Quality assurance/Quality control (QA/QC) Guidebook for Acid Deposition Monitoring Network in East Asia - 2016

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Abbreviation in this document

EC	Electric conductivity
NH_4^+	Ammonium ion
Na^+	Sodium ion
K^+	Potassium ion
Ca^{2+}	Calcium ion
Mg^{2+}	Magnesium ion
Al^{3+}	Aluminum ion
SO_4^{2-}	Sulfate ion
NO_3^-	Nitrate ion
Cl^-	Chloride ion
PO_4^{3-}	Phosphate ion
SO_2	Sulphur dioxide
NO_2	Nitrogen dioxide
NO	Nitrogen oxide
O_3	Ozone
HNO_3	Nitric acid
NH_3	Ammonia
HCl	Hydrochloric acid
PM	Particulate matter
pH(H_2O)	pH value of adhered water in soil sample
pH(KCl)	pH value including exchangeable hydrogen ion in soil sample
ECEC	Effective cation exchangeable capacity
T–C	Total carbon content
T–N	Total nitrogen content
DOC	Dissolved organic carbon
TOC	Total organic carbon
COD	Chemical oxygen demand
DO	Dissolved oxygen
TSP	Total suspended particulates
SS	Suspended solids
SCOR	Scientific Committee on Oceanic Research
UNESCO	United Nations Educational, Scientific and Cultural Organization

1 Introduction

Acid deposition is a general term that includes more than simply acid rain. Acid deposition is primarily the result of emissions of sulphur dioxide (SO_2) and nitrogen oxides (NOx) that can be transformed into dry or moist secondary pollutants such as sulfuric acid (H_2SO_4), ammonium (NH_4^+), nitrate (NO_3^-) and nitric acid (HNO_3) as they are transported in the atmosphere over distances of hundreds to thousands of kilometers.

Acid Deposition Monitoring Network in East Asia (EANET) was established as a regional cooperative initiative to promote efforts for environmental sustainability. The First Session of the Intergovernmental Meeting (IG1) on the EANET was held in March 1998 in Yokohama, Japan. Based on the agreement at the IG1, EANET was started the preparatory phase activities in April 1998, and this activity has been already implemented for more than 15 years.

The cooperative activities of EANET participating countries based on developed national monitoring plans include the implementation of monitoring of wet deposition, dry deposition, inland aquatic environment, and soil and vegetation in line with the guidelines and other technical documents with the conducting of quality assurance/quality control (QA/QC) programs as an important part of the monitoring activities. It is expected that the participating countries create a common understanding on the status of the acid deposition problems through EANET activities, which will become a scientific basis for taking further steps to tackle the problems.

EANET has made progress and important achievements in monitoring, data acquisition and management, research, and other technical issues. The EANET development covered the main goals and objectives of the network. The measurements collected for ten years are able to draw more precise and definite conclusions on temporal and spatial variations of atmospheric deposition.

There is general agreement that improvements on monitoring and data quality are among the most important directions for EANET to focus on. Progress in these areas should provide a more solid basis for advanced assessment of acid deposition and related environmental problems.

A part of the EANET activities is summarized as follows:

1) Each participating country develops and implements their national monitoring plans. Acid deposition monitoring is implemented in accordance with the monitoring guidelines, technical manuals and other technical documents adopted by the Network.
2) The monitoring data and other information submitted by participating countries is compiled, evaluated and stored by the Network Center.
3) In order to obtain monitoring data of high quality, the quality assurance/quality control (QA/QC) programs are implemented in full collaboration among the participating countries.

Based on the experiences of the EANET monitoring activities during past 16 years, securing the high quality monitoring data and their comparability are significantly requested and the need of the establishment of common quality management scheme is raised.

This guidebook is expected to be utilized among the monitoring laboratories and activities in the participating countries of EANET in order to keep and improve their quality of monitoring data to be reliable and comparable not only in the EANET activities, but also in the international acid deposition monitoring activities.

Suggestions and recommendations are described in the guidebook to ensure the quality of the monitoring data in the participating countries and expected to be used as one of the textbook for training the personnel who are in charge of the acid deposition monitoring.

2 Quality Management System

The National Center for EANET should establish its quality management system to ensure its quality assurance and quality control (QA/QC) activities.

2.1 Scope

General recommendations are described in this guidebook for the monitoring activities of the National Center including sampling.
This guidebook was prepared to be used in the monitoring laboratories to establish their Quality Management System (QMS), and also to be utilized for confirming and approving these laboratories by the National Center for EANET.

2.2 Organization

2.2.1 Network Center

The Network Center carries out the tasks under the guidance of the Intergovernmental Meeting to handle scientific and technical matters of the EANET activities and to facilitate cooperation among the participating countries in a transparent manner. The tasks of the Network Center related to the QA/QC activities are described below:

a) Preparation and implementation of the QA/QC programme:
   i) Appointment of a Network QA/QC Manager,
   ii) Development of data quality objectives,
   iii) Provision of information for preparing Standard Operating Procedures (SOPs)
   iv) Exchange of information and technical support for the National Centers, and,
   v) Implementation of the Inter-laboratory Comparison Project;

b) Compilation, evaluation, storage and analysis of monitoring data and related information; and,

c) Development and implementation of education/training programs for those engaged in the EANET activities.

2.2.2 Network Quality Assurance/Quality Control (QA/QC) Manager

Network QA/QC manager who belongs to the Network Center has a responsibility to implement the QA/QC activities of the Network Center.

2.2.3 National Center

The National Center and the monitoring laboratories shall be designated by the National Focal Point of each participating country. The National Center is requested to implement the following tasks:

a) preparation of a national monitoring plan;

b) collection, analysis and evaluation of national monitoring data;

c) submission of monitoring data to the Network Center;

d) implementation of the national segment of the QA/QC programs:

i) appointment of a National QA/QC Manager to implement national QA/QC programs,

ii) field comparison of sampling method,

iii) comparison of chemical analysis methods,

iv) inter-laboratory comparison, and,

v) auditing of monitoring sites and laboratories;

e) compilation, evaluation and storage of, and access to information;

f) preparation of a report on the state of the acid deposition problem; and,

g) other relevant activities.

2.2.4 National QA/QC Manager

The National QA/QC Manager is designated by the National Center to implement the national QA/QC programs.

2.2.5 Technical manager

The National Center should appoint a responsible technical manager to keep and improve the technical skills of the laboratories. Primary task of the technical manager is to deal with the technical problems.

2.3 Development of National QA/QC program

Each National Center shall develop its own National QA/QC programs. Appropriate revision of National QA/QC program shall be done, taking the national conditions into consideration.

2.4 Management of records

2.4.1 General item

The National Center and the laboratories should prepare the protocols for the identification of quality and technical records, compilation of the information, storage of these information, maintenance and rejection.

The records shall be easy to read and keep then in the appropriate conditions to avoid any damage, degradation and loss.

2.4.2 Technical records

The National Center and the laboratories shall store their original data, the records for keeping the traceability, calibration records, records of the staffs and reports in an appropriate manner.

The responsible staff, such as technical manager and/or National QA/QC Manager, who checks and/or approves the specified records, shall be apparently identified in each record.

2.5 Technical requirements

2.5.1 General item

Many elements define the accuracy and reliability of the measurement in the laboratory. These elements contain contribution from the following items:

a) Human factor;
b) Facility and circumstances;
c) Methodology and its validation;
d) Instruments and equipment;
e) Traceability of the measurement;
f) Sampling; and,
g) Handling of the samples and their measured data.

The extent of the contribution to the overall uncertainty of the data from above items can be different according to the individual measurement. The laboratory should take these items into account to carry out the measurement.

2.5.2 Human factor

2.5.2.1 Personnel

The technical manager should ensure the ability of each personnel related to the operation of the specified facility, measurement, evaluation of the analytical results and reporting.

All of the personnel should be trained and educated, and the technical manager should qualify the personnel based on the verification as the need arise.

2.5.2.2 Education and training

The technical manager should set the goal of the education, training and skills for the personnel. The results of the education and training should be recorded.

The operation of whole monitoring activities should be carried out by the qualified personnel.

2.5.3 Facility and circumstances

Every environmental condition for the operation should be fit to the quality requirement of the measurement to avoid any data to be avoided.

2.5.4 Methodology and its validation

The laboratory should adopt appropriate methods for the monitoring. The methods shall contain the procedures for sampling, handling, transportation, storage and preparation.

The laboratory is also expected to prepare the directions for the monitoring when there may be some skeptical about the results of the monitoring.

The methodological manuals shall be kept new version and can be used easily by all technical staff. Any deviation of the methods from the technical manual shall be validated, allowed and accepted by

the National QA/QC Manager.

2.5.5 Management of the data

Data processing and transcription should be properly reviewed with the systematic method.

When the laboratory uses computer or any other automatic data processing system for the compilation of the data, processing, recording, reporting, storage and retrieval, the laboratory should ensure the following items:

a) The software which is developed by the laboratory should be documented in detail and validated properly; and,

b) The procedure for protecting the data has been established and utilised;

2.5.6 Facilities

The laboratory should possess all of the facilities and instruments for required activities such as sampling and measurement. The facilities and its software should satisfy the required specifications and should be operated by the qualified technical staff.

The record of operation for each significant facility and instrument should be maintained at least including following items:

a) Identification of each facility and instrument;

b) Name of the manufacturer, identification of the type and serial number or any other identification;

c) Confirmation of the compatibility of the facilities to the specification for the implementation of monitoring;

d) Date of calibration and its expiration date; and,

e) Records of failure, replacement of the consumable parts, modification or repairment.

2.6 Handling of samples

The laboratory should prepare the sample handling procedures for transport, reception, handling, preservation, storage, holding and/or disposal.

The samples should be identified by labeling specific codes and the codes should be kept throughout whole process of the monitoring. The codes are expected to avoid any confusion for handling the samples.

When the laboratory receives the samples, any kinds of bad conditions or deviation from the provision of the methods shall be recorded.

The laboratory should prepare the proper storage area and its operating procedure to prevent any degradation, loss or damage. It is recommended that the samples be stored until the adoption of annual data by EANET meetings.

2.7 Management of the monitoring procedures

The most significant activities to keep the quality of monitoring data are preservation of the chain of custody for whole process. The meaning of the chain of custody is the documentation showing the full process of monitoring data acquisition including sampling, transfer of sample, sample storage, handling and disposition of physical or electronic materials.
The original records of sampling and its observation, sample transport, storage, extraction and/or preparation of samples, daily check of the analytical instruments, derived data with sufficient information, record of calibration and copies of issued report should be preserved.
Each record of monitoring should include sufficient information and make the repetitive testing easy with almost same conditions as previous testing. These records can be realized the qualified personnel for each process, such as sampling, measurement and reviewing of the results.

Every observed results, data and calculation should be prepared when these parameters are produced and identified.

2.8 Preparation of Standard Operating Procedures (SOPs)

SOPs are the procedures used in all the processes of the monitoring system, i.e. in the field (sampling site), laboratory and data management areas. SOPs provide a method to ensure that all personnel follow the same procedures to avoid variance of data quality between personnel in charge, and that they conduct their works with scientific sound understanding of QA/QC. Each of the sampling and chemical analysis organizations or laboratories should make effort to prepare SOPs that meet the actual conditions of respective organizations in consideration of the Technical Manuals and the national QA/QC programmes. The SOPs should be prepared to be specifically and clearly addressed even for beginners by careful reviewing, and updated timely in accordance with the latest technical and administrative advances.

SOPs should be prepared for all elements of operation starting from the provision of sampling through data reporting, in accordance with the Technical Manuals to minimize difference of precision by different analysts. It is important to ensure that SOPs be written to reflect the actual operational details. Even if samplers or analytical instruments conform to the monitoring manual, their manufacturers and/or types may be different in different sampling organizations or analytical laboratories. SOPs should be customized for each organization/laboratory. Individual SOPs should clearly describe the scope of application, designation of operational staff, their supervisors, and reporting formats etc. Additions and/or deletions to the table may be needed to ensure the individual SOPs apply to each organization. The major items to be included in the SOPs for each monitoring media are described in Table 2.8.1.

Table 2.8.1 Major items and recommended structures of SOPs

1. Sampling
  1.1. Appointment of sampling staff and their supervisors
  1.2. Check of possible changes around the sampling sites
    1) Local situation (new construction of emission and contamination sources etc.)
    2) On-site situation
  1.3. Check of sampling instruments apparatus
    1) Appearance of sampler (check for corrosion etc.)
    2) Operation of sampler (rain sensor, moving of lid, documentation of repair of sampler)
    3) Collection efficiency (comparison with standard rain gauge)
    4) Cleaning of sampling parts
  1.4. Sampling methods
    1) Sampler (including documentation of check and maintenance)
    2) Sampling interval (sampling dates)
    3) Change of sample vessels
    4) Addition of biocide

2. Sample transportation and storage
  2.1. Transportation of samples
  2.2. Sample storage
    1) On-site storage
    2) Laboratory storage

3. Measurement and chemical analysis
  3.1. Appointment of analysis staff and their supervisors for each item
  3.2. Training plan
  3.3. Pure water
    1) Daily maintenance
    2) Documentation of maintenance
  3.4. Measurement by instruments
    1) Measuring conditions of instruments
    2) Calibration
    3) Performance tests (sensitivity, stability, interference and its removal, documentation of repair)
    4) Calculation of lowest detection limits and lowest determination limits
    5) Documentation of maintenance
  3.5. Operating procedures for measurements
    1) Preparation of calibration curves
    2) Measurement/analysis of samples

3) Repeated measurements/analyses
4) Check of sensitivity fluctuation

3.6. Treatment of measurement results
1) Calculation of concentrations
2) Measurement of sensitivity fluctuation
3) Repeat measurements/analyses
4) Calculation of ion balances
5) Comparison of measured and calculated electric conductivity

4. Quality assurance and quality control

4.1. Evaluation of sample collection
1) Comparison of precipitation amount with standard rain gauge
2) Evaluation of ion balance
3) Evaluation of conductivities

4.2. Evaluation of reliability
1) Evaluation of sensitivity fluctuations
2) Evaluation of repeated measurements/analyses
3) Evaluation of field blanks
4) Comparison between measured data and lowest detection and determination limits

4.3. Evaluation of results
1) Representativeness of sampling sites
2) Evaluation of sample validity
3) Evaluation of completeness for the sampling period
4) Determination of total precision

5. Management of sampling instruments, laboratory, measurement/analysis instruments and reagent/glassware

5.1. Management of sampling instruments
1) Appointment of management stuff and their supervisors
2) Documentation of names of manufacturers, types, manufacture dates and operation methods
3) Daily and regular maintenance and inspection methods (including troubleshooting, parts supply and recording)

5.2. Laboratory management
1) Appointment of management staff and their supervisors
2) Daily and regular maintenance and inspection methods (including items and recording format)

5.3. Management of measurement/analysis instruments
1) Appointment of responsible staff for each instrument, and overall measurement
2) Documentation of names of manufacturers, types, manufacture dates and operation methods

3) Daily and regular maintenance and inspection methods (including troubleshooting, parts supply and recording)

5.4. Management of reagents, standard materials, etc.

1) Appointment of management staff and their supervisors

2) Receiving and disposal of reagents (recording format of dates, manufacturer names, dealers, purity, degree of standard and valid period)

5.5. Management of glassware and polyethylene vessels

1) Appointment of management staff and their supervisors

2) Cleaning methods

3) Storage

4) Confirmation of cleanliness

6. External audit

1) Check of sampling sites

2) Measurement of field blank values

3) Operation check of samplers

4) Evaluation of the results of quality control

5) Evaluation of the measured results

2.9 Training and education

The technical manager should set the goal of education and training for improving the technical skills and knowledge of the technical staff. The laboratory should specify the significance of the education and training and should provide the opportunities of participation of the personnel in training with apparent objectives and procedures.

After the implementation of the education and/or training, the effectiveness of the education and/or training for the technical staff shall be evaluated.

3 Preparation of the National Monitoring Plan

3.1 Outline of National Monitoring Plan

National Monitoring Plan is a document which includes the information on monitoring sites, monitoring methods, monitoring frequency etc. in participating countries. This information is crucial for QA/QC activities in EANET. The participating countries of EANET are required to submit the following information included in their National Monitoring Plan to the Network Center.

- Information on the National Center and contact person(s)
- Information on the implementation body
- Number of monitoring sites
- Measurement parameters and monitoring interval
- Information on the participating laboratories for each monitoring activities
- Information on each monitoring site includes:
  - ✓ Outline of the monitoring site;
  - ✓ Methodologies of sample collection;
  - ✓ Meteorological observation; and,
  - ✓ Information on the situation of the monitoring site with maps.

The National Monitoring Plan shall be reviewed every year and revised by each participating country, if necessary, because

i) The EANET activities shall be carried out according to the National Monitoring Plan; and

ii) Suitability of the completed activities to the National Monitoring Plan shall be inspected in every year.

Even if there is no point of revision, the existing state of the EANET activities can be re-confirmed periodically and this state should be reported to the Network Center.

The template of the National Monitoring Plan is shown in Appendix 1. The National Monitoring Plan shall be developed by using this template. Hereafter, the detailed instruction for preparation of National Monitoring Plan is described.

The information on the National Center and contact person(s) should be prepared not only in the National Monitoring Plan, but also in the data report of each participating country which submitted by the National Quality Assurance/Quality Control Manager (National QA/QC Manager) as shown in Form 3.1.1. General information of the National Monitoring Plan should be summarized as shown in Form 3.1.2 – 3.1.4. The Form 3.1.4 should be prepared for each laboratory.

Form 3.1.1 Information on the National Center and contact persons (*Example*)

Date of Preparation or review	July 25, 2013
Country	Japan
Organization	Asia Center for Air Pollution Research
Department	Data Management Department
Contact person	
National QA/QC Manager	
Postal address	1182 Sowa, Nishi-ku, Niigata City, 950-2144, Japan
Contact information	Telephone: +81-25-263-0562 Facsimile: +81-25-263-0567 E-mail address:

Form 3.1.2 Overview of the implementation body (*Example*)

Created date of the plan	
Country	
Responsible organization	
Department	
Person in charge	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:

Form 3.1.3 Overview of measurement parameters and monitoring interval (*Example*)

Items	Measurement parameters	Monitoring interval
Wet deposition	1: pH, 2: EC, 3: NH_4^+, 4: Na^+, 5: K^+, 6: Ca^{2+}, 7: Mg^{2+}, 8: SO_4^{2-}, 9: NO_3^-, 10: Cl^-, 11: other ( )	1: daily 2: other ( )
Air concentration (Dry deposition)	1: SO_2, 2: NO_2, 3: NH_4^+, 4: O_3, 5: other gases (HNO_3, NH_3, HCl), 6: particulate matter (PM), 7: components in PM	1: hourly 2: other ( )
Soil	1: pH(H_2O), 2: pH(KCl), exchangeable (3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: Al^{3+}, 8: H^+), 9: exchangeable acidity, 10: ECEC, 11: Carbonate, 12: T–C, 13: T–N, 14: SO_4^{2-}, 15: available phosphate, 16: other ( )	Monitoring period (month:_____, year:_____)
Vegetation	1: observation of tree decline, 2: description of trees, 3: other ( )	
Inland aquatic environment	1: Water temperature, 2: pH, 3: EC, 4: alkalinity, 5: NH_4^+, 6: Na^+, 7: K^+, 8: Ca^{2+}, 9: Mg^{2+}, 10: SO_4^{2-}, 11: NO_3^-, 12: Cl^-, 13: other ( ), 14: transparency, 15: water colour, 16: DOC(COD), 17: , 18: , 19: sediment (SO_4^{2-}, NO_3^-, and NH_4^+ in pore water), 20: others (, ,)	1: regularly (____times/year) 2: irregularly (month:_____, year:_____)

Form 3.1.4(1) participating laboratories for each monitoring activity (*Example*)

wet deposition / air concentration (dry deposition)			
Organization	Japan Environmental Sanitation Center, East Branch Office, Environmental Science Dept.	Code	JP 10
Person in charge in the laboratory			
Postal address	10-6 Yotsuyakami-cho, Kawasaki-ku, Kawasaki City, Kanagawa Prefecture, Japan, 210-0828		
Contact information	Telephone: +81-44-288-5130 Facsimile: +81-44-288-5232 E-mail address:		
Note			

Form 3.1.4(2) participating laboratories for each monitoring activity (*Example*)

soil and vegetation			
Organization	Shimane Agricultural Technology Center	Code	
Person in charge in the laboratory			
Postal address	2440 Ashiwata-cho, Izumo-shi, Shimane, Japan, 693-0035		
Contact information	Telephone: +81-853-22-6984 Facsimile: +81-853-21-8380 E-mail address:		
Note			

Form 3.1.4(3) participating laboratories for each monitoring activity (*Example*)

inland aquatic environment			
Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

3.2 Site selection

3.2.1 Classification of the monitoring sites

EANET monitoring sites are classified into two basic categories, namely deposition monitoring sites and ecological survey sites.

Deposition monitoring sites are sampling sites to collect fundamental data on the temporal and spatial distribution of acid deposition, and are further classified into three sub-categories: remote sites, rural sites and urban sites for the objectives of the monitoring.

Ecological survey sites are those to provide basic data for assessing the effects of acidification on terrestrial ecosystems, and further classified into two sub-categories: basic survey sites and ecosystem

analysis sites.

All sites in each country should be classified according to these categories. Regarding the deposition monitoring sites, at least one or more remote or rural sites should be established in a participating country in the EANET activities.

3.2.2 Deposition monitoring sites

Deposition monitoring sites in this network should be classified into three sub-categories as described above. These sub-category sites should be established according to the objectives of the monitoring.

Wet deposition monitoring, and desirably dry deposition monitoring as well, should be carried out at these sites.

In general, a deposition monitoring site should not be located in areas dominated by local emission sources and contamination sources. Coastal areas may be influenced by sea spray. Volcanic areas and hot spring resorts may receive influence by geothermal emissions such as sulphur dioxide (SO_2), hydrochloric acid (HCl) and hydrogen sulphide (H_2S), gravel roads, farmyards and tilled agricultural field by windblown soil dust, and grazing land and pasture by ammonia.

In particular, ammonia is a special problem since the emissions are mainly linked with animal husbandry and agricultural activities.

In selecting the deposition monitoring site, following consideration should be made:

- Topographic features and land use types around the sites;
- Availability of the meteorological conditions such as annual precipitation amounts and prevailing wind directions;
- Excluding the areas which dominated by local meteorological conditions such as mountaintops, cols, coastal sites with the effects from local wind;
- Excluding the areas which are subjected to the formation of stagnant air such as valleys and basins
- Considering the emission sources within 20 km from the possible candidate site;
- Considering the minimization of local influences; and,
- Preparing of the records and reports concerning the detailed information around the site and the possible influence.

For all types of the sites, particular care must be taken that each site keeps representing the region of interest in terms of natural and anthropogenic emissions, and topographic features.

No sources should be confirmed to impact the site in consideration of gravel roads, tilled agricultural fields, grazing land and pasture.

Meteorological conditions, including annual precipitation amounts and prevailing wind directions, should be taken into account. For elimination of local meteorological influences, a site selection should not be made from mountaintops, cols, valleys or basins. In general, they should not be located around strong natural sources such as volcanoes unless the focus is to monitor their influences on precipitation chemistry.

Available stable electricity throughout the year is a critical point of the wet-only sampling practice.

Solar power will be a solution to select a remote site whose location is topographically appropriate but that electricity is unavailable.

3.2.2.1 Remote sites

- Remote sites should be representative of the EANET region by being located in areas, where:
  - ✓ no significant changes in land-use practices are expected for decades within a reasonable distance as will be mentioned in all directions from the site; away from majour populations and industrial centers, away from majour highways and airports; if possible on inlands, mountain ranges and majour forest reserves;
  - ✓ effects of majour natural phenomena including volcanic eruptions, forest fires and dust storms are not frequently experienced; and,
  - ✓ the airshed is supposed to be entirely free of the influence of local pollution sources and contains only diluted vestiges of chemical species transported from long distant sources at least 30 – 50 kilometers away.
- Remote sites are to be established for the assessment of the state of acid deposition in background areas. The monitoring data can be used to evaluate long-range transport and transmission models of acidic substances in East Asia.
- The remote sites which located at existing meteorological stations, in particular, upper wind monitoring stations, or in their vicinity are required.
- Remote sites should not be located in areas within 50 km of large emission sources such as cities, thermal power plants and majour highways.
- The remote sites should not be located in the areas within 500 m from heavy traffic roads (more than 500 vehicles/day)

3.2.2.2 Rural sites

- Rural sites should be located:
  - ✓ in areas sufficiently far away from population and industrial centers, and the site is free from the effect of large local sources of air pollution throughout most of the year.
- Rural sites are to be established for the assessment of the state of acid deposition in rural areas or inlands.
- The monitoring data can be used, for instance, to evaluate the effects of acid deposition on agricultural crops and forests.
- The location of these sites should be selected in areas with minour influence from local emission and contamination sources.
- The rural sites should be sites away from significant stationary and mobile sources, and should be free from these influences to the extent possible.
- Some rural sites which generally satisfy the criteria for remote sites may also be used to evaluate long-range transport and deposition models of acidic substances.
- Rural sites should not be located in areas within 20 km of large emission sources.

- The rural sites should not be located in the areas within 500 m from heavy traffic roads (more than 500 vehicles/day)

3.2.2.3 Urban sites

- Urban sites are to be established for the assessment of the state of acid deposition in urban areas.
- Urban and industrialised areas, and the areas in the close vicinity of such areas, can be included.
- The monitoring data can be used such as the evaluation of the effects of acid deposition on buildings and historical monuments.
- Monitoring data at these sites may also be available for the assessment of acidity of precipitation and the trends in urban areas.

3.2.2.4 Local criteria

The criteria for locating samplers in remote sites, rural sites and sites in ecological area are as follows:

- An open, flat, grassy area far enough from trees, hills and other obstructions to avoid effects on sampling. No objects should be within a few meters of the sampler, and no objects should shade the sampler;
- The horizontal distance between a large obstruction and the sampler should be at least twice the obstruction height, or the top of an obstruction as viewed from the collector should be less than 30^{o} above the horizon;
- The sampler should be free from local emission and contamination sources such as waste disposal sites, incinerators, parking lots, open storage of agricultural products and domestic heating. Regions within 100 m of these emission and contamination sources should be excluded; and,
- The horizontal distance between sampler and rain gauge (and dry deposition sampler) should be greater than 2 meters. The rain gauge and the wet deposition sampler should cross the direction of the prevailing wind during precipitation events.

3.2.3 Ecological survey sites

Ecosystem analysis sites are to be established for the assessment of acid deposition impacts on whole ecosystems through application of, for instance, terrestrial ecosystem analysis and/or catchment analysis.

The location of these sites should be selected in areas where terrestrial ecosystems are sensitive to changes in atmospheric acidity. Some of these sites should also be located in ecologically conserved areas.

Elemental dynamics in ecosystems should be surveyed, and environmental sensitivity to acid deposition should be estimated at these sites.

Acid deposition models may also be developed for these sites.

3.2.3.1 Basic survey of soil and forest

The soil and vegetation monitoring could be an establishment of baseline data, and also early detection

of possible impacts of acid deposition, particularly on plants and forest ecosystems.

Soil and forest properties may be characterized by area specific factors such as climate, geological and geographical features. For the evaluation of data in soil and forest monitoring, these area specific factors should be reported.

Preliminary surveys should be carried out to select sites for permanent monitoring. Preliminary surveys should be conducts over extensive areas to select sites for continuous monitoring to detect possible impacts of acid deposition on forest ecosystem.

The geographical range of such surveys should cover the area within a radius of approximately 50 km of deposition monitoring sites.

1) Establishment of permanent monitoring sites

The following criteria should also be considered for the selection of soil and forest monitoring sites:

- Two forest sites, whose soils have different sensitivities to acid deposition, are recommended to be selected. When there are some difficulties to find the soils which have different sensitivities, selecting only one site is also acceptable.
- Each site should be established in a continuous forest area of more than one hectare. If the area is surrounded with a suitable shelter belt, 0.2 hectare is sufficient.
- Sites must be accessible for surveying over a long period (decades). The sites on which land use patterns do not change over this period of observation should be selected.
- A common tree species or the dominant vegetation type between the sites will be expected to be selected.

2) Characterisation of basic survey site

The soil and forest monitoring should be carried out in a basic survey site. When some symptoms would be detected in the basic survey site, intensive survey for clarification of the implication with acid deposition would be carried out.

3) Collection of information on soils, vegetation and other characteristics.

The following information on soils, vegetation, geography, and meteorology should be collected in the preliminary surveys. Fieldwork should be carried out if necessary. Information on the monitoring sites should be recorded correctly, and the characteristics of the sites in the country should be clarified.

Collection of the comparable maps with standardised international taxonomy of soil and vegetation is recommended.

Soil and vegetation classification should be unified according to the “FAO/UNESCO Soil Map of the World (FAO/UNESCO. 1977)”.

a) Soil information

Most East Asian countries already have their own soil maps. However, these maps are sometimes described using specific soil units in individual countries.

For the comparison purpose, collection of the comparable maps with standardised international taxonomy of soil and vegetation, such as the FAO/UNESCO Soil Map of the World is recommended.

When these information are not available, it is expected that the maps in each country will be accompanied by columnar sections of representative soil profiles and analytical data, which clarify the nature of the soils.

Mineralogical composition and land use history are also useful.

The soil maps using a scale of 1:50,000, preferably 1:25,000, should be collected to carry out preliminary survey.

Note:

- ✓ *If any soil maps are not available for the areas of preliminary surveys, fieldwork should be carried out to collect geological, geographical and/or land-use information.*
- ✓ *Surface geological maps, geographical maps and land-use maps may also be available for the evaluation of characteristics of monitoring sites.*
- ✓ *Any kinds of relevant available information should be collected for the preliminary survey.*

.

b) Vegetation information

Most East Asian countries have already had their own vegetation (plant-sociological) maps, Physiognomic vegetation maps and/or land-use maps. As mentioned above, the collection of maps which correspond to the international taxonomy, such as "FAO/UNESCO Soil Map of the World" is expected for comparison purpose.

Note:

- ✓ *If any vegetation maps are not available for the areas of preliminary surveys, using aerial photographs and/or satellite images which shows vegetation is also effective.*

c) Climate and meteorological information

Each country should use meteorological observation stations to collect meteorological data, including temperature, precipitation, evapotranspiration, wind direction, wind velocity and insolation (e.g. photosynthetically active radiation, PAR). Especially annual mean temperature and annual precipitation should be required for more than 10 years in the past. These meteorological data will be collected from the observation stations in the area within a radius of approximately 50 km of deposition monitoring sites.

All the items of climate and meteorological information for the preliminary surveys are not mandatory. The items, which can be obtained in accordance with the procedures of the meteorological monitoring system of each country, could be used.

d) Selection of plots for soil monitoring

When forest monitoring sites are selected, two forest sites, whose soils have different sensitivities to acid deposition, is recommended to be selected.

Several plots, at least two plots, occupying areas from 5 m-square to 10 m-square, should be selected randomly at each monitoring site (each soil type).

For establishment of plots, soil profile description should be carried out.

In the plot, five sub-plots, each occupying 1 m-square, are selected in principle at the center and on the diagonal lines of the plot.

3.2.3.2 Basic survey for inland and aquatic environment

a) Criteria for site selection of lakes and/or revers (streams)

- Lakes will be selected as monitoring sites.
- When the appropriate lakes are not available, rivers (streams) that are potentially susceptible to acidification and have little artificial influence should be selected.
- The sampling point should be representative in the water bodies.
- The representativeness of the sampling site concerning to the water quality of the water body should be confirmed by analyzing relevant items of surface water in several points (more than five sites including the center of the water body) within a half year from starting of sampling
- In the case that there are islands at the center of site, the detailed survey is needed to decide a representative point in the site.
- It is desirable that the monthly and ten-day period variations be investigated to evaluate the representativeness of a sampling site (more than 4 times, in each season).
- For the time being, on-site measurement of water temperature, electric conductivity and pH values can be deemed as a substitute method for these investigations.

i) **Criteria of lakes**

- The selection of harmonic lakes which are considered to be potentially susceptible to acidification is recommended.
- The priority of selecting natural lakes is much higher than that of artificial lakes.
- When the management such as dredge is carried out, effects of the management should carefully be investigated.
- Oligotrophic or Mesotrophic of harmonic lake is recommended (as shown in Table 3.2.1).
- When there is no harmonic lake, dystrophic lakes could be selected for monitoring. In this case, however, appropriate monitoring methods should be further investigated.
- Choosing the monitoring lakes which are harmonic type with low BOD, COD, or TOC (inorganic acidic lakes, organic acidic lakes or alkaline-based eutrophic lakes is not good for the monitoring) is expected.
- The monitoring lakes having a maximum depth of approximately 10 m or less, a water retention time of 1 year or less, water area from 1 hectare to 100 hectares, low alkalinity (less than 200 $\mu eq\ L^{-1}$) or electric conductivity (less than 10 $mS\ m^{-1}$), minimal anthropogenic water pollution and no coverage of the surface with aquatic plants are also preferable.
- The catchment area in the lakes is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation. The access from the site to the laboratory is desirable to be short for preventing change of the sample qualities.

Table 3.2.1. Classification of harmonic lakes by trophic level (OECD, 1982)

Classification	TP* / mg m^{-3}	Chlorophyll-a / mg m^{-3}		Transparency / m	
		mean	max	mean	min
Extreme oligotrophic	≤ 4.0	≤ 1.0	≤ 2.5	≥ 12.0	≥ 6.0
Oligotrophic	≤ 10.0	≤ 2.5	≤ 8.0	≥ 6.0	≥ 3.0
Mesotrophic	10 ~ 35	2.5~8	8~25	6~3	3~1.5
Eutrophic	35 ~ 100	8~25	25~75	3~1.5	1.5~0.7
Hypereutrophic	≥ 100	≥ 25	≥ 75	≤ 1.5	≤ 0.7

* TP: Total Phosphorus

- Preliminary chemical analysis is recommended for site selection on items as follows,
  - ✓ Water temperature (W.T.)
  - ✓ pH
  - ✓ electric conductivity (EC)
  - ✓ transparency
  - ✓ water color
  - ✓ alkalinity
  - ✓ dissolved oxygen (DO)
  - ✓ dissolved organic carbon (DOC) (if impossible, chemical oxygen demand (COD))
  - ✓ Cations: NH_4^+, Na^+, Ca^{2+}, Mg^{2+}, K^+ and total dissolved Al
  - ✓ Anions: SO_4^{2-}, NO_3^- , NO_2^-, Cl^- and PO_4^{3-}

ii) **Criteria of rivers (streams)**

- Rivers or streams that are potentially susceptible to acidification may be selected, where the impacts of human activities such as deforestation, slash-and-burn farming, stock-farming or cultivation is not being conducted or planned in the future in the upper stream area of the water sampling site.
- Streams have higher priority than rivers in the site selection to prevent the influence of other pollutions and storm runoff.
- In the case of selecting rivers, the upper streams of a river or first-order streams (as stream order) is desirable for the areas with storm events. At upper reach of the stream area, monitoring should be done at one point, and measurement of the flow is desirable.
- Choosing monitoring rivers (streams) which are natural rivers (streams), having low alkalinity (less than 200 μeq $L^{-1)}$ or electric conductivity (less than 10 mS m^{-1}) with low BOD, COD, or TOC is recommended. The recommendations for catchment properties and accessibility are the same as the lakes.
- Flow volume and ion concentrations change dramatically with intense rainfall in rivers (streams).
- Sampling should be carried out when there is no or small rainfall (below 10 mm per day) within 2 days before monitoring for average samples.

- Samples should also be collected during flood and after intensive rainfalls or snow melting, if possible. This will allow us to get more reliable information already on the stage of a plot selection. On this stage, the most important parameters to be measured are the temperature, electric conductivity, and pH values.
- The river/stream's catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation.
- Preliminary chemical analysis is recommended for site selection on items as follows,
  - ✓ Water temperature (W.T.)
  - ✓ pH
  - ✓ electric conductivity (EC)
  - ✓ transparency
  - ✓ water color
  - ✓ alkalinity
  - ✓ dissolved oxygen (DO)
  - ✓ dissolved organic carbon (DOC) (if impossible, chemical oxygen demand (COD))
  - ✓ Cations: NH_4^+, Na^+, Ca^{2+}, Mg^{2+}, K^+ and total dissolved Al
  - ✓ Anions: SO_4^{2-}, NO_3^- , NO_2^-, Cl^- and PO_4^{3-}
- Recommended criteria for site selection are summarized in Table 3.2.2.

Table 3.2.2. Recommended criteria for site selection

Recommendation items	Lakes	Rivers (streams)
Alkalinity	less than 200 μeq L^{-1}	
EC	less than 10 mS m^{-1}	
Trophic level	oligotrophic	–
BOD (COD), TOC	Low	
Retention time	Less than 1 year	–
Depth	Less than 10 m (max)	Less than 2 m (cross-sectional mean)
Discharge	–	< 5 m^3 s^{-1}
Water area	1~100 ha	–
Surface situation	No coverage of aquatic plants	
Human activities	No or minimal	
Recommendation items for the catchment of the site		
Location of river	Rivers in the mountain areas	
Catchment Area	< 500 ha	
Bedrock geology	Acidic or neutrality	
Vegetation	Natural	

b) Collection of information concerning monitoring site

- An inventory of lakes (including man-made reservoirs) based on their limnological significance and/or with water area of larger than 1 hectare in the area in question should first be prepared.

- The monitoring site should be selected from the inventory, based on the criteria for site selection. Then the following information on both the selected site and its watershed/catchment should be collected as much as possible from the past to the present.
- A colored photograph of the site is useful. An aerial view of the site is most preferable.
- The standard format and an example of information on the site and its watershed/catchment are shown the following items.

i) **Lakes**

- Characteristics of lakes
  - ✓ location and location map
  - ✓ elevation
  - ✓ origin
  - ✓ area
  - ✓ shore line length,
  - ✓ lake hydrologic type (seepage, closed, drainage, and reservoir)
  - ✓ lake trophic type (oligotrophic, mesotrophic, eutrophic and dystrophic with indication of OECD criteria etc.)
  - ✓ water depth (mean and maximum),
  - ✓ water volume
  - ✓ bathometric map
  - ✓ range of annual water level fluctuation
  - ✓ residence time of water
  - ✓ lake utilization (irrigation, domestic water, electric power, fish culture, sightseeing, and others)
- Watersheds/Catchments
  - ✓ area
  - ✓ elevation and topography
  - ✓ surface geology
  - ✓ soil types
  - ✓ vegetation,
  - ✓ land use
  - ✓ population
  - ✓ numbers and discharge of streams (inlets and outlets),
  - ✓ numbers, discharge and water qualities of spring or ground waters around the shore
  - ✓ wind direction and speed (mean and prevailing)
  - ✓ precipitation
  - ✓ solar radiation
- Living organisms in lakes
  - ✓ chlorophyll pigments

- ✓ fauna
- ✓ flora
- ✓ biomass of bacteria and phytoplankton,
- ✓ primary productivity of phytoplankton
- ✓ zooplankton
- ✓ fish
- ✓ benthic organisms

➢ Sediment in lakes

Physico-chemical properties:

- ✓ texture
- ✓ grain size
- ✓ volumetric water content(bulk density)
- ✓ electric potential of hydrogen (Eh)
- ✓ organic carbon
- ✓ SO_4^{2-}
- ✓ NO_3^-
- ✓ sulfur stable isotope ratio of sulfate (if available)
- ✓ sedimentation rate (if available)

Biological properties:

- ✓ Diatom species

ii) **Rivers (streams)**

➢ Characteristics of rivers (streams)

- ✓ location and location map
- ✓ elevation
- ✓ origin
- ✓ area
- ✓ range of annual discharge fluctuation (at the sampling site)
- ✓ river utilization (irrigation, domestic water, electric power, fish culture, sightseeing, and others)

➢ Watershed and/or catchment of rivers (streams)

- ✓ area
- ✓ elevation and topography
- ✓ surface geology
- ✓ soil types
- ✓ vegetation
- ✓ land use
- ✓ population
- ✓ numbers, discharge and water qualities of spring or ground waters around the river

- ✓ precipitation
- ✓ solar radiation
- ✓ wind direction and speed (mean and prevailing)

➢ Living organisms in rivers (streams)

- ✓ fauna
- ✓ flora
- ✓ fish
- ✓ benthic organisms

➢ Sediment in rivers (streams)

Physico-chemical properties:

- ✓ texture
- ✓ grain size
- ✓ volumetric water content(bulk density)
- ✓ electric potential of hydrogen (Eh)
- ✓ organic carbon
- ✓ SO_4^{2-}
- ✓ NO_3^-,
- ✓ sulfur stable isotope ratio of sulfate (if available)
- ✓ sedimentation rate (if available)

Biological properties:

- ✓ attached algae (diatom species)
- ✓ chlorophyll pigments

3.2.4 Catchment study sites

Sites for the catchment-scale monitoring should be selected taking the following recommendations into account:

- ➢ A forest catchment with a stream should be selected, while the size of the catchment may depend on each situation.
- ➢ The catchment, where the water budget has been estimated, is preferable.
- ➢ Sensitivity of soil or bedrock geology to atmospheric deposition should be considered for site selection.
- ➢ If possible, the site should be in vicinity of the EANET acid deposition site to estimate atmospheric deposition amounts precisely.
- ➢ Other ecological information from nearby sites is valuable.

3.2.5 Information on the selected sites

The detailed information on the selected monitoring sites shall be prepared as a part of the National Monitoring Plan.

Related part of the National Monitoring Plan shall be prepared for each site.

3.2.5.1 Wet deposition monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.1.

Form 3.2.1 Outline of monitoring site (*Example*)

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	° ’ ” N S	Longitude	° ’ ” E
Altitude	m		
Height of sampling funnel	from the ground level: m from the floor of sampler installed: m		

where:

Site name: Name of the site shall be written in official English spelling.

Code: Code of the site has been set by the Network Center and informed

Site classification: Classification of the site shall be defined in accordance with the criteria described in Section 3.1.2.

Latitude and longitude: These parameters should described based upon the World Geodetic System, such as WGS84 (2004).

Altitude: This parameter should be described as a height from sea level.

2) Sample collection

The format for preparing this part is shown in Form 3.2.2. This format shall be filled with the sampling information of each site.

Form 3.2.2 Sample collection (*Example*)

Period of sample collection	1: daily, 2: every precipitation event, 3: weekly, 4: biweekly, 5: monthly, 6: daily collection and weekly composite analysis, 7: other ( )
Sampling system	1: wet only sampler 2: other ( )
Sampler	Manufacturer: Model: Funnel diameter: mm

3) Meteorological observation

The format for preparing this part is shown in Form 3.2.3. This format shall be filled with the meteorological observation around each site.

Form 3.2.3 Meteorological observation (*Example*)

On site measurement of precipitation amount	Usage of rain gauge: 1: yes 2: no if yes, Manufacturer: Model: Height from the ground level: m Measurement mode: 1: tipping bucket, 2: gravimetric, 3: other ( )
On-site observation of other parameters	1: wind direction, 2: wind velocity, 3: temperature, 4: humidity, 5: solar radiation, 6: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):
	Possible obtaining data: 1: precipitation amount, 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )

4) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.2.4 – Form 3.2.6. In these forms, the surrounding conditions for each direction shall be described in the following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of "Outline of monitoring site". And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

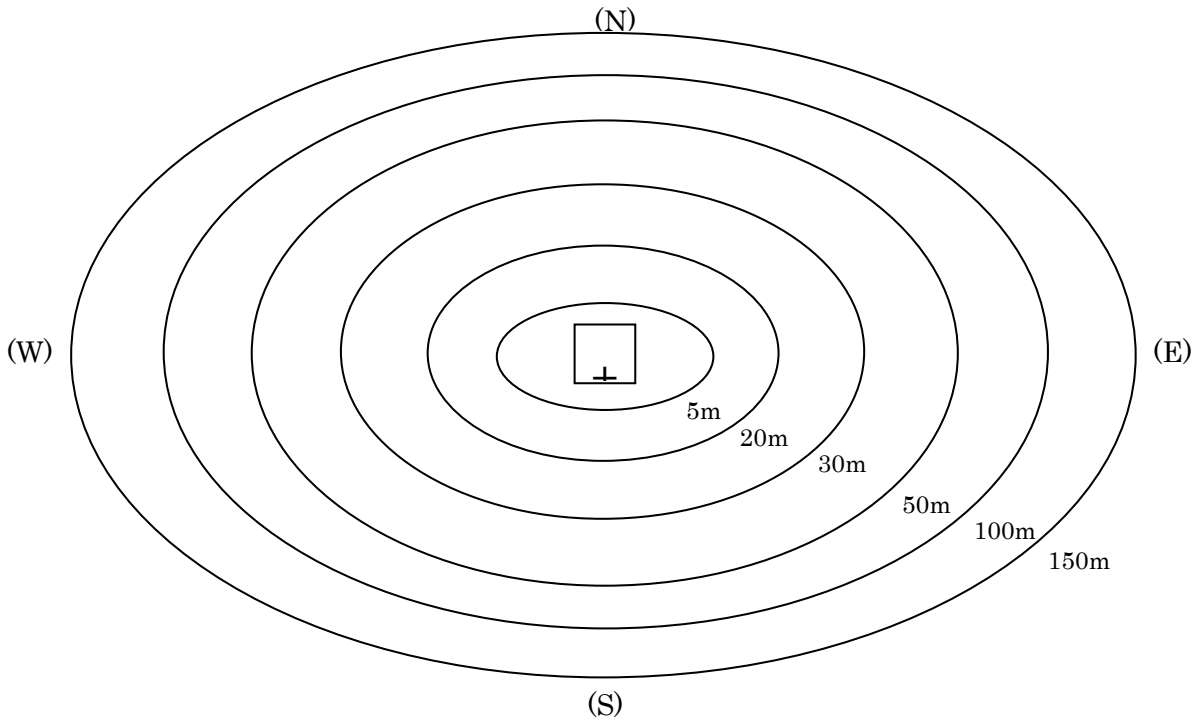
- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

Form 3.2.4 Outline of monitoring site: On-site scale (distance within 150 m) (*Example*)

Items	North direction (NW – NE)	East direction (NE – SE)	South direction (SE – SW)	West direction (SW – NW)
Existence of trees, poles and buildings, and the height of those				
Existence of incinerators, domestic heating, parking lots, storage of fuel and agricultural products, daily farm, and many livestocks				
Slope degree of the site	º _ º	º _ º	º _ º	º _ º
Surface condition of the site				
Existence of a forest, river, lake, marsh, farm or fields				
Existence of roads and their traffic densities*				

* Describe roads with more than 100 vehicles/day for remote sites and roads with more than 1,000 vehicles/day for urban and rural sites.

On-site Scale (within 150 m)



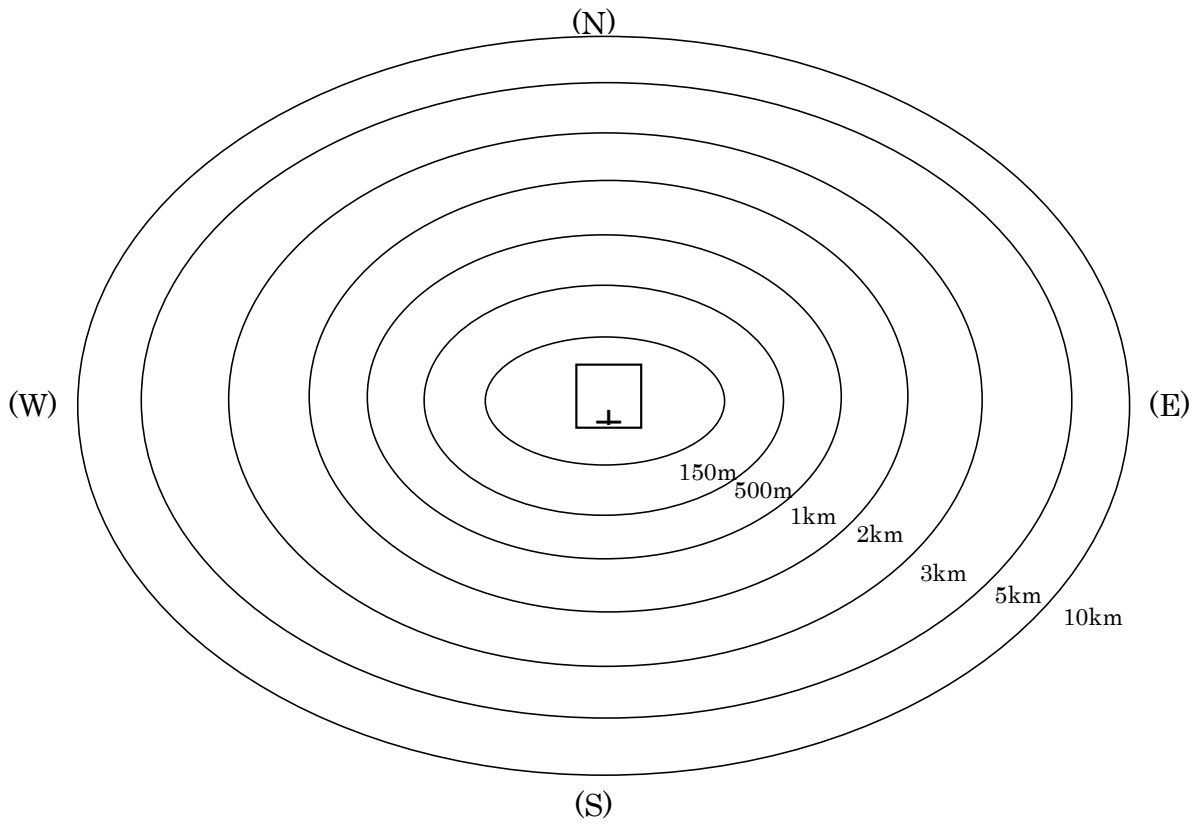
Site Name : _____

Form 3.2.5 Outline of monitoring site: Local scale (distance 150 m – 10 km) (*Example*)

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Information on trunk roads, expressways, and their traffic densities (with more than 5,000 vehicles/day)				
Information on airports and railways				
Information on major emission sources such as large industries, and power plants and their fuel consumptions and so on				
Information on houses/ settlements with more than 5,000 persons, and their population				
Descriptive information around the site such as topography and meteorological condition				

* Describe roads with more than 100 vehicles/day for remote sites and roads with more than 1,000 vehicles/day for urban and rural sites.

Local Scale (150 m – 10 km)

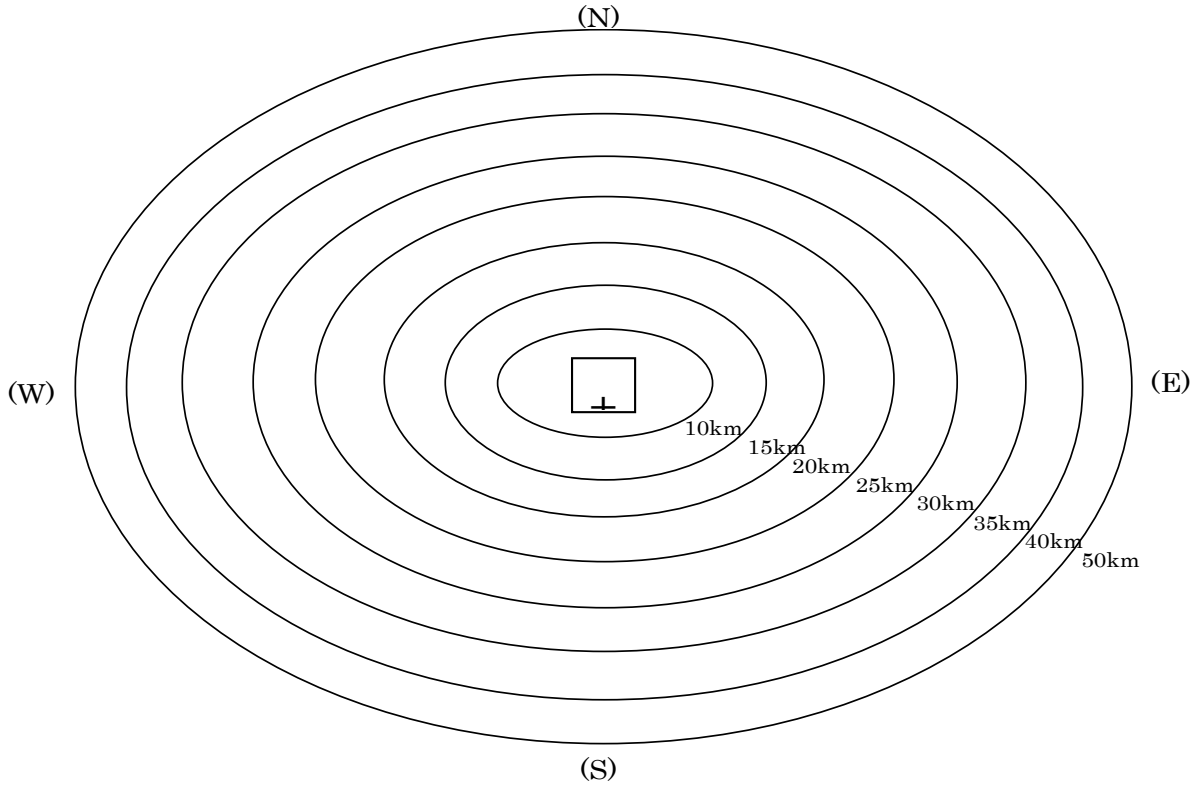


Site Name : _____

Form 3.2.6 Outline of monitoring site: Regional scale (distance 10 km – 50 km) (*Example*)
*: For rural site, description should be made on huge emission sources larger than 10,000 tons/y and other major pollution sources.

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Existence of main stationary air pollution sources*				
Existence of trunk roads with more than 10,000 vehicles/day, and their traffic densities				
Existence of cities with the population more than 10,000 persons				

Regional Scale (10 km – 50 km)



Site Name : _____

3.2.5.2 Dry deposition monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.7.

Form 3.2.7 Outline of monitoring site (*Example*)

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	° ’ ” N S	Longitude	° ’ ” E
Altitude	m		
Height of sampling funnel	from the ground level: m from the floor of sampler installed: m		

where:

Site name: Name of the site shall be written in official English spelling.

Code: Code of the site has been set by the Network Center and informed.

Site classification: Classification of the site shall be defined in accordance with the criteria described in Section 3.1.2.

Latitude and longitude: These parameters should be described based upon the World Geodetic System, such as WGS84 (2004).

Altitude: This parameter should be described as a height from sea level.

2) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.2.4 – Form 3.2.6.

In these tables, the surrounding conditions for each direction shall be described in the following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of “Outline of monitoring site”. And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

3) Outline of monitoring

The format for preparing this part is shown in Form 3.2.8 – 3.2.9 for gaseous sample collection and

Form 3.2.10 – 3.2.11 for particulate sample collection. These formats shall be filled with the sampling information of each site. Form 3.2.8 and Form 3.2.11 shall be prepared for all monitoring parameters, independently.

Form 3.2.8 Outline of monitoring (Gas) (*Example*)

Measuring parameters	1: SO_2, 2: NO_2, 3: NO, 4: O_3, 5: others (HNO_3, NH_3, HCl)
Period of sample collection	1: an hour, 2: 12 hours, 3: a day, 4: a week, 5: two weeks, 6: a month, 6: other ( )
Measurement interval	1: continuous, 2: hourly, 3: daily, 4: weekly, 5: biweekly, 6: monthly, 7: other ( )

Form 3.2.9 Monitoring method (Gas) (*Example*)

Measuring parameters	1: SO_2, 2: NO_2, 3: NO, 4: O_3, 5: others (HNO_3, NH_3, HCl)
Method	1: automatic monitor (method:) Manufacturer: Model:
	2: manual method 1) filtration [(a) diffusion denuder, (b) filter pack] Sampling flow rate: liters/min

Form 3.2.10 Outline of monitoring (Particulate) (*Example*)

Measuring and analyzing parameters	1: gravimetric method (a: TSP, b: PM-___), 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 8: NO_3^-, 9: Cl^-, 10: others ( )
Period of sample collection	1: an hour, 2: a day, 3: a week, 4: two weeks, 5: a month, 6: other ( )
Measurement interval	1: continuous, 2: hourly, 3: daily, 4: weekly, 5: biweekly, 6: monthly, 7: other ( )

Form 3.2.11 Monitoring method (Particulate) (*Example*)

Method	1: automatic monitor (method:), Manufacturer: Model: 2: gravimetric method (a: Hi-vol sampler, b: Low-vol sampler), 3: other ( )

4) Meteorological observation

The format for preparing this part is shown in Form 3.2.12. This format shall be filled with the meteorological observation around each site.

Form 3.2.12 Meteorological observation (*Example*)

On-site observation of other parameters	1: precipitation amount (a: tipping bucket, b: gravimetric, c: other( )) 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )
In case of using nearest	Name of the station: Distance from the site: km

meteorological station data	Direction from the site (bearing):

3.2.5.3 Soil and vegetation monitoring

1) Outline of monitoring site

The format for preparing this part is shown in Form 3.2.13.

Form 3.2.13 Outline of monitoring site (Permanent site for soil monitoring) (*Example*)

Site name (Soil type)	( )		Code	
Location				
Latitude	° ’ ” N S	Longitude	° ’ ” E	
Altitude	m			
Data of wet deposition	1: on site measuring data 2: use the nearest wet deposition monitoring site data			
In case of use the nearest wet deposition monitoring site data	Name of the site: distance from the site: km direction from the site (bearings):			
Site classification of the wet deposition monitoring site	1: urban 2: rural 3: remote			

2) Situation around the site

The surrounding conditions, such as situation of the topography, land use, vegetation, sources of air pollutants, shall be described in the outline of monitoring site tables as shown in Form 3.2.4 – Form 3.2.6.

In these tables, the surrounding conditions for each direction shall be described in the following scale.

The maps for the explanation of the surrounding conditions shall be prepared as shown in each form of “Outline of monitoring site”. And, colour photographs of eight bearings should be attached for on-site scale.

The description in each table contains the detailed surrounding conditions around the monitoring sites at each four bearings.

There are three site scale information as follows:

- On-site scale (A): within 150 m from sampler (Form 3.2.4)
- Local scale (B): distance between 150 m and 10 km from sampling site (Form 3.2.5)
- Regional scale (C): distance between 10 km to 50 km from sampling site (Form 3.2.6)

3) Outline of monitoring

The format for preparing this part is shown in Form 3.2.14 and 3.2.15. This format shall be filled with the monitoring information of each site.

Form 3.2.14 Outline of monitoring for soil (*Example*)

Monitoring parameters	1: pH (H_2O), 2: pH (KCl), 3: exchangeable (3: Na^+, 4: K^+, 5: Ca^{2+}, 6:Mg^{2+}, 7: Al^{3+}, 8: H^+), 9: exchangeable acidity, 10: ECEC, 11: Carbonate, 12: T–C, 13: T–N, 14: SO_4^{2-}, 15: available phosphate, 16: others ( )
Monitoring interval	1: annual, 2: every___years, 3: irregular (date of the last survey [dd / mm / yyyy])

Form 3.2.15 Outline of monitoring for vegetation observation (*Example*)

Monitoring parameters	1: observation of tree decline, 2: description of trees, 3: others ( )
Monitoring interval	1: annual, 2: every___years, 3: irregular (date of the last survey [mm / dd / yyyy])

4) Meteorological observation

The format for preparing this part is shown in Form 3.2.16. This format shall be filled with the meteorological observation around each site.

Form 3.2.16 Meteorological observation (*Example*)

On site measurement of precipitation amount	Usage of rain gauge: 1: yes, 2: no if yes, Manufacturer: Model: Height from the ground level: m Measurement mode: 1: tipping bucket, 2: gravimetric, 3: other ( )
On-site observation of other parameters	1: wind direction, 2: wind velocity, 3: temperature, 4: humidity, 5: solar radiation, 6: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):
	Possible obtaining data: 1: precipitation amount, 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )

3.2.5.4 Inland aquatic environment monitoring

1) Outline of the monitoring site

The format for preparing this part is shown in Form 3.2.17.

Table 3.2.17. Standard format for the site properties (research year) (*Example*)

Country			
Location			
Kind	1. Lake 2. River (stream) 3. Other ( )		
Site name			
Altitude	m above sea-level		
Site Classification	1. Urban 2. Rural 3. Remote		
Latitude	° ' " N S	Longitude	° ' " E
Origin (for lakes/ponds)			
Nearest Wet deposition monitoring site	(km)		
Living organisms			
Catchment Area	km^2 (based on the sampling site)		
Catchment elevation and topography	m~ m		
Surface geology			
Soil types			
Vegetation			
Land use			
Population			
Lake area	m^2	Lake shape	
Shore line length	m		
Lake trophic type			
Water depth(mean)	m	(maximum)	m
Water volume	m^3		
Annual water level fluctuation	m ~ m (mean m)		
Residence time of water			
Lake utilization			
Number of inflow river		Number of outflow river	
River length			
River water depth (mean)	m	Minimum & maximum	m
Flow discharge (m^3 sec^{-1})	Mean Minimum Maximum		
Drought or freeze	1. Nothing 2. Existence(~)		
Lake or river (flows into)			
Precipitation (mm)	Annual and monthly data		
Evaporation (mm)	At least annual		
Solar radiation			
Wind speed	mean		
Prevailing Wind direction			
Annual air temperature			
Relative humidity			
Nearest meteorological station			
Soil chemical properties in the catchment area			
Bottom sediment			

2) Criteria for site selection of lakes and/or rivers (streams)

Lakes will be selected as monitoring sites. If appropriate lakes are not available, rivers (streams) that

are potentially susceptible to acidification and have little artificial influence should be selected.

Because the sampling point should be representative in the water bodies, it should be confirmed within half a year from the start of sampling, that the sampling site represents the water quality of the water body, by analyzing relevant items of surface water in several points (more than five sites including the center of the water body). In the case that there are islands at the center of site, the detailed survey is needed to decide a representative point in the site. It is desirable that the monthly and 10-days period variations be investigated to evaluate the representativeness of a sampling site (more than 4 times, in each season). For the time being, on-site measurement of water temperature, electric conductivity and pH values can be deemed as a substitute method for these investigations.

a) Criteria of lakes

It is recommended that harmonic lakes which are considered to be potentially susceptible to acidification should be selected. Natural lakes have higher priority for selection of sites than artificial lakes. If the management such as dredge is carried out, effects of the management should carefully be investigated. Oligotrophic or Mesotrophic of harmonic lake is recommended. If there is no harmonic lake, dystrophic lakes could be selected for monitoring. However, in this case, appropriate monitoring methods should further be investigated.

It is desirable to choose monitoring lakes which are harmonic type with low BOD, COD, or TOC (inorganic acidic lakes, organic acidic lakes or alkaline-based eutrophic lakes is not good for the monitoring), preferably having a maximum depth of approximately 10 m or less, a water retention time of 1 year or less, water area from 1 hectare to 100 hectares, low alkalinity (less than 200 μeq L^{-1}) or electric conductivity (less than 10 mS m^{-1}), minimal anthropogenic water pollution and no coverage of the surface with aquatic plants.

The lakes' catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation. The access from the site to the laboratory is desirable to be short for preventing change of the sample qualities.

b) Criteria of rivers (streams)

Rivers or streams that are potentially susceptible to acidification may be selected, where the impacts of human activities such as deforestation, slash-and-burn farming, stock-farming or cultivation is not being conducted or planned in the future in the upper stream area of the water sampling site. The river/stream's catchment area is desirable to be not so big. It is also desirable that the catchment is covered by acidic or neutrality bedrock geology, nature protection (conservation) areas and natural vegetation.

Especially, to prevent the influence of other pollutions and storm runoff, streams have higher priority than rivers in the site selection. In the case of selecting rivers, the upper streams of a river or first-order streams (as stream order) is desirable for the areas with storm events. At upper reach of the stream area, monitoring should be done at one point, and measurement of the flow is desirable.

It is desirable to choose monitoring rivers (streams) which are natural rivers (streams), having low alkalinity (less than 200 μeq L^{-1}) or electric conductivity (less than 10 mS m^{-1}) with low BOD, COD, or TOC. The recommendations for catchment properties and accessibility are the same as the lakes.

In the case of river (streams), flow volume and ion concentrations change dramatically with intense rainfall. Therefore, sampling should be carried out when there is no or small rainfall (below 10 mm per day) within 2 days before monitoring for average samples. Samples should also be collected during flood and after intensive rainfalls or snow melting, if possible. This will allow us to get more reliable information already on the stage of a plot selection. On this stage, the most important parameters to be measured are the temperature, electric conductivity, and pH values.

3) Outline of monitoring

The format for preparing this part is shown in Form 3.2.18, 3.2.19 and 3.2.20. This format shall be filled with the monitoring information of each site.

Form 3.2.18 Outline of monitoring (on-site) (*Example*)

Monitoring parameters (Ever sampling event)	1: Water temperature, 2: pH, 3: EC, 4: Dissolved oxygen, 5: Water color, 6: other ( )

Form 3.2.19 Outline of monitoring for lakes (*Example*)

Monitoring parameters (mandatory) (4 times a year)	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon or total organic carbon, 11: NO_2^-, 12: PO_4^{3-}, 13: Chlorophyll a, 14: Total phosphorus, 15: Total nitrogen, 16: other ( )
Monitoring parameters (Optional) (4 times a year)	1: Total dissolved Al, 2: Reactive Al, 3: Chemical oxygen demand, 4: Phytoplankton, 5: other ( )
Monitoring parameters (Optional) (every 3 – 5 years)	1: Living organisms other than phytoplankton, 2: Pb, ^{210}Pb and stable isotope S in sediment 3: other ( )

Form 3.2.20 Outline of monitoring for rivers (streams) (*Example*)

Monitoring parameters (mandatory) (every 1 or 2 month(s))	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon (DOC) or total organic carbon (TOC), 11: NO_2^-, 12: PO_4^{3-}, 13: Total phosphorus, 14: Total nitrogen, 15: Suspended solids, 16: other ( )
Monitoring parameters (Optional) (every 1 or 2 month(s))	1: Hydrological flow (at sampling time), 2: Total dissolved Al, 3: Reactive Al, 4: Chemical oxygen demand, 5: other ( )
Monitoring parameters (Optional) (4 times a year)	1: Epilithic algae, 2: other ( )
Monitoring parameters (Optional) (every 3 or52 years)	1: Living organisms other than epilithic algae 2: other ( )

3.2.5.5 Catchment-scale monitoring

The outline of the monitoring site shall be clarified according to Form 3.2.21.

Form 3.2.21 Outline of the site for catchment-scale monitoring (*Example*)

Site name			code	
Location	(attach the map which can specify the sampling point of the stream water)			
Latitude (at the outlet of the catchment)	(north, south) ° ‘	Longitude (at the outlet of the catchment)	(east) ° ‘	
Altitude	m - m			
Catchment area	km^2			
Surface geology				
Soil type				
Vegetation (dominant species)				
Land use (coverage %)				
Population within the catchment area				

The monitoring items and parameters shall also be clarified for input, output and biogeochemical processes, respectively. The detailed templates can be found in Appendix 1.

3.3 Analytical methodology and instrumentation for EANET monitoring

3.3.1 Analytical methodologies for the monitoring

According to the requirement in the technical manual, the overview of the analytical method for each monitoring item is shown in Table 3.3.1. The items for catchment-scale monitoring will be analyzed according to the methods for the respective media. The responsible laboratories should select the proper method to use and describe the selected method on the National Monitoring Plan.

3.3.2 Adopted analytical method

3.3.2.1 Wet deposition monitoring

The adopted analytical methods for mandatory and optional items of wet deposition monitoring should be described in the Form 3.3.1a and 3.3.1b. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.1.

Table 3.3.1 Analytical techniques used for the analysis of monitoring items

Method	Measuring item(s)	Media			
		Wet	Dry	Soil	IAE*
conductivity cell method	electric conductivity	✓			✓
glass electrode method	pH	✓		✓	✓
ion chromatograph	chloride, nitrate, sulfate, ammonium, sodium, potassium, calcium, magnesium, hydrogen carbonate, nitrite, fluoride, phosphate, organic acids	✓	✓		✓
spectrometry	chloride, nitrate, sulfate, ammonium, nitrite, fluoride, phosphate	✓	✓		✓
ultraviolet fluorometry	sulphur dioxide (automatic monitor)		✓		
electric conductivity method			✓		
chemical emission spectrometry	Nitrogen oxides (automatic monitor)		✓		
spectrometry (Salzmann)			✓		
ultraviolet spectrometry	ozone (automatic monitor)		✓		
spectrometry (KI method)			✓		
gravimetry	particulate matter (automatic monitor)		✓		
beta-ray absorption			✓		
tapered element oscillating microbalance			✓		
light dispersion			✓		
atomic absorption	sodium, potassium, calcium, magnesium, total aluminum	✓	✓	✓	✓
emission spectrometry	sodium, potassium, calcium, magnesium	✓	✓	✓	✓
ICP/AES** or ICP/MS***	total aluminum, lead				✓
HPLC****	hydrogen carbonate	✓			
Titration	Exchangeable acidity (aluminum and hydrogen), alkalinity			✓	✓

* IAE: Inland aquatic environment
** ICP/ES: Inductively coupled plasma / Atomic emission spectrometry
*** ICP/MS: Inductively coupled plasma / mass spectrometry
**** HPLC: High performance liquid chromatography

Form 3.3.1a Adopted analytical method for wet deposition monitoring (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Mandatory		
pH	1: Glass electrode, 2: other ( )	
EC	1: Conductivity cell, 2: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury (II) thiocyanate, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	

Form 3.3.1b Adopted analytical method for wet deposition monitoring (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Optional		
F^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HCO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
R-COO^- (Organic acids)	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamine, b: other), 3: other ( )	
PO_4^{3-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other), 3: other ( )	

3.3.2.2 Air concentration (dry deposition) monitoring

The adopted analytical methods for mandatory and optional items of air concentration monitoring should be described in the Form 3.3.2a and 3.3.2b. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.2.

Form 3.3.2a Adopted analytical method of automatic system for air concentration monitoring (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
SO_2	1: Ultraviolet fluorometry, 2: H_2O_2 oxidation/Electric conductivity 3: other ( )	
NO_2	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
NO	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
O_3	1: Ultraviolet absorption spectrometry, 2: Spectrometry with neutral potassium iodide, 3: other ( )	

Form 3.3.2b Adopted analytical method for air concentration monitoring with filter pack method (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
Gases substances		
SO_2	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HNO_3	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HCl	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
NH_3	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Nessler's reagent, b: Indophenol blue, 3: other ( )), 3: other ( )	
Particulate matter components		
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor),	

	2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	

3.3.2.3 Soil monitoring for basic survey site

The adopted analytical methods of soil monitoring for basic survey site should be described in the Form 3.3.3. When the laboratory does not adopt the method which is listed in Table 3.3.1, the validity of the method is expected to be described in Form 3.3.3.

Form 3.3.3 Adopted analytical method for soil monitoring (*Example*)

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
pH (H_2O)	1: Glass electrode (extracted with water)	
pH (KCl)	1: Grass electrode (extracted with KCl aq.)	
Exchangeable Na^+	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable K^+	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Ca^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Mg^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Exchangeable Al^{3+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: Titration, 4: other ( )	
Exchangeable H^+	1: Subtract Al^{3+} data from Titration data, 2: other ( )	
Exchangeable acidity	1: Titration, 2: other ( )	
ECEC		
HCO_3^-	1: Volumetric calcimeter, 2: other ( )	
T–C	1: Titration (Walkeley0Black), 2: Carbon-nitrogen analyser, 3: other ( )	
T–N	1: Titration (Kjeldahrl), 2: Carbon-nitrogen analyser 3: other ( )	
SO_2	1: Ultraviolet fluorometry, 2: H_2O_2 oxidation/Electric conductivity 3: other ( )	
Available phosphate	1: Spectrometry (Bray-1), 2: other ( )	

3.3.2.4 Inland aquatic environment monitoring

The adopted analytical methods for inland aquatic environment monitoring site should be described in the Form 3.3.4. When the laboratory does not adopt the method which is listed in Table 3.3.1, the

validity of the method is expected to be described in Form 3.3.4

Form 3.3.4a Adopted analytical method for inland aquatic environment monitoring (on-site) (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
Water temperature	1: Thermometer, 2: pH meter, 3: EC meter, 4: other ( )	
pH	1: Glass electrode, 2: other ( )	
EC	1: Conductivity cell, 2: other ( )	
Dissolved oxygen	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: other ( )	
Available phosphate	1: Spectrometry (Bray-1), 2: other ( )	

Form 3.3.4b Adopted analytical method for inland aquatic environment monitoring (mandatory) (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
Alkalinity	1: Titration using burette, 2: Titration using digital burette 3: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamine, b: other), 3: other ( )	
PO_4^{3-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other), 3: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor),	

	2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
Ca^{2+}	1: Ion chromatography, 2: Atomic absorption spectrometry, 3: other ( )	
Mg^{2+}	1: Ion chromatography, 2: Atomic absorption spectrometry, 3: other ( )	
Na^{+}	1: Ion chromatography 2: Atomic absorption spectrometry, 3: Flame emission spectrometry, 4: other ( )	
K^{+}	1: Ion chromatography 2: Atomic absorption spectrometry, 3: Flame emission spectrometry, 4: other ( )	
Cl^{-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other), 3: other ( )	

Form 3.3.4c Adopted analytical method for inland aquatic environment monitoring (mandatory) (continued) (*Example*)

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
DOC or TOC	1: Total organic carbon analyzer, 2: Wet-oxidation method, 3: other ( )	
Chlorophyll a	1: SCOR/UNESCO method, 2: other ( )	
Total P	1: Potassium peroxodisulfate decomposition, 2: other ( )	
Total N	1: Ultraviolet absorption spectrometry, 2: Hydrazinium sulfate reduction, 3: other ( )	
SS	1: Gravimetry (1 mm glass fiber filter filtration) 2: other ( )	
Total dissolved Al	1: Atomic absorption spectrometry with graphite furnace, 2: ICP/AES or ICP/MS 3: other ( )	
Reactive Al	1: Lumogallion method, 2: Spectrometry, 3: other ( )	
COD	1: Potassium bichromate method, 2: Acidic potassium permanganate method, 3: other ( )	
DO	1: DO meter, 2: Winkler-modified sodium azide method, 3: other ( )	

Form 3.3.4d Adopted analytical method suggested for lake sediment and their pore water (*Example*)

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other), 3: other ( )	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other), 3: other ( )	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other), 3: other ( )	
^{210}Pb	1: Isotope ratio mass spectrometry, 2: other ( )	
Pb	1: Atomic absorption spectrometry with graphite furnace, 2: ICP/AES or ICP/MS 3: other ( )	

3.3.2.5 Catchment-scale monitoring

Most of items on catchment-scale monitoring have been measured or recommended for deposition monitoring or ecological monitoring. The existing technical manuals can be referred for the respective media. Analytical methods of the items on catchment-scale monitoring should also be specified using the above forms for the respective media, if necessary.

4 Site/Laboratory Audit

The National Center should carry out an annual technical audit for each site to ensure that the on-site criteria are being met and to provide an opportunity for a detailed review of the site including the condition of the infrastructure and status of the instrumentation. Such site visits encourage communication between the National Center and site operators facilitating problem solving, technical upgrades and training. A site performance audit should be implemented in accordance with the corresponding technical documents.

The laboratory operations should also be audited by the National Center with similar frequencies to the site and sampling audit. Focus is placed on sample handling, capability of the instrumentation, the SOPs, and all QA/QC activities and their records and the log book. The audit practice should be clearly reported and stored for further discussion and long-term evaluations of the QA/QC of the long-term monitoring operation.

It is recommended that the National Canter carry out the observation site and laboratory audit once in a year. Example of Site/Laboratory Audit Form is shown in Appendix 2. This example can be used for references but the check items of site and laboratory audit form are dependent on each National QA/QC Program.

4.1 Wet deposition monitoring site

Checking site information is important to judge whether the monitoring site is satisfied with site criteria and to classify either of the following three site categories: remote, rural and urban site. The following check points should be observed.

(Check points for site location)

a) An open, flat, grassy area far enough free tree, hills, and other obstruction to avoid effect on sampling. No object is within a few meter of the collector, and no object shade the collector.
b) The horizontal distance between a large obstruction and collector is at least twice the obstruction height, or the top of an obstruction as viewed from the collector is less than 30 degree above the horizon.
c) The collector is free from local emission and contamination source such as waste disposal site, incinerators, parking lots, open storage of agricultural products, and domestic heating. Regions within 100 m of these emission and contamination sources are excluded.
d) The horizontal distance between collector and rain gauge (and dry deposition collector) is greater than 2 meters, and collector and rain gauge cross the direction of the prevailing wind during precipitation events.

(Check points for emission and contamination sources>

a) Regions within 50 km of large pollution sources such as city, thermal power plants and major motorways are excluded as remote sites.
b) Regions within 20 km of large pollution sources are excluded as rural sites.
c) Regions within 500 m of main roads (more than 500 vehicles/day) are excluded as remote sites and rural sites.

The instruments used for wet deposition sampling are a rain gauge, precipitation collector and rainfall sensor. Generally, the following points should be checked at the audit.

a) The conductivity of deionized water used for cleaning is less than 0.15 mS m^{-1} (1.5 μS cm^{-1}).
b) Operation of precipitation auto collector should be checked on the following item:
   · Proper rainfall sensor response and operation of opening lid is checked.
   · Proper rainfall sensor heating ;
   · Mechanical operation of the collector; and
   · The cleanliness of collecting funnel and collecting vessels.

Sample handling and transportation from the sampling site to laboratory are important check point for wet deposition. The wet deposition samples should be handled with disposable plastic gloves. Transportation of the samples from sampling sites to chemical analysis laboratories must be done in cooler boxes filled in freezer packs or by cool delivery service. However, when biocide is used for sample preservation, the cooling of samples is not required.

4.2 Dry deposition monitoring site

At many sites, wet and dry deposition monitoring are conducted at the same place. In this case, checking site information is the same as wet deposition monitoring. If dry deposition monitoring is conducted at a different place, the site condition should be checked individually. Sampling sites are important for dry deposition monitoring. The technical manual for air concentration monitoring in East Asia recommends to monitor SO_2, NOx, O_3 and PM at the height of 3.0 – 10 m above the ground. Additionally, it is also recommended the sampling inlet should be located at the position higher than the roof of the station building. If these conditions a not satisfied, the inlet should be located at the position keeping distance 2.0 – 3.0 m or more from the wall of the station building. In the same meaning, when dry deposition monitoring is implemented in a forest area, the sampling inlet should be set at the position higher than the top of canopy or keeping enough horizontal distance from trees.

Humidity, in which monitoring instruments are located, should be carefully assessed. Air conditioning should be provided in a cabin where automatic instruments are located. However, if the temperature in the cabin is significantly lower than outside temperature, it will lead to condensation of water in

sample inlet lines, and measurement errors.

The following automatic monitors should be checked for manufacturer, model, used years, monitoring interval, data storage and other instrumental information: O_3, SO_2, NOx, PM_{10} and $PM_{2.5}$.

For automatic instruments, certified standard gases of the concerned chemical species should be used for calibration. The following check points should be observed for calibration.

- Concentration, expire date, manufacturer of standard gases
- Record of calibration factor (Zero point and span)
- Traceability for SI unit or standard reference photometer for O_3
- Linearity of the signal response
- Check of converter efficiency from NO_2 to NO
- Check of mass flow controller/flow meter

It is important to check the maintenance record to operate the instruments for a long time in a stable manner for maintaining high-level of performance and data quality. Routine check and maintenance should be carried out at least once in two weeks (or at the same timing of sample collection) to check the operation of the concerned instruments, and change consumables as appropriate. Periodic check and maintenance have more detailed procedures than routine ones, such as the calibration for assuring the data quality and replacement of exhausted parts. The frequency and interval of periodic check and maintenance are different from instrument to instrument (generally between 3 months to one year, depending on the items to be checked and/or maintained). Appropriate frequency and interval should be determined for respective instruments.

4.3 Soil and Vegetation monitoring site

Together with on-site audit, sampling plots and subplots, on-site sample handling and data documentation should be inspected by the National Center. The National Center should prepare a SOP for on-site inspection. The audit results should be recorded and stored.

Each organization in charge of soil and vegetation monitoring will appoint supervisors in charge of fieldwork and sampling. Since experience and particular skills are necessary for some monitoring items, the persons in charge of fieldwork and sampling should be well trained. The supervisor and person who carry out fieldwork and sampling at each site should be registered to the National Center. The name of the person who collects each sample should be recorded at the on-site audit.

(Soil monitoring)
For the establishment of plots, the soil profile description should be checked. The soil profile should be described near the center of the candidate plots before soil sampling. Several plots, at least two

plots, occupying areas from 5 m x 5 m to 10 m x 10 m, should be selected randomly at each monitoring site. Five subplots for soil sampling, each occupying 1 m x 1 m, are selected in principle at the center and on the diagonal lines of the plot (5 m x 5 m to 10 m x 10 m). Soil samples are collected from these subplots and analyzed.

In each subplot, after removing the litter layer (O horizon), 1 – 2 kg soil samples are collected by fixed depth. Two layers, uppermost (0-10cm) and underlying (10 – 20 cm) layers should be collected with shovel or metal sampling cylinder. The sample is collected in equal proportions over the whole layer. In the center subplot soil samples should be collected beside the hole for soil profile description. For the corner subplots, appropriate size of holes for sampling should be dug, then similar sampling procedures should be employed. From the next sampling, the same procedures should be adopted for the center subplot.

(Vegetation monitoring)
In each selected monitoring site, a measuring plot should be subdivided to three coaxial circles with radii of 7.98 m, 11.28 m and 17.85 m (0.02, 0.04, and 0.1 hectare, respectively), and the center and borders should be marked by stakes and color painting of the bark of trees.

The sample trees are selected systematically. Mark four points of north, south, east and west, 12 m apart from the center of the vegetation monitoring site. Select five dominant trees randomly around each such point. A total of twenty trees are thus selected as the monitoring trees. The serial number of each monitoring tree should be noted as numbering had been done at tree enumeration.

4.4 Inland aquatic environment site

Site selection should be checked if it is satisfied with criteria. It is recommended that harmonic lakes which are considered to be potentially susceptible to acidification should be selected. If there is no harmonic lake, dystrophic lakes could be selected for monitoring. However, in this case, appropriate monitoring methods should further be investigated. Natural lakes have higher priority for selection of sites than artificial lakes. If appropriate lakes are not available, then springs, headwaters or rivers that are potentially susceptible to acidification and have little artificial influence, should be considered. It is desirable to choose monitoring lakes which are harmonic type, preferably having a depth of approximately 10m or less, a water retention time of 1 year or less, water area of 1 hector or more, low alkalinity (less than 0.05 meq/L) or electric conductivity, minimal anthropogenic water pollution and no coverage of the surface with aquatic plants.

Representativeness survey of sampling sites and time is important check point for inland aquatic environment monitoring. Because the sampling point should be representative in the water bodies, it should be confirmed within half a year from the start of sampling that the sampling site represents the

water quality of the water body, by analyzing relevant items of surface water in several points (more than five sites including the center of the water body). In the case that there are islands at the center of lake, the detailed survey is needed to decide a representative point in the lake. It is desirable that the monthly and hourly variations be investigated to evaluate the representativeness of a sampling site (more than 4 times, in each season) in the preparatory phase. For the time being, on-site measurement of water temperature

Regarding sample treatment, surface water should be sampled directly by a clean polyethylene bucket or a dipper at the representative point of the lake. The duplicate samples should be collected at the same point. The water sample should be taken full up in well washed 2 L polyethylene or polypropylene bottle without air after washing by sample water.

4.5 Laboratory audit and inter-laboratory comparison

In a laboratory of chemical analysis, freedom from contamination of the apparatus, materials and reagents used for measurement and analysis must be confirmed beforehand; blank values of target substances should be as low as possible. Measurement and analysis should be conducted by persons who are well trained. To maintain high analytical quality, SOPs must be prepared for the management of apparatus, materials and reagents. The important check items in a laboratory are shown below.

(Measurement and chemical analysis of samples)

a) List of standard materials and standard solutions
b) Storage and pretreatment of samples
c) Manufacturer, model, used years of analytical instruments
d) Maintenance records of analytical instruments
e) Detection limits and determination limits for each parameter
f) Implementation of Duplicate and repeated analysis
g) Ion balance check (R1)
h) Comparison of calculated and measured conductivity (R2)

(Data management)

a) Treatment of extraordinary data, and data validation
b) Feedback of interlaboratory comparison
c) Assessment of adequacy of sampling sites, and completeness
d) Data storage

The Inter-laboratory Comparison Project was conducted among the analytical laboratories in participating countries of the EANET, based on the QA/QC Program of EANET. The objectives of this project are shown below. The evaluation includes analytical results as well as performance of

analytical skills, condition of analytical equipment, analytical operating procedures and data checking procedure.

(i) To recognize the analytical precision and accuracy of the measurement in each participating laboratory;
(ii) To give further opportunities to improve the quality of the analysis on wet deposition, dry deposition (filter pack method), soil and inland aquatic monitoring of EANET; and,
(iii) To improve reliability of analytical data through the assessment of suitable analytical methods and techniques.

The Inter-laboratory Comparison Project of wet deposition (artificial rainwater sample), dry deposition (artificial gas collection filter sample), soil (homogenized and sterilized soil sample) and inland aquatic environment (artificial inland water sample) is implemented by the NC annually. It is recommended that the Inter-laboratory comparison sample analysis be implemented at the same time of laboratory audit and the result of inter-laboratory comparison be a part of laboratory audit report. The results of inter-laboratory comparison should be used to study and find solutions to existing laboratory problems and improve the quality of laboratory analyses.

Appendix 1 Template of the National Monitoring Plan

[Form-01]

National Monitoring Plan for Acid Deposition Monitoring Network in East Asia

Country:

Prepared or reviewed by	Date of preparation or review
Endorsed by	Date of endorsement

Information on the National Focal Point

Name of National Focal Point	
Title and Department	
Organization	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:

PART I

Overview of the National Center for EANET and Implementation of the Acid Deposition Monitoring

1. Outline of the National Center and implementation of monitoring

1) Implementation body (National Center for EANET) **[Form-02]**

Organization in charge of the National Center for EANET	
Department	
Representative of the National Center	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:
National QA/QC Manager	
Postal address	
Contact information	Telephone: Facsimile: E-mail address:

If there is another National Center, above table format shall be duplicated and fill the information about another National Center.

If more than one person has been designated as the National QA/QC manager, the column for this information shall be expanded.

2) Number of monitoring sites **[Form-03]**

Items	Planed monitoring sites			Monitoring site in the future		
	Urban	Rural	Remote	Urban	Rural	Remote
Wet deposition						
Air concentration (Dry deposition)						
Soil and vegetation						
Inland aquatic environment						
Catchment-scale survey						

3) List of monitoring sites, testing laboratories and meteorological observing stations, and their correlation **[Form-04]**

Monitoring site	Corresponding laboratory	Monitoring item*				
		WD	AC	SV	IAE	CSM

* WD: wed deposition, AC: air concentration, SV: soil and vegetation monitoring, IAE: inland aquatic environment monitoring, CSM: catchment scale monitoring

4) Overview of measurement parameters and monitoring interval for wet deposition monitoring

[Form-05]

Items	Measurement parameters	Monitoring interval
Wet deposition	**[Mandatory items]** ➢ pH ➢ Electric conductivity (EC) ➢ Concentration of cations (NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}) ➢ Concentration of Anions (SO_4^{2-}, NO_3^-, Cl^-) *If there might be some additional items for the monitoring, every monitoring item should be described below:* ➢ HCO_3^-, NO_2^-, F^-, Br^-, PO_4^{3-} ➢ Organic ions ($HCOO^-$, CH_3COO^-, $(COO^-)_2$	1: daily 2: composited weekly 3: event basis
	<Meteorological measurements> ➢ Wind direction and velocity ➢ Temperature ➢ Relative humidity ➢ Precipitation amount ➢ Solar radiation ➢ Meteorological data acquired from the nearest meteorological observation station	

5) Overview of measurement parameters and monitoring interval for air concentration monitoring

[Form-06]

Items	Measurement parameters	Monitoring interval
Air concentration (Dry deposition)	**<Filter pack sampling>** ➢ SO_2 concentration converted from SO_4^{2-} concentration ➢ NO_2 concentration converted from NO_3^- concentration ➢ HCl concentration converted from Cl^- concentration ➢ NH_3 concentration converted from NH_4^+ concentration ➢ Na^+, K^+, Ca^{2+}, Mg^{2+}	1: weekly 2: bi-weekly 3: daily
	<Passive sampling> ➢ SO_2 concentration converted from SO_4^{2-} concentration ➢ O_3 concentration converted from NO_3^- concentration ➢ NH_3 concentration converted from NO_2^- concentration ➢ NO_2 concentration converted from NO_2^- concentration ➢ NOx concentration converted from NO_2^- concentration	1: one week 2: two weeks 3: three weeks 4: one month
	<Annular denuder> ➢ Concentration of N as HNO_3 ➢ Concentration of S as SO_2 ➢ Concentration of N as NH_3	1: weekly 2: bi-weekly
	<Automatic Monitor> ➢ SO_2, NOx, O_3 and PM	➢ Every one minute

6) Overview of measurement parameters and monitoring interval for Soil and vegetation monitoring

[Form-07]

Items	Measurement parameters	Monitoring interval
Soil	**[Mandatory items for chemical properties]** ➢ Moisture content ➢ pH(H_2O) and pH(KCl) ➢ Exchangeable base cations (Na^+, K^+, Ca^{2+}, Mg^{2+}) ➢ Exchangeable acidity ➢ Effective cation exchangeable capacity (ECEC) ➢ Carbonate content (when pH(H_2O) > 7) **[Optional items for chemical properties]** ➢ Exchangeable cations (Al^{3+}, H^+) ➢ Carbonate content (when pH(H_2O) is less than or equal to 7) ➢ Total carbon content ➢ Total nitrogen content ➢ Available PO_4^{3-} ➢ SO_4^{2-} **[Optional items for physical properties]** ➢ Fine earth bulk density ➢ Penetration resistance in the fieldwork	➢ Once in every 3 to 5 years
Forest monitoring	**[Mandatory items]** **<General description of the forest>** ➢ Description of the tree (name of species, diameter at breast height and height of tree) ➢ Understory vegetation survey **<Survey of tree decline>** ➢ Observation of tree decline **[Optional items]** **<Survey of tree decline>** ➢ Photographic record of tree decline ➢ Estimation of decline causes	**<General description of the forest>** ➢ Once in every 3 to 5 years **<Survey of tree decline>** **[Mandatory items]** ➢ Once in a year **[Optional items]** ➢ Once in every 3 to 5 years
Intensive survey	**[Optional items]** **<Rain>** ➢ Acidity (pH) ➢ Electric conductivity (EC) ➢ Cations (Na^+, K^+, Ca^{2+}, Mg^{2+} and NH_4^+) ➢ Anions (NO_2^-, NO_3^-, SO_4^{2-},Cl^- and PO_4^{3-}) **<Throughfall>** ➢ Acidity (pH) ➢ Electric conductivity (EC) ➢ Cations (Na^+, K^+, Ca^{2+}, Mg^{2+} and NH_4^+) ➢ Anions (NO_2^-, NO_3^-, SO_4^{2-},Cl^- and PO_4^{3-}) **<Stemflow>** ➢ Acidity (pH) ➢ Electric conductivity (EC) ➢ Cations (Na^+, K^+, Ca^{2+}, Mg^{2+} and NH_4^+) ➢ Anions (NO_2^-, NO_3^-, SO_4^{2-},Cl^- and PO_4^{3-})	➢ Weekly collection (preferable) ➢ Biweekly collection (acceptable)

7) Overview of measurement parameters and monitoring interval for Inland aquatic environment monitoring **[Form-08]**

Items	Measurement parameters	Monitoring interval
Inland aquatic environment	**<Lakes>** **[Mandatory items]** ➢ Water temperature ➢ pH ➢ EC ➢ Alkalinity (Gran's plot titration/ pH 4.8 endpoint) ➢ Cations (NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}) ➢ Anions (SO_4^{2-}, NO_3^-, Cl^-) ➢ Transparency ➢ Water color ➢ Dissolved organic carbon (DOC) or total organic carbon (TOC) ➢ NO_2^- and PO_4^{3-} ➢ Chlorophyll a ➢ Total P ➢ Total N ➢ Dissolved oxygen (DO) ➢ SO_4^{2-}, NO_3^-, and NH_4^+ in pore water of sediment **[Optional items]** **[category-1]** ➢ Total dissolved Al ➢ Reactive Al, if total dissolved Al is greater than 200 μg L^{-1} ➢ Chemical oxygen demand (COD) ➢ Phytoplankton (Diatom species) **[category-2]** ➢ Living orgasms other than phytoplankton ➢ Pb, ^{210}Pb and stable isotope of S in the sediment	**[Mandatory items]** ➢ Four times a year except sediment ➢ Once in every 3 to 5 years for sediment **[Optional items]** ➢ Four times a year for category-1 ➢ Once in every 3 to 5 years for category-2
	<Rivers> **[Mandatory items]** ➢ Water temperature ➢ pH ➢ EC ➢ Alkalinity (Gran's plot titration/ pH 4.8 endpoint) ➢ Cations (NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}) ➢ Anions (SO_4^{2-}, NO_3^-, Cl^-) ➢ Water color ➢ Dissolved organic carbon (DOC) or total organic carbon (TOC) ➢ NO_2^- and PO_4^{3-} ➢ Total P ➢ Total N ➢ Suspended solid (SS) **[Optional items]** **[category-1]** ➢ Hydrological flow at sampling time ➢ Total dissolved Al ➢ Reactive Al, if total dissolved Al is greater than 200 μg L^{-1} ➢ Chemical oxygen demand (COD) **[category-2]** ➢ Epilithic algae (diatom species) **[category-3]** ➢ Living orgasms other than epilithic algae	**[Mandatory items]** ➢ Once in every one or two months **[Optional items]** ➢ Once in every one or two months for category-1 ➢ Four times a year for category-2 ➢ Once in every 3 to 5 years for category-3

8) Overview of measurement parameters and monitoring interval for catchment-scale monitoring

[Form-09]

Items	Detailed items		Measurement items	Monitoring interval
Input (total deposition)*[1]	**[Mandatory items]** a) Precipitation amount b) Wet deposition c) Total deposition throughfall-stemflow method or summation of wet and dry deposition **[Optional item]** d) Air concentration		a) Meteorological data b) refer to 4) c) calculated by summing of 4) and 5) or refer to 6) d) refer to 5)	➢ continuously ➢ hourly ➢ daily ➢ weekly ➢ biweekly ➢ monthly
Output (discharge from the stream)	**[Mandatory items]** a) Water discharge (weir, H-Q curve method) b) Stream water chemistry c) Chemical discharge (calculation based on water discharge and stream water concentration)		a) Water flux b) refer to 7) c) calculated using the data obtained by a) and b)	➢ continuously ➢ daily ➢ weekly ➢ biweekly ➢ monthly ➢ intensive
Biogeo-chemical processes	Soil*[2]	**[Mandatory item]** a) Soil chemical properties **[Optional items]** b) Soil solution c) Soil moisture d) Soil physical properties e) Soil gas emission	a) refer to 6) b) cations (NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}), anions (SO_4^{2-}, NO_3^-, Cl^-), SiO_2, pH and EC c) moisture measured by; ➢ Time domain reflectometry ➢ Amplitude domain reflectometry d) Fine earth bulk density, Penetration resistance e) N_2O, CO_2	a) ➢ Once for several years ➢ Twice a year b) ➢ Monthly ➢ Four times a year c) Continuously d) Once e) ➢ Monthly ➢ Four times a year
	Vegetation*[2]	**[Mandatory item]** a) Plant growth **[Optional items]** b) Species composition c) Elemental contents (litter trap, leaf element analysis)	a) Description of trees, dendrometer, tree ring analysis b) Understory vegetation survey c) Total carbon, Total nitrogen, base cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), total Al	a) once for several years for description of tree ➢ continuously b) once for several years c) litter trap ➢ biweekly ➢ monthly c') leaf analysis ➢ monthly ➢ bimonthly
	Water balance	Evapotranspiration **[Optional item]**	Evapotranspiration rate (mm per unit time)	Continuously

Note. *[1] If the deposition data at the nearest EANET station is used as input data, specify the name of the station.
*[2] If the data on regular soil and vegetation monitoring is used, specify the plot name.

[Form-10]

PART II

Detailed description for each sample collection and analytical activities

Name of monitoring site:

Monitoring items

- wet deposition
- air concentration
- soil and vegetation
- inland aquatic environment
- catchment scale

Name of corresponding laboratory

Name of corresponding meteorological observing station (if available)

This part of the sheet should be prepared for each monitoring site

1. Monitoring site

1) Outline of monitoring site of acid deposition related species concentration in precipitation

[Form-11]

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	º ’ ” N S	Longitude	º ’ ” E
Height from sea level	m		

2) Outline of monitoring site of atmospheric acid deposition related species concentration **[Form-12]**

Site name		Code	
Address			
Site classification	1: urban 2: rural 3: remote		
Latitude	º ’ ” N S	Longitude	º ’ ” E
Height from sea level	m		

3) Additional information for soil and vegetation monitoring **[Form-13]**

Site name	
Data of wet deposition	1: on site measuring data 2: use the nearest wet deposition monitoring site data
In case of use the nearest wet deposition monitoring site data	Name of the site: distance from the site: km direction from the site (bearings):
Site classification of the wet deposition monitoring site	1: urban 2: rural 3: remote

4) Site properties for inland aquatic environment monitoring (research year) **[Form-14]**

Kind	1. Lake 2. River (stream) 3. Other ( )		
Origin (for lakes/ponds)			
Nearest Wet deposition monitoring site	(km)		
Living organisms			
Catchment Area	km^2 (based on the sampling site)		
Catchment elevation and topography	m~ m		
Surface geology			
Soil types			
Vegetation			
Land use			
Population			
Lake area	m^2	Lake shape	
Shore line length	m		
Lake trophic type			
Water depth(mean)	m	(maximum)	m
Water volume	m^3		
Annual water level fluctuation	m ~ m (mean m)		
Residence time of water			
Lake utilization			
Number of inflow river		Number of outflow river	
River length			
River water depth (mean)	m	Minimum & maximum	m
Flow discharge (m^3 sec^{-1})	Mean: Minimum: Maximum		
Drought or freeze	1. Nothing 2. Existence(~)		
Lake or river (flows into)			
Precipitation (mm)	Annual and monthly data		
Evaporation (mm)	At least annual		
Solar radiation		Wind speed	mean
Prevailing Wind direction		Annual air temperature	
Relative humidity			
Nearest meteorological station			
Soil chemical properties in the catchment area			
Bottom sediment			

5) On-site monitoring items for inland aquatic environment monitoring **[Form-15]**

Monitoring parameters (Ever sampling event)	1: Water temperature, 2: pH, 3: EC, 4: Dissolved oxygen, 5: Water color, 6: other ( )

6) Outline of the site for catchment-scale monitoring **[Form-16]**

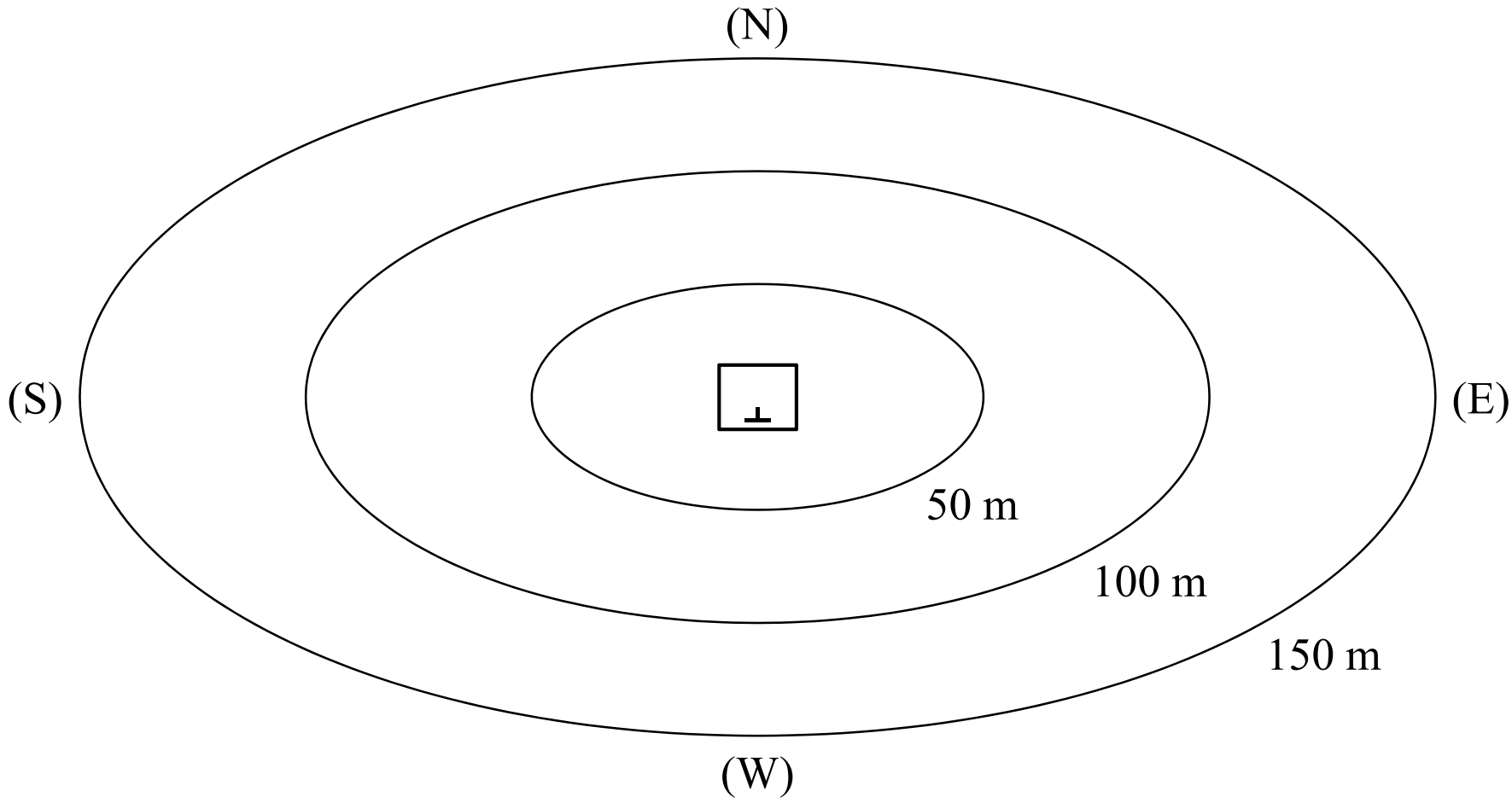
Site name		code	
Location	(attach the map which can specify the sampling point of the stream water)		
Latitude (at the outlet of the catchment)	o ' " N S	Longitude (at the outlet of the catchment)	o ' " E
Altitude	m - m		
Catchment area	km^2		
Surface geology			
Soil type			
Vegetation (dominant species)			
Land use (coverage %)			
Population within the catchment area			

1) Outline of monitoring site: On-site scale (distance within 150 m) **[Form-17]**

Items	North direction (NW – NE)	East direction (NE – SE)	South direction (SE – SW)	West direction (SW – NW)
Existence of trees, poles and buildings, and the height of those				
Existence of incinerators, domestic heating, parking lots, storage of fuel and agricultural products, daily farm, and many livestocks				
Slope degree of the site	° – °	° – °	° – °	° – °
Surface condition of the site				
Existence of a forest, river, lake, marsh, farm or fields				
Existence of roads and their traffic densities*				

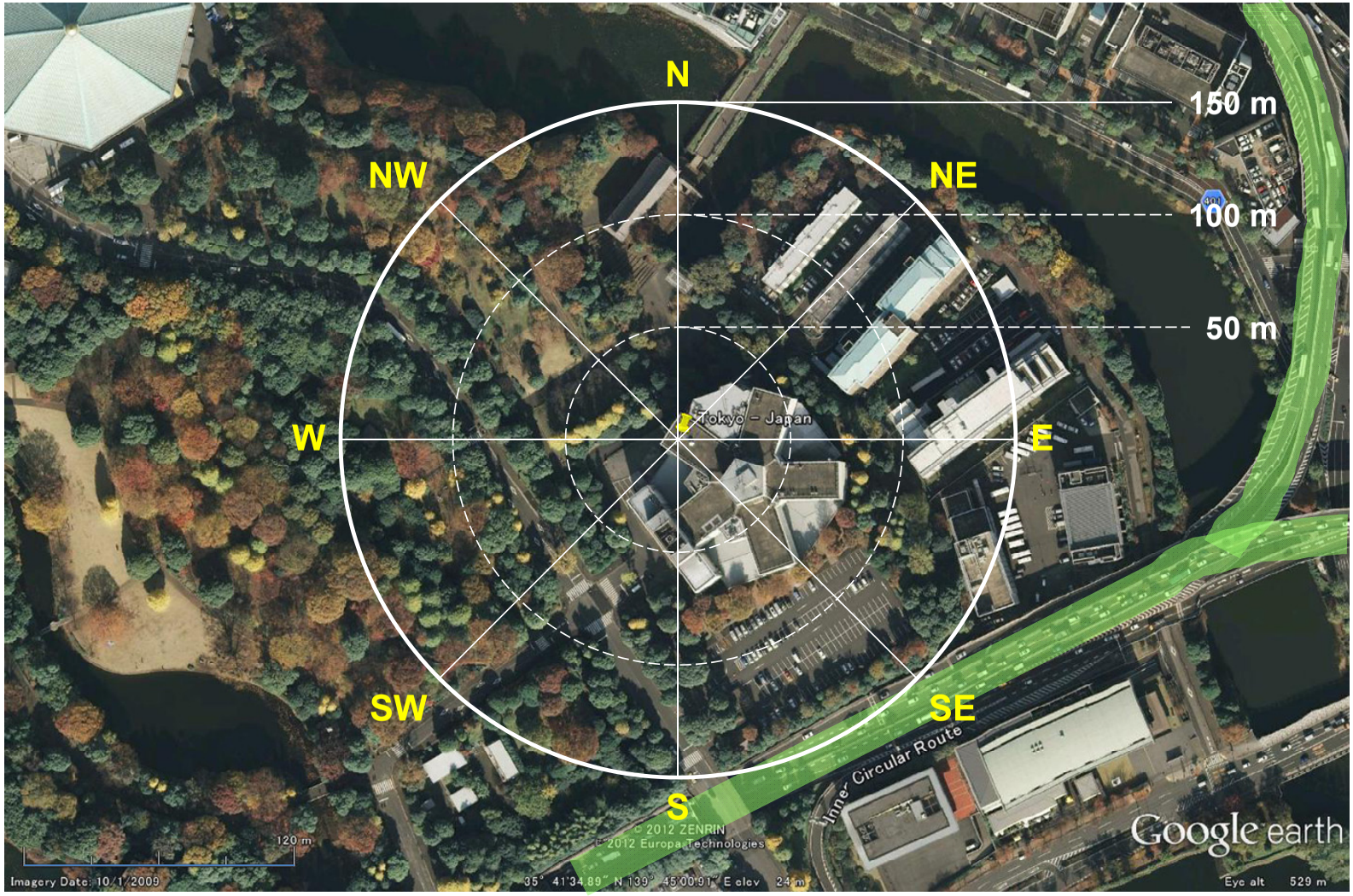
* Describe roads with more than 100 vehicles/day for remote sites and roads with more than 1,000 vehicles/day for urban and rural sites.

On-site Scale (S) (within 150 m) [Form-18.1]



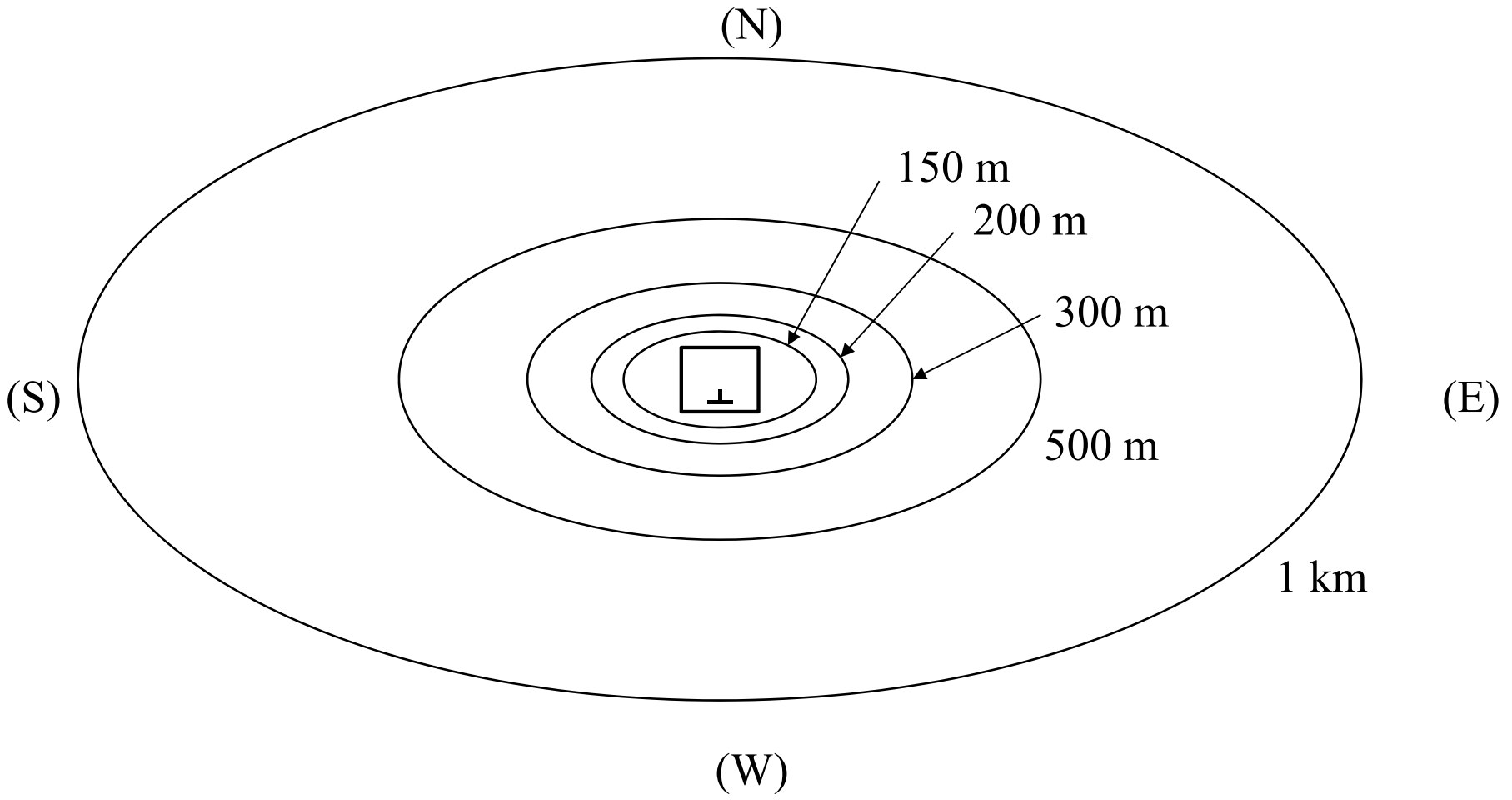
Site Name : _____

Example: On-site Scale (S) (within 150 m) [Form-18.1]



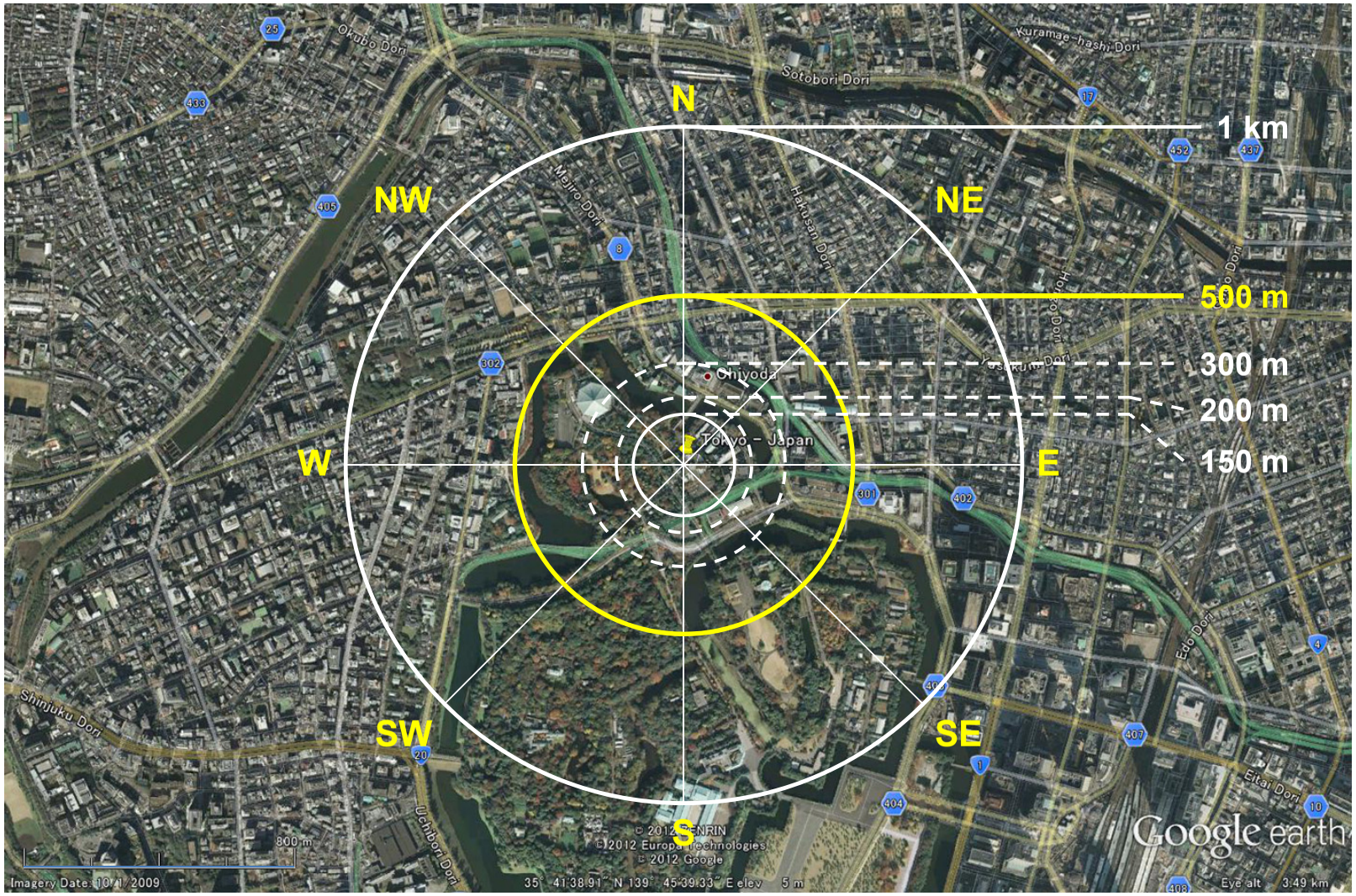
Site name: Tokyo, Japan

On-site Scale (L) (within 1 km) [Form-18.2]



Site Name : _____

Example: On-site Scale (L) (within 1 km) [Form-18.2]



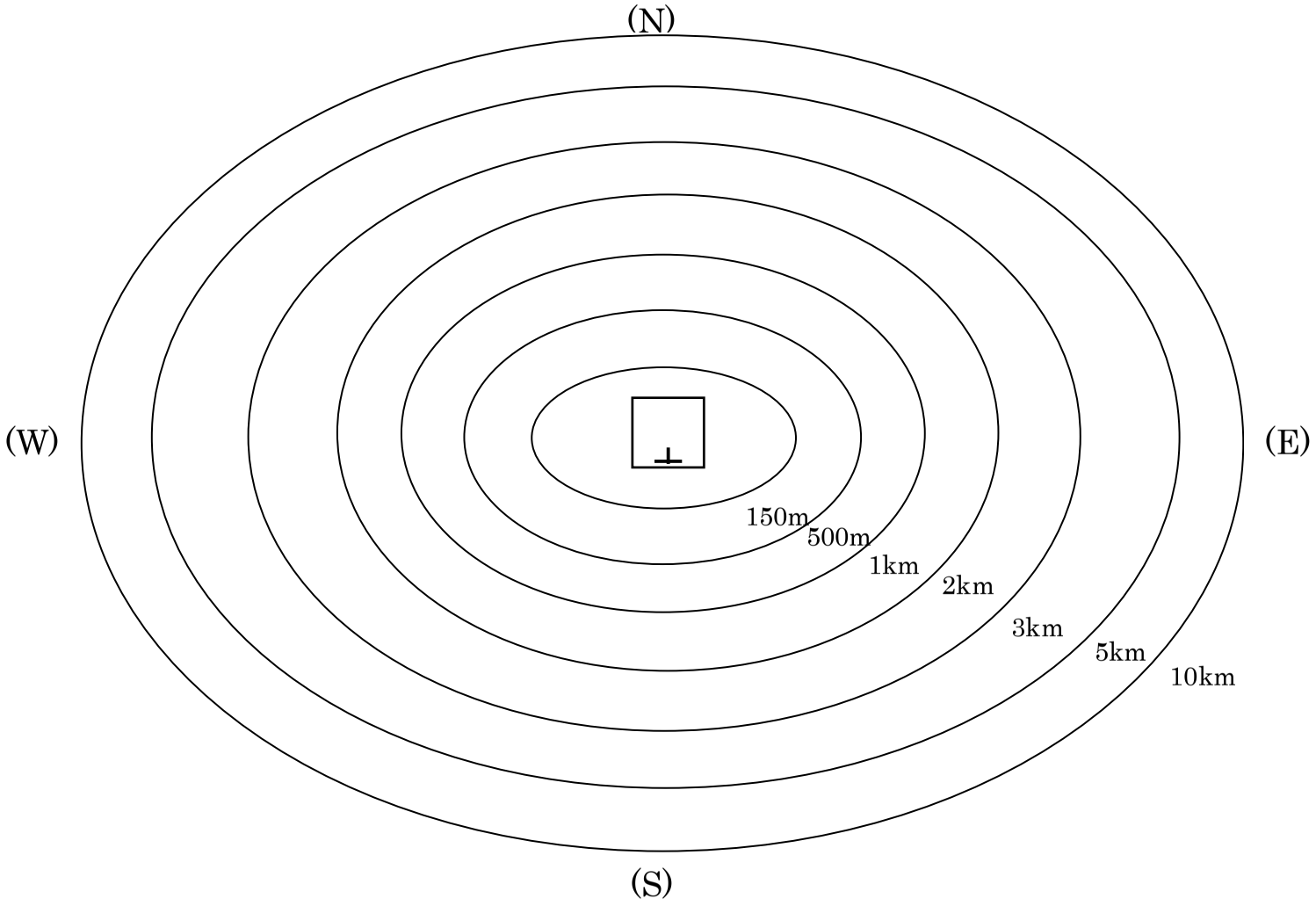
Site name: Tokyo, Japan

2) Outline of monitoring site: Local scale (distance 150 m – 10 km) **[Form-19]**

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Information on trunk roads, expressways, and their traffic densities (with more than 5,000 vehicles/day)				
Information on airports and railways				
Information on major emission sources such as large industries, and power plants and their fuel consumptions and so on				
Information on houses/ settlements with more than 5,000 persons, and their population				
Descriptive information around the site such as topography and meteorological condition				

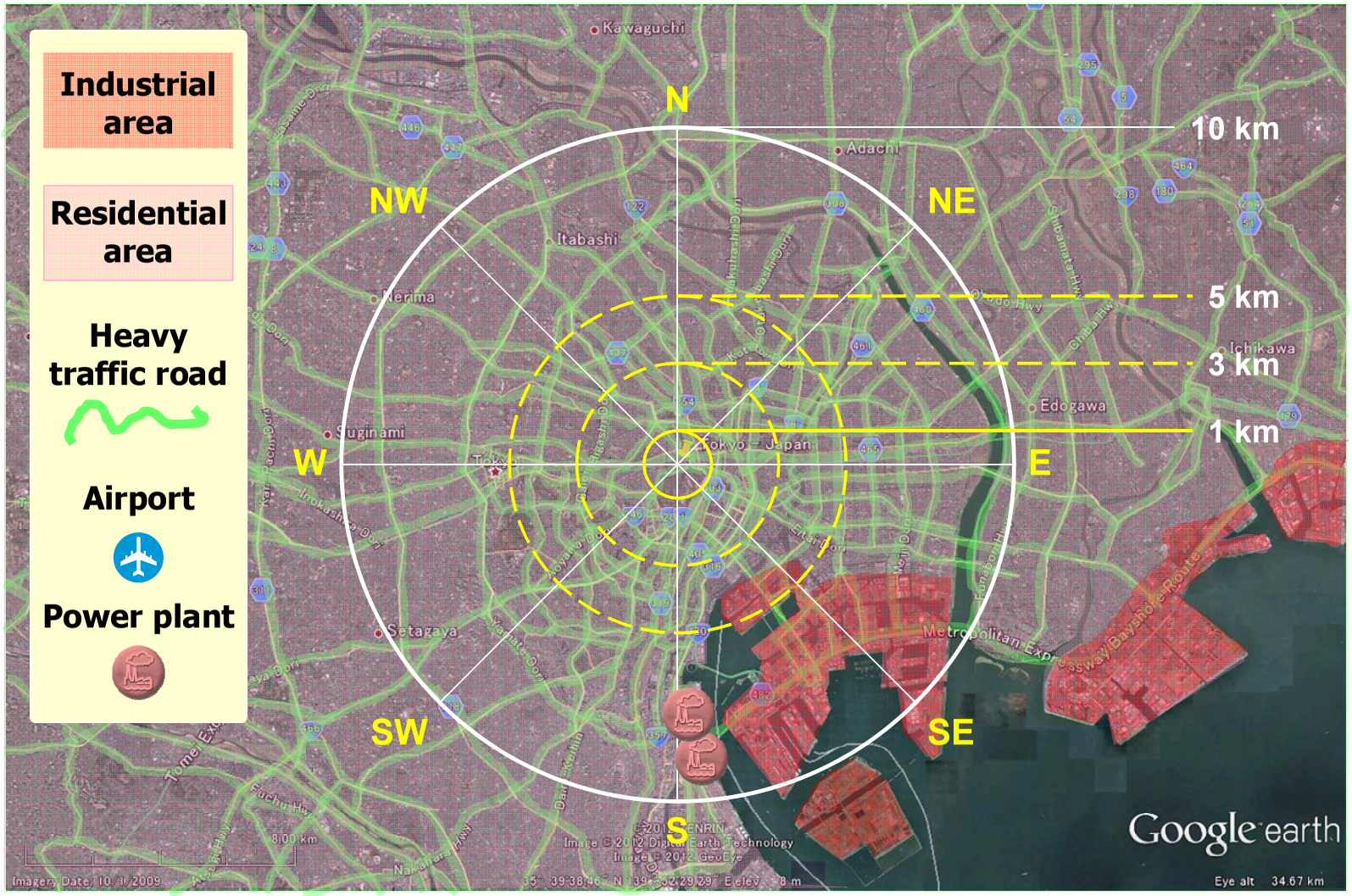
* Describe roads with more than 100 vehicles/day for remote sites and roads with more than 1,000 vehicles/day for urban and rural sites.

Local Scale (150 m – 10 km) [Form-20]



Site Name : _____

Example: Local Scale (150 m – 10 km) [Form-20]



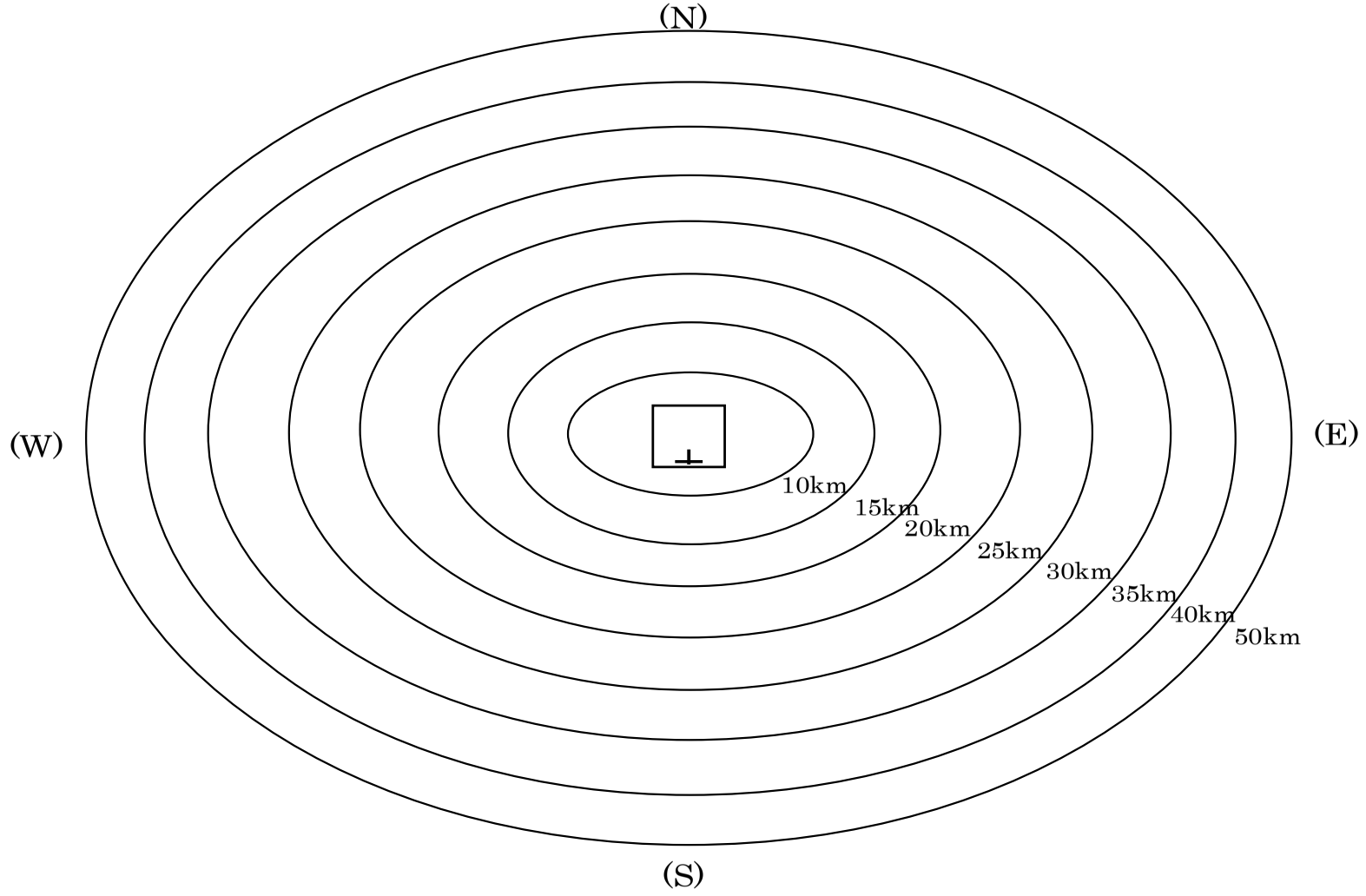
Site Name : Tokyo, Japan

3) Outline of monitoring site: Regional scale (distance 10 km – 50 km) **[Form-21]**

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Existence of main stationary air pollution sources*				
Existence of trunk roads with more than 10,000 vehicles/day, and their traffic densities				
Existence of cities with the population more than 10,000 persons				

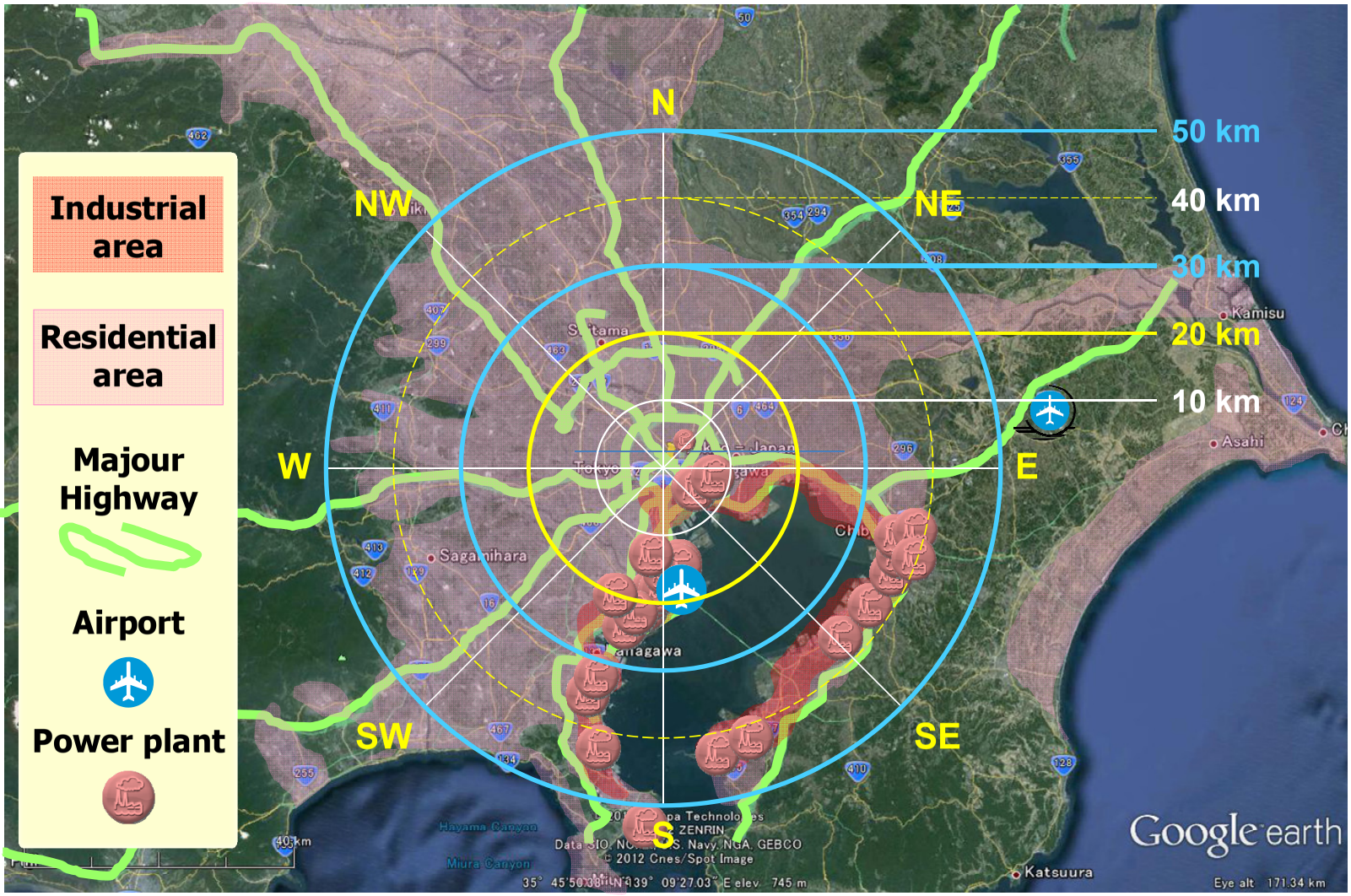
*: For rural site, description should be made on huge emission sources larger than 10,000 tons/y and other major pollution sources.

Regional Scale (10 km – 50 km) [Form-22]



Site Name : _____

Example: Regional Scale (10 km – 50 km) [Form-22]



Site Name : Tokyo, Japan

2. Laboratories for each monitoring activity

1) Wet deposition / air concentration (dry deposition) **[Form-23]**

Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

2) Soil and vegetation **[Form-24]**

Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

3) Inland aquatic environment **[Form-25]**

Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information	Telephone: Facsimile: E-mail address:		
Note			

4) Catchment-scale **[Form-26]**

Organization		Code	
Person in charge in the laboratory			
Postal address			
Contact information			
Note	Tel: Fax: E-mail address:		
Organization			

Note. If more than one laboratory is involved, describe main laboratory in charge of the stream water chemistry.

3. Implementation of monitoring

3.1 Wet deposition monitoring

1) Sample collection for wet deposition monitoring **[Form-27]**

Sampling system	1: wet only sampler 2: other ( )
Sampler	Manufacturer: Model: Funnel diameter: mm Height of sampling funnel from the ground level: m from the floor of sampler installed: m

3.2 Air concentration (dry deposition) monitoring

1) Monitoring method (Gas) **[Form-28]**

Method for Gas sample	1: automatic monitor (method:) Manufacturer: Model:
	2: manual method 1) filtration [(a) diffusion denuder, (b) filter pack] Sampling flow rate: liters/min
Method for Particulate sample	1: automatic monitor (method:), Manufacturer: Model: 2: gravimetric method (a: Hi-vol sampler, b: Low-vol sampler), 3: other ( )

3.3 Soil and vegetation monitoring

1) Outline of monitoring for soil **[Form-29]**

Measurement parameters	1: pH (H_2O), 2: pH (KCl), 3: exchangeable (3: Na^+, 4: K^+, 5: Ca^{2+}, 6:Mg^{2+}, 7: Al^{3+}, 8: H^+), 9: exchangeable acidity, 10: ECEC, 11: Carbonate, 12: T–C, 13: T–N, 14: SO_4^{2-}, 15: available phosphate, 16: others ( )
Interval	1: annual, 2: every___years, 3: irregular (date of the last survey [dd / mm / yyyy])

2) Outline of monitoring for vegetation observation **[Form-30]**

Measurement parameters	1: observation of tree decline, 2: description of trees, 3: others ( )
Interval	1: annual, 2: every___years, 3: irregular (date of the last survey [mm / dd / yyyy])

3.4 Inland aquatic environment monitoring

1) Outline of monitoring (on-site) **[Form-31]**

Monitoring parameters (Ever sampling event)	1: Water temperature, 2: pH, 3: EC, 4: Dissolved oxygen, 5: Water color, 6: other ( )

2) Outline of monitoring for lakes **[Form-32]**

Monitoring parameters (mandatory) (4 times a year)	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon or total organic carbon, 11: NO_2^-, 12: PO_4^{3-}, 13: Chlorophyll a, 14: Total phosphorus, 15: Total nitrogen, 16: other ( )
Monitoring parameters (Optional)	1: Total dissolved Al, 2: Reactive Al, 3: Chemical oxygen demand, 4: Phytoplankton, 5: other ( )

(4 times a year)	
Monitoring parameters (Optional) (every 3 – 5 years)	1: Living organisms other than phytoplankton, 2: Pb, ^{210}Pb and stable isotope S in sediment 3: other ( )

3) Outline of monitoring for rivers (streams) **[Form-33]**

Monitoring parameters (mandatory) (every 1 or 2 month(s))	1: alkalinity, 2: NH_4^+, 3: Na^+, 4: K^+, 5: Ca^{2+}, 6: Mg^{2+}, 7: SO_4^{2-}, 8: NO_3^-, 9: Cl^-, 10: Dissolved organic carbon (DOC) or total organic carbon (TOC), 11: NO_2^-, 12: PO_4^{3-}, 13: Total phosphorus, 14: Total nitrogen, 15: Suspended solids, 16: other ( )
Monitoring parameters (Optional) (every 1 or 2 month(s))	1: Hydrological flow (at sampling time), 2: Total dissolved Al, 3: Reactive Al, 4: Chemical oxygen demand, 5: other ( )
Monitoring parameters (Optional) (4 times a year)	1: Epilithic algae, 2: other ( )
Monitoring parameters (Optional) (every 3 or52 years)	1: Living organisms other than epilithic algae 2: other ( )

3.5 Catchment-scale monitoring

(1) Input (total deposition) **[Form-34]**

Items	Outline of the sampling method	Note
1. Precipitation amount 2. Wet deposition 3. Dry deposition (Air concentration measurement for Inferential method) 4. Total deposition	1. Rain gauge 2. wet only sampling or bulk sampling in forest area 3. Filter pack method ( ) Automatic monitor ( ) Passive sampler ( ) 4. calculation as wet+dry or throughfall-stemflow method	If the deposition data at the nearest EANET station will be used as the input data, specify the name of the station.

(2) Output **[Form-35]**

Items	Outline of the method	Note
1. Water discharge 2. Stream water chemistry 3. Chemical discharge	1. Weir or H-Q curve method 2. Collection to a plastic bottle at the outlet of the catchment 3. Calculation based on water discharge and stream water concentration	

(3) Biogeochemical processes **[Form-36]**

Items		Outline of the sampling method	Note
Soil	1. Soil chemical properties 2. Soil solution 3. Soil moisture 4. Soil physical properties 5. Soil gas emission	1. Number of plot and subplots 2. Suction cup method, Pan lysimeter method, Resin capsule method, *or* Others ( ) 3. TDR, ADR, or others ( ) 4. Fine earth bulk density: Metal sampling cylinder method Penetration resistance: Pocket penetrometer method 5. Chamber method or others ( )	If the data on regular soil and vegetation monitoring is used, specify the plot name.
Vegetation	1. Plant growth (field measurement) 2. Species composition (field measurement) 3. Elemental contents (litter trap, leaf element analysis)	1. Number of plots (with three coaxial sub-plots) 2. Number of plots 3. Litter trap: size of the trap (m^2), height of the trap (m), number of the trap ( ) Collection of living leaf: height of branches (m), number of samples ( )	
Water balance	1. Evapotanspiration	1. Heat balance method, others ( )	

3.6 Meteorological observation **[Form-37]**

On site measurement of precipitation amount	Usage of rain gauge: 1: yes 2: no if yes, Manufacturer: Model: Height from the ground level: m Measurement mode: 1: tipping bucket, 2: gravimetric, 3: other ( )
On-site observation of other parameters	1: wind direction, 2: wind velocity, 3: temperature, 4: humidity, 5: solar radiation, 6: other ( )
In case of using nearest meteorological station data	Name of the station: Distance from the site: km Direction from the site (bearing):
	Possible obtaining data: 1: precipitation amount, 2: wind direction, 3: wind velocity, 4: temperature, 5: humidity, 6: solar radiation, 7: other ( )

2. Outline of analytical methodologies

1) Adopted analytical method for wet deposition monitoring **[Form-38]**

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Mandatory		
pH	Glass electrode	
EC	Conductivity cell	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other)	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other)	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury (II) thiocyanate, b: other)	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent)	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	

2) Adopted analytical method for wet deposition monitoring **[Form-39]**

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
Optional		
F^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
HCO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
$R\text{-}COO^-$	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: other ( )	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamine, b: other)	
PO_4^{3-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other)	

3) Adopted analytical method of automatic system for air concentration monitoring **[Form-40]**

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type of the instrument Upper: manufacturer Lower: type
SO_2	1: Ultraviolet fluorometry, 2: H_2O_2 oxidation/Electric conductivity 3: other ( )	
NO_2	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
NO	1: Chemiluminescence, 2: Spectrometry with Salzmann reagent 3: other ( )	
O_3	1: Ultraviolet absorption spectrometry, 2: Spectrometry with neutral potassium iodide, 3: other ( )	

4) Adopted analytical method for air concentration monitoring with filter pack method **[Form-41]**

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
Gaseous substances		
SO_2	1: Ion chromatography (a: with suppressor, b: no suppressor)	
HNO_3	1: Ion chromatography (a: with suppressor, b: no suppressor)	
HCl	1: Ion chromatography (a: with suppressor, b: no suppressor)	
NH_3	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Nessler's reagent, b: Indophenol blue, 3: other ( ))	
Particulate matter components		
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other)	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other)	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other)	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other)	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry, 4: other ( )	
Ca^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	

5) Adopted analytical method for soil and vegetation monitoring **[Form-42]**

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
pH (H_2O)	Glass electrode (extracted with water)	
pH (KCl)	Grass electrode (extracted with KCl aq.)	
Exchangeable Na^+	1: Atomic absorption spectrometry, 2: Emission spectrometry	
Exchangeable K^+	1: Atomic absorption spectrometry, 2: Emission spectrometry	
Exchangeable Ca^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry	
Exchangeable Mg^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry	
Exchangeable Al^{3+}	Titration	
Exchangeable H^+	Subtract Al^{3+} data from Ex-acidity	
Exchangeable acidity	Titration	
ECEC		
HCO_3^-	1: Volumetric calcimeter	
Total organic carbon	1: Titration (Walkeley-Black), 2: Carbon-nitrogen analyser	
T–N	1: Titration (Kjeldahrl), 2: Carbon-nitrogen analyser	
SO_4^{2-}	1: Turbidimetry 2: Ion chromatograph 3: Emission spectrometry	
Available phosphate	1: Spectrometry (Bray-1)	

6) Adopted analytical method for inland aquatic environment monitoring – 1 **[Form-43.1]**

Name of monitoring laboratory	

Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
pH	1: Glass electrode	
EC	Conductivity cell	
Alkalinity	1: Titration (Gran's plot), 2: other ( )	
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other)	
NO_2^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Naphthyl ethylenediamine, b: other)	
PO_4^{3-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Molybdenum blue , b: other)	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: BaCrO4, b: BaCrO4-Carbazide, c: other)	
NH_4^+	1: Atomic absorption spectrometry, 2: Emission spectrometry	
Ca^{2+}	1: Atomic absorption spectrometry, 2: Emission spectrometry, 3: Titration	
Mg^{2+}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
Na^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
K^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Atomic absorption spectrometry, 3: Emission spectrometry	
Cl^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Mercury(II)thiocyanate, b: other)	
DOC or TOC	1: Total Organic Carbon analyzer Method, 2: Wet-Oxidation Method	
Chlorophyll a	SCOR/UNESCO Method	
Total Phosphorus	Potassium Peroxodisulfate Decomposition	

7) Adopted analytical method for inland aquatic environment monitoring – 2 **[Form-43.2]**

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer, Lower: type
Total Nitrogen	1: Ultra-violet absorption spectrophotometry, 2: Hydrazinium sulfate reduction	
SS	gravimetry (1 μm Glass Fiber Filter method)	
Total dissolved Al	1: Atomic Absorption Spectrometry (Graphite Furnace), 2: ICP Emission Spectrometry 3: ICP/MS	
Reactive Al	1: Lumogallion method, 2: spectrophotometry	
COD	1: Potassium Bichromate Method, 2: Acidic Potassium Permanganate Method	
DO	1: DO Meter Method, 2: Winkler-Modified Sodium Azide Method	

7) Adopted analytical method suggested for lake sediment and their pore water **[Form-44]**

Name of monitoring laboratory		
Monitoring item	Adopted analytical method	Manufacturer and type Upper: manufacturer Lower: type
NO_3^-	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Cadmium reduction, b: other)	
NH_4^+	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: Indophenol blue, b: Nessler's reagent, c: other)	
SO_4^{2-}	1: Ion chromatography (a: with suppressor, b: no suppressor), 2: Spectrometry (a: $BaCrO_4$, b: $BaCrO_4$-Carbazide, c: other)	
^{210}Pb	Isotope ratio mass spectrometry	
Pb	1: Atomic absorption spectrometry with graphite furnace, 2: ICP/AES or ICP/MS	

Analytical methods of the items on catchment-scale monitoring should also be specified using the above forms for the respective media, if necessary.

Appendix 2 Example of Site/Laboratory Audit Form

Appendix 2.1 Audit for atmospheric deposition monitoring

Name of Site and Laboratory _____
Date: _____
Organization in charge of the monitoring and analysis: _____
_____
Person in charge of the monitoring and analysis: _____
_____
Organization of auditor: _____
Name of auditor: _____

At monitoring site

<Site information>

1. An open, flat, grassy area far enough free tree, hills, and other obstruction to avoid effect on sampling. No object is within a few meter of the collector, and no object shade the collector.
   Obstructions: _____
   [Note]

2. The horizontal distance between a large obstruction and collector is at least twice the obstruction height, or the top of an obstruction as viewed from the collector is less than 30^{o} above the horizon.
   [Note]

3. The collector is free from local emission and contamination source such as waste disposal site, incinerators, parking lots, open storage of agricultural products, and domestic heating. Regions within 100 m of these emission and contamination sources are excluded.
   North: _____
   South: _____
   East: _____
   West: _____
   [Note]

4. The horizontal distance between collector and rain gauge (and dry deposition collector) is greater than 2 meters, and collector and rain gauge cross the direction of the prevailing wind during precipitation events.
   Distance: _____m
   Direction of the prevailing wind: _____
   [Note]

<Minimum distance to emission and contamination sources>

1. Regions within 50 km of large pollution sources such as city, thermal power plants and major motorways are excluded as remote sites.
   [Note]

2. Regions within 20 km of large pollution sources are excluded as rural sites.
   [Note]

3. Regions within 500 m of main roads (more than 500 vehicles/day) are excluded as remote sites and rural sites.
   [Note]

< Precipitation Collector>

1. Type of collector, manufacturer, model, used years
   Type of collector: □ Wet only, □ Wet/dry , □ Other(_____)
   □ Unit type, □ Separate type, □ Other (_____)
   Manufacturer: _____
   Model: _____
   Used years: _____

2. The collector container or funnel opens automatically within 1 minute of the onset of precipitation and closes promptly at the end of the precipitation event.
   [Note]

3. The wet sample is shielded from contamination by dry deposition.
   [Note]

4. The collector bucket or funnel with bottle is chemically inert to major constituents in acid precipitation.
   Collector bucket: □ Polyethylene, □ Teflon coating, □ Other(_____)
   Collector funnel: □ Polyethylene, □ Teflon coating, □ Other(_____)
   [Note]

5. The height of the collection bucket or funnel is 1.0 to 1.5 m from the ground.
   [Note]

6. Condition of standard rain gauge.
   Manufacturer: _____
   Model: _____
   The height of standard rain gauge: _____ m from the ground

Usage of wind shield: □ Yes (Type:), □ No
[Note]

<Sampling of Precipitation>

1. Sampling period or start and end time.
   Sampling period: □ Daily, □ Weekly, □ Event, □ Other( )
   Start/end time: □ 9:00am/9:00am, □ 0:00am/0:00am, □ Other( )

2. Name and Dept of collection operator.
   Name:
   Department:

3. The conductivity of deionized water used in cleaning is less than 0.15mS/m.
   [Note]

4. A field blank test is undertaken. □Yes, □ No
   Period: □ Once/month, □ Twice/month, □ Other ( )
   [Note]

5. Cleaning of the collection funnel or the bucket. . □ Yes, □ No
   [Note]

6. Operators wear disposable plastic gloves whenever handling the collection vessel.
   . □ Yes, □ No
   [Note]

7. Measurement parameter and method on the site.
   Measurement parameter:
   □ Weight of sample, □ pH, □ Other ( )
   : Method:
   [Note]

8. Use of the refrigerator on the collector. □ Yes, □ No
   [Note]

9. Filtration of precipitation samples. □ Yes, □ No
   [Note]

10. Use of biocides. □ Yes, □ No
    [Note]

<Automatic air concentration and meteorological monitors>

1. Name of instrument operator
   Name: _____
   Department: _____

2. Sampling inlet
   Sampling Height: From ground: _____ From rooftop _____
   Use of sampling manifold: □ Yes, □ No
   Use of heater: □ Yes, □ No
   Condition of blower in a manifold: □ Good, □ Problem(_____)

3. Type of automatic air concentration monitor, manufacturer, model
   (1) O_3
   Manufacturer: _____
   Model: _____
   Used years: _____
   (2) SO_2
   Manufacturer: _____
   Model: _____
   Used years: _____
   (3) NOx/NO_2
   Manufacturer: _____
   Model: _____
   Used years: _____
   (4) PM_{10}
   Manufacturer: _____
   Model: _____
   Used years: _____
   (5) $PM_{2.5}$
   Manufacturer: _____
   Model: _____
   Used years: _____
   (7) Automatic calibrator of gas monitors
   Manufacturer: _____
   Model: _____
   Used years: _____
   (8) Meteorological Instrument
   Manufacturer: _____
   Model: _____
   Used years: _____

4. Monitoring parameter and instrumental setting
   Parameter: □ O_3, □ SO_2, □ NO, □ NO_2, □PM_{10}, □$PM_{2.5}$,
   □ Other (_____)
   Instrumental setting (Full scale, minimum sensitivity, etc.)
   _____

5. Calibration of gas monitor
   Standard gas concentrations: SO_2: _____ NO: _____ Others: _____
   SI traceability of standard gas: □ Yes, □ No

Expiration date of standard gas: ____/____/____ □ Expired, □ Not expired
Calibration operation: □ Manual, □ Automatic (Interval: ____)

6. Calibration of PM monitor
   Standard filter equivalent weight: ____ $\mu g/m^3$
   Calibration frequency: ____

7. Monitoring interval: □ Hourly, □ Daily, □ Monthly, □ Other(____)

8. Routine instrument checking and maintenance. □ Yes, □ No
   Frequency: ____
   Contents:
   ____

9. Data storage instrument and its condition
   [Note]

10. Problems concerning instruments
    [Note]

<Manual air concentration samplers>

1. Name and Dept of collection operator.
   Name: ____
   Department: ____

2. Sampling inlet
   Sampling Height: From ground: ____ From rooftop: ____
   Sampling direction: □ Upward, □ Downward
   Condition of shelter: □ Good, □ Problem(____)

3. Type of samplers
   (1) Filter pack
   Manufacturer: ____
   Model: ____
   Used years: ____
   Flow rate: ____
   Use of mass flow controller and thermometer
   ____

   (2) Passive sampler
   Manufacturer: ____
   Model: ____
   Used years: ____
   Use of thermometer and hydrometer
   ____

4. Sampling period or start and end time.
   Sampling period: □ Weekly, □ Bi-Weekly, □ Monthly, □ Other (____)
   Start/end time: □ 9:00/9:00, □ 0:00/0:00, □ Other (____)

5. Operators wear disposable plastic gloves whenever handling the manual samplers.

. □ Yes, □ No
[Note]

<Ohers>

1. Transportation of samples
   Keep in cold temperature □ Yes, □ No
   Transportation method: □ Automobile, □ Parcel, □ Other (_____)
   Transportation time to the laboratory: _____

2. Technical documents and SOPs for sample collection, collector and automatic instruments are kept. □ Yes, □ No
   [Note]

3. The documentation of conditions around the sampling site or field record is kept. □ Yes, □ No
   [Note]

4. Safety management and countermeasure against power failure. □ Yes, □ No
   [Note]

5. Setting temperature inside the monitoring station. _____ ^{o}C
   [Note]

6. Take pictures around the sampling site (Eight orientation).

In Laboratory

<Pure water apparatus>

1. Type of pure water apparatus, manufacturer, model, used years
   Manufacturer: _____
   Model: _____
   Used years: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Electric conductivity value of pure water
   EC: _____ mS/m～ _____ mS/m

<Electric conductivity measurement>

1. Manufacturer, model, used years
   Manufacturer: _____
   Model: _____
   Used years: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Use of the water bath (measure at 25 degree). □ Yes, □ No
   [Note]

4. Concentration and traceability of KCl standard solution
   [Note]

<pH measurement>

1. Manufacturer, model, used years
   Manufacturer: _____
   Model: _____
   Used years: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Use of the water bath (measure at 25 degree). □ Yes, □ No
   [Note]

4. pH and traceability of standard solution
   [Note]

<Electric balance>

1. Manufacturer, model, used years, scale
   Manufacturer: _____
   Model: _____
   Used years: _____
   Full and minimum scale: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Set on a flat and vibration proof table. □ Yes, □ No

4. Regular maintenance and calibration by a standard weight
   [Note]

<Ion chromatography>

1. Manufacturer, model, used years and other information
   Manufacturer: _____
   Model: _____
   Used years: _____
   Column: _____
   Eluent: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Measurement parameter
   [Note]

4. Use of suppressor. □ Yes, □ No
   [Note]

5. Use of autosampler. □ Yes, □ No
   [Note]

6. Concentration and traceability of ion standard solutions
   [Note]

7. Chromatograph (Peak separation, peak tailing, retention time)
   [Note]

8. Calibration curve (Linearity, treatment for out of calibration range, repeat calibration)
   [Note]

9. Problems concerning on chromatograph analyzer
   [Note]

<Atomic absorption spectrometry or other >

1. Type of pure water apparatus, manufacturer, model, used years
   Manufacturer: _____
   Model: _____
   Used years: _____

2. Name and Dept of instrument operator
   Name: _____
   Department: _____

3. Measurement parameter
   [Note]

4. Use of autosampler: □ Yes, □ No
   [Note]

5. Concentration and traceability of ion standard solutions
   [Note]

6. Calibration curve (Linearity, treatment for out of calibration range, repeat calibration)
   [Note]

7. Problems concerning on chromatograph analyzer
   [Note]

<Pre-treatment of filter pack samples>

1. Type of shaker, manufacturer, model, used years
   Manufacturer: _____
   Model: _____
   Used years: _____

2. Use of assemble apparatus: □ Yes, □ No

3. Leak check of filter pack: □ Yes, □ No

4. Use of disposable plastic gloves and chemically inert tweezer: □ Yes, □ No

5. Replacement of consumables
   [Note]

6. Preservation in a refrigerator before pre-treatment: □ Yes, □ No

7. Extraction volume and time, analysis time after extraction
   [Note]

8. Analysis of filter blank
   [Note]

< The results of inter-laboratory comparison project of wet and dry deposition>

1. Flagged data in any items: □ Yes, □ No
   [Note]

2. If yes in the item 1, tried to solve existing laboratory problems and improve the quality of laboratory analyses: □ Yes, □ No

3. Improvement of the quality of laboratory analyses
   [Note]

< Data quality of wet and dry deposition data>

1. Confirmation of detection and determination limits: □ Yes, □ No
   [Note]

2. Analysis of standard reference materials: □ Yes, □ No
   [Note]

3. Repeated analysis of samples: □ Yes, □ No
   [Note]

4. Check of R1 and R2 for wet deposition samples: □ Yes, □ No
   [Note]

5. Check of filter pack samples such as ion balances of particulate matter: □ Yes, □ No
   [Note]

6. Verification of automatic monitoring data: □ Yes, □ No
   [Note]

7. Preparation of Standard Operating Procedures (SOPs)

Name of SOP	Preparation date	Latest revision date	Storage Place

Use for reference in daily operation: □ Yes, □ No
Revision record of SOPs: □ Yes, □ No

<Ozone monitor calibration by transfer standard>

Ozone monitor calibration record sheet

Prefectur: Tokyo | Site: Ogasawara | Date: 2010/11/15 | Operator: ****

Ternary standard

Block: ACAP | Manufacturer: HORIBA

Model: OZGU360 | Serial #: 4098302007 | Span: 0.9529 | Zero: 5.0000

Ozone monitor information

Manufact: HORIBA | Model: APOA-360 | Serial #: X881JTSJ

Temp. and Press. Correc.: Yes | Minus signal: Yes

Previous span: 1.0000 | Previous zero: -17.0000

Ozone calibration result

✔Span and Zero Calibration

Span after calib. **0.9094** | **Zero after calib.** **-20.0000**

✔Repeatability

	1st	2nd	3rd
Span value (ppb)	192.8	192.7	193.0
Zero value (ppb)	0.0	0.0	0.1

SD for span **0.1247** | **SD for zero** **0.0471**

✔Linearity

Setting O3 conc.	Zero	ca. 60ppb	ca. 120ppb	span gas (180～250ppb)
Ozone std. (X)(ppb)	0.0	55.0	148.3	192.9
Ozone monitor (Y)(ppb)	0.0	54.4	148.0	192.9

Linear regression **y = 1.0005x - 0.2752** | **Correlation Coeff.** **R^2 = 0.9999**

<PM monitor>

Date: Site name:
Auditor: Person in charge of operation:
Manufacturer: PM monitor Model:
Serial No.: Reference flow meter model:
Ambient Pressure: Previous audit date:
Ambient Temperature.:

T Case (^{O}C): *T* Cap (^{O}C):
T Air (^{O}C): *F* Main (LPM):
F Aux (LPM):

	Reference	Measured	Difference
Main flow	3.00 LPM	2.97 LPM	2.0%
Bypass flow	13.7 LPM	13.6 LPM	0.4%
Total	16.7 LPM	16.6 LPM	0.7%
Amb Temp	26.7 ^{O}C	26.2 ^{O}C	-0.5 ^{O}C
Amb Press	0.862 atm	0.856 atm	-0.006 atm

Audit Criteria Difference of Flow: ± 4%
Ambient Temperature: ± 2 ^{O}C
Ambient Pressure: ± 0.013 atm

Leak Check

Main flow: 0.03 LPM Audit Criteria: <0.15 LPM
Bypass flow: 0.19 LPM <0.60 LPM

Blank Test

Start Time	
End Time	
Average 1 hour (μg/m^3)	
Maximum 1 hour (μg/m^3)	
Minimum 1 hour (μg/m^3)	
Standard deviation (μg/m^3)	
Average ambient temp. (^{O}C)	
Average ambient press. (atm)	
Average inner temp. (^{O}C)	

Audit Criteria: Average 1 hour < ± 2μg/m^3
Standard deviation < 2μg/m^3

<Meteorological instrument>

Date: Site name:

Auditor: Person in charge of operation:

Manufacturer: Instrument Model:

Serial No.: Previous audit date:

(Anemometer)

WS Input	WS Meas.	WS Differ.	WD Input	WD Meas.	WD Differ.
0 m/s	0 m/s	0%	0	0	0 deg.
5 m/s	5.1 m/s	0.1 m/s	90	90.2	0.2 deg.
10 m/s	10.1 m/s	0.1 m/s	180	179.6	-0.4 deg.
20 m/s	20.2 m/s	1.0%	270	270.4	0.4 deg.
30 m/s	30.0 m/s	0.0%	360	359.6	-0.4 deg.
60 m/s	60.5 m/s	0.8%			

Audit Criteria: WS ≤ 10.0 m/s; ± 0.3 m/s, WS ≥ 10.0 m/s; ±.3 %
WD < ± 3 degree

(Thermometer)

Input	Meas.	Differ.	Input	Meas.	Differ.
-50 ^{O}C	-50.0 ^{O}C	0 ^{O}C	10 ^{O}C	10.1 ^{O}C	0.1 ^{O}C
-30 ^{O}C	-30.0 ^{O}C	0 ^{O}C	20 ^{O}C	20.2 ^{O}C	0.2 ^{O}C
-20 ^{O}C	-19.9 ^{O}C	0.1 ^{O}C	30 ^{O}C	30.2 ^{O}C	0.2 ^{O}C
-10 ^{O}C	-9.9 ^{O}C	0.1 ^{O}C	40 ^{O}C	39.9 ^{O}C	-0.1 ^{O}C
0 ^{O}C	0.1 ^{O}C	0.1 ^{O}C	50 ^{O}C	50.0 ^{O}C	0 ^{O}C

Audit Criteria: ± 0.5 ^{O}C

(Hydeometer)

Input	Meas.	Differ.
0 %	0 %	0%
20 %	20 %	0%
40 %	40 %	0%
60 %	60 %	0%
80 %	80 %	0%
100 %	100 %	0%

Audit Criteria: ±.3 %

(Rainguage)

Input	Meas.	WS Differ.
0 mm	0 mm	0%
20 mm	20.0 mm	0%
40 mm	40.0 mm	0%
60 mm	60.0 mm	0%
80 mm	80.0 mm	0%
100 mm	100.0 mm	8%

Audit Criteria: Precip. ≤ 20 mm; ± 0.5 mm, WS ≥ 20 mm; ±.3 %

Appendix 2.3 Audit for soil and vegetation monitoring

1. Outline of the audit
   (1) Date of the audit: _____
   (2) Name and address of the monitoring site: _____
   (3) Organization in charge of the monitoring: _____
   (4) Person in charge of the monitoring: _____

2. Items to be checked in the monitoring site
   (1) Conditions of the surrounding area
   - Emission sources
   - Soil type
   - Conditions of forest (plant community type, and dominant tree species)
   - Possibility of long-term conservation of the monitoring site

   (2) Soil monitoring
   1) Establishment of the soil-monitoring plots and subplots
   - Confirmation of two plots
   - Confirmation of five subplots
   - Location of the respective plots within the monitored forest
   - Positional relationship with the vegetation-monitoring plot
   - Topography
     - Slope
     - Specific topographic features, such as valley, basin, etc. (*Such specific topographies should be avoided for selection of the monitoring plots*.)
     - Effects of stemflow (*Soil should not be collected close to tree trunks.*)

   2) Soil sampling method
   - Soil collection from the fixed depths, 0-10 and 10-20 cm
   - Confirmation of the sampling procedure
     - Use of shovel, sampling cylinder, etc.
     - Amount of sampled soil, and procedures for sampling and shipping
   - Conservation of the plots and subplots (by using permanent signs, such as stainless-steel or plastic stakes)

   (3) Vegetation monitoring
   3) Establishment of the vegetation-monitoring plot
   - Location of the vegetation-monitoring plot, including positional relationship with the soil-monitoring plot

- Topography
  - Slope
  - Specific topographic features, such as valley, basin, etc. (*Such specific topographies should be avoided for selection of the monitoring plots*.)
- Establishment of the plot
  - Confirmation of the coaxial-circle plots

4) Vegetation surveys

- Confirmation of the survey items
  - Description of trees (Species name, diameter at breast height (DBH), and height of trees)
  - Understory vegetation survey
  - Survey of tree decline (observation, photographic record, and estimated cause of decline)
- Conservation of the plot (by marking, numbering, etc.)

3. Laboratory audit

Name of organization:

- Pretreatment of soil samples: air drying, sieving, etc.
- Method and location of the sample storage
- Chemical analysis: instruments and/or methods
  - Moisture content
  - pH
  - Exchangeable base cations (use of modifiers for atomic absorption spectrometry (AAS) analysis)
  - Exchangeable acidity
- Pure water generator
- Soil extract method
- The results of inter-laboratory comparison project of soil

4. Auditor

Organization: _____

Department: _____

Name: _____

Appendix 2.4 Audit for inland aquatic environment monitoring

1. Outline of audit

1) Date of the audit
   i. Analytical organization: _____
   ii. Monitoring site: _____
2) Place of the audit
   i. Analytical organization
      - Name: _____
      - Address: _____
   ii. Monitoring lake
      - Name of the lake: _____
      - Address: _____
3) Name of Auditor: _____
   Organization: _____
4) Persons whom the auditor met: Name, position, contact address, e-mail, etc.:

_____

2. Analytical organization

1) General information on analytical works in the organization
2) Preparation of the Standard Operating Procedures (SOP)
   - If not, recommend preparing the SOP. As a reference, the SOP of ACAP will be shared with the organization.
3) Condition of the laboratory
   - What kinds of chemical analysis have been done in the same laboratory? Are there any possible sources of contamination for the acid deposition monitoring?
4) Pure water generator
   i. Name of manufacturer, type, age of use
   ii. Electrical conductivity, lower than 0.15 mS m^{-1}
   iii. Condition of the instrument
   iv. Photograph of the instrument
5) Condition of analytical instruments
   i. Name of manufacturer, type, age of use
   ii. Condition of the instrument

	Manufacture	Type	Age of use	Condition of the instrument

pH				
EC				
Alkalinity				
Anions				
Cations				
Pure water generator				EC: mS/m

iii. Frequency of changes in consumable parts
- pH electrode
- EC electrode
- IC columns

iv. Records of daily maintenance and/or regular maintenance

v. Photographs of the respective instruments

6) Measurement of alkalinity

i. Type of the instrument (burette or auto titration system)

ii. Sulfate concentration used for titration (0.01 mol L^{-1}, according to the Technical Manual)

iii. Exchange frequency of sulfate solution

iv. Photographs of the instrument

7) Storage of the sample

i. Use of refrigerator

ii. Photograph

8) Transport of the sample

i. Transport time from the lake to the laboratory
ii. Refrigerated (cool) condition or not

9) Filtration of the sample
   i. Filtration of the samples for ion analysis
   ii. On-site filtration of the sample
      - If not, filtration should be done immediately after arrival in laboratory.

10) Chemical analysis
   i. Standard solutions for preparation of calibration curve
      - Traceability of the standard solutions should be confirmed.
   ii. Use of reference materials
      - If not, recommend using reference materials
   iii. Use of water bath to keep 25 °C, for measurement of pH and EC
   iv. Photograph of the water bath

11) Others
   i. Explanation of the steps until finalization of the monitoring data
   ii. The results of inter-laboratory comparison project of inland aquatic environment
   iii. Condition of the monitoring activities in this year (any problems due to disasters or not)
   iv. Any request to the ACAP
   v. Other information exchange

3. Audit of the monitoring lake

1) Information on possible sources of emissions/contaminations near the monitoring lake
2) Appropriateness of the sampling date
   - High-flow period during/after heavy rains and/or heavy-wind period should be avoided.
3) Appropriate record/measurement of the items at the site
   i. Climate
   ii. Air temperature
   iii. Water temperature
   iv. Transparency
   v. pH
   vi. Electrical conductivity
4) Measurement at the center of the lake (Fluctuation of the measurement/sampling points by winds or not)
5) Collection of surface water and bottom water
6) Duplicate sampling of the lake water
7) Use of gloves during the sampling
8) Use of recommended samplers for the bottom water (according to the Technical Manual)

- Name of the sampler

9) Sample volume

10) Materials of sample bottles
    - Polyethylene or polypropylene

11) Titration of the samples
    - On-site or not?

12) Transport of the sample
    - Use of cooling box, etc. (under refrigerated or cool conditions)

13) Others
    i. Information around the site
    ii. Any problems on the surveys
    iii. Manpower
    iv. Any request for the ACAP

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