Title: Precipitation chemistry concentrations and fluxes, HJ Andrews Experimental Forest, 1969 to present

Abstract:

Collection and analyses of precipitation chemistry were initiated in 1969 at the low-elevation Primary Met site, and in 1973 at a mid-elevation Hi-15 site. Rain collection samples accumulate from one week to three weeks in bulk and NADP type collectors and then are transported to Cooperative Chemical Analytical Laboratory (CCAL) for analysis. Analytes include nitrogen, phosphorus, carbon, and cations and anions as well as pH, conductivity, alkalinity and particulate sediment. Concentration and volume of precipitation are combined for inflow. Dry deposition chemistry concentrations began in 1989 and are analyzed 2-4 times per year at one site. The original objectives were to evaluate precipitation chemistry inputs versus chemistry outputs in streamflow from forested watersheds. The study has evolved into a general monitoring effort for precipitation chemistry that is among the least contaminated of any within the USA. This study is conducted in conjunction with Andrews streamflow chemistry (CF002) and the U.S. National Atmospheric Deposition Program (NADP).

Keywords: Chemical analysis; Hydrology/Water; Nutrients; Precipitation; Solution transport; Timber harvesting; Water chemistry; Inorganic nutrients; Hydrology; Water chemistry; Precipitation; Chemical properties; Concentration; Suspended solids; Timber harvest; Inorganic nutrients; Nutrients; Water;

Date data commenced: 1968-10-01

Date data terminated: 2019-05-22

Principal Investigator: Sherri L. Johnson

List of Entities:

1. Precipitation water sample nutrient concentrations
2. Precipitation water nutrient inflow in kg/ha
3. Precipitation water nutrient mean annual concentrations
6. Precipitation water sample log sheet: field and laboratory comments

1. Precipitation water sample nutrient concentrations

Precipitation samples are collected and analyzed on a 3-week basis for nutrient concentrations. Precipitation amounts for each sampling period are provided.

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Derived nutrient inputs based on precipitation nutrient concentration data (Entity 1) and actual precipitation for the sampling period.

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6. Precipitation water sample log sheet: field and laboratory comments

**Attribute List:**

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Attributes Definitions:

ALK
Alkalinity as calcium carbonate (CaCO3); method: electrometric titration to pH 4.5; all data is converted from the formerly used units of bicarbonate carbon (HCO3-C)

ALK_INPUT
Alkalinity inflow as CaCO3 (units have been converted for all values from bicarbonate (HCO3-C) to calcium carbonate)

ALK_YR
Mean annual alkalinity concentration as CaCO3 (calcium carbonate) - all values have been converted from HCO3-C (bi-carbonate)

ALKCODE
Alkalinity value qualifier code

ALKCODE_YR
Annual alkalinity qualifier value code

ANCA
Anion-cation ratio: micro equivalence ratio of anions to cations by calculation - provided only as an analytical check. Requires anions: ALK, SO4S, CL, NO3N, PO4P, cations: pH, Na, K, Ca, Mg, NH4N

ANCACODE
Anion-cation ratio qualifier code

CA
Dissolved calcium (filtrable) concentration; method flame atomic absorption spectroscopy

CA_INPUT
Calcium inflow

CA_YR
Mean annual calcium concentration

CACODE
Ca value qualifier code

CACODE_YR
Annual Ca value qualifier code

CL
Chloride (dissolved) concentration; method: ion chromatography (automated ferric thiocyanate before 1993)

CL_INPUT
Chloride inflow
CL_YR
Mean annual chloride concentration

CLCODE
Cl value qualifier code

CLCODE_YR
Annual Cl value qualifier code

COND
Specific conductance; method: wheatstone bridge

COND_YR
Mean annual specific conductivity concentration

CONDCODE
Conductivity value qualifier code

CONDCODE_YR
Annual conductivity value qualifier code

DATE_TIME
Collection date and time (PST) of the precipitation sample - sample represents deposition from the previous sample date and time. Assume beginning date of first sample period for each collector is October 1st.

DOC
DOC, dissolved organic carbon concentration; method: combustion

DOC_INPUT
Dissolved organic carbon inflow

DOC_YR
Mean annual dissolved organic carbon concentration

DOCCODE
DOC value qualifier code

DOCCODE_YR
Annual DOC value qualifier code

DON
Dissolved organic nitrogen - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N.

DON_INPUT
Dissolved organic N inflow - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N

DON_YR
Mean annual dissolved organic N concentration - not measured analytically; mathematically determined by subtracting NH3-N and NO3-N from Total dissolved nitrogen. Values before May 2005 are determined by TKN minus NH3-N

DONCODE
Dissolved organic nitrogen value qualifier code

DONCODE_YR
Annual dissolved organic N value qualifier code

ENTITY
Entity number

FIELD_COMMENTS
Field comments related to the collection of the water sample

K
K, dissolved potassium (filtrable) concentration; method flame atomic absorption spectroscopy

K_INPUT
Potassium inflow

K_YR
Mean annual potassium concentration

KCODE
K value qualifier code

KCODE_YR
Annual K value qualifier code

LAB_COMMENTS
Laboratory comments related to the handling and analyses of the sample

LABNO
Lab number code for sample

LOW_VOLUME
Indicator of a low volume sampler that may restrict the breadth of laboratory analyses

MG
Mg, dissolved magnesium (filtrable) concentration; method flame atomic absorption spectroscopy

MG_INPUT
Magnesium inflow

MG_YR
Mean annual magnesium concentration

MGCODE
Mg value qualifier code

MGCODE_YR
Annual Mg value qualifier code

NA
Na, dissolved sodium (filtrable) concentration; method flame atomic absorption spectroscopy

NA_INPUT
Sodium inflow

NA_YR
Mean annual sodium concentration
NACODE
Na value qualifier code

NACODE_YR
Annual Na value qualifier code

NH3N
Ammonia-nitrogen (NH3-N) concentration, ammonia as nitrogen; method: automated phenate

NH3N_INPUT
Ammonia-nitrogen (NH3-N) inflow

NH3N_YR
Mean annual ammonia (NH3-N) concentration

NH3NCODE
NH3-N value qualifier code

NH3NCODE_YR
Annual NH3-N value qualifier code

NO3N
Nitrate-nitrogen (NO3-N), nitrate + nitrite as nitrogen concentration; method: automated cadmium reduction

NO3N_INPUT
Nitrate-nitrogen (NO3-N) inflow

NO3N_YR
Mean annual nitrate-nitrogen (NO3-N) concentration

NO3NCODE
NO3-N value qualifier code

NO3NCODE_YR
Annual NO3-N value qualifier code

PARTN
Particulate N, also known as total suspended nitrogen - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTN_INPUT
Particulate N inflow - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTN_YR
Mean annual particulate N concentration - not measured analytically; mathematically determined by subtraction of Total dissolved nitrogen (TDN) from Unfiltered Total nitrogen (UTN). Values before May 2005 are determined by UTKN minus TKN.

PARTNCODE
Particulate N value qualifier code

PARTNCODE_YR
Annual particulate N value qualifier code

PARTP
Particulate P, also known as total suspended phosphorus - not measured analytically; mathematically determined by subtraction of Total
Dissolved P (TDP) from Unfiltered Total P (UTP)

**PARTP_INPUT**

Particulate P inflow - not measured analytically; mathematically determined by subtraction of Total Dissolved P (TDP) from Unfiltered Total P (UTP)

**PARTP_YR**

Mean annual particulate P - not measured analytically; mathematically determined by subtraction of Total Dissolved P (TDP) from Unfiltered Total P (UTP)

**PARTPCODE**

Particulate P value qualifier code

**PARTPCODE_YR**

Annual particulate P value qualifier code

**PCODE**

Precipitation value qualifier code

**PCODE_YR**

Annual precipitation value qualifier code

**PH**

pH (hydrogen concentration); method: glass electrode

**PH_YR**

Mean annual pH

**PHCODE**

pH value qualifier code

**PHCODE_YR**

Annual pH value qualifier code

**PO4P**

Ortho phosphorus concentration, soluble reactive phosphorus, phosphate (PO4-P); method: ascorbic acid finish

**PO4P_INPUT**

Ortho phosphorus (PO4-P) inflow

**PO4P_YR**

Mean annual ortho phosphorus (PO4-P) concentration

**PO4PCODE**

Ortho phosphorus value qualifier code

**PO4PCODE_YR**

Annual ortho phosphorus value qualifier code

**PRECIP_CM**

Precipitation in centimeters for the exact sample period. Based on precipitation stations CS2MET or PRIMET (beginning WY 2003) for collector RCADMN and H15MET or CENMET (beginning WY 2006) for collectors RCHIF7, RCHIR7 and RCHI15.

**PRECIP_CM**

Precipitation in centimeters for the exact sample period. Based on CS2MET (RCADMN) or H15MET (RCHIR7, RCHI15) meteorological station precipitation.
PRECP_YR
Total annual precipitation for the water year

PVOL
Sample volume from precipitation collector; for dry deposition sample - includes any precipitation collected and DI water added to sample for analysis

PVOLCODE
Sample volume qualifier code

QA_SAMPLE
Quality assurance sample number assigned if sample water is further analyzed for internal laboratory purposes

QCCODE
Quality control sample codes are assigned to samples collected for examining integrity of proportional sample analysis

SAMPLER_TYPE
Type of water sampler or method used to collect water

SEQ_INDEX
Sequential index generated primarily by the temporal order in which samples are collected

SI
Silica as silicon concentration; method: automated molybdenum blue

SI_INPUT
Silica inflow

SI_YR
Mean annual silica concentration

SICODE
Silica value qualifier code

SICODE_YR
Annual silica value qualifier code

SITECODE
Precipitation or dry deposition collector site code

SO4S
SO4-S (dissolved) concentration, sulfate as sulfur; method ion chromatography (automated barium sulfate before 1993)

SO4S_INPUT
SO4-S (sulfate-sulfur) inflow

SO4S_YR
Mean annual SO4-S (sulfate-sulfur) concentration

SO4SCODE
SO4-S value qualifier code

SO4SCODE_YR
Annual SO4-S value qualifier code

SSED
Suspended sediment concentration; method: nonfiltrable residue, gravimetric

SSED_INPUT
Suspended sediment inflow

SSED_YR
Mean annual suspended sediment concentration

SSEDCODE
Suspended sediment value qualifier code

SSEDCODE_YR
Annual suspended sediment value qualifier code

STCODE
Study code

TDN
Total dissolved nitrogen concentration (filtered sample); method: persulfate digestion and analysis by automated colorimetric analysis; instrument: Technicon Auto-Analyzer II

TDN_INPUT
Total dissolved nitrogen inflow (filtered sample)

TDN_YR
Mean annual total dissolved nitrogen concentration

TDNCODE
Total dissolved nitrogen value qualifier code

TDNCODE_YR
Annual total dissolved nitrogen value qualifier code

TDP
Total dissolved phosphorus concentration; method: persulfate/H2SO4 digestion, ascorbic acid finish

TDP_INPUT
Total dissolved phosphorus inflow

TDP_YR
Mean annual total dissolved phosphorus concentration

TDPCODE
Total dissolved phosphorus value qualifier code

TDPCODE_YR
Annual total dissolved phosphorus value qualifier code

TKN
Total Kjeldahl nitrogen concentration on filtered sample (dissolved); method: Kjeldahl digestion H2SO4, CuSO4/KCl, nessler finish

TKN_INPUT
Total Kjeldahl nitrogen (dissolved) inflow

TKN_YR
Mean annual total Kjeldahl nitrogen concentration (dissolved)
TKNCODE
Total Kjeldahl nitrogen value qualifier code

TKNCODE_YR
Annual total Kjeldahl nitrogen value qualifier code

TYPE
Sample type indicator - indicates dry deposition samples and other qualifying information

UTKN
Total Kjeldahl nitrogen concentration on unfiltered sample; method: Kjeldahl digestion H2SO4, CuSO4/KCl, nessler finish

UTKN_INPUT
Unfiltered total Kjeldahl nitrogen inflow

UTKN_YR
Mean annual unfiltered total Kjeldahl nitrogen concentration

UTKNCODE
Unfiltered total Kjeldahl nitrogen value qualifier code

UTKNCODE_YR
Annual unfiltered total Kjeldahl nitrogen value qualifier code

UTN
Total nitrogen concentration (unfiltered sample); method: persulfate digestion and analysis by automated colorimetric analysis; instrument: Technicon Auto-Analyzer II

UTN_INPUT
Total nitrogen inflow (unfiltered sample)

UTN_YR
Mean annual total nitrogen concentration (unfiltered samples)

UTNCODE
Unfiltered total nitrogen value qualifier code

UTNCODE_YR
Annual unfiltered total nitrogen value qualifier code

UTP
Unfiltered total phosphorus concentration; method: persulfate/H2SO4 digestion, ascorbic acid finish

UTP_INPUT
Unfiltered total phosphorus inflow

UTP_YR
Mean annual unfiltered total phosphorus concentration

UTPCODE
Unfiltered total phosphorus value qualifier code

UTPCODE_YR
Annual unfiltered total phosphorus value qualifier code

WATERYEAR
Water year of sample or annual summary (October-September)

Enumerated Domains:

Enumerated Domain for Attribute: ALKCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: ANCACODE
- N: No anion-cation ratio calculation determined due to missing analytical components
- D: Derived anion-cation ratio value is based on the full set of anions and cations
- D*: Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
- DE: Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
- DQ: Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: CACODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CLCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CONDCODE
- A: Accepted value
- E: Estimated value
- N: No analytical measurement
- *: Value is below detection limit for analysis (used beginning in 1991)
- Q: Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: DOCCODE
- A: Accepted value
- E: Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: KCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: MGCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NACODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NH3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C  Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: NO3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: PO4PCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PCODE
N No precipitation recorded for period. For saved sample (type='S'), precipitation for this period is included in the following period.
E Estimated precipitation
A Accepted value for precipitation
Q Precipitation value is questionable
M Missing value

Enumerated Domain for Attribute: PHCODE
A Accepted value
E Estimated value
N No analytical measurement
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PVOLCODE
Q Sample volume value is questionable - typically implies volume is measured correctly, but volume does not represent the entire collection period
N No sample volume value available
A Accepted value
K Volume is precipitation plus added DIW (usually 250 ml). concentration values are based on this volume.
L Volume of lab water (DIW) added to dry bucket (usually 250 ml). concentration values are based on this volume.
M Volume is precipitation in dry bucket (liters). Concentration values are based on this volume. No DIW added to the precipitation water.

Enumerated Domain for Attribute: SICODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SO4SCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SSEDCODE
A Accepted value
E Estimated value
N No analytical measurement
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: STCODE
CP002 Study code CP002

Enumerated Domain for Attribute: TKNCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TDPCODE
A Accepted value
E Estimated value
N No analytical measurement
* Value is below detection limit for analysis (used beginning in 1991)
Q Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: TYPE
S Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981
P Partial sample - precipitation was not collected successfully over the entire period (includes problems with NADP-style collector motor or samples that may have overflowed)
YE Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. ‘YE’ markers are inserted every Sep 30.
C Sample is combined with preceeding saved sample(s) for analysis. Combined samples of this type are not used after 1981.
DW Dry deposition sample - dry bucket contains rain water
F Sample is successfully collected over the entire period - a "Full" sample.
N No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.
DF Dry deposition sample - sample is dry and not contaminated with precipitation water
B Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition
DC Dry deposition sample - dry bucket contains rain water and other insects/contaminants

Enumerated Domain for Attribute: UTKNCODE
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**Enumerated Domain for Attribute: UTPCODE**

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<td>Value is below detection limit for analysis (used beginning in 1991)</td>
</tr>
<tr>
<td>Q</td>
<td>Value is questionable (used beginning in 1991)</td>
</tr>
</tbody>
</table>

**Enumerated Domain for Attribute: PARTPCODE**

<table>
<thead>
<tr>
<th>N</th>
<th>No derived value is calculated due to missing analytical components</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Derived value - mathematically determined from other analytical measurements</td>
</tr>
<tr>
<td>D*</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit</td>
</tr>
<tr>
<td>DE</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values</td>
</tr>
<tr>
<td>DQ</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values</td>
</tr>
</tbody>
</table>

**Enumerated Domain for Attribute: UTNCODE**

<table>
<thead>
<tr>
<th>A</th>
<th>Accepted value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Estimated value</td>
</tr>
<tr>
<td>*</td>
<td>Value is below detection limit for analysis (used beginning in 1991)</td>
</tr>
<tr>
<td>Q</td>
<td>Value is questionable (used beginning in 1991)</td>
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<tr>
<td>D</td>
<td>Derived value - mathematically determined from other analytical measurements</td>
</tr>
<tr>
<td>D*</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit</td>
</tr>
<tr>
<td>DE</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values</td>
</tr>
<tr>
<td>DQ</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values</td>
</tr>
<tr>
<td>N</td>
<td>No analytical measurement or no derived value calculated due to missing analytical components</td>
</tr>
</tbody>
</table>

**Enumerated Domain for Attribute: TDNCODE**

<table>
<thead>
<tr>
<th>A</th>
<th>Accepted value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Estimated value</td>
</tr>
<tr>
<td>*</td>
<td>Value is below detection limit for analysis (used beginning in 1991)</td>
</tr>
<tr>
<td>Q</td>
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</tr>
<tr>
<td>D</td>
<td>Derived value - mathematically determined from other analytical measurements</td>
</tr>
<tr>
<td>D*</td>
<td>Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit</td>
</tr>
</tbody>
</table>
DE  Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ  Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
N   No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: DONCODE
N   No derived value is calculated due to missing analytical components
D   Derived value - mathematically determined from other analytical measurements
D*  Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE  Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ  Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: PARTNCODE
N   No derived value is calculated due to missing analytical components
D   Derived value - mathematically determined from other analytical measurements
D*  Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE  Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ  Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: ALKCODE
A   Accepted value
E   Estimated value
N   No analytical measurement
*   Value is below detection limit for analysis (used beginning in 1991)
Q   Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CACODE
A   Accepted value
E   Estimated value
N   No analytical measurement
*   Value is below detection limit for analysis (used beginning in 1991)
Q   Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: CLCODE
A   Accepted value
E   Estimated value
N   No analytical measurement
*   Value is below detection limit for analysis (used beginning in 1991)
Q   Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: DOCCODE
A   Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: KCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: MGCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NACODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: NH3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C  Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: NO3NCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
C  Value confirmed, contamination suspected (code use begins May 2007)

Enumerated Domain for Attribute: PO4PCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: PCODE
N  No precipitation recorded for period. For saved sample (type='S'), precipitation for this period is included in the following period.
E  Estimated precipitation
A  Accepted value for precipitation
Q  Precipitation value is questionable
M  Missing value

Enumerated Domain for Attribute: SICODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SO4SCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: SSEDCODE
A  Accepted value
E  Estimated value
N  No analytical measurement
*  Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)

Enumerated Domain for Attribute: STCODE
CP002  Study code CP002

Enumerated Domain for Attribute: TKNCODE
A  Accepted value
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Estimated value</td>
</tr>
<tr>
<td>N</td>
<td>No analytical measurement</td>
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</tbody>
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**Enumerated Domain for Attribute: TDPCODE**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>A</td>
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<tr>
<td>E</td>
<td>Estimated value</td>
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<tr>
<td>N</td>
<td>No analytical measurement</td>
</tr>
<tr>
<td>*</td>
<td>Value is below detection limit for analysis (used beginning in 1991)</td>
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<tr>
<td>Q</td>
<td>Value is questionable (used beginning in 1991)</td>
</tr>
</tbody>
</table>

**Enumerated Domain for Attribute: TYPE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981 period (includes problems with NADP-style collector motor or samples that may have overflowed)</td>
</tr>
<tr>
<td>P</td>
<td>Partial sample - precipitation was not collected successfully over the entire period</td>
</tr>
<tr>
<td>YE</td>
<td>Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. ‘YE’ markers are inserted every Sep 30.</td>
</tr>
<tr>
<td>C</td>
<td>Sample is combined with preceding saved sample(s) for analysis. Combined samples of this type are not used after 1981.</td>
</tr>
<tr>
<td>DW</td>
<td>Dry deposition sample - dry bucket contains rain water</td>
</tr>
<tr>
<td>F</td>
<td>Sample is successfully collected over the entire period - a &quot;Full&quot; sample.</td>
</tr>
<tr>
<td>N</td>
<td>No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.</td>
</tr>
<tr>
<td>DF</td>
<td>Dry deposition sample - sample is dry and not contaminated with precipitation water</td>
</tr>
<tr>
<td>B</td>
<td>Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition</td>
</tr>
<tr>
<td>DC</td>
<td>Dry deposition sample - dry bucket contains rain water and other insects/contaminants</td>
</tr>
</tbody>
</table>

**Enumerated Domain for Attribute: UTKNCODE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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**Enumerated Domain for Attribute: UTPCODE**

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</tr>
<tr>
<td>Q</td>
<td>Value is questionable (used beginning in 1991)</td>
</tr>
</tbody>
</table>
Enumerated Domain for Attribute: PARTPCODE
N  No derived value is calculated due to missing analytical components
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: UTNCODE
A  Accepted value
E  Estimated value
* Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
N  No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: TDNCODE
A  Accepted value
E  Estimated value
* Value is below detection limit for analysis (used beginning in 1991)
Q  Value is questionable (used beginning in 1991)
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values
N  No analytical measurement or no derived value calculated due to missing analytical components

Enumerated Domain for Attribute: DONCODE
N  No derived value is calculated due to missing analytical components
D  Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: PARTNCODE
N  No derived value is calculated due to missing analytical components
D Derived value - mathematically determined from other analytical measurements
D* Derived value - mathematically determined from other analytical measurements, one or more of which were below the detection limit
DE Derived value - mathematically determined from other analytical measurements, one or more of which were estimated values
DQ Derived value - mathematically determined from other analytical measurements, one or more of which were questionable values

Enumerated Domain for Attribute: ALKCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: CACODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: CLCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit
Enumerated Domain for Attribute: CONDCODE_YR
- Q: Annual value includes questionable values
- N: No analyses conducted in water year
- A: Annual value is accepted
- E: Annual value includes estimated values
- I: Annual value incomplete; one or more values are missing for part of the year
- I*: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- IE: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
- IQ: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
- *: Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: DOCCODE_YR
- Q: Annual value includes questionable values
- N: No analyses conducted in water year
- A: Annual value is accepted
- E: Annual value includes estimated values
- I: Annual value incomplete; one or more values are missing for part of the year
- I*: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- IE: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
- IQ: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
- *: Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: KCODE_YR
- Q: Annual value includes questionable values
- N: No analyses conducted in water year
- A: Annual value is accepted
- E: Annual value includes estimated values
- I: Annual value incomplete; one or more values are missing for part of the year
- I*: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- IE: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
- IQ: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
- *: Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: MGCODE_YR
- Q: Annual value includes questionable values
- N: No analyses conducted in water year
- A: Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NACODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NH3NCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: NO3NCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: PO4PCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
* Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: DONCODE_YR
N No derived values are calculated for the entire water year
D Annual value based on derived values
D* Annual value based on derived values; one or more values measured below the detection limit
DE Annual value based on derived values; one or more values estimated
DQ Annual value based on derived values; one or more values questionable
ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: PCODE_YR
I Incomplete, parts of year missing from annual summary
A All precipitation is included and not estimated for the wateryear
E Total includes estimated precipitation values
Q Precipitation total may be questionable for some periods of the wateryear

Enumerated Domain for Attribute: PHCODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable

Enumerated Domain for Attribute: PARTNCODE_YR
N No derived values are calculated for the entire water year
D Annual value based on derived values
D* Annual value based on derived values; one or more values measured below the detection limit
DE Annual value based on derived values; one or more values estimated
DQ Annual value based on derived values; one or more values questionable
ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: PARTPCODE_YR
N No derived values are calculated for the entire water year
D Annual value based on derived values
D* Annual value based on derived values; one or more values measured below the detection limit
DE Annual value based on derived values; one or more values estimated
DQ Annual value based on derived values; one or more values questionable
ID Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
ID* Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
IDE Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
IDQ Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: SICODE_YR
Q Annual value includes questionable values
N No analyses conducted in water year
A Annual value is accepted
E Annual value includes estimated values
I Annual value incomplete; one or more values are missing for part of the year
I* Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: SO4SCODE_YR
Q
Annual value includes questionable values
N
No analyses conducted in water year
A
Annual value is accepted
E
Annual value includes estimated values
I
Annual value incomplete; one or more values are missing for part of the year
I*
Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE
Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ
Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*
Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: SSEDCODE_YR
Q
Annual value includes questionable values
N
No analyses conducted in water year
A
Annual value is accepted
E
Annual value includes estimated values
I
Annual value incomplete; one or more values are missing for part of the year
IE
Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ
Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*
Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: STCODE
CP002
Study code CP002

Enumerated Domain for Attribute: TKNCODE_YR
Q
Annual value includes questionable values
N
No analyses conducted in water year
A
Annual value is accepted
E
Annual value includes estimated values
I
Annual value incomplete; one or more values are missing for part of the year
I*
Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE
Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ
Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*
Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: TDPCODE_YR
Q
Annual value includes questionable values
N
No analyses conducted in water year
A    Annual value is accepted
E    Annual value includes estimated values
I    Annual value incomplete; one or more values are missing for part of the year
I*   Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE   Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ   Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*    Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: UTKCODE_YR
Q    Annual value includes questionable values
N    No analyses conducted in water year
A    Annual value is accepted
E    Annual value includes estimated values
I    Annual value incomplete; one or more values are missing for part of the year
I*   Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
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Enumerated Domain for Attribute: UTPCODE_YR
Q    Annual value includes questionable values
N    No analyses conducted in water year
A    Annual value is accepted
E    Annual value includes estimated values
I    Annual value incomplete; one or more values are missing for part of the year
I*   Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE   Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ   Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*    Annual value includes one or more values measured below the detection limit

Enumerated Domain for Attribute: UTNCODE_YR
Q    Annual value includes questionable values
N    No analyses conducted in water year
A    Annual value is accepted
E    Annual value includes estimated values
I    Annual value incomplete; one or more values are missing for part of the year
I*   Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
IE   Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
IQ   Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
*    Annual value includes one or more values measured below the detection limit
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td>Annual value incomplete; one or more values are missing for part of the year; one or more values estimated</td>
</tr>
<tr>
<td>IQ</td>
<td>Annual value incomplete; one or more values are missing for part of the year; one or more values questionable</td>
</tr>
<tr>
<td>*</td>
<td>Annual value includes one or more values measured below the detection limit</td>
</tr>
<tr>
<td>D</td>
<td>Annual value based on derived values</td>
</tr>
<tr>
<td>D*</td>
<td>Annual value based on derived values; one or more values measured below the detection limit</td>
</tr>
<tr>
<td>DE</td>
<td>Annual value based on derived values; one or more values estimated</td>
</tr>
<tr>
<td>DQ</td>
<td>Annual value based on derived values; one or more values questionable</td>
</tr>
<tr>
<td>ID</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values</td>
</tr>
<tr>
<td>ID*</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit</td>
</tr>
<tr>
<td>IDE</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated</td>
</tr>
<tr>
<td>IDQ</td>
<td>Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable</td>
</tr>
</tbody>
</table>

Enumerated Domain for Attribute: TDNCODE_YR
- Q: Annual value includes questionable values
- N: No analyses conducted in water year
- A: Annual value is accepted
- E: Annual value includes estimated values
- I: Annual value incomplete; one or more values are missing for part of the year
- I*: Annual value incomplete; one or more values are missing for part of the year; one or more values measured below the detection limit
- IE: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated
- I*E: Annual value incomplete; one or more values are missing for part of the year; one or more values estimated below the detection limit
- I*Q: Annual value incomplete; one or more values are missing for part of the year; one or more values questionable
- *: Annual value includes one or more values measured below the detection limit
- D: Annual value based on derived values
- D*: Annual value based on derived values; one or more values measured below the detection limit
- DE: Annual value based on derived values; one or more values estimated
- DQ: Annual value based on derived values; one or more values questionable
- ID: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values
- ID*: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values measured below the detection limit
- IDE: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are estimated
- IDQ: Annual value incomplete; one or more values are missing for part of the year; annual value based on derived values of which one or more values are questionable

Enumerated Domain for Attribute: STCODE
- CP002: Study code CP002
Enumerated Domain for Attribute: TYPE

S  Sample saved and combined with the following collection due to insufficient water for analyses - samples were no longer saved and combined after 1981.
P  Partial sample - precipitation was not collected successfully over the entire period (includes problems with NADP-style collector motor or samples that may have overflowed).
YE Year end marker allows summary by water year - this is not a sample. Flux values are calculated from precip ending Sep 30 and use analyte concentrations from the following sample. 'YE' markers are inserted every Sep 30.
C  Sample is combined with preceding saved sample(s) for analysis. Combined samples of this type are not used after 1981.
DW Dry deposition sample - dry bucket contains rain water.
F  Sample is successfully collected over the entire period - a "Full" sample.
N  No sample is collected - generally indicates periods of little or no rain, but can be a lost sample.
DF Dry deposition sample - sample is dry and not contaminated with precipitation water.
B  Biased sample - Lid on NADP sampler malfunctions and sample includes dry deposition.
DC Dry deposition sample - dry bucket contains rain water and other insects/contaminants.

Enumerated Domain for Attribute: QCCODE

NA Water sample is not a quality control sample.
QZ Miscellaneous quality control water sample.

Enumerated Domain for Attribute: SAMPLER_TYPE

BC Bulk collection includes both wet and dry deposition.
NP NADP-type sampler that separates wet deposition from dry deposition.
RC Bulk samples from original, locally-designed rain collectors that includes both wet and dry deposition.

Enumerated Domain for Attribute: LOW_VOLUME

N  Sample is of sufficient volume for laboratory analyses.
Y  Sample is low volume and laboratory analyses may be limited.