

NADP Site Selection and Installation Manual



For information about the National Atmospheric Deposition Program (NADP) contact:

NADP Program Office
Illinois State Water Survey
University of Illinois at Urbana-Champaign
2204 Griffith Drive
Champaign, Illinois 61820-7495

URL: <http://nadp.isws.illinois.edu>
e-mail: nadp@isws.illinois.edu
phone : 217-333-7871

Acknowledgements

This manual was revised with guidance from the Quality Assurance Advisory Group and the Network Operations Subcommittee of the National Atmospheric Deposition Program (NADP). Their assistance was invaluable.

The authors wish to thank the following individuals for their efforts:

Roger Claybrooke, Illinois State Water Survey
Tracy Dombek, Illinois State Water Survey
Eric Hebert, Environmental Engineering & Measurement Services, Inc.
Maria Jones, Environmental Engineering & Measurement Services, Inc.
Mike Kolian, U.S. Environmental Protection Agency
Chris Lehmann, Illinois State Water Survey
Amy Ludtke, United States Geological Survey
Mark Nilles, United States Geological Survey
Mark Olson, Illinois State Water Survey
Pamela Padgett, USDA Forest Service
Eric Prestbo, Tekran Research and Development
Jane Rothert, Illinois State Water Survey
Melissa Puchalski, U.S. Environmental Protection Agency
John Sherwell, Maryland Department of Natural Resources
Marcus Stewart, AMEC
Greg Wetherbee, United States Geological Survey

Document Change History

Version	Description	Effective Date
1.8	Prohibit irrigation sources near NADP monitoring sites	10/2013
1.5	Addition of AMNet and AMoN, 2 new NADP networks	05/2011
1.0	Initial document	09/2009

Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
CAL	Central Analytical Laboratory
FGS	Frontier Global Sciences
FOF	Field Observer Form
FORF	Field Observer Report Form
HAL	Mercury (Hg) Analytical Laboratory
MDN	Mercury Deposition Network
MOF	Mercury Observer Form
NADP	National Atmospheric Deposition Program
NED	Network Equipment Depot
NTN	National Trends Network
PDA	Personal Digital Assistant
PO	Program Office
QA	Quality Assurance
QC	Quality Control
SAES	State Agricultural Experiment Stations
SOP	Standard Operating Procedures
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

I. Introduction

This document, *NADP Site Selection and Installation Manual*, details the rules and guidelines for site selection and equipment installation for a National Atmospheric Deposition Program (NADP) monitoring station. The networks associated with the NADP consider wet-deposition (AIRMoN, MDN, and NTN), atmospheric mercury (AMNet), and atmospheric ammonia (AMoN).

Selection of monitoring sites within the NADP is based on the site's potential to: provide insight into changing atmospheric chemistry, help assess the contributions to sensitive ecosystems, and help validate atmospheric models. Of particular interest are major physiographic, agricultural, aquatic, and forested areas within states, regions, and ecoregions.

Siting criteria were established to meet the goal of having regionally representative measurements, and comparability between network sites. Those criteria are considered in this document.

II. Site Classification

Sites are classified by the population density (based on current census data) within a 15 km radius of the site. The table below indicates the NADP site classifications.

Table 1. NADP Site Classifications.

Site Classification	Population within 15km of the site (people/km ²)
Isolated (I)	< 10
Rural (R)	10 – 99
Suburban (S)	100 – 399
Urban (U)	≥ 400
Research/Provisional (P)	na

Sites that do not meet NADP siting criteria, but are of scientific interest, are designated as *Research/Provisional*. A monitoring station on a tower, above a forest canopy is an example of such a site.

III. General Criteria for Site Selection

A site should be accessible year round, and in normal weather conditions. It should be secure against vandalism, and from animals, both wild (e.g., bears) and domestic (e.g., cows). When a fence is used to secure a site, the Siting Criteria Rules, as outlined in Section IV, must be considered. Placement of the NADP instrumentation relative to the fence, in terms of both horizontal and vertical proximity, and the type of fence (e.g., chain link, wood post) are important. In some instances, the fence material may be a concern as well. Wet-deposition equipment (i.e., collectors and raingages), AMoN samplers, and AMNet equipment should be located such that they cannot be impacted by irrigation sources. Wind speed and wind direction should be considered when assessing potential impact from nearby irrigation sources.

Collocation of an NADP site with other long-term monitoring networks is encouraged. Established sites have a data archive that can be evaluated. Such sites have documentation that may be reviewed as well. Data must not be compromised when monitoring sites are collocated. This is true whether multiple NADP networks are collocated, or whether an NADP network is collocated with another network (e.g., CASTNET, IMPROVE). Local site conditions should be evaluated to ensure that there is appropriate space to operate the networks, and that site activities will not impact sample collection or site operations.

IV. Rules

All new and existing NADP sites must comply with siting criteria that are designated as Rules. These criteria are supported by scientific practices that ensure uniform data quality, and provide a framework for site selection. Sites that do not meet these criteria, but wish to join an NADP network must submit a petition to seek exception. Petitions for exception to siting criteria rules are evaluated by the QA Manager, the NADP Network Operations Subcommittee (NOS) Chair, and the NOS Vice Chair. Note, an exception is not an exemption from the criteria. Depending on the situation, data collected from the site may be qualified. Existing sites that do not meet the Siting Criteria Rules should endeavor to achieve compliance. In some instances a site will be designated as Research/Provisional due to the extent and/or nature of the non-compliance with siting criteria.

Rules are defined for both installation of the equipment at a site, and for continued operation of the site. Appendix A to this document includes diagrams illustrating these rules for each of the three types of networks: wet-deposition, atmospheric mercury, and atmospheric ammonia. Rules are indicated in **red**, and a regular font style in the diagrams.

All heights are measured relative to the base of the instrumentation (e.g., collector, raingage). Angles of projection are measured from the instrument inlet (e.g., bucket orifice, inlet tube). For an angle of 45° from horizontal, the object must be a distance equal to the object's height away from the instrument. For an angle of 30° from horizontal, the object must be a distance equal to twice the object's height away from the instrumentation. Local siting criteria are based on the typical footprint of an NADP site, a 30 meter radius from the primary instrument (e.g., the collector for wet-deposition networks).

V. Guidelines

It is beneficial, but not required, for all new and existing NADP sites to comply with siting criteria that are designated as Guidelines. These criteria are recommendations based on scientific judgment. Due to practical siting considerations and research goals, it may not be possible for sites to meet one or more of these criteria. Failure to meet these criteria does not prohibit a site from either joining, or remaining in an NADP network. Again, the extent of the departure from these criteria may designate the site as *Research/Provisional*. This decision will be made by the NADP Program Office (PO) with input from the site supervisor and funding agency.

Guidelines are defined for both the installation of the equipment at a site, and for continued operation of the site. Appendix A to this document includes diagrams illustrating the guidelines

for each of the three types of networks: wet-deposition, atmospheric mercury, and atmospheric ammonia. Guidelines are indicated in blue, and an *italicized* font style in the diagrams.

Again, all heights are measured relative to the base of the instrumentation. All angles of projection are measured from the instrument inlet.

VI. Site Re-location

In the event that a site needs to be re-located from its original, approved location, the Site Liaison for that network should be consulted. The contact information for each of the NADP network Site Liaisons is included in section XII (Contact List) of this document.

The type of documentation required for a move depends on the extent of the move. See Table 2 for details. If possible, new coordinates (latitude, longitude, and elevation) should be provided to the PO for the proposed collector location prior to relocation of the site. Note, relocating a site more than 10 km will require designation of a new SiteID for the site.

Table 2. Requirements for Re-location of an NADP Network Site.

Distance from Original Location	Network	Required Action
≤ 30 m	All	- notify Site Liaison of date and purpose for move - submit new site sketch - submit new site photos
> 30 m and ≤ 10 km	All	- notify Site Liaison of date and purpose of move - submit new site sketch - submit new site photos - submit new Site Information Worksheet (SIW)
> 10 km	All	- notify Site Liaison of date and purpose of move - submit new site sketch - submit new site photos - submit new Site Information Worksheet (SIW) - new SiteID will be assigned

VII. Site Changes/Modifications

Changes or modifications to NADP sites must be coordinated with the Site Liaison for the network. This includes: equipment modifications, equipment replacement, installation of additional equipment at the site, installation/removal of equipment platforms, long-term storage of equipment and/or materials which may violate siting criteria, construction activities, and as previously discussed, site re-locations. Changes within 30m of the instrumentation are of particular concern. Land-use changes in the area around the site should be documented and discussed with the Site Liaison. Such changes may impact data quality. The introduction of

livestock, changes to agricultural practices, and the operation of new manufacturing facilities may impact sample chemistry.

VIII. New Sites

A Site Information Worksheet (SIW), site sketch, and site photos (one in each of the following directions from the proposed location: *N, NE, E, SE, S, SW, W, and NW*) are required for all sites applying to one of the NADP networks. Both the SIW and the template for the site sketch are available on the NADP website (<http://nadp.isws.illinois.edu>). Completed SIWs, site sketches, and site photos should be sent to the address listed below. Alternatively, documentation may be submitted via email at rclay@illinois.edu.

Roger Claybrooke
NADP Program Office
Illinois State Water Survey
University of Illinois at Urbana-Champaign
2204 Griffith Drive
Champaign, Illinois 61820-7495

SiteIDs are assigned by the PO. The SiteID is based on the County where the station is located. Sites located at National Parks have a separate code. The U.S. Environmental Protection Agency's Office of Air Quality Planning and Standards' (U.S. EPA, OAQPS) AEROS Manual of Code is used to determine the code.

IX. Power Requirements

A. Wet-deposition, AC Operation, 110V

110 V AC power is the preferred method for powering an NADP site. For those sites located in areas where power is interrupted frequently, a trickle charged battery backup is recommended. Configuration of the trickle charger is important. As illustrated in Figure 1 below, the trickle charger should not interrupt AC power to the collector.

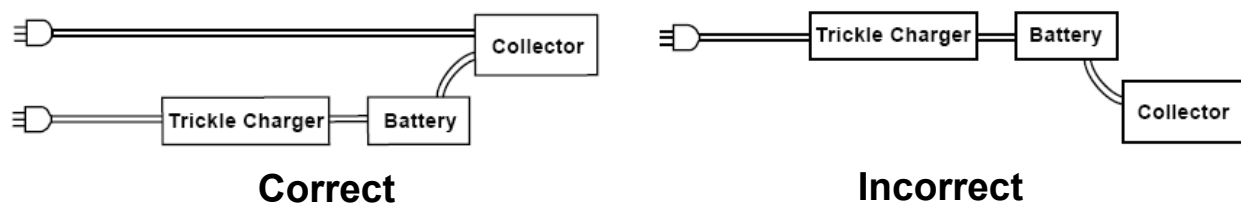


Figure 1. Trickle Charger Configuration in AC Power Line.

If a battery failure occurred with the configuration on the right, AC power would not reach the collector, and the trickle charge would be the sole source of power to the collector. Both the

Aerochem Metrics and the N-CON collectors have trickle chargers which operate in parallel to direct line AC power, as illustrated in the configuration on the left in Figure 1.

Some trickle charges may overcharge the battery, and damage it. Particular attention should be given to the selection of a trickle charger. Contact the Site Liaison for the network for guidance, if needed.

B. Wet-deposition, DC Operation

For networks that do not require AC power, a 12 VDC source may be used if AC power is not available at the site. The 12 VDC power source may be maintained by swapping batteries periodically, or by using a solar panel and/or a wind turbine in conjunction with a trickle charger. Please contact the site liaison for assistance when selecting the appropriate sized solar panel.

Deep cycle marine batteries should be used as the 12 VDC source. Ordinary automotive batteries, though cheaper, are not designed to be drawn down and recharged. Deep cycle marine batteries are rated for 2,000 cycles. Gel batteries have a couple of advantages over lead-acid batteries. Gel batteries weigh less than lead acid batteries for an equal capacity, and gel batteries do not freeze at low temperatures when not fully charged.

Alternatively, two 6VDC golf cart type batteries, wired in series, may be used. Such a system is more forgiving than deep cycle marine batteries when drained. Additionally, this configuration allows individual batteries to be tested without disconnecting them from the system, and is less likely to be damaged by the charging voltage (17-18 VDC) generated by solar panels. Contact the site liaison for additional information regarding this system.

C. Atmospheric Mercury

110V AC power is required for operation of the instrumentation used to measure and speciate atmospheric mercury. Operation of the instruments requires at least two 20 amp circuits. The power source must be continuous and reliable.

D. Atmospheric Ammonia

Monitoring stations in the AMoN are passive. Power is not required to operate the samplers.

X. Equipment Installation

The most current information regarding the installation of equipment can be found on the NADP website (<http://nadp.isws.illinois.edu>). The site liaison for the network may be contacted for additional information.

When installing the equipment necessary for network operation, please consult NADP documentation and the installation manuals that accompany each device. Information included in NADP documentation supersedes that in the manufacturer's documentation. This ensures consistent operation of the instrumentation across all sites and all networks. All instrumentation, regardless of the network, must be level and secure.

As noted in the wet-deposition siting criteria diagram in Appendix A to this document, the collector should be installed with the wet-side bucket (Aerochem Metrics collectors only) to the west and the sensor facing north. Particular orientation is not a requirement of AMoN or AMNet. Appendix B includes a diagram illustrating installation of equipment for monitoring atmospheric ammonia.

After installing the equipment, it is important that the station be tested to determine whether it is operating properly. In the case of the wet-deposition networks, the collector lid should fit snugly, and be centered over the wet-side bucket/sample train. The sensor should trigger with a drop of water (grid type sensor), or by breaking the optical path repeatedly for 20 seconds (optical sensor). Triggering the sensor should cause the collector to open, and the Event Recorder to log the event. AMNet equipment should be monitored for a minimum of 24 hours to ensure proper operation. In the case of AMoN, no testing is required to verify proper operation of the equipment as it is a passive sampling system.

XI. Site Performance and Systems Surveys

Each site in an NADP wet-deposition network will be surveyed once every 3-4 years by an independent contractor as part of the quality assurance program. During the survey the following items will be verified:

- calibration, condition, and correct operation of instrumentation
- site contact information
- site condition
- power
- NADP siting criteria
- operating procedures
- quantity and type of supplies

Conditions at the site will be documented with photographs, and the site sketch will be updated. The survey team will also answer questions regarding the operation and maintenance of the site with regard to NADP procedures and policies. The Site Liaison and the PO will address any issues discovered during the site survey. Information from the site survey is available on the NADP website for each monitoring site.

Each site in the AMNet will be surveyed by the network site liaison on an annual basis. Conditions at the site will be documented with photographs (site overview, and each cardinal direction from the instrument inlet location) that are submitted to the PO. The site liaison will document site conditions and equipment performance as described in AMNet Site Survey SOP.

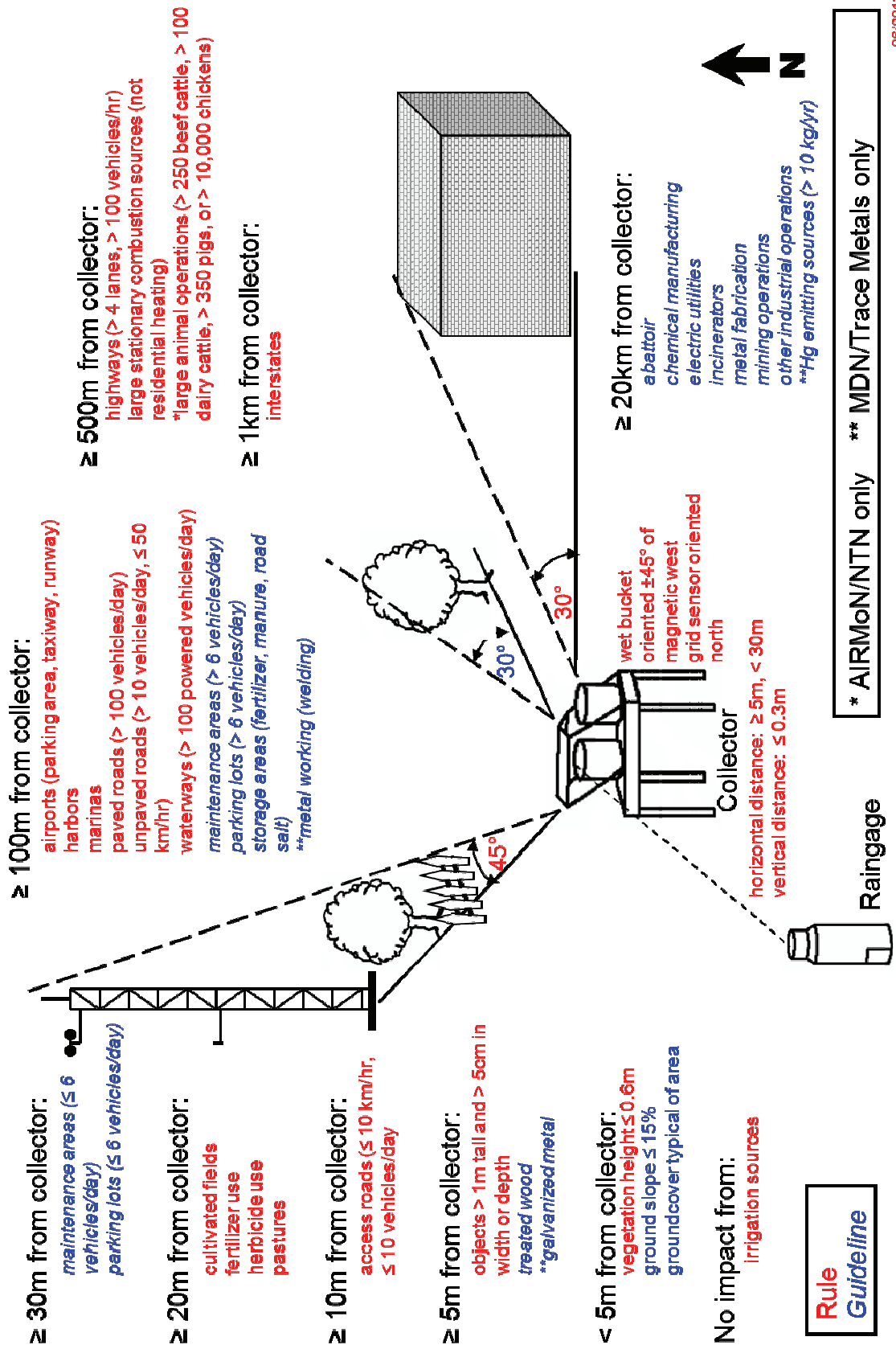
Conditions at each AMoN site will be documented at least annually. Documentation may be submitted more frequently if deemed necessary by the site operator. Site operators will submit photographs of the site (site overview, sampler housing, and each cardinal direction from the sampler location) to the PO. Site operators will also complete a checklist to document changes at the site.

XII. Contact List

NADP Personnel		
Contact	Phone Number	email address
AIRMoN Site Liaison	800-952-7353	airmon@isws.illinois.edu
AMNet Site Liaison	608-335-4232	amnet@isws.illinois.edu
AMoN Site Liaison	800-952-7353	amon@isws.illinois.edu
MDN Site Liaison	877-622-6960	hal@frontiergs.com
Network Equipment Depot, wet-deposition networks	217-244-1913	tleon@illinois.edu
Network Equipment Depot, AMNet	608-335-4232	amnet@isws.illinois.edu
NTN Site Liaison	800-952-7353	ntn@isws.illinois.edu
Site Performance and Systems Survey Program	217-244-6413	rhodes1@illinois.edu
USGS External Quality Assurance Program	303-236-1837	wetherbe@usgs.gov

Appendix A: NADP Siting Criteria Diagrams

NADP Siting Criteria – Wet Deposition



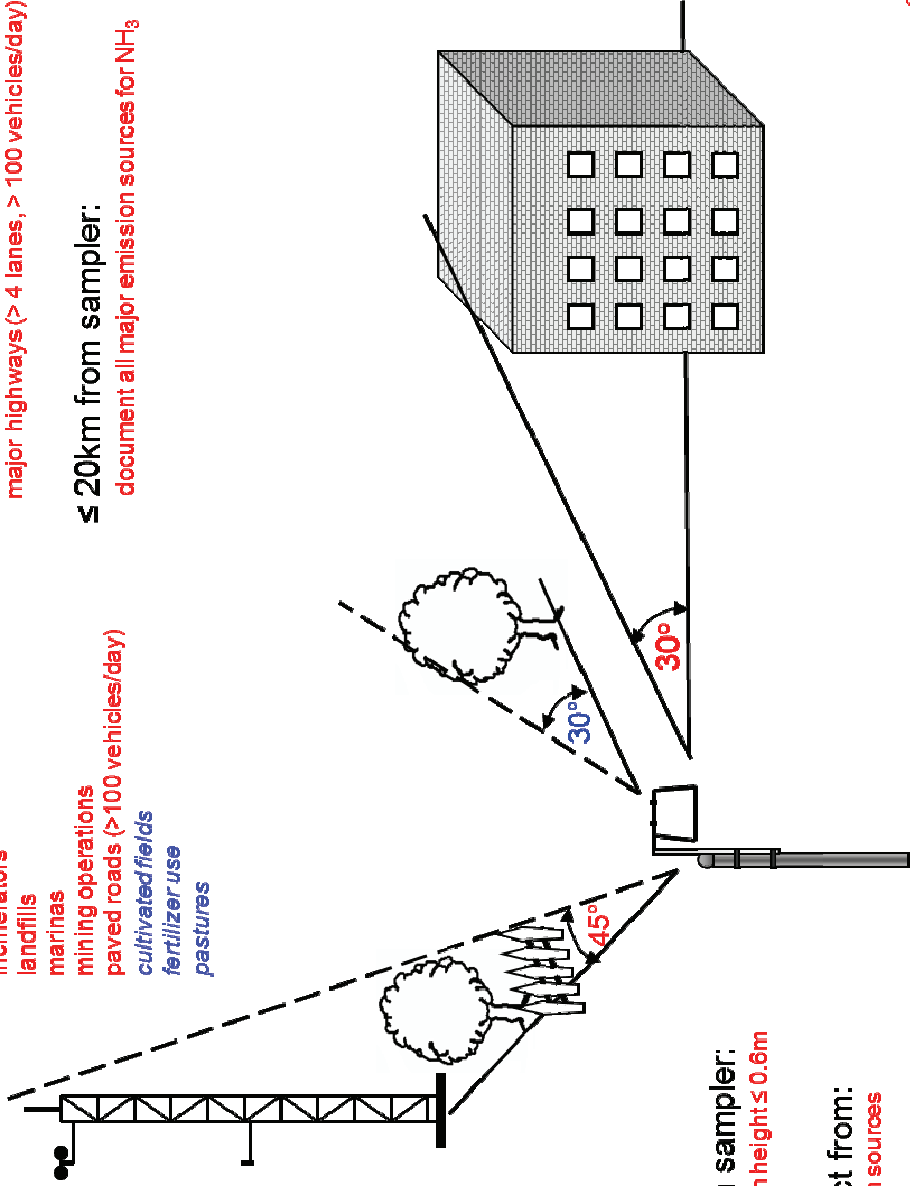
NADP Siting Criteria – Atmospheric Mercury Network

- ≥ 50m from instrument inlet:**
densely forested/land fertilizer use maintenance areas (≤ 6 vehicles/day) parking lots (≤ 6 vehicles/day)
 - ≥ 20m from instrument inlet:**
cultivated fields herbicide use pastures
 - ≥ 10m from instrument inlet:**
access roads (≤ 10 mph, ≤ 10 vehicles/day,) instrument exhaust
 - ≥ 5m from instrument inlet:**
HVAC unit
 - < 5m from instrument inlet:**
groundcover typical of area vegetation height ≤ 0.6m
 - No impact from:**
irrigation sources
 - inside instrument shelter:**
instrument shelter air: < 10 ng Hg/m³, < 15 ng Hg/m³ handling of Hg⁰ (e.g., Tekran 2505 reservoir): none Hg sources (e.g., Hg thermometer, Hg barometer, Hg-type thermostats, stored Hg compounds): none fluorescent lighting: none in use, none in storage
- Rule**
Guideline
- Location of instrument inlet:**
height above ground: $\geq 6m, \geq 4 m$
height above mounting surface: $\geq 2 m, \geq 1 m$
elevation within 2km: **maximize**
inlet airflow: **unrestricted (i.e. maximize fetch)**
shelter corner: **nominally upwind for site**

document the relative location of ALL Hg sources
- cement plants
- CFL recycler/manufacturer
- chlor-alkali plants
- crematories
- energy boilers (coal, oil, gas, wood, refuse, other)
- energy utilities (coal, oil, gas, refuse, other)
- incinerators (hazardous, waste, other)
- landfills
- metal refineries
- metal works
- oil/gas refineries
- other known sources
- 06/2013

NADP Siting Criteria – Ammonia Monitoring Network

- ≥ 30m from sampler:**
 unpaved roads (> 10 vehicles/day, ≤ 50 km/hr)
 waterways (> 100 power vehicles/day)
 maintenance areas (> 6 vehicles/day)
 parking lots (> 6 vehicles/day)
- ≥ 20m from sampler:**
 cultivated fields
 fertilizer use
 herbicide use
 pastures
- ≥ 10m from sampler:**
 access roads (≤ 10 km/hr, ≤ 10 vehicles/day)
 maintenance areas (≤ 6 vehicles/day)
 parking lots (≤ 6 vehicles/day)
- ≥ 5m from sampler:**
 objects > 1m tall and >5cm in width or depth
- < 5m from sampler:**
 avoid local low elevations
 groundcover typical of area
 ground slope ≤ 15%
 vegetation height ≤ 0.6m
- ≥ 100m from sampler:**
 airports
 chemical manufacturing
 electric utilities
 small feedlot operations
 harbors
 incinerators
 landfills
 marinas
 mining operations
 paved roads (> 100 vehicles/day)
 cultivated fields
 fertilizer use
 pastures
- ≥ 500m from sampler:**
 animal operations (>250 beef cattle, >100 dairy cattle, >350 pigs, or >10,000 chickens)
 industrial complex/large stationary sources
 major highways (> 4 lanes, > 100 vehicles/day)
- ≤ 20km from sampler:**
 document all major emission sources for NH₃



Rule
Guideline

No impact from:
irrigation sources

< 2m from sampler:
vegetation height ≤ 0.6m

Appendix B: Installation Diagram Atmospheric Ammonia

