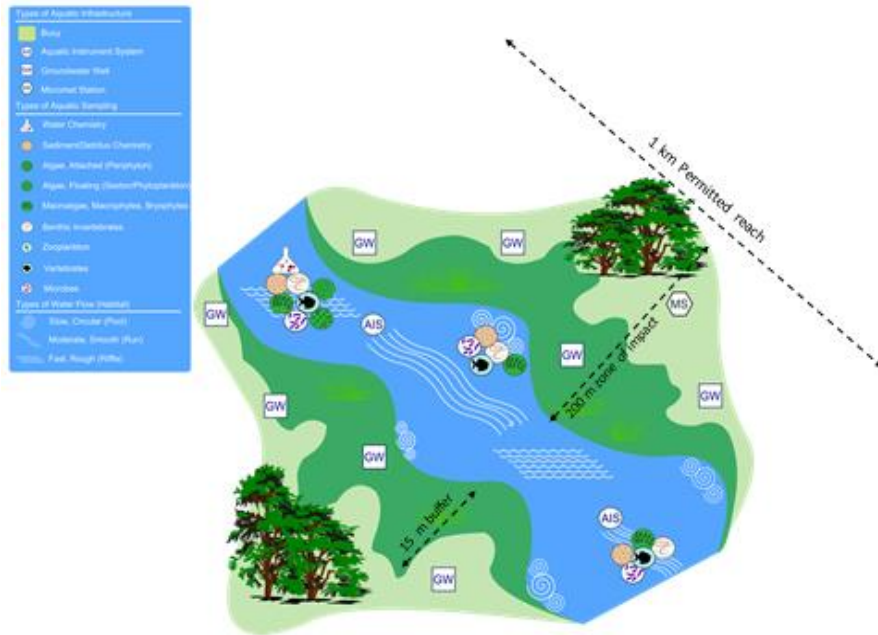


Figure 4. Generalized aquatic sampling scheme for a wadeable stream site denoting the location of instrumental infrastructure and observational sampling stations.

Streams (non-wadeable):

The aquatic instrument infrastructure (AIS) is located within the 1 km stream reach. The instrument infrastructure consists of one sensor set equivalent to that installed in wadeable streams. Further infrastructure consists of a meteorological station located in the riparian zone and a suite of up to eight instrumented groundwater wells located within the 200 m permitted boundary. All observational sampling (AOS) takes place within the 1 km stream reach.

Lakes:

The aquatic instrument infrastructure (AIS) is located within the lake and surrounding 200 m permitted boundary. The instrument infrastructure consists of a profiling buoy located in the deepest zone of the lake and two sensor sets (pressure, temperature and underwater photosynthetically active radiation (PAR)) located in the nearshore zones denoted by inlets and outlets or hydrologically impacted zones. Further infrastructure consists of a meteorological station located in the riparian zone and a suite of up to eight instrumented groundwater wells located within the 200 m permitted boundary. All observational sampling (AOS) takes place within the lake (Fig. 5).

Aquatic sites span hydrologic and chemical gradients across the continent and these gradients provide the basis for scaling up across space and time. Likewise, the science designs of the Aquatic and

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

Terrestrial components of NEON are co-developed so that the data from aquatic sites can be combined with terrestrial data to ask questions related to ecohydrology and biogeochemistry.

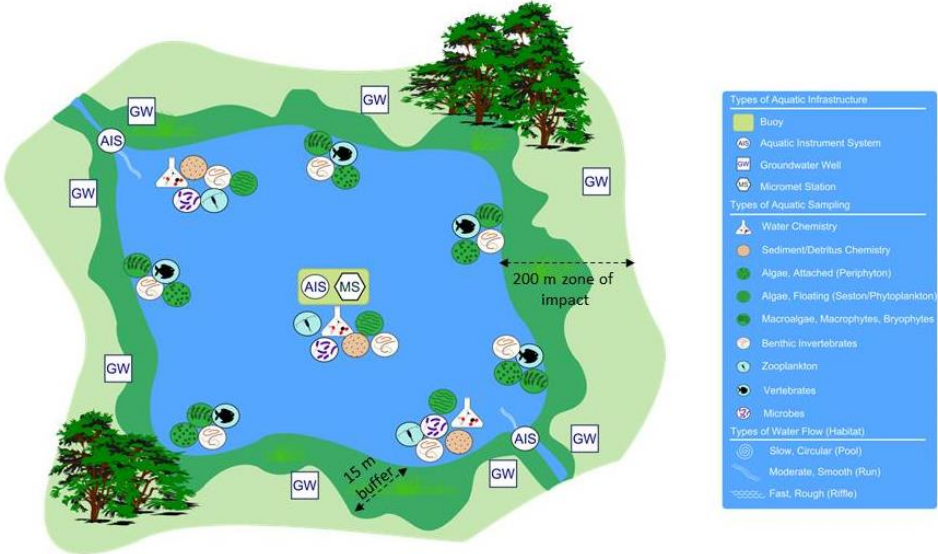


Figure 5. Generalized aquatic sampling scheme for a lake site denoting the location of instrumental infrastructure.

As with terrestrial sampling locations, NEON encourages the use of aquatic sites as controls for other experiments and research activities, subject to the guidelines presented below. Sampling or other activities within NEON stream reaches or lakes, or within the 15 m buffer zones surrounding them may be permissible under the assignable assets program (see RD [05]).

5 RESEARCH AROUND NEON LOCATIONS

Much, though not all, of the NEON infrastructure has been developed to accommodate additional sampling and experimentation. However, the role of NEON observations as long-term controls or baseline observations can only be maintained if NEON and the site host coordinate to ensure the integrity of observations over time. While most external investigator-initiated research around NEON locations will likely have no impact on NEON measurements, NEON wishes to ensure that all impacts are understood and documented.

Research activities on-going at any given site were assessed when the site was initially proposed to become part of NEON. When new research activities within the exclusion areas and buffer zones around NEON locations (see details below) are proposed to the site host, NEON requests notification and the opportunity to review and comment on the proposed activity, as needed, to provide specifics

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
<i>NEON Doc. #:</i> NEON.DOC.004312	<i>Author:</i> D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	<i>Revision:</i> D

about the NEON operations and to avoid conflicts with the NEON effort.² Similarly, if NEON proposes to add a new activity to existing infrastructure or plans to implement a new suite of measurements, NEON will provide a proposal to the site host to secure authorization of the new activity.

6 LAND MANAGEMENT

NEON plans to collect data and biological samples for an extended period of time, with core sites being active for a minimum of 30 years, and relocatable sites for five to ten years. The intent is to ensure, to the extent practicable, the integrity of its measurement and observation systems over the entire extent of its tenure on the site. This presents a challenge for site hosts accustomed to accommodating researchers for relatively short periods of time.

NEON assumes that the site will continue to be managed by the landowner or site manager following the site-specific strategies, procedures and protocols in place at the time that the land use agreement is put into place, and that they will continue to do so in cooperation and coordination with NEON. Terrestrial sampling locations, tower infrastructure/management, and the aquatic infrastructure should not interfere with or change site management strategies related to, for example, grazing, fire, forest management, agriculture and/or scientific research. NEON sampling is managed in a manner consistent with these strategies.

Altering or disturbing any NEON infrastructure should be avoided without prior NEON approval in accordance with the extant land use agreements. NEON coordinates with site hosts to make sure that reasonable measures are in place to prevent vandalism of NEON facilities. The site host takes reasonable precautions to avoid or minimize impacts of other unapproved activities by external researchers, site guests, and the general public.

NEON may participate in advisory structures that are established on sites, especially where significant ongoing research activities will continue to take place -- i.e., biological field stations and other locations established for research purposes. This helps to maintain an appropriate level of communication and coordination at these sites and to avoid inadvertent impacts on on-going and planned observational studies and research activities. The NEON Field Operations Manager serves as the liaison with these advisory bodies where they exist.

7 RECOMMENDED EXCLUSIONS NEAR NEON LOCATIONS

General guidelines for avoiding impacts on the science associated with the specific NEON locations are provided in this section. It must be recognized that recommended restrictions related to one type of measurement or physical infrastructure are not mutually exclusive of one another. One requirement

² Note that it is the responsibility of the principal investigator (PI) to identify and secure all other required permits from the site host and other state and federal agencies as appropriate prior to beginning work as their activities are not covered under NEON’s permits.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

does not nullify another – all must be considered collectively. Charts in Appendix A provide a graphic illustration of the guidelines described below.

7.1 Tower Location

Information on TIS tower locations and flux source areas is detailed in the individual site metadata and will be made available via the NEON data portal. Specific site planning details can also be provided upon request. The following guidelines only consider site impact on TIS measurements -- TOS tower plot sampling is covered under Terrestrial Sampling Locations below.

7.1.1 Flux Scale

The tower footprint is the critical area within which flux measurements are obtained – i.e., CO₂, water and energy flux (see Figure 1). It is delineated to ensure that the measured fluxes are from a source area representative of the dominant ecosystem at the site. Proposed access to and activities within the tower footprint that NEON wishes to control are those that have the potential to alter the sources and sinks of key measurement variables (scalars) or that cause changes to the physical flow over and through the ecosystem.

Conducting a project within the flux footprint will have some impact no matter how far away from the tower. As such, when there is a request for any external research to be performed at one of the NEON tower locations, the researchers should be encouraged to locate their research activity outside of the 90% source area (Figure 6).

The impact of disturbances caused by individual sampling activities has been extensively modeled at each of NEON’s tower locations to delineate “research exclusion zones” that surround TIS instrumentation. Exclusion zones vary depending upon the nature and scope of the sampling activities involved (RD [06]). The tower measurement areas are determined by defining a flux footprint (ER [01] and a radiation footprint (ER [02]). A specific exclusion zone can then be defined to minimize mutual interference associated with specific research activities by considering annual visitation frequency, length and width of trail used when visiting the location, area disturbed by research, disturbance impact weighting factor, and scientific value factor (see details at RD [06]).

1. Non-Destructive Sampling (Chart 1):

- a. Sampling may take place within the prevailing wind flux footprint of the 90% source area if the proposed research involves only seasonal-to-annual visits, does not change process rates or scalar measurements (e.g., addition of CO₂ for mosquito traps), and is unlikely to result in impacts from travel through the area. NEON requests that the prospective researcher contact NEON so that NEON science staff can assist in determining the best approach to minimizing impact on NEON measurements (per RD [06]).

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

b. Sampling activities that involve daily-weekly-monthly visits have the potential to change process rates or scalar measurement, and/or have the potential to result in noticeable impacts from travel through the source area. NEON requests that the prospective researcher contact NEON so that NEON science staff can assist in determining the best approach to minimizing impact on NEON measurements (per RD [06]).

2. Destructive Sampling and Manipulative Experiments (Chart 1):

For sampling and experimentation that is destructive, manipulative or otherwise results in changes in process rates -- e.g., due to biomass removal, exclosures and nutrient additions - NEON requests that the prospective researcher contact NEON so that NEON science staff can assist in determining the best approach to minimizing impact on NEON measurements (per RD [06]).

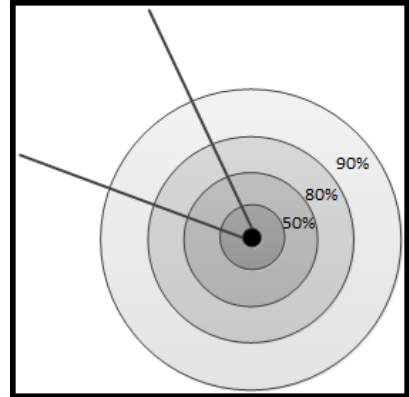


Figure 6. Schematic of the 90%, 80%, and 50% source areas around the tower as well as the prevailing wind flux footprint

3. Establishing Infrastructure in Shrubland or Forest (Chart 2):

a. Physical infrastructure can be established in the direction of the prevailing wind flux footprint(Figure 6) if the infrastructure:

- i. Does not affect wind flows – convective, turbulent structure, nighttime drainage, etc.
- ii. Is outside of the 80% source area³, and any trees or shrubs removed are likely to have a minimal impact on the overall forest structure and canopy.
- iii. Does not change local ecosystem process rates due to, e.g., fertilization, emissions, irrigation, rain-out shelters, warming experiment, land use change, etc.
- iv. Has no more than minimal impact to the source area due to travel through the site – i.e., primarily involves seasonal to annual travel through the area.

b. If otherwise, infrastructure must be established outside the 90% source area⁴ ±20° of the prevailing wind flux footprint (Figure 6).

4. Establishing Infrastructure in Grasslands or Tundra (canopy height < 1.75 meters) (Chart 3):

Physical infrastructure of any height will affect the wind flows (convective, turbulent structure, nighttime drainage, etc.) within these low stature communities.

a. Physical infrastructure may be established in the direction of the prevailing wind flux footprint but outside the 80% source area if it is placed a minimum of 5 length scales beyond the 80% source, where one length scale is equal to the height of the proposed object as illustrated in Figure 7.

³ The 80% source area is a function of the distance required to be outside of 80% of the accumulated flux footprint. It is determined on a site-by-site basis.

⁴ The 90% source area is a function of the distance required to be outside of 90% of the accumulated flux footprint. It is determined on a site-by-site basis.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

- b. Physical infrastructure should be placed outside the 90% source area and $\pm 20^\circ$ beyond the prevailing wind flux footprint (Figure 6) if the overall impact from travel through the source area is daily, weekly or monthly and/or likely to result in noticeable impacts.

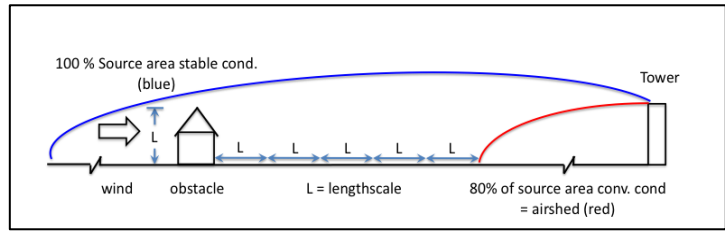


Figure 7. The three different use conditions around the tower infrastructure, (a) the 80 percent source area footprint under daytime convective conditions, (b) the distance (5L) away an obstacle has to be from the footprint, and (c) the 100% stable source.

In the event of any doubts with regard to the above, NEON science staff is available and can assist in determining the best approach to minimizing impact on NEON measurements (per RD [06]).

7.1.2 Microclimate Scale

The microclimate scale exclusion area is defined as an 80m radius buffer centered on the NEON tower.⁵ Any research activity within the 80m buffer has the potential to impact the tower microclimate and should be limited to the extent practicable. All traffic (public or otherwise) within the 80 m buffer should stay on designated boardwalks or paths.

1. Non-destructive Sampling (Chart 4A):

- a. Sampling may be permitted within the 80 m buffer if the proposed research involves only seasonal to annual visits, is likely to result in minimal impacts from travel through buffer area and is consistent with the exclusion zone described above.
- b. Sampling must take place on the leeward side of the tower and outside the 80 m buffer if the proposed research involves daily-weekly-monthly visits and/or has the potential to result in noticeable impacts from travel through the buffer area.

2. Destructive Sampling and Experimental Manipulations (Chart 4B):

- a. NEON advises against destructive sampling (including limb shooting, soil coring and tree coring) and manipulation experiments anywhere within the 80 m buffer area.
- b. Destructive sampling and manipulation experiments may be permitted on the leeward side of the tower outside the 80 meter buffer zone if the activity involves:
 - i. Only seasonal to annual visits and is likely to result in minimal impacts from travel through the buffer area, and

⁵ Typically, activities that are inadvisable at the flux scale would also be inadvisable at the microclimate and soil scales. Guidelines presented here for the microclimate and soil scales would apply for those activities that were found to be otherwise permissible at the flux scale. It is not clear how often this might occur – the guidelines are provided in order to account for such possibilities.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

- ii. The size and level of impact are deemed unlikely to impact the tower microclimate.

3. Establishing Infrastructure (Chart 4B):

- a. NEON advises against placing any physical infrastructure within the 80 m buffer zone.
- b. Physical infrastructure may be permitted on the leeward side of the tower outside the 80 meter buffer zone if the activity involves:
 - i. Only seasonal to annual visits and is likely to result in minimal impacts from travel through the buffer area, and
 - ii. The size and level of impact are deemed unlikely to impact the tower microclimate.

7.1.3 Soil Scale

The soil array exclusion area is defined as a 10 m buffer zone around the array and is typically located within the flux footprint.⁶ The specific arrangement of the soil array may vary from site to site -- information can be provided separately that is specific to each site. All traffic (public or otherwise) must stay on designated boardwalks or paths within area of the soil array, unless prior approval is granted.

1. **Non-destructive Sampling (Chart 5A):** Sampling may be permitted within the 10 m buffer if the proposed work is consistent with the aforementioned exclusion zones (note that the soil array is located within the flux footprint).
2. **Destructive Sampling and Manipulative Experiments (Chart 5B):** Limited destructive sampling and manipulative experiments, such as soil coring, may be permitted within the 10 m buffer area if it is consistent with the aforementioned exclusion zones.
3. **Establishing Infrastructure (Chart 5B):** NEON advises against placing any physical infrastructure within the soil array buffer zone.

7.2 Terrestrial Sampling Locations

While it is understood that limiting people from incidentally walking through a plot is difficult, as a general rule, active and repetitive access through a sampling plot – i.e., daily, weekly or monthly – should be avoided and actively discouraged. Any and all sampling on or within any of NEON’s terrestrial sampling locations is prohibited save for activities approved under NEON’s assignable asset program (RD[05]).

⁶ Ibid

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

7.2.1 Tower Plots

Between 4 and 20 ecosystem productivity and plant phenology sampling plots are placed within the TIS tower airshed using a stratified random design (Figures 1 and 3). The exclusions described above for the TIS airshed (flux scale) apply here as well.

1. **Destructive and Non-destructive Sampling and Manipulative Experiments:** Any sampling within the vicinity of tower plots should be consistent with the flux scale guidelines above.
2. **Establishment of Infrastructure:** NEON advises against placement of physical structures of any sort in the vicinity of the tower plots, consistent with tower infrastructure guidelines above.

7.2.2 Distributed and Gradient Plots (Including Tick Plots)

1. **Nondestructive Sampling (Chart 6A):** NEON advises limiting research activities within 20 m of distributed and gradient plots, especially if the proposed research involves daily-weekly-monthly visits and/or has the potential to result in noticeable impacts from travel through the area.
2. **Destructive Sampling and Manipulative Experiments (Chart 6B):** Destructive sampling and manipulative experimentation has the potential to impact NEON measurements if conducted in the vicinity of these plots. NEON advises prohibiting any such research within 20 m of these plots.
3. **Establishing Infrastructure (Chart 6C):** Physical infrastructure may be permitted in the vicinity of these plots if it is unlikely to impact the quality or quantity of samples collected from the sampling location, particularly if it involves only seasonal to annual visits and is likely to result in minimal impacts from travel through the area.
4. **Additional Considerations for Beetle Pitfall Sampling (Chart 6D):** It may be appropriate to restrict additional beetle pitfall trapping as it is possible that beetles could be oversampled, especially where threatened, endangered or other at-risk species may be known to exist.^{7,8}
5. **Additional Considerations for Mosquito Traps (Chart 6E):** Additional concurrent sampling for mosquitos using a CO₂ baiting system should be avoided within a 300m buffer around NEON mosquito sampling points in order to avoid trap competition. Non-concurrent sampling within this buffer would be acceptable.

⁷ Includes species of concern but not on an official list of protected species; e.g., candidates for listing or species of concern as recognized in databases such as NatureServe. These will generally be known to the site host or local conservation groups and may have been determined in conjunction with the NEON programmatic Environmental Assessment.

⁸ Note that access to and use of beetle and other by-catch will be subject to separate policies and procedures currently being developed

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

7.2.3 Small Mammal Grids

The biological integrity of the sampled populations should be maintained, as NEON will collect data on population and community dynamics.

- 1. Nondestructive Sampling (Chart 7A):** NEON advises limiting research activities within 20 m of the small mammal grids, especially if the proposed research involves daily-weekly-monthly visits and/or has the potential to result in noticeable impacts from travel through the area.
- 2. Destructive Sampling and Manipulative Experiments (Chart 7B):** Destructive sampling and manipulative experimentation have the potential to impact NEON measurements if conducted in the vicinity of small mammal grids. NEON advises prohibiting any such research within 20 m of these grids plots.
- 3. Establishing Infrastructure (Chart 7C):** Physical infrastructure in the vicinity of small mammal plots is problematic to the extent that it may attract predatory bird species that can use the infrastructure as a hunting perch. NEON requests to be advised of any infrastructure that is proposed to be placed within 50 m of any small mammal grid so that potential impacts can be evaluated by the NEON vertebrate ecologist.
- 4. Additional Considerations (Chart 7D):** Additional small mammal trapping near NEON sampling locations may result in over-sampling and stress to the small mammal populations and, therefore, should generally be avoided if possible. Additional sampling that is proposed within 100 m of NEON small mammal grids should be coordinated to the extent practical to identify synergies and minimize the overall impact on the local population.⁹

7.2.4 Bird Grids

Activity in the immediate vicinity of bird point-count grids while counting (or acoustic recording) is occurring should be avoided as it may interfere with bird activity and bias results.

- 1. Nondestructive Sampling (Chart 8A):** NEON advises limiting research activities within 50 m of bird grids during NEON point-count sampling periods, especially if the proposed research involves frequent visits and/or has the potential to result in noticeable impacts from travel through the area. Sampling that takes place outside of the breeding and early nesting periods (dates vary by site) is preferable.
- 2. Destructive Sampling and Manipulative Experiments (Chart 8B):** Destructive sampling and manipulative experimentation has the potential to impact NEON measurements if conducted in the

⁹ Note that proposals to take additional measurements from small mammals captured by NEON personnel would be handled through the NEON assignable asset program (RD [05])

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
<i>NEON Doc. #:</i> NEON.DOC.004312	<i>Author:</i> D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	<i>Revision:</i> D

vicinity of bird grids. NEON advises prohibiting any such research activity within 50 m of the bird grids, and, if permitted, to avoid such activities during NEON point-count sampling periods.

3. **Establishing Infrastructure (Chart 8C):** Physical infrastructure >2m tall in the vicinity of bird grids is problematic to the extent that it may attract predatory bird species that can use the infrastructure as a hunting perch. NEON requests to be advised of any infrastructure that is proposed to be placed within 150 m of any bird grid so that potential impacts can be evaluated by the NEON vertebrate ecologist.

7.3 Aquatic Locations

NEON measurements at a stream, river or lake site are intended to sample the chemical, biological and physical conditions relative to existing flow regime, as affected by climate, large scale land use and other ambient factors. Any and all sampling on or within NEON’s aquatic 15 m buffer zones is prohibited save for activities approved under NEON’s assignable asset program (RD [05]).

7.3.1 Aquatic Streams

The following guidelines are suggested to minimize impacts to the aquatic stream locations.

1. **General Access (Chart 9 A):**
 - a. Access and alterations to a stream should be minimized when working near or on the shorelines.
 - b. Wading in the stream and erosion on banks from human presence should be minimized.
 - c. NEON advises against any alterations to the landscape within the 200 m zone of impact of the NEON stream reach (unless part of a site land management plan) that may affect physical, chemical or biological condition in the aquatic system.
 - d. When necessary, access to the stream should occur downstream of the NEON reach or at designated entry points.
 - e. When necessary, access to the stream should occur at designated entry points.
 - f. Access to the lake should not be within a 15 m radius of NEON infrastructure.
2. **Non-destructive Sampling (Chart 9B):** Sampling may take place upstream or downstream of a NEON stream reach if it:
 - a. Does not modify water volume, water travel time, flow regime or discharge (e.g., dams, weirs) upstream or downstream such that the reach is impounded in any way.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

- b. Does not modify chemical or biological conditions upstream of or within the NEON reach, thereby, leaving a research footprint.
- c. Involves only seasonal to annual visits and is likely to have minimal impact on stream biology and geomorphology.
- d. Does not occur within 5 m radius or directly upstream of sensors (Figure 8).

3. **Destructive Sampling and Manipulative Experiments (Chart 9C):** NEON advises against destructive sampling and experimental manipulations upstream of NEON’s aquatic reach. This includes the addition of any biological or chemical, tracer, or nutrient discharges upstream within or lateral to these locations.¹⁰

4. **Establishing Infrastructure (Chart 9D):**

- a. NEON advises against placing physical infrastructure that may modify flow regimes and conditions within 200 m upstream or downstream of the NEON stream reach or laterally from the stream/lake bank, and requests notification if any such infrastructure placement is proposed.
- b. NEON requests to be notified of physical infrastructure proposed to be located greater than 200 m upstream or downstream of the NEON reach or laterally from stream/river bank if it has the potential to alter:
 - i. Water volume, water travel time, flow regime or discharge (e.g., dams, weirs) upstream or downstream such that the reach is impounded in any way.
 - ii. Chemical or biological conditions upstream of and within the NEON reach, thereby leaving a research footprint.
 - iii. Riparian vegetation and/or stream geomorphology.

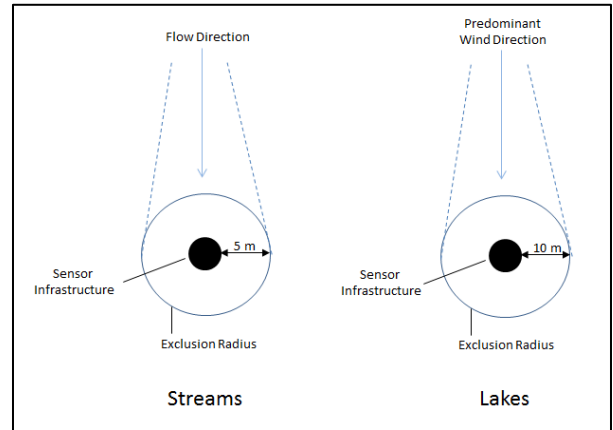


Figure 8. Conceptual illustration of the exclusion area around sensor infrastructure in streams and lakes as a function of flow and predominant wind direction.

7.3.2 **Aquatic Lakes and Ponds**

The following guidelines are suggested to minimize impacts to the aquatic sampling locations.

¹⁰ The lateral distance is to be determined on a site specific basis and is a function of subsurface flows, topography and ecosystem structure.

<i>Title:</i> NEON Site Research Coordination Guidelines		<i>Date:</i> 08/252016
<i>NEON Doc. #:</i> NEON.DOC.004312	<i>Author:</i> D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	<i>Revision:</i> D

1. General Access (Chart 10A):

- a. Access and alterations to the lakes should be minimized when working near or on the shorelines.
- b. Wading in the nearshore areas of lakes and erosion on banks from human presence should be minimized.
- c. NEON advises against any alterations to the landscape within the 200 m zone of impact of the NEON lake reach (unless part of a site land management plan) that may affect physical, chemical or biological condition in the aquatic system.
- d. When necessary, access to the lake should occur at designated entry points.
- e. Access to the lake should not be within a 10 m radius of NEON infrastructure

The following guidelines are suggested to minimize potential impacts at a NEON lake sampling location.

1. Non-destructive Sampling (Chart 10B): Nondestructive sampling may take place within the lake if it does not involve

- a. Modification to the physical, chemical or biological patterns and process within the lake or 200m zone of impact, thereby leaving a research footprint.
- b. New collections of chemical or biological research samples in the lake, upslope basin and tributaries or in the 200 m zone of impact, thereby leaving a research footprint
- c. Daily to monthly visits and is unlikely to have a measurable impact on the lake system
- d. Sampling within 10 m radius or directly upwind of sensors (Figure 8).

2. Destructive Sampling and Manipulative Experiments (Chart 10C): NEON advises against destructive sampling and experimental manipulations that are not already on-going in the lake or pond or within 200 m of the shoreline unless first discussed and agreed to by NEON.¹¹ The addition of any biological, chemical, tracer or nutrient discharges directly into the lake or the upslope watershed basin that is in the flow path of the sampling location should be avoided.¹²

3. Establishing Infrastructure (Chart 10D):

¹¹ There may be instances where NEON would want researchers to add to NEON by collecting biological specimens that we currently do not collect or that would enhance the spatial-temporal design.

¹² The exact lateral distance and locations are to be determined on a site specific basis as a function of subsurface flows, topography and ecosystem structure.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

- a. NEON advises against placing physical infrastructure within 200 m of the lake shore that may modify chemical, physical or biological conditions within the lake and requests notification if any such infrastructure is proposed.
 - b. NEON requests to be advised of any physical infrastructure to be placed greater than 200 m laterally from the lake shore that has the potential to alter:
 - i. Surface or subsurface water flow to the lake.
 - ii. Chemical or biological conditions, thereby leaving a research footprint.
 - iii. Riparian vegetation and/or geomorphology.
4. **Additional Considerations:** NEON encourages coordination of any proposed changes to lake banks and riparian zones, including construction of docks and access routes.

7.3.3 Groundwater Wells

NEON advises against terrestrial sampling within 30 m of NEON’s permitted groundwater wells if it has the potential to impact ground water chemical, biological or physical conditions. (Chart 11A)

NEON requests to be notified of any manipulative experiments within the NEON zone of impact that may affect groundwater chemical, biological or physical conditions. (Chart 11B)

8 CONTACTS

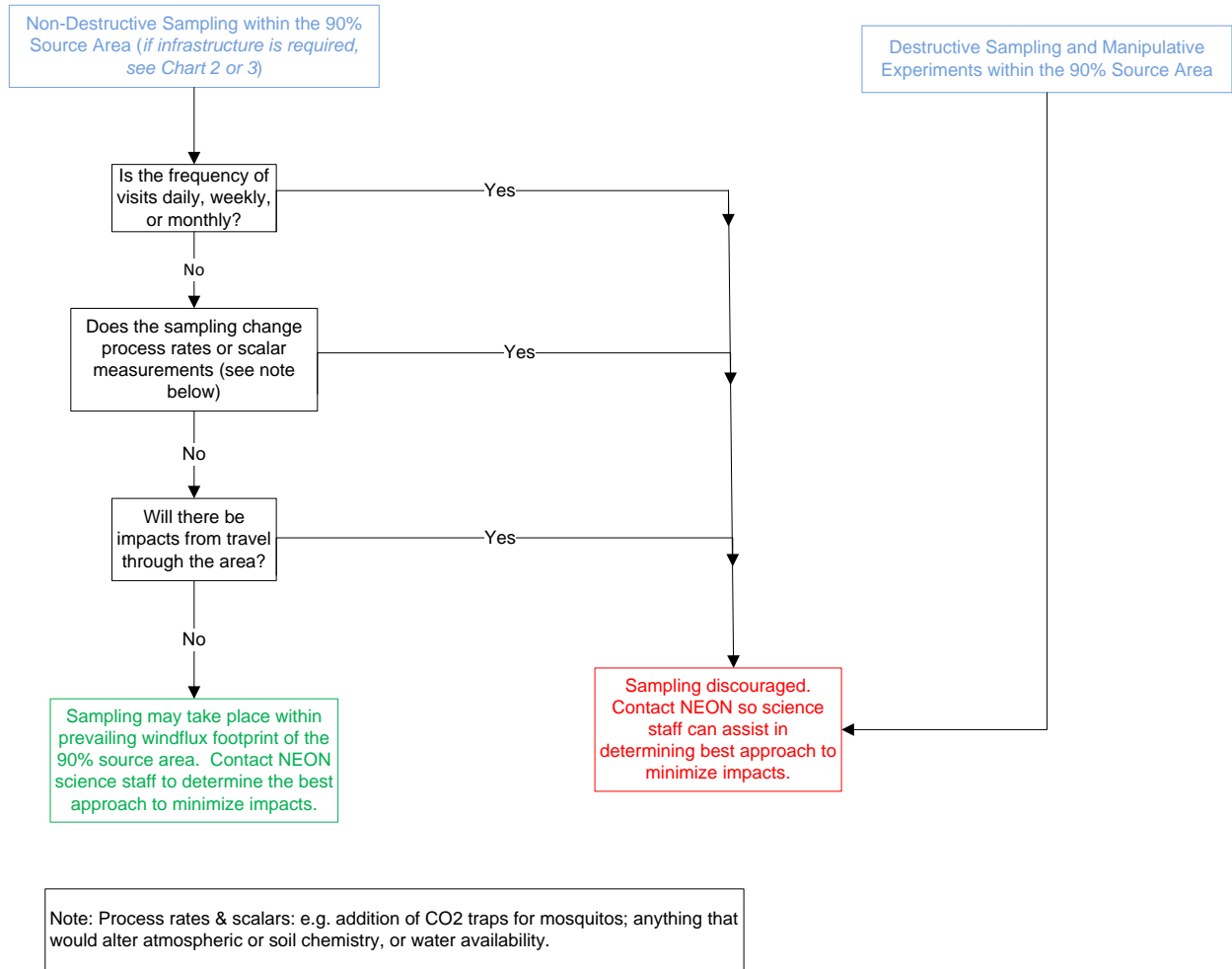
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Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

APPENDIX A NEON SITE RESEARCH COORDINATION FLOWCHARTS

**TOWER LOCATION: FLUX SCALE (CO₂, WATER, ENERGY FLUX)
TERRESTRIAL SAMPLING LOCATIONS: TOWER PLOTS**

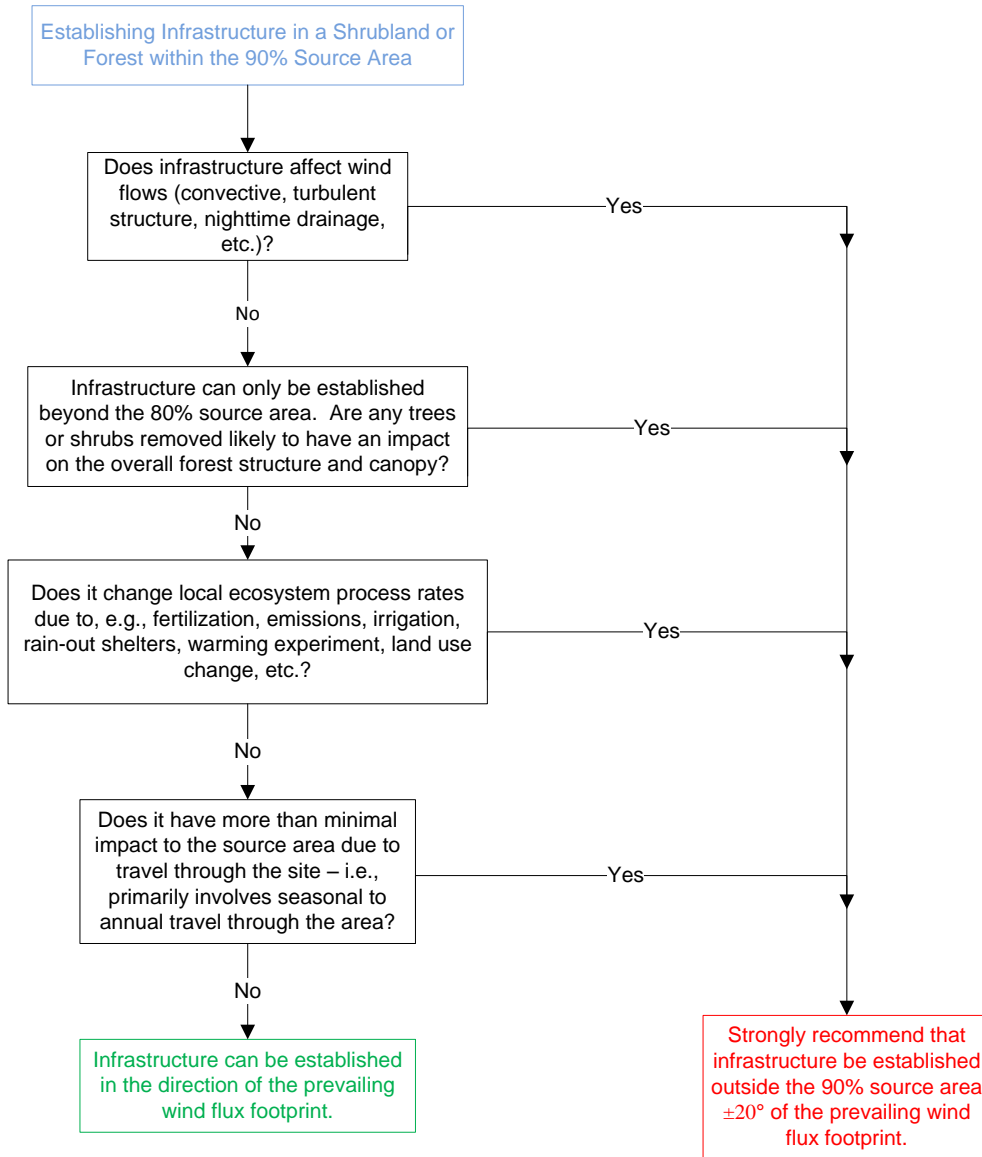
CHART 1



Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

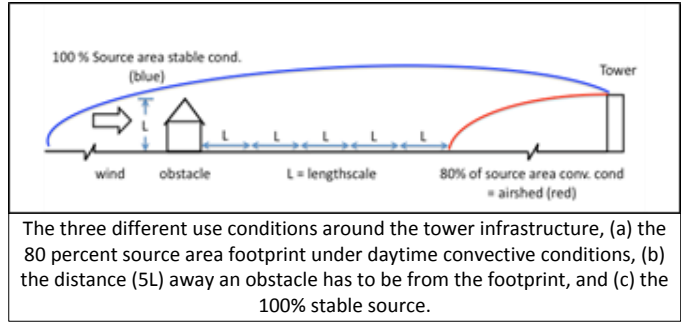
**TOWER LOCATION: FLUX SCALE (CO₂, WATER, ENERGY FLUX)
TERRESTRIAL SAMPLING LOCATIONS: TOWER PLOTS**

CHART 2



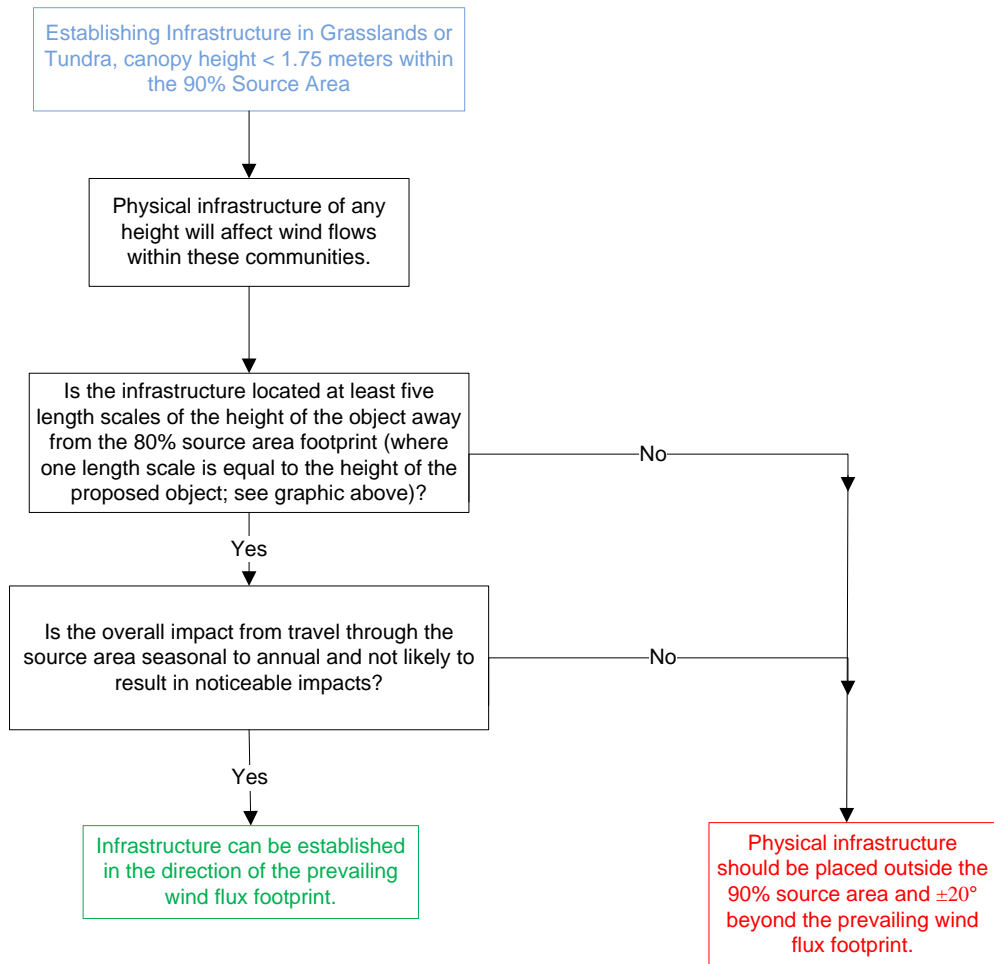
Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

**TOWER LOCATION: FLUX SCALE (CO₂, WATER, ENERGY FLUX)
 TERRESTRIAL SAMPLING LOCATIONS: TOWER PLOTS**



The three different use conditions around the tower infrastructure, (a) the 80 percent source area footprint under daytime convective conditions, (b) the distance ($5L$) away an obstacle has to be from the footprint, and (c) the 100% stable source.

CHART 3



TOWER LOCATION: MICROCLIMATE SCALE (80 M BUFFER SURROUNDING THE TOWER)

CHART 4A

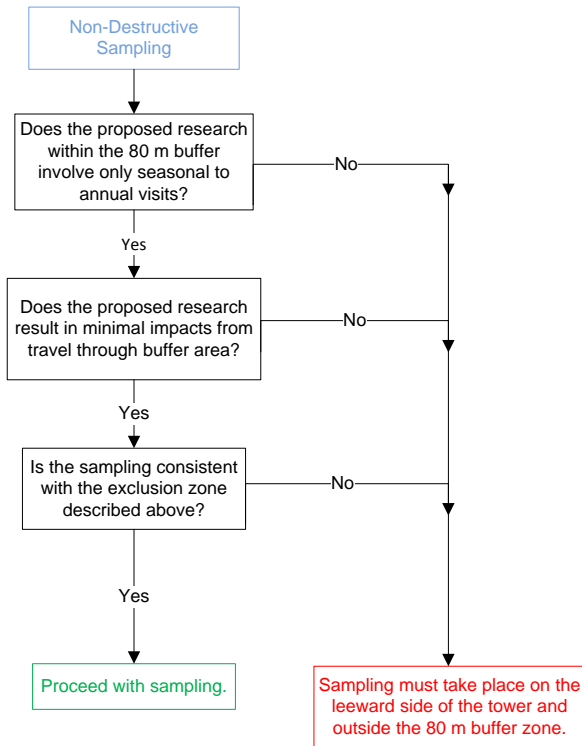
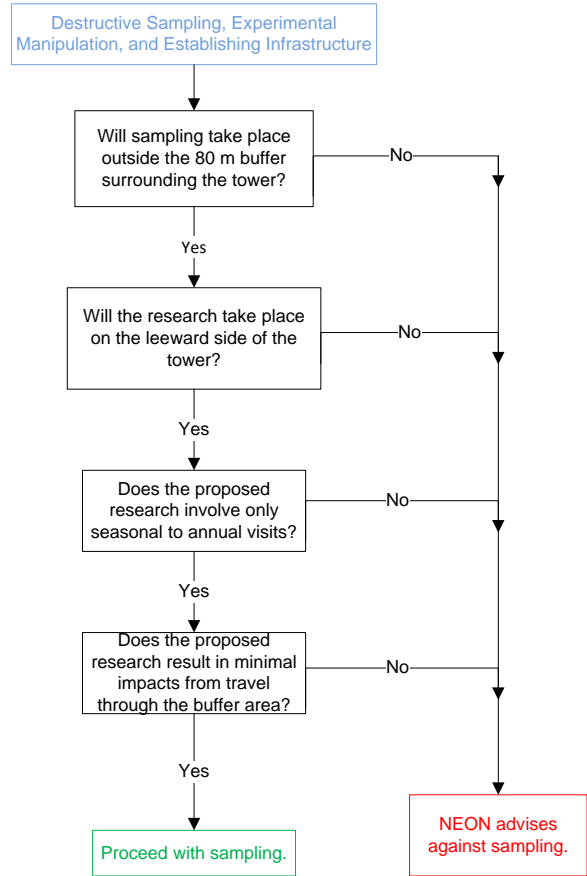


CHART 4B



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

TOWER LOCATION: SOIL SCALE (10 M BUFFER SURROUNDING THE SOIL ARRAY)

CHART 5A

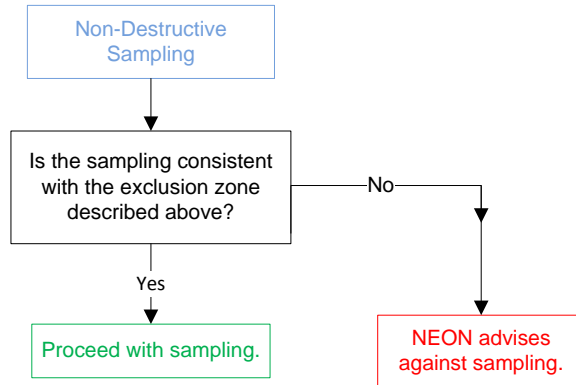
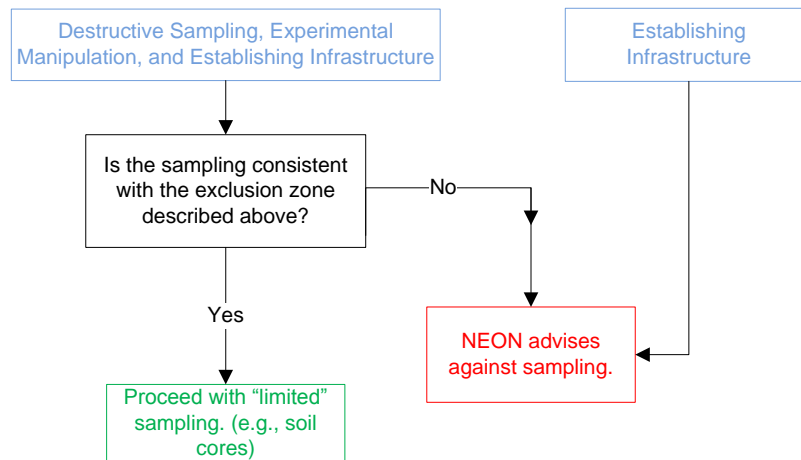


CHART 5B



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

TERRESTRIAL SAMPLING LOCATIONS: DISTRIBUTED AND GRADIENT PLOTS (INCLUDING TICKS)

CHART 6A

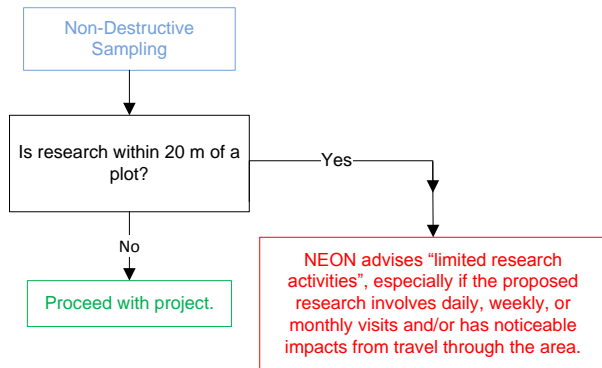


CHART 6B

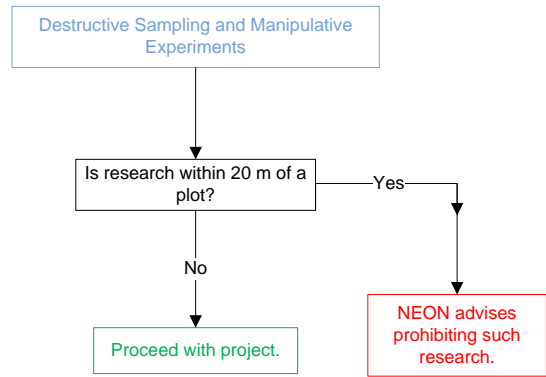


CHART 6C

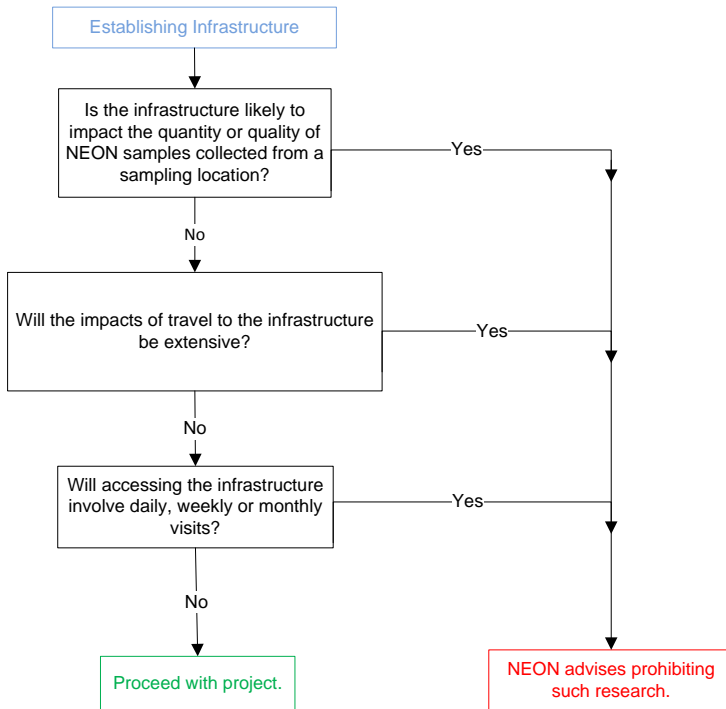


CHART 6D

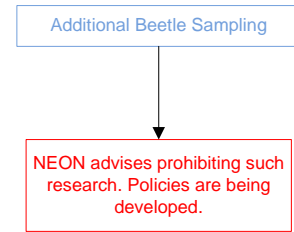
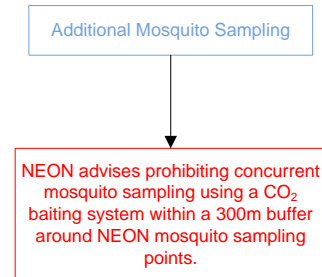


CHART 6E



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

TERRESTRIAL SAMPLING LOCATIONS: SMALL MAMMAL GRIDS

CHART 7A

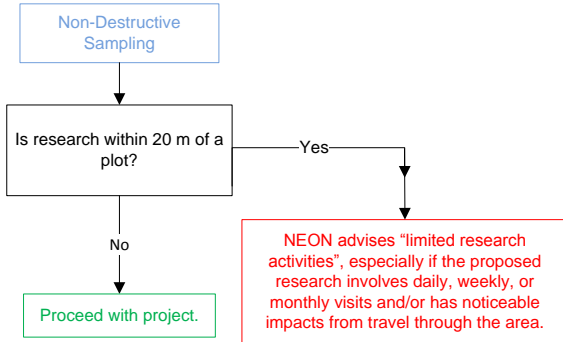


CHART 7B

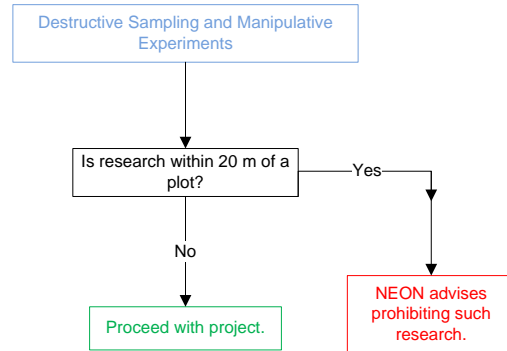


CHART 7C

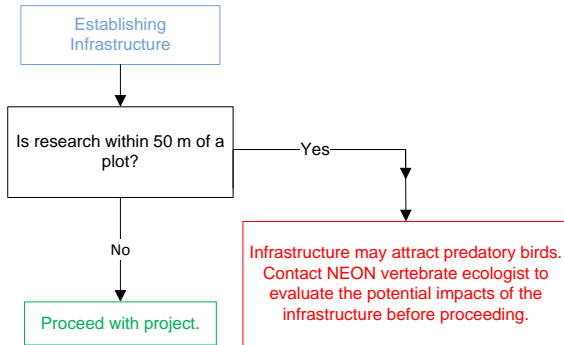
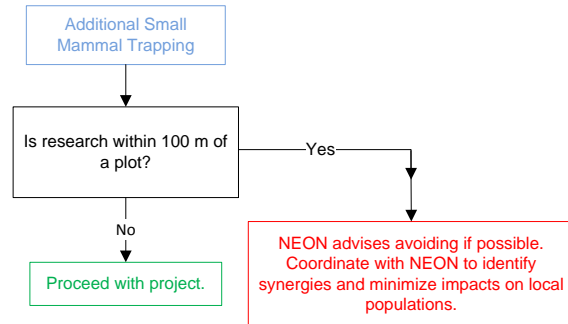


CHART 7D



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

TERRESTRIAL SAMPLING LOCATIONS: BIRD GRIDS

CHART 8A

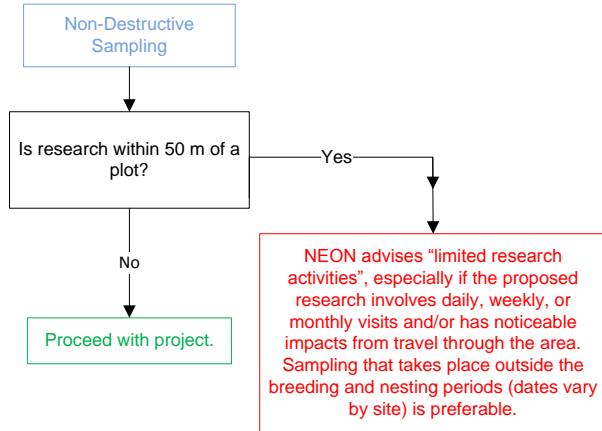


CHART 8B

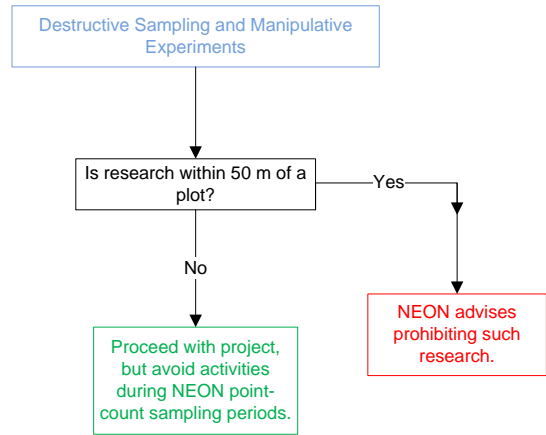
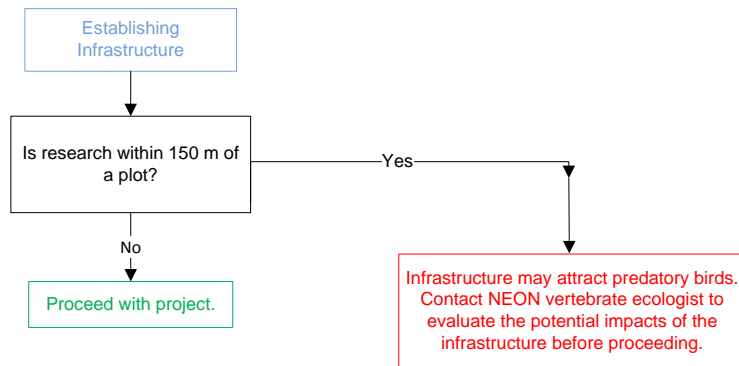


CHART 8C



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

AQUATIC LOCATIONS: STREAMS

CHART 9A

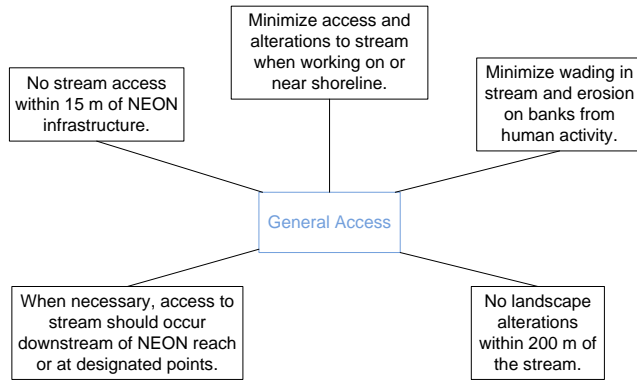


CHART 9B

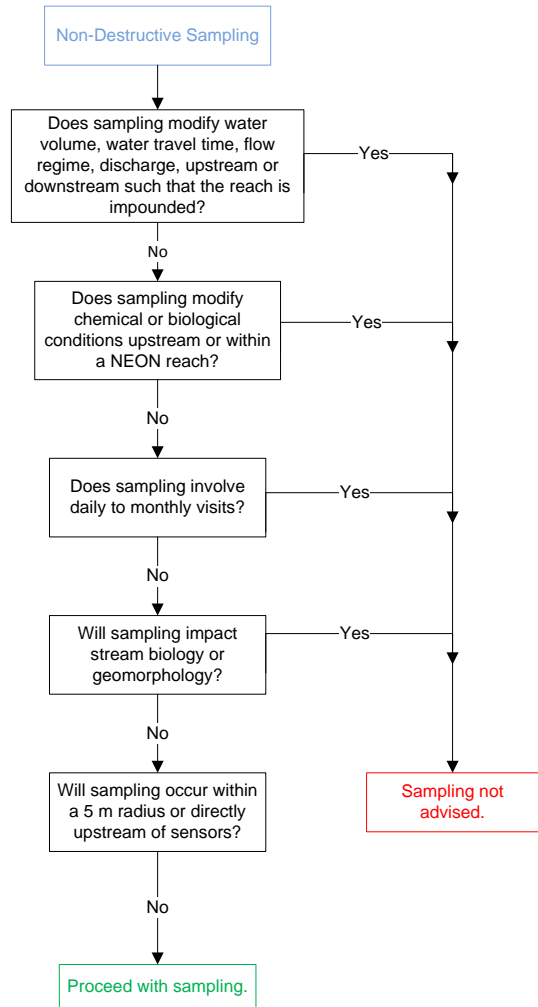
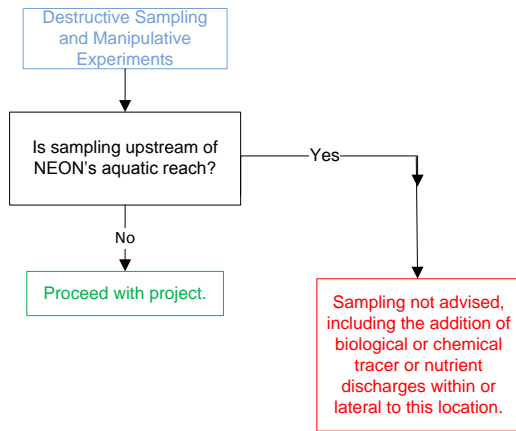


CHART 9C

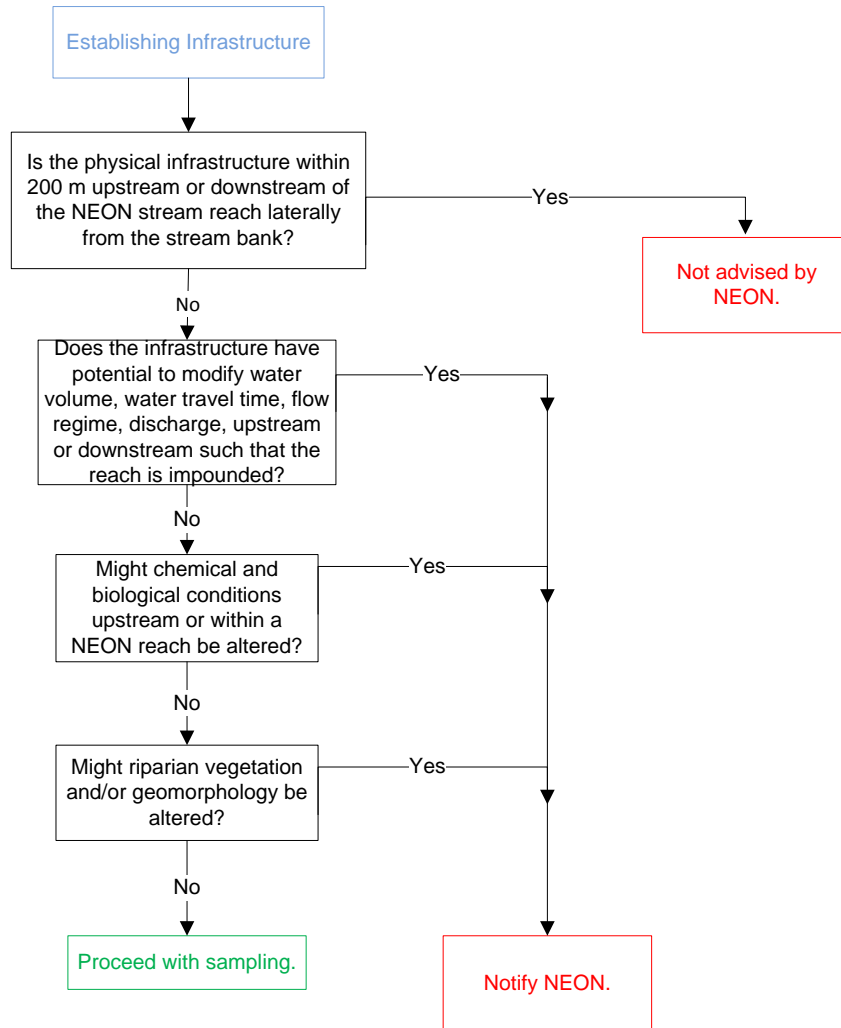


Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

AQUATIC LOCATIONS: STREAMS

CHART 9D



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

AQUATIC LOCATIONS: LAKES AND PONDS

CHART 10A

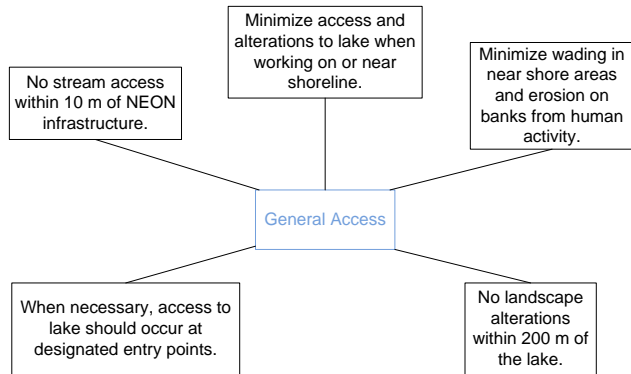


CHART 10B

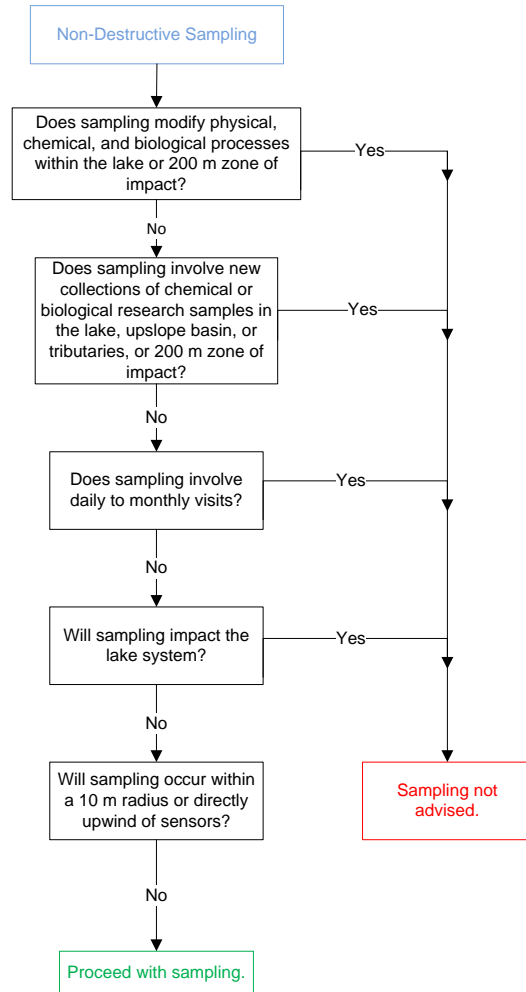
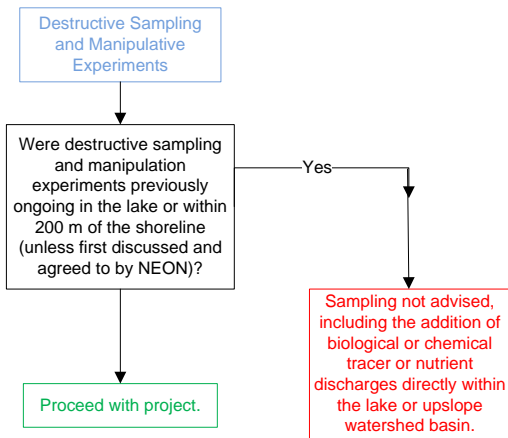


CHART 10C

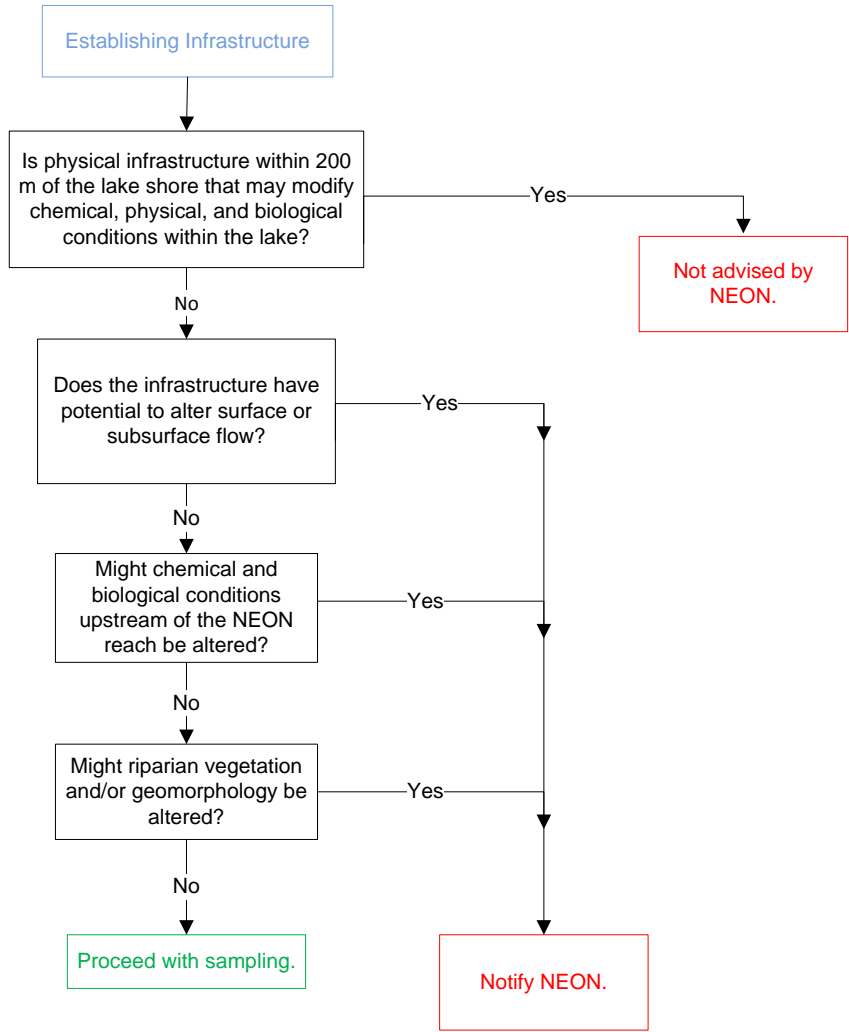


Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

AQUATIC LOCATIONS: LAKES AND PONDS

CHART 10D



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.

Title: NEON Site Research Coordination Guidelines		Date: 08/252016
NEON Doc. #: NEON.DOC.004312	Author: D. Tazik, H. Loescher, A. Thorpe, T. Baldwin, M. SanClements, K. Thibault, K. Kirby, A. Karam	Revision: D

AQUATIC LOCATIONS: GROUNDWATER WELLS

CHART 11A

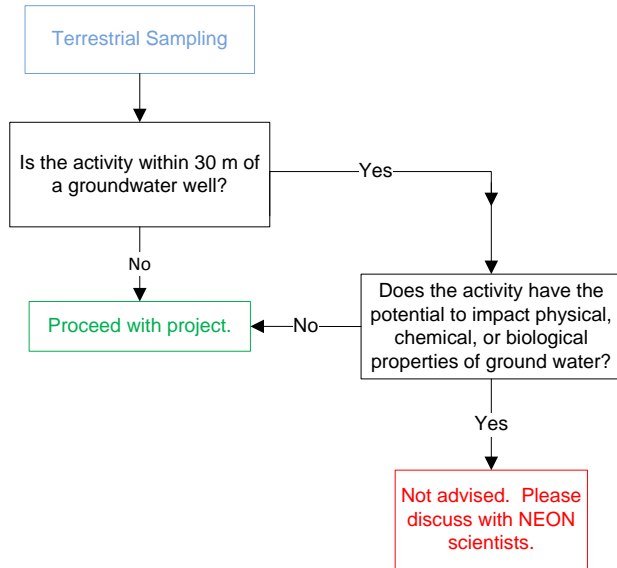
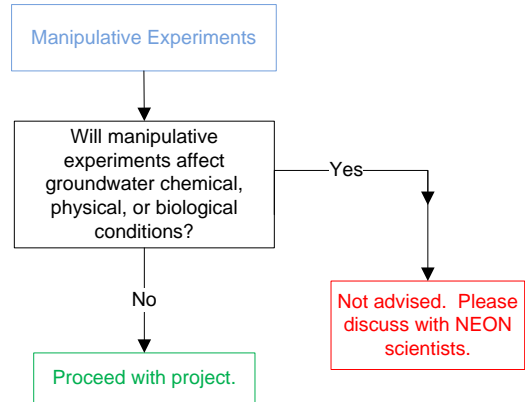


CHART 11B



Use the suggested buffer limits above with caution; if you know there might be a significant impact even when sampling is conducted outside a buffer, contact Science.