A User Comment Draft of the Joint Committee on the NTCIP

NTCIP 1204 version v04.20

National Transportation Communications for ITS Protocol

Environmental Sensor Station (ESS) Interface Protocol

Draft v04.20 June 07, 2016

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Recent Minor Version Revision History

Revision	Date	Note: New on top
NTCIP 1204 v04.20	06/07/2016	UCD distributed. UCD Comments due 7/07 to jean.johnson@nema.org .
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NTCIP 1204 v04.18	02/18/2016	Prepared for ESS WG voting member consideration as draft pUCD. (Johnson)
NTCIP 1204 v04.16-17	01/11/2016	Updated and corrected the class diagrams for Section 4.4.
NTCIP 1204 v04.16	10/16/2015	Reviewed/verified revisions in Second Draft SDD in preparation for send to AASHTO for review & submission to USDOT.
NTCIP 1204 v04.15	10/13/15	Submittal to NEMA for ESS WG review. Note: The Class diagrams in Section 4.4. still needs to be updated, but the consultant is proposing that Section 4.4 be removed.
NTCIP 1204 v04.14	9/02/2015	Revised SDD & TP, to AASHTO for final review, and delivery to USDOT.
NTCIP 1204 v04.13	8/28/2015	Revised (revised) SDD & TP to NEMA.
NTCIP 1204 v04.12	8/24/2015	Revised SDD & TP, reflecting post-walkthrough revs to NEMA.
NTCIP 1204 v04.11	07/30/2015	Conformed Note (v. NOTE); identified reference to NTCIP 1214 v01 at Annex G.3, to be deleted. Renumbered headings in Annex C to use Annex-4 or -5, not Heading 4, or 5 (numbering of Test Procedures changed). Deleted reference to “microdegrees…Celsius” (for long/lat), and replaced with “microdegrees…” No “Error! Reference Not Found” entries. Ran update. At Sec. 3.1.1.1, N/A entry, changed from v03 to v04. Tbl 3 Needs Header Row within Table. At Sec. 3 (early words), indicate difference between Object STATUS and M/O in PRL.
NTCIP 1204 v04.10	07/06/2015	Revised SDD and Test Procedures, submitted to AASHTO for delivery to USDOT. Rebuilt document, running compare, to identify and track changes. At Sec. 5.14.5, sulfur spelling corrected. Page numbers, footers, and cross-references updated.
NTCIP 1204 v04.09	06/29/15	Initial Design Content
NTCIP 1204 v04.08	01/23/2015	Revised FR, reflecting Walkthrough inputs, submitted to AASHTO for delivery to USDOT. Yellow highlights reflect reminders to the SE for future work. Aqua highlights represent a reminder to SE and AASHTO/NEMA staff to review references to retired objects, in light of NTCIP 8004 v02 provisions regarding STATUS of deprecated and obsolete. Note to Reviewers: The Contents listing does Not yet contain all entries that are present in published NTCIP 1204 v03 (with errata). Those Contents entries are being included in a draft, in preparation for work to occur during the SDD phase of this project.
NTCIP 1204 v04.07a	01/12/2015	Proposed Functional Requirements Document submitted to NEMA, for delivery to USDOT.
NTCIP 1204 v04.07	01/05/2015	Initial updated Functional Requirements based on Requirements Walkthrough. Submitted to interested parties for review.
NTCIP 1204 v04.06a	11/6/2014	Updated Functional Requirements for FR Walkthrough based on Noblis comments.
NTCIP 1204	10/14/2014	Proposed Functional Requirements for FR Walkthrough.

Revision	Date	Note: New on top
v04.06		
1204v04-FR-draft4	09/25/2014	Initial Functional Requirements to ESS WG and interested parties for review and comments.
NTCIP 1204 v04.05	08/14/2014	Returned ConOps to AASHTO (ultimately, for transmission to USDOT) with USDOT comments addressed, and other revisions.
NTCIP 1204 v04.04 ConOps	08/13/2014	Address ConOps comments returned x USDOT. For Chan review/revision
NTCIP 1204 v04.03A	08/08/14	With edits of ConOps from NEMA to AASHTO, for delivery to USDOT.
NTCIP 1204 ConOps v04.02	08/06/14	Addresses comments and ConOps Walkthrough
NTCIP 1204 ConOps v04.01	07/02/14	Proposed Concept of Operations

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ACKNOWLEDGEMENTS

NTCIP 1204 v04 was prepared by the NTCIP Environmental Sensor Station Working Group (ESS WG), which is a subdivision of the Joint Committee on the NTCIP. The Joint Committee is organized under a Memorandum of Understanding among the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA). The Joint Committee on the NTCIP consists of six representatives from each of the standards organizations, and provides guidance for NTCIP development.

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[To be revised as NTCIP 1204 v04 development proceeds.]

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In addition to the many volunteer efforts, recognition is also given to those organizations that supported the effort by providing comments and funding, including:
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FOREWORD

NTCIP 1204 v04, an NTCIP standards publication, identifies and defines how a management station may wish to interface with a field device to control and monitor pavement sensors, weather stations, air quality sensors, and other equipment related to the monitoring of and response to environmental conditions in an NTCIP-conformant fashion. NTCIP 1204 v04 uses only metric units.

NTCIP 1204 v04 is titled *Environmental Sensor Station (ESS) Interface Protocol* to express the multiple sections and annexes that are included in this standards publication. This NTCIP 1200-series standards publication has grown beyond the "object definitions" that were reflected in the title for the NTCIP 1204 versions v01, v02 and v03.

NTCIP 1204 v04 provides definitions of data elements for environmental sensor data, including weather data, pavement condition data, water level data, and air quality data. The data is defined using the Simple Network Management Protocol (SNMP) object-type format as defined in RFC 1212 and NTCIP format defined in NTCIP 8004 v02. This data is typically exchanged between a management station and a field device using one of the NTCIP 1103 v02-recognized Application Layers (e.g., SNMP). The data may also be exchanged among management stations using other protocols.

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The following keywords apply to NTCIP 1204 v04: AASHTO, ITE, NEMA, NTCIP, ESS, data, data dictionary, object, environmental sensor.

NTCIP 1204 v04 contains four normative and four informative annexes:

a) Annex A is normative and contains a Requirements Traceability Matrix (RTM) that traces requirements to dialogs and data concepts (messages, data frames, and data elements) used to fulfill one or more requirements.
b) Annex B is informative and provides a graphical representation of the major nodes of the ISO tree as defined by NTCIP 1204 v04.
c) Annex C is normative and defines the test procedures for NTCIP 1204 v04.
d) Annex D is informative and identifies the significant revisions in NTCIP 1204 v04 that have been made since previous versions of NTCIP 1204 v04.
e) Annex E is informative and responds to user requests by providing an explanation as to how certain complex features can be supported by NTCIP 1204 v04 and why certain other features are not supported by NTCIP 1204 v04.
f) Annex F is informative and provides sample encodings of block objects.
g) Annex G is normative and contains the definitions for the Generic SNMP interface including the definitions to perform GET, SET, GET NEXT commands. These definitions may be moved to a different NTCIP standard at a future date, because this content is applicable to all device-specific NTCIP standards.
h) Annex H is normative and serves as a placeholder for systems engineering descriptions that may be moved to a different NTCIP standard at a future date, because this content is applicable to all device-specific NTCIP standards.

NTCIP 1204 v04 is also an NTCIP Data Dictionary standard. Data Dictionary standards provide definitions of data concepts (messages, data frames, and data elements) for use within NTCIP systems; they are approved by AASHTO, ITE, and NEMA through a ballot process, after a recommendation by the NTCIP Joint Committee. For more information about NTCIP standards, visit www.ntcip.org.

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Approvals

NTCIP 1204 v04 was separately balloted and approved by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP. Each organization has approved NTCIP 1204 v04 as the following standard type, as of the date:

AASHTO—Standard Specification;
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History

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began development of the NTCIP. The Transportation Section's purpose was in response to user needs to include standardized systems communication in the NEMA TS 2 standard, *Traffic Controller Assemblies*. Under the guidance of the Federal Highway Administration's NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation Systems (ITS) network.

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In September 1996, an agreement was executed among AASHTO, ITE, and NEMA to jointly develop, approve, and maintain the NTCIP standards. Under the guidance of a Joint AASHTO/ITE/NEMA Committee on the NTCIP, a Working Group was created to develop the object definitions for Environmental Sensor Stations. The first meeting of this working group was in November 1996, and the 1204 version 01 was produced in 1998. In 2001, efforts began to update and enhance the standard, which resulted in version 02, produced in 2005. In 2006, efforts began to update and enhance the standard with test procedures, which resulted in NTCIP 1204 v03, produced in 2009.

NTCIP 1204 version 01 (v01) was published as NTCIP 1204:1998 and was also formerly known as NEMA TS 3.7. NTCIP 1204 v02 was developed to reflect lessons learned, to update to new documentation formats, and to add new features such as the control of automated de-icing equipment. NTCIP 1204 v03 was developed to add test procedures (Annex C) and to correct issues that had been identified with NTCIP 1204 v02. NTCIP 1204 v04 was developed to reflect lessons learned since publication of NTCIP 1204 v03 and to support newly identified user needs.

~~NTCIP 1204 v03.03—In May 2007, the Joint Committee on the NTCIP accepted v03.03 as a User Comment Draft. Standards Bulletin B0121 sent v03.03c out for comment.~~

~~NTCIP 1204 v03.08—In January 2008, the Joint Committee on the NTCIP accepted v03.07 as a Recommended Standard. Standards Bulletin B01217 sent v03.07b out for ballot and approval. In January to May 2008, the ESS WG disposed of seven comments as editorial, and one comment as technical. The version v03.07d was revised to include the disposition of the seven comments, and with explanatory notes on the technical changes. To further prepare this version v03.08 for publication, portions were edited for purposes of clarity and consistency, and for grammar and format.~~

Compatibility of Versions

To distinguish NTCIP 1204 v04 (as published) from previous drafts, NTCIP 1204 v04 also includes NTCIP 1204 v04.XX on each page header. All NTCIP Standards Publications have a major and minor version number for configuration management. The version number syntax is "v00.00a," with the major version number before the period, and the minor version number and edition letter (if any) after the period.

NTCIP 1204 v04 is designated, and should be cited as, NTCIP 1204 v04. Anyone using NTCIP 1204 v04 should seek information about the version number that is of interest to them in any given circumstance. The MIB, the PRL, and the PICS should all reference the version number of the standards publication that was the source of the excerpted material.

Compliant systems based on later, or higher, version numbers MAY NOT be compatible with compliant systems based on earlier, or lower, version numbers. Anyone using NTCIP 1204 v04 should also consult NTCIP 8004 v02 for specific guidelines on compatibility.

~~Introduction~~

~~NTCIP 1204 v04 provides definitions of data elements for environmental sensor data, including weather data, pavement condition data, water level data, and air quality data. The data is defined using the Simple Network Management Protocol (SNMP) object-type format as defined in RFC 1212 and NTCIP format defined in NTCIP 8004 v02. This data would typically be exchanged between a management station and a field device using one of the NTCIP 1103 v02-recognized Application Layers (e.g., SNMP). The data may also be exchanged among management stations using other protocols.~~

~~NTCIP 1204 v04 defines requirements that are applicable to all NTCIP environments and it also contains optional and conditional sections that are applicable to specific environments for which they are intended.~~

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Section 1
General [Informative]

1.1 Scope

Environmental sensor stations (ESS) include a wide array of sensors, including those that monitor weather, roadway surface, water level, and air quality conditions. These sensors are typically connected to a nearby microprocessor termed a remote processor unit (RPU~~), which lies within an ESS~~). An environmental sensor station (ESS) consists of the RPU plus its suite of sensors.

Typically, this equipment is fixed or permanently located at a site along a travel corridor. In some cases, the "stations" may be portable, or even mobile. For NTCIP 1204 v04 purposes, all three types of stations are called ESS. In the transportation community, these devices are frequently used to improve roadway maintenance and traffic operations.

Environmental sensors are also frequently co-located with pavement treatment systems (PTS) and, in fact, may use the same controller. Thus, for NTCIP 1204 v04 purposes, the term ESS may also include a PTS.

Note: The PTS portion of NTCIP 1204 v04 may be placed in a separate standard in the future.

Unfortunately, there have not been standards defining how these devices communicate with management systems. As a result, each manufacturer has developed its own protocol to meet its own particular needs. This approach has resulted in systems that are not interchangeable or interoperable. If an agency wishes to use either a central management system or additional ESS from a different vendor, the agency encounters significant systems integration challenges, requiring additional resources to address. These additional resource requirements inhibit information sharing within and between various potential users of the data and prevent vendor independence. Without manufacturer independence, resource requirements further increase because of a lack of a competitive market.

These problems have not been limited to weather and environmental monitoring. Many other devices also need to exchange information. In surface transportation, examples include traffic signal controllers, dynamic message signs, bus priority sensors, etc. To address these problems, NTCIP is developing a family of open standards for communications between field devices and central management systems.

NTCIP 1204 v04 is part of that larger family and is designed to define an interoperable and interchangeable interface between a transportation management system and an ESS, while still allowing for extensions beyond NTCIP 1204 v04 to allow for new functions as needed. This approach is expected to support the deployment of ESS from one or more vendors in a consistent and resource-efficient way.

NTCIP 1204 v04 only addresses a subset of the requirements needed for procurement. It does not address requirements related to the performance of the sensors (e.g., accuracy, the supported detection range, the time it takes to detect conditions, etc.), hardware components, mounting details, etc.

NTCIP 1204 v04 standardizes the communications interface by identifying the various operational needs of the users (Section 2) and subsequently identifying the necessary requirements (Section 3) that support each need. NTCIP 1204 v04 then defines the NTCIP standardized communications interface used to fulfill these requirements by identifying the dialogs (Section 4) and related data concepts (Section 5) that support each requirement.

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Traceability among the various sections is defined by the Protocol Requirements List (Section ~~3.~~3**3.3**) and the Requirements Traceability Matrix (Annex A). Conformance requirements for NTCIP 1204 v04 are provided in Section 3.3.

An implementation of NTCIP 1204 v04 requires lower level services to structure, encode, and exchange the data concepts defined by NTCIP 1204 v04. NTCIP 1204 v04 assumes that the data concepts are exchanged by one of the protocols defined in NTCIP 2301 v02.

1.2 References

1.2.1 Normative References

Normative references contain provisions that, through reference in this text, constitute provisions of NTCIP 1204 v04. By reference herein, these standards are adopted, in whole or in part as indicated, in this publication. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on NTCIP 1204 v04 are encouraged to investigate the possibility of applying the most recent editions of the standards listed.

Identifier	Title
Glossary of Meteorology	*Glossary of Meteorology, Second Edition; American Meteorological Society, 2000*
AASHTO / ITE / NEMA NTCIP 1103 v02	*Transportation Management Protocols (TMP)* published July 2010
AASHTO / ITE / NEMA NTCIP 1201 v03	*Global Object (GO) Definitions* published March 2011
AASHTO / ITE / NEMA NTCIP 2301 v02:2001	*Simple Transportation Management Framework (STMF) Application Profile (AP) (AP-STMF)* published July 2010
AASHTO / ITE / NEMA NTCIP 8004 v02	*Structure and Identification of Management Information (SMI)* published June 2010
WMO No. 306:1995	*Technical Regulations; Manual on Codes, International Codes, Volume 1.2, Annex II, FM 94-X Ext. BUFR—Binary Universal Form for the Representation of Meteorological Data*

1.2.2 Other References

The following documents and standards may provide the reader with a more complete understanding of the entire protocol and the relations between all parts of the protocol. However, these documents do not contain direct provisions that are required by NTCIP 1204 v04. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on NTCIP 1204 v04 are encouraged to investigate the possibility of applying the most recent editions of the standard listed.

Identifier	Title
DIN EN 15518-3:2011	*Winter maintenance equipment - Road weather information systems - Part 3:Requirements on measured values of stationary equipment*, European Standard, 2011
IAB STD 16	(RFC 1155) *Structure and Identification of Management Information for TCP/IP-based Internets,* M. Rose, K. McCloghrie, May 1990, (RFC 1212) *Concise MIB Definitions*, M. Rose and K. McCloghrie, March 1991
National ITS Architecture 7.1~~0~~	National ITS Architecture 7.~~0~~1, USDOT *http://www.iteris.com/itsarch/*
AASHTO / ITE / NEMA NTCIP 2201:2003	*Transportation Transport Profile (T2)* published September 2005

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Identifier	Title
AASHTO / ITE / NEMA NTCIP 2202:2001	*Transport Profile for Internet (TCP/IP and UDP/IP)* published December 2001
AASHTO / ITE / NEMA NTCIP 2306 v01	*Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (NTCIP-C2CXML)* published December 2008
AASHTO / ITE / NEMA NTCIP 8007 v01	*Testing and Conformity Assessment Documentation within NTCIP Standards Publications* published May 2008
RFC 5935 (IAB)	*Expressing SNMP SMI Datatypes in XML Schema Definition Language,* M. Rose, K. McCloghrie, August 2010
OMG Unified Modeling Language Specification, Version 1.5	*OMG Unified Modeling Language Specification,* Object Management Group, 2003
Publication No. FHWA-SA-98-008	*Assessing the Results of the Strategic Highway Research Program, FHWA, 1998* www.workzonesafety.org/research/record/82
Weather-Responsive Traffic Management	*Weather-Responsive Traffic Management – Concept of Operations. FHWA, 2003* ops.fhwa.dot.gov/weather/best_practices/WeatherConOps0103.pdf

1.2.3 Contact Information

1.2.3.1 American Meteorological Society & World Meteorological Organization (WMO) Documents

Prepayment is required prior to shipment of these documents. Printed copies are available from:

American Meteorological Society
45 Beacon Street
Boston, MA 02108
(617) 227-2425
www.ametsoc.org

1.2.3.2 Internet Documents

Obtain Request for Comment (RFC) electronic documents from several repositories on the World Wide Web, or by “anonymous” File Transfer Protocol (FTP) with several hosts. Browse or FTP to:

www.rfc-editor.org
www.rfc-editor.org/repositories.html
for FTP sites, read ftp://ftp.isi.edu/in-notes/rfc-retrieval.txt

1.2.3.3 National ITS Architecture

The National ITS Architecture may be viewed on-line at:

www.its.dot.gov/arch/index.htm

1.2.3.4 NTCIP Standards

Copies of NTCIP standards may be obtained from:

NTCIP Coordinator
National Electrical Manufacturers Association

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1300 N.17th Street, Suite 900
Rosslyn, Virginia 22209-3801
www.ntcip.org
e-mail: ntcip@nema.org

Draft amendments, which are under discussion by the relevant NTCIP Working Group, and amendments recommended by the NTCIP Joint Committee are available.

1.2.3.5 Object Management Group Documents

Copies of OMG standards may be obtained electronically from the Object Management Group at:

www.omg.org

1.2.3.6 Office of the Federal Coordinator for Metrology (OFCM) Documents

Copies of OFCM documents may be obtained from:

Office of the Federal Coordinator for Meteorology
8455 Colesville Rd., Suite 1500
Silver Spring, MD 20910
(301) 427-2002
www.ofcm.gov

1.3 General Statements

<In the opinion of the responsible NTCIP working group, Section 1.3 does not apply in the context of NTCIP 1204 v04.>

1.4 Terms

For the purposes of NTCIP 1204 v04, the following terms, definitions, acronyms, and abbreviations apply. Meteorological terms not defined in this section are in accordance with their definitions in the *Glossary of Meteorology*. Electrical and electronic terms not defined here are used in accordance with their definitions in IEEE Std 100-2000. English words not defined here or in IEEE Std 100-2000 are used in accordance with their definitions in *Webster's New Collegiate Dictionary*.

Term	Definition
Binary Universal Form for the Representation of Meteorological Data (BUFR)	The name of the WMO standard binary code for the exchange and storage of non-gridded meteorological data.
Compatible	The ability of two or more systems or components to exchange information. Note: See IEEE 610.12-1990.
Consistent	The ability of two or more systems or components to exchange information and use the supported information that has been exchanged and gracefully reject any unsupported information according to defined rules.

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Term	Definition
Controller	A host computing platform that is used to manage the collection and reporting of sensor data and/or to manage the treatment of pavement for icing conditions. Note: Within the ESS community, sometimes called a remote processing unit or “RPU”.
Current	Reflecting the conditions at the present time (or at the time at which the data is time stamped) as determined by the Controller.
Deprecated	In the context of a MIB, “deprecated” is an object STATUS value that indicates the object is valid in limited circumstances, but has been replaced by another. Note: This definition is modified from “Understanding SNMP MIBS.” To maintain multi-version interoperability (backward compatibility) for legacy implementations, objects with a STATUS value of “deprecated” may require support. When necessary to support legacy implementations, required support for objects with a STATUS value of “deprecated” is indicated using the PICS or Protocol Requirements List (PRL). See NTCIP 8004 v02.
Environmental Monitoring Equipment Package	The component within a management subsystem which performs advanced processing of the collected environmental data. This would include the analysis, forecasting and packaging of weather and road condition information for resource management.
Environmental Sensor Station (ESS)	A location that includes a remote processor unit (RPU) connected to one or more sensors for the collection of environmental or meteorological data. It may also include a pavement treatment system (PTS). Note: The acronym ESS may also be used as a plural.
Feature	A behavior of the device.
Interchangeable	A condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves, or adjoining items, except for adjustment, and without selection for fit and performance. Note: See National Telecommunications and Information Administration, U.S. Department of Commerce
Interoperable	The ability of two or more systems or components to exchange information and use the information that has been exchanged. Note: See NTCIP 8004 v02.
Management Information Base (MIB)	Management information of object definitions so that devices on a network can be remotely monitored, configured and controlled. The information is provided in a format called Abstract Syntax Notation.1 (ASN.1), which is an international standard for defining objects.

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Term	Definition
Management Station	The computer system with which the device communicates. Typically, the management station commands and monitors the device.
Mobile	In the context of an ESS, the ESS, including environmental sensors and pavement treatment devices, is able to operate while in motion.
Obsolete	In the context of a MIB, an object STATUS value that indicates the definition is no longer valid, was found to be flawed, was redundant or not useful. Note: In the next (or some future) edition of a standard, the object or group with a STATUS value of “obsolete” may be removed. This definition is modified from “Understanding SNMP MIBS.” See NTCIP 8004 v02.
Operator	The person who interfaces with the management station software, typically located at a control center.
Permanent (Fixed)	In the context of an ESS, an ESS not designed to be relocated, hence fixed.
Protocol	A specific set of rules, procedures, and conventions defining the format and timing of data transmissions between devices that are accepted and used to understand each other. Note: See NTCIP 8004 v02.
Remote Processor Unit (RPU)	A field processor that collects data from sensors and can communicate the collected data to other computers; the processor may also process the collected data and/or control equipment.
Requirement	A requirement describes a condition or capability to which a system shall conform; either derived directly from user needs, or stated in a contract, standard, specification, or other normative document. A desired feature, property, or behavior of a system.
Requirements Traceability	The ability to follow or study the logical progression among the needs, requirements, and design details in a step-by-step fashion.
Return	When discussing device requirements for providing data when an external system requests it, the term “return” is understood to mean that the data is sent to the requester.
Road Weather Data Collection Market Package	A set of components that perform all operations related to sensing, collecting, processing, and exchanging environmental related information, including the exchange of data among the dispersedly located equipment.
Road/Weather Information System	The collection of RPUs and sensors connected to a central system for analysis and use by maintenance personnel and transportation system managers.
Sensor	A device that is capable of detecting a condition and reporting the result to an RPU.
Simple Network Management Protocol (SNMP)	A communications protocol developed by the IETF, used for configuration and monitoring of network devices.

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Term	Definition
Simple Transportation Management Framework (STMF)	Describes the organization of information within devices and methods of retrieving or modifying any information within the device. Note: STMF also explains how to generate and use computer-readable information organization descriptions. See NTCIP 8004 v02.
Specification	A document that references a standard either to define the capabilities of a component (e.g., a specification sheet) or to define the required capabilities of a component being procured (e.g., a procurement specification).
Sub-Feature	A specialization of a more generic feature.
Transportable	In the context of an ESS, an ESS capable of being relocated, but its environmental sensors and pavement treatment devices do not operate while moving.
Upload	To transfer information from the referenced device to the central computer or an attached portable computer.
User	A person using the system that is developed.
User Need	The business or operational problem (opportunity) that is to be fulfilled to justify procurement or use. Note: While this is termed a “user need” within the NTCIP community, it reflects needs of all stakeholders.

1.5 Abbreviations

The abbreviations and acronyms used in NTCIP 1204 v04 are defined as follows:

AC	Alternating Current
ASN.1	Abstract Syntax Notation One
CAN	Controller Area Network
ESS	Environmental Sensor Station
IANA	Internet Assigned Number Authority
IP	Internet Protocol
OID	OBJECT IDENTIFIER
PMPP	Point to Multi-Point Protocol
PRL	Profile Requirements List
PTS	Pavement Treatment System (or Systems)
T2	Transportation Transport Profile
TCP	Transmission Control Protocol
TMC	Traffic Management Center
TMP	Transportation Management Protocol

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UDP	User Datagram Protocol
WG	Working Group
WMO	World Meteorological Organization

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Section 2
Concept of Operations [Normative]

Section 2 defines the user needs that subsequent sections within NTCIP 1204 v04 address. Accepted system engineering processes detail that requirements should only be developed to fulfill well-defined user needs. The first stage in this process is to identify the ways in which the system is intended to be used. In the case of NTCIP 1204 v04, this entails identifying the various ways in which transportation operations personnel may use ESS information to fulfill their duties.

This concept of operations provides the reader with:

a) a detailed description of the scope of this standard;
b) an explanation of how an ESS is expected to fit into the larger context of an ITS network;
c) a starting point in the agency procurement process; and
d) an understanding of the perspective of the designers of NTCIP 1204 v04.

Section 2 is intended for all readers of NTCIP 1204 v04, including:

a) transportation operations managers
b) transportation operations personnel
c) transportation engineers
d) system integrators
e) device manufacturers

For the first three categories of readers, Section 2 is useful to understand how ESS equipment can be used in their system. For this audience, Section 2 serves as the starting point in the procurement process, and enables these readers to become familiar with each feature covered by NTCIP 1204 v04 and determine whether that feature is appropriate for their implementation. If it is, then the procurement specification needs to require support for the feature and all of the mandatory requirements related to that feature.

For the last two categories of readers, Section 2 provides a more thorough understanding as to why the more detailed requirements exist later in NTCIP 1204 v04.

2.1 Tutorial [Informative]

A concept of operations describes a proposed system from the users' perspective. Typically, a concept of operations is used on a project to ensure that system developers understand users' needs. Within the context of NTCIP standards, a concept of operations documents the intent of each feature for which NTCIP 1204 v04 supports a communications interface. It also serves as the starting point for users to select which features may be appropriate for their project.

The concept of operations starts with a discussion of the current situation and issues that have led to the need to deploy systems covered by the scope of NTCIP 1204 v04 and to the development of NTCIP 1204 v04 itself. This discussion is presented in layman's terms such that both the potential users of the system and the system developers can understand and appreciate the situation.

The concept of operations then documents key aspects about the proposed system, including:

a) Reference Physical Architecture - The reference physical architecture defines the overall context of the proposed system and defines which specific interfaces are addressed by NTCIP 1204 v04. The reference physical architecture is supplemented with one or more samples that describe how the reference physical architecture may be realized in an actual deployment.

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b) Architectural Needs - The architectural needs section discusses the issues and needs relative to the system architecture that have a direct impact on NTCIP 1204 v04.
c) Features - The features identify and describe the various functions that users may want components of an ESS system to perform. These features are derived from the high level user needs identified in the problem statement but are refined and organized into a more manageable structure that forms the basis of the traceability tables contained in Section 3 and Annex A.

The architectural needs and features are collectively called *user needs*. Section 3 uses these user needs in the analysis of the system to define the various functional requirements of an ESS. Each user need shall be traced to one or more functional requirements, and each functional requirement shall be derived from at least one user need. This traceability is shown in the Protocol Requirements List (PRL) as provided in Section 3.3.

While NTCIP 1204 v04 is intended to standardize communications across a wide range of deployments, it is not intended to mandate support for every feature for every deployment. Therefore, the PRL also defines each user need and requirement as mandatory, optional, or conditional. The only items marked mandatory are those that relate to the most basic functionality of the device. To obtain a device that meets specific needs, the user first identifies which optional needs are necessary for the specific project.

Each requirement identified is then presented in the Requirements Traceability Matrix (RTM) in Annex A, which defines how the requirement is fulfilled through standardized dialogs and data element definitions provided in Section 4 and Section 5.

A conformant device may support other user needs, as long as they are conformant with the requirements of NTCIP 1204 v04 and its normative references (see Section 1.2.1). For example, a device may support data that has not been defined by NTCIP 1204 v04; however, when exchanged via one of the NTCIP 2301 v02 protocols, the data shall be properly registered with a valid OBJECT IDENTIFIER under the Global ISO Naming Tree.

> Note: Off-the-shelf interoperability and interchangeability can only be obtained by using well-documented user needs, along with their corresponding requirements and design, that are broadly supported by the industry as a whole. Designing a system that uses environments or features not defined in a standard or not typically deployed in combination with one another inhibits the goals of interoperability and interchangeability, especially if the documentation of these user needs is not available for distribution to system integrators. NTCIP 1204 v04 allows implementations to support additional user needs to support innovation, which is constantly needed within the industry, but users should be aware of the risks involved with using such environments or features.

The concept of operations concludes by describing the degree to which security issues have been addressed by the NTCIP 1204 v04 and by providing a description of how NTCIP 1204 v04 relates to the National ITS Architecture.

2.2 Current Situation and Problem Statement [Informative]

Transportation system managers use ESS in a variety of ways to improve transportation system operations. The primary uses of ESS data support the following:

a) sharing data with the broader weather community contributes to better weather forecasts
b) improved highway maintenance operations through supporting timely, accurate, and relevant weather forecasting and knowledge of existing road weather conditions
c) more accurate traveler information, which can result in better route planning by travelers and more effective, safer transportation system use
d) improved management of facilities maintenance resources, leading to more timely facilities clearance and improved traveler safety
e) more effective use of advisory and regulatory mechanisms to ensure public safety

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f) enhanced monitoring of potential hazardous conditions, to improve transportation system security and traveler safety
g) Facilitate sharing of air quality information collected by sensors in field devices and on mobile platforms

Additional information about how this data can be used is provided in *Weather-Responsive Traffic Management-Concept of Operations.* One of the most common ESS deployed by transportation system managers is the road/weather ESS. These ESS are used to collect information about road and weather conditions, such as precipitation and air and surface temperatures. With the data returned by these ESS, transportation system managers can determine when there are incipient hazardous travel conditions because of precipitation, fog, high winds, snow, ice, and/or flooding. When travel is becoming hazardous because of snow and/or ice, transportation system managers can dispatch road maintenance crews to treat the roads and remove snow and ice if possible.

Transportation system managers can also use ESS in conjunction with other Intelligent Transportation System (ITS) devices, such as Dynamic Message Signs (DMS), to advise travelers of poor travel conditions or to notify travelers of travel policy changes because of bad weather. For example, foggy conditions could trigger a DMS to display a lowered speed limit in a high-speed area. Snow and ice conditions could trigger a DMS to display a requirement for travelers to use chains on their tires. Icy conditions on bridges or roadways can also lead to the triggering of a spraying device that sprays anti-icing or de-icing chemicals on bridge or roadway surfaces to improve driving conditions. High water or high wind conditions could trigger a DMS to display a message either recommending that travelers choose a different route or that they reduce their speed to protect themselves against the potential hazard.

Although transportation system managers are the normal users of ESS, the data from these ESS are sometimes used by emergency management personnel. For example, when flood conditions occur, regardless of their extent, emergency management personnel use data on the depth of water in areas covered by ESS to determine how and when to respond to flooding. Emergency management personnel re-route travelers from flooded areas, in some cases by deploying (in conjunction with transportation system personnel) signs indicating that sections of road are closed because of flooding.

A transportation system manager may also be interested in using an ESS to measure air quality. This data can be used to monitor concentrations of certain chemicals to ensure that they do not exceed toxic levels. For example, tunnel systems frequently use sensors to ensure that carbon monoxide levels stay within safe levels. The data can also provide a valuable resource to air quality management systems to determine the accuracy of predictions. Finally, some research has suggested that air quality hot spots could be monitored to encourage traffic to avoid these areas during problematic periods.

An ESS is typically deployed along the roadside as part of a network of sensors that report their findings to a central management system. The ESS data received at the central system is processed to provide the transportation system manager with intelligence about road weather conditions that can trigger operator action. For example, high wind conditions might trigger a warning to travelers; if the high wind conditions are severe or in an area where they constitute a high risk, they might trigger the closing of a bridge or a section of roadway. Likewise, a network of ESS may also be used to provide the transit system operator information about conditions that affect the health or safety of transit riders. The processing logic could be rather simple (e.g., monitoring high winds) or very complex (e.g., predictions of weather conditions on or near the road). In the latter case, the ESS data would likely serve as one of many inputs; others might include data from the national weather service and other sources.

However, ESS can also be deployed on a vehicle or a transportable platform (such as on a trailer). Usually, these ESS are atmospheric sensors or pavement sensors, gathering information about snow and ice conditions, pavement conditions, and similar data designed to provide the transportation system manager with information about conditions along a particular section of roadway. The data from mobile ESS are used to complement those from stationary ESS also deployed along the transportation network.

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If the ESS data is shared with other agencies, that agency may be interested in the metadata about the sensor used to report the data. Such metadata might include the make, model, and version of the device components, the technology used, and, on a mobile station, the placement of the sensor relative to the mobile platform. The metadata is needed to indicate how the sensor readings can be used. For example, the snow depth on the roadway, before and after a snow plow passes, indicates two very different things.

2.3 Reference Physical Architecture [Informative]

Figure 1 -represents an overview of what a complete environmental system may look like for a transportation agency, and what information standards may be applicable for each interface.

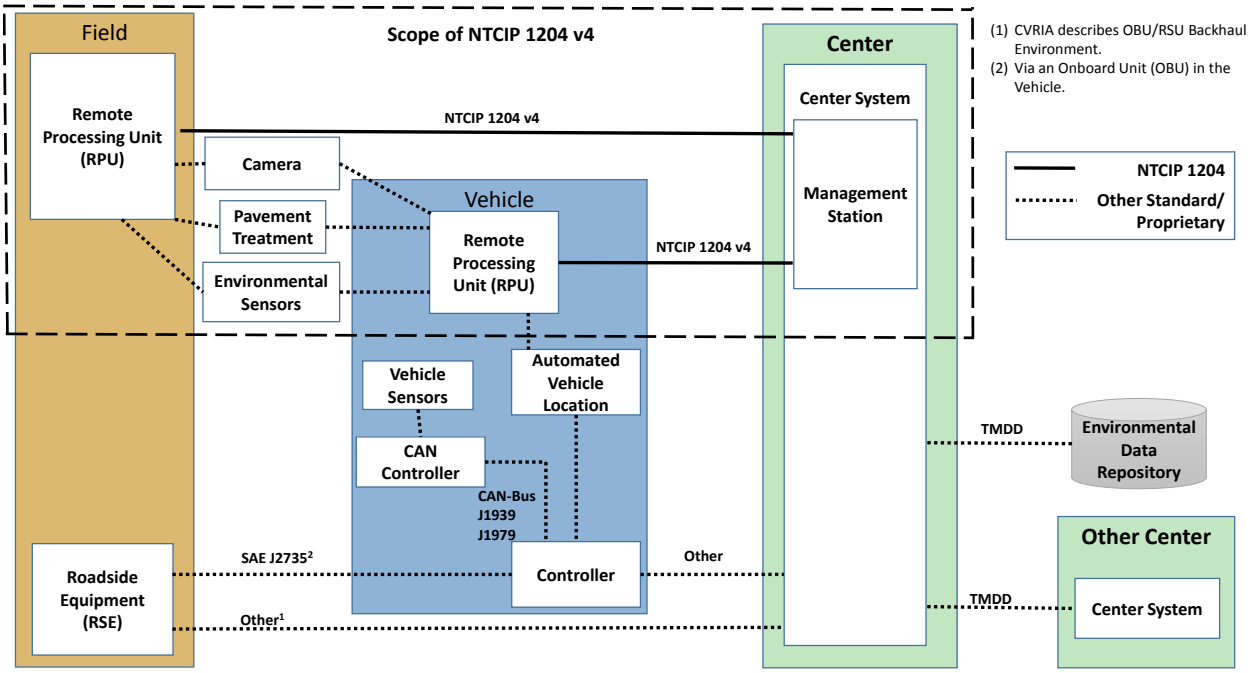

Figure 1 Reference Physical Architecture - —Weather System

~~**Figure 1 Reference Physical Architecture—Weather System**~~

The major components of the weather system include:

a) **Management Station:** One or more host computing platforms that manage one or more NTCIP field devices, such as an ESS. Management stations are typically located in some type of management center (e.g., a Traffic Management Center) and may be a considerable distance from the ESS. Other types of management stations include maintenance laptops that a field technician may use on a trip to visit the device or a field processor that may monitor the data reported from the ESS and automatically activate signs or other equipment under certain conditions. There may be multiple management stations for a given ESS. Within the ESS community, a management station is sometimes called a central processing unit or "CPU". The management station is responsible for configuring, monitoring, and controlling the ESS.

b) ~~**Controller:**~~**Remote Processing Unit (RPU):** A host computing platform that is used to manage the collection and reporting of sensor data and/or to manage the treatment of pavement for icing conditions. ~~Within the ESS community, a controller is sometimes called a remote processing unit or "RPU". The controller is responsible for continually monitoring conditions. When a controller~~The RPU

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continuously monitors weather, roadway, surface, water level and air quality conditions. When a RPU receives a request, it shall immediately respond with its most recent reading for that data. A system operator should be aware that the nature of some information may require significant time to collect (e.g., average wind speed), or may be dated (e.g., information stored in a log); thus, the information contained in the response may have been collected some time prior to the request being sent.

c) **Environmental Sensor:** A device that responds to an environmental physical stimulus and transmits a resulting impulse.

d) **Pavement Treatment:** A system to perform maintenance on a roadway pavement. This may include a snowplow, a device to dispense materials on the roadway pavement, or a device that stores the materials to be dispensed.

e) **Controller:** A host computing platform that is used to manage the collection and reporting of sensor data.

~~e)~~f) **Vehicle Sensor:** A device connected to a vehicle's controller area network that responds to a physical stimulus and transmits a resulting impulse.

~~f)~~g) **Center System:** A system located within a management center used to monitor and operate an agency's assets.

~~g)~~h) **Environmental Data Repository:** A central place where environmental data is stored and maintained.

~~h)~~i) **CAN Controller:** Receives and stores information from a vehicles' controller area network (CAN).

~~i)~~j) **Roadside Unit:** A wireless access point that can provide communications with the infrastructure.

NTCIP 1204 v04 addresses the communications interface between a management station and a ~~controller~~RPU. The relationship between these and other logical components is depicted in Figure 2.

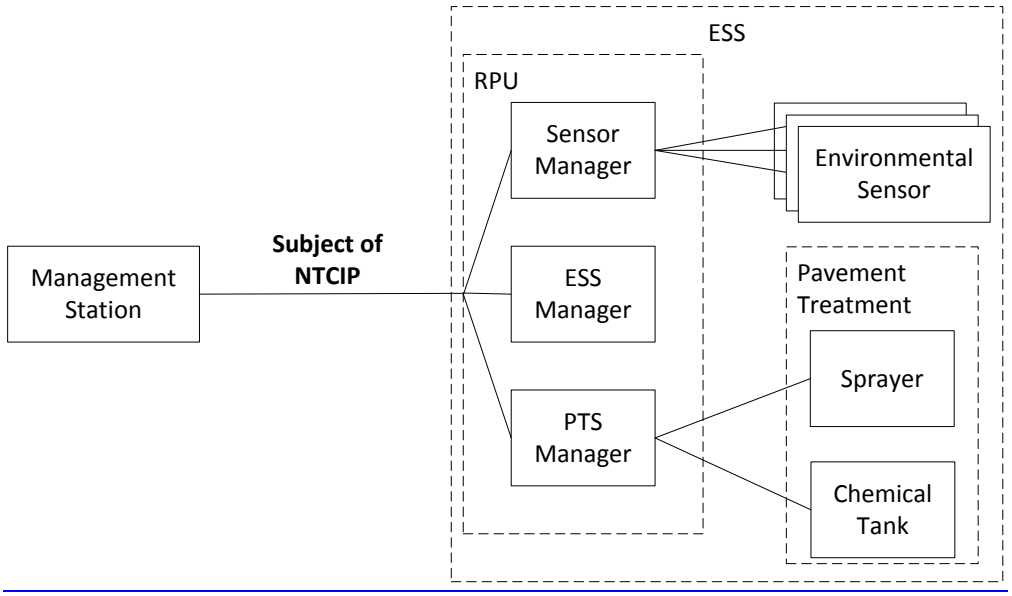

Figure 2 Reference Logical Architecture—ESS

The major components of the system are:

a) **ESS:** ~~A Controller~~An RPU and its connected equipment, such as environmental sensors and/or pavement treatment equipment, including sprayer(s) and a chemical tank. Each of its sub-components is defined further. The ~~controller~~RPU includes an ESS Manager and may include a Sensor Manager and/or a PTS Manager.

b) **Sensor Manager:** The portion of the ~~controller~~RPU that manages the collection and reporting of sensor data.

c) **ESS Manager:** The portion of the ~~controller~~RPU that deals with general functionality that applies to both sensor management and PTS management.
d) **PTS Manager:** The portion of the ~~controller~~RPU that manages the treatment of pavement for icing conditions.
e) **Sprayer:** A device that dispenses the chemical from the storage tank as a fine mist.
f) **Chemical Tank:** A vessel used to store a chemical mixture for later application to the roadway.

The actual physical arrangement of these components may vary from deployment to deployment.

Sections 2.3.1 through 2.3.5 provide sample physical architectures that are supported by this reference architecture.

2.3.1 Remote Weather Station

Figure 3 depicts a wind sensor that is connected by a low speed wireless radio link because of its remote location.

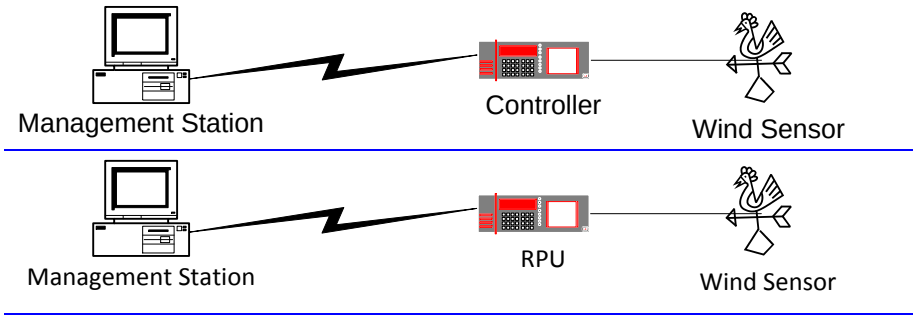

Figure 3 Remote Weather Station

2.3.2 Air Quality Station

Figure 4 depicts an air quality sensor that is connected by a fiber optic network.

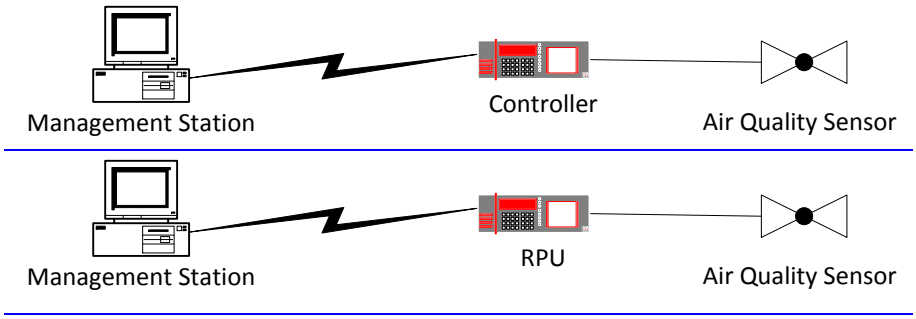

Figure 4 Air Quality Station

2.3.3 Mobile Weather Station

Figure 5 depicts a non-invasive pavement sensor mounted on a maintenance vehicle that is connected by a cellular data modem because of its mobile characteristics.

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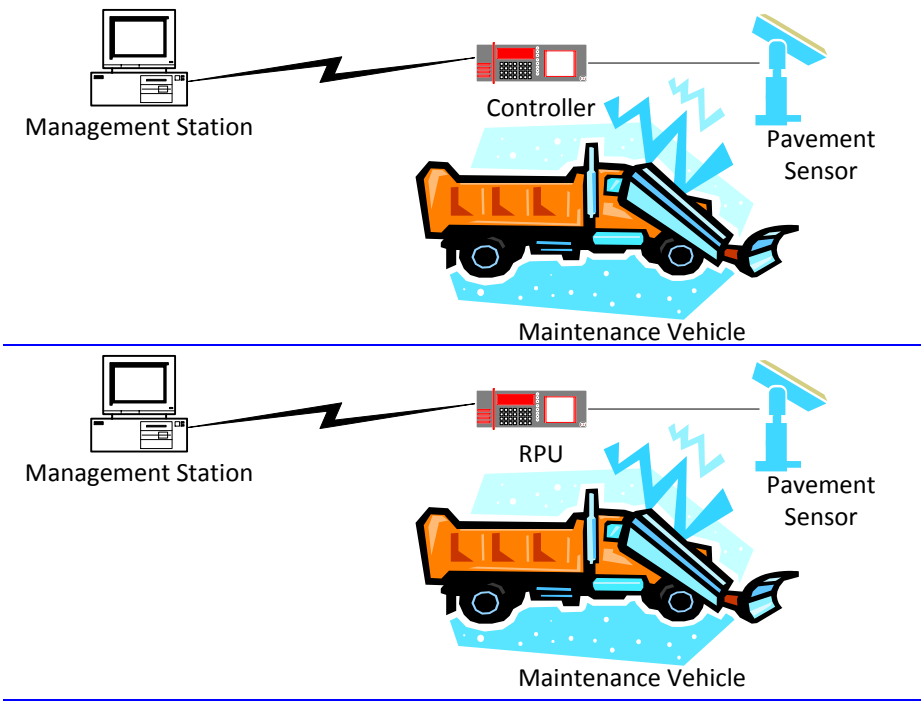

Figure 5 Mobile Weather Station

2.3.4 Sprayer Combined with a Pavement Sensor

Figure 6 depicts an ESS consisting of a ~~controller~~RPU, a pavement sensor, and a sprayer. The ~~controller~~RPU is connected to the management station through a separate connection, perhaps a dial-up link.

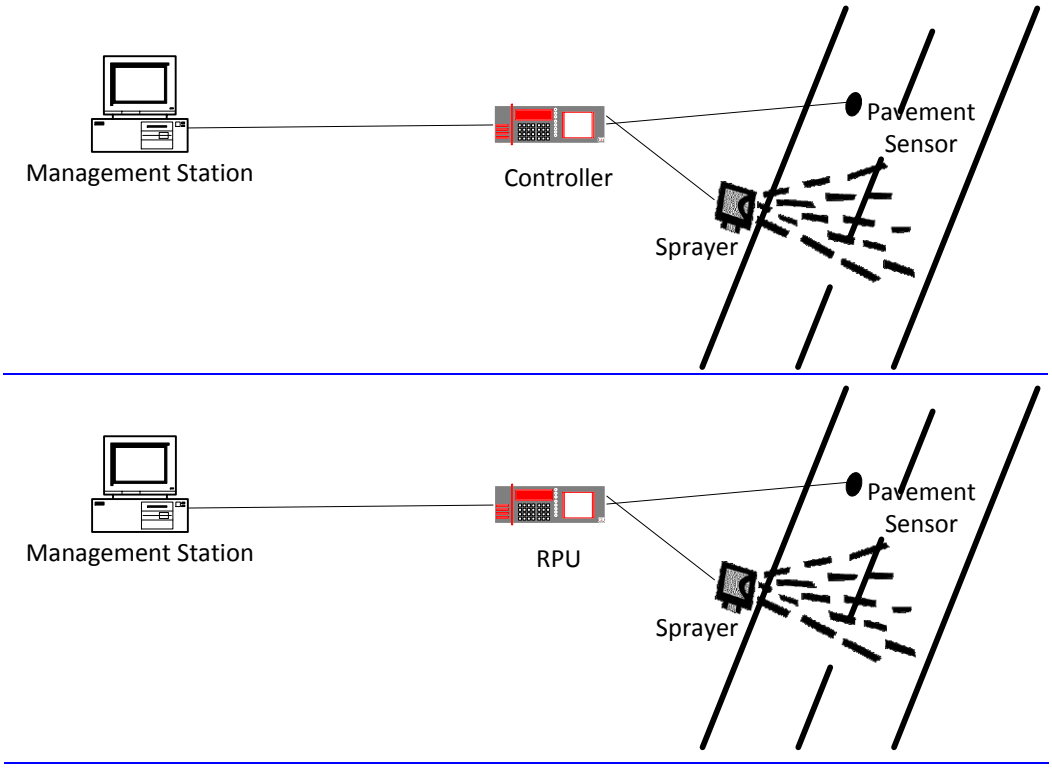

Figure 6 Sprayer Combined with a Pavement Sensor

2.3.5 Pavement Treatment Station

Figure 7 depicts a transportable ESS that only consists of sprayers for pavement treatment.

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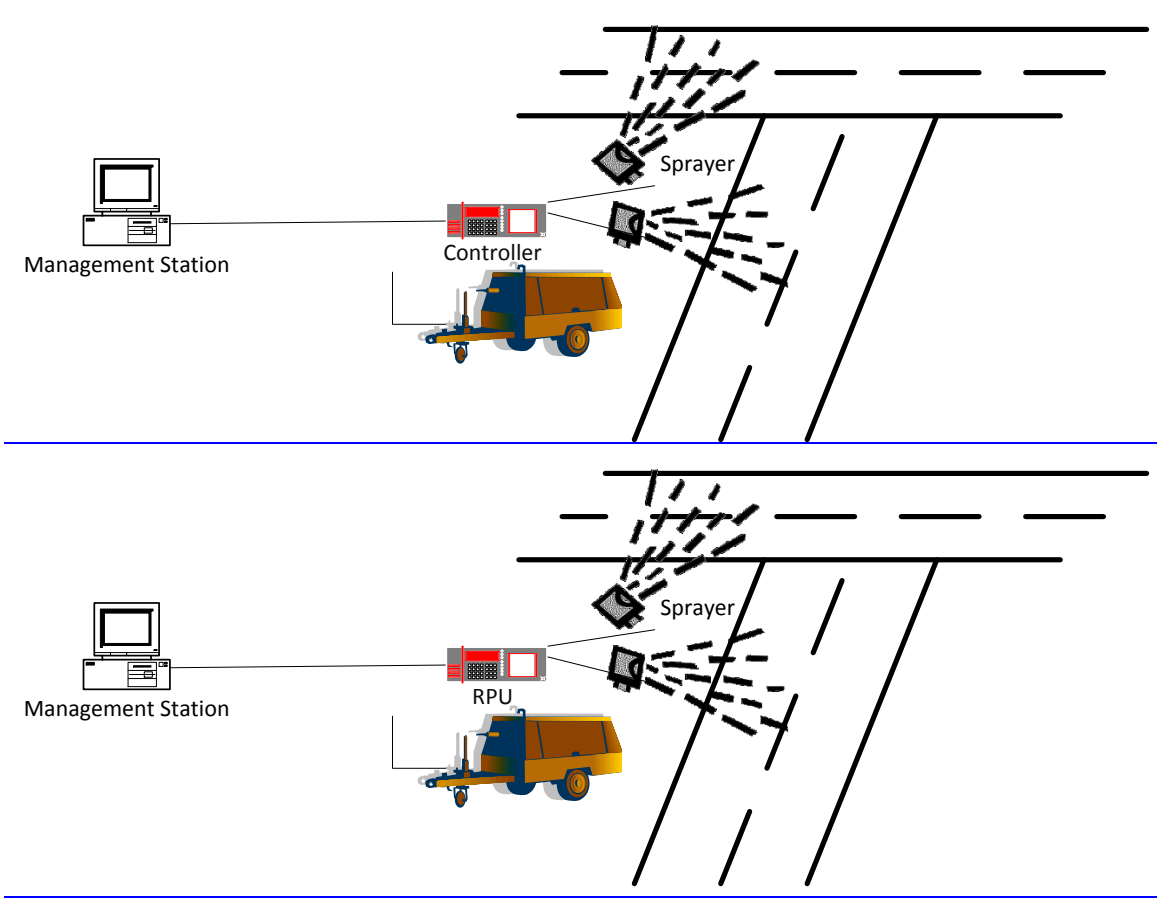

Figure 7 Transportable Pavement Treatment Station

2.4 Architectural Needs

NTCIP 1204 v04 addresses the interface between an ESS and one or more management stations (e.g., central computers, laptops, etc.). The data collected by the ESS may include data from multiple sensors. When communicating with a management station, each reading needs to be clearly associated with a specific sensor. After the management station has retrieved the data of interest, the operator can use the retrieved data to make decisions and initiate other events (such as changes to DMS messages) to better manage the transportation system.

To enable communications between these components, the transportation system manager needs to establish a communication system that links the ESS with a management station. For some systems, the resources required for communications may be minimal and as such the system may be designed for constant polling; other systems may require significant resources for communicating with the ESS and as such the system may be designed to minimize data exchanges. When deploying an ESS, the system designer needs to consider which of the following operational environments need to be supported.

An ESS is expected to operate in the communications environment defined as follows.

2.4.1 Generic Architectural Needs

The features defined in Annex F.1.1 shall be incorporated into this standard by reference.

Note: ~~Some user needs apply to a wide range of different types of NTCIP devices. These user needs are expected to eventually be documented in a separate standard. However, at this time, the separate standard does not exist.~~ Some user needs apply to a wide range of different types of NTCIP devices. It is expected that these user needs are expected to eventually be documented in a separate standard. However, at this time, the separate standard does not exist. Instead, these user needs are defined ~~here~~in Annex F as an interim step to the creation of a separate standard.

~~NOTE - These architectural needs were moved from Annex F in NTCIP 1204 v04 to Section 2 to keep the architecture needs together in the document.~~

~~2.4.1 Provide Live Data~~

~~The typical operational environment allows a management station to monitor and control the device by issuing requests (e.g., requests to access information, alter information, or control the device). In this environment, the device responds to requests from the management station immediately (e.g., through the provision of live data, success/failure notice of information alteration, or success/failure of the command).~~

~~2.4.2 Provide Compressed Data~~

~~Some operational environments have limited data capacity due to limitations in the data rates of the media and/or due to multiple entities or devices sharing the same communications channel. In such environments, compressed data provides the capability for grouping sets of data together so that data can be transmitted more efficiently over telecommunications networks, thereby conserving the limited data capacity of the channel.~~

~~2.4.3 Provide Off-line Log Data~~

~~Some operational environments do not have always-on connections (e.g., dial-up links). In such environments, a transportation system operator may wish to define conditions under which data is placed into a log, which can then be uploaded at a later time. For example, the transportation system manager may wish to maintain a log of when the cabinet door is opened.~~

~~2.4.4 Condition-based Exception Reporting~~

~~In some operational environments, it may be desirable to have the ESS automatically transmit data to the management station when certain conditions occur. Under this scenario, the transportation system operator can define under what conditions s/he wishes to be notified and the device automatically notifies the management station when the condition occurs. An example may be the transportation system manager who wants to know when a sensor on a mobile platform detects a patch of ice on the roadway.~~

2.5 Features

Section 2.5 identifies and describes the various features that may be offered by the ESS. It is divided into the following:

a) ESS Manager Features
b) Sensor Manager Features
c) Pavement Treatment System Manager Features

2.5.1 ESS Manager Features

Section 2.5.1 identifies and describes the various features that may be offered by the ESS Manager, which is the part of the ~~controller~~RPU that performs the functionality that may apply to both a Sensor Manager and a PTS Manager. It consists of the following features:

a) Generic Features
b) Monitor Door Status
c) Monitor Power
d) Monitor Mobile Station Data
e) Determine ESS Type
~~f) View Environmental Image~~

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2.5.1.1 Generic Features

~~Some user needs apply to a wide range of different types of NTCIP devices. These user needs are expected to eventually~~The features defined in Annex F.1.2 shall be ~~documented in a separate~~ incorporated into this standard by reference.

> Note: Some user needs apply to a wide range of different types of NTCIP devices. These user needs are expected to eventually be documented in a separate standard. However, at this time, the separate standard does not exist. ~~. However, at this time, the separate standard does not exist.~~ Instead these user needs are defined ~~here~~in Annex F as an interim step to the creation of a separate standard.

~~NOTE - These user needs were moved from Annex F in NTCIP 1204 v04 to Section 2 to keep the features together in the document.~~

~~2.5.1.1.1 Retrieve Device Identity~~

~~A transportation system operator needs to request and obtain/receive basic information about the device, such as its location, and the make, model, and version of the device components.~~

~~2.5.1.1.2 Control Auxiliary Inputs/Outputs~~

~~A transportation system operator may need to monitor and control external devices through the auxiliary input and output ports on the controller. For example, the ESS may be co-located with a warning sign equipped with flashing beacons; this feature would allow the controller to activate and deactivate the beacons, rather than requiring an additional controller at the site.~~

2.5.1.2 Monitor Door Status

A transportation system operator may need to determine if any doors on permanent or transportable ESS equipment are open; this may assist the operator in determining whether a ~~controller~~RPU needs maintenance and/or may act as an indication to the system to treat any data as suspect.

2.5.1.3 Monitor Power

A transportation system operator may need to monitor the power for the ESS to ensure proper operation; this may assist the operator in determining whether the power source for the ESS is suspect and needs maintenance. This need may not apply to a mobile ESS using the vehicle's power source.

2.5.1.4 Monitor Mobile Station Data

A transportation system operator may need to monitor the movements of a mobile ESS. This feature allows the transportation system operator to determine the location where sensor readings are collected.

2.5.1.5 Determine ESS Type

Some features defined within NTCIP 1204 v04 are not applicable to all ESS - some features are dependent on whether an ESS is permanent, transportable, or mobile.

a) **Permanent:** The ESS is not designed to be relocated.
b) **Transportable:** The ESS is capable of being relocated, but its environmental sensors and pavement treatment devices do not operate while moving.
c) **Mobile:** The ESS, including environmental sensors and pavement treatment devices, is able to operate while in motion.

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Thus, the user categorizes the ESS according to whether it is permanent, transportable, or mobile prior to determining which requirements are mandatory for a particular project or ESS.

Note: An agency (procurement) specification may include one to all of these types.

2.5.1.6 Monitor the Status of the ESS

A transportation system operator needs to monitor the ESS status to determine the operational state of the ESS. This feature allows the operator to determine if the ESS has detected a fault, such as sensor failure, that may prevent the proper operation of the ESS.

2.5.2 Sensor Manager Features

Section 2.5.2 identifies and describes the various features that may be offered by the Sensor Manager:

a) monitor weather conditions
b) monitor pavement
c) monitor subsurface conditions
d) monitor human readings
e) monitor water levels
f) monitor air quality and biohazards
g) monitor mobile weather profile

2.5.2.1 Monitor Weather Conditions

This feature focuses on weather conditions that can directly or indirectly affect the transportation system. It includes the following sub-features.

2.5.2.1.1 Monitor Atmospheric Pressure

A transportation system operator may need to monitor the atmospheric pressure in the vicinity of the ESS and to configure and retrieve the metadata for the atmospheric pressure measurements. This feature allows the operator to monitor changing weather conditions.

2.5.2.1.2 Monitor Winds

A transportation system operator may need to monitor the current wind conditions in the vicinity of the ESS and to configure and retrieve the metadata for the wind measurements. This feature allows an operator to determine if vehicle restrictions on a given roadway or bridge span should be issued or to restrict roadway maintenance (e.g., fire alerts).

2.5.2.1.3 Monitor Air Temperature

A transportation system operator may need to monitor the air temperature at the ESS location and to configure and retrieve the metadata for the temperature measurement. This feature allows an operator to dispatch maintenance vehicles to treat roadway pavement or to determine if restrictions or warnings to travelers should be issued.

2.5.2.1.4 Monitor Relative Humidity

A transportation system operator may need to monitor the relative humidity at the ESS location and to configure and retrieve the metadata for the humidity measurement. This feature allows an operator to schedule roadway maintenance activities, such as painting.

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2.5.2.1.5 Monitor Precipitation

A transportation system operator may need to monitor the amount, intensity, and type of precipitation in the vicinity of the ESS and to configure and retrieve the metadata for the precipitation measurements. This feature allows an operator to determine if restrictions or warnings, such as flood warnings, should be issued to travelers.

2.5.2.1.6 Monitor Solar Radiation

A transportation system operator may need to monitor the amount of solar radiation in the vicinity of the ESS and to configure and retrieve the metadata for the solar radiation measurements. This feature allows an operator to schedule maintenance activities (e.g., based on pavement temperatures) or restrict roadway usage.

2.5.2.1.7 Monitor Visibility

A transportation system operator may need to monitor the visibility in the vicinity of the ESS and to configure and retrieve the metadata for the visibility measurement. This feature allows an operator to determine if restrictions or warnings are needed, such as lowering vehicle speed limits.

2.5.2.1.8 View Environmental Image

A transportation system operator may need to visually inspect weather or pavement conditions and/or verify the reported weather or pavement conditions.

2.5.2.1.9 Monitor Dewpoint Temperature

A transportation system operator may need to monitor the dew point temperature. The dew point temperature can be calculated or measured, and is used to determine the temperature when condensation (dew, frost) occurs.

2.5.2.2 Monitor Pavement

This feature focuses on monitoring road conditions that may adversely affect transportation operations immediately or in the near future. It supports the transportation system operator's ability to dispatch equipment to address the condition or to provide appropriate warnings. It includes the following sub-features.

2.5.2.2.1 Monitor Pavement Surface Condition

~~This feature focuses on the conditions on the roadway pavement surface that can directly or indirectly affect the transportation system. It includes the following sub-features.~~
~~NOTE—This user need was revised in NTCIP 1204 v04 to more accurately reflect the user needs.~~

~~2.5.2.2.1.1 Monitor Pavement Temperature~~

A transportation system operator may need to monitor the pavement surface temperature~~-~~, the moisture condition (e.g., dry, wet, snowy, icy, chemical concentration, etc.) on and ~~to~~around the roadway pavement, and to configure and retrieve the metadata for the ~~pavement surface temperature. This feature allows an operator to issue vehicle restrictions (for example, otherwise there could be damage to the~~ roadway pavement ~~due to high temperatures), and to determine whether the pavement may ice up.~~

~~2.5.2.2.1.2 Monitor Pavement Conditions~~

~~A transportation system operator may need to monitor the measured conditions of the roadway~~sensors. This feature allows an operator to monitor for readings that could lead to hazardous conditions on the

roadway ~~other than~~based on moisture~~, such as~~ or low roadway friction, and ~~dispatch~~allows maintenance ~~crews~~managers to ~~remedy~~determine, in combination with other data, if they need to treat the ~~conditions~~road.

2.5.2.2.2 Monitor Icing Conditions

A transportation system operator may need to monitor whether pavement conditions are likely for ice formation on the pavement. This includes the ability to monitor pavement temperature (i.e., as opposed to surface temperature), the depth of any water film on the surface, and the predicted freeze point of the surface. This feature focuses on the conditions on the roadway pavement surface that can directly or indirectly lead to icing that affects the transportation system. ~~It includes the following sub-features. NOTE—This user need was revised in NTCIP 1204 v04 to more accurately reflect the user needs.~~

~~2.5.2.2.2.1 Monitor Surface Moisture Conditions~~

A transportation system operator may ~~need to monitor the moisture type and depth on the surface layer and to retrieve the metadata for the surface moisture readings. This feature allows an operator to monitor for readings that could lead to hazardous conditions on the roadway due to moisture (e.g., icing, high snow drifts), and dispatch maintenance crews to remedy the conditions. This includes the ability to monitor the depth of any water film on the surface, and the predicted freeze point of the surface.~~

~~2.5.2.2.2.2 Configure Pavement Controller~~

~~A transportation system operator may~~also need to monitor and configure the ~~controller~~RPU parameters. The operator needs to be able to change the parameters based on the treatment that is being applied on the pavement so accurate readings are measured by the pavement sensors.

2.5.2.2.3 View Pavement Image

A transportation system operator may need to visually inspect pavement conditions and/or verify the reported pavement conditions.

2.5.2.3 Monitor Subsurface Conditions

A transportation system operator may need to retrieve the conditions below the road surface and to retrieve the metadata for the subsurface measurements. The operator may monitor for readings that could lead to road damage and/or affect the onset of icing conditions (e.g., water level table). It supports the transportation system operator's ability to dispatch equipment to address the condition or to provide appropriate warnings.

2.5.2.4 Monitor Human Readings

A transportation system operator may need to retrieve data that was manually observed and entered by field personnel, such as a snow plow operator. This feature allows an operator to verify measured sensor readings.

2.5.2.5 Monitor Water Level

A transportation system operator may need to monitor the depth of water at one or more locations (e.g., over a roadway, in a stream, of a reservoir, etc.). ~~For example, this~~This feature allows an operator to issue flood warnings to travelers, public safety agencies, and maintenance crews, if necessary.

2.5.2.6 Monitor Air Quality and Biohazards

A transportation system operator may need to monitor the current air quality in the vicinity of the ESS and to retrieve the metadata for the air quality measurements. The operator may monitor these measurements

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to determine whether there are airborne biohazards in the vicinity of the ESS. These measurements are also used to issue ozone alert warnings to the public.

2.5.2.7 Monitor Mobile Weather Profile

A transportation system operator may need to monitor information that is specific to a mobile ~~station~~ESS such as vehicle speed. This feature allows an operator to log the route of the mobile ~~station~~ESS and develop an environmental profile that can be used as an input for weather forecast models or maintenance decision support systems. This may also include odometer readings for verification purposes.

2.5.3 Pavement Treatment System Manager Features

The following identify and describe the various features that may be offered by a Pavement Treatment System Manager. It consists of the following features:

a) manage stationary spray system
b) manage mobile spray system

2.5.3.1 Manage Stationary Spray System

A transportation system operator may need to manage the application of anti-icing or de-icing chemicals through the use of a sprayer connected to ~~the~~a permanent or transportable ESS (e.g., a bridge sprayer). ~~The management of this device~~ This feature includes the configuration, monitoring, and activation of ~~this device.~~a permanent or transportable spray system. This feature allows ~~an operator to~~ pre-~~treat~~treatment of the roadway pavement, either manually or programmatically, before hazardous conditions occur, or to remedy a hazardous condition.

2.5.3.2 Manage Mobile Spray System

A transportation system operator may need to manage the application of anti-icing or de-icing materials from a mobile pavement treatment system (e.g., a salt truck). This feature allows an operator to monitor and ~~remotely~~ change the rate anti-icing or de-icing materials are applied.

~~**2.5.3.3 Monitor Pavement Treatment Materials**~~

~~A transportation system operator may need to monitor what roadway treatment materials are being dispersed so the operator can determine how the roadway is being maintained.~~

2.5.4 Backward Compatibility Needs

Note: These user needs were moved from Section 2.6 in NTCIP 1204 v034 to conform with NTCIP 8002~~,~~ Annex B1.

2.5.4.1 Backward Compatible with NTCIP 1204 v01

A newer transportation system component may need to communicate with other components that conform to NTCIP 1204 v01.

2.5.4.2 Backward Compatible with NTCIP 1204 v02

A newer transportation system component may need to communicate with other components that conform to NTCIP 1204 v02.

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2.5.4.3 Backward Compatible with NTCIP 1204 v03

A newer transportation system component may need to communicate with other components that conform to NTCIP 1204 v03.

2.6 Security

NTCIP 1204 v04 does not address any security issues. Any security pertaining to protecting the communications with an ESS should be implemented either physically by protecting the communications access points, or logically by enabling security features associated with the underlying communications protocols.

2.7 Relationship to the ITS National Architecture [Informative]

NTCIP 1204 v04 addresses eight (8) National ITS Architecture Flows associated with the operation of an ESS. These flows are:

a) **Environmental Sensors Control:** Data used to configure and control environmental sensors.
b) **Environmental Sensor Data:** Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) as measured and reported by fixed and/or mobile environmental sensors. Operational status of the sensors is also included.
c) **Environmental Conditions:** Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) that are measured by environmental sensors.
d) **Environmental Probe Data:** Data from vehicle safety and convenience systems that can be used to estimate environmental conditions, including measured air temperature, exterior light status, wiper status, sun sensor status, rain sensor status, traction control status, anti-lock brake status, and other collected vehicle system status and sensor information. The collected data is reported along with the location, heading, and time that the data was collected. Both current data and snapshots of recent events (e.g., traction control or anti-lock brake system activations) may be reported.
e) **Pollution Sensor Control:** Data used to configure and control area pollution and air quality sensors.
f) **Area Pollution Data:** Measured air quality data, including measured levels of atmospheric pollutants including ozone, particulate matter, carbon monoxide, and nitrogen oxides, and operational status of the sensors.
g) **Roadway Treatment System Control:** Control data for remotely located, automated devices that affect the roadway surface (e.g. de-icing applications).
h) **Roadway Treatment System Status:** Current operational status of automated roadway treatment devices (e.g., anti-icing systems).

Each Architecture Flow is associated with one of the following interfaces identified within the National ITS Architecture as:

a) Between a Traffic Management Center (TMS) and a ~~Controller~~RPU (Roadway Subsystem (RS))
b) Between a Maintenance and Construction Management Center (MCMS) and a ~~Controller~~RPU (Roadway Subsystem (RS))
c) Between a Maintenance and Construction Vehicle (MCV) and a Maintenance and Construction Management Center (MCMS)
d) Between a Maintenance and Construction Vehicle (MCV) and a ~~Controller~~RPU (Roadway System (RS))
e) Between a Surface Transportation Weather Service (STWS) and a ~~Controller~~RPU (Roadway System (RS))
f) Between a Weather Service (WS) and a ~~Controller~~RPU (Roadway System (RS))
g) Between a Emissions Management Subsystem (EMMS) and a ~~Controller~~RPU (Roadway System (RS))
h) Between an Information Service Provider (ISP) and a ~~Controller~~RPU (Roadway System (RS))

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The main user need groups (features), as identified in Section 2, are related to the National ITS Architecture Flows as shown in Table 1.

Table 1 User Need Groups and National ITS Architecture Flows

User Need Group	Source	Architecture Flow	Destination
Manage ESS	MCMS	environmental sensors control	RS
	MCV	environmental sensors control	MCMS
	MCV	environmental sensors control	RS
	TMS	environmental sensors control	RS
	STWS	environmental sensors control	RS
	WS	environmental sensors control	RS
	EMMS	pollution sensor control	RS
Monitor weather conditions	MCV	environmental sensors data	MCMS
	RS	environmental sensors data	MCMS
	RS	environmental sensors data	MCV
	RS	environmental sensors data	TMS
	RS	environmental sensors data	STWS
	RS	environmental sensors data	WS
	RS	environmental probe data	ISP
	RS	environmental probe data	MCMS
Monitor pavement	MCV	environmental sensors data	MCMS
	RS	environmental sensors data	MCMS
	RS	environmental sensors data	MCV
	RS	environmental sensors data	TMS
	RS	environmental sensors data	STWS
	RS	environmental sensors data	WS
	RS	environmental probe data	ISP
	RS	environmental probe data	MCMS
Monitor subsurface conditions	MCV	environmental sensors data	MCMS
	RS	environmental sensors data	MCMS
	RS	environmental sensors data	MCV
	RS	environmental sensors data	TMS
	RS	environmental sensors data	STWS
	RS	environmental sensors data	WS
	RS	environmental probe data	ISP
	RS	environmental probe data	MCMS
Monitor human readings	MCV	environmental sensors data	MCMS
	RS	environmental sensors data	MCMS
	RS	environmental sensors data	MCV
	RS	environmental sensors data	TMS
	RS	environmental sensors data	STWS
	RS	environmental sensors data	WS
	RS	environmental probe data	ISP
	RS	environmental probe data	MCMS
Monitor flood levels	MCV	environmental sensors data	MCMS
	RS	environmental sensors data	MCMS
	RS	environmental sensors data	MCV
	RS	environmental sensors data	TMS
	RS	environmental sensors data	STWS
	RS	environmental sensors data	WS

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User Need Group	Source	Architecture Flow	Destination
Monitor air quality	MCV	environmental sensors data	MCMS
	RS	area pollution data	EMMS
Control pavement treatment	MCMS	roadway treatment system control	RS
	RS	roadway treatment system status	MCMS

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Section 3
Functional Requirements [Normative]

Section 3 defines the Functional Requirements based on the user needs identified in Section 2, and provides the reader with:

a) A tutorial
b) **Architectural Requirements**: These requirements relate to the architectural needs defined in Section 2.4.
c) **Data Exchange Requirements:** These requirements relate to the features identified in Section 2.5 that can be realized through a data exchange. For example, this includes the requirement to be able to retrieve weather information.
d) **Supplemental Requirements**: These are additional requirements derived from Section 2 that do not fall into categories b) or c). For example, they include performance requirements and requirements related to filename formats.

Section 3 is intended for all readers, including:

a) transportation operations managers
b) transportation operations personnel
c) transportation engineers
d) system integrators
e) device manufacturers

For the first three categories of readers, Section 3 provides a useful understanding of the details of what NTCIP 1204 v04 requires of an ESS. Section 3.3 may be particularly useful to these readers in preparing procurement specifications and mapping various rows of this table to the more detailed text contained elsewhere.

For the last two categories of readers, Section 3 provides a useful understanding of what is required of equipment conforming to NTCIP 1204 v04. For these readers, Section 3.3 provides a table to document the capabilities of their implementations.

3.1 Tutorial [Informative]

Section 3 defines the requirements that are intended to fulfill the user needs identified in Section 2. This is achieved through the development of a Protocol Requirements List (PRL) that traces each user need to one or more requirements. The details of each requirement are then presented following the PRL. The requirements are presented in three broad categories as follows:

a) **Architectural Requirements**: These requirements define the required behavior of the system in exchanging data across the communications interface, including any restrictions to general architectural requirements, based upon the architectural needs identified in Section 2.
b) **Data Exchange Requirements:** These requirements define the required behavior of the system in exchanging data across the communications interface based on the features identified in Section 2.
c) **Supplemental Requirements:** These requirements define additional requirements of the system that are derived from the architectural and/or data exchange requirements, but are not themselves architectural or data exchange requirements. A given supplemental requirement may relate to multiple architectural and/or data exchange requirements.

3.2 Scope of the Interface [Informative]

Section 3.2 does not apply in the context of NTCIP 1204 v04.

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3.3 Protocol Requirements List (PRL)

The PRL, provided in a table in Section 3.3.3, maps the user needs defined in Section 2 to the requirements defined in Section 3. The PRL can be used by:

a) a user or specification writer to indicate which requirements are to be implemented in a project-specific implementation
b) the protocol implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight
c) the supplier and user, as a detailed indication of the capabilities of the implementation
d) the user, as a basis for initially checking the potential interoperability with another implementation

3.3.1 Notation [Informative]

The following notations and symbols are used to indicate status and conditional status in the PRL within all NTCIP standards. Not all of these notations and symbols may be used within NTCIP 1204 v04.

3.3.1.1 Conformance Symbols

The ~~following~~ symbols in Table 2 are used to indicate status in the PRL table (Section 3.3.3).

Table 2 Conformance Symbols

Symbol	Status
M	Mandatory
M.#	Support of every item of the group labeled by the same numeral # required, but only one is active at time
O	Optional
O.# (range)	Part of an option group. Support of the number of items indicated by the '(range)' is required from all options labeled with the same numeral #
C	Conditional
N/A	Not applicable (i.e., logically impossible in the NTCIP 1204 v0~~3~~4 scope)
X	Excluded or prohibited

The O.# (range) notation is used to show a set of selectable options (e.g., O.2 (1..*) would indicate that one or more of the option group 2 options is required to be implemented). Two character combinations are used for dynamic requirements. In this case, the first character refers to the static (implementation) status, and the second refers to the dynamic (use); thus "MO" means "mandatory to be implemented, optional to be used."

3.3.1.2 Conditional Status Notation

The predicate notations in Table 3 may be used. ~~The support column can be used by a procurement specification to identify the required features for the given procurement or by an implementer to identify which features have been implemented. In either case, the user circles the appropriate answer (Yes, No, or N/A) in the support column:~~

Table 3 Conditional Status Notation

~~Yes~~	~~Supported by the implementation.~~
~~No~~	~~Not supported by the implementation.~~
~~N/A~~	~~Not applicable for the implementation.~~

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~~3.3.1.3 Support Column Symbols~~

~~The following predicate notations may be used:~~

~~Table 4 Support Column Entries~~

Predicate	Notation
<predicate>:	This notation introduces a single item that is conditional on the <predicate>.
<predicate>::	This notation introduces a table or a group of tables, all of which are conditional on the <predicate>.
(predicate)	This notation introduces the first occurrence of the predicate. The feature associated with this notation is the base feature for all options that have this predicate in their conformance column.

The <predicate>: notation means that the status following it applies only when the PRL states that the feature or features identified by the predicate are supported. In the simplest case, <predicate> is the identifying tag of a single PRL item. The <predicate>:: notation may precede a table or group of tables in a section. When the group predicate is true then the associated section shall be completed. The symbol <predicate> also may be a Boolean expression composed of several indices. "AND", "OR", and "NOT" shall be used to indicate the Boolean logical operations.

The predicates used in NTCIP 1204 v04 map to the ~~following~~ sections indicated in Table 4.

Table 4 Predicate Mapping to NTCIP 1204 v04 Section

Predicate	Section
Active	3.6.9
~~Air~~	~~2.5.2.6~~2.5.2.6
~~AirMetadata~~AirLoc	3.5.2.1.~~15~~20.1
~~Compressed~~	~~2.4F.1.1.2.2~~
CO	3.5.2.3.6.1
CO2	3.5.2.3.6.2
Friction	~~3.5.2.1.19.1~~3.5.2.1.~~14~~19.1
HumLoc	3.5.2.1.13.1
Mobile	02.5.1.5.c
~~Passive~~N2O	3.5.2.3.6.3~~.3~~
NO2	~~3.5.2.3.6.4~~3.5.2.3.6.4
O3	~~3.5.2.3.6.6~~3.5.2.3.6.6
Passive	~~3.6.10~~3.6.10
PaveLoc	~~3.5.2.1.17.1~~3.5.2.1.17.1
~~Pavement~~	~~3.5.2.2~~2.5.2.2
Pave~~ment~~Meta	~~3.5.2.1.4~~3.5.2.1.4
~~Precipitation~~	~~3.5.2.1.10~~
PM10	~~3.5.2.3.6.7~~3.5.2.3.6.7
PM2.5	~~3.5.2.3.6.9~~3.5.2.3.6.9
Portv03	~~3.5.4.13~~3.5.4.13
~~Pressure~~PrecipLoc	~~3.5.2.1.14.1~~3.5.2.1.14.1
~~Radiation~~PrecipRate	~~3.5.2.3.2.6.5~~3.5.2.3.~~1.12~~2.6.5
PrecipUser	~~3.5.2.3.2.6.6~~3.5.2.3.2.6.6
PressLoc	~~3.5.2.1.10.1~~3.5.2.1.10.1
PTSLoc	3.5.2.1.21.1
~~3.5.2.1.10.2~~RadLoc	~~3.5.2.1.15.1~~3.5.2.1.15.1

Predicate	Section
SO2	~~3.5.2.3.6.5~~3.5.2.3.6.5
SubLoc	~~3.5.2.1.18.1~~3.5.2.1.18.1
SubMeta	~~3.5.2.1.5~~3.5.2.1.5
~~Subsurface~~	~~3~~2.5.2.3~~.5.2.1.5~~
Temperature	~~3.5.2.1.3~~3.5.2.1.3
TempLoc	~~3.5.2.1.12.1~~3.5.2.1.12.1
~~TotalRadiation~~	~~3.5.2.3.2.7.4~~
WaterLoc	~~3.5.2.1.21.1~~3.5.2.1.1621.1
WaterWarn	~~3.5.2.1.21.3~~3.5.2.1.21.3
~~Weather~~	~~2.5.2.1~~2.5.2.1
Wind	3.5.2.1.2
WindLoc	~~3.5.2.1.11.1~~3.5.2.1.11.1
VisibLoc	~~3.5.2.1.16.1~~3.5.2.1.16.1

~~3.3.1.4~~3.3.1.3 Support Column Symbols

The support column can be used in a procurement specification to identify the required features for the given procurement or by an implementer to identify which features have been implemented. In either case, the user circles the appropriate answer (Yes, No, or N/A) in the support column. See Table 5.

Table 5 Support Column Entries

Entry	Identifier
Yes	Supported by the implementation.
No	Not supported by the implementation.
N~~/~~A	Not applicable for the implementation.

3.3.2 Instructions for Completing the PRL [Informative]

In the Support column, each response shall be selected either from the indicated set of responses (for example: Yes / No / N/A), or it shall reference additional items that are to be attached.

If a conditional requirement is inapplicable, use the Not Applicable (N/A) choice. If a mandatory requirement is not satisfied, exception information shall be supplied by entering a reference Xi, where i is a unique identifier, to an accompanying rationale for the non-conformance. When the status is expressed as a two-character combination (as defined in Annex A.3.1), the response shall address each element of the requirement; e.g., for the requirement "mo," the possible compliant responses are "yy" or "yn."

> Note: An agency specification can allow for flexibility in a deliverable by leaving the selection in the 'Support' column blank for a given row. For example, an agency specification could allow for either passive or active icing detectors by selecting 'Yes' on PRL line 2.5.2.2.2, and leaving PRL lines 3.5.2.3.3.2 and 3.5.2.3.3.3 blank.

3.3.2.1 Conformance Definition

To claim "Conformance" to NTCIP 1204 v04, the vendor shall minimally fulfill the mandatory requirements as identified in the PRL table (see Section 3.3.3). In addition, a conformant device may offer additional (optional) features, as long as they are conformant with the requirements of NTCIP 1204 and the standards it references.

> Note: The reader and user of NTCIP 1204 v04 is advised that 'conformance' to NTCIP 1204 v04 should not be confused with 'compliance' to a specification. NTCIP 1204 v04 is as broad as possible to allow a very simple ESS~~SCP~~ implementation to be 'conformant' to NTCIP 1204 v04.

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> An agency specification needs to identify the requirements of a particular project and needs to require the support of those requirements. A specification writer is advised to match the requirements of a project with the corresponding standardized requirements defined in NTCIP 1204 v04 to achieve interoperability. This means that functions and requirements defined as 'optional' in NTCIP 1204 v04 might need to be selected in a specification (in effect made 'mandatory' for the project-specific specification).

A conformant device may offer additional (optional) features, as long as they are conformant with the requirements of NTCIP 1204 v04 and the standards it references (e.g., NTCIP 1201 v03 and NTCIP 2301 v02). For example a device may also support data that has not been defined by NTCIP 1204 v04; however, when exchanged via one of the NTCIP 2301 v02 protocols, the data shall be properly registered with a valid OBJECT IDENTIFIER under the Global ISO Naming Tree.

> Note: Off-the-shelf interoperability and interchangeability can only be obtained through well documented features broadly supported by the industry as a whole. Designing a system that uses features not defined in a standard or not typically deployed in combination with one another inhibits the goals of interoperability and interchangeability, especially if the documentation of these features is not available for distribution to system integrators. Standards allow the use of additional features to support innovation, which is constantly needed within the industry; but users should be aware of the risks involved with using such features.

3.3.3 Protocol Requirements List (PRL) Table

In addition to the Conformance column and the Support column, which were discussed in Section 3.3.1, the additional columns in the PRL table are the User Need ID and User Need columns, FR ID and Functional Requirement columns and the Additional Specifications column.

a) User Need ID - the number assigned to the user need statement. The user needs are defined within Section 2 and the PRL is based upon the user need sections within that Section.
b) User Need – a short descriptive title identifying the user need.
c) FR ID – the number assigned to the functional requirement statement. The requirements are defined within Section 3 and the PRL references the traces from user needs to these requirements.
d) Functional Requirement – a short descriptive title identifying the functional requirement.
e) Conformance – Indicates if the implementation is mandatory or optional.
f) Support – user selectable to indicate yes or no to the requirement.
g) Additional Specifications - identifies other requirements that must be satisfied, including user selectable range values. The "Additional Specifications" column may (and should) be used by a procurement specification to provide additional notes and requirements for the product to be procured or may be used by an implementer to provide any additional details about the implementation. In some cases, default text already exists in this field, which the user should complete to fully specify the equipment. However, additional text can be added to this field as needed to fully specify a feature.

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Table 6 Protocol Requirements List

Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.4~~2.4~~	Architectural Needs			M	Yes	
2.4.1	Generic Architectural Needs			M	Yes	
2.5	Features			M	Yes	
2.5.1	ESS Manager Features			M	Yes	
2.5.1.1	Generic Features			M	Yes	
2.5.1.2	Monitor Door Status			O	Yes / No	
		3.5.1.2.1	Retrieve ESS Door Status	M	Yes / NA	
2.5.1.3	Monitor Power			O	Yes / No	
		3.5.1.2.2	Retrieve Battery Status	O.1 (1..*)	Yes / No / NA	
		3.5.1.2.3	Retrieve Line Volts	O.1 (1..*)	Yes / No / NA	
2.5.1.4	Monitor Mobile Station Data			Mobile:M	Yes / NA	
		3.5.1.3.1	Retrieve Mobile ESS Movement	M	Yes / NA	NTCIP 1204 v04 does not impose any accuracy requirements. Any accuracy requirements should be inserted here.
		~~3.5.1.3.4~~	~~Retrieve Compressed Mobile ESS~~	~~M~~	~~Yes / NA~~	
2.5.1.5	Determine ESS Type			M	Yes	
2.5.1.5.a	Permanent			O.2 (1)	Yes / No	
2.5.1.5.b	Transportable			O.2 (1)	Yes / No	
2.5.1.5.c (Mobile)	Mobile			O.2 (1)	Yes / No	
		3.5.1.1.1	Retrieve ESS Characteristics	M	Yes	
2.5.1.6	Monitor the Status of the ESS			O	Yes / No	
		3.5.1.2.4	Retrieve ESS Status	M	Yes / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2	Sensor Manager Features			O.3 (1..*)	Yes / No	
2.5.2.1 ~~(Weather)~~	Monitor Weather Conditions			O.4 (1..*)	Yes / No / NA	
2.5.2.1.1	Monitor Atmospheric Pressure			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.10.1 (PressLoc)	Retrieve Atmospheric Pressure Metadata - Location	O	Yes / No / NA	
		3.5.2.1.10.2 ~~(PressSensor)~~	Retrieve Atmospheric Pressure Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.10.3	Configure Atmospheric Pressure Metadata - Location	PressLoc:O	Yes / No / NA	
		~~3.5.2.1.10.4~~		~~PressSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.2.10	Retrieve Atmospheric Pressure	M	Yes / NA	
		3.6.1	Required Number of Atmospheric Pressure Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) atmospheric pressure sensors.
2.5.2.1.2	Monitor Winds			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.2 (Wind)	Retrieve Metadata for Each Wind Sensor - Text Description	O	Yes / No / NA	
		3.5.2.1.11.1 (WindLoc)	Retrieve Metadata for Each Wind Sensor - Location	O	Yes / No / NA	
		3.5.2.1.11.2 ~~(WindSensor)~~	Retrieve Metadata for Each Wind Sensor - Sensor Information	O	Yes / No / NA	
		3.5.2.1.11.3	Configure Wind Sensor Metadata - Location	Wind:O; WindLoc:O	Yes / No / NA	
		~~3.5.2.1.11.4~~		~~WindSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.2.2	Retrieve Wind Data	M	Yes / NA	
		3.6.2	Required Number of Wind Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) wind sensors.
2.5.2.1.3	Monitor Air Temperature			O.5 (1..*)	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.1.3 (Temperature)	Retrieve Temperature Sensor Metadata - Height	O	Yes / No / NA	
		3.5.2.1.12.1 (TempLoc)	Retrieve Temperature Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.12.2 ~~(TempSensor)~~	Retrieve Temperature Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.12.3	Configure Temperature Sensor Metadata - Location	Temperature:O; TempLoc:O	Yes / No / NA	
		~~3.5.2.1.12.4~~		~~TempSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.2.3	Retrieve Air Temperature	M	Yes / NA	
		3.5.2.3.2.4	Retrieve Daily Minimum and Maximum Temperature	M	Yes / NA	
		3.6.3	Required Number of Temperature Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) temperature sensors.
2.5.2.1.4	Monitor Relative Humidity			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.13.1 (HumLoc)	Retrieve Humidity Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.13.2 ~~(HumSensor)~~	Retrieve Humidity Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.13.3	Configure Humidity Sensor Metadata - Location	HumLoc:O	Yes / No / NA	
-	-	~~3.5.2.1.13.4~~		~~HumSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.2.11	Retrieve Relative Humidity	M	Yes / NA	
		3.6.4	Required Number of Humidity Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) humidity sensors.
2.5.2.1.5	Monitor Precipitation			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.14.1 (PrecipLoc)	Retrieve Precipitation Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.14.2 ~~(PrecipSensor)~~	Retrieve Precipitation Sensor Metadata - Sensor Information	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.1.14.3	Configure Precipitation Sensor Metadata - Location	PrecipLoc:O	Yes / No / NA	
		~~3.5.2.1.14.4~~		~~PrecipSensor:O~~	~~Yes / No / NA~~	
		3.5.2.1.14.4	Configure Precipitation Total User Specified Period	PrecipUser:O	Yes / No / NA	
		3.5.2.3.2.6.4	Retrieve Precipitation Presence	M	Yes / NA	
		3.5.2.3.2.6.5 (PrecipRate)	Retrieve Precipitation Rates	O	Yes / No / NA	
		3.5.2.3.2.6.6 ~~(PrecipUser)~~	Retrieve Precipitation Totals	O	Yes / No / NA	
		3.5.2.3.2.6.7 (PrecipUser)	Retrieve Precipitation Totals - User Specified	~~PrecipUser:~~O	Yes / No / NA	
		3.5.2.3.2.6.8	Retrieve Precipitation Type	O	Yes / No / NA	
		3.5.2.3.5.2	Retrieve Precipitation Situation	O	Yes / No / NA	
		3.6.5	Required Number of Precipitation Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) precipitation sensors.
		F.2.2.1.5.1	Set Time	PrecipRate:M	Yes / NA	
		F.2.2.1.5.2	Retrieve Current Time	PrecipRate:M	Yes / NA	
2.5.2.1.6	Monitor Solar Radiation			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.15.1 (RadLoc)	Retrieve Solar Radiation Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.15.2 ~~(RadSensor)~~	Retrieve Solar Radiation Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.15.3	Configure Solar Radiation Sensor Metadata - Location	RadLoc:O	Yes / No / NA	
		~~3.5.2.1.15.4~~		~~RadSensor:O~~	~~Yes / No / NA~~	
		~~3.5.2.1.15.5~~	~~Configure Total Radiation Period~~	~~M~~	~~Yes / NA~~	
		3.5.2.3.2.12~~3.5.2.3.2.7~~	Retrieve Solar Radiation	M	Yes / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.6.6	Required Number of Solar Radiation Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) solar radiation sensors.
2.5.2.1.7	Monitor Visibility			O.5 (1..*)	Yes / No / NA	
		3.5.2.1.16.1 (VisibLoc)	Retrieve Visibility Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.16.2 ~~(VisibSensor)~~	Retrieve Visibility Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.16.3	Configure Visibility Sensor Metadata - Location	VisibLoc:O	Yes / No / NA	
		~~3.5.2.1.16.4~~		~~VisibSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.2.8	Retrieve Visibility	M	Yes / NA	
		3.5.2.3.5.4~~3.5.2.3.5.4~~	Retrieve Visibility Situation	O	Yes / No / NA	
		3.5.2.3.5.7	Retrieve Cloud	O	Yes / No / NA	
		3.6.7	Required Number of Visibility Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) visibility sensors.
2.5.2.1.8	View Environmental Image			O	Yes / No	
		3.5.2.1.9	Configure Snapshot Camera	M	Yes / NA	
		3.5.2.3.8	Retrieve Snapshot	M	Yes / NA	
		3.5.2.3.9~~3.5.2.3.9~~	Retrieve Snapshot Camera Configuration~~Retrieve Snapshot Camera Configuration~~	M	Yes / NA	
		3.5.2.4.1	Capture Snapshot Image	M	Yes / NA	
		3.5.2.4.2	Delete Snapshot	M	Yes / NA	
		~~3.5.2.4.3~~3.5.2.4.~~3~~	~~Delete Snapshot – [Deprecated]~~	~~M~~	~~Yes / NA~~	~~Deprecated.~~
		3.6.20	Required Number of Snapshot Cameras	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) snapshot cameras.

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.6.23	Support Camera Number in Filename	O	Yes / No / NA	
		3.6.24	Support Sequence Number in Filename	O	Yes / No / NA	
		3.6.25	Support Date in Filename	O	Yes / No / NA	
		3.6.26	Support Time in Filename	O	Yes / No / NA	
		3.6.27	Support Long Filenames~~Support Long Filenames~~	O	Yes / No / NA	
2.5.2.1.9	Monitor Dewpoint Temperature			O.5 (1..*)	Yes / No	
		3.5.2.3.2.11	Retrieve Relative Humidity	M	Yes / NA	
2.5.2.2 ~~(Pavement)~~	Monitor Pavement			O.4 (1..*)	Yes / No / NA	
2.5.2.2.1	Monitor Pavement Surface Condition			M	Yes / NA	
		3.5.2.1.4 (PaveMeta)	Retrieve Pavement Sensor Metadata~~Retrieve Pavement Sensor Metadata~~	O	Yes / No / NA	
		3.5.2.1.6	Configure Pavement Sensor~~Configure Pavement Sensor~~	PaveMeta:O	Yes / No / NA	
		3.5.2.1.17.1 (PaveLoc)	Retrieve Pavement Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.17.2 ~~(PaveSensor)~~	Retrieve Pavement Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.17.3	Configure Pavement Sensor - Location	PaveLoc:O	Yes / No / NA	
		~~3.5.2.1.17.4~~		~~PaveSensor:O~~	~~Yes / No / NA~~	
		~~3.5.2.1.19.1 (Friction)~~		~~O.6 (1..*)~~	~~Yes / No / NA~~	
		~~3.5.2.1.19.2~~		~~Friction:O~~	~~Yes / No / NA~~	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.3.3.4~~3.5.2.3.3.4~~	Retrieve Adjacent Snow Depth [Versions 01 to 03 - Deprecated in v04]	O	Yes / No / NA	
		3.5.2.3.3.5	Retrieve Roadway Snow Depth [Versions 01 to 03 - Deprecated in v04]	O	Yes / No / NA	
		3.5.2.3.3.6	Retrieve Roadway Ice Thickness [Versions 01 to 03 - Deprecated in v04]	O	Yes / No / NA	
		3.5.2.3.3.8	Retrieve Pavement Surface Condition	O~~.6 (1..*)~~	Yes / No / NA	
		3.5.2.3.3.9	Retrieve Forecasted Pavement Surface Condition	O	Yes / No / NA	
		3.5.2.3.3.10~~3.5.2.3.3.10.1~~	Retrieve Roadway Friction Coefficient	~~Friction:~~O~~.7 (1..*)~~	Yes / No / NA	
		~~3.5.2.3.3.10.2~~		~~Friction:O.7 (1..*)~~	~~Yes / No / NA~~	
		~~3.5.2.3.3.11~~		~~O~~	~~Yes / No / NA~~	
		~~3.5.2.3.3.12~~		~~O~~	~~Yes / No / NA~~	
		3.6.8	Required Number of Pavement Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) pavement sensors.
2.5.2.2.2	Monitor Icing Conditions			O	Yes / No / NA	
		3.5.2.1.4 (PaveMeta)	Retrieve Pavement Sensor Metadata~~Retrieve Pavement Sensor Metadata~~	O	Yes / No / NA	
		3.5.2.1.6	Configure Pavement Sensor~~Configure Pavement Sensor~~	PaveMeta:O	Yes / No / NA	
		3.5.2.1.8	Configure Passive Ice Detection Logic	Passive:M	Yes / NA	
		3.5.2.1.17.1 (PaveLoc)	Retrieve Pavement Sensor Metadata - Location	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.1.17.2 ~~(PaveSensor)~~	Retrieve Pavement Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.17.3	Configure Pavement Sensor - Location	PaveLoc:O	Yes / No / NA	
		~~3.5.2.1.17.4~~		~~PavSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.3.2	Retrieve Conditions for Freezing Algorithms - Active	Active:M	Yes / NA	
		3.5.2.3.3.3	Retrieve Conditions for Freezing Algorithms - Passive	Passive:M	Yes / NA	
		~~3.5.2.3.3.13~~		~~Compressed:M~~	~~Yes / No / NA~~	
		3.6.9 (Active)	Active Pavement Treatment Sensors	O.6~~8~~ (1..*)	Yes / No / NA	
		3.6.10 (Passive)	Passive Pavement Treatment Sensors	O.6~~8~~ (1..*)	Yes / No / NA	
2.5.2.2.3	View Pavement Image			O	Yes / No	
		3.5.2.1.9	Configure Snapshot Camera	M	Yes / NA	
		3.5.2.3.8	Retrieve Snapshot	M	Yes / NA	
		3.5.2.3.9	Retrieve Snapshot Camera Configuration	M	Yes / NA	
		3.5.2.4.1	Capture Snapshot Image	M	Yes / NA	
		3.5.2.4.2	Delete Snapshot	M	Yes / NA	
		~~3.5.2.4.3~~3.5.2.4.~~3~~	~~Delete Snapshot – [Deprecated]~~	~~M~~	~~Yes / NA~~	~~Deprecated.~~
		3.6.20	Required Number of Snapshot Cameras	M	Yes / NA	The ESS shall support at least ____ snapshot cameras (1..255:Default=1).
		3.6.23	Support Camera Number in Filename	O	Yes / No / NA	
		3.6.24	Support Sequence Number in Filename	O	Yes / No / NA	
		3.6.25	Support Date in Filename	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.6.26	Support Time in Filename	O	Yes / No / NA	
		3.6.27	Support Long Filenames~~Support Long Filenames~~	O	Yes / No / NA	
2.5.2.3 ~~(Subsurface)~~	Monitor Subsurface Conditions			O.4 (1..*)	Yes / No / NA	
		3.5.2.1.5 (SubMeta)	Retrieve Subsurface Sensor Metadata	O	Yes / No / NA	
		3.5.2.1.7	Configure Subsurface Sensor	SubMeta:O	Yes / No / NA	
		3.5.2.1.18.1 (SubLoc)	Retrieve Subsurface Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.18.2 ~~(SubSensor)~~	Retrieve Subsurface Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.18.3	Configure Subsurface Sensor - Location	SubLoc:O	Yes / No / NA	
		~~3.5.2.1.18.4~~		~~SubSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.4.1	Retrieve Subsurface Temperature	M	Yes / NA	
		3.5.2.3.4.2	Retrieve Subsurface Moisture	O	Yes / No / NA	
		~~3.5.2.3.4.3~~	~~Retrieve Compressed Subsurface Condition Data~~	~~Compressed:M~~	~~Yes / No / NA~~	
		3.6.11	Required Number of Subsurface Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) subsurface sensors.
2.5.2.4	Monitor Human Readings			O.4 (1..*)	Yes / No / NA	
		3.5.2.3.5.1	Retrieve Wind Situation	M	Yes / NA	
		3.5.2.3.5.2	Retrieve Precipitation Situation	M	Yes / NA	
		3.5.2.3.5.4~~3.5.2.3.5.4~~	Retrieve Visibility Situation	M	Yes / NA	
		3.5.2.3.5.5	Retrieve Ground State	O	Yes / No / NA	
-	-	~~3.5.2.3.5.6~~	~~Retrieve Pavement State~~	~~O~~	~~Yes / No / NA~~	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.3.5.7	Retrieve Cloud Situation	M	Yes / NA	
		3.5.2.3.5.9	Retrieve Pavement State	O	Yes / No / NA	
2.5.2.5	Monitor Water Level			O.4 (1..*)	Yes / No / NA	
		3.5.2.1.20.1 (WaterLoc)	Retrieve Water Level Metadata - Location	O	Yes / No / NA	
		3.5.2.1.20.2 ~~(WaterSensor)~~	Retrieve Water Level Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.20.3 (WaterWarn)	Retrieve Water Level Metadata - Warning Level	O	Yes / No / NA	
		3.5.2.1.20.4	Configure Water Level Metadata - Location	WaterLoc:O	Yes / No / NA	
		~~3.5.2.1.21.5~~		~~WaterSensor:O~~	~~Yes / No / NA~~	
		3.5.2.1.20.5	Configure Water Level Metadata - Warning Level	WaterWarn:O	Yes / No / NA	
		3.5.2.3.7	Retrieve Water Level	M	Yes / NA	
		3.6.22~~3.6.28~~	Required Number of Water Level Sensors	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) water level sensors.
2.5.2.6 ~~(Air)~~	Monitor Air Quality and Biohazards			O.4 (1..*)	Yes / No / NA	
		3.5.2.1.19.1 (AirLoc)	Retrieve Air Quality Sensor Metadata - Location	O	Yes / No / NA	
		3.5.2.1.19.2 ~~(AirSensor)~~	Retrieve Air Quality Sensor Metadata - Sensor Information	O	Yes / No / NA	
		3.5.2.1.19.3	Configure Air Quality Sensor Metadata - Location	AirLoc:O	Yes / No / NA	
		~~3.5.2.1.20.4~~		~~AirSensor:O~~	~~Yes / No / NA~~	
		3.5.2.3.6.1 (CO)	Retrieve Carbon Monoxide Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.2 (CO2)	Retrieve Carbon Dioxide Reading	O.7~~9~~ (1..*)	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.2.3.6.3 (N2O)	Retrieve Nitrous Oxide Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.4 (NO2)	Retrieve Nitrogen Dioxide Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.5 (SO2)	Retrieve Sulfur Dioxide Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.6 (O3)	Retrieve Ozone Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.7 (PM10)	Retrieve Small Particulate Matter Reading	O.7~~9~~ (1..*)	Yes / No / NA	
		3.5.2.3.6.9 (PM2.5)	Retrieve Particulate Matter (2.5) Reading	O.7~~9~~ (1..*)	Yes / No / NA	
-	-	~~3.5.2.3.6.10~~		~~Compressed:M~~	~~Yes / No / NA~~	
		3.6.13	Required Number of Carbon Monoxide Sensors	CO:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) carbon monoxide sensors.
		3.6.14	Required Number of Carbon Dioxide Sensors	CO2:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) carbon dioxide sensors.
		3.6.15	Required Number of Nitrous Oxide Sensors	N2O:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) nitrous oxide sensors.
		3.6.16	Required Number of Nitrogen Dioxide Sensors	NO2:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) nitrogen dioxide sensors.
		3.6.17	Required Number of Sulfur Dioxide Sensors	SO2:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) sulfur dioxide sensors.
		3.6.18	Required Number of Ozone Sensors	O3:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) ozone sensors.
		3.6.19	Required Number of Small Particulate Matter Sensors	PM10:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) small particulate matter sensors.
		3.6.28~~3.6.29~~	Required Number of Small Particulate Matter (2.5) Sensors	PM2.5:O	Yes / No / NA	The ESS shall support at least ____ (Default=1) particulate matter (2.5) sensors.

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
2.5.2.7	Monitor Mobile Weather Profile			O	Yes / No / NA	
		3.5.2.3.10	Retrieve Sensor Profile with Mobile Sources	M	Yes / NA	
		F.2.1.2.1	Retrieve Current Configuration of Logging Service	M	Yes / NA	
		F.2.1.2.2	Configure Logging Service	M	Yes / NA	
		F.2.1.2.3	Retrieve Logged Data	M	Yes / NA	
		F.2.1.2.4	Clear Log	M	Yes / NA	
		F.2.1.2.5	Retrieve Capabilities of Event Logging Service	M	Yes / NA	
		F.2.1.2.6	Retrieve Total Number of Logged Events	M	Yes / NA	
		F.2.2.1.5.1	Set Time	M	Yes / NA	
		F.2.2.1.5.2	Retrieve Current Time	M	Yes / NA	
2.5.3	Pavement Treatment System Manager Features			O.3 (1..*)	Yes / No / NA	
2.5.3.1	Manage Stationary Spray System			Mobile:X; O	Yes / No / NA	The ESS shall support at least ____ (1..255: Default=1) pavement treatment products.
		3.5.2.1.21.1 (PTSLoc)	Retrieve Pavement Treatment System Metadata - Location	O	Yes / No / NA	
		3.5.2.1.21.2	Retrieve Pavement Treatment Metadata - System Information	O	Yes / No / NA	
		3.5.2.1.21.3	Configure Pavement Treatment System Metadata - Location	PTSLoc:O	Yes / No / NA	
		3.5.3.1.1	Retrieve Stationary Pavement Treatment Configuration	M	Yes / NA	
		3.5.3.1.2	Configure Stationary Pavement Treatment System	M	Yes / NA	
		3.5.3.2.1	Retrieve Pavement Treatment Status	M	Yes / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.3.4.1	Set PTS Operational Mode	M	Yes / NA	
		3.5.3.4.2	Manually Activate PTS Sprayer	M	Yes / NA	
		3.6.12	Required Number of Pavement Treatment Products	M	Yes / NA	The ESS shall support at least ____ pavement treatment products (1..255).
2.5.3.2	Manage Mobile Spray System			Mobile: O	Yes / No / NA	
		3.5.2.1.21.1 (PTSLoc)	Retrieve Pavement Treatment System Metadata - Location	O	Yes / No / NA	
		3.5.2.1.21.2	Retrieve Pavement Treatment Metadata - System Information	O	Yes / No / NA	
		3.5.2.1.21.3	Configure Pavement Treatment System Metadata - Location	PTSLoc:O	Yes / No / NA	
		~~3.5.3.1.33.5.3.1.3~~	~~Retrieve Mobile Pavement Treatment Configuration~~	~~M~~	~~Yes / NA~~	
		3.5.3.1.4	Configure Mobile Pavement Treatment System	~~M~~O	Yes / No / NA	
		3.5.3.1.5	Retrieve Mobile Pavement Treatment Configuration	O	Yes / No / NA	
		3.5.3.2.1	Retrieve Pavement Treatment Status	M	Yes / NA	
		3.5.3.3.1	Retrieve Pavement Treatment Profile with Mobile Sources	O	Yes / No / NA	
		3.5.3.4.1	Set PTS Operational Mode	O	Yes / No / NA	
		3.5.3.4.2	Manually Activate PTS Sprayer	O	Yes / No / NA	
2.5.4	Backward Compatibility Needs			O	Yes / No	
2.5.4.1	Backward Compatible with NTCIP 1204 v01			O	Yes / No / NA	
		3.5.4.1	NTCIP 1204 v01 Wind Sensor Meta Data	O	Yes / No / NA	
		3.5.4.2	NTCIP 1204 v01 Average Wind Sensor Data	O	Yes / No / NA	

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User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.4.3	NTCIP 1204 v01 Spot Wind Sensor Data	O	Yes / No / NA	
		3.5.4.4	NTCIP 1204 v01 Wind Gust Data	O	Yes / No / NA	
		3.5.4.5	NTCIP 1204 v01 Wind Situation	O	Yes / No / NA	
		3.5.4.6	NTCIP 1204 v01 Water Depth	O	Yes / No / NA	
		3.5.4.7	NTCIP 1204 v01 Solar Radiation	O	Yes / No / NA	
		3.5.4.8	NTCIP 1204 v01 Surface Water Depth	O	Yes / No / NA	
		3.5.4.9	NTCIP 1204 v01 Surface Conductivity	O~~O~~	Yes / No / NA~~Yes / No / NA~~	
		3.5.4.13	NTCIP 1204 v03 Retrieve External Port Information	O	Yes / No / NA	
		3.5.4.14	NTCIP 1204 v03 Configure Port Information	O	Yes / No / NA	
		3.5.4.15	NTCIP 1204 v03 Monitor Status of External Device	O	Yes / No / NA	
		3.5.4.16	NTCIP 1204 v03 Control External Device	O	Yes / No / NA	
		3.5.4.19	NTCIP 1204 v01-v03 Atmospheric Pressure Height	O	Yes / No / NA	
		3.5.4.21	NTCIP 1204 v01-v03 Atmospheric Pressure	O	Yes / No / NA	
		3.5.4.22	NTCIP 1204 v01-v03 Humidity	O	Yes / No / NA	
		3.5.4.23	NTCIP 1204 v01-v03 Precipitation Presence	O	Yes / No / NA	
		3.5.4.24	NTCIP 1204 v01-v03 Precipitation Rates	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.4.25	NTCIP 1204 v01-v03 Precipitation Totals	O	Yes / No / NA	
		3.5.4.28	NTCIP 1204 v01-v03 Pavement Surface Condition	O	Yes / No / NA	
		3.5.4.34	NTCIP 1204 v01-v03 Cloud Situation	O	Yes / No / NA	
2.5.4.2	Backward Compatible with NTCIP 1204 v02			O	Yes / No / NA	
		3.5.4.10	NTCIP 1204 v02 Station Meta Data Block	O	Yes / NA	
		3.5.4.11	NTCIP 1204 v02 Weather Block	O	Yes / No / NA	
		3.5.4.12	NTCIP 1204 v02 Pavement Block	O	Yes / No / NA	
		3.5.4.13	NTCIP 1204 v03 Retrieve External Port Information	O	Yes / No / NA	
		3.5.4.14	NTCIP 1204 v03 Configure Port Information	O	Yes / No / NA	
		3.5.4.15	NTCIP 1204 v03 Monitor Status of External Device	O	Yes / No / NA	
		3.5.4.16	NTCIP 1204 v03 Control External Device	O	Yes / No / NA	
		3.5.4.19	NTCIP 1204 v01-v03 Atmospheric Pressure Height	O	Yes / No / NA	
		3.5.4.21	NTCIP 1204 v01-v03 Atmospheric Pressure	O	Yes / No / NA	
		3.5.4.22	NTCIP 1204 v01-v03 Humidity	O	Yes / No / NA	
		3.5.4.23	NTCIP 1204 v01-v03 Precipitation Presence	O	Yes / No / NA	
		3.5.4.24	NTCIP 1204 v01-v03 Precipitation Rates	O	Yes / No / NA	
		3.5.4.25	NTCIP 1204 v01-v03 Precipitation Totals	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.4.28	NTCIP 1204 v01-v03 Pavement Surface Condition	O	Yes / No / NA	
		3.5.4.30	NTCIP 1204 v01-v03 Adjacent Snow Depth	O	Yes / No / NA	
		3.5.4.31	NTCIP 1204 v01-v03 Roadway Snow Depth	O	Yes / No / NA	
		3.5.4.32	NTCIP 1204 v01-v03 Roadway Ice Thickness	O	Yes / No / NA	
		3.5.4.34	NTCIP 1204 v01-v03 Cloud Situation	O	Yes / No / NA	
		3.5.4.35	NTCIP 1204 v01-v03 Ground State	O	Yes / No / NA	
		3.5.4.36	NTCIP 1204 v01-v03 Pavement State	O	Yes / No / NA	
2.5.4.3	Backward Compatible with NTCIP 1204 v03			O	Yes / No / NA	
		3.5.4.13 (Portv03)	NTCIP 1204 v03 Retrieve External Port Information	O	Yes / No / NA	The ESS shall support at least ____ binary analog output ports (1..255).
		3.5.4.14	NTCIP 1204 v03 Configure Port Information	Portv03:O	Yes / No / NA	
		3.5.4.15	NTCIP 1204 v03 Monitor Status of External Device	Portv03:O	Yes / No / NA	
		3.5.4.16	NTCIP 1204 v03 Control External Device	Portv03:O	Yes / No / NA	
		3.5.4.17	NTCIP 1204 v03 Station Metadata Block	O	Yes / No / NA	
		3.5.4.18	NTCIP 1204 v03 Mobile ESS Data Block	O	Yes / No / NA	
		3.5.4.19	NTCIP 1204 v01-v03 Atmospheric Pressure Height	O	Yes / No / NA	
		3.5.4.20	NTCIP 1204 v03 Weather Profile with Mobile Sources	O	Yes / No / NA	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.5.4.21	NTCIP 1204 v01-v03 Atmospheric Pressure	O	Yes / No / NA	
		3.5.4.22	NTCIP 1204 v01-v03 Humidity	O	Yes / No / NA	
		3.5.4.23	NTCIP 1204 v01-v03 Precipitation Presence	O	Yes / No / NA	
		3.5.4.24	NTCIP 1204 v01-v03 Precipitation Rates	O	Yes / No / NA	
		3.5.4.25	NTCIP 1204 v01-v03 Precipitation Totals	O	Yes / No / NA	
		3.5.4.26	NTCIP 1204 v03 Solar Radiation	O	Yes / No / NA	
		3.5.4.27	NTCIP 1204 v03 Weather Block	O	Yes / No / NA	
		3.5.4.28	NTCIP 1204 v01-v03 Pavement Surface Condition	O	Yes / No / NA	
		3.5.4.29	NTCIP 1204 v03 Pavement Condition Block	O	Yes / No / NA	
		3.5.4.33	NTCIP 1204 v03 Subsurface Condition Block	O	Yes / No / NA	
		3.5.4.34	NTCIP 1204 v01-v03 Cloud Situation	O	Yes / No / NA	
		3.5.4.37	NTCIP 1204 v03 Air Quality Block	O	Yes / No / NA	
		3.5.4.38	NTCIP 1204 v03 Mobile Pavement Treatment Block	O	Yes / No / NA	
F.1.1	Generic Architectural Needs					
F.1.1.1	Provide Live Data			M	Yes	
		F.2.1.1.1	Retrieve Data	M	Yes	
		F.2.1.1.2	Deliver Data	M	Yes	
		F.2.1.1.3	Explore Data	M	Yes	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		3.6.21	Maximum Response Time for Requests	M	Yes	The Response Time for all requests shall be ___ milliseconds (25-500: Default=100).
F.1.1.2 (Compressed)	Provide Compressed Data			Mobile:M; O	Yes / No	
		~~3.5.1.1.5~~		~~O~~	~~Yes / No / NA~~	
		~~3.5.2.3.2.12~~		~~Weather:M~~	~~Yes / NA~~	
		~~3.5.2.3.3.7~~	~~Retrieve Compressed Pavement Condition Data~~	~~Pavement:M~~	~~Yes / NA~~	
		~~3.5.2.3.4.3~~	~~Retrieve Compressed Subsurface Condition Data~~	~~Subsurface:M~~	~~Yes / NA~~	
		~~3.5.2.3.6.8~~	~~Retrieve Compressed Air Quality Data~~	~~Air:M~~	~~Yes / NA~~	
		3.6.21	Maximum Response Time for Requests	M	Yes	The Response Time for all requests shall be ___ milliseconds (25-500: Default=100).
F.1.1.3	Provide Off-line Log Data			O	Yes / No	
		F.2.1.2.1	Retrieve Current Configuration of Logging Service	M	Yes / NA	
		F.2.1.2.2	Configure Logging Service	M	Yes / NA	
		F.2.1.2.3	Retrieve Logged Data	M	Yes / NA	
		F.2.1.2.4	Clear Log	M	Yes / NA	
		F.2.1.2.5	Retrieve Capabilities of Event Logging Service	M	Yes / NA	
		F.2.1.2.6	Retrieve Total Number of Logged Events	M	Yes / NA	
		F.2.2.1.5.1	Set Time	M	Yes / NA	
		F.2.2.1.5.2	Retrieve Current Time	M	Yes / NA	
		F.2.3.1.1	Record and Timestamp Events	M	Yes / NA	
		F.2.3.1.2	Support a Number of Event Classes	M	Yes / NA	The ESS shall support at least ____ event classes.

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		F.2.3.1.3	Support a Number of Event Types to Monitor	M	Yes / NA	The ESS shall support at least ____ event types.
		F.2.3.1.4.1	Support On-Change Events	M	Yes / NA	
		F.2.3.1.4.2	Support Greater Than Events	M	Yes / NA	
		F.2.3.1.4.3	Support Less Than Events	M	Yes / NA	
		F.2.3.1.4.4	Support Hysteresis Events	M	Yes / NA	
		F.2.3.1.4.5	Support Periodic Events	M	Yes / NA	
		F.2.3.1.4.6	Support Bit Flag Events	M	Yes / NA	
		F.2.3.1.5	Support Event Monitoring on Any Data	M	Yes / NA	
		F.2.3.1.6	Support a Number of Events to Store in Log	M	Yes / NA	The ESS shall be capable of storing at least ____ events in the event log file.
		3.6.21	Maximum Response Time for Requests	M	Yes / NA	The Response Time for all requests shall be ___ milliseconds (25-500: Default=100).
F.1.1.4	Condition-based Exception Reporting			~~O~~N/A	~~Yes / No~~N/A	
		~~F.2.1.1.4.1A.1.1.1~~		~~M~~	~~Yes / NA~~	
		~~F.2.1.1.4.2~~		~~M~~	~~Yes / NA~~	
		~~F.2.1.1.4.3~~		~~M~~	~~Yes / NA~~	
		~~3.6.22~~		~~M~~	~~Yes / NA~~	~~The Maximum Transmission Start Time for all reports shall be ___ seconds (Default=10).~~
F.1.2	Generic Features					
F.1.2.1	Retrieve Device Identity			M	Yes	
		3.5.1.1.1	Retrieve ESS Characteristics	M	Yes	
		3.5.1.1.2	Retrieve Compressed Station Metadata [Deprecated]			
		3.5.1.1.3	Configure ESS Manager	M	Yes	

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Protocol Requirements List (PRL)						
User Need ID	**User Need**	**FR ID**	**Functional Requirement**	**Conformance**	**Support**	**Additional Specifications**
		~~3.5.1.1.4~~	~~Configure ESS Location~~	~~M~~	~~Yes~~	
		~~3.5.1.1.5~~		~~Compressed:O~~	~~Yes / No / NA~~	
		F.2.2.1.1	Retrieve Device Component Information	M	Yes	
		F.2.2.1.2	Retrieve Device Configuration Identifier	M	Yes	
		F.2.2.1.3	Retrieve Supported Standards	M	Yes	
		F.2.2.1.4	Retrieve System Name	O	Yes / No	
F.1.2.2~~0~~	Control External Devices			O	Yes / No	
		F.2.2.1.6	Retrieve External Port Information	M	Yes / NA	
		F.2.2.1.7	Configure Port Information	M	Yes / NA	
		F.2.2.2.1	Monitor Status of External Device	M	Yes / NA	
		F.2.2.4.1	Control External Device	M	Yes / NA	
		F.2.3.2	Required Number of Auxiliary Ports	M	Yes / NA	The ESS shall support at least ____ (1..255:Default=1) binary analog output ports.

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3.4 Architectural Requirements

~~Requirements for an ESS responding to requests from a management station are provided in the following subsections.~~

~~3.4.1 Support Basic Communications Requirements~~

~~Requirements for an ESS responding to requests from a management station are provided in the following subsections.~~

~~3.4.1.1 Provide Data~~

~~An ESS shall be able to provide any set of data requested by a management station at any time.~~

~~3.4.1.2 Receive Data~~

~~An ESS shall be able to receive data (e.g., configuration data, commands, etc.) from a management station at any time.~~

~~A.1.1.1.1 Explore Data~~
~~A management station shall be able to dynamically discover what data and data instances are supported by the ESS.~~

~~3.4.2 Support Condition-based Exception Reporting~~

~~An ESS shall be able to transmit data to the management station when user specified conditions are met.~~
There are no unique architectural requirements defined in NTCIP 1204 v04. The architectural needs are fully met through the generic architectural requirements defined in Annex F.2.1.

3.5 Data Exchange and O~~o~~perational ~~e~~Environment Requirements

Data exchange requirements for ESS follow.

3.5.1 ESS Manager Requirements

Requirements for managing an ESS Manager follow.

3.5.1.1 ESS Configuration Requirements

Requirements for configuring an ESS Manager follow.

3.5.1.1.1 Retrieve ESS Characteristics

~~Requirements for retrieving information related to the station type, category, and location follow.~~

~~3.5.1.1.1.1 Retrieve ESS Category~~

Upon request, the ESS shall return the ESS type, category, and location. This information consists of:

the ESS ~~to the management station. Valid ESS categories are permanent, transportable, mobile, or other.~~

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~~3.5.1.1.1.2 Retrieve ESS Type~~

a) ~~Upon request, the ESS shall return the type of ESS to the management station.~~type. The ESS type indicates if the sensor data is collected electronically or mechanically, or the data are human readings. The valid ESS types are automatic, staffed, reserved, or missing value (unknown). The ESS type can be a hybrid station (i.e., data is collected electronically/mechanically and by humans), in which case both automatic and staffed types are returned~~.~~;

~~3.5.1.1.1.3 Retrieve ESS Location~~

b) ~~Upon request,~~ the category of ESS. Valid ESS ~~shall return~~ categories are permanent, transportable, mobile, or other; and

~~b)~~c) the location of ~~ESS to~~ the ~~management station. The ESS location~~ESS, which consists of the latitude, longitude, height and a textual description of the location. The latitude and longitude are in microdegrees (10^{-6} degrees). The height of the ESS is in meters above mean sea level, and is measured to the base of the structure for a permanent ESS, to the ground surface on which the ESS resides for a transportable ESS, and to the surface under the vehicle for a mobile ESS.

3.5.1.1.2 Retrieve Compressed Station Metadata [Deprecated]

Upon request, the ESS shall return the following information about the station ~~in a compressed form~~:

a) ~~ESS~~category ~~(see requirement 3.5.1.1.1.1);~~

~~c) ESS type (see requirement 3.5.1.1.1.2);~~

b) ~~ESS~~ type of station

~~b)~~c) location ~~(see requirement 3.5.1.1.1.3);~~of ESS

~~d) configuration of sensors attached to the ESS (See requirements 3.5.2.1.1 to 3.5.2.1.7, and requirements 3.5.2.1.10 to 3.5.2.1.16); and~~

d) location of sensors

~~c)~~e) pavement treatment ~~mix (See requirement 3.5.2.1.8).~~information

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v0~~3~~4. See Annex D for further information regarding this change from NTCIP v03 to NTCIP 1204 v04 ~~of NTCIP 1204~~.

~~NOTE - This requirement was revised in NTCIP 1204 v04 to more accurately reflect the design.~~

3.5.1.1.3 Configure ESS Manager

Upon request, the ESS shall store the textual description of the ESS location, as provided within the request.

~~3.5.1.1.4 Configure ESS Location~~

~~Upon request, the ESS shall store the location of the ESS, as provided within the request. The ESS location consists of the latitude, longitude, and height. The height of the ESS is in meters above mean sea level, and is measured to the base of the structure for a permanent ESS, to the ground surface on which the ESS resides for a transportable ESS, and to the surface under the vehicle for a mobile ESS.~~

3.5.1.2 ~~ESS~~~~Section ()Section ()Section ()ote:~~ ~~NTCIP 1204 v~~~~NTCIP 1204 NTCIP 1204~~ ESS Status Monitoring Requirements

Requirements for monitoring the status of an ESS Manager follow.

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3.5.1.2.1 Retrieve ESS Door Status

Upon request, the ESS shall return an indication as to whether any doors related to the ESS (e.g., cabinet doors, housing doors, etc.) are open.

3.5.1.2.2 Retrieve Battery Status

Upon request, the ESS shall return the charge status of the battery in percent, with 100% representing a full charge.

3.5.1.2.3 Retrieve Line Volts

Upon request, the ESS shall return the voltage, in Volts Root Mean Squared, on the incoming A/C power line.

3.5.1.2.4 Retrieve ESS Status

Upon request, the ESS shall return an indication if an error condition has been detected on the ESS hardware or software. The error conditions reported are:

a) Watchdog failure
b) Power error
c) Sensor failure

A watchdog is a circuit that monitors the ESS software and firmware for any stall condition. While the ESS is powered on, the software polls the watchdog and resets the timing circuitry. A watchdog failure occurs if the watchdog circuitry times out without being reset by the software. Note: reporting of a watchdog failure assumes that the main process itself is not in a stall condition.

A power error is reported an irregular occurrence is detected with the primary power source. Examples or an irregular occurrence includes when the charge status of the battery drops below a certain percentage or the voltage on the incoming A/C power line drops below or exceeds a "normal" operating range.

A sensor failure occurs when a condition has been detected that prevents the proper reporting of sensor values (e.g., a dirty lens) or the sensor values has been deemed invalid or suspect.

3.5.1.3 ESS Data Retrieval Requirements

Requirements for retrieving data from an ESS Manager follow.

3.5.1.3.1 Retrieve Mobile ESS Movement

~~Requirements for retrieving the position and movement of a mobile ESS platform follow.~~

~~**3.5.1.3.1.1 Retrieve Mobile ESS Location**~~

Upon request, the ESS shall return the following information about the mobile platform:

a) the location of the mobile platform, ~~expressed in~~ consisting of the latitude, longitude, and height. The latitude and longitude are in microdegrees (10^{-6} degrees). The height of the mobile platform (ESS) is in meters above mean sea level~~.~~, and is measured to the surface under the vehicle;

~~**3.5.1.3.1.2 Retrieve Mobile ESS Speed**~~

b) ~~Upon request, the ESS shall return~~ the speed of the mobile platform in kilometers per hour~~.~~;

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~~3.5.1.3.1.3 Retrieve Mobile ESS Bearing~~

c) ~~Upon request, the ESS shall return~~ the bearing (direction of travel) of the mobile platform in degrees, measured clockwise from True North~~.~~; and

~~3.5.1.3.1.4 Retrieve Mobile ESS Odometer~~

~~Upon request, the ESS shall return the odometer reading of the mobile platform in meters.~~

d) the distance traveled, in meters, by the mobile platform from a reference point. This information is used to create a profile between the observations collected and the distance traveled. This may be the odometer reading on the mobile platform.

3.5.1.3.2 Retrieve Mobile Treatment Information [~~Deprecated in v03~~Obsolete]

Upon request, the ESS shall return the pavement treatment that the mobile platform is dispersing.

Note: This requirement is effectively deleted from NTCIP 1204 v03. It was determined to be redundant with Section ~~requirement~~ 3.5.3.1.3 and is more appropriately defined there (i.e., according to the terms used in NTCIP 1204 v03, the ESS Manager does not include pavement treatment information; that information would be stored in the PTS Manager.)
~~NTCIP 1204 v03, the ESS Manager does not include pavement treatment information; that information would be stored in the PTS Manager.)~~

3.5.1.3.3 Retrieve Compressed Mobile ESS Data [Version 03 - Deprecated in v04]

Upon request, the ESS shall return the following information about the station in a compressed form:

a) location of ESS
b) speed of ESS
c) pavement treatment information

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v04. ~~xxxx~~See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~3.5.1.3.3 Retrieve Compressed Mobile ESS Information~~

~~Upon request, the ESS shall return the following information about the station in a compressed form:~~

~~a) the location of the mobile platform, expressed in latitude, longitude, and meters above sea level (See requirement 3.5.1.3.1.1);~~
~~b) the speed of the mobile platform in kilometers per hour (See requirement 3.5.1.3.1.2);~~
~~c) the bearing (direction of travel) of the mobile platform in degrees, measured clockwise from True North (See requirement 3.5.1.3.1.3);~~
~~d) the odometer reading of the mobile platform in meters (See Section requirement 3.5.1.3.1.4);~~
~~e) Section Section the quantity of treatment being applied in kilograms per lane kilometer;Section~~
~~f) the width of the spread of treatment in meters; andSection~~
~~d) the mix of chemicals to use when spraying. The mix consists of the pavement treatment type, pavement treatment form and the percentage mix (by weight).~~

3.5.1.4 ESS Control Requirements

There are no control requirements for the ESS Manager.

3.5.2 Sensor Manager Requirements

Requirements for managing a Sensor Manager follow.

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3.5.2.1 Sensor Configuration Requirements

Requirements for configuring a Sensor Manager follow.

Note: A Sensor Manager may also require a user to configure proprietary data during initial set-up.

3.5.2.1.1 Retrieve Atmospheric Pressure Height [Versions 01 to 03 Only - Deprecated in v04]

~~Upon request, the ESS shall return the number of atmospheric pressure sensors connected to the ESS and the following information for each atmospheric pressure sensor:~~

~~a) a textual description of the atmospheric pressure sensor location;~~
Upon request, the ESS shall return the relative height of the atmospheric pressure sensor~~ from the height of the ESS (station) in meters;~~.
~~b) the location of the atmospheric sensor, in latitude and longitude; and~~
~~c) the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

Note: This requirement was used in NTCIP 1204 v01 to v03, but ~~was revised in~~ has been replaced in NTCIP 1204 v04~~ to satisfy~~. NTCIP 1204 v04 adds support for multiple atmospheric pressure sensors and additional ~~user needs.~~metadata. These additions are found in Section ~~requirement~~ 3.5.2.1.10. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.1.2 Retrieve Metadata for Each Wind Sensor - Text Description

Upon request, the ESS shall return the number of wind sensors connected to the ESS and the following information for each wind sensor:

a) a textual description of the wind sensor location; and
b) the relative height of ~~each~~the wind sensor to the reference height of the ESS (station) in meters~~;~~.
~~c) the location of the wind sensor, in latitude and longitude; and~~
~~d) the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

~~NOTE - This requirement was revised in NTCIP 1204 v04 to satisfy additional user needs.~~

3.5.2.1.3 Retrieve Temperature Sensor Metadata - ~~—~~H~~-~~eight

Upon request, the ESS shall return the number of air temperature sensors connected to the ESS and the ~~following information for~~relative height of each air temperature sensor~~:~~ to the reference height of the ESS (station) in meters.

~~a) a textual description of the air temperature sensor location;~~
~~b) the relative height of each air temperature sensor to the height of the ESS (station) in meters;~~
~~c) the location of the air temperature sensor, in latitude and longitude; and~~
~~d) the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~
~~NOTE - This requirement was revised in NTCIP 1204 v04 to satisfy additional user needs.~~

3.5.2.1.4 Retrieve Pavement Sensor Metadata

Upon request, the ESS shall return the number of pavement sensors connected to the ESS and the following information for each pavement sensor:

a) a textual description of the location that the pavement sensor is monitoring;

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b) the type of pavement the sensor is monitoring. Valid values are asphalt, open grade asphalt, concrete, steel bridge, concrete bridge, asphalt overlay bridge, timber bridge, other and unknown;
c) the relative height of the pavement surface at the location being monitored to the reference height of the ESS (station) in meters;
d) an indication of the ~~amount of sunlight~~skyview factor, in percent, to which the monitored pavement is subjected. A value of 100 (percent) indicates a fully visible sky; and
e) an indication of the sensor technology used. Valid values are contactPassive, contactActive, infrared, radar, vibrating, microwave, laser, and other~~;~~.

3.5.2.1.5 ~~NOTE - This requirement was~~ Retrieve Subsurface Sensor Metadata - Text Description

Upon request, the ESS shall return the number of subsurface sensors connected to the ESS and the following information for each subsurface sensor:

a) a textual description of the location that the subsurface sensor is monitoring;
b) the type of subsurface the subsurface sensor is monitoring. Valid values are concrete, asphalt, open graded asphalt, gravel, clay, loam, sand, permafrost, various aggregates, air, other, and unknown; and
c) the depth of the subsurface sensor location, in centimeters below the pavement surface.~~.~~

3.5.2.1.6 Configure Pavement Sensor

Upon request, the ESS shall store configuration information for a specified pavement sensor. The configuration information includes:

a) a textual description of the location that the pavement sensor is monitoring;
b) the type of pavement the sensor is monitoring. Valid values are asphalt, open grade asphalt, concrete, steel bridge, concrete bridge, asphalt overlay bridge, timber bridge, other and unknown; and
c) an indication of the skyview factor, in percent, to which the monitored pavement is subjected. A value of 100 (percent) indicates a fully visible sky~~;~~.

3.5.2.1.7 Configure Subsurface Sensor - Text Description

Upon request, the ESS shall store configuration information for a specified subsurface sensor. The configuration information includes:

a) a textual description of the location that the subsurface sensor is monitoring;
b) the type of subsurface the subsurface sensor is monitoring. Valid values are concrete, asphalt, open graded asphalt, gravel, clay, loam, sand, permafrost, various aggregates, air, other, and unknown; and
c) the depth of the subsurface sensor location, in centimeters below the pavement surface.

3.5.2.1.8 Configure Passive Ice Detection Logic

Upon request, the ESS shall store information regarding the pavement treatments being applied so that the ESS may more accurately estimate icing conditions using passive logic. The information includes:

a) the number of different pavement treatments stored by the ESS;
b) Each pavement treatment type stored by the ESS. Valid pavement treatment types include sand, dirt, gravel, cinders, water (as a diluting agent), enhanced salts, NaCL, CaCl, MgCl, cMA, kAC, NaFormate, NaA, and other;
c) the form of each pavement treatment type. Valid values are: dry, prewet, liquid and other; and
d) the percentage of each pavement treatment type and form by total application weight.

Different pavement treatments may be the same pavement treatment type but in different forms and in different percentages (by weight).

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NOTE: There are now combinations of pavement treatments that are used, and they may impact the calibration of the algorithms used.

3.5.2.1.9 Configure Snapshot Camera

Upon request, the ESS shall store a textual description of the location and direction to which the camera points and the filename to be used when storing new snapshots.

Note: This requirement was modified in NTCIP 1204 v03 to more accurately reflect the design.

3.5.2.1.10 ~~Retrieve Precipitation Sensor~~Manage Atmospheric Pressure Metadata

Requirements for managing atmospheric pressure sensor metadata follow.

3.5.2.1.10.1 Retrieve Atmospheric Pressure Metadata - Location

Upon request, the ESS shall return the number of atmospheric pressure sensors connected to the ESS and the following information for each atmospheric pressure sensor:

a) a textual description of the precipitation sensor location;
~~a)~~b) the relative height of the ~~precipitation~~atmospheric pressure sensor ~~to~~from the reference height of the ESS (station) in meters; and
~~b)~~c) the location ~~of the precipitation sensor, in~~ (latitude ~~and~~, longitude~~; and~~) of the atmospheric sensor, in microdegrees (10^{-6} degrees).
~~the~~

3.5.2.1.10.2 Retrieve Atmospheric Pressure Metadata - Sensor Information

Upon request, the ESS shall return the number of atmospheric pressure sensors connected to the ESS and the make, model and version number of ~~the~~each sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

~~3.5.2.1.10.1~~3.5.2.1.10.3 Configure Atmospheric Pressure Metadata - Location

Upon request, the ESS shall store the following information for a specified atmospheric pressure sensor:

a) a textual description of the atmospheric pressure sensor location;
b) relative height of the atmospheric pressure sensor from the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the atmospheric sensor, in ~~latitude and longitude; and~~microdegrees (10^{-6} degrees).

~~the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

3.5.2.1.11 ~~Configure~~Manage Wind Sensor Metadata

Requirements for managing wind sensor metadata follows.

3.5.2.1.11.1 Retrieve Metadata for Each Wind Sensor - Location

Upon request, the ESS shall return the number of wind sensors connected to the ESS and the location (latitude and longitude) of each wind sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

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3.5.2.1.11.2 Retrieve Metadata for Each Wind Sensor - Sensor Information

Upon request, the ESS shall return the number of wind sensors connected to the ESS and the make, model and version number of each wind sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

3.5.2.1.11.3 Configure Wind Sensor Metadata - Location

Upon request, the ESS shall store the following information for a specified wind sensor:

a) a textual description of the wind sensor location;
b) the relative height of the wind sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the wind sensor, in ~~latitude and longitude; and~~microdegrees (10^{-6} degrees) ~~Celsius~~.

~~the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

3.5.2.1.12 ~~Configure~~Manage Temperature Sensor Metadata

Requirements for managing temperature sensor metadata follow.

3.5.2.1.12.1 Retrieve Temperature Sensor Metadata - Location

Upon request, the ESS shall return the number of air temperature sensors connected to the ESS and the following information for each air temperature sensor:

a) a textual description of the air temperature sensor location;
b) the relative height of the air temperature sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the air temperature sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.12.2 Retrieve Temperature Sensor Metadata - Sensor Information

Upon request, the ESS shall return the number of air temperature sensors connected to the ESS and the make, model and version number of each temperature sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

3.5.2.1.12.3 Configure Temperature Sensor Metadata - Location

Upon request, the ESS shall store the following information for a specified air temperature sensor:

a) a textual description of the air temperature sensor location;
b) the relative height of the air temperature sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the air temperature sensor, in ~~latitude and longitude; and~~microdegrees (10^{-6} degrees) ~~Celsius~~.

~~the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

3.5.2.1.13 ~~Configure Precipitation~~Manage Humidity Sensor Metadata

Requirements for managing humidity sensor metadata follow.

3.5.2.1.13.1 Retrieve Humidity Sensor Metadata - Location

Upon request, the ESS shall return the number of humidity sensors connected to the ESS and the following information for each humidity sensor:

a) a textual description of the humidity sensor location;
the relative height of the humidity sensor to the reference height of the ESS (station) in meters;~~Upon request, the ESS shall store the following information for a specified precipitation sensor:~~

~~a) a textual description of the precipitation sensor location;~~
~~b) the relative height of the precipitation sensor to the height of the ESS (station) in meters;~~
b) and
c) the location (latitude, longitude) of the ~~precipitation~~humidity sensor, in ~~latitude~~microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.13.2 Retrieve Humidity Sensor Metadata - Sensor Information

~~c)~~ Upon request, the ESS shall return the number of humidity sensors connected to the ESS and ~~longitude; and~~
the make, model and version number of ~~the~~each humidity sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

~~3.5.2.1.13.1~~3.5.2.1.13.3 Configure Humidity Sensor Metadata - Location

Upon request, the ESS shall store following information for a specified humidity sensor:

a) a textual description of the humidity sensor location;
b) the relative height of the humidity sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the humidity sensor, in ~~latitude and longitude; and~~microdegrees (10^{-6} degrees) ~~Celsius~~.
~~the make, model and version number of the sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

3.5.2.1.14 ~~Configure Solar Radiation~~Manage Precipitation Sensor Metadata

Requirements for managing precipitation sensor metadata follow.

3.5.2.1.14.1 Retrieve Precipitation Sensor Metadata - Location

Upon request, the ESS shall ~~store~~return the number of precipitation sensors connected to the ESS and the following information for ~~a specified solar radiation~~each precipitation sensor:

a) a textual description of the ~~solar radiation~~ precipitation sensor location;
b) the relative height of the ~~solar radiation~~precipitation sensor to the reference height of the ESS (station) in meters; and
c) the location ~~of the solar radiation sensor, in~~ (latitude ~~and~~, longitude~~; and~~) of the precipitation sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.14.2 Retrieve Precipitation Sensor Metadata - Sensor Information

Upon request, the ESS shall return the number of precipitation sensors connected to the ESS and the make, model and version number of each precipitation sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

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3.5.2.1.14.3 Configure Precipitation Sensor Metadata - Location

Upon request, the ESS shall store the following information for a specified precipitation sensor:
a) relative height of the precipitation sensor to the reference height of the ESS (station) in meters; and
b) the location (latitude, longitude) of the precipitation sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.14.4 Configure Precipitation Total User Specified Period

Upon request, the ESS shall store the collection period, in seconds, for measuring the total precipitation recorded for a specified precipitation sensor.

3.5.2.1.15 Manage Solar Radiation Sensor Metadata

Requirements for managing solar radiation sensor metadata follow~~s~~.

3.5.2.1.15.1 Retrieve Solar Radiation Sensor Metadata - Location

Upon request, the ESS shall return the number of solar radiation sensors connected to the ESS and the following information for each solar radiation sensor:

a) a textual description of the solar radiation sensor location;
b) the relative height of the solar radiation sensor to the reference height of the ESS (station) in meters;~~the make, model and version number of the~~ and
c) the location (latitude, longitude) of the solar radiation sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.15.2 Retrieve Solar Radiation Sensor Metadata - Sensor Information

Upon request, the ESS shall return the number of solar radiation sensors connected to the ESS and the make, model and version number of the specified solar radiation sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

3.5.2.1.15.3 Configure Solar Radiation Sensor Metadata - Location

Upon request, the ESS shall store the following information for a specified solar radiation sensor:

a) a textual description of the solar radiation sensor location;
b) the relative height of the solar radiation sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the solar radiation sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.
~~, sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

~~3.5.2.1.14.1 Configure Total Radiation Period~~

~~Upon request, the ESS shall store the collection period, in seconds, for measuring the total radiation collected for a specified solar radiation sensor.~~

3.5.2.1.16 Manage Visibility Sensor Metadata

Requirements for managing visibility sensor metadata follow.

3.5.2.1.16.1 Retrieve Visibility Sensor Metadata - Location

Upon request, the ESS shall return the following information for a visibility sensor:

a) a textual description of the visibility sensor location;

b) the relative height of the visibility sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the visibility sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.16.2 Retrieve Visibility Sensor Metadata - Sensor Information

Upon request, the ESS shall return the make, model and version number of a visibility sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

~~3.5.2.1.14.2~~3.5.2.1.16.3 Configure Visibility Sensor Metadata - Location

Upon request, the ESS shall store the following information for a ~~specified~~ visibility sensor:

a) a textual description of the visibility sensor location;
b) the relative height of the visibility sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the visibility sensor, in ~~latitude and longitude; and~~microdegrees (10^{-6} degrees) ~~Celsius~~.

~~the make, model and version number of the~~

3.5.2.1.17 Manage Pavement Sensor Metadata

Requirements for managing pavement sensor metadata follow~~s~~.

3.5.2.1.17.1 Retrieve Pavement Sensor Metadata - Location

Upon request, the ESS shall return the number of pavement sensors connected to the ESS and the following information for each pavement sensor:

a) a textual description of the pavement sensor location and the location of the pavement surface area the pavement sensor is monitoring;
b) the relative height of the pavement sensor to the reference height of the ESS (station) in meters;
c) the location (latitude, longitude) of the pavement sensor, in microdegrees (10^{-6} degrees); and
d) the location (latitude, longitude) of the geometric center of the pavement surface area that the pavement sensor is monitoring, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.17.2 Retrieve Pavement Sensor Metadata - Sensor Information

Upon request, the ESS shall return the number of pavement sensors connected to the ESS and the make, model and version number of each pavement sensor so that the management station is able to properly interpret the accuracy of the data and precise meanings of code lists.

3.5.2.1.17.3 Configure Pavement Sensor - Location

Upon request, the ESS shall store the following information for a pavement sensor:

a) a textual description of the pavement sensor location and the location of the pavement surface area the pavement sensor is monitoring;
b) the location (latitude, longitude) of the pavement sensor, in microdegrees (10^{-6} degrees);
c) the location (latitude, longitude) of the geometric center of the pavement surface area that the pavement sensor is monitoring, in microdegrees (10^{-6} degrees); and
d) the relative height of the pavement surface to the reference height of the ESS (station) in meters.

3.5.2.1.18 Manage Subsurface Sensor Metadata

Requirements for managing subsurface sensor metadata follow~~s~~.

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3.5.2.1.18.1 Retrieve Subsurface Sensor Metadata - Location

Upon request, the ESS shall return the number of subsurface sensors connected to the ESS and the following information for each subsurface sensor:

a) a textual description of the subsurface sensor location; and
b) the location (latitude, longitude) of the geometric center of the subsurface sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.18.2 Retrieve Subsurface Sensor Metadata - Sensor Information

Upon request, the ESS shall return the number of subsurface sensors connected to the ESS and the make, model and version number of each subsurface sensor so that the management station is able to properly interpret the accuracy of the data and precise meanings of code lists.

3.5.2.1.18.3 Configure Subsurface Sensor - Location

Upon request, the ESS shall store the following information for a specified subsurface sensor:

a) a textual description of the subsurface sensor location; and
b) the location (latitude, longitude) of the geometric center of the subsurface sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

~~sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.~~

~~3.5.2.1.15~~3.5.2.1.19 ~~Configure Friction~~Manage Air Quality Sensor Metadata

Requirements for managing air quality sensor metadata follow~~s~~.

3.5.2.1.19.1 Retrieve Air Quality Sensor Metadata - Location

Upon request, the ESS shall ~~store~~return the ~~type of friction sensor used~~number of air quality sensors connected to ~~measure roadway friction (grip). Valid values are friction wheel, infrared,~~ the ESS and ~~other.~~

~~3.5.2.1.16 Configure Air Quality Sensor Metadata~~

~~Upon request, the ESS shall store~~ the following information for ~~a specified~~each air quality sensor:

a) a textual description of the air quality sensor location;
b) the relative height of the air quality sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the air quality sensor, in ~~latitude and longitude;~~microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.19.2 Retrieve Air Quality Sensor Metadata - Sensor Information

~~a)~~ Upon request, the ESS shall return the number of air quality sensors connected to the ESS and the make, model and version number of the air quality sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

~~3.5.2.1.16.1~~3.5.2.1.19.3 Configure ~~Water Level~~ Air Quality Sensor Metadata - Location

Upon request, the ESS shall store the following information for a specified air quality sensor:

a) a textual description of the air quality sensor location;
b) the relative height of the air quality sensor to the reference height of the ESS (station) in meters; and

c) the location (latitude, longitude) of the air quality sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.
~~,~~

3.5.2.1.20 Manage Water Level Sensor Metadata

Requirements for managing water level sensor~~:~~ metadata follow~~s~~.

3.5.2.1.20.1 Retrieve Water Level Metadata - Location

Upon request, the ESS shall return the number of water level sensors connected to the ESS and the following information for each water level sensor:

a) a textual description of the water level sensor location, including a description of the reference point that the water depth is measured against;
b) the relative height of the water level sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the water level sensor, in ~~latitude~~microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.20.2 Retrieve Water Level Metadata - Sensor Information

~~a)~~ Upon request, the ESS shall return the number of water level sensors connected to the ESS and ~~longitude; and~~
the make, model, and version number of ~~the~~each water level sensor so that the management station is able to properly interpret the accuracy, resolution and limits of the data.

3.5.2.1.20.3 Retrieve Water Level Metadata - Warning Level

Upon request, the ESS shall return the number of water level sensors connected to the ESS and the water level depth, measured in centimeters from a user defined point, for each water level sensor that the water level is of concern. This water level depth may be the depth when the water levels may overflow onto the roadway pavement, or may damage electronic roadside equipment in a cabinet.

3.5.2.1.20.4 Configure Water Level Metadata - Location

Upon request, the ESS shall store the following information for a specified water level sensor:

a) a textual description of the water level sensor location, including a description of the reference point that the water depth is measured against;
b) the relative height of the water level sensor to the reference height of the ESS (station) in meters; and
c) the location (latitude, longitude) of the water level sensor, in microdegrees (10^{-6} degrees) ~~Celsius~~.

3.5.2.1.20.5 Configure Water Level Metadata - Warning Level

Upon request, the ESS shall store the water level depth of the specified water level sensor, measured in centimeters from a user defined point, that the water level is of concern.

3.5.2.1.21 Manage Pavement Treatment System Metadata

Requirements for managing pavement treatment system metadata follow.

3.5.2.1.21.1 Retrieve Pavement Treatment System Metadata - Location

Upon request, the ESS shall return the number of water level sensors connected to the ESS and the following information for each water level sensor:

a) a textual description of the pavement treatment system location; and

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b) the location (latitude, longitude) of the pavement treatment system location, in microdegrees (10^{-6} degrees).

3.5.2.1.21.2 Retrieve Pavement Treatment Metadata - System Information

Upon request, the ESS shall return the make, model, and version number of the pavement treatment system so that the management station is able to properly interpret the capabilities of the pavement treatment system.

3.5.2.1.21.3 Configure Pavement Treatment System Metadata - Location

Upon request, the ESS shall store the following information for a pavement treatment system:

a) a textual description of the pavement treatment system location; and
b) the location (latitude, longitude) of the pavement treatment system, in microdegrees (10^{-6} degrees).

3.5.2.2 Sensor Status Monitoring Requirements

There are no status monitoring requirements for the Sensor Manager.

3.5.2.3 Sensor Data Retrieval Requirements

Requirements for retrieving data from a Sensor Manager follow.

3.5.2.3.1 Retrieve Weather Profile with Mobile Sources [Version 03 Only - Deprecated in v04]

Upon request, the ESS shall return a list of records recorded by the ESS over a period of time, with each record containing the following information about the mobile station:

location~~Upon request, the ESS shall return a list of records recorded by the ESS over a period of time, with each record containing the following information about the mobile station:~~

a) ~~location~~
b) speed~~, by latitude and longitude (See~~
c) bearing
d) odometer reading
e) roadway friction
f) local weather observation
g) time of reading

~~a)~~ Note: This requirement was ~~requirement 3.5.1.3.1.1);~~
~~b) elevation of pavement surface under the mobile platform, in meters above mean sea level (See requirement 3.5.1.3.1.1);~~
~~current~~ used in NTCIP 1204 v03, but has been replaced in NTCIP 1204 v04. This replacement was made to support multiple observation values from multiple atmospheric pressure sensors, humidity sensors and precipitation sensors, and changes in observation values for the pavement surface condition. The replacement can be found in Section 3.5.2.3.10. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~c) speed of the mobile platform, in kilometers per hour (See requirement 3.5.1.3.1.2);~~
~~d) bearing of the mobile platform, in degrees measured clockwise from true North (See requirement 3.5.1.3.1.3);~~
~~e) odometer reading of the mobile platform, in meters (See requirement 3.5.1.3.1.4);~~
~~f) measured roadway friction (See requirement 3.5.2.3.3.8);~~
~~g) weather conditions (See 3.5.2.3.2.1 to 3.5.2.3.2.8); and~~
~~h) date and time of reading, in seconds.~~

3.5.2.3.2 Monitor Weather Condition

Requirements for monitoring weather conditions follow.

~~**3.5.2.3.2.1 Retrieve Atmospheric Pressure**~~

~~Upon request, the ESS shall return the current atmospheric pressure in 1/10ths of millibars (a.k.a. tenths of hectoPascals) for each atmospheric sensor reporting to the ESS.~~

3.5.2.3.2.1 Retrieve Atmospheric Pressure [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the current atmospheric pressure.

> Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. NTCIP 1204 v04 adds support for returning multiple atmospheric pressure values from an ESS with multiple atmospheric pressure sensors. The replacement can be found in Section 3.5.2.3.2.10. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.2.2 Retrieve Wind Data

Upon request, the ESS shall return the following information for each wind sensor reporting to the ESS:

a) ~~T~~the ~~two-minute~~ average wind speed recorded during the 2 minutes preceding the observation in tenths of meters per second;
b) ~~T~~the ~~two-minute~~ average direction the wind is blowing from, ~~measured~~ as recorded during the 2 minutes preceding the observation, measured clockwise in degrees from true north;
c) ~~T~~the current wind speed in tenths of meters per second;
d) ~~T~~the current direction the wind is blowing from, measured clockwise in degrees from true north;
e) ~~T~~the maximum wind gust recorded during the 10 minutes preceding the observation in tenths of meters per second; ~~and~~
f) ~~T~~the direction of the maximum wind gust recorded during the 10 minutes preceding the observation, measured in degrees clockwise from true north~~.~~; and
g) the assessment of the wind situation from a staffed station as defined by the Beaufort Wind Scale in the Glossary of Meteorology. Valid values are: other, unknown, calm, light breeze, moderate breeze, strong breeze, gale, moderate gale, strong gale, storm winds, hurricane force winds, and gusty winds.

3.5.2.3.2.3 Retrieve Air Temperature

Upon request, the ESS shall return the current ambient air temperature in tenths of degrees Celsius for each air temperature sensor reporting to the ESS.

3.5.2.3.2.4 Retrieve Daily Minimum and Maximum Temperature

Upon request, the ESS shall return the minimum and maximum ambient air temperatures that have been recorded within the previous 24 hours in tenths of degrees Celsius.

3.5.2.3.2.5 Retrieve Humidity [Versions 01 to 03 Only - Deprecated in v04]

~~Upon request, the ESS shall return the following information for each humidity sensor reporting to the ESS:~~

~~a) the current humidity in percent;~~
~~b) the ambient dewpoint temperature in tenths of degrees Celsius;~~Upon request, the ESS shall return the current humidity, dew point, and

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~~the ambient~~ wet- bulb temperature ~~in tenths of degrees Celsius~~.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple relative humidity, dew point temperature, and wet bulb temperature values from an ESS with multiple humidity sensors. The replacement can be found in Section 3.5.2.3.2.11. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.2.6 Monitor Precipitation

Requirements for monitoring precipitation follow.

3.5.2.3.2.6.1 Retrieve Precipitation Presence [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return an indication of whether precipitation is currently detected and an indication of the make and model of the sensor so that the management station is able to be aware of the likely accuracy of the reading.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple precipitation values from an ESS with multiple precipitation sensors. The replacement can be found in Section 3.5.2.3.2.6.4. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.2.6.2 Retrieve Precipitation Rates [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the rate at which precipitation is currently falling and the start and stop time of the latest recorded precipitation.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple precipitation values from an ESS with multiple precipitation sensors. The replacement can be found in Section 3.5.2.3.2.6.5. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.2.6.3 Retrieve Precipitation Totals [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the total amounts of precipitation recorded over the last one hour, three hours, six hours, twelve hours, and 24 hours.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple precipitation values from an ESS with multiple precipitation sensors. The replacement can be found in Section 3.5.2.3.2.6.6. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~3.5.2.3.2.6.1~~3.5.2.3.2.6.4 Retrieve Precipitation Presence

Upon request, the ESS shall return an indication of whether precipitation is currently detected for each precipitation sensor reporting to the ESS. Valid values are precipitation detected, precipitation not detected, and error.

Precipitation is detected if 0.01 inches of liquid water equivalent is detected. ~~.~~

Note: The previously available requirement to retrieve precipitation presence has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning multiple

precipitation values from an ESS with multiple precipitation sensors. The previously available requirement can be found in Section 3.5.2.3.2.6.1. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~3.5.2.3.2.6.2~~3.5.2.3.2.6.5 Retrieve Precipitation Rates

Upon request, the ESS shall return the rate of precipitation for each precipitation sensor reporting to the ESS as follows:

a) The rate the rain is currently falling, or the water equivalent of snow, in tenths of grams per square meter;
b) the rate that snow is accumulating in 10^-7 meters per second; and
c) the start and stop times of the latest recorded precipitation event measured in seconds since 00:00:00 January 1,1970 UTC. The precipitation event can be rainfall or snowfall.

Note: The previously available requirement to retrieve precipitation rates has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning multiple precipitation values from an ESS with multiple precipitation sensors. The previously available requirement can be found in Section 3.5.2.3.2.6.2. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~3.5.2.3.2.6.3~~3.5.2.3.2.6.6 Retrieve Precipitation Totals

Upon request, the ESS shall return the total amount of precipitation recorded over the last one hour, three hour, six hour, twelve hour, and ~~24~~twenty-four hour rolling periods, in tenths of kilograms per square meter, for each precipitation sensor reporting to the ESS.

~~Retrieve Solar Radiation~~

~~Requirements for returning solar radiation follows~~Note: The previously available requirement to retrieve precipitation totals has been deprecated in NTCIP 1204 v 04. This replacement was made because users required support for returning multiple precipitation values from an ESS with multiple precipitation sensors. The previously available requirement can be found in Section 3.5.2.3.2.6.3. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~NOTE - This requirement was modified in NTCIP 1204 v04 to more accurately reflect the design.~~

~~3.5.2.3.2.6.4~~3.5.2.3.2.6.7 Retrieve ~~Amount of Sunshine~~Precipitation Totals - User Specified

Upon request, the ESS shall return the total amount of precipitation recorded over a user specified, rolling time period, in tenths of kilograms per square meter, for a selected precipitation sensor reporting to the ESS.

3.5.2.3.2.6.8 Retrieve Precipitation Type

Upon request, the ESS shall return the assessment of the type and intensity of the current precipitation situation. Valid values are other, unknown, no precipitation, slight unidentified (precipitation), moderate unidentified, heavy unidentified, slight snow, moderate snow, heavy snow, slight, moderate rain, heavy rate, slight frozen precipitation, moderate frozen precipitation, and heavy frozen precipitation. The precipitation intensity is defined as follows: slight < 2 mm/hour water equivalent, moderate is ≥ 2 and < 8 mm/hour equivalent, and heavy is ≥ 8 mm/hour water equivalent.

3.5.2.3.2.7 Retrieve Solar Radiation [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the solar radiation data. The types of measured solar radiation data that the ESS shall provide are:

a) total minutes of sun over a 24 hour period

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b) instantaneous infrared
c) instantaneous ultraviolet
d) visible
e) near-infrared
~~total radiation over a user set period~~

Note: The previously available requirement to retrieve solar radiation readings has been deprecated in NTCIP 1204 v 04. This replacement was made because users required support for returning multiple solar radiation readings from an ESS with multiple solar radiation sensors. The previously available requirement can be found in Section 3.5.2.3.2.12. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~a) total minutes of sunshine measured over the preceding 24-hour period, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 031, for each solar radiation sensor reporting to the ESS.~~

~~**3.5.2.3.2.7.1** Retrieve Current Amount of Infrared Radiation~~

~~b) Upon request, the ESS shall return the instantaneous infrared radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 017, for each solar radiation sensor reporting to the ESS.~~

~~**3.5.2.3.2.7.2** Retrieve Current Amount of Total Radiation~~

~~c) Upon request, the ESS shall return the instantaneous ultraviolet, visible and infrared radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 018, for each solar radiation sensor reporting to the ESS.~~

~~**3.5.2.3.2.7.3** Retrieve Amount of Total Radiation~~

~~d) Upon request, the ESS shall return the total radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 025, over a user defined period, measured in seconds, for each solar radiation sensor reporting to the ESS.~~

3.5.2.3.2.8 Retrieve Visibility

Upon request, the ESS shall return the current visibility distance in decimeters (tenths of a meter~~) for each visibility sensor reporting to the ESS.~~).

3.5.2.3.2.9 Retrieve Compressed Weather Data [Deprecated]

~~Upon request, the ESS shall return, in a compressed form, all current weather information, as defined in Sections~~requirements ~~3.5.2.3.2.1 through 3.5.2.3.2.6.2~~ and requirements ~~3.5.2.3.2.7~~ to ~~3.5.2.3.2.8, that is supported by the ESS.~~

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v04. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04.

3.5.2.3.2.10 Retrieve Atmospheric Pressure

Upon request, the ESS shall return the current atmospheric pressure in 1/10ths of millibars (a.k.a. tenths of hectoPascals) for each atmospheric sensor reporting to the ESS.

Note: The previously available requirement to retrieve atmospheric pressure has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning multiple atmospheric pressure values from an ESS with multiple atmospheric pressure sensors. The previously available requirement can be found in Section 3.5.2.3.2.1. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v044.

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3.5.2.3.2.11 Retrieve Relative Humidity

Upon request, the ESS shall return the following information for each humidity sensor reporting to the ESS:

~~c)~~a) the current humidity in percent;
b) the derived ambient dewpoint temperature in tenths of degrees Celsius; and
c) the derived ambient wet-bulb temperature in tenths of degrees Celsius.

Note: The previously available requirement to retrieve humidity has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning multiple relative humidity, dew point temperature, and wet bulb temperature values from an ESS with multiple humidity sensors. The previously available requirement can be found in Section 3.5.2.3.2.5. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.2.12 Retrieve Solar Radiation

Upon request, the ESS shall return the solar radiation data for each solar radiation sensor reporting to the ESS. The types of measured solar radiation data that the ESS shall provide are:

a) the total minutes of sunshine measured over the preceding 24-hour period, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 031;
b) the instantaneous infrared radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 017;
c) the instantaneous ultraviolet, visible and near-infrared radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 018; and
d) the average total radiation measured, in watts per square meter, as defined by WMO Code Form FM 94 BUFR Table B item 0 14 025, over a user defined rolling period, measured in seconds.

Note: The previously available requirement to retrieve solar radiation has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning multiple solar radiation readings from an ESS with multiple solar radiation sensors. The previously available requirement can be found in Section 3.5.2.3.2.7. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3 Monitor Pavement Condition

Requirements for monitoring pavement conditions follow.

3.5.2.3.3.1 Retrieve Pavement Surface Condition [Versions 01 to 03 - Deprecated in v04]

~~Upon request, the ESS shall return the following information for each pavement sensor reporting to the ESS:~~
~~a) the current pavement surface temperature, in tenths of degrees celsius;~~
~~a) the validity of the data reported. Valid values for the data error are none (no error), no response, cut cable, short circuit, dirty lens, and other; and~~
~~b) any presence of moisture and the type of moisture on the surface. Valid values for moisture type includes dry, trace moisture, wet, chemically wet, ice warning, ice watch, snow warning, snow watch, absorption, dew, frost, absorption at dewpoint, other and error.~~

~~The definitions of the valid values for moisture type are as follows:~~
~~other - The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information~~~~Upon request, the ESS shall return the current temperature of the pavement surface and shall indicate any presence of moisture on the surface along with an indication of whether any of this data might be in error. The ESS shall also indicate the make and model of the sensor~~

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~~so that the management station is able to properly interpret the accuracy of the data and precise meanings of code lists.~~

~~a) noReport - The sensor is not providing any reading for surface status and may not be responding~~
~~b) error - The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect~~
~~c) dry - The sensor does not detect any moisture or unusual conditions.~~
~~d) trace moisture - The sensor detects some moisture, but it is suspected to be isolated~~
~~e) wet - The sensor detects a significant amount of moisture indicating a wet roadway.~~
~~f) chemically wet - The sensor detects a significant amount of moisture mixed with a de-icing or anti-icing chemical.~~
~~g) ice - The sensor detects ice or black ice.~~
~~h) Ice watch - The risk of the formation of ice or black ice on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain~~
~~i) slush - The sensor detects snow or slush.~~
~~j) slushAdvisory - The risk of the accumulation of snow or slush on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain~~
~~k) freezeAdvisory - The risk of the formation of some sort of frozen moisture on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain~~
~~l) freezeHazard - The sensor detects some sort of frozen moisture but is unable to classify as slush or ice.~~
~~m) absorption - A salt chemical is present that is not fully dissolved in water. As a result, the conductivity readings will result in erroneous calculations for amount of chemical in the mix.~~
~~n) dew - The sensor detects moisture that is suspected to be from the formation of dew~~
~~o) frost - The sensor detects the formation of frost~~

~~NOTE - This requirement was modified in NTCIP 1204 v04 to more accurately reflect the design.~~Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made to separate pavement surface conditions that are currently observed and pavement surface conditions that are forecasted. The replacement can be found in Section 3.5.2.3.3.8, while the make and model of the sensor can be found in Section 3.5.2.1.17.2. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.2 Retrieve ~~Icing~~ Conditions for Freezing Algorithms - Active

There are two methods to determine ice and moisture conditions on the pavement surface – active and passive. Active pavement sensors determine the ~~predicted~~ freeze point on the pavement surface by actively freezing a portion of the roadway surface. For an active pavement sensor, upon request, the ESS shall return:

a) the ~~current~~ pavement surface temperature, in tenths of degrees ~~c~~Celsius;
b) the ~~current~~ pavement temperature, in tenths of degrees ~~c~~Celsius;
c) the depth below the pavement surface that the pavement temperature is measured, in centimeters;
d) the ~~predicted~~ freeze point on the pavement surface at which the existing solution on the roadway will freeze, in tenths of degrees ~~c~~Celsius;
e) if black ice detected on the pavement surface. Valid values are no ice, black ice, detector error and other;
f) the depth of any water/solution film or ice on the pavement surface, in tenths of a millimeter; and
g) an indication of whether any of this data might be in error. Valid values for the data error are none (no error), no response, cut cable, short circuit, dirty lens, and other.

3.5.2.3.3.3 Retrieve ~~Icing~~ Conditions for Freezing Algorithms - Passive

There are two methods to determine ice and moisture conditions on the pavement surface -~~–~~ active and passive. Passive pavement sensors use ~~estimate~~ the freeze point on the pavement surface using

algorithms without freezing the chemical mixture on the roadway surface. For a passive pavement sensor, upon request, the ESS shall return the following:

a) the ~~current~~ pavement surface temperature, in tenths of degrees ~~c~~Celsius;
b) the ~~current~~ pavement temperature, in tenths of degrees ~~c~~Celsius;
c) the depth below the pavement surface that the pavement temperature is measured, in centimeters;
d) the ~~predicted~~ freeze point on the pavement surface at which the existing solution on the roadway will freeze, in tenths of degrees ~~c~~Celsius;
e) if black ice detected on the pavement surface. Valid values are no ice, black ice, detector error and other;
f) the depth of any water/solution film or ice on the pavement surface, in tenths of a millimeter;
g) the salinity of the water/solution film on the pavement surface, in parts per one hundred thousand, by weight;
h) the conductivity of the water/solution film on the pavement surface, as detected by the pavement surface sensor, in tenths of ~~milli-mhos~~milliohms/cm;
i) an indication of whether any of this data might be in error. Valid values for the data error are none (no error), no response, cut cable, short circuit, dirty lens, and other;
j) the pavement treatment type used for algorithm. Valid pavement treatment types include sand, dirt, gravel, cinders, water (as a diluting agent) , enhanced salts, NaCL, CaCl, MgCl, cMA, kAC, NaFormate, NaA, and other;
k) the form of each pavement treatment type. Valid values are dry, prewet, liquid and other; and
l) the percentage of the total application weight that is of the pavement treatment type.

3.5.2.3.3.4 Retrieve Adjacent Snow Depth [Versions 01 to 03 - Deprecated in v04]~~th~~

Upon request, the ESS shall return the current depth of snow adjacent to the traveled way (e.g., roadway, rail line, etc.), in centimeters. The depth shall be representative of the snow depth in the area, exclusive of plowed areas and snow drifts.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple snow depth values from an ESS with multiple sensors. The replacement can be found in Section 3.5.2.3.3.11. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.5 Retrieve Roadway Snow Depth [Versions 01 to 03 - Deprecated in v04]~~th~~

Upon request, the ESS shall return the current depth of packed and unpacked snow on the roadway pavement (i.e., roadway, rail line, etc.), in centimeters.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple roadway snow depth values from an ESS with multiple sensors. The replacement can be found in Section 3.5.2.3.3.12. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.6 Retrieve Roadway Ice Thickness [Versions 01 to 03 - Deprecated in v04]~~ss~~

Upon request, the ESS shall return the current thickness of ice on the roadway pavement in millimeters.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because users required support for returning multiple snow depth values from an ESS with multiple sensors. The replacement can be found in Section 3.5.2.3.3.13. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

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3.5.2.3.3.7 Retrieve Compressed Pavement Condition Data [Deprecated]

~~Upon request, the ESS shall return, in compressed form, all current pavement condition information, as defined in Sections 3.5.2.3.3.1 through 3.5.2.3.3.6, that is supported by the ESS. Current pavementdevice.~~

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v04. ~~s~~See Annex D for further information ~~includes:~~regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.8 Retrieve Pavement Surface Condition

Upon request, the ESS shall return the following information for each pavement sensor reporting to the ESS:

a) the current pavement surface temperature, in tenths of degrees ~~c~~Celsius;
b) the validity of the data reported. Valid values for the data error are none (no error), no response, cut cable, short circuit, dirty lens, and other; and
c) any presence of moisture and the type of moisture on the surface. Valid values for moisture type are dry, moist, chemically moist, wet, chemically wet, standing water, frost, slush, snow, ice, other, no report, and error.

The definitions of valid values follow:

a) **dry:** no moisture over the sensor (EN 15518-3)
b) **moist:** from 0.01 mm to 0.2 mm water film thickness over the sensor (EN 15518-3)
c) **chemically moist:** from 0.01 mm to 0.2 mm water film thickness over the sensor mixed with de-icing or anti-icing chemical
d) **wet:** from 0.2 mm water film thickness to 2.0 mm water film thickness over the sensor (EN 15518-3)
e) **chemically wet:** from 0.2 mm water film thickness or greater mixed with de-icing or anti-icing chemical
f) **standing water:** from 2.0 mm or greater water film thickness over the sensor (EN 15518-3)
g) **frost:** formation of frost (ice crystals) is detected over the sensor
h) **slush:** snow or ice that has been reduced to a soft water mixture by rain, warm temperature, and/or chemical treatment (Glossary of Meteorology)
i) **snow:** snow is detected over the sensor
j) **ice:** ice or black ice is detected
k) **other:** The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information
l) **noReport:** The sensor is not providing any reading for surface status and may not be responding
m) **error:** The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect

Note: The previously available requirement to retrieve pavement surface conditions has been deprecated in NTCIP 1204 v04. This replacement was made to separate pavement surface conditions that are observed and pavement surface conditions that are forecasted. The previously available requirement can be found in Section 3.5.2.3.3.1. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.9 Retrieve Forecasted Pavement Surface Condition

Upon request, the ESS shall return the forecasted pavement surface condition for each pavement sensor reporting to the ESS. The forecast is derived based on the current pavement surface condition and other weather observations. Valid values are: no advisory, ice advisory, slush advisory, freeze advisory, freeze hazard, other, no report and error.

The definitions of ~~the~~ valid values ~~are as~~ follow~~s~~:

a) **noAdvisory:** No frozen moisture is detected and the risk of frozen moisture is low.
b) **iceAdvisory:** The risk of the formation of ice or black ice on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
c) **slushAdvisory:** The risk of the accumulation of snow or slush on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
d) **freezeAdvisory:** The risk of the formation of some sort of frozen moisture on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
e) **freezeHazard:** The sensor detects some sort of frozen moisture but is unable to classify as slush or ice
f) **other:** The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information.
g) **noReport:** The sensor is not providing any reading for surface status and may not be responding
h) **error:** The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect

3.5.2.3.3.10 Retrieve Roadway Friction Coefficient

Upon request, the ESS shall return the friction coefficient of the roadway pavement. The calculation of coefficient of friction is complex and is dependent on many variables, such as the tire on a vehicle itself, and thus it is difficult to measure for each vehicle. However, the reported friction coefficient shall be based on an empirical model that has a strong correlation with actual measured friction coefficients using a standard test method and test apparatus, such as a decelerometer or a surface friction tester.

3.5.2.3.3.11 Retrieve Adjacent Snow Depth

Upon request, the ESS shall return the current depth of snow adjacent to the traveled way (e.g., shoulders), in centimeters, for each sensor. The depth shall be representative of the snow depth in the area, exclusive of plowed areas and snow drifts.

> Note: The previously available requirement to retrieve the adjacent snow depth has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning the adjacent snow depths for an ESS from multiple sensors. The previously available requirement can be found in Section 3.5.2.3.3.4. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.12 Retrieve Roadway Snow Depth

Upon request, the ESS shall return the current depth of packed and unpacked snow on the roadway pavement (i.e., roadway, rail line, etc.), in centimeters, for each sensor.

> Note: The previously available requirement to retrieve the roadway snow depth has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning the roadway snow depths for an ESS from multiple sensors. The previously available requirement can be found in Section 3.5.2.3.3.5. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.3.13 Retrieve Roadway Ice Thickness

Upon request, the ESS shall return the current thickness of ice on the roadway pavement in millimeters for each pavement sensor.

> Note: The previously available requirement to retrieve the thickness of ice on the roadway pavement has been deprecated in NTCIP 1204 v04. This replacement was made because users required support for returning the roadway ice thickness for an ESS from multiple sensors. The previously

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available requirement can be found in Section 3.5.2.3.3.6. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.
~~temperature, in tenths of degrees Celsius~~

3.5.2.3.4 Monitor Subsurface Conditions

Requirements for monitoring subsurface conditions follow.

3.5.2.3.4.1 Retrieve Subsurface Temperature

Upon request, the ESS shall return the current subsurface temperature in tenths of degrees ~~c~~Celsius. The ESS shall also return an indication of whether any of this data might be in error. Valid values for the data error are none (no error), no response, cut cable, short circuit, and other.

3.5.2.3.4.2 Retrieve Subsurface Moisture

Upon request, the ESS shall return the amount of moisture, in percent, currently present in the subsurface. A value of 0% indicates that the subsurface is dry, while a value of 100% indicates the subsurface is saturated.

3.5.2.3.4.3 Retrieve Compressed Subsurface Condition Data [Deprecated]

~~Upon request, the ESS shall return, in a compressed form, all current subsurface condition information, as defined in Sections 3.5.2.3.4.1 through 3.5.2.3.4.2, supported by the devicesubsurface sensor.~~

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v04. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.5 Monitor Situation Assessments

Requirements for monitoring situation assessments follow.

3.5.2.3.5.1 Retrieve Wind Situation

Upon request, the ESS shall return the assessment of the wind situation from a staffed station as defined by the Beaufort Wind Scale in the Glossary of Meteorology. Valid values are: other, unknown, calm, light breeze, moderate breeze, strong breeze, gale, moderate gale, strong gale, storm winds, hurricane force winds, and gusty winds.

3.5.2.3.5.2 Retrieve Precipitation Situation

Upon request, the ESS shall return the assessment of the type and intensity of the current precipitation situation. The assessment may be made through automated processes, or if it is a staffed station, manually. ~~Valid values are defined by WMO Binary Code Form FM 94 BUFR Table B item 0 20 003 where Table B defines the Classification of elements, class 0 20 defines the observed phenomena, and entry 003 represent Present Weather~~Valid values are other, unknown, no precipitation, slight unidentified (precipitation), moderate unidentified, heavy unidentified, slight snow, moderate snow, heavy snow, slight, moderate rain, heavy rate, slight frozen precipitation, moderate frozen precipitation, and heavy frozen precipitation. The precipitation intensity is defined as follows: slight < 2 mm/hour water equivalent, moderate is ≥ 2 and < 8 mm/hour equivalent, and heavy is ≥ 8 mm/hour water equivalent.

3.5.2.3.5.3 Retrieve Cloud Situation [Versions 01 to 03 Only - Deprecated in v04]

~~Upon request, the ESS shall return the assessment of the cloud situation. Valid values are overcast, cloudy, partly cloudy, mostly clear, and clear. It is assumed that theThe assessment wasmay be made~~

~~through automated processes, or if it is a staffed station, manually entered by an authorized observer at the ESS site.~~

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because the values used in the retired requirement were too subjective while the replacement requirement used values as defined by the World Meteorological Organization. The replacement can be found in Section 3.5.2.3.5.7. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.2.3.5.4 Retrieve Visibility Situation

Upon request, the ESS shall return the assessment of the visibility situation. The assessment may be made through automated processes, or if it is a staffed station, manually. ~~Valid values are defined by WMO Binary Code Form FM 94 BUFR Table B item 0 20 003. Table B defines the Classification of elements, class 0 20 defines the observed phenomena, and entry 003 represent Present Weather. OR~~ Valid values are other, unknown, clear, fog not patchy, patchy fog, blowing snow, smoke, sea spray, vehicle spray, blowing dust or sand, sun glare, and swarms of insects.

3.5.2.3.5.5 Retrieve Ground State [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the assessment of the ground state next to the roadway~~.~~ (the roadside, and not the roadway pavement or shoulders). The assessment ~~may be~~is made ~~through automated processes, or if it is~~ from a staffed station~~, manually~~. Valid values are other, dry, moist, wet, flooded, frozen, glaze, dusty sandy, very dry, icy, patchy wet snow, moderate wet snow cover, full wet snow cover, patchy dry snow, moderate dry snow cover, full dry snow cover, drifting snow, and unknown.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because the values used in the retired requirement were expanded. The replacement can be found in Section 3.5.2.3.5.8. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04.

3.5.2.3.5.6 Retrieve Pavement State [Versions 01 to 03 Only - Deprecated in v04]

Upon request, the ESS shall return the assessment of the pavement surface. The assessment ~~may be~~is made ~~through automated processes, or if it is~~ from a staffed station~~, manually~~. Valid values are other, dry, wet, puddles, shallow standing water, shallow flowing water, deep standing water, deep flowing water, dusting fresh snow, moderate fresh snow, deep fresh snow, plowed snow, slush, packed snow patches, packed snow, light snow drift, moderate snow drifts, heavy snow drifts, frost, ice patches, moderately icy, heavy icing, black ice, sheet ice, and frozen slush.

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because the values used in the retired requirement were expanded. The replacement can be found in Section 3.5.2.3.5.9. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04~~ of NTCIP 1204~~.

3.5.2.3.5.7 Retrieve Cloud Situation

Upon request, the ESS shall return the amount of cloud cover in the sky, measured in oktas, as defined in WMO code table 2700. The assessment may be made through automated processes, or if it is a staffed station, manually.

Note: The previously available requirement to retrieve the cloud situation has been deprecated in NTCIP 1204 v04. This replacement was made because the previous values supported were subjective while the new values are based on a World Meteorological Organization definition. The previously available requirement can be found in Section 3.5.2.3.5.3. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04~~ of NTCIP 1204~~.

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3.5.2.3.5.8 Retrieve Ground State

Upon request, the ESS shall return the assessment of the ground state next to the roadway (the roadside, and not the roadway pavement or shoulders). The assessment is made from a staffed station. Valid values are other, dry, moist, wet, flooded, frozen, glaze, dusty sandy, very dry, icy, patchy wet snow, moderate wet snow cover, full wet snow cover, patchy dry snow, moderate dry snow cover, full dry snow cover, drifting snow, puddles, standing water, flowing water, fresh snow, plowed snow, slush, and unknown.

> Note: The previously available requirement to retrieve the pavement state has been deprecated in NTCIP 1204 v04. This replacement was made because the values used in the retired requirement were expanded. The previously available requirement can be found in Section 3.5.2.3.5.5. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04.

3.5.2.3.5.9 Retrieve Pavement State

Upon request, the ESS shall return the assessment of the pavement surface. The assessment is made from a staffed station. Valid values are other, dry, wet, puddles, shallow standing water, shallow flowing water, deep standing water, deep flowing water, dusting fresh snow, moderate fresh snow, deep fresh snow, plowed snow, slush, packed snow patches, packed snow, light snow drift, moderate snow drifts, heavy snow drifts, frost, ice patches, moderately icy, heavy icing, black ice, sheet ice, frozen slush, absorption, absorption at dewpoint, bare and dry, bare and wet, blowing snow, ~~chemical wet,~~ chemically wet, dew, damp, and wet slush.

> Note: The previously available requirement to retrieve the pavement state has been deprecated in NTCIP 1204 v04. This replacement was made because the values used in the retired requirement were expanded. The previously available requirement can be found in Section 3.5.2.3.5.6. See Annex D for further information regarding this change from NTCIP 1204 v03 to NTCIP 1204 v04 ~~of NTCIP 1204~~.

3.5.2.3.6 Monitor Air Quality and Biohazard Conditions

Requirements for monitoring air quality and biohazard conditions follow.

3.5.2.3.6.1 Retrieve Carbon Monoxide Reading

Upon request, the ESS shall return the current concentration of carbon monoxide in the air, in parts per million for each air quality sensor reporting to the ESS.

3.5.2.3.6.2 Retrieve Carbon Dioxide Reading

Upon request, the ESS shall return the current concentration of carbon dioxide in the air, in parts per billion for each air quality sensor reporting to the ESS.

3.5.2.3.6.3 Retrieve Nitrous Oxide Reading

Upon request, the ESS shall return the current concentration of nitrous oxide in the air, in parts per million for each air quality sensor reporting to the ESS.

3.5.2.3.6.4 Retrieve Nitrogen Dioxide Reading

Upon request, the ESS shall return the current concentration of nitrogen dioxide in the air, in parts per billion for each air quality sensor reporting to the ESS.

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3.5.2.3.6.5 Retrieve Sulfur Dioxide Reading

Upon request, the ESS shall return the current concentration of sulfur dioxide in the air, in parts per billion for each air quality sensor reporting to the ESS.

3.5.2.3.6.6 Retrieve Ozone Reading

Upon request, the ESS shall return the current concentration of ozone in the air, in parts per one hundred billion for each air quality sensor reporting to the ESS.

3.5.2.3.6.7 Retrieve Small Particulate Matter Reading

Upon request, the ESS shall return the current concentration in the air of small particulate matter of 10 micrometers or less in diameter. The concentration is measured in micrograms per cubic meter for each air quality sensor reporting to the ESS.

3.5.2.3.6.8 Retrieve Compressed Air Quality Data [Deprecated]

~~Upon request, the ESS shall return all current air quality condition information supported by the device in a compressed form.~~

Note: This requirement was used in NTCIP 1204 v03, but has been deprecated in NTCIP 1204 v04. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

~~Upon request, the ESS shall return, in a compressed form, all current air quality condition information, as defined in Section 3.5.2.3.6.1 through 3.5.2.3.6.7 and Section 3.5.2.2.6.9, supported by the ESS.~~

3.5.2.3.6.9 Retrieve Particulate Matter (2.5) Reading

Upon request, the ESS shall return the current concentration in the air of small particulate matter of 2.5 micrometers or less in diameter for each air quality sensor reporting to the ESS. The concentration is measured in micrograms per cubic meter.

~~Upon request, the ESS shall return, in a compressed form, all current air quality condition information, as defined in Section 3.5.2.3.6.1 through 3.5.2.3.6.7 and Section 3.5.2.2.6.9, supported by the ESS.ote: NTCIP 1204 v~~

3.5.2.3.7 Retrieve Water Level

Upon request, the ESS shall return the current depth of water, in centimeters, from a user defined point for each water level sensor reporting to the ESS. The current depth of water can be over a body of water, such as a stream or a reservoir, or the current depth of water on a roadway pavement, such as an underpass. This requirement is concerned with the water depth in bodies of water or the pavement surface for flooding concerns, as opposed to requirements 3.5.2.3.3.2.f or 3.5.2.3.3.3.f, water film depth, which are concerned about icing or hydroplaning on the pavement surface.

3.5.2.3.8 Retrieve Snapshot

Upon request, the ESS shall return a copy of the specified snapshot image.

3.5.2.3.9 Retrieve Snapshot Camera Configuration

Upon request, the ESS shall return the location in which new snapshots are stored, the textual description of the location to which the camera points and the filename to be used when storing new snapshots.

Note: This requirement was revised in NTCIP 1204 v03 to more accurately reflect the design.

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3.5.2.3.10 Retrieve Sensor Profile with Mobile Sources

Upon request, the ESS shall return a list of records recorded by the ESS over a period of time, with each record containing the below information about the mobile station. Each piece of information shall be present if the data is supported by the implementation and is valid. If the piece of information is invalid or not supported by the implementation, that piece of information shall be omitted.

a) the location of the mobile platform consisting of the latitude, longitude, and height. The latitude and longitude are in microdegrees (10^{-6} degrees). The height of the mobile platform (ESS) is in meters above mean sea level, and is measured to the surface under the vehicle;
b) the speed of the mobile platform in kilometers per hour;
c) the bearing (direction of travel) of the mobile platform in degrees, measured clockwise from True North;
d) the distance traveled, in meters, by the mobile platform from a reference point;
e) wind data (See Section 3.5.2.3.2.2);
f) air temperature (See Section 3.5.2.3.2.3);
g) precipitation presence (See Section 3.5.2.3.2.6.4);
h) precipitation rate (See Section 3.5.2.3.2.6.5);
i) precipitation totals (See Section 3.5.2.3.2.6.6);
j) visibility conditions (See Section 3.5.2.3.2.8);
k) atmospheric pressure (See Section 3.5.2.3.2.10);
l) relative humidity (See Section 3.5.2.3.2.11); ~~Section Sections 3.5.2.3.2.6.7~~
m) adjacent snow depth (See Sections ~~requirement~~ 3.5.2.3.3.4);
n) roadway snow depth (See Sections ~~requirement~~ 3.5.2.3.3.5);
o) roadway ice thickness (See Section ~~requirement~~ 3.5.2.3.3.6);
p) the freeze point on the pavement surface at which the existing solution on the roadway will freeze, in tenths of degrees Celsius;
q) depth of any water/solution film on the pavement surface, in tenths of a millimeter;
r) salinity of any water/solution film on the pavement surface, in parts per one hundred thousand, by weight;
s) percentage of ice on the surface;
t) current pavement surface condition (See Section ~~requirement~~ 3.5.2.3.3.8);
u) forecasted pavement surface condition (See Section ~~requirement~~ 3.5.2.3.3.9);
v) measured roadway friction coefficient (See Section ~~requirement~~ 3.5.2.3.3.10);
w) ~~Section~~ type and intensity of the current precipitation situation (See Section ~~requirement~~ 3.5.2.3.5.2);
x) assessment of the wind situation (See Section ~~requirement~~ 3.5.2.3.5.1);
y) assessment of the visibility situation (See Section ~~requirement~~ 3.5.2.3.5.4);
z) ~~SectionSection~~ assessment of the cloud situation (See Section ~~requirement~~ 3.5.2.3.5.7);
aa) assessment of the ground state next to the roadway (See Section 3.5.2.3.5.8);
bb) assessment of the pavement state (See Section 3.5.2.3.5.9); and
cc) date and time of the observation recorded, in seconds.

3.5.2.4 Sensor Control Requirements

Requirements for controlling a Sensor Manager follow.

3.5.2.4.1 Capture Snapshot Image

Upon request, the ESS shall capture, and store to a temporary location, the current image (snapshot) from the specified attached camera.

3.5.2.4.2 Delete Snapshot

Upon request, the ESS shall delete the specified snapshot image.

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3.5.2.4.3 Copy Snapshot - [~~Deprecated~~Obsolete]

~~Upon request, the ESS shall copy the specified snapshot image to a new file with the specified filename.~~

Note: This requirement was Deprecated from NTCIP 1204 v03. Requirement 3.5.2.4.3 was determined to be redundant with Section ~~requirement~~ 3.5.3.1.3 and is more appropriately defined with PTS requirements (i.e., according to the terms used in NTCIP 1204 v03, the ESS Manager does not include pavement treatment information; that information would be stored in the PTS Manager.)

Note: This requirement was added in NTCIP 1204 v02; however, it was later determined that FTP does not support a copy operation. This requirement had been replaced with the ability to define a sequence number in the filename. See Section 3.6.24.

3.5.3 PTS Manager Requirements

Requirements for managing a PTS Manager follow.

3.5.3.1 PTS Configuration Requirements

Requirements for configuring a PTS Manager follow.

3.5.3.1.1 Retrieve Stationary Pavement Treatment Configuration

Upon request, the PTS shall return the configuration data for a stationary pavement treatment system identifying:

a) the pavement sensors that the PTS monitors to determine when to trigger the sprayers;
b) the duration in milliseconds required for a signal to activate the sprayer; ~~and~~
c) the ~~mix~~number of ~~chemicals to use when spraying. The mix consists of the pavement~~pavement treatment products that the PTS has been programmed for; and
~~c)~~d) for each pavement treatment product, the pavement treatment product type, pavement treatment form and the percentage mix (by weight). Pavement treatment product types supported are sand, dirt, gravel, cinders, water, enhancedSalts, NaCl, CaCl, MgCl, CMA, KAC, NaFormate, NaA and other. Pavement treatment forms supported are dry, preset, liquid, and other.

A pavement treatment product is a chemical that can be applied to the roadway to de-ice or prevent icing of the pavement. This requirement allows a transportation system operator to determine what pavement treatments may be applied by the PTS.

3.5.3.1.2 Configure Stationary Pavement Treatment System

Upon request, the PTS shall change the configuration for a stationary pavement treatment system identifying:

a) the pavement sensors that the PTS monitors to determine when to trigger the sprayers;
b) the duration in milliseconds required for a signal to activate the sprayer; ~~and~~
c) the ~~mix~~number of ~~chemicals to use when spraying. The mix consists of~~pavement treatment products that the PTS has been programmed for; and
~~c)~~d) for each pavement treatment product, the pavement treatment type, pavement treatment form and the percentage mix (by weight). Pavement treatment product types supported are: sand, dirt, gravel, cinders, water, enhancedSalts, NaCl, CaCl, MgCl, CMA, KAC, NaFormate, NaA and other. Pavement treatment forms supported are: dry, preset, liquid, and other.

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3.5.3.1.3 Retrieve Mobile Pavement Treatment Configuration [Versions 01 to 03 Only - Deprecated in v04]

~~Upon request, the PTS shall return the configuration dataidentifying the mix of chemicals to be used when spraying.for a mobile pavement treatment system identifying:~~

~~a) the quantity of treatment being applied in kilograms per lane kilometer;~~
~~b) the width of the spread of treatment in meters; and~~
~~c) the mix of chemicals to use when spraying. The mix consists of the pavement treatment type, pavement treatment form and the percentage mix (by weight).~~::

Note: This requirement was used in NTCIP 1204 v01 to v03, but has been replaced in NTCIP 1204 v04. This replacement was made because the compressed data is no longer used. The replacement can be found in Section 3.5.3.1.5. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.3.1.4 Configure Mobile Pavement Treatment System

Upon request, the PTS shall change the configuration for a mobile pavement treatment system identifying:

a) the quantity of treatment being applied in kilograms per lane kilometer;
b) the width of the spread of treatment in meters;~~ and~~
c) the ~~mix~~minimum amount of ~~chemicals~~time the sprayer needs to ~~use when spraying. The mix consists of~~detect a signal to activate and the duration to stay active; and
~~c)~~d) for each pavement treatment product that the PTS has been programmed for, the pavement treatment type, pavement treatment form and the percentage mix (by weight). Pavement treatment product types supported are: sand, dirt, gravel, cinders, water, enhancedSalts, NaCl, CaCl, MgCl, CMA, KAC, NaFormate, NaA and other. Pavement treatment forms supported are: dry, preset, liquid, and other.

3.5.3.1.5 Retrieve Mobile Pavement Treatment Configuration

Upon request, the PTS shall return the configuration data for a mobile pavement treatment system identifying:

a) the quantity of pavement treatment being applied in kilograms per lane kilometer;
b) the width of the spread of treatment in meters; and
c) for each pavement treatment product that the PTS has been programmed for, the pavement treatment type, pavement treatment form and the percentage mix (by weight). Pavement treatment product types supported are: sand, dirt, gravel, cinders, water, enhancedSalts, NaCl, CaCl, MgCl, CMA, KAC, NaFormate, NaA and other. Pavement treatment forms supported are: dry, preset, liquid, and other.

A pavement treatment product is a chemical that can be applied to the roadway to de-ice or prevent icing of the pavement. This requirement allows a transportation system operator to determine what pavement treatments may be applied by the PTS.

Note: The previously available requirement to retrieve the mobile pavement treatment configuration has been deprecated in NTCIP 1204 v04. This replacement was made because compressed data was deprecated. The previously available requirement can be found in Section 3.5.3.1.3. See Annex D for further information regarding this change from v03 to v04 of NTCIP 1204.

3.5.3.2 PTS Status Monitoring Requirements

Requirements for monitoring the status of a PTS Manager follow.

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3.5.3.2.1 Retrieve Pavement Treatment Status

Upon request, the PTS shall return the current status of the sprayer and the number of spray events that have occurred~~.~~ on a pavement treatment system. The status~~is~~ consists of ~~includes~~:

~~a)~~ If the ~~operational mode of the~~ sprayer is ~~off, manual, or automatic;~~
~~b) If the sprayer has been commanded to be~~ active~~,~~ (spraying), inactive~~,~~ (not spraying), or other ~~(command state);~~
~~c) If the sprayer is active, inactive, or other;~~
~~d)~~a)~~the minimum amount of time the sprayer needs to detect a signal to activate and the duration to stay active~~;
~~e)~~b)a counter indicating the number of signal events that have occurred;
~~f)~~c) the date and time the sprayer last received a signal event;
~~g)~~d)a counter indicating the number of active events that have occurred;
~~h)~~e)a counter indicating the number of inactive events that have occurred;
~~i)~~f) the date and time the sprayer of the last active event;
~~j)~~g) the date and time the sprayer of the last inactive event; and
~~k)~~h)the ~~status~~state of readiness of the sprayer. The valid values for status is ok, tank low, error, other (unknown or initial status).

3.5.3.3 PTS Data Retrieval Requirements

Requirements for retrieving data from a PTS Manager follow.~~There are no data retrieval requirements for a PTS Manager.~~

3.5.3.3.1 Retrieve Pavement Treatment Profile with Mobile Sources

Upon request, a mobile PTS shall return a list of records recorded by the PTS over a period of time, with each record containing the below information about the mobile PTS. Each piece of information shall be present if the data is supported by the implementation and is valid. If the piece of information is invalid or not supported by the implementation, that piece of information shall be omitted.

a) the location of the mobile platform consisting of the latitude, longitude, and height. The latitude and longitude are in microdegrees (10^{-6} degrees). The height of the mobile platform (ESS) is in meters above mean sea level, and is measured to the surface under the vehicle;
b) the speed of the mobile platform in kilometers per hour;
c) the bearing (direction of travel) of the mobile platform in degrees, measured clockwise from True North;
d) the distance traveled, in meters, by the mobile platform from a reference point;
e) the quantity of treatment being applied in kilograms per lane kilometer;
f) the width of the spread of treatment in meters; and
g) for each pavement treatment product that the PTS has been programmed for, the pavement treatment type, pavement treatment form and the percentage mix (by weight). Pavement treatment product types supported are: sand, dirt, gravel, cinders, water, enhancedSalts, NaCl, CaCl, MgCl, CMA, KAC, NaFormate, NaA and other. Pavement treatment forms supported are: dry, preset, liquid, and other.

3.5.3.4 PTS Control Requirements

Requirements for controlling a PTS Manager follow.

3.5.3.4.1 Set PTS Operational Mode

Upon request, the stationary PTS shall change its operational mode to that requested. Valid operational modes are:

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a) Off, which shall prevent any operation of the sprayer;
b) Manual, which shall allow manual activation of the sprayer; and
c) Automatic, which shall allow either manual activation or activation based on internal logic per the configuration parameters.

3.5.3.4.2 Manually Activate PTS Sprayer

Upon request, the stationary PTS shall trigger the sprayer to spray its pavement treatment solution. The trigger shall be activated for the configured duration period.

3.5.4 Backward Compatibility Requirements

The following define the requirements for backward compatibility.

3.5.4.1 NTCIP 1204 v01 Wind Sensor Meta Data

Upon request, the ESS shall return the relative height of the first wind sensor connected to the ESS in the NTCIP v01 format.

3.5.4.2 NTCIP 1204 v01 Average Wind Sensor Data

Upon request, the ESS shall return the average wind speed and direction for the first wind sensor in the NTCIP 1204 v01 format.

3.5.4.3 NTCIP 1204 v01 Spot Wind Sensor Data

Upon request, the ESS shall return the spot wind speed and direction for the first wind sensor in the NTCIP 1204 v01 format.

3.5.4.4 NTCIP 1204 v01 Wind Gust Data

Upon request, the ESS shall return the wind gust speed and direction for the first sensor in the NTCIP 1204 v01 format.

3.5.4.5 NTCIP 1204 v01 Wind Situation

Upon request, the ESS shall return the assessment of the wind situation (e.g., calm, light breeze, gale, gusty, etc.) in the NTCIP 1204 v01 format.

3.5.4.6 NTCIP 1204 v01 Water Depth

Upon request, the ESS shall return the water depth as measured by the first sensor in the NTCIP 1204 v01 format.

3.5.4.7 NTCIP 1204 v01 Solar Radiation

Upon request, the ESS shall return the solar radiation in the NTCIP 1204 v01 format.

3.5.4.8 NTCIP 1204 v01 Surface Water Depth

Upon request, the ESS shall return the surface water depth in the NTCIP 1204 v01 format.

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3.5.4.9 NTCIP 1204 v01 Surface Conductivity

Upon request, the ESS shall return the surface conductivity in the NTCIP 1204 v01 format.

Note: ~~It should be noted that t~~The NTCIP 1204 v01 definition was ambiguous and resulted in interoperability problems.

3.5.4.10 NTCIP 1204 v02 Station Meta Data Block

Upon request, the ESS shall return the Station Meta Data Block in the NTCIP 1204 v02 format.

3.5.4.11 NTCIP 1204 v02 Weather Block

Upon request, the ESS shall return the Weather Block in the NTCIP 1204 v02 format.

3.5.4.12 NTCIP 1204 v02 Pavement Block

Upon request, the ESS shall return the Pavement Block in the NTCIP 1204 v02 format.

3.5.4.13 NTCIP 1204 v03 Retrieve External Port Information

Upon request, the ESS shall return the number of auxiliary ports and the following information for each port in the NTCIP 1204 v03 format:

a) an indication of whether the port is analog or digital;
b) a description of the port;
c) an indication of the port resolution; and
d) an indication of whether the port can be used for input, output, or both.

3.5.4.14 NTCIP 1204 v03 Configure Port Information

Upon request, the ESS shall store the indicated description for the indicated auxiliary port in the NTCIP 1204 v03 format.

3.5.4.15 NTCIP 1204 v03 Monitor Status of External Device

Upon request, the ESS shall return the following information for the indicated auxiliary port in the NTCIP 1204 v03 format:

a) Current state; and
b) Last commanded state.

3.5.4.16 NTCIP 1204 v03 Control External Device

Upon request, the ESS shall activate or de-activate, as requested, a simple external device connected through an analog auxiliary port in the NTCIP 1204 v03 format.

3.5.4.17 NTCIP 1204 v03 Station Metadata Block

Upon request, the ESS shall return the Station Metadata Block, containing information about the station, in the NTCIP 1204 v03 format.

3.5.4.18 NTCIP 1204 v03 Mobile ESS Data Block

Upon request, the ESS shall return the Mobile ESS Data Block, containing information about the mobile station in the NTCIP 1204 v03 format.

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3.5.4.19 NTCIP 1204 v01-v03 Atmospheric Pressure Height

Upon request, the ESS shall return the relative height of the atmospheric pressure sensor in the NTCIP 1204 v01-v03 format.

3.5.4.20 NTCIP 1204 v03 Weather Profile with Mobile Sources

Upon request, the ESS shall return a list of records recorded by the ESS over a period of time in the NTCIP 1204 v01-v03 format.

3.5.4.21 NTCIP 1204 v01-v03 Atmospheric Pressure

Upon request, the ESS shall return the current atmospheric pressure in the NTCIP 1204 v01-v03 format.

3.5.4.22 NTCIP 1204 v01-v03 Humidity

Upon request, the ESS shall return the current humidity, dew point, and wet bulb temperature in the NTCIP 1204 v01-v03 format.

3.5.4.23 NTCIP 1204 v01-v03 Precipitation Presence

Upon request, the ESS shall return an indication of whether precipitation is currently detected in the NTCIP 1204 v01-v03 format.

3.5.4.24 NTCIP 1204 v01-v03 Precipitation Rates

Upon request, the ESS shall return the rate at which precipitation is currently falling and the start and stop time of the latest precipitation in the NTCIP 1204 v01-v03 format.

3.5.4.25 NTCIP 1204 v01-v03 Precipitation Totals

Upon request, the ESS shall return the total amounts of precipitation recorded over the last one hour, three hours, six hours, twelve hours, and 24 hours in the NTCIP 1204 v01-v03 format.

3.5.4.26 NTCIP 1204 v03 Solar Radiation

Upon request, the ESS shall return the solar radiation readings in the NTCIP 1204 v03 format.

3.5.4.27 NTCIP 1204 v03 Weather Block

Upon request, the ESS shall return the Weather Block in the NTCIP 1204 v03 format.

3.5.4.28 NTCIP 1204 v01-v03 Pavement Surface Condition

Upon request, the ESS shall return the current temperature of the pavement surface and shall indicate any presence of moisture on the surface in the NTCIP 1204 v01-v03 format.

3.5.4.29 NTCIP 1204 v03 Pavement Condition Block

Upon request, the ESS shall return the Pavement Condition Block in the NTCIP 1204 v03 format.

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3.5.4.30 NTCIP 1204 v01-v03 Adjacent Snow Depth

Upon request, the ESS shall return the current depth of snow adjacent to the traveled way (e.g., roadway, rail line, etc.) in the NTCIP 1204 v01-v03 format. The depth shall be representative of the snow depth in the area, exclusive of plowed areas and snow drifts.

3.5.4.31 NTCIP 1204 v01-v03 Roadway Snow Depth

Upon request, the ESS shall return the current depth of packed and unpacked snow on the roadway pavement (i.e., roadway, rail line, etc.) in the NTCIP 1204 v01-v03 format.

3.5.4.32 NTCIP 1204 v01-v03 Roadway Ice Thickness

Upon request, the ESS shall return the current thickness of ice on the roadway pavement in the NTCIP 1204 v01-v03 format.

3.5.4.33 NTCIP 1204 v03 Subsurface Condition Block

Upon request, the ESS shall return the Subsurface Condition Block in the NTCIP 1204 v03 format.

3.5.4.34 NTCIP 1204 v01-v03 Cloud Situation

Upon request, the ESS shall return the cloud situation assessment in the NTCIP 1204 v01-v03 format.

3.5.4.35 NTCIP 1204 v01-v03 Ground State

Upon request, the ESS shall return the ground state assessment in the NTCIP 1204 v01-v03 format.

3.5.4.36 NTCIP 1204 v01-v03 Pavement State

Upon request, the ESS shall return the pavement state assessment in the NTCIP 1204 v01-v03 format.

3.5.4.37 NTCIP 1204 v03 Air Quality Block

Upon request, the ESS shall return the Air Quality Block in the NTCIP 1204 v03 format.

3.5.4.38 NTCIP 1204 v03 Mobile Pavement Treatment Block

Upon request, the ESS shall return the Mobile Pavement Treatment Configuration Block in the NTCIP 1204 v03 format.

3.6 Supplemental Non-Communications Requirements

Supplemental requirements for ESS follow. These requirements do not directly involve communications between the management station and the ESS, but, if the supplemental requirement is selected in the PRL, the ESS shall fulfill the stated requirement to claim conformance to NTCIP 1204 v04.

3.6.1 Required Number of Atmospheric Pressure Sensors

The ESS shall support the number of atmospheric pressure sensors as defined by the agency specification. If the agency specification does not define the number of atmospheric pressure sensors, the number of atmospheric pressure sensors supported by the ESS is one (1).

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3.6.2 Required Number of Wind Sensors

The ESS shall support the number of wind sensors as defined by the agency specification. If the agency specification does not define the number of wind sensors, the number of wind sensors supported by the ESS is one (1).

3.6.3 Required Number of Temperature Sensors

The ESS shall support the number of temperature sensors as defined by the agency specification. If the agency specification does not define the number of temperature sensors, the number of temperature sensors supported by the ESS is one (1).

3.6.4 Required Number of Humidity Sensors

The ESS shall support the number of humidity sensors as defined by the agency specification. If the agency specification does not define the number of humidity sensors, the number of humidity sensors supported by the ESS is one (1).

3.6.5 Required Number of Precipitation Sensors

The ESS shall support the number of precipitation sensors as defined by the agency specification. If the agency specification does not define the number of precipitation sensors, the number of precipitation sensors supported by the ESS is one (1).

3.6.6 Required Number of Solar Radiation Sensors

The communications interface only allows the ESS to return a single set of values for the solar radiation; however, these values may be derived from multiple sensors. The ESS shall support the number of solar radiation sensors as defined by the agency specification. If the agency specification does not define the number of solar radiation sensors, the number of solar radiation sensors supported by the ESS is one (1).

3.6.7 Required Number of Visibility Sensors

The communications interface only allows the ESS to return a single value for the visibility; however, this value may be derived from multiple sensors. The ESS shall support the number of visibility sensors as defined by the agency specification. If the agency specification does not define the number of visibility sensors, the number of visibility sensors supported by the ESS is one (1).

3.6.8 Required Number of Pavement Sensors

The ESS shall support the number of pavement sensors as defined by the agency specification. If the agency specification does not define the number of pavement sensors, the number of pavement sensors supported by the ESS is one (1) or more.

3.6.9 Active Pavement Treatment Sensors

The ESS shall determine the predicted freeze-point of the pavement by actively freezing a portion of the mixture on the roadway surface.

3.6.10 Passive Pavement Treatment Sensors

The ESS shall determine the freeze point of the pavement through an algorithm that does not require the freezing of the chemical mixture on the roadway surface.

> Note: Different makes and models of equipment may use different algorithms for a variety of reasons. To overcome problems that may result from this variation, NTCIP 1204 v03 links each

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pavement sensor with a row of the module table so that a system can identify the make and model of the specific pavement sensor.

3.6.11 Required Number of Subsurface Sensors

The ESS shall support the number of subsurface sensors as defined by the agency specification. If the agency specification does not define the number of subsurface sensors, the number of subsurface sensors supported by the ESS is one (1) or more.

3.6.12 Required Number of Pavement Treatment Products

The ESS shall support the number of pavement treatment products as defined by the agency specification. If the agency specification does not define the number of pavement treatment products, the number of pavement treatment products supported by the ESS is one (1) or more.

3.6.13 Required Number of Carbon Monoxide Sensors

The communications interface only allows the ESS to return a single value for carbon monoxide; however, this value may be derived from multiple sensors. The ESS shall support the number of carbon monoxide sensors as defined by the agency specification. If the agency specification does not define the number of carbon monoxide sensors, the number of carbon monoxide sensors supported by the ESS is one (1).

3.6.14 Required Number of Carbon Dioxide Sensors

The communications interface only allows the ESS to return a single value for carbon dioxide; however, this value may be derived from multiple sensors. The ESS shall support the number of carbon dioxide sensors as defined by the agency specification. If the agency specification does not define the number of carbon dioxide sensors, the number of carbon dioxide sensors supported by the ESS is one (1).

3.6.15 Required Number of Nitrous Oxide Sensors

The communications interface only allows the ESS to return a single value for nitrous oxide; however, this value may be derived from multiple sensors. The ESS shall support the number of nitrous oxide sensors as defined by the agency specification. If the agency specification does not define the number of nitrous oxide sensors, the number of nitrous oxide sensors supported by the ESS is one (1).

3.6.16 Required Number of Nitrogen Dioxide Sensors

The communications interface only allows the ESS to return a single value for nitrogen dioxide; however, this value may be derived from multiple sensors. The ESS shall support the number of nitrogen dioxide sensors as defined by the agency specification. If the agency specification does not define the number of nitrogen dioxide sensors, the number of nitrogen dioxide sensors supported by the ESS is one (1).

3.6.17 Required Number of Sulfur Dioxide Sensors

The communications interface only allows the ESS to return a single value for sulfur dioxide; however, this value may be derived from multiple sensors. The ESS shall support the number of sulfur dioxide sensors as defined by the agency specification. If the agency specification does not define the number of sulfur dioxide sensors, the number of sulfur dioxide sensors supported by the ESS is one (1).

3.6.18 Required Number of Ozone Sensors

The communications interface only allows the ESS to return a single value for ozone; however, this value may be derived from multiple sensors. The ESS shall support the number of ozone sensors as defined by

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the agency specification. If the agency specification does not define the number of ozone sensors, the number of ozone sensors supported by the ESS is one (1).

3.6.19 Required Number of Small Particulate Matter Sensors

The communications interface only allows the ESS to return a single value for small particulate matter; however, this value may be derived from multiple sensors. The ESS shall support the number of small particulate matter sensors as defined by the agency specification. If the agency specification does not define the number of small particulate matter sensors, the number of small particulate matter sensors supported by the ESS is one (1).

3.6.20 Required Number of Snapshot Cameras

The ESS shall support the number of snapshot cameras as defined by the agency specification. If the agency specification does not define the number of snapshot cameras, the number of snapshot cameras supported by the ESS is one (1).

~~3.6.1~~3.6.21 Maximum Response Time for Requests

The ESS shall process all requests in accordance with all of the rules of the relevant base standards (i.e., NTCIP 1103 v02 and NTCIP 2303:2001), including updating the value ~~in the~~ the RPU is storing internally (e.g., database) and initiating the transmission of the appropriate response (assuming that the ESS has permission to transmit) within the Maximum Response Time. This is a requirement on the device to generate the response message within the device, and not on the transmission, which may dependent on the communications system. If the agency specification does not indicate the Maximum Response Time, the Maximum Response Time shall be 100 milliseconds. The Maximum Response Time is measured as the time between the receipt of the last byte of the request and the transmission of the first byte of the response.

3.6.22 Required Number of Water Level Sensors

The ESS shall support the number of water level sensors as defined by the agency specification. If the agency specification does not define the number of water level sensors, the number of water level sensors supported by the ESS is one (1).

~~3.6.2 Maximum Transmission Start Time~~

~~When a user-specified condition-based exception reporting occurs, the ESS shall initiate the transmission of the appropriate report within the Maximum Transmission Start Time. If the agency specification does not indicate the Maximum Transmission Start Time, the Maximum Transmission Start Time shall be 10 seconds. The Maximum Response Start Time is measured as the time between the time the ESS first notes the occurrence of the event to the time the ESS initiates communications with the management station (e.g., handshake).~~

~~3.6.3~~3.6.23 Support Camera Number in Filename

The ESS shall support the ability to specify a field in the filename parameter that is replaced by the camera number when a snapshot is ~~-~~saved. This is ~~shall be~~ the '<camera>' field as defined in Section 5.16.3.6.~~This shall be the '<camera>' field as defined in Section 5.16.3.6.<N: Reference to be completed in the design document>.~~

~~3.6.4~~3.6.24 Support Sequence Number in Filename

The ESS shall support the ability to specify a field in the filename parameter that is replaced by the current sequence number when a snapshot~~-~~ is saved. This is ~~shall be~~ the '<sequence>' field as defined in

Section 5.16.3.6.~~This shall be the '<sequence>' field as defined in Section <N: Reference to be completed in the design document>..~~

~~3.6.5~~3.6.25 Support Date in Filename

The ESS shall support the ability to specify a field in the filename parameter that is replaced by the current UTC date when a snapshot is saved. ~~This shall be the '<date>' field as defined in Section.<N: Reference to be completed in the design document>~~ This is ~~shall be~~ the '<date>' field as defined in Section 5.16.3.6.

~~3.6.6~~3.6.26 Support Time in Filename

The ESS shall support the ability to specify a field in the filename parameter that is replaced by the current UTC time when a snapshot is saved. This is ~~shall be~~ the '<time>' field as defined in Section 5.16.3.6.~~This shall be the '<time>' field as defined in Section <N: Reference to be completed in the design document>..~~

~~3.6.7~~3.6.27 Support Long Filenames

The ESS shall support the ability to specify filenames up to 255 characters in length, including any extension.

~~3.6.8 Maximum Transmission Start Time~~

~~When a user-specified condition-based exception reporting occurs, the ESS shall initiate the transmission of the appropriate report within the Maximum Transmission Start Time. If the agency specification does not indicate the Maximum Transmission Start Time, the Maximum Transmission Start Time shall be 10 seconds. The Maximum Response Start Time is measured as the time between the time the ESS first notes the occurrence of the event to the time the ESS initiates communications with the management station (e.g., handshake).~~

3.6.28 Required Number of Small Particulate Matter (2.5) Sensors

The communications interface only allows the ESS to return a single value for small particulate matter 2.5 microns or less in diameter; however, this value may be derived from multiple sensors. The ESS shall support the number of small particulate matter (≤ 2.5 microns diameter) sensors as defined by the agency specification. If the agency specification does not define the number of small particulate matter (≤ 2.5 microns diameter) sensors, the number of small particulate matter (2.5) sensors supported by the ESS is one (1).

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Section 4
Dialogs [Normative]

Section 4~~Section 4~~ defines the dialogs (i.e., sequence of data exchanges) that fulfill various Data Exchange requirements defined in Section 3.5.~~3.5.~~ As SNMP communications are largely driven by the management station, most of the requirements define how the device shall respond to the various possible actions a management station might take.

The NTCIP standards effort is based on SNMP. This protocol offers a high degree of flexibility as to how the management station structures its requests. For example, with SNMP, the management station can do any of the following:

a) Send only those requests that are critical at the current time, whereas a standardized dialog typically sends requests relating to all associated data, regardless of whether it is critical for current purposes
b) Combine a number of requests in a single packet, whereas a standardized dialog dictates the exact contents of each packet
c) Separate a group of requests into multiple packets, whereas a standardized dialog dictates the exact contents of each packet
d) Interweave requests from multiple dialogs, whereas a standardized dialog dictates the exact ordering of messages, which are not interrupted with other messages

This flexibility can be a powerful tool allowing a management system to optimize the use of communication facilities, which is the primary reason that SNMP was chosen as the core NTCIP protocol. However, the flexibility also means that there are numerous allowable variations in the management process that a management station may choose to use and that an agent shall support to conform to NTCIP 1204~~ v03~~.

Unfortunately, this flexibility presents a challenge to ensuring interoperability.

~~Unfortunately, this flexibility presents a challenge to ensuring interoperability. While a conformant ESS is required to support all operations defined within this standard, ensuring that a given ESS actually supports every possible combination would be impractical. Instead, most agencies only require that the device be tested to a standard set of procedures, which would use standardized dialogs (as defined in Section 4.2, Annex A, and Annex F.3). To improve communications efficiency, management stations may use non-standard dialogs (e.g., a combination of GET and/or SET requests that is not defined as a standardized dialog, but which a conformant device is required to support according to the ACCESS and SetConstraint rules defined in Section 4.3 and Section 5). Because these more efficient dialogs may not be known until the acquisition of the management station, which may be years after the acquisition of the device, there is a potential for an interoperability problem to arise.~~

To overcome this complication, Section 4~~Section 4~~ defines a lowest common denominator approach to communications between a management station and a device. It defines the standardized dialog for each Data Exchange Requirement. Management stations may support other dialogs to fulfill these same requirements, as long as these dialogs are consistent with the rules defined in NTCIP 1204 v04~~v03~~. Such a management station is termed a “consistent management station.” A consistent management station interoperates with any “conformant” device. ~~However, since an agency cannot be certain that a device is 100% conformant to every possible scenario (given practical constraints), interoperability problems could still arise.~~

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A “conformant management station” is required to offer a mode in which it only uses the standardized dialogs as defined in Section 4.~~Section 4.~~ With this limited definition, there is relatively little variability in what constitutes a conformant management station. Thus, fully testing a management station for conformance is a relatively straight forward process that can be done within the practical constraints faced by most procuring agencies. Thus, a conformant management station provides an agency with a much greater chance of achieving interoperability with off-the-shelf devices that have been tested against NTCIP 2104 v03, and the designation of such a system is intended to provide a guaranteed base level of interoperability.

The rules for the standardized dialogs follow:

a) The dialogs are defined by a sequence of GET or SET requests. These requests shall equate to the GET and SET operations defined in Annexes G.1~~F.3.1~~and G.3~~0~~ and shall be transmitted as a single message.
b) The contents of each request are identified by an object name. Each object name consists of an object type and an instance identifier. Definitions of each object type are provided in Section 5~~Section 5~~ and NTCIP 1201 V03~~2~~. The meaning of the instance identifier is provided by these same definitions coupled with standard SNMP rules (see RFC 1212).
c) Each message shall contain all of the objects as shown, unless otherwise indicated
d) A message shall not contain any other objects
e) The contents of each message sent by the management station may appear in any order Note: ~~OTE—~~Ideally, the order of objects should match the order as shown in NTCIP 1204 v04~~v03~~ to provide the highest probability of interoperability. However, it is recognized that many implementations may use off-the-shelf software, which may prevent the designation of an exact ordering of objects and as a result, this ordering is not a requirement of NTCIP 1204 v04~~v03~~.
f) After sending a message, the management station shall not transmit any other data across the communications channel until the earlier of:
   1) The management station receiving a response from the device; or
   2) The expiration of the maximum response time.
g) If the response indicates an error occurred in the operation, the management station shall exit the process, unless specific error-handling rules are specified by the dialog.
h) Dialogs containing a sequence of only GET requests may request objects in any order.

However, since consistent management stations can alter the order of requests, this standard defines rules for when certain data exchanges are allowed. Unless otherwise indicated, a conformant device shall allow an object to be retrieved (through a GET request) or altered (through a SET request, if the object is writable) at any time. However, the access to some data is associated with a state machine, and Section 4.2.16~~4.3~~ defines the various rules that apply to these state machines.

Finally, Section 4.4~~4.4~~ presents an overview of all of the data defined by this standard, prior to presenting the complete definition for each piece of data in Section 5~~Section 5~~.

4.1 Tutorial [Informative]

The Requirements Traceability Matrix (RTM) in Annex A identifies the standardized dialog that can be used to achieve each of the data exchange requirements defined in Section 3.5.~~3.5.~~ Simple data exchange requirements reference one of the generic SNMP dialogs along with a list of data elements. These equate to a single message being sent (e.g., a GET request) containing the referenced data elements followed by the appropriate response per the generic dialog specification.

Section 2~~4.1~~ defines the standardized dialogs for the more complicated data exchange requirements. Each of these dialogs is defined by a number of steps. Many of the steps reference data elements that are defined in Section 5.~~Section 5.~~ These data elements are also shown in the corresponding row of the RTM along with their precise section number.

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The dialogs may also be accompanied by an informative figure that provides a graphical depiction of the normative text. The figures conform to the Unified Modeling Language and depict the management station as an outside actor sending a series of messages to the device and the device returning responses. If there is any conflict between the figure and the text, the text takes precedence.

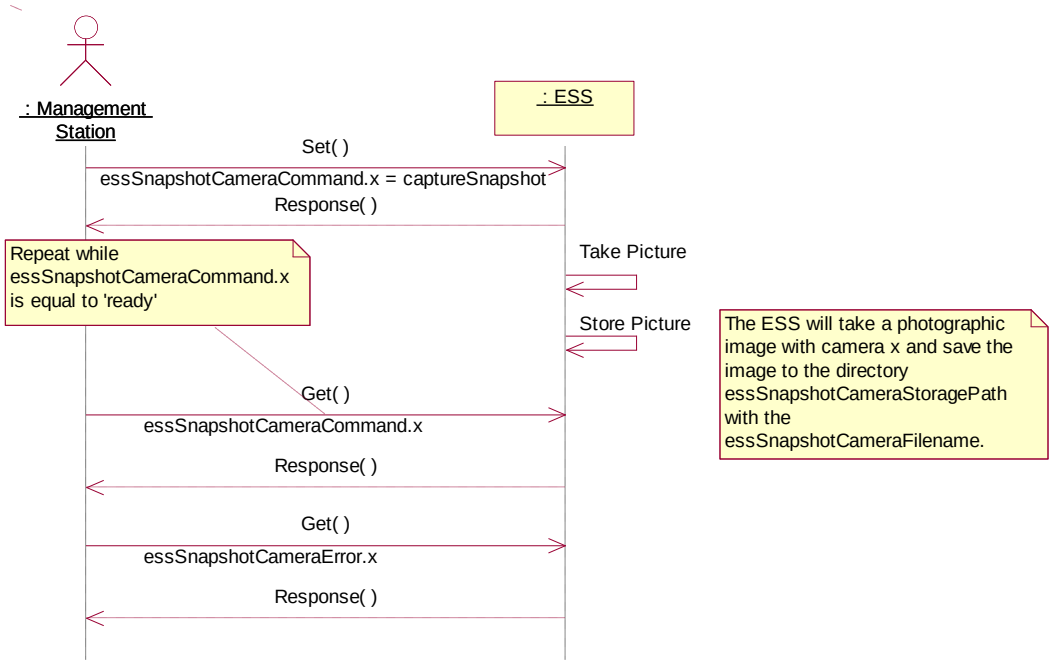
4.2 Specified Dialogs

4.2.1 Capture Snapshot Image

The standardized dialog for a management station to capture a snapshot image shall be:

a) The management station shall SET essSnapshotCameraCommand.x to the value of *captureSnapshot*~~captureSnapsot~~ *(2)*.
b) The ESS shall take the picture with camera x.
c) The ESS shall store the captured picture to the directory essSnapshotCameraStoragePath.x and to the file essSnapshotCameraFilename.x.
d) The management station shall repeatedly GET essSnapshotCameraCommand.x until it equals *ready (1)*.
e) The management station shall GET essSnapshotCameraError.x to verify the picture was successful.
f) The ESS shall respond with the indicated value.

This process is depicted in the UML diagram in Figure 8~~Figure 5~~.



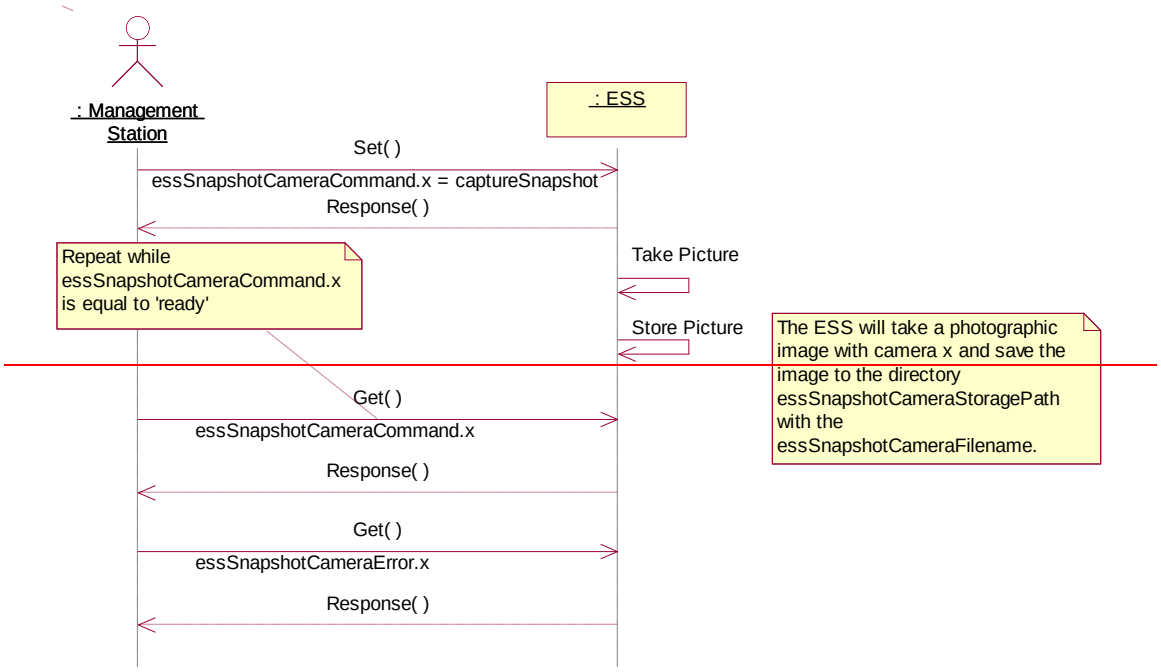


Figure 8 Dialog for Capture Snapshot Image

4.2.2 Retrieve Snapshot

The standardized dialog for a management station to retrieve a snapshot image shall conform to NTCIP 2303:2001.

The device shall adhere to the following rules:

a) The login directory is the root directory and a user cannot traverse to any parent directories.
b) Subdirectories may be used.
c) FTP access user name and password shall be defined in the agency specification.
d) Device shall use FTP port "21."
e) Zero or one FTP login session with the specification username shall exist at any given time.

4.2.3 Delete Snapshot

The standardized dialog for a management station to delete a snapshot image shall conform to NTCIP 2303:2001 and to the rules defined in Section 4.2.~~4.2.~~

4.2.4 Copy Snapshot—Deprecated in v03

~~The standardized dialog for a management station to copy a snapshot image shall conform to NTCIP 2303 (File Transfer Protocol) and to the rules defined in Clause 4.2.~~

Note: ~~OTE—~~This dialog was added in NTCIP 1204 v02; however, it was later determined that FTP does not support a copy operation. It has been replaced with the ability to define a sequence number in the filename. See Section 3.6.24~~3.6.24~~.

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4.2.5 Retrieve Stationary Pavement Treatment Configuration

The standardized dialog for a management station to retrieve the pavement treatment configuration for a stationary ESS shall be as follows:

a) The management station shall GET numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall GET the following objects:
   1) essPaveTreatProductType.x
   2) essPaveTreatProductForm.x
   3) essPercentProductMix.x
c) The management station shall GET the following objects:
   1) ptsSignalDuration
   2) ptsMonitoringDetectors

Where,
x = the index of the treatment

4.2.6 Retrieve Icing Conditions—Passive

The standardized dialog for a management station to retrieve the current and predicted icing conditions from a passive sensor shall be as follows:

a) (Precondition) The management station is aware of the sensor from which data is desired.
b) The management station shall GET the following objects:
   1) essSurfaceTemperature.x
   2) essPavementTemperature.x
   3) essSurfaceSalinity.x
   4) essSurfaceFreezePoint.x
   5) essSurfaceBlackIceSignal.x
   6) essPavementSensorError.x
c) The management station shall GET the following objects:
   1) essSurfaceIceOrWaterDepth.x
   2) essSurfaceConductivityV2.x
   3) pavementSensorTemperatureDepth.x
   Note: These are NTCIP 1204 v02 objects that may result in a noSuchName error.
d) The management station shall GET numEssTreatments.0.
e) For each treatment from 1 to the number of treatments, the management station shall GET the following objects:
   1) essPaveTreatProductType.y
   2) essPaveTreatProductForm.y
   3) essPercentProductMix.y

Where,
x = the sensor index,
y = the index of the treatment

4.2.7 Configure Stationary Pavement Treatment System

The standardized dialog for a management station to configure a stationary pavement treatment system shall be as follows:

a) The management station shall GET numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall SET the following objects to the desired values:
   1) essPaveTreatProductType.x

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   2) essPaveTreatProductForm.x
c) The management station shall SET every instance of essPercentProductMix.x to the desired values such that the total of all instances shall equal 100.
d) The management station shall SET the following objects to their desired values:
   1) ptsSignalDuration.0
   2) ptsMonitoringDetectors.0

Where,
x = the index of the treatment

4.2.8 Configure Passive Ice Detection Logic

The standardized dialog for a management station to configure the passive ice detection logic shall be as follows:

a) The management station shall GET numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall SET the following objects to the desired values:
   1) essPaveTreatProductType.x
   2) essPaveTreatProductForm.x
c) The management station shall set every instance of essPercentProductMix.x to the desired value such that the total of all instances shall equal 100.

Where,
x = the index of the treatment

4.2.9 Configure Mobile Pavement Treatment System

The standardized dialog for a management station to configure a mobile pavement treatment system shall be as follows:

a) The management station shall GET numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall SET the following objects to the desired values:
   1) essPaveTreatProductType.x
   2) essPaveTreatProductForm.x
c) The management station shall SET every instance of essPercentProductMix.x to the desired values such that the total of all instances shall equal 100.
d) The management station shall SET the following objects to their desired values:
   1) essPaveTreatmentAmount.0
   2) essPaveTreatmentWidth.0

Where,
x = the index of the treatment

4.2.10 Configure Snapshot Camera

The standardized dialog for a management station to configure a snapshot camera shall be as follows:

a) (Precondition) The management station shall be aware of which row in the table is to be configured.
b) For the specified row, the management station shall SET the following object to the desired value:
   1) essSnapshotCameraDescription.x
a) For the specified row, the management station shall SET the following object to the desired value:
   1) essSnapshotCameraFilename.x

Where,

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x = the index of the snapshot camera

Note: The standardized dialog is divided into two steps for backward compatibility; older devices may not support the essSnapshotCameraFilename object. These devices store the files using a filename convention that is manufacturer-specific.

4.2.11 Retrieve Snapshot Camera Configuration

The standardized dialog for a management station to retrieve the snapshot camera configuration shall be as follows:

a) The management station shall GET essSnapshotNumberOfCameras.0.
b) For each snapshot camera from 1 to the number of cameras, the management station shall GET the following objects:
   1) essSnapshotCameraDescription.x
   2) essSnapshotCameraStoragePath.x
c) For each snapshot camera from 1 to the number of cameras, the management station shall GET the following object:
   1) essSnapshotCameraFilename.x

Where,

x = the index of the treatment

Note: The standardized dialog is divided into two steps for backwards compatibility; older devices may not support the essSnapshotCameraFilename object. These devices store the files using a filename convention that is manufacturer-specific.

4.2.12 Retrieve Precipitation Presence [Versions 01 to 03]

The standardized dialog for a management station to retrieve precipitation presence shall be as follows:

a) The management station shall GET essPrecipYesNo.0.
b) The management station shall GET precipitationSensorModelInformation.0.

Note: This is an NTCIP 1204 v02 object that may result in a noSuchName. This level of detail was not provided in NTCIP 1204 v01.

Note: To understand the sensor model information, the management station either needs to be aware of the contents of the Module Table prior to performing this dialog or to retrieve the information after performing the dialog.

4.2.13 Retrieve Solar Radiation [Versions 01 to 03]

The standardized dialog for a management station to retrieve solar radiation shall be as follows:

a) The management station shall GET essTotalSun.0.
b) The management station shall GET the following objects:
   1) essInstantaneousTerrestrialRadiation.0.
   2) essInstantaneousSolarRadiation.0.
   3) essTotalRadiation.0.
   4) essTotalRadiationPeriod.0.
   Note: These are NTCIP 1204 v02 objects that may result in a noSuchName error.
c) If the device responds with a noSuchName error, the management station shall GET essSolarRadiation.0

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4.2.14 Retrieve Pavement Surface Condition

The standardized dialog for a management station to retrieve precipitation presence shall be as follows:

a) (Precondition) The management station shall be aware of which row of the table is to be retrieved.
b) The management station shall GET the following objects for the pavement sensor of interest:
   1) essSurfaceStatus.x
   2) essSurfaceTemperature.x
   3) essPavementSensorError.x
c) The management station shall GET pavementSensorModelInformation.x.
   Note: This is an NTCIP 1204 v02 object that may result in a noSuchName. This level of detail was not provided in NTCIP 1204 v01.

   Note: To understand the sensor model information, the management station either needs to be aware of the contents of the Module Table prior to performing this dialog or to retrieve the information after performing the dialog.

4.2.15 Retrieve Icing Conditions—Active

The standardized dialog for a management station to retrieve active icing condition information shall be as follows:

a) (Precondition) The management station shall be aware of which row of the table is to be retrieved.
b) The management station shall GET the following objects for the pavement sensor of interest:
   1) essSurfaceTemperature.x
   2) essPavementTemperature.x
   3) essSurfaceFreezePoint.x
   4) essSurfaceBlackIceSignal.x
   5) essPavementSensorError.x
c) The management station shall GET the following objects for the pavement sensor of interest:
   1) essSurfaceIceOrWaterDepth.x
   2) pavementSensorTemperatureDepth.x

   Note: These are NTCIP 1204 v02 objects that may result in a noSuchName error. This level of detail was not provided in NTCIP 1204 v01.

4.2.16 Retrieve Precipitation Presence

The standardized dialog for a management station to retrieve precipitation presence shall be as follows:

a) (Precondition) The management station shall be aware of which row of the table is to be retrieved.
b) The management station shall GET the following objects for the precipitation sensor of interest:
   1) essPrecipYesNo.x
   2) precipitationSensorModelInformation~~.~~.x

   Note: To understand the sensor model information, the management station either needs to be aware of the contents of the Module Table prior to performing this dialog or to retrieve the information after performing the dialog.

4.2.17 Retrieve Solar Radiation

The standardized dialog for a management station to retrieve solar radiation shall be as follows:

a) The management station shall GET radiationSensorTableNumSensors.0.
b) For each sensor from 1 to the number of solar radiation sensors, the management station shall GET the following objects:

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1) essTotalSunV4.x
2) essInstantaneousTerrestrialRadiationV4.x.
3) essInstantaneousSolarRadiationV4.x.
4) essTotalRadiationV4.x.

c) The management station shall GET essTotalRadiationPeriod.0.

Where,
x = the index of the solar radiation sensor

4.2.18 Retrieve Mobile Pavement Treatment System

The standardized dialog for a management station to retrieve the configuration of a mobile pavement treatment system shall be as follows:

a) The management station shall GET numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall GET the following objects:
   1) essPaveTreatProductType.x
   2) essPaveTreatProductForm.x
   3) essPercentProductMix.x
c) The management station shall GET the following objects:
   1) essPaveTreatmentAmount.0
   2) essPaveTreatmentWidth.0

Where,
x = the index of the treatment

4.2.19 Retrieve Pavement Treatment Profile

The standardized dialog for a management station to retrieve the pavement treatment profile of a mobile pavement treatment system shall be as follows:

a) The management station shall GET the following objects:
   1) essLatitude.0
   2) essLongitude.0
   3) essVehicleSpeed.0
   4) essVehicleBearing.0
   5) essOdometer.0
   6) essReferenceHeight.0
   7) numEssTreatments.0.
b) For each treatment from 1 to the number of treatments, the management station shall GET the following objects:
   1) essPaveTreatProductType.x
   2) essPaveTreatProductForm.x
   3) essPercentProductMix.x
c) The management station shall GET the following objects:
   1) essPaveTreatmentAmount.0
   2) essPaveTreatmentWidth.0

Where,
x = the index of the treatment

4.2.20 Retrieve Sensor Profile for Mobile Platforms

The standardized dialog for a management station to retrieve the sensor profile of a mobile station shall be as follows:

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a) The management station shall GET the following objects:
   1) globalTime.0
   2) globalDaylightSaving.0
b) If supported, the management station shall GET the following objects:
   1) essLatitude.0
   2) essLongitude.0
   3) essVehicleSpeed.0
   4) essVehicleBearing.0
   5) essOdometer.0
   6) essReferenceHeight.0
c) If supported, for each wind sensor from 1 to the number of wind sensors, the management station shall GET the following objects:
   1) windSensorAvgSpeed.x
   2) windSensorAvgDirection.x
   3) windSensorSpotSpeed.x
   4) windSensorSpotDirection.x
   5) windSensorGustSpeed.x
   6) windSensorGustDirection.x
   7) windSensorSituation.x
d) If supported, for each temperature sensor from 1 to the number of temperature sensors, the management station shall GET the following objects:
   1) essAirTemperature.x
e) If supported, for each precipitation sensor from 1 to the number of precipitation sensors, the management station shall GET the following objects:
   1) precipitationSensorPrecipYesNo.x
   2) precipitationSensorPrecipRate.x
   3) precipitationSensorSnowfallAccumRate.x
   4) precipitationSensorIceThickness.x
   5) precipitationSensorPrecipitationStartTime.x
   6) precipitationSensorPrecipitationEndTime.x
   7) precipitationSensorPrecipitationOneHour.x
   8) precipitationSensorPrecipitationThreeHours.x
   9) precipitationSensorPrecipitationSixHours.x
   10) precipitationSensorPrecipitationTwelveHours.x
   11) precipitationSensorPrecipitation24Hours.x
   12) essAdjacentSnowDepth.x
   13) essRoadwaySnowDepth.x
   14) essRoadwaySnowPackDepth.x
f) If supported, the management station shall GET the following objects:
   1) essVisibility.0
g) If supported, for each atmospheric sensor from 1 to the number of atmospheric sensors, the management station shall GET the following objects:
   1) essPressureSensorAtmosphericPressure.x
h) If supported, for each humidity sensor from 1 to the number of humidity sensors, the management station shall GET the following objects:
   1) humiditySensorRelativeHumidity.x
   2) humiditySensorWetbulbTemp.x
   3) humiditySensorDewpointTemp.x
i) If supported, for each pavement sensor from 1 to the number of pavement sensors, the management station shall GET the following objects:
   1) essSurfaceTemperature.x
   2) essSurfaceSalinity.x
   3) essSurfaceFreezePoint.x
   4) essPavementSensorError.x
   5) essSurfaceIceOrWaterDepth.x

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6) pavementSensorSurfaceCondition.x
7) pavementSensorForecastCondition.x
8) pavementSensorFrictionCoefficient.x
9) pavementIcePercentage.x

j) If supported, the management station shall GET the following objects:
1) essPrecipSituation.0
2) essVisibilitySituation.0
3) essMobileObservationGroundStateV4.0
4) essMobileObservationPavementV4.0
5) essCloudSituationV4.0

Where,
x = the index of the treatment

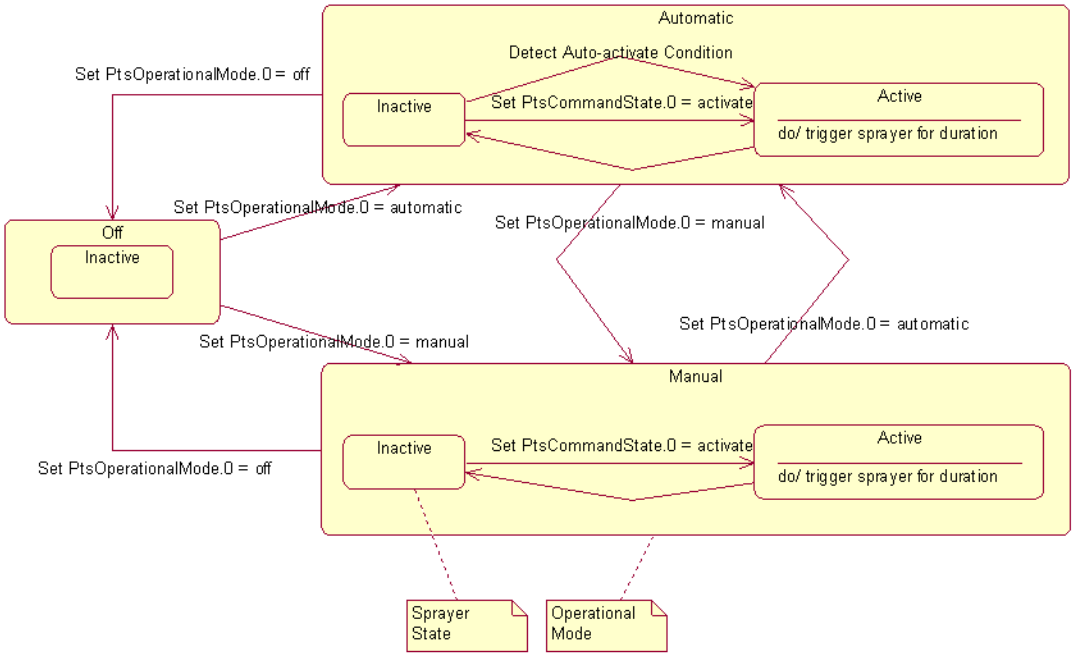
~~**4.2.16 Retrieve Weather and Pavement Profile**~~

4.3 State Transition Diagrams

The following define the states for various object classes that may be supported by the device.

4.3.1 Pavement Treatment System State Transition Diagram

Figure 9~~Figure 6~~ depicts the state transition diagram for the Pavement Treatment System class.



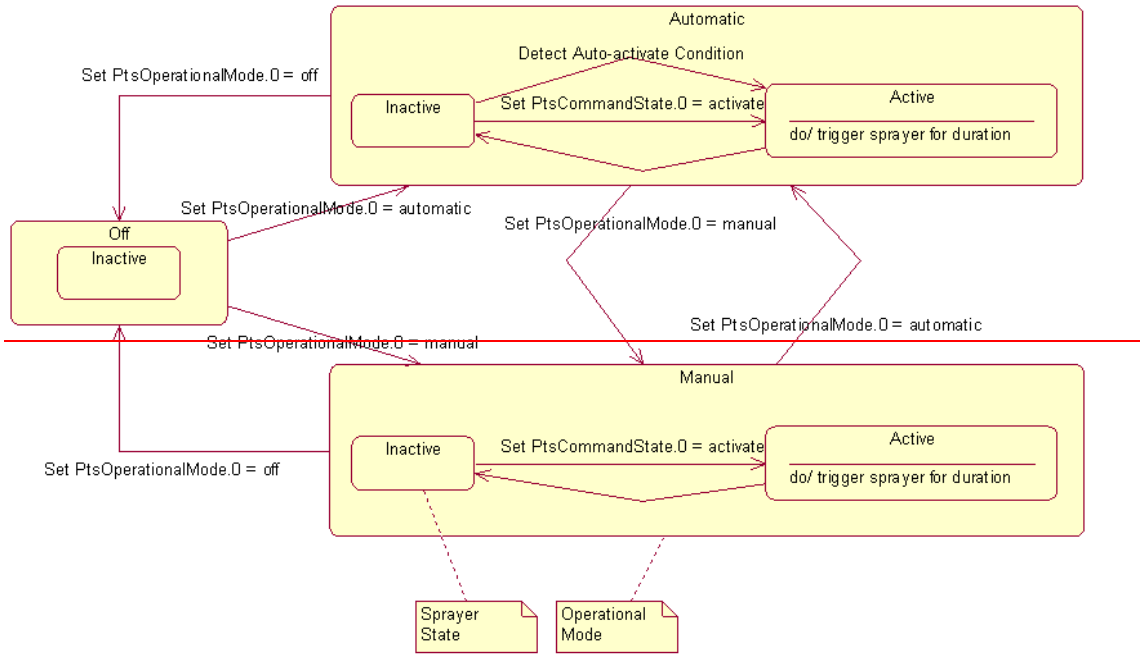


Figure 9 Pavement Treatment System State Machine Diagram

4.3.1.1 Off

When in the "off" state, the PTS shall not trigger the sprayer even if commanded to do so and shall always be inactive. The PTS shall transition to the requested operational mode, upon request.

4.3.1.2 Automatic

When in the "automatic" state, the PTS shall monitor conditions and trigger the sprayer based on a manufacturer specific algorithm. The algorithm shall only consider input from the detectors selected in the ptsMonitoringDetectors object. The PTS shall also trigger the sprayer if commanded to do so via the ptsCommandStateV3 object. The PTS shall transition to the requested operational mode, upon request.

4.3.1.3 Manual

When in the "manual" state, the PTS shall trigger the sprayer if commanded to do so via the ptsCommandStateV3 object. The PTS shall transition to the requested operational mode, upon request.

4.3.1.4 Inactive

When in the "inactive" state, the PTS shall not be spraying.

4.3.1.5 Active

Upon entering the "active" state, the PTS shall trigger the sprayer and spray the chemical for a duration as defined by the ptsSignalDuration object. Upon expiration of this duration, the PTS shall automatically transition back to the "inactive" state.

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4.4 Class Diagrams

The relationships between data elements are described through the use of UML class diagrams. Figure 10~~Figure 7~~ provides a sample class diagram.

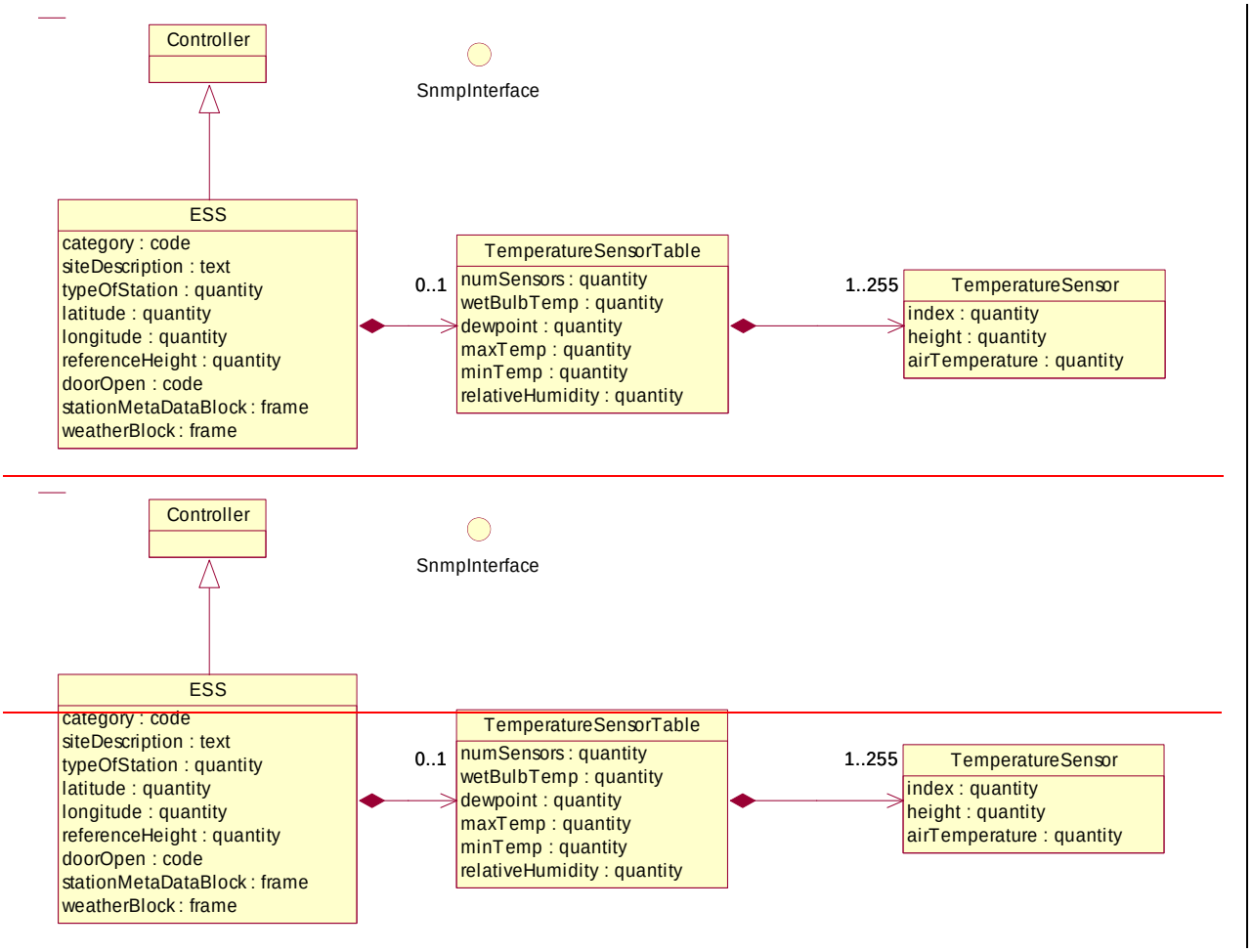

Figure 10 Sample Class Diagram for Temperature Sensors

Each box represents a logical class (grouping) of data. The box contains a name in the upper compartment and a list of any applicable attributes (i.e., individual pieces of information to describe the class) in the lower compartment. Lines between classes indicate that the classes have a relationship.

A diamond on the end of a line indicates aggregation. The class that has the diamond is the whole; the other class represents a part. If the diamond is filled in, it indicates composition, meaning that the part may only be owned by one whole and when the whole is deleted, all of its parts are automatically deleted. However, a part of an aggregate relationship that is not a composition can exist without the whole or may be part to several wholes. At a university, for example, a course would be considered to be an aggregation of students. A student may be enrolled in several courses at once and the student is not “deleted” if the course is cancelled.

A number at the end of a relationship line indicates the number of instances of the class that may exist in relation to one instance of the other class. An asterisk (*) indicates an infinite number. A range of values may be indicated in the format of a number followed by two periods followed by another number.

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An open arrow indicates that the class from which the arrow originates is a type of the class to which the arrow points (i.e., an ESS is a type of controller).

A circle connected by a line indicates an interface for the class. An interface is one or more operations that may be performed. Within the context of NTCIP 1204 v04~~v03~~, there are two interfaces, the SNMP Interface (as shown in the sample diagram), and the FTP Interface (not shown here, but shown later in Section 4).

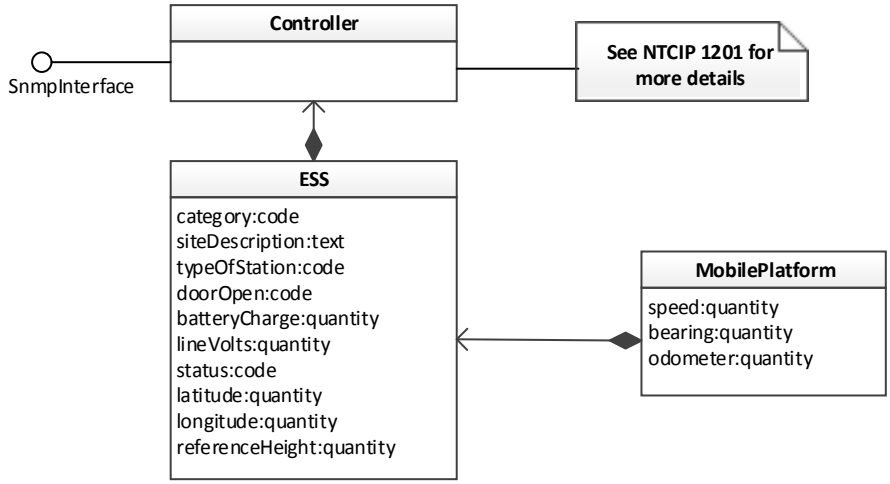
After the diagram, there is text describing the important rules depicted in the diagram

Each piece of data referenced is depicted in a class diagram and named according to ISO 14817 naming conventions. However, these naming conventions violate the rules for SNMP object names, as defined by RFC 1212. Thus, each class diagram is associated with a table that maps the descriptive names to the SNMP object names and the section number of the MIB where the data is defined.

4.4.1 ESS Characteristics

4.4.1.1 ESS Characteristics Class Diagram

An ESS can be described by a number of attributes as defined in the following sections and as depicted in the UML class diagram provided in Figure 11.~~Figure 8.~~ The diagram indicates that an ESS is a type of a Controller. The data that may be supported by a Controller is defined by NTCIP 1201 v03~~2~~~~V02~~. The Controller, and thus the ESS, shall support an SNMP Interface as defined in Annex G~~Annex FG~~.~~Annex F.~~ A MobilePlatform is a special type of ESS that is able to collect information while in motion. While MobilePlatforms are relatively new to the industry, this standard provides a basic level of support for monitoring such devices.



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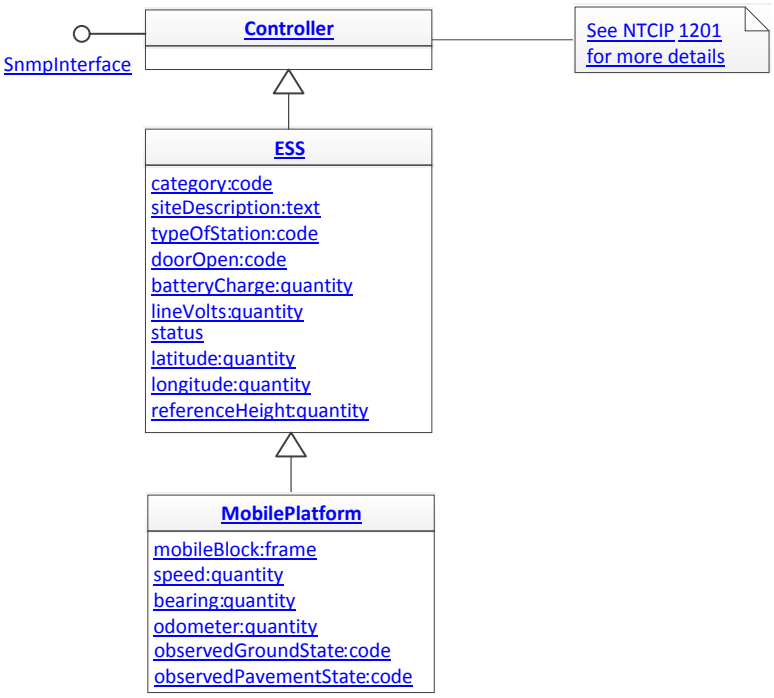

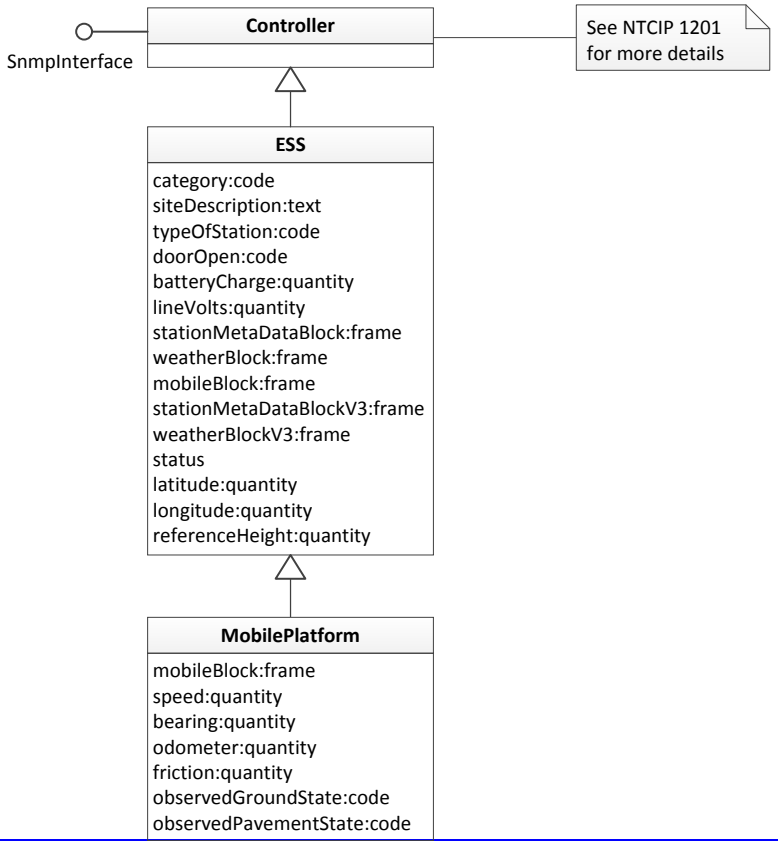

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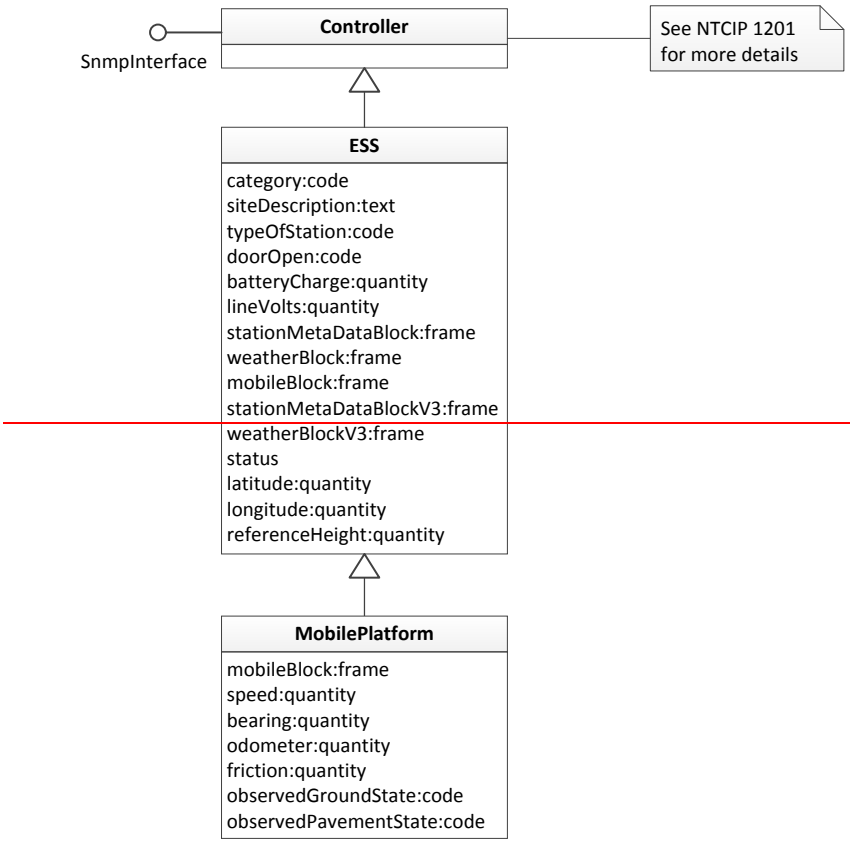

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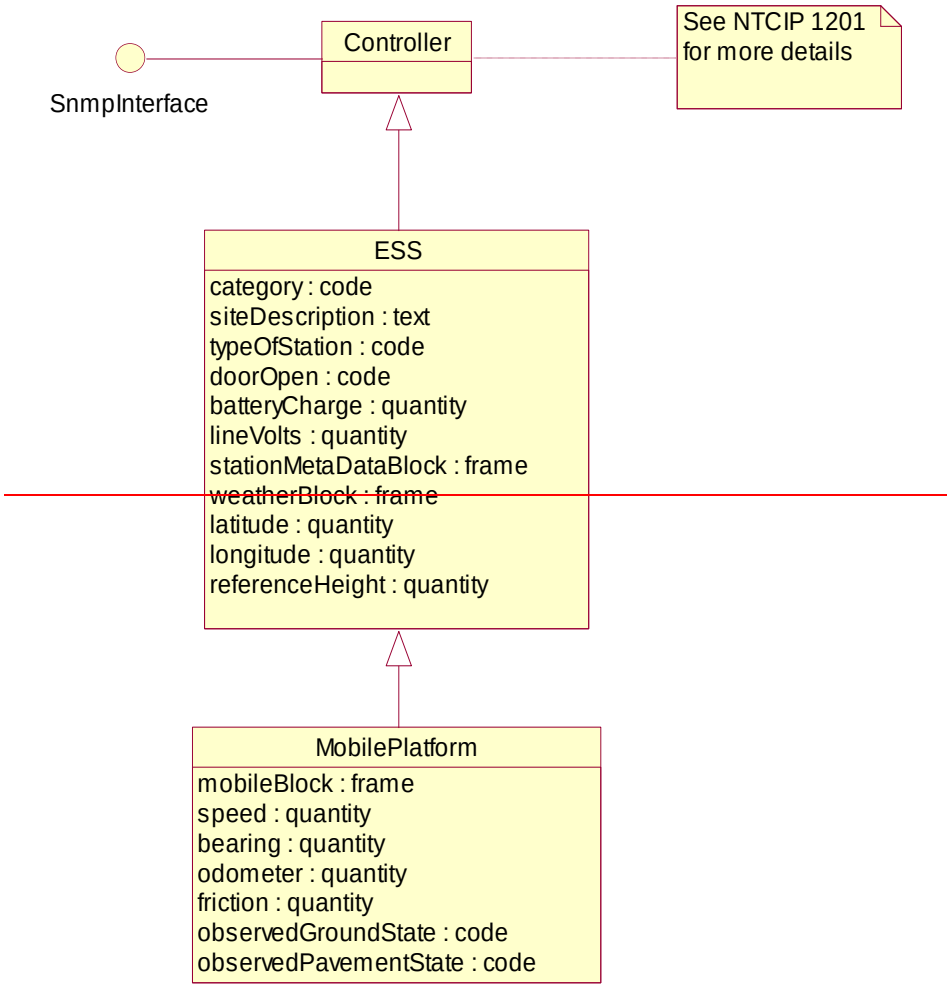


Figure 11 ESS Characteristics Class Diagram

4.4.1.2 ESS

An ESS is any type of device that is able to detect one or more environmental conditions and/or provide for pavement treatment. It can be described through a number of attributes as indicated Table 7~~Table 6~~.

Table 7 ESS Descriptive Name, Section, and Object Name

Descriptive Name	Section	Object Name
ESS.category:code	5.2.1	essNtcipCategory
ESS.siteDescription:text	5.2.2	essNtcipSiteDescription
ESS.typeOfStation:code	5.3.1	essTypeofStation
ESS.doorOpen:code	5.3.2	essDoorStatus
ESS.batteryCharge:quantity	5.3.3	essBatteryStatus
ESS.lineVolts:quantity	5.3.4	essLineVolts
~~ESS.stationMetaDataBlock:frame~~	~~5.3.5~~	~~essStationMetaDataBlock~~
~~ESS.weatherBlock:frame~~ X	~~5.3.6~~	~~essWeatherBlock~~
ESS.status:code	5.3.10	essStatus
ESS.latitude:quantity	5.4.1	essLatitude
~~ESS.mobileBlock:frame~~	~~5.3.7~~	~~essMobileBlock~~
~~ESS.stationMetaDataBlockV3:frame~~	~~5.3.8~~	~~essStationMetaDataV3Block~~
~~ESS.weatherBlockV3:frame~~	~~5.3.9~~	~~essWeatherV3Block~~
~~ESS.status:code~~	~~5.3.10~~	~~essStatus~~
ESS.longitude:quantity	5.4.2	essLongitude
ESS.referenceHeight:quantity	5.5.1	essReferenceHeight

4.4.1.3 Mobile Platform

A mobile platform is a type of ESS that is able to operate while in motion. It can be described through a number of attributes as indicated in Table 8~~Table 7~~.

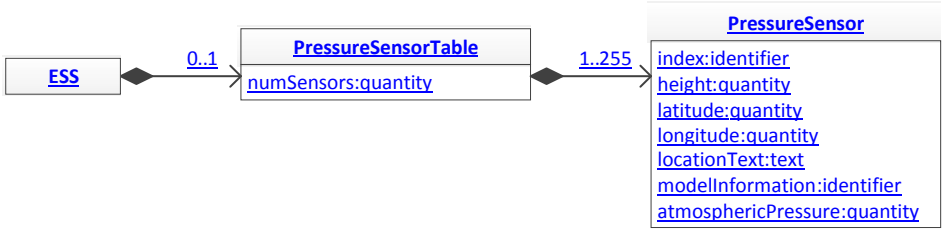
Table 8 Mobile Platform Attributes

Descriptive Name	Section	Object Name
~~MobilePlatform.mobileBlock:frame~~	~~5.3.7~~	~~essMobileBlock~~
MobilePlatform.speed:quantity	5.4.3	essVehicleSpeed
MobilePlatform.bearing:quantity	5.4.4	essVehicleBearing
MobilePlatform.odometer:quantity	5.4.5	essOdometer
~~MobilePlatform.friction:quantity~~	~~5.12.1~~	~~essMobileFriction~~
~~MobilePlatform.observedGroundState:code~~	~~5.12.42~~	~~essMobileObservationGroundStateV4~~
~~MobilePlatform.observedPavementState:code~~	~~5.12.53~~	~~essMobileObservationPavementV4~~

4.4.2 Pressure Sensor

4.4.2.1 Pressure Sensor Class Diagram

The ESS shall support one logical atmospheric pressure sensor if required by the agency specification. This information is depicted in Figure 12~~Figure 9~~.



Note: The logical sensor may represent a value derived from multiple physical sensors.

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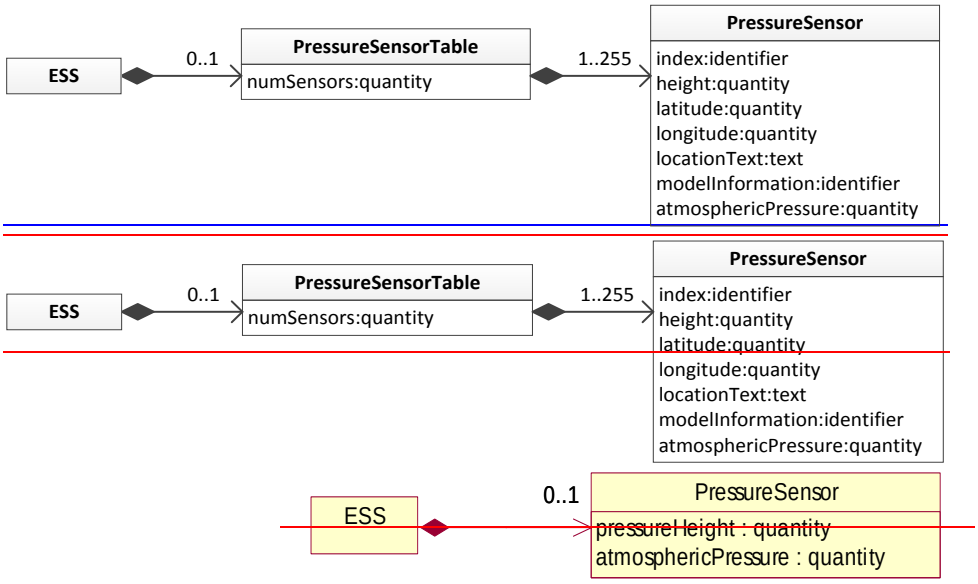

Figure 12 Pressure Sensor Class Diagram

4.4.2.2 Pressure Sensor Table

The pressure sensor table contains information about all of the pressure sensors supported by the ESS. It can be described through a number of attributes as indicated in ~~Table 9 Pressure Sensor Table~~Table 9.

Table 9 Pressure Sensor Table

Descriptive Name	Section	Object Name
PressureSensorTable.numSensors:quantity	5.5.5~~18.1~~	numEssPressureSensors

~~4.4.2.2~~4.4.2.3 Pressure Sensor

A pressure sensor is a sensor that detects the atmospheric pressure. It can be described through a number of attributes as indicated in Table 10~~Table 8~~.

Table 10 Pressure Sensor Attributes

Descriptive Name	Section	Object Name
PressureSensor.index:identifier	~~5.18.3.1~~ 5.5.7.1	essPressureSensorIndex
PressureSensor.height~~pressureHeight~~:quantity	~~5.18.3~~5.~~2~~5.5.7.2	essPressureSensorHeight ~~essPressureHeight~~
PressureSensor.latitude:quantity	~~5.18.3.3~~ 5.5.7.3	essPressureSensorLatitude
PressureSensor.longitude:quantity	~~5.18.3.4~~ 5.5.7.4	essPressureSensorLongitude
PressureSensor.location:text	~~5.18.3.5~~ 5.5.7.5	essPressureSensorLocation
PressureSensor.modelInformation:identifier	~~5.18.3.6~~ 5.5.7.6	essPressureSensorModelInformation
PressureSensor.atmosphericPressure:quantity	5.5.7~~18.3~~.7~~5.4~~	essPressureSensorAtmosphericPressure ~~essAtmosphericPressure~~

4.4.3 Wind Data

4.4.3.1 Wind Data Class Diagram

The ESS shall support one wind sensor table if required by the agency specification. The wind sensor table shall be associated with the number of wind sensors as defined in the agency specification.The information supported by the wind sensor is depicted in Figure 13~~Figure 10~~.

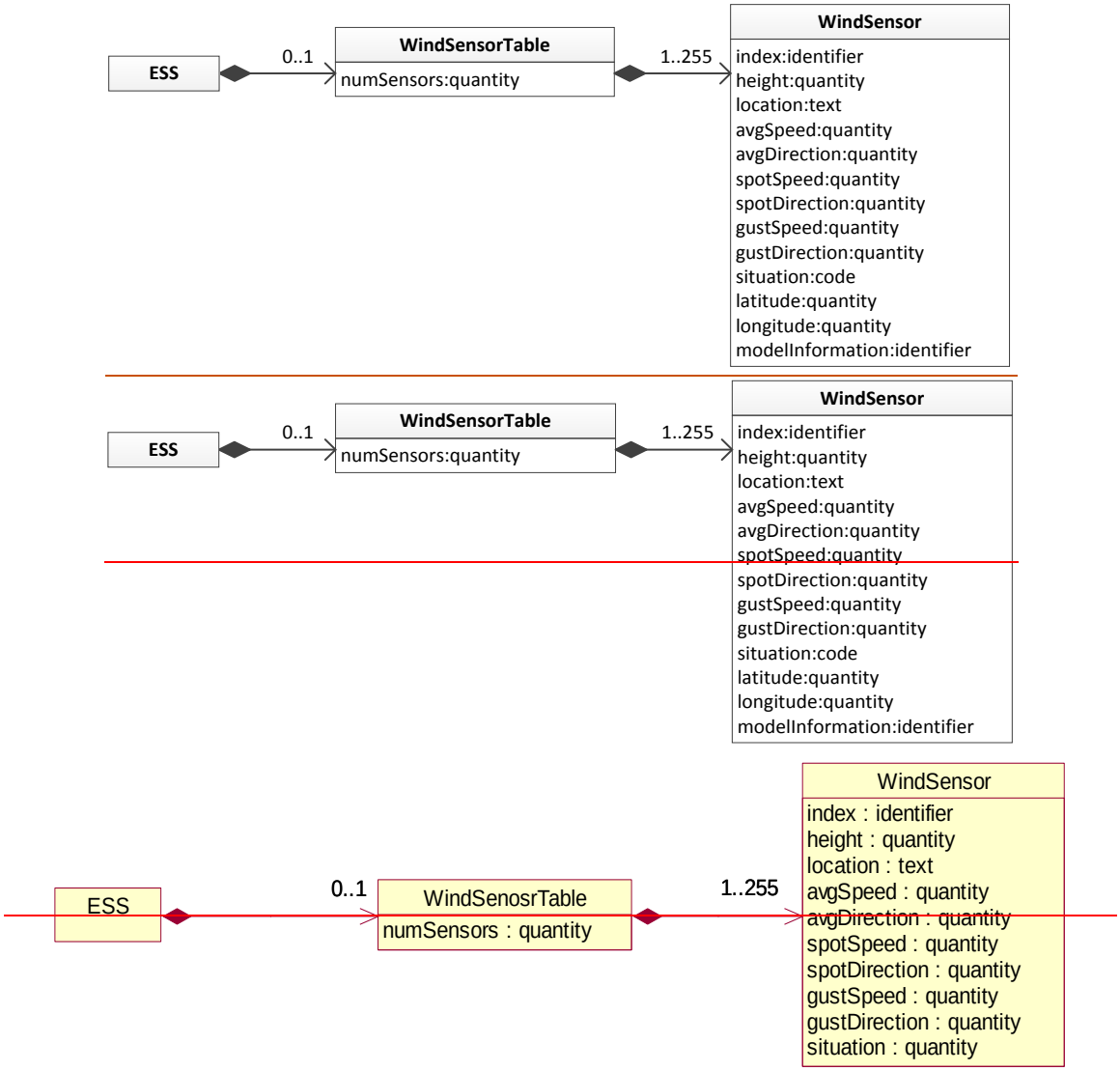

Figure 13 Wind Sensor Class Diagram

4.4.3.2 Wind Sensor Table

The wind sensor table contains information about all of the wind sensors supported by the ESS. It can be described through a number of attributes as indicated in- Table 11.

Table 11 Wind Sensor Table

Descriptive Name	Section	Object Name
WindSensorTable.numSensors:quantity	5.6.8	windSensorTableNumSensors

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4.4.3.3 Wind Sensor

A wind sensor is a sensor that reports the wind speed and direction. It can be described through a number of attributes as indicated in Table 12~~Table 9~~.

Table 12 Wind Sensor Attributes

Descriptive Name	Section	Object Name
WindSensor.index:identifier	5.6.10.1	windSensorIndex
WindSensor.height:quantity	5.6.10.2	windSensorHeight
WindSensor.location:text	5.6.10.3	windSensorLocation
WindSensor.avgSpeed:quantity	5.6.10.4	windSensorAvgSpeed
WindSensor.avgDirection:quantity	5.6.10.5	windSensorAvgDirection
WindSensor.spotSpeed:quantity	5.6.10.6	windSensorSpotSpeed
WindSensor.spotDirection:quantity	5.6.10.7	windSensorSpotDirection
WindSensor.gustSpeed:quantity	5.6.10.8	windSensorGustSpeed
WindSensor.gustDirection:quantity	5.6.10.9	windSensorGustDirection
WindSensor.situation:code	5.6.10.10	windSensorSituation
WindSensor.latitude:quantity	5.6.10.11	windSensorLatitude
WindSensor.longitude:quantity	5.6.10.12	windSensorLongitude
WindSensor.modelInformation:identifier	5.6.10.13	windSensorModelInformation

~~4.4.3.4 Wind Sensor Table~~

~~The wind sensor table contains information about all of the wind sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 10.~~

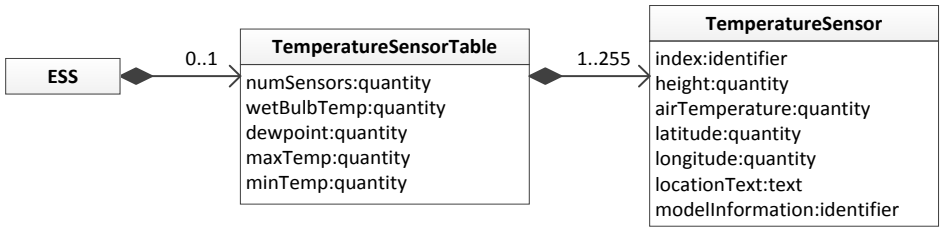
~~**Table 10 Wind Sensor Table**~~

~~Descriptive Name~~	~~Section~~	~~Object Name~~
~~WindSensorTable.numSensors:quantity~~	~~5.6.8~~	~~windSensorTableNumSensors~~

4.4.4 Temperature

4.4.4.1 Temperature Class Diagram

The ESS shall support one temperature sensor table if required by the agency specification. The temperature sensor table shall be associated with the number of temperature sensors as defined in the agency specification. The information supported by the temperature sensor is depicted in Figure 14~~Figure 11~~.



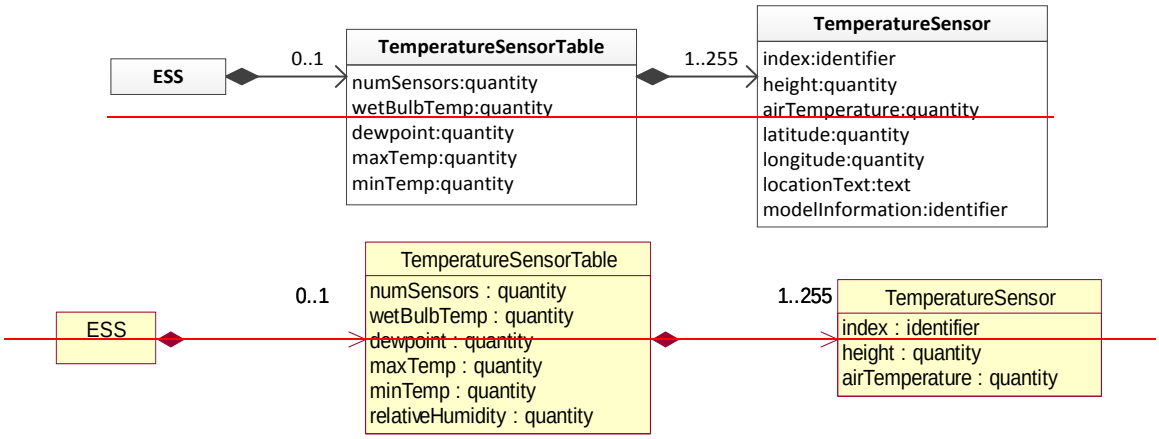


Figure 14 Temperature Sensor Class Diagram

4.4.4.2 Temperature Sensor Table

The temperature sensor table contains summary information about all of the temperature sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 13~~Table 11~~.

Table 13 Temperature Sensor Table Attributes

Descriptive Name	Section	Object Name
TemperatureSensorTable.numSensors:quantity	5.7.1	essNumTemperatureSensors
TemperatureSensorTable.wetBulbTemp:quantity	5.7.4	essWetbulbTemp
TemperatureSensorTable.dewpoint:quantity	5.7.5	essDewpointTemp
TemperatureSensorTable.maxTemp:quantity	5.7.6	essMaxTemp
TemperatureSensorTable.minTemp:quantity	5.7.7	essMinTemp
~~TemperatureSensorTable.relativeHumidity:quantity~~	~~5.8.1~~	~~essRelativeHumidity~~

4.4.4.3 Temperature Sensor

A temperature sensor is a sensor that reports the current air temperature at a defined height. It can be described through a number of attributes as indicated in Table 14~~Table 12~~.

Table 14 Temperature Sensor Attributes

Descriptive Name	Section	Object Name
TemperatureSensor.index:identifier	5.7.3.1	essTemperatureSensorIndex
TemperatureSensor.height:quantity	5.7.3.2	essTemperatureSensorHeight
TemperatureSensor.airTemperature:quantity	5.7.3.3	essAirTemperature
TemperatureSensor.latitude:quantity	5.7.3.4	essTemperatureSensorLatitude
TemperatureSensor.longitude:quantity	5.7.3.5	essTemperatureSensorLongitude
TemperatureSensor.location:text	5.7.3.6	essTemperatureSensorLocation
TemperatureSensor.modelInformation:identifier	5.7.3.7	essTemperatureSensorModelInformation

4.4.5 Precipitation

4.4.5.1 Precipitation Class Diagram

~~The~~ ESS shall support one ~~logical~~ precipitation sensor table if required by the agency specification. ~~The ESS shall support one water level sensor table if required by the agency specification. The water level~~

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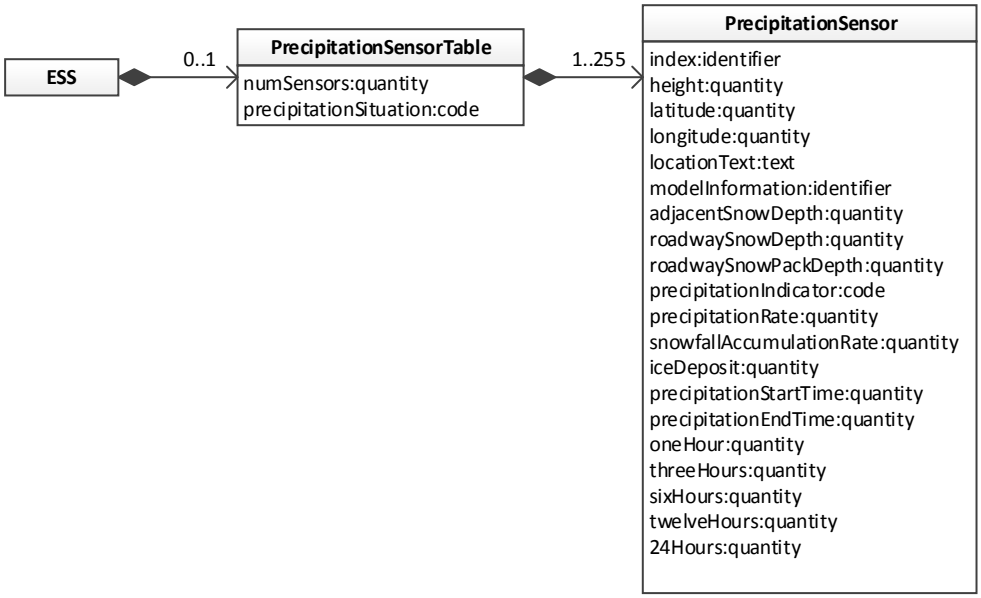
~~sensor table shall be associated with the number of water level sensors as defined in the agency specification. The information supported by these sensors are depicted in~~ The precipitation sensor table shall be associated with the number of precipitation sensors as defined in the agency specification. The information supported by these sensors are depicted in Figure 15~~Figure 12~~.

Note: The logical sensor may represent a value derived from multiple physical sensors.



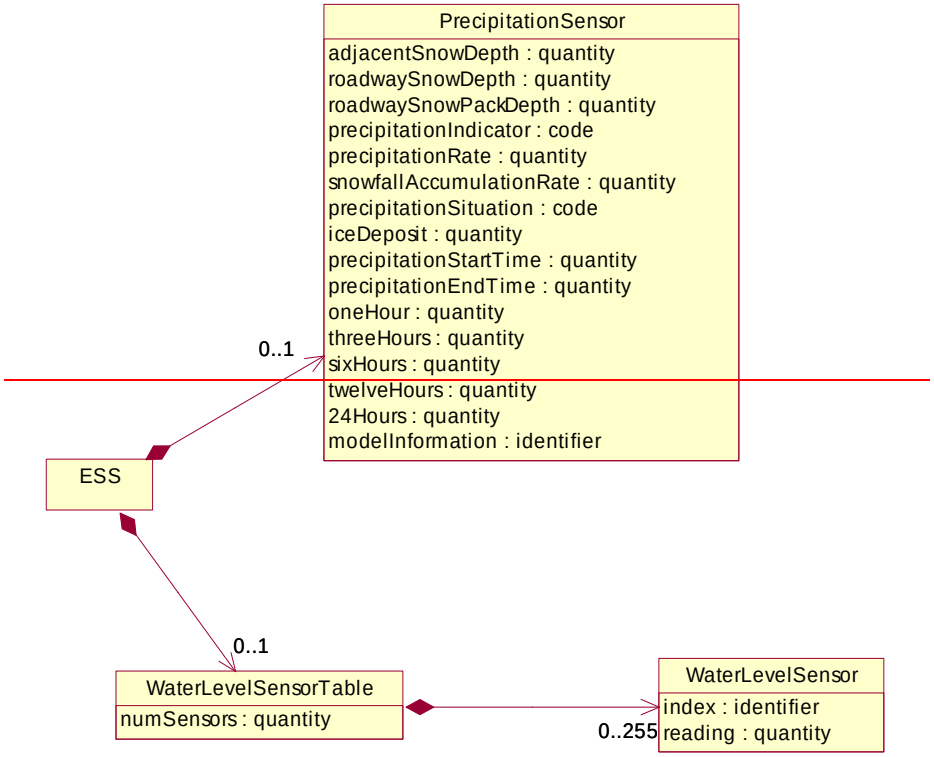


Figure 15 Precipitation Sensor Class Diagram

4.4.5.2 Precipitation Sensor Table

The precipitation sensor table contains information about all of the precipitation sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 15.

Table 15 Precipitation Sensor Table Attributes

Descriptive Name	Section	Object Name
PrecipitationSensorTable.numSensors:quantity	5.8.22	precipitationSensorTableNumSensors
PrecipitationSensor.precipitationSituation:code	5.8.9	essPrecipSituation
~~PrecipitationSensorTable.totalPrecipitationPeriod:quantity~~	~~5.8.25~~	~~essTotalPrecipitationPeriod~~

~~4.4.5.2~~4.4.5.3 Precipitation Sensor

A precipitation sensor is a sensor that reports information about precipitation. It can be described through a number of attributes as indicated in Table 16~~Table 13~~.

Table 16 Precipitation Sensor Attributes

Descriptive Name	Section	Object Name
PrecipitationSensor.index:identifier	5.8.24.1	precipitationSensorIndex
PrecipitationSensor.height:quantity	5.8.24.2	precipitationSensorHeight
PrecipitationSensor.latitude:quantity	5.8.24.3	precipitationSensorLatitude
PrecipitationSensor.longitude:quantity	5.8.24.4	precipitationSensorLongitude
PrecipitationSensor.location:text	5.8.24.5	precipitationSensorLocation
PrecipitationSensor.modelInformation:identifier	5.8.24.6~~18~~	precipitationSensorModelInformationV4
PrecipitationSensor.totalPrecipitationPeriod:quantity	5.8.24.7	precipitationSensorPeriod
PrecipitationSensor.adjacentSnowDepth:quantity	5.8.24.8~~5.8.3~~	precipitationSensor~~ess~~AdjacentSnowDepth
PrecipitationSensor.roadwaySnowDepth:quantity	5.8.24.9~~5.8.4~~	precipitationSensorRoadway~~essRoadway~~SnowDepth
PrecipitationSensor.roadwaySnowPackDepth:quantity	5.8.24.10~~5.8.5~~	precipitationSensorRoadway~~essRoadway~~SnowPackDepth
PrecipitationSensor.precipitationIndicator:code	5.8.24.11~~5.8.6~~	precipitationSensor~~ess~~PrecipYesNo
PrecipitationSensor.precipitationRate:quantity	5.8.24.12~~5.8.7~~	precipitationSensor~~ess~~PrecipRate
PrecipitationSensor.snowfallAccumulationRate:quantity	5.8.24.13~~5.8.8~~	precipitationSensor~~ess~~SnowfallAccumRate
~~PrecipitationSensor.precipitationSituation:code~~	~~5.8.9~~	~~essPrecipSituation~~
PrecipitationSensor.iceDeposit:quantity	5.8.24.14~~5.8.10~~	precipitationSensor~~ess~~IceThickness
PrecipitationSensor.precipitationStartTime:quantity	5.8.24.15~~5.8.11~~	precipitationSensor~~ess~~PrecipitationStartTime
PrecipitationSensor.precipitationEndTime:quantity	5.8.24.16~~5.8.12~~	precipitationSensor~~ess~~PrecipitationEndTime
PrecipitationSensor.oneHour:quantity	5.8.24.17~~5.8.13~~	precipitationSensor~~ess~~PrecipitationOneHour
PrecipitationSensor.threeHours:quantity	5.8.24.18~~5.8.14~~	precipitationSensor~~ess~~PrecipitationThreeHours
PrecipitationSensor.sixHours:quantity	5.8.24.19~~5.8.15~~	precipitationSensor~~ess~~PrecipitationSixHours

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Descriptive Name	Section	Object Name
PrecipitationSensor.twelveHours:quantity	5.8.24.205~~.8.16~~	precipitationSensor~~ess~~PrecipitationTwelveHours
PrecipitationSensor.24Hours:quantity	5.8.24.215~~.8.17~~	precipitationSensor~~ess~~Precipitation24Hours
PrecipitationSensor.UserDefined:quantity ~~PrecipitationSensor.modelInformation:identifier~~	5.8.24.225~~.8.18~~	precipitationSensorPrecipitationUserDefined ~~precipitationSensorModelInformation~~

4.4.5.4 Water Level Class Diagram

The ESS shall support one water level sensor table if required by the agency specification. The water level sensor table shall be associated with the number of water level sensors as defined in the agency specification. The information supported by these sensors are depicted in Figure 16 .

Note: The logical sensor may represent a value derived from multiple physical sensors.

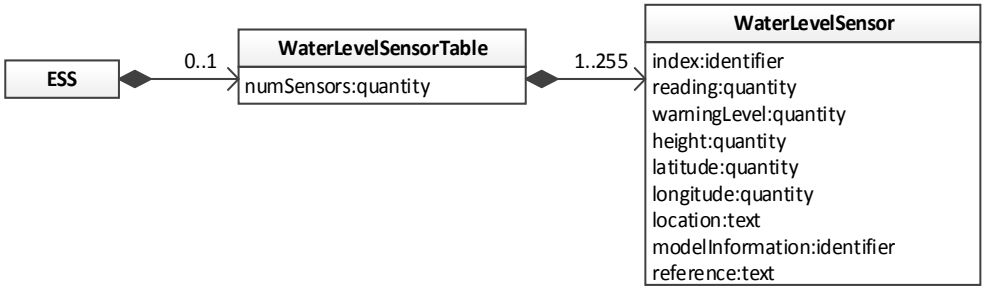

Figure 16 Water Level Sensor Class Diagram

~~4.4.5.3~~4.4.5.5 Water Level Sensor Table

The water level sensor table contains information about all of the water level sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 17~~Table 14~~.

Table 17 Water Level Sensor Table Attributes

Descriptive Name	Section	Object Name
WaterLevelSensorTable.numSensors:quantity	5.8.19	waterLevelSensorTableNumSensors

~~4.4.5.4~~4.4.5.6 Water Level Sensor

A water level sensor is a sensor that reports the current level of water as measured from a defined point. It can be described through a number of attributes as indicated in Table 18~~Table 15~~.

Table 18 Water Level Sensor Attributes

Descriptive Name	Section	Object Name
WaterLevelSensor.index:identifier	5.8.21.1	waterLevelSensorIndex
WaterLevelSensor.reading:quantity	5.8.21.2	waterLevelSensorReading
WaterLevelSensor.warningLevel:quantity	5.8.21.3	waterLevelSensorWarningLevel
WaterLevelSensor.height:quantity	5.8.21.4	waterLevelSensorHeight
WaterLevelSensor.latitude:quantity	5.8.21.5	waterLevelSensorLatitude
WaterLevelSensor.longitude:quantity	5.8.21.6	waterLevelSensorLongitude
WaterLevelSensor.location:text	5.8.21.7	waterLevelSensorLocation
WaterLevelSensor.modelInformation:identifier	5.8.21.8	waterLevelSensorModelInformation
WaterLevelSensor.reference:text	5.8.21.9	waterLevelSensorReferencePoint

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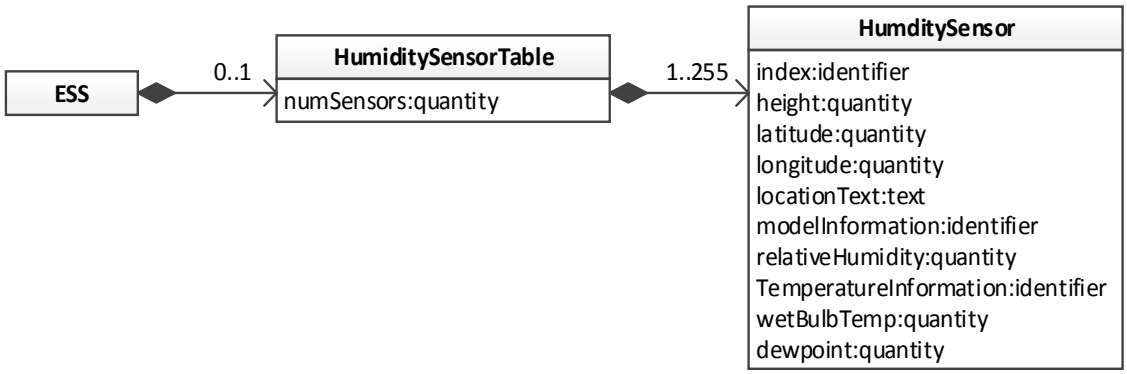
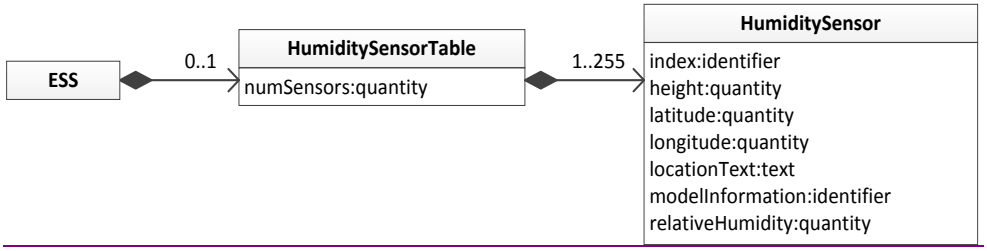
4.4.5.7 Humidity Class Diagram

The ESS shall support one humidity sensor table if required by the agency specification. The humidity sensor table shall be associated with the number of water level sensors as defined in the agency specification. The information supported by these sensors is depicted in Figure 17.

Note: The logical sensor may represent a value derived from multiple physical sensors.





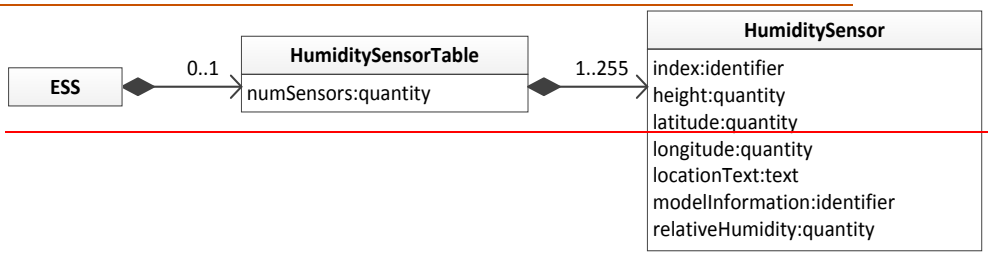


Figure 17 Humidity Sensor Class Diagram

4.4.5.8 Humidity Sensor Table

The humidity sensor table contains information about all of the humidity sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 19.

Table 19 Humidity Sensor Table Attributes

Descriptive Name	Section	Object Name
HumiditySensorTable.numSensors:quantity	5.8.2~~6~~5	humiditySensorTableNumSensors

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4.4.5.9 Humidity Sensor

A humidity sensor is a sensor that reports the current relative humidity as measured from a defined point. It can be described through a number of attributes as indicated in Table 20.

Table 20 Humidity Sensor Attributes

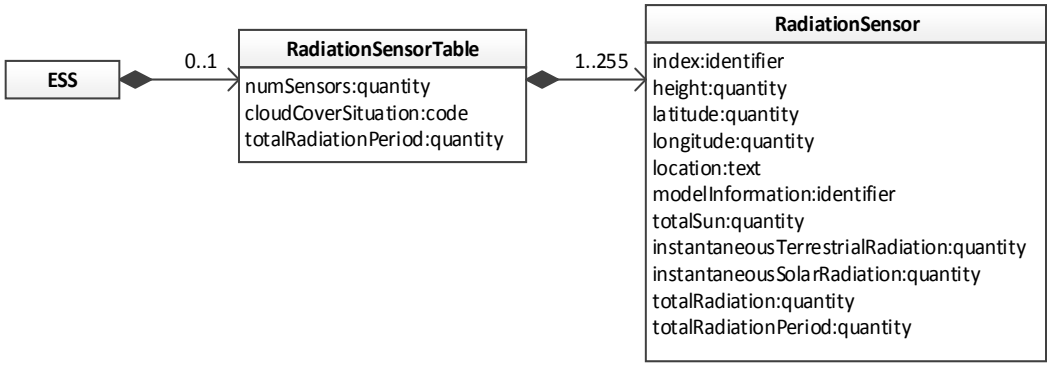
Descriptive Name	Section	Object Name
HumiditySensor.index:identifier	5.8.278.1	humiditySensorIndex
HumiditySensor.height:quantity	5.8.278.2	humiditySensorHeight
HumiditySensor.latitude:quantity	5.8.278.3	humiditySensorLatitude
HumiditySensor.longitude:quantity	5.8.278.4	humiditySensorLongitude
HumiditySensor.location:text	5.8.278.5	humiditySensorLocation
HumiditySensor.modelInformation:identifier	5.8.278.6	humiditySensorModelInformation
HumiditySensor.relativeHumidity:quantity	5.8.27.71	humiditySensorRelativeHumidityessRelativeHumidity
HumiditySensor.TemperatureInformation:identifier	5.8.27.8	humiditySensorTemperatureInformation
HumiditySensor.wetBulbTemp:quantity	5.8.27.9	humiditySensorWetbulbTemp
HumiditySensor.dewpoint:quantity	5.8.27.10	humiditySensorDewpointTemp

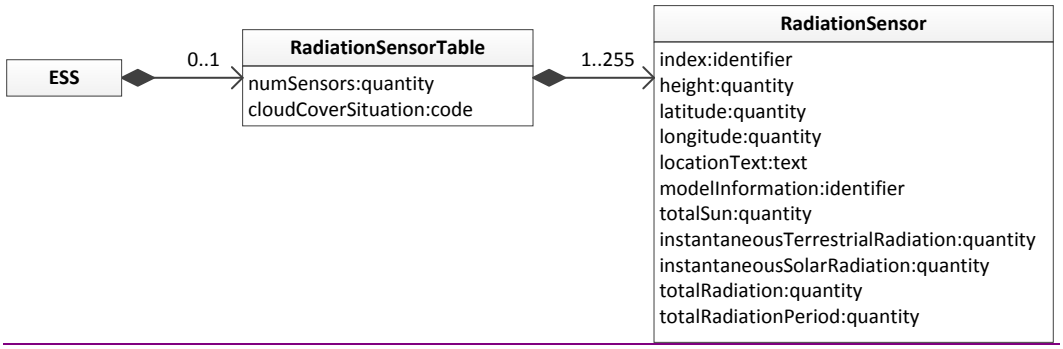
4.4.6 Radiation

4.4.6.1 Radiation Class Diagram

The ESS shall support one logical radiation sensor table if required by the agency specification. The radiation sensor table shall be associated with the number of radiation sensors as defined in the agency specification. The information supported by the radiation sensor is depicted in Figure 18Figure 13.

Note: The logical sensor may represent a value derived from multiple physical sensors.





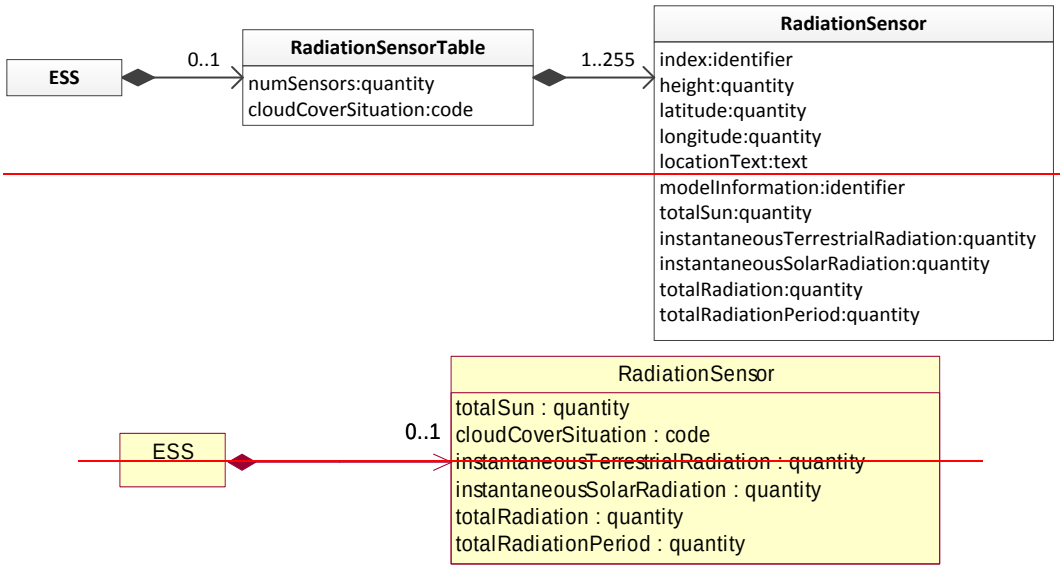


Figure 18 Radiation Sensor Class Diagram

4.4.6.2 Radiation Sensor Table

The radiation table contains information about all of the radiation sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 21.

Table 21 Radiation Sensor Table

Descriptive Name	Section	Object Name
RadiationSensorTable.numSensors:quantity	5.9.8	radiationSensorTableNumSensors
RadiationSensorTable.cloudCoverSituation:code	5.9.~~3~~11	essCloudSituationV4
RadiationSensorTable.totalRadiation:quantity	5.9.10.10	essTotalRadiationV4

~~4.4.6.2~~4.4.6.3 Radiation Objects

A radiation sensor is a sensor that reports the amount of solar and terrestrial radiation to which the sensor is exposed. It can be described through a number of attributes as indicated Table 22~~Table 16~~.

Table 22 Radiation Sensor Attributes

Descriptive Name	Section	Object Name
RadiationSensor.index:identifier	5.9.10.1	radiationSensorIndex
RadiationSensor.height~~totalSun~~:quantity	5.9.10.2	radiationSensorHeight~~essTotalSun~~
RadiationSensor.latitude:quantity~~cloudCoverSituation:code~~	5.9.10.3~~2~~	radiationSensorLatitude~~essCloudSituation~~
RadiationSensor.longitude:quantity	5.9.10.4	radiationSensorLongitude
RadiationSensor.location:text	5.9.10.5	radiationSensorLocation
RadiationSensor.modelInformation:identifier	5.9.10.6~~5.9.10.6~~	radiationSensorModelInformation
RadiationSensor.totalSun:quantity	5.9.10.7~~5.9.2~~	essTotalSun-V4
RadiationSensor.instantaneousTerrestrialRadiation:quantity	5.9.10.8~~5.9.4~~	essInstantaneousTerrestrialRadiationV4
RadiationSensor.instantaneousSolarRadiation:quantity	5.9.10.9~~5.9.5~~	essInstantaneousSolarRadiationV4

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Descriptive Name	Section	Object Name
~~RadiationSensor.totalRadiation:quantity~~	~~5.9.10.10~~ ~~5.9.6~~	~~essTotalRadiationV4~~
RadiationSensor.totalRadiationPeriod:quantity	5.9.75~~5.9.7~~	essTotalRadiationPeriod

4.4.7 Visibility

4.4.7.1 Visibility Class Diagram

The ESS shall support one ~~logical~~ visibility sensor table if required by the agency specification. The visibility sensor table shall be associated with the number of visibility sensors as defined in the agency specification. The information supported by the visibility sensor is depicted in Figure 19~~Figure 14~~.

Note: The logical sensor may represent a value derived from multiple physical sensors.

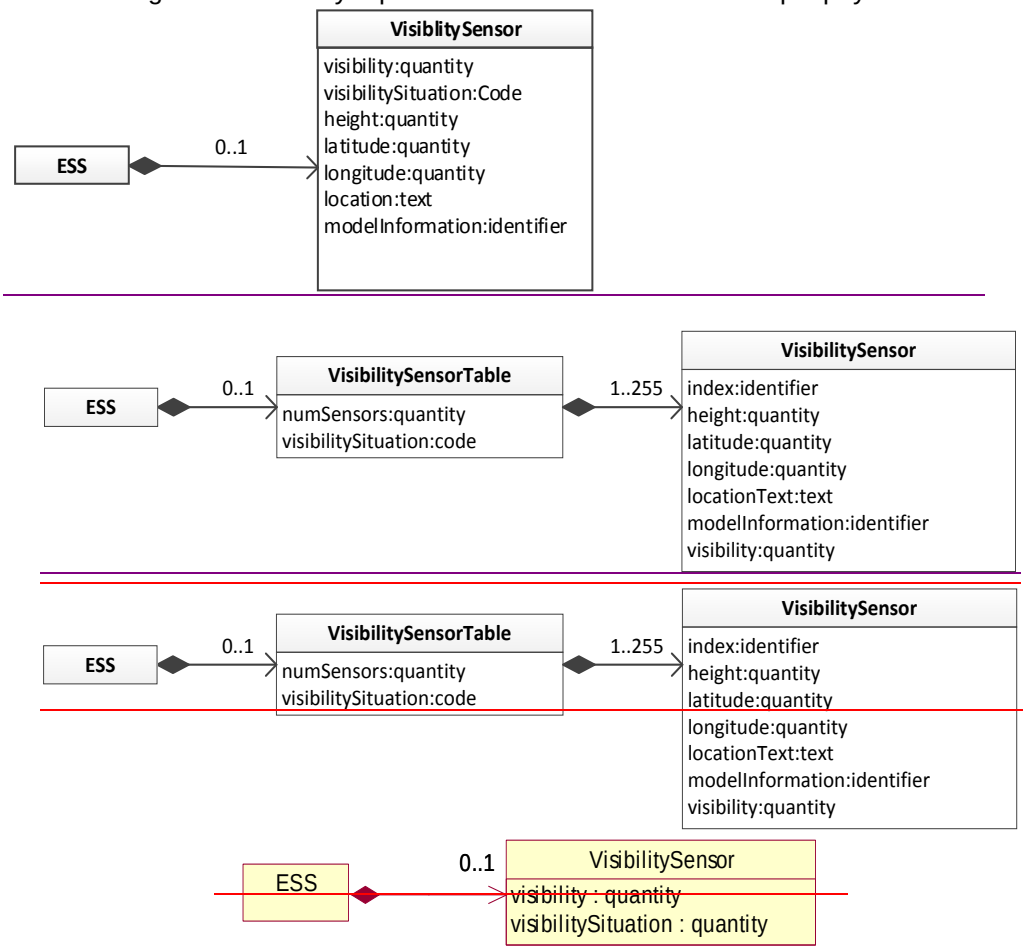

Figure 19 Visibility Sensor Class Diagram

~~**Visibility Sensor Table**~~

~~The visibility sensor table contains information about all of the visibility sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 23.~~

~~**Table 23 Visibility Sensor Table Attributes**~~

~~**Descriptive Name**~~	~~**Section**~~	~~**Object Name**~~

~~Descriptive Name~~	~~Section~~	~~Object Name~~
~~VisibilitySensorTable.numSensors:quantity~~	~~5.10.3~~	~~visibilitySensorTableNumSensors~~
~~VisibilitySensor.visibilitySituation:code~~	~~5.10.2~~	~~essVisibilitySituation~~

4.4.7.2 Visibility Sensor

A visibility sensor is a sensor that reports the distance at which things are visible. It can be described through a number of attributes as indicated in Table 23~~Table 17~~.

Table 23 Visibility Sensor Attributes

Descriptive Name	Section	Object Name
VisibilitySensor.visibility:quantity	5.10.1	essVisibility
VisibilitySensor.visibilitySituation:code	5.10.2	essVisibilitySituation
~~VisibilitySensor.index:identifier~~	~~5.10.5.1~~	~~visibilitySensorIndex~~
VisibilitySensor.height:quantity	5.10.~~5.2~~3	visibilitySensorHeight
VisibilitySensor.latitude:quantity	5.10.~~5.3~~4	visibilitySensorLatitude
VisibilitySensor.longitude:quantity	5.10.5~~.4~~	visibilitySensorLongitude
VisibilitySensor.location:text	5.10.~~5.5~~6	visibilitySensorLocation
VisibilitySensor.modelInformation:identifier	5.10.~~5.6~~7	visibilitySensorModelInformation
~~VisibilitySensor.visibility:quantity~~	~~5.10.1~~	~~essVisibility~~
~~VisibilitySensor.visibilitySituation:code~~~~VisibilitySensor.visibilitySituation:code~~	~~5.10.2~~5.10.2	~~essVisibilitySituation~~ ~~essVisibilitySituation~~

4.4.8 Pavement Sensor Data

4.4.8.1 Pavement Sensor Data Class Diagram

The ESS shall support one pavement sensor table if required by the agency specification. The pavement sensor table shall be associated with the number of pavement sensors as defined in the agency specification. The information supported by these sensors is depicted in Figure 20~~Figure 15~~.

If the ESS uses a passive pavement sensor to predict the temperature at which ice forms, the ESS shall also support the pavement treatment table. The pavement treatment table shall be associated with the number of pavement treatments as defined in the agency specification. See Section 4.4.12~~4.4.12~~.

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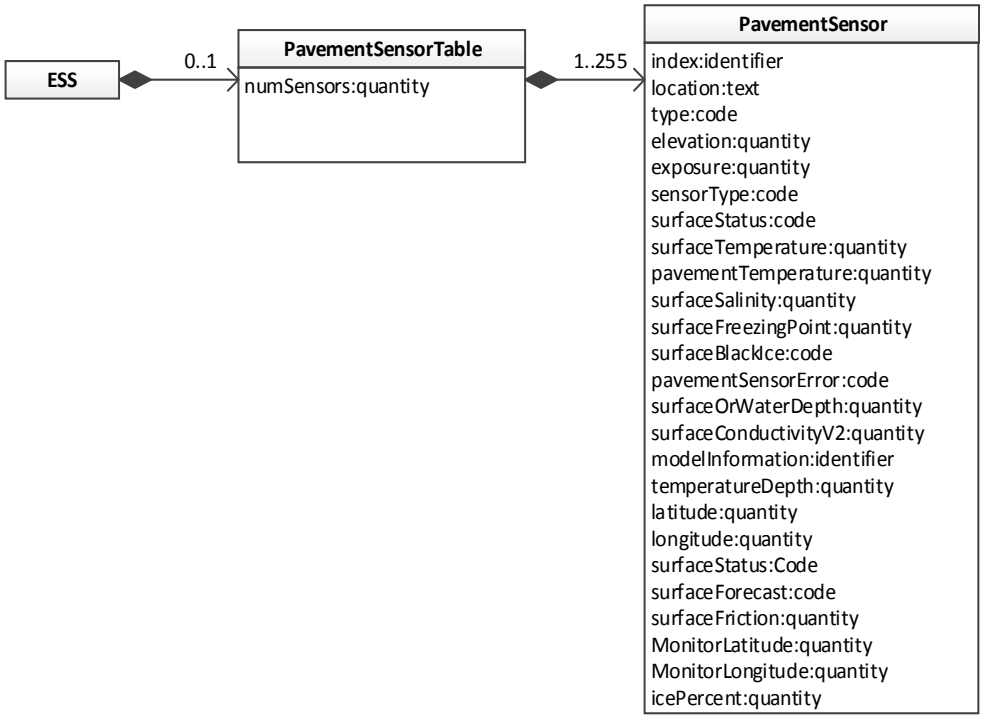

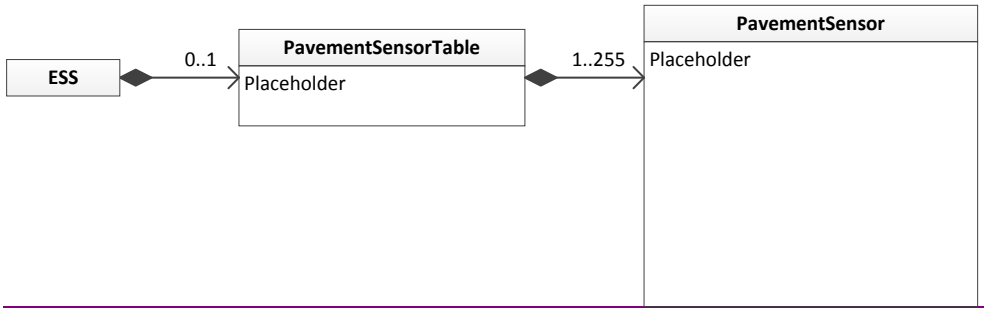

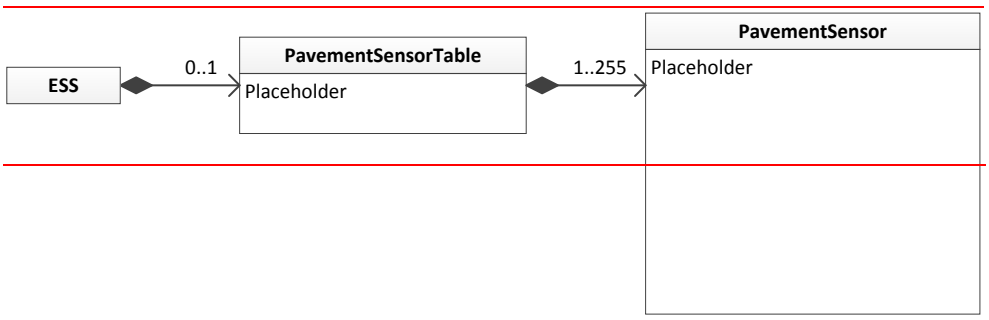

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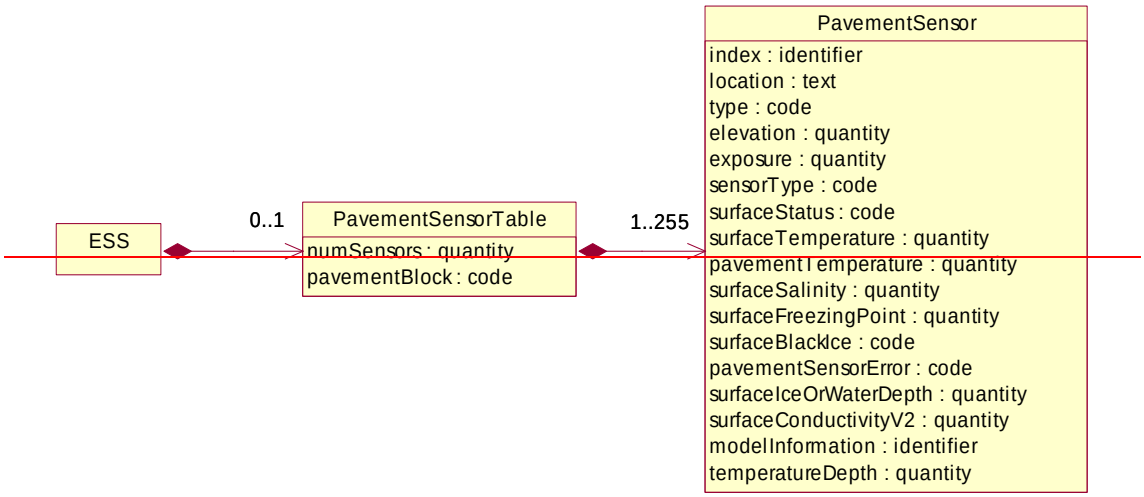

Figure 20 Pavement Sensor Class Diagram

4.4.8.2 Pavement Sensor Table

The pavement sensor table provides information related to the various pavement senosrs supported by the ESS. It can be described through a number of attributes as indicated in Table 24.

Table 24 Pavement Sensor Table Attributes

Descriptive Name	Section	Object Name
PavementSensorTable.numSensors:quantity	5.11.1	numEssPavementSensors
~~PavementSensorTable.pavementBlock:code~~	~~5.11.7~~	~~essPavementBlock~~

4.4.8.3 Pavement Sensor Data

A pavement sensor provides information related to the state of the pavement. It can be described through a number of attributes as indicated in Table 25~~Table 18~~.

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Table 25 Pavement Sensor Attributes

Descriptive Name	Section	Object Name
PavementSensor.index:identifier	5.11.3.1	essPavementSensorIndex
PavementSensor.location:text	5.11.3.2	essPavementSensorLocation
PavementSensor.type:code	5.11.3.3	essPavementType
PavementSensor.elevation:quantity	5.11.3.4	essPavementElevation
PavementSensor.exposure:quantity	5.11.3.5	essPavementExposure
PavementSensor.sensorType:code	5.11.3.6	essPavementSensorType
PavementSensor.surfaceStatus:code	5.11.3.7	essSurfaceStatus
PavementSensor.surfaceTemperature:quantity	5.11.3.8	essSurfaceTemperature
PavementSensor.pavementTemperature:quantity	5.11.3.9	essPavementTemperature
PavementSensor.surfaceSalinity:quantity	5.11.3.11	essSurfaceSalinity
PavementSensor.surfaceFreezingPoint:quantity	5.11.3.13	essSurfaceFreezePoint
PavementSensor.surfaceBlackIce:code	5.11.3.14	essSurfaceBlackIceSignal
PavementSensor.pavementSensorError:code	5.11.3.15	essPavementSensorError
PavementSensor.surfaceOrWaterDepth:quantity	5.11.3.16	essSurfaceIceOrWaterDepth
PavementSensor.surfaceConductivityV2:quantity	5.11.3.17	essSurfaceConductivityV2
PavementSensor.modelInformation:identifier	5.11.3.18	pavementSensorModelInformation
PavementSensor.temperatureDepth:quantity	5.11.3.19	pavementSensorTemperature Depth
PavementSensor.latitude:quantity	5.11.3.20	pavementSensorLatitude
PavementSensor.longitude:quantity	5.11.3.21~~5.11.3.21~~	pavementSensorLongitude
PavementSensor.surfaceStatus:code	5.11.3.22	pavementSensorSurfaceCondition
PavementSensor.surfaceForecast:code	5.11.3.23	pavementSensorForecastCondition
PavementSensor.surfaceFriction:quantity	5.11.3.24	pavementSensorFrictionCoefficient
PavementSensorMonitor.latitude:quantity	5.11.3.25	pavementMonitorLatitude
PavementSensorMonitor.longitude:quantity	5.11.3.26	pavementMonitorLongitude
PavementSensor.~~i~~icePpercent:quantity	5.11.3.27	pavementIcePercentage

~~These are probably per sensor (currently 5.11.10, 5.11.11, 5.11.12)~~
~~[ADD FORECASTED PAVEMENT SURFACE CONDITION]~~
~~[ADD PAVEMENT SURFACE FRICTION COEFFICIENT]~~
~~[ADD PAVEMENT SURFACE GRIP]~~

~~4.4.8.4 Pavement Sensor Table~~

~~The pavement sensor table provides information related to the various pavement senosrs supported by the ESS. It can be described through a number of attributes as indicated in Table 19.~~

~~Table 19 Pavement Sensor Table Attributes~~

~~Descriptive Name~~	~~Section~~	~~Object Name~~
~~PavementSensorTable.numSensors:quantity~~	~~5.11.1~~	~~numEssPavementSensors~~
~~PavementSensorTable.pavementBlock:code~~	~~5.11.7~~	~~essPavementBlock~~

4.4.9 Subsurface Data

4.4.9.1 Subsurface Data Class Diagram

The ESS shall support one subsurface sensor table if required by the agency specification. The subsurface sensor table shall be associated with the number of subsurface sensors as defined in the agency specification. The information supported by these sensors are depicted in Figure 21~~Figure 16~~.

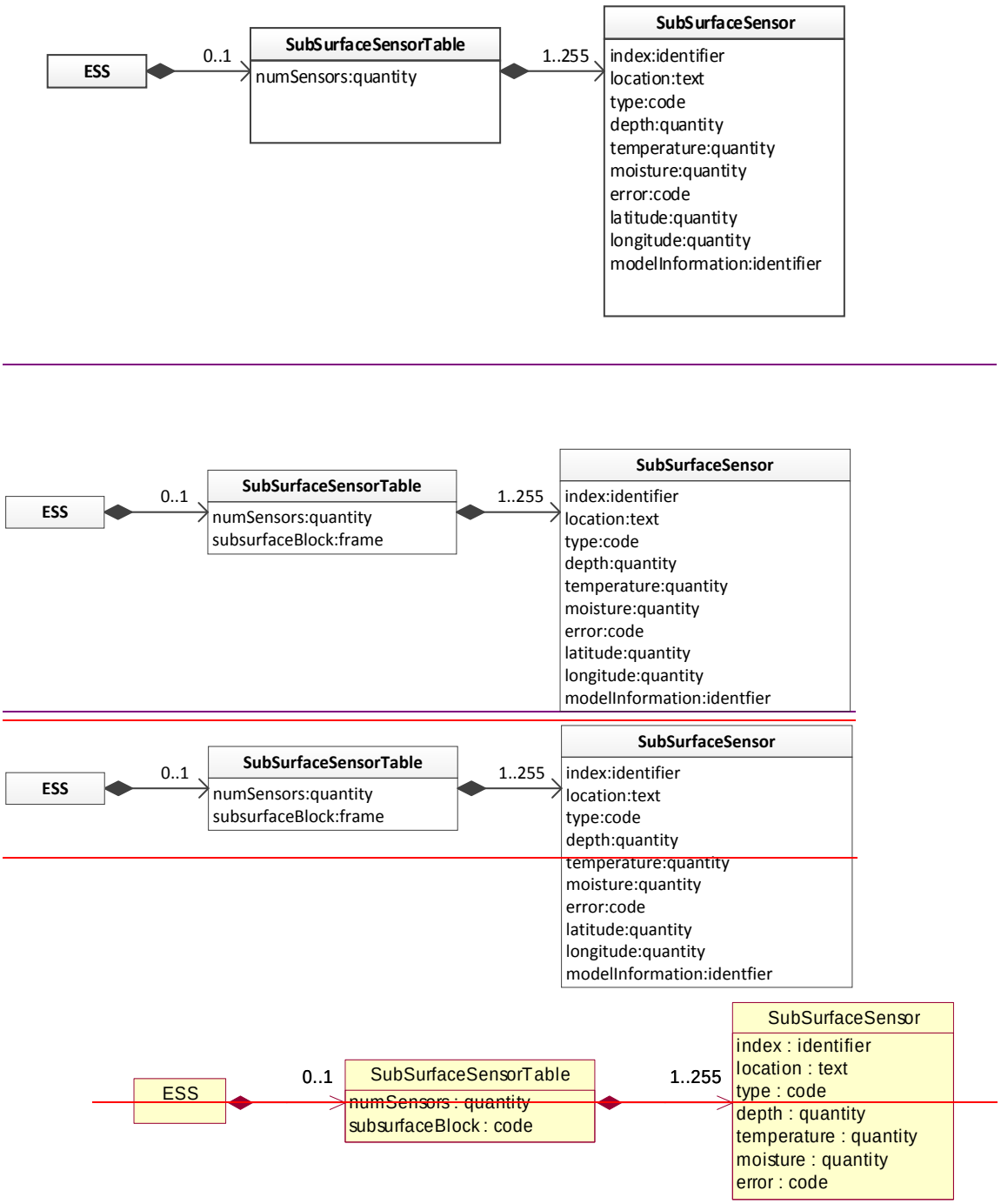

Figure 21 Subsurface Sensor Class Diagram

4.4.9.2 Subsurface Sensor Table

The subsurface sensor table provides summary information related to the subsurface sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 26~~Table 20~~.

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Table 26 Subsurface Sensor Table Attributes

Descriptive Name	Section	Object Name
SubSurfaceSensorTable.numSensors:quantity	5.11.4	numEssSubSurfaceSensors
~~SubSurfaceSensorTable.subsurfaceBlock:code~~	~~5.11.8~~	~~essSubsurfaceData~~

4.4.9.3 Subsurface Sensor

A subsurface sensor provides information related to the state of the pavement subsurface. It can be described through a number of attributes as indicated in Table 27~~Table 21~~

Table 27 Subsurface Sensor Attributes

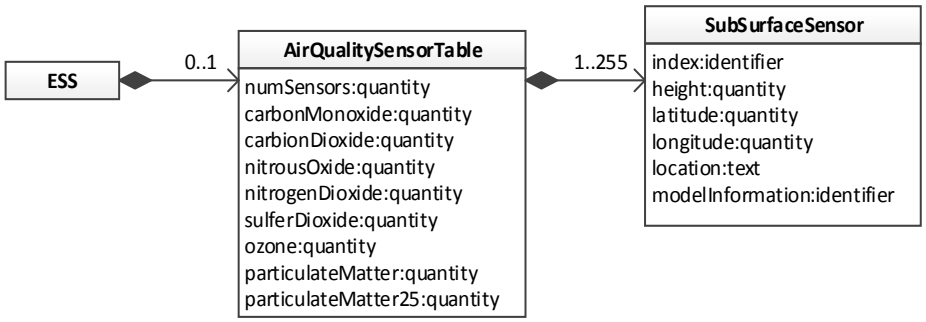
Descriptive Name	Section	Object Name
SubSurfaceSensor.index:identifier	5.11.6.1	essSubSurfaceSensorIndex
SubSurfaceSensor.location:text	5.11.6.2	essSubSurfaceSensorLocation
SubSurfaceSensor.type:code	5.11.6.3	essSubSurfaceType
SubSurfaceSensor.depth:quantity	5.11.6.4	essSubSurfaceSensorDepth
SubSurfaceSensor.temperature:quantity	5.11.6.5	essSubSurfaceTemperature
SubSurfaceSensor.moisture:quantity	5.11.6.6	essSubSurfaceMoisture
SubSurfaceSensor.error:code	5.11.6.7	essSubSurfaceSensorError
SubSurfaceSensor.latitude:quantity	5.11.6.8	essSubSurfaceSensorLatitude
SubSurfaceSensor.longitude:quantity	5.11.6.9	essSubSurfaceSensorLongitude
SubSurfaceSensor.modelInformation:identifier	5.11.6.10	essSubSurfaceModelInformation

4.4.10 Air Quality Data

4.4.10.1 Air Quality Data Class Diagram

The ESS shall support one ~~logical~~ air quality sensor table if required by the agency specification. The air quality sensor table shall be associated with the number of air quality sensors as defined in the agency specification. The information supported by this sensor is depicted in Figure 22~~Figure 17~~.

Note: The logical sensor may represent a value derived from multiple physical sensors.



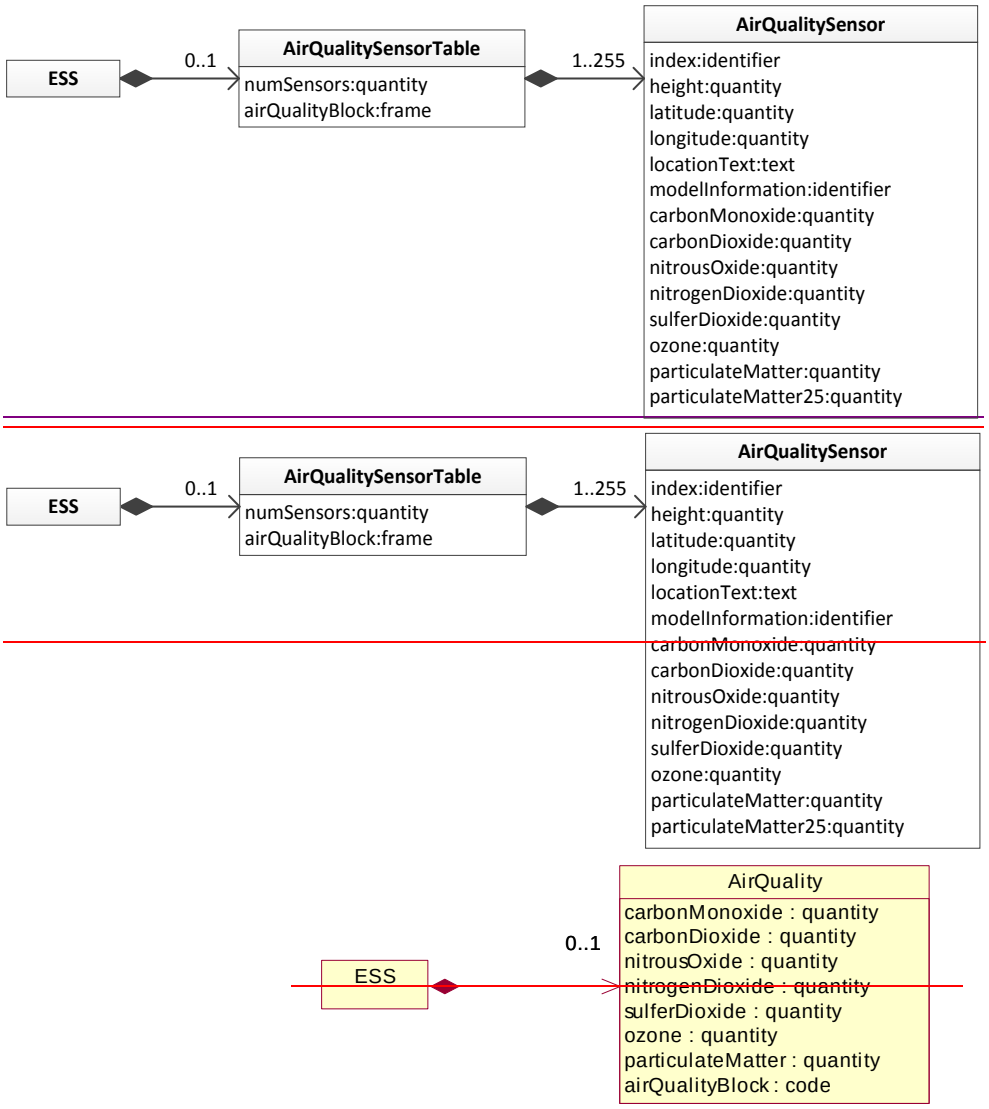


Figure 22 Air Quality Sensor Class Diagram

4.4.10.2 Air Quality Sensor Table

The air quality sensor table provides information related to the various air quality sensors supported by the ESS. It can be described through a number of attributes as indicated in Table 28.

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Table 28 Air Quality Sensor Table Attributes

Descriptive Name	Section	Object Name
AirQualitySensorTable.numSensors:quantity	5.14.10	numAirQualitySensors
AirQualitySensor.carbonMonoxide:quantity	5.14.1	essCO
AirQualitySensor.carbonDioxide:quantity	5.14.2	essCO2
AirQualitySensor.nitrousOxide:quantity	5.14.3	essNO
AirQualitySensor.nitrogenDioxide:quantity	5.14.4	essNO2
AirQualitySensor.sulfurDioxide:quantity	5.14.5	essSO2
AirQualitySensor.ozone:quantity	5.14.6	essO3
AirQualitySensor.particulateMatter:quantity	5.14.7	essPM10
AirQualitySensor.particulateMatter25:quantity	5.14.9	essPM25
~~AirQualitySensorTable.airQualityBlock:code~~	~~5.14.8~~	~~essAirQualityData~~

~~4.4.10.2~~4.4.10.3 Air Quality Sensor

An air quality sensor is a sensor that reports the concentration of various chemicals in the air. It can be described through a number of attributes as indicated in Table 29~~Table 22~~.

Table 29 Air Quality Sensor Attributes

Descriptive Name	Section	Object Name
AirQualitySensor.index:identifier	5.14.12.1	essAirQualitySensorIndex
AirQualitySensor.height:quantity	5.14.12.2	essAirQualitySensorHeight
AirQualitySensor.latitude:quantity	5.14.12.3	essAirQualitySensorLatitude
AirQualitySensor.longitude:quantity	5.14.12.4	essAirQualitySensorLongitude
AirQualitySensor.location:text	5.14.12.5	essAirQualitySensorLocation
AirQualitySensor.modelInformation:identifier	5.14.12.6	essAirQualitySensorModelInformation
~~AirQualitySensor.carbonMonoxide:quantity~~	~~5.14.1~~	~~essCO~~
~~AirQualitySensor.carbonDioxide:quantity~~	~~5.14.2~~	~~essCO2~~
~~AirQualitySensor.nitrousOxide:quantity~~	~~5.14.3~~	~~essNO~~
~~AirQualitySensor.nitrogenDioxide:quantity~~	~~5.14.4~~	~~essNO2~~
~~AirQualitySensor.sulfuerDioxide:quantity~~	~~5.14.5~~	~~essSO2~~
~~AirQualitySensor.ozone:quantity~~	~~5.14.6~~	~~essO3~~
~~AirQualitySensor.particulateMatter:quantity~~	~~5.14.7~~	~~essPM10~~
~~AirQualitySensor.particulateMatter25:quantity.airQualityBlock:code~~	~~5.14.12.94.8~~	~~essPM25AirQualityData~~

4.4.11 Snapshot Data

4.4.11.1 Snapshot Data Class Diagram

The ESS shall support one snapshot camera table if required by the agency specification. The snapshot camera table shall be associated with the number of snapshot cameras as defined in the agency specification. The information supported by these entities are depicted in Figure 23~~Figure 18~~.

The ESS shall also support a dynamic number of snapshots managed through the FTP Interface.

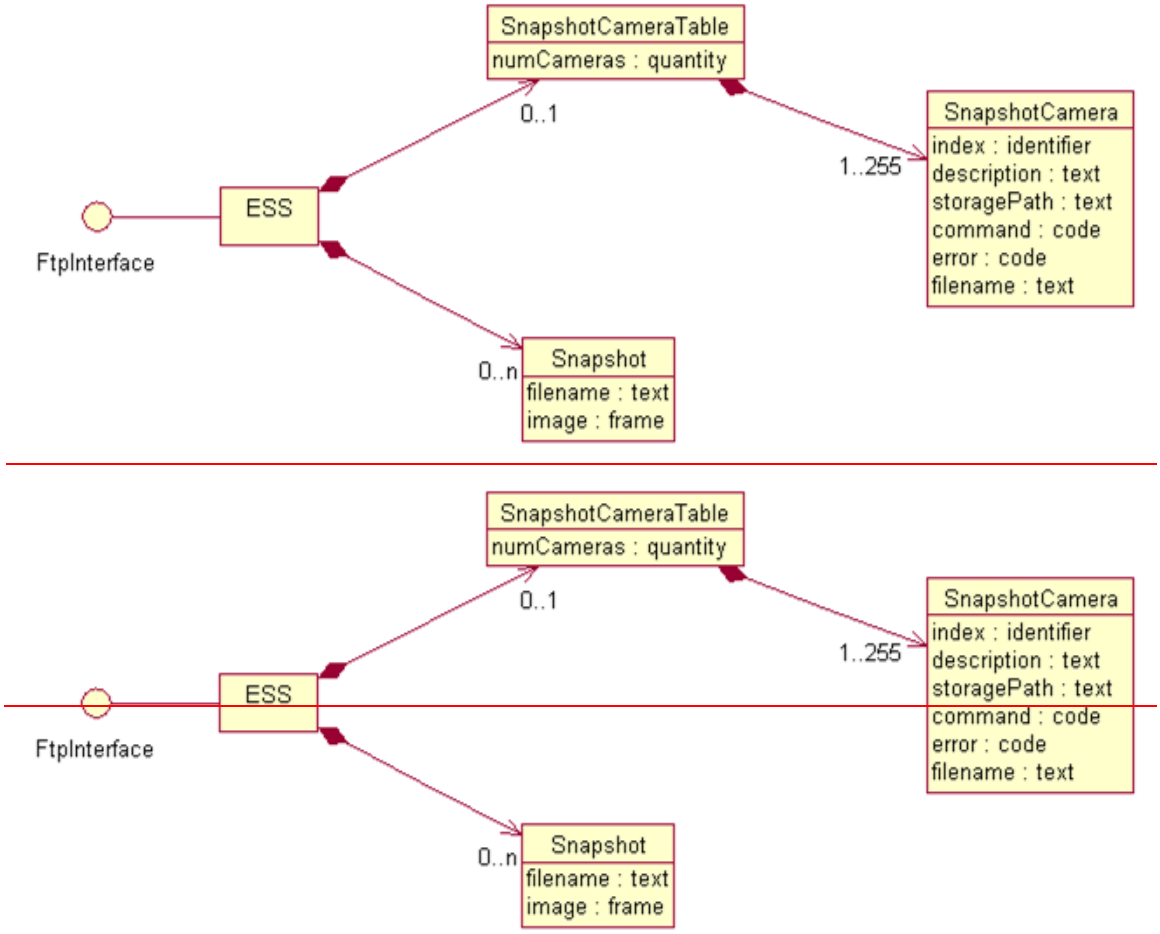

Figure 23 Snapshot Class Diagram

4.4.11.2 Snapshot Camera

A snapshot camera allows an ESS to capture and store a snapshot image. It can be described through a number of attributes as indicated in Table 30~~Table 23~~.

Table 30 Snapshot Camera Attributes

Descriptive Name	Section	Object Name
SnapshotCamera.index:identifier	5.16.3.1	essSnapshotCameraIndex
SnapshotCamera.description:text	5.16.3.2	essSnapshotCameraDescription
SnapshotCamera.storagePath:text	5.16.3.3	essSnapshotCameraStoragePath
SnapshotCamera.command:code	5.16.3.4	essSnapshotCameraCommand
SnapshotCamera.error:code	5.16.3.5	essSnapshotCameraError
SnapshotCamera.filename:text	5.16.3.6	essSnapshotCameraFilename

4.4.11.3 Snapshot

A snapshot is any image that has been captured by the snapshot camera. It can be described through a number of attributes as indicated in Table 31~~Table 24~~.

Table 31 Snapshot Attributes

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Descriptive Name	Section	Object Name
Snapshot.filename:text	5.17.1	<not an SNMP object>
Snapshot.image:frame	5.17.2	<not an SNMP object>

4.4.11.4 Snapshot Camera Table

The snapshot camera table provides summary information related to the snapshot cameras supported by the ESS. It can be described through a number of attributes as indicated in Table 32~~Table 25~~.

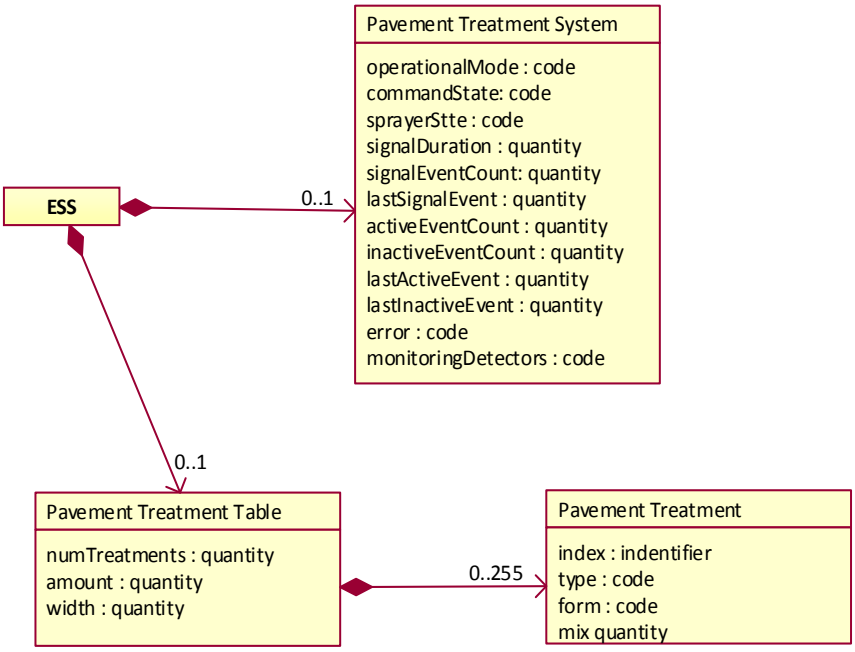
Table 32 Snapshot Camera Table Attibutes

Descriptive Name	Section	Object Name
SnapshotCameraTable.numCameras:quantity	5.16.1	essSnapshotNumberOfCameras

4.4.12 Pavement Treatment System

4.4.12.1 Pavement Treatment System Class Diagram

The ESS shall support a pavement treatment system if required by the agency specification. The information supported by the PTS is depicted in Figure 24~~Figure 19~~.



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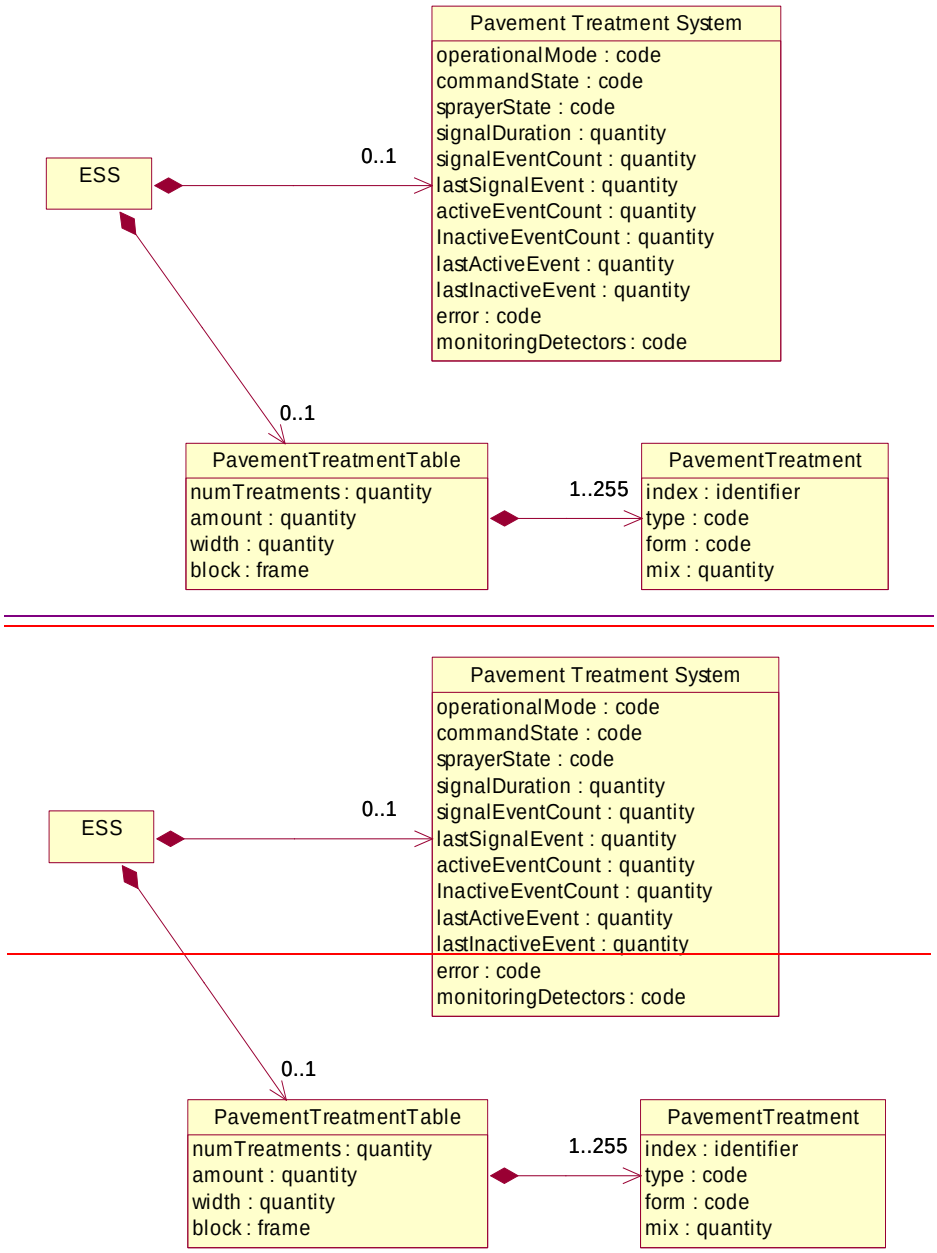

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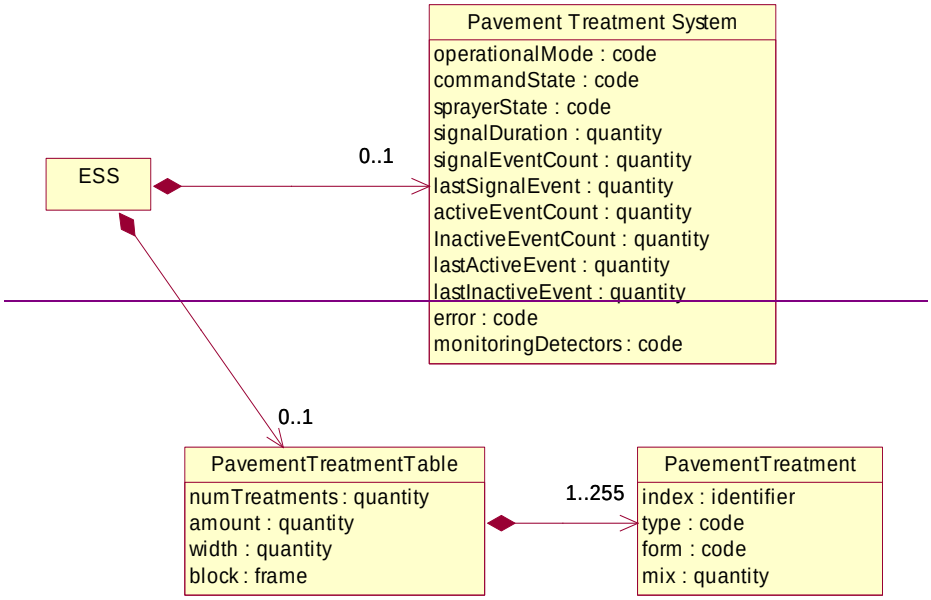

Figure 24 Pavement Treatment Class Diagram

4.4.12.2 Pavement Treatment System

A pavement treatment system is a system that controls the operation of a sprayer that disperses chemicals to prevent ice from forming on roadways. It can be described through a number of attributes as indicated in Table 33~~Table 26~~.

Table 33 Pavement Treatment System Attributes

Descriptive Name	Section	Object Name
PTS.operationalMode<u>V3</u>~~V3~~.code	5.13.19	ptsOperationalModeV3
PTS.commandState<u>V3</u>~~V3~~:code	5.13.20	ptsCommandStateV3
PTS.sprayerState:code	5.13.9	ptsSprayerState
PTS.signalDuration:quantity	5.13.10	ptsSignalDuration
PTS.signalEventCount:quantity	5.13.11	ptsSignalEventCount
PTS.lastSignalEvent:quantity	5.13.12	ptsLastSignalEvent
PTS.activeEventCount:quantity	5.13.13	ptsActiveEventCount
PTS.inactiveEventCount:quantity	5.13.14	ptsInactiveEventCount
PTS.lastActiveEvent:quantity	5.13.15	ptsLastActiveEvent
PTS.lastInactiveEvent:quantity	5.13.16	ptsLastInactiveEvent
PTS.error:code	5.13.17	ptsError
PTS.monitoringDetectors:code	5.13.18	ptsMonitoringDetectors

4.4.12.3 Pavement Treatment Table

The pavement treatment table contains information about the various treatments that may be applied to the roadway surface. It can be described through a number of attributes as indicated in Table 34~~Table 27~~.

Table 34 Pavement Treatment Table Attributes

Descriptive Name	Section	Object Name
PavementTreatmentTable.numTreatments:quantity	5.13.1	numEssTreatments
PavementTreatmentTable.amount:quantity	5.13.4	essPaveTreatmentAmount
PavementTreatmentTable.width:quantity	5.13.5	essPaveTreatmentWidth
~~PavementTreatmentTable.block:frame~~	~~5.13.6~~	~~pavementTreatmentBlock~~

4.4.12.4 Pavement Treatment

A pavement treatment is a chemical that can be applied to a roadway surface to inhibit ice formation or promote ice melting. It can be described through a number of attributes as indicated in Table 35~~Table 28~~.

Table 35 Pavement Treatment Attributes

Descriptive Name	Section	Object Name
PavementTreatement.index:identifier	5.13.3.1	essPavementTreatmentIndex
PavementTreatement.type:code	5.13.3.2	essPaveTreatProductType
PavementTreatement.form:code	5.13.3.3	essPaveTreatProductForm
PavementTreatement.mix:quantity	5.13.3.4	essPercentProductMix

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Section 5
Management Information Base (MIB) [Normative]

Section 5~~Section 5~~ defines those objects that are specifically used by Environmental Sensor Stations (ESS). The objects are defined using the OBJECT-TYPE macro as specified in RFC 1212 and NTCIP 8004 v02. The text provided from Section 5~~Section 5~~ through the end of Section 5.17.2~~5.18.3.7Section 5.16.3.6~~ (except the section headings) constitutes the standard NTCIP1204 v04~~-v03~~ MIB.

All of the objects defined in this NTCIP 1204 v04~~v03~~ reside under the “ess” node of the global naming tree. To aid in object management, the “ess” node has been subdivided into logical categories, each defined by a node under the “ess” node. The individual objects are then located under the appropriate node.

Conformance requirements for any object is determined by the use of the Requirements Traceability Matrix (RTM) in. Annex A~~.~~ To support any defined Requirement, an implementation shall support all objects to which the Requirement traces in the RTM. The value of the STATUS field for every object in the MIB is "mandatory," and indicates that it is mandatory if any associated Requirement is selected.

For all bitmapped objects, if a bit is zero (0), then the referenced function is disabled or not supported, and if a bit is one (1), then the referenced function is enabled or supported.

A computer readable format of this information, called a Management Information Base, is available from NEMA (ntcip@nema.org). The MIB has been verified using SMICng Version 2.2.07 (Book).

Previous versions of NTCIP 1204 v04~~v03~~ defined data elements that have been replaced to resolve ambiguities; however, central systems may need to interoperate with older equipment and support such data elements. Annex D documents the reason that the ESS WG decided to deprecate various objects.

5.1 ~~5.0~~ MIB ~~Comment~~ Header

```
--*******************************************************************
-- Filename:    1204v0~~3~~4~~08~~14.MIB
-- Description: This MIB defines the Environmental Sensor Station
--              Objects
--*******************************************************************
```

~~5.2 MIB Header~~

```
NTCIP1204-v04~~v03~~ DEFINITIONS ::= BEGIN
IMPORTS
  Counter
      FROM RFC1155-SMI
  DisplayString
      FROM RFC1213-MIB
  OBJECT-TYPE
      FROM RFC-1212
  ess, OerString
      FROM NTCIP8004v02;

-- For the purpose of this section, the following OBJECT IDENTIFIERS
-- are used:

essBufr OBJECT IDENTIFIER ::= {ess 1}
```

```
-- This node contains objects that describe BUFR information based on
-- the BUFR Standards.

essNtcip OBJECT IDENTIFIER ::= {ess 2}
-- This node contains objects that describe surface transportation
-- environmental information which deviate from the BUFR Standards.
```

~~5.3~~5.2 Identification Objects

```
-- These are objects used to describe the identification of the
-- environmental sensor station.
essNtcipIdentification  OBJECT IDENTIFIER ::= {essNtcip 1 }
```

~~5.3.1~~5.2.1 Station Category

```
essNtcipCategory OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        permanent (2),
                        transportable (3),
                        mobile (4)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the category of station as it relates to
mobility.
~~<SetConstraint>read-only~~
<DescriptiveName>ESS.category:code
<Valid Value Rule>
value          description
other          of a design not listed in this standard~~frict~~.~~standard.~~
permanent      not designed to be relocated.
transportable  able to be relocated, but does not take readings while moving.
mobile         capable of taking readings while moving.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.1.1"
::=   { essNtcipIdentification 1 }
```

~~5.3.2~~5.2.2 Site Description

```
essNtcipSiteDescription OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual description of the station's location.
~~<SetConstraint>always~~
<Informative>Version 02 of the standard incorrectly defined a SetConstraint
of read-only, even though the object has always been defined with an ACCESS
of read-write. This was corrected in version 03.
<DescriptiveName>ESS.siteDescription:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.1.2"
::=   { essNtcipIdentification 2 }
```

~~5.4~~5.3 Data Instrumentation Objects

```
-- Contains objects used to describe the type of data and the type of
-- instrumentation used to collect the data being received from the
```

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```
-- ess.
essBufrInstrumentation  OBJECT IDENTIFIER ::= { essBufr 2 }
essNtcipInstrumentation OBJECT IDENTIFIER ::= { essNtcip 15 }

-- It is also recognized that there would be a great value of an object
-- to indicate the quality of data; however, this is a very complex
-- topic and thus we have not determined an appropriate
-- mechanism.
```

~~5.4.1~~5.3.1 Type of Station

```
essTypeofStation OBJECT-TYPE
SYNTAX      INTEGER (0..3)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Integer value that indicates the type of station. If
the station is a hybrid station, it shall be defined as two stations, one
staffed and one automatic.
<Informative>The value of 2 has been explicitly defined as being reserved. To
be defined as two stations (e.g., for a hybrid), a station needs to have two
addresses and two instances of this MIB.
<SetConstraint>read-only
<DescriptiveName>ESS.typeOfStation:code
<Valid Value Rule>
value                 description
0 - automatic       the data is collected electronically/mechanically
1 - staffed         the data is collected by humans
2 - reserved
3 - missingValue    the type of station is unknown.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.2.1"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 02 001"
::=   { essBufrInstrumentation 1 }
```

~~5.4.2~~5.3.2 Door Status

```
essDoorStatus OBJECT-TYPE
SYNTAX      INTEGER (0..1)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates whether any of the doors attached to the
station are open. If the value is one (1), at least one door is open; if the
value is zero (0), all doors associated with the ESS are closed.
<SetConstraint>read-only
<DescriptiveName>ESS.doorOpen:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.1"
::=   { essNtcipInstrumentation 1 }
```

~~5.4.3~~5.3.3 Battery Status

```
essBatteryStatus OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the current charge stored in the battery.
```

```
<DescriptiveName>ESS.batteryCharge:quantity
<Valid Value Rule>
Values 0 to 100 indicate percent of full charge. The value 101 indicates an
error in determining the percent of charge.
<Data Concept Type>Data Element
<Unit>Percent
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.2"
::=   { essNtcipInstrumentation 2 }
```

~~5.4.4~~5.3.4 Line Volts

```
essLineVolts OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the voltage measured on the incoming power
line for the controller. The value reported will indicate one-half of the
actual voltage; thus, this object will indicate a value of 55 when the
voltage is 110 Vrms. This object shall only be used to indicate A/C power
conditions. If the line power is DC, this object shall not apply (i.e., will
either not be supported or have a value of 255) and the essBatteryStatus
object shall indicate the status of the batteries.
<DescriptiveName>ESS.lineVolts:quantity
<Valid Value Rule>
Values 0 through 254 shall indicate valid values. The value 254 shall mean a
voltage of 508 Vrms or greater. The value of 255 shall indicate an error
condition or missing value.
<Data Concept Type>Data Element
<Unit>2 Volts Root Mean Squared (Vrms) (i.e., the value reported shall be
one-half the actual voltage).
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.3"
::=   { essNtcipInstrumentation 3 }
```

~~5.4.5~~5.3.5 Station Meta Data Block

-- This object has been deprecated. See Annex D.2.10~~8~~ for more
~~--~~information.

```
essStationMetaDataBlock OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssStationMetaData
structure as defined below. This object is used for uploading configuration
data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssStationMetaData ::= SEQUENCE {
essNtcipCategory.0,                 OPTIONAL,   -- @NTCIP1204-v03
essTypeOfStation.0,                 OPTIONAL,   -- @NTCIP1204-v03
essLatitude.0,                      OPTIONAL,   -- @NTCIP1204-v03
essLongitude.0,                     OPTIONAL,   -- @NTCIP1204-v03
essReferenceHeight.0,               OPTIONAL,   -- @NTCIP1204-v03
essPressureHeight.0,                OPTIONAL,   -- @NTCIP1204-v03
essWindSensorHeight.0,              OPTIONAL,   -- @NTCIP1204-v03
```

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```
temperatureMetaData     SEQUENCE OF TemperatureMetaData     OPTIONAL,
pavementMetaData        SEQUENCE OF PavementMetaData  OPTIONAL,
subSurfaceMetaData      SEQUENCE OF SubSurfaceMetaData      OPTIONAL,
treatmentMetaData       SEQUENCE OF TreatmentMetaData OPTIONAL
}

TemperatureMetaData ::= SEQUENCE {
essTemperatureSensorIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essTemperatureSensorHeight.x        OPTIONAL    -- @NTCIP1204-v03
}

PavementMetaData ::= SEQUENCE {
essPavementSensorIndex.x,           OPTIONAL,   -- @NTCIP1204-v03
essPavementType.x,                  OPTIONAL,   -- @NTCIP1204-v03
essPavementElevation.x              OPTIONAL,   -- @NTCIP1204-v03
essPavementExposure.x               OPTIONAL,   -- @NTCIP1204-v03
essPavementSensorType.x             OPTIONAL    -- @NTCIP1204-v03
}

SubSurfaceMetaData ::= SEQUENCE {
essSubSurfaceSensorIndex.x          OPTIONAL,   -- @NTCIP1204-v03
essSubSurfaceType.x                 OPTIONAL,   -- @NTCIP1204-v03
essSubSurfaceSensorDepth.x          OPTIONAL    -- @NTCIP1204-v03
}

TreatmentMetaData ::= SEQUENCE {
essPavementTreatmentIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essPaveTreatProductType.x           OPTIONAL,   -- @NTCIP1204-v03
essPaveTreatProductForm.x           OPTIONAL,   -- @NTCIP1204-v03
essPercentProductMix.x              OPTIONAL    -- @NTCIP1204-v03
}
<Informative>This object has been replaced by essStationMetaDataV3Block (See
5.3.8).
<SetConstraint>read-only
<DescriptiveName>ESS.stationMetaDataBlock:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.4"
::=   { essNtcipInstrumentation 4 }
```

5.4.65.3.6 Weather Block

```
-- This object has been deprecated. See Annex D.2.108 for more
-- information.
essWeatherBlock OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssWeatherData
structure as defined in Section 4. This object is used for uploading current
weather data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssWeatherData ::= SEQUENCE {
essAtmosphericPressure.0            OPTIONAL,   -- @NTCIP1204-v03
```

```
essWindData                         EssWindData             OPTIONAL,
essTemperatureData                  EssTemperatureData      OPTIONAL,
essPrecipData                       EssPrecipData           OPTIONAL,
essVisibilityData                   EssVisibilityData       OPTIONAL
}

EssWindData ::= SEQUENCE {
essAvgWindDirection.0               OPTIONAL,   -- @NTCIP1204-v03
essAvgWindSpeed.0                   OPTIONAL,   -- @NTCIP1204-v03
essWindSituation.0                  OPTIONAL,   -- @NTCIP1204-v03
essMaxWindGustSpeed.0               OPTIONAL,   -- @NTCIP1204-v03
essMaxWindGustDir.0                 OPTIONAL,   -- @NTCIP1204-v03
essSpotWindDirection.0              OPTIONAL,   -- @NTCIP1204-v03
essSpotWindSpeed.0                  OPTIONAL    -- @NTCIP1204-v03
}

EssTemperatureData ::= SEQUENCE {
essWetBulbTemp.0                    OPTIONAL,   -- @NTCIP1204-v03
essDewpointTemp.0                   OPTIONAL,   -- @NTCIP1204-v03
essMaxTemp.0                        OPTIONAL,   -- @NTCIP1204-v03
essMinTemp.0                        OPTIONAL,   -- @NTCIP1204-v03
essRelativeHumidity.0               OPTIONAL,   -- @NTCIP1204-v03
      -- for (
--    x = 1;
--    x < essNumTemperatureSensors.0;
--    x++)
temperatureTable              SEQUENCE OF Temperature OPTIONAL
}

Temperature ::= SEQUENCE {
essTemperatureSensorIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essAirTemperature.x                 OPTIONAL    -- @NTCIP1204-v03
}

EssPrecipData ::= SEQUENCE {
essWaterDepth.0                     OPTIONAL,   -- @NTCIP1204-v03
essAdjacentSnowDepth.0              OPTIONAL,   -- @NTCIP1204-v03
essRoadwaySnowDepth.0               OPTIONAL,   -- @NTCIP1204-v03
essRoadwaySnowPackDepth.0           OPTIONAL,   -- @NTCIP1204-v03
essPrecipYesNo.0                    OPTIONAL,   -- @NTCIP1204-v03
essPrecipRate.0                     OPTIONAL,   -- @NTCIP1204-v03
essSnowfallAccumRate.0              OPTIONAL,   -- @NTCIP1204-v03
essPrecipSituation.0                OPTIONAL,   -- @NTCIP1204-v03
essIceThickness.0                   OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationStartTime.0         OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationEndTime.0           OPTIONAL    -- @NTCIP1204-v03
}
```

~~Editor's Note - I think we decided to remove the following yes?~~

```
essPrecipitationOneHour.0           OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationThreeHours.0        OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationSixHours.0          OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationTwelveHours.0       OPTIONAL,   -- @NTCIP1204-v03
essPrecipitation24Hours.0           OPTIONAL    -- @NTCIP1204-v03

EssVisibilityData ::= SEQUENCE {
essSolarRadiation.0                 OPTIONAL,   -- @NTCIP1204-v03
essTotalSun.0                       OPTIONAL,   -- @NTCIP1204-v03
```

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```
essCloudSituation.0                 OPTIONAL,   -- @NTCIP1204-v03
essVisibility.0                     OPTIONAL,   -- @NTCIP1204-v03
essVisibilitySituation.0            OPTIONAL    -- @NTCIP1204-v03
}
<Informative>This object has been replaced by essWeatherV3Block (See 5.3.9).
<SetConstraint>read-only
<DescriptiveName>ESS.weatherBlock:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.5"
::=   { essNtcipInstrumentation 5 }
```

5.4.75.3.7 Mobile Block

```
-- This object has been deprecated. See Annex D.3.2 for more information.
essMobileBlock OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssMobileData structure
as defined below. This object is used for uploading current mobile station
data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssMobileData ::= SEQUENCE {
      essLatitude.0                       OPTIONAL, -- @NTCIP1204-v03
      essLongitude.0                      OPTIONAL, -- @NTCIP1204-v03
      essReferenceHeight.0                OPTIONAL, -- @NTCIP1204-v03
      essVehicleSpeed.0                   OPTIONAL, -- @NTCIP1204-v03
      essVehicleBearing.0                 OPTIONAL, -- @NTCIP1204-v03
      essVehicleOdeometer.0               OPTIONAL, -- @NTCIP1204-v03
      essMobileFriction.0                 OPTIONAL, -- @NTCIP1204-v03
      essMobileObservationGroundState.0   OPTIONAL, -- @NTCIP1204-v03
      essMobileObservationPavement.0      OPTIONAL, -- @NTCIP1204-v03
      essPaveTreatmentAmount.0            OPTIONAL, -- @NTCIP1204-v03
      essPaveTreatmentWidth.0             OPTIONAL  -- @NTCIP1204-v03
      }
<SetConstraint>read-only
<DescriptiveName>MobilePlatform.mobileBlock:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.6"
::=   { essNtcipInstrumentation 6 }
```

5.4.85.3.8 Station Meta Data Block Version 3

```
-- This object has been deprecated. See Annex D.3.2 for more information.
essStationMetaDataV3Block OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssStationMetaDataV3
structure as defined below. This object is used for uploading configuration
data from the ESS in a bandwidth efficient manner.
```

The OPTIONAL fields shall be present if the data is supported by the implementation and is valid. The OPTIONAL fields shall be omitted for any data that is invalid or not supported by the implementation.

```
EssStationMetaDataV3 ::= SEQUENCE {
essNtcipCategory.0,                 OPTIONAL,   -- @NTCIP1204-v03
essTypeOfStation.0,                 OPTIONAL,   -- @NTCIP1204-v03
essLatitude.0,                      OPTIONAL,   -- @NTCIP1204-v03
essLongitude.0,                     OPTIONAL,   -- @NTCIP1204-v03
essReferenceHeight.0,               OPTIONAL,   -- @NTCIP1204-v03
essPressureHeight.0,                OPTIONAL,   -- @NTCIP1204-v03
precipitationSensorModelInformation.0     OPTIONAL -- @NTCIP1204-v03
windMetaData.0,         SEQUENCE OF WindMetaData            OPTIONAL,
temperatureMetaData     SEQUENCE OF TemperatureMetaData     OPTIONAL,
pavementMetaData        SEQUENCE OF PavementMetaData        OPTIONAL,
subSurfaceMetaData      SEQUENCE OF SubSurfaceMetaData      OPTIONAL,
treatmentMetaData       SEQUENCE OF TreatmentMetaData       OPTIONAL,
}

WindMetaData ::= SEQUENCE {
windSensorIndex.x                   OPTIONAL,   -- @NTCIP1204-v03
windSensorHeight.x                  OPTIONAL,   -- @NTCIP1204-v03
}

TemperatureMetaData ::= SEQUENCE {
essTemperatureSensorIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essTemperatureSensorHeight.x        OPTIONAL,   -- @NTCIP1204-v03
}

PavementMetaData ::= SEQUENCE {
essPavementSensorIndex.x,           OPTIONAL,   -- @NTCIP1204-v03
essPavementType.x,                  OPTIONAL,   -- @NTCIP1204-v03
essPavementElevation.x              OPTIONAL,   -- @NTCIP1204-v03
essPavementExposure.x               OPTIONAL,   -- @NTCIP1204-v03
essPavementSensorType.x             OPTIONAL,   -- @NTCIP1204-v03
pavementSensorModelInformation.x    OPTIONAL,   -- @NTCIP1204-v03
pavementSensorTemperatureDepth.x    OPTIONAL    -- @NTCIP1204-v03
}

SubSurfaceMetaData ::= SEQUENCE {
essSubSurfaceSensorIndex.x          OPTIONAL,   -- @NTCIP1204-v03
essSubSurfaceType.x                 OPTIONAL,   -- @NTCIP1204-v03
essSubSurfaceSensorDepth.x          OPTIONAL,   -- @NTCIP1204-v03
}

TreatmentMetaData ::= SEQUENCE {
essPavementTreatmentIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essPaveTreatProductType.x           OPTIONAL,   -- @NTCIP1204-v03
essPaveTreatProductForm.x           OPTIONAL,   -- @NTCIP1204-v03
essPercentProductMix.x              OPTIONAL,   -- @NTCIP1204-v03
}
```

~~<SetConstraint>read-only~~
<DescriptiveName>ESS.stationMetaDataBlock:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.7"
::= { essNtcipInstrumentation 7 }

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~~5.4.9~~5.3.9 Weather Block Version 3

```
-- This object has been deprecated. See Annex D.3.2 for more information.
essWeatherV3Block OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssWeatherDataV3
structure as defined below. This object is used for uploading current weather
data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssWeatherDataV3 ::= SEQUENCE {
essAtmosphericPressure.0            OPTIONAL,   -- @NTCIP1204-v03
essWindData                   SEQUENCE OF EssWindDataV3     OPTIONAL,
essTemperatureData                  EssTemperatureData      OPTIONAL,
essPrecipData                       EssPrecipDataV3         OPTIONAL,
essVisibilityData                   EssVisibilityDataV3     OPTIONAL,
essRadiationData                    EssRadiationData        OPTIONAL,
}

EssWindDataV3 ::= SEQUENCE {
windSensorIndex.x                   OPTIONAL,   -- @NTCIP1204-v03
windSensorAvgSpeed.x                OPTIONAL,   -- @NTCIP1204-v03
windSensorAvgDirection.x            OPTIONAL,   -- @NTCIP1204-v03
windSensorSpotSpeed.x               OPTIONAL,   -- @NTCIP1204-v03
windSensorSpotDirection.x           OPTIONAL,   -- @NTCIP1204-v03
windSensorGustSpeed.x               OPTIONAL,   -- @NTCIP1204-v03
windSensorGustDirection.x           OPTIONAL,   -- @NTCIP1204-v03
windSensorSituation.x               OPTIONAL,   -- @NTCIP1204-v03
}

EssTemperatureData ::= SEQUENCE {
essWetBulbTemp.0                    OPTIONAL,   -- @NTCIP1204-v03
essDewpointTemp.0                   OPTIONAL,   -- @NTCIP1204-v03
essMaxTemp.0                        OPTIONAL,   -- @NTCIP1204-v03
essMinTemp.0                        OPTIONAL,   -- @NTCIP1204-v03
essRelativeHumidity.0               OPTIONAL,   -- @NTCIP1204-v03
      -- for (
--    x = 1;
--    x < essNumTemperatureSensors.0;
--    x++)
temperatureTable              SEQUENCE OF Temperature OPTIONAL,
}

Temperature ::= SEQUENCE {
essTemperatureSensorIndex.x         OPTIONAL,   -- @NTCIP1204-v03
essAirTemperature.x                 OPTIONAL,   -- @NTCIP1204-v03
}

EssPrecipDataV3 ::= SEQUENCE {
waterLevelSensorTable               SEQUENCE OF WaterLevel  OPTIONAL,
essAdjacentSnowDepth.0              OPTIONAL,   -- @NTCIP1204-v03
```

```
essRoadwaySnowDepth.0                OPTIONAL,   -- @NTCIP1204-v03
essRoadwaySnowPackDepth.0            OPTIONAL,   -- @NTCIP1204-v03
essPrecipYesNo.0                     OPTIONAL,   -- @NTCIP1204-v03
essPrecipRate.0                      OPTIONAL,   -- @NTCIP1204-v03
essSnowfallAccumRate.0               OPTIONAL,   -- @NTCIP1204-v03
essPrecipSituation.0                 OPTIONAL,   -- @NTCIP1204-v03
essIceThickness.0                    OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationStartTime.0          OPTIONAL,   -- @NTCIP1204-v03
essPrecipitationEndTime.0            OPTIONAL,   -- @NTCIP1204-v03
}

WaterLevel ::= SEQUENCE {
waterLevelSensorIndex.x              OPTIONAL,   -- @NTCIP1204-v03
waterLevelSensorReading.x            OPTIONAL,   -- @NTCIP1204-v03
}

EssVisibilityDataV3 ::= SEQUENCE {
essVisibility.0                      OPTIONAL,   -- @NTCIP1204-v03
essVisibilitySituation.0             OPTIONAL,   -- @NTCIP1204-v03
}

EssRadiationData ::= SEQUENCE {
essTotalSun.0                        OPTIONAL,   -- @NTCIP1204-v03
essInstantaneousTerrestrialRadiation.0    OPTIONAL, -- @NTCIP1204-v03
essInstantaneousSolarRadiation.0     OPTIONAL,   -- @NTCIP1204-v03
essTotalRadiation.0                  OPTIONAL,   -- @NTCIP1204-v03
essTotalRadiationPeriod.0            OPTIONAL,   -- @NTCIP1204-v03
essCloudSituation.0                  OPTIONAL,   -- @NTCIP1204-v03
}
```

~~<SetConstraint>read-only~~
<DescriptiveName>ESS.weatherBlock:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.8"
::= { essNtcipInstrumentation 8 }

5.3.10 ESS Status

essStatus OBJECT-TYPE
SYNTAX INTEGER (0..3)
ACCESS read-only
STATUS mandatory
DESCRIPTION "<Definition>Integer value that indicates whether an error condition has been detected in the ESS hardware or software.
~~<Informative>~~
~~<SetConstraint>read-only~~
<DescriptiveName>ESS.status:code
<Valid Value Rule>

value	description
0 - no~~-e~~Error	no error is reported
1 - watchdog~~-f~~Failure	the watchdog has failed
2 - powerE~~-e~~rror	~~------~~irregular occurrence detected with ~~charge status of the battery~~primary power source
3 - sensor~~-f~~Failure	~~missingValue - the type of station is unknown.~~condition detected preventing proper reporting or a sensor value is deemed invalid or suspect

<Data Concept Type>Data Element

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```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.15.9"
::=   { essNtcipInstrumentation 9 }
```

~~5.5~~5.4 Location Objects

```
-- Contains objects used to describe the location of the ess that is
-- transmitting the collected data.
essNtcipLocation OBJECT IDENTIFIER ::= {essNtcip 2 }
```

~~5.5.1~~5.4.1 Latitude

```
essLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS station,
per WGS-84 datum.
<SetConstraint>read-only
<DescriptiveName>ESS.latitude:quantity
<Valid Value Rule>
The essLatitude at the North Pole is 90,000,000. The essLatitude at the South
Pole is -90,000,000. The value 90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.2.1"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { essNtcipLocation 1 }
```

~~5.5.2~~5.4.2 Longitude

```
essLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS location.
<SetConstraint>read-only
<DescriptiveName>ESS.longitude:quantity
<Valid Value Rule>
The essLongitude of 180 degrees West shall be -180,000,000. The essLongitude
of 180 degrees East shall be 180,000,000. The value 180,000,001 shall
indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.2.2"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { essNtcipLocation 2 }
```

~~5.5.3~~5.4.3 Vehicle Speed

```
essVehicleSpeed OBJECT-TYPE
```

```
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the current speed being reported by the
vehicle in kilometers per hour.
<SetConstraint>read-only
<DescriptiveName>MobilePlatform.speed:quantity
<Valid Value Rule>
The value 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>kilometers per hour
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.2.3"
::=   { essNtcipLocation 3 }
```

5.5.45.4.4 Vehicle Bearing

```
essVehicleBearing OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the current bearing of the vehicle in
degrees, measured clockwise from True North.

<SetConstraint>read-only
<DescriptiveName>MobilePlatform.bearing:quantity
<Valid Value Rule>
The value 0 shall indicate that the vehicle is stopped. The value 361 shall
indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.2.4"
::=   { essNtcipLocation 4 }
```

5.5.55.4.5 Odometer

```
essOdometer OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the distance traveled, in meters, by the
vehicle current odometer reading of the vehicle in metersfrom a reference
point.  Could be a vehicle odometer reading or a calculation from the
vehicle's GPS.
<SetConstraint>read-only
<DescriptiveName>MobilePlatform.odometer:quantity
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.2.5"
::=   { essNtcipLocation 5 }
```

5.65.5 Station Elevation Objects

```
-- Contains objects used to describe the elevation and atmospheric
-- pressure at the ess that is transmitting the collected data along
-- with the height of various sensors
essNtcipHeight OBJECT IDENTIFIER ::= {essNtcip 3 }
```

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```
essBufrLocationVertical OBJECT IDENTIFIER ::= {essBufr 7 }
essNtcipPressure OBJECT IDENTIFIER ::== {essNtcip 16 }
```

~~5.6.1~~5.5.1 Reference Height

```
essReferenceHeight OBJECT-TYPE
SYNTAX      INTEGER (-400..8001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The reference elevation of the ESS in meters above
mean sea level. For a permanent station, this height shall be measured to the
base of the structure; for transportable stations, this height shall be
measured to the ground surface upon which the station resides; and for
mobile, this height shall be measured to the surface under the vehicle.
<SetConstraint>read-only
<DescriptiveName>ESS.referenceHeight:quantity
<Valid Value Rule>
The value of 8001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.3.1"
REFERENCE   "Resolution based on WMO Binary Code Form FM 94 BUFR Table B item
0 07 001."
::=   { essNtcipHeight 1 }
```

~~5.6.2~~5.5.2 Pressure Height

```
-- This object has been deprecated. See Annex D.3.3.1 for more information.
-- Deprecate
essPressureHeight OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The height of the pressure sensor with respect to
the essReferenceHeight in meters.
<SetConstraint>read-only
<DescriptiveName>PressureSensor.pressureHeight:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.3.2"
REFERENCE   "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=   { essNtcipHeight 2 }
```

~~5.6.3~~5.5.3 Wind Sensor Height

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essWindSensorHeight OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The height of the primary wind sensor with respect
to the essReferenceHeight in meters.
<SetConstraint>read-only
```

```
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.3.3"
::=   { essNtcipHeight 3 }
```

~~5.6.4~~5.5.4 Atmospheric Pressure

```
-- This object has been deprecated. See Annex D.3.3.1 for more information.
essAtmosphericPressure OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The force per unit area exerted by the atmosphere in
1/10ths of millibars, a.k.a. tenths of hectoPascals.
~~<SetConstraint>read-only~~
<DescriptiveName>PressureSensor.atmosphericPressure:quantity
<Valid Value Rule>
A value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>Decapascal
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.7.4"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 07 004."
::=   { essBufrLocationVertical 4 }
```

5.5.5 Number of Pressure Sensors

```
essNumPressureSensors OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the pressure
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<DescriptiveName>PressureSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.1"
::=   { essNtcipPressure 1 }
```

5.5.6 Pressure Sensor Table

```
essPressureSensorTable OBJECT-TYPE
SYNTAX      SEQUENCE OF EssPressureSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Table containing the pressure sensor data.
<DescriptiveName>PressureSensorTable
<Data Concept Type>Class
<TableType>static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2"
::=   { essNtcipPressure 2 }
```

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5.5.7 Pressure Sensor

```
essPressureSensorEntry OBJECT-TYPE
SYNTAX      EssPressureSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>A pressure sensor is a sensor that reports the
atmospheric pressure. It can be described through a number of attributes as
indicated by the following subclauses.
<DescriptiveName>PressureSensor
<Data Concept Type>Class"
INDEX { essPressureSensorIndex }
::=   { essPressureSensorTable 1 }

EssPressureSensorEntry ::= SEQUENCE {
      essPressureSensorIndex                INTEGER,
      essPressureSensorHeight               INTEGER,
      essPressureSensorLatitude             INTEGER,
      essPressureSensorLongitude            INTEGER,
      essPressureSensorLocation             DisplayString,
      essPressureSensorModelInformation     INTEGER,
      -- SENSOR READINGS
      essPressureSensorAtmosphericPressure      INTEGER}
```

5.5.7.1 Pressure Sensor Index

```
essPressureSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
atmospheric pressure sensor data.
<DescriptiveName>PressureSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.1"
::= { essPressureSensorEntry 1 }
```

5.5.7.2 Pressure Sensor Height

```
essPressureSensorHeight OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The height of the pressure sensor with respect to
the essReferenceHeight in meters.
<DescriptiveName>PressureSensor.height:quantity
<Valid Value Rule>The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.2"
REFERENCE   "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=   { essPressureSensorEntry 2 }
```

5.5.7.3 Pressure Sensor Latitude

```
essPressureSensorLatitude OBJECT-TYPE
```

```
SYNTAX       INTEGER (-90000000..90000001)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS pressure
sensor, per WGS-84 datum.
<DescriptiveName>PressureSensor.latitude:quantity
<Valid Value Rule>The essPressureLatitude at the North Pole is 90,000,000.
The essPressureLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.3"
REFERENCE    "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=    { essPressureSensorEntry 3 }
```

5.5.7.4 Pressure Sensor Longitude

```
essPressureSensorLongitude OBJECT-TYPE
SYNTAX       INTEGER (-180000000..180000001)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS pressure sensor location.
<DescriptiveName>PressureSensor.longitude:quantity
<Valid Value Rule>The essPressureLongitude of 180 degrees West shall be -
180,000,000. The essPressureLongitude of 180 degrees East shall be
180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.4"
REFERENCE    "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=    { essPressureSensorEntry 4 }
```

5.5.7.5 Pressure Sensor Location

```
essPressureSensorLocation OBJECT-TYPE
SYNTAX       DisplayString (SIZE (0..255))
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
pressure sensor.
<DescriptiveName>PressureSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.5"
::= { essPressureSensorEntry 5 }
```

5.5.7.6 Pressure Sensor Model Information

```
essPressureSensorModelInformation OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-write
STATUS       mandatory
```

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```
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Pressure Sensor Table.
<DescriptiveName>PressureSensor.modelInformation:identifier
<Valid Value Rule>The value of zero indicates that this information is not
available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.6"
::= { essPressureSensorEntry 6 }
```

5.5.7.7 Pressure Sensor Atmospheric Pressure

```
essPressureSensorAtmosphericPressure OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The force per unit area exerted by the atmosphere in
1/10ths of millibars, a.k.a. tenths of hectoPascals.
<DescriptiveName>PressureSensor.atmosphericPressure:quantity
<Valid Value Rule>A value of 65535 shall indicate an error condition or
missing value.
<Data Concept Type>Data Element
<Unit>Decapascal
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.16.2.7"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 07 004."
::=   { essPressureSensorEntry 7 }
```

~~5.7~~5.6 Wind Data Section

```
-- Contains objects used to describe the wind data that is collected at
-- the ess.
essBufrWind OBJECT IDENTIFIER ::= {essBufr 11 }
essNtcipWind OBJECT IDENTIFIER ::= {essNtcip 4 }
```

~~5.7.1~~5.6.1 Average Wind Direction

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essAvgWindDirection OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>A two minute average of the direction from which the
wind is blowing measured clockwise in degrees from true North and measured at
a height as indicated by essWindSensorHeight. A value of 361 shall indicate
an error condition or missing value.
~~<SetConstraint>read-only~~
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.11.1"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 11 001."
::=   { essBufrWind 1 }
```

~~5.7.2~~5.6.2 Average Wind Speed

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essAvgWindSpeed OBJECT-TYPE
```

```
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>A two minute average of the wind speed in tenths of
meters per second as measured by the primary wind sensor.
<SetConstraint>read-only
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.11.2"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 11 002."
::=   { essBufrWind 2 }
```

5.7.35.6.3 Spot Wind Direction

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essSpotWindDirection OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The direction from which the wind is blowing
measured in degrees clockwise from true North and measured at a height as
indicated by essWindSensorHeight. A value of 361 shall indicate an error
condition or missing value. For mobile platforms, the wind direction shall be
corrected for vehicle movement.
<SetConstraint>read-only
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.1"
::=   { essNtcipWind 1 }
```

5.7.45.6.4 Spot Wind Speed

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essSpotWindSpeed OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The wind speed in tenths of meters per second
measured by the primary wind sensor. For mobile platforms, the wind speed
shall be corrected for vehicle movement.
<SetConstraint>read-only
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.1"
::=   { essNtcipWind 2 }
```

5.7.55.6.5 Wind Situation

```
-- This object has been deprecated. See Annex D.1.3 for more information.
essWindSituation OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
```

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```
                        calm (3),
                        lightBreeze (4),
                        moderateBreeze (5),
                        strongBreeze (6),
                        gale (7),
                        moderateGale (8),
                        strongGale (9),
                        stormWinds (10),
                        hurricaneForceWinds (11),
                        gustyWinds (12)}
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>Describes the weather and travel situation in terms
of wind from staffed stations only. Specific ranges for these values are
defined in the Glossary of Meteorology.
<SetConstraint>read-only
<Valid Value Rule>
Range       Meaning
other       not defined within this standard, see manufacturers documentation
unknown     Unknown conditions
calm        Calm
lightBreeze Light breeze
moderateBreeze    Moderate breeze
strongBreeze      Strong breeze
gale        Gale
moderateGale      Moderate gale
strongGale  Strong gale
stormWinds  Storm winds
hurricaneForceWinds     Hurricane force winds
gustyWinds  defined by a peak and a lull of greater than 46.3 tenths of
            meters per second within a 2 minute period.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.3"
::=   { essNtcipWind 3 }
```

~~5.7.6~~5.6.6 Wind Gust Speed

-- This object has been deprecated. See Annex D.1.3 for more information.

```
essMaxWindGustSpeed OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The maximum wind gust recorded by the primary wind
sensor during the 10 minutes preceding the observation measured in tenths of
meters per second.
<SetConstraint>read-only
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.11.41"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 11 041."
::=   { essBufrWind 41 }
```

~~5.7.7~~5.6.7 Wind Gust Direction

-- This object has been deprecated. See Annex D.1.3 for more information.

```
essMaxWindGustDir OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The direction of the maximum wind gust recorded
during the 10 minutes preceding the observation at a height as indicated by
essWindSensorHeight; measured in degrees clockwise from true North. The value
361 shall indicate an error condition or missing value.
<SetConstraint>read-only
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.11.43"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 11 043."
::=   { essBufrWind 43 }
```

5.7.85.6.8 Number of Wind Sensors

```
windSensorTableNumSensors OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the wind sensor
table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>WindSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.7"
::=   { essNtcipWind 7 }
```

5.7.95.6.9 Wind Sensor Table

```
windSensorTable OBJECT-TYPE
SYNTAX      SEQUENCE OF WindSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Table containing the wind sensor data fields.
<DescriptiveName>WindSensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8"
::=   { essNtcipWind 8 }
```

5.7.105.6.10 Wind Sensor

```
windSensorEntry OBJECT-TYPE
SYNTAX      WindSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Parameters for specific wind sensor data fields.
<DescriptiveName>WindSensor
<Data Concept Type>Class"
```

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```
INDEX { windSensorIndex }
::=   { windSensorTable 1 }

WindSensorEntry ::= SEQUENCE {
      windSensorIndex                INTEGER,
      windSensorHeight               INTEGER,
      windSensorLocation             DisplayString,
      windSensorAvgSpeed             INTEGER,
      windSensorAvgDirection         INTEGER,
      windSensorSpotSpeed            INTEGER,
      windSensorSpotDirection        INTEGER,
      windSensorGustSpeed            INTEGER,
      windSensorGustDirection        INTEGER,
      windSensorSituation            INTEGER, }
      windSensorLatitude             INTEGER,
      windSensorLongitude            INTEGER,
      windSensorModelInformation     INTEGER }
```

~~5.7.10.1~~5.6.10.1 Wind Sensor Index

```
windSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
wind sensor data. The first entry shall be that of the primary wind sensor.
<SetConstraint>read-only
<DescriptiveName>WindSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.1"
::= { windSensorEntry 1 }
```

~~5.7.10.2~~5.6.10.2 Wind Sensor Height

```
windSensorHeight OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The height of the wind sensor with respect to the
essReferenceHeight in meters.
<Informative>Changed to read-write from read-only in NTCIP 1204 v04.

<SetConstraint>read-only
<DescriptiveName>WindSensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.2"
::= { windSensorEntry 2 }
```

~~5.7.10.3~~5.6.10.3 Wind Sensor Location

```
windSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
```

```
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the wind
sensor.
<SetConstraint>always
<DescriptiveName>WindSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.3"
::= { windSensorEntry 3 }
```

5.7.10.45.6.10.4 Wind Sensor Average Speed

```
windSensorAvgSpeed OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A two minute average of the wind speed in tenths of
meters per second as measured by the wind sensor.
<SetConstraint>read-only
<DescriptiveName>WindSensor.avgSpeed:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.4"
REFERENCE "WMO Binary Code Form FM 94 BUFR Table B item 0 11 002."
::= { windSensorEntry 4 }
```

5.7.10.55.6.10.5 Wind Sensor Average Direction

```
windSensorAvgDirection OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A two minute mode (average) of the direction from
which the wind is blowing measured clockwise in degrees from true north as
measured by the wind sensor.
<SetConstraint>read-only
<DescriptiveName>WindSensor.avgDirection:quantity
<Valid Value Rule>
The value of zero (0) shall indicate 'calm', when the associated speed is
zero (0), or 'light and variable,' when the associated speed is greater than
zero (0). Normal observations, as defined by the WMO, shall report a wind
direction in the range of 1 to 360 with 90 meaning from the east and 360
meaning from the north. The value of 361 shall indicate an error condition
and shall always be reported if the associated speed indicates error.
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.5"
REFERENCE "WMO Code Form FM 94 BUFR Table B item 0 11 001."
::= { windSensorEntry 5 }
```

5.7.10.65.6.10.6 Wind Sensor Spot Speed

```
windSensorSpotSpeed OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
```

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```
STATUS      mandatory
DESCRIPTION "<Definition>The wind speed in tenths of meters per second
measured by the wind sensor. For mobile platforms, the wind speed shall be
corrected for vehicle movement.
<SetConstraint>read-only
<DescriptiveName>WindSensor.spotSpeed:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.6"
::= { windSensorEntry 6 }
```

5.7.10.7 5.6.10.7 Wind Sensor Spot Direction

```
windSensorSpotDirection OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The direction from which the wind is blowing
measured in degrees clockwise from true North as measured by the wind sensor.
For mobile platforms, the wind direction shall be corrected for vehicle
movement.
<SetConstraint>read-only
<DescriptiveName>WindSensor.spotDirection:quantity
<Valid Value Rule>
The value of zero (0) shall indicate 'calm', when the associated speed is
zero (0), or 'light and variable,' when the associated speed is greater than
zero (0). Normal observations, as defined by the WMO, shall report a wind
direction in the range of 1 to 360 with 90 meaning from the east and 360
meaning from the north. The value of 361 shall indicate an error condition
and shall always be reported if the associated speed indicates error.
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.7"
::= { windSensorEntry 7 }
```

5.7.10.8 5.6.10.8 Wind Sensor Gust Speed

```
windSensorGustSpeed OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The maximum wind gust recorded by the wind sensor
during the 10 minutes preceding the observation measured in tenths of meters
per second.
<SetConstraint>read-only
<DescriptiveName>WindSensor.gustSpeed:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.8"
REFERENCE "WMO Code Form FM 94 BUFR Table B item 0 11 041."
::= { windSensorEntry 8 }
```

~~5.7.10.9~~5.6.10.9 Wind Sensor Gust Direction

```
windSensorGustDirection OBJECT-TYPE
SYNTAX      INTEGER (0..361)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The direction of the maximum wind gust recorded
during the 10 minutes preceding the observation measured in degrees clockwise
from true North by the wind sensor.
<SetConstraint>read-only
<DescriptiveName>WindSensor.gustDirection:quantity
<Valid Value Rule>
The value of zero (0) shall indicate 'calm', when the associated speed is
zero (0), or 'light and variable,' when the associated speed is greater than
zero (0). Normal observations, as defined by the WMO, shall report a wind
direction in the range of 1 to 360 with 90 meaning from the east and 360
meaning from the north. The value of 361 shall indicate an error condition
and shall always be reported if the associated speed indicates error.
<Data Concept Type>Data Element
<Unit>degrees
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.9"
REFERENCE "WMO Code Form FM 94 BUFR Table B item 0 11 043."
::= { windSensorEntry 9 }
```

~~5.7.10.10~~5.6.10.10 Wind Sensor Situation

```
windSensorSituation OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        calm (3),
                        lightBreeze (4),
                        moderateBreeze (5),
                        strongBreeze (6),
                        gale (7),
                        moderateGale (8),
                        strongGale (9),
                        stormWinds (10),
                        hurricaneForceWinds (11),
                        gustyWinds (12)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition> The assessment of the wind situation from a staffed
station as defined by the Beaufort Wind Scale in the Glossary of Meteorology.
Describes the weather and travel situation in terms of wind from staffed
stations only. Specific ranges for these values are defined in the Glossary
of Meteorology.
<DescriptiveName>WindSensor.situation:code
<Valid Value Rule>
Range       Meaning
other       not defined within this standard, see manufacturers documentation
unknown     Unknown conditions
calm        Calm
lightBreeze Light breeze
moderateBreeze    Moderate breeze
strongBreeze      Strong breeze
gale        Gale
moderateGale      Moderate gale
```

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```
strongGale  Strong gale
stormWinds  Storm winds
hurricaneForceWinds     Hurricane force winds
gustyWinds  defined by a peak and a lull of greater than 46.3 tenths of
            meters per second within a 2 minute period.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.10"
::= { windSensorEntry 10 }
```

5.6.10.11 Wind Sensor Latitude

```
windSensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS wind
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>WindSensor.latitude:quantity
<Valid Value Rule>
The ~~ess~~windSensorLatitude at the North Pole is 90,000,000. The
windSensorLatitude~~essLatitude~~ at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.11"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { windSensorEntry 11 }
```

5.6.10.12 Wind Sensor Longitude

```
windSensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS wind sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>WindSensor.longitude:quantity
<Valid Value Rule>
The windSensor~~ess~~Longitude of 180 degrees West shall be -180,000,000. The
windSensorLongitude ~~essLongitude~~ of 180 degrees East shall be 180,000,000.
The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.12"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { windSensorEntry 12 }
```

5.6.10.13 Wind Sensor Model Information

```
windSensorModelInformation OBJECT-TYPE
```

```
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Wind Sensor Table.
<DescriptiveName>WindSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.4.8.13"
::= { windSensorEntry 13 }
```

~~5.8~~5.7 Temperature Data Objects

```
-- Contains objects used to describe the temperature data that is
-- collected at the ess.
essNtcipTemperature OBJECT IDENTIFIER ::= {essNtcip 5}
```

~~5.8.1~~5.7.1 Number of Temperature Sensors

```
essNumTemperatureSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the temperature
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>TemperatureSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.1"
::=   { essNtcipTemperature 1 }
```

~~5.8.2~~5.7.2 Temperature Sensor Table

```
essTemperatureSensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF EssTemperatureSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the temperature sensor data fields.
<DescriptiveName>TemperatureSensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2"
::=   { essNtcipTemperature 2 }
```

~~5.8.3~~5.7.3 Temperature Sensor

```
essTemperatureSensorEntry OBJECT-TYPE
SYNTAX       EssTemperatureSensorEntry
ACCESS       not-accessible
```

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```
STATUS      mandatory
DESCRIPTION "<Definition>Parameters for specific temperature sensor as
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>TemperatureSensor
<Data Concept Type>Class"
INDEX { essTemperatureSensorIndex }
::=   { essTemperatureSensorTable 1 }

EssTemperatureSensorEntry ::= SEQUENCE {
      essTemperatureSensorIndex                 INTEGER,
      essTemperatureSensorHeight                INTEGER,
      essAirTemperature                         INTEGER, }
      essWetbulbTemp                            INTEGER,
      essDewpointTemp                           INTEGER,
      essMaxTemp                                INTEGER,
      essMinTemp                                INTEGER,
      -- The below are new
      essTemperatureSensorLatitude              INTEGER,
      essTemperatureSensorLongitude             INTEGER,
      essTemperatureSensorLocation              INTEGER,
      essTemperatureSensorModelInformation      INTEGER}
```

~~5.8.3.1~~5.7.3.1 Temperature Sensor Index

```
essTemperatureSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
temperature sensor data.
<SetConstraint>index
<DescriptiveName>TemperatureSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.1"
::= { essTemperatureSensorEntry 1 }
```

~~5.8.3.2~~5.7.3.2 Temperature Sensor Height

```
essTemperatureSensorHeight OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The height of the temperature sensor as measured in
meters above essReferenceHeight.
<Informative>Changed to read-write from read-only in NTCIP 1204 v04.
<SetConstraint>read-only
<DescriptiveName>TemperatureSensor.height:quantity
<Valid Value Rule>
The value 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.2"
::= { essTemperatureSensorEntry 2 }
```

~~5.8.3.3~~5.7.3.3 Air Temperature

```
essAirTemperature OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The dry-bulb temperature in tenths of degrees
Celsius. The temperature is an instantaneous reading at the height specified
by essTemperatureSensorHeight.
<SetConstraint>read-only
<DescriptiveName>TemperatureSensor.airTemperature:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.3"
REFERENCE "Resolution is based on WMO Binary Code Form FM 94 BUFR Table B
item 0 12 001; temperature in Kelvin is determined by adding 273.15 to this
value."
::= { essTemperatureSensorEntry 3 }
```

5.7.3.4 Temperature Sensor Latitude

```
essTemperatureSensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS temperature
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>TemperatureSensor.latitude:quantity
<Valid Value Rule>
The essTemperatureSensorLatitude at the North Pole is 90,000,000. The
essTemperatureSensorLatitude ~~essLatitude~~ at the South Pole is -90,000,000.
The value 90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.4"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { essTemperatureSensorEntry 4 }
```

5.7.3.5 Temperature Sensor Longitude

```
essTemperatureSensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS temperature sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>TemperatureSensor.longitude:quantity
<Valid Value Rule>
The essTemperatureSensorLongitude of 180 degrees West shall be -180,000,000.
The essTemperatureSensorLongitude ~~essLongitude~~ of 180 degrees East shall be
180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
```

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```
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.5"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { essTemperatureSensorEntry 5 }
```

5.7.3.6 Temperature Sensor Location

```
essTemperatureSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
temperature ~~pressure~~ sensor.
~~<SetConstraint>always~~
<DescriptiveName>TemperatureSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.6"
::= { essTemperatureSensorEntry 6 }
```

5.7.3.7 Temperature Sensor Model Information

```
essTemperatureSensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Temperature Sensor Table.
<DescriptiveName>TemperatureSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.2.7"
::= { essTemperatureSensorEntry 7 }
```

~~5.8.4~~5.7.4 Wetbulb Temperature

```
essWetbulbTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The wet-bulb temperature in tenths of degrees
Celsius. The temperature is an instantaneous reading at the height specified
by the essTemperatureSensorHeight as specified in the first row of the
essTemperatureTable.
~~<SetConstraint>read-only~~
<DescriptiveName>TemperatureSensorTable.wetBulbTemp:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.3"
REFERENCE   "is based on WMO Binary Code Form FM 94 BUFR Table B item 0 12
002; temperature in Kelvin is determined by adding 273.15 to this value."
```

```
::=   { essNtcipTemperature 3 }
```

~~5.8.5~~5.7.5 Dewpoint Temperature

```
essDewpointTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The dewpoint temperature in tenths of degrees
Celsius. The temperature is an instantaneous reading at the height specified
by the essTemperatureSensorHeight for this temperature sensor~~as specified in
the first row of the essTemperatureTable~~.
~~<SetConstraint>read-only~~
<DescriptiveName>TemperatureSensorTable.dewpoint:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.4"
REFERENCE   "Resolution is based on WMO Binary Code Form FM 94 BUFR Table B
item 0 12 003; temperature in Kelvin is determined by adding 273.15 to this
value."
::=   { essNtcipTemperature 4 }
```

~~5.8.6~~5.7.6 Maximum Temperature

```
essMaxTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The maximum temperature in tenths of degrees Celsius
recorded during the 24 hours preceding the observation at the height
specified by the essTemperatureSensorHeight as specified in the first row of
the essTemperatureTable.
~~<SetConstraint>read-only~~
<DescriptiveName>TemperatureSensorTable.maxTemp:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.5"
REFERENCE   "Resolution is based on WMO Binary Code Form FM 94 BUFR Table B
item 0 12 011; temperature in Kelvin is determined by adding 273.15 to this
value."
::=   { essNtcipTemperature 5 }
```

~~5.8.7~~5.7.7 Minimum Temperature

```
essMinTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The minimum temperature in tenths of degrees Celsius
recorded during the 24 hours preceding the observation at the height
specified by the essTemperatureSensorHeight as specified in the first row of
the essTemperatureTable.
```

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```
<SetConstraint>read-only
<DescriptiveName>TemperatureSensorTable.minTemp:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.5.6"
REFERENCE   "Resolution is based on WMO Binary Code Form FM 94 BUFR Table B
item 0 12 012; temperature inKelvin is determined by adding 273.15 to this
value."
::=   { essNtcipTemperature 6 }
```

5.95.8 Humidity and Precipitation Data Objects

```
-- Contains objects used to describe the humidity and precipitation
-- data that is collected by the ess.
essBufrPrecip OBJECT IDENTIFIER ::= {essBufr 13 }
essNtcipPrecip OBJECT IDENTIFIER ::= {essNtcip 6 }
```

5.9.15.8.1 Relative Humidity

```
-- This object has been deprecated. See Annex D.3.3.2 for more information.
essRelativeHumidity OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-only
STATUS      deprecatedmandatory
DESCRIPTION "<Definition>The relative humidity in percent.
<SetConstraint>read-only
<DescriptiveName>TemperatureSensorTable.relativeHumidity:quantity
<Valid Value Rule>
The value of 101 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>percent humidity
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.3"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 003."
::=   { essBufrPrecip 3 }
```

5.9.25.8.2 Water Depth

```
-- This object has been deprecated. See Annex D.1.4 for more information.
essWaterDepth OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>Indicates the depth of the water from a user defined
point in centimeters. The value of 65535 shall indicate an error condition or
missing value. This may be used for stream depth, depth of water over a
roadway, reservoir depth, or other such uses.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.waterDepth:quantity
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.1"
::=   { essNtcipPrecip 1 }
```

~~5.9.3~~5.8.3 Adjacent Snow Depth

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essAdjacentSnowDepth OBJECT-TYPE
SYNTAX      INTEGER (0..3001)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The depth of snow in centimeters on representative
areas other than the highway pavement, avoiding drifts and plowed areas.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.adjacentSnowDepth:quantity
<Valid Value Rule>
The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.2"
::=   { essNtcipPrecip 2 }
```

~~5.9.4~~5.8.4 Roadway Snow Depth

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essRoadwaySnowDepth OBJECT-TYPE
SYNTAX      INTEGER (0..3001)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The current depth of unpacked snow in centimeters on
the driving surface.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.roadwaySnowDepth:quantity
<Valid Value Rule>

The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.3"
::=   { essNtcipPrecip 3 }
```

~~5.9.5~~5.8.5 Roadway Snow Pack Depth

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essRoadwaySnowPackDepth OBJECT-TYPE
SYNTAX      INTEGER (0..3001)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The current depth of packed snow in centimeters on
the roadway surface.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.roadwaySnowPackDepth:quantity
<Valid Value Rule>
The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.4"
::=   { essNtcipPrecip 4 }
```

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~~5.9.6~~5.8.6 Precipitation Indicator

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipYesNo OBJECT-TYPE
SYNTAX      INTEGER {   precip (1),
                        noPrecip (2),
                        error (3)}
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>Indicates whether or not moisture is detected by the
sensor.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationIndicator:code
<Valid Value Rule>
precip - Moisture is currently being detected by the precipitation sensor
noPrecip - Moisture is not currently being detected by the precipitation
sensor
error - The sensor is either not connected, not reporting, or is indicating
an error
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.5"
::=   { essNtcipPrecip 5 }
```

~~5.9.7~~5.8.7 Rainfall or Water Equivalent of Snow

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipRate OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The rainfall, or water equivalent of snow, rate in
tenths of grams per square meter per second (for rain, this is approximately
to 0.36 mm/hr).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationRate:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of grams per square meter per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.14"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 014."
::=   { essBufrPrecip 14 }
```

~~5.9.8~~5.8.8 Snowfall Accumulation Rate

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essSnowfallAccumRate OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The snowfall accumulation rate in 10^-7 meters per
second (this is equivalent to 0.36 mm/hr).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.snowfallAccumulationRate:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
```

```
<Unit>10^-7 meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.15"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 015."
::=   { essBufrPrecip 15 }
```

~~5.9.9~~5.8.9 Precipitation Situation

```
essPrecipSituation OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        noPrecipitation (3),
                        unidentifiedSlight (4),
                        unidentifiedModerate (5),
                        unidentifiedHeavy (6),
                        snowSlight (7),
                        snowModerate (8),
                        snowHeavy (9),
                        rainSlight (10),
                        rainModerate (11),
                        rainHeavy (12),
                        frozenPrecipitationSlight (13),
                        frozenPrecipitationModerate (14),
                        frozenPrecipitationHeavy (15)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Describes the weather situation in terms of
precipitation.  For automated stations, describes the intensity and
precipitation type as specified in the first row of the
precipitationSensorTable.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationSituation:code
<Valid Value Rule>
Intensity     Meaning
slight      < 2mm/h water equivalent
moderate    >= 2 and < 8 mm/h water equivalent
heavy       >= 8 mm/h water equivalent If one exists, the corresponding BUFR
value is indicated for staffed (BUFRs) and automated (BUFRa) stations. The
indicated value can be found in the BUFR Table referenced below. Defined
values are:
Range   BUFRa   BUFRs  Meaning
1                      other
2                      unknown
3                      no precipitation
4                      unidentified slight
5                      unidentified moderate
6                      unidentified heavy
7       171      85    snow slight
8       172      86    snow moderate
9       173      86    snow heavy
10               61    rain slight
11      165      63    rain moderate
12      163      65    rain heavy
13                     frozen precipitation slight
14                     frozen precipitation moderate
15                     frozen precipitation heavy
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.6"
```

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```
REFERENCE   "The values identified in the above table for BUFRa and BUFRs can
be found in WMO Binary Code Form FM 94 BUFR Table B item 0 20 003."
::=   { essNtcipPrecip 6 }
```

~~5.9.10~~5.8.10 Ice Deposit (Thickness)

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essIceThickness OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>Indicates the thickness of the ice in millimeters.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.iceDeposit:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>millimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.7"
::=   { essNtcipPrecip 7 }
```

~~5.9.11~~5.8.11 Precipitation Start Time

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationStartTime OBJECT-TYPE
SYNTAX      INTEGER (0..4294967295)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The time at which the most recent precipitation
event began, measured in seconds since 00:00:00 January 1, 1970 UTC.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationStartTime:quantity
<Valid Value Rule>
As this standard has been developed long after 1970, a value of~~a~~ 0 for time
should indicate to the management station that the data received is suspect.
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.8"
::=   { essNtcipPrecip 8 }
```

~~5.9.12~~5.8.12 Precipitation End Time

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationEndTime OBJECT-TYPE
SYNTAX      INTEGER (0..4294967295)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The time at which the most recently completed
precipitation event ended, measured in seconds since 00:00:00 January 1, 1970
UTC.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationEndTime:quantity
<Valid Value Rule>
As this standard has been developed long after 1970, a value of 0 for the
time should indicate to the management station that the data received is
suspect.
```

```
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.9"
::=   { essNtcipPrecip 9 }
```

~~5.9.13~~5.8.13 Total Precipitation Past One Hour

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationOneHour OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The total water equivalent precipitation over the
hour preceding the observation in tenths of kilograms per square meter (for
rain, this is approximately tenths of millimeters).
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.oneHour:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.19"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 019."
::=   { essBufrPrecip 19 }
```

~~5.9.14~~5.8.14 Total Precipitation Past Three Hours

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationThreeHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The total water equivalent precipitation over the
three hours preceding the observation in tenths of kilograms per square meter
(for rain, this is approximately tenths of millimeters).
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.threeHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.20"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 020."
::=   { essBufrPrecip 20 }
```

~~5.9.15~~5.8.15 Total Precipitation Past Six Hours

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationSixHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecatedmandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
six hours preceding the observation in tenths of kilograms per square meter
(for rain, this is approximately tenths of millimeters).
<SetConstraint>read-only
```

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```
<DescriptiveName>PrecipitationSensor.sixHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.21"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 021."
::=   { essBufrPrecip 21 }
```

~~5.9.16~~5.8.16 Total Precipitation Past Twelve Hours

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitationTwelveHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated ~~mandatory~~
DESCRIPTION "<Definition>The total water equivalent precipitation over the
twelve hours preceding the observation in tenths of kilograms per square
meter (for rain, this is approximately to tenths of millimeters).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.twelveHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.22"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 022."
::=   { essBufrPrecip 22 }
```

~~5.9.17~~5.8.17 Total Precipitation Past Twenty-Four Hours

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
essPrecipitation24Hours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated ~~mandatory~~
DESCRIPTION "<Definition>The total water equivalent precipitation over the
twenty-four hours preceding the observation in tenths of kilograms per square
meter (for rain, this is equivalent to tenths of millimeters).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.24Hours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.13.23"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 023."
::=   { essBufrPrecip 23 }
```

~~5.9.18~~5.8.18 Precipitation Sensor Model Information

```
-- This object has been deprecated. See Annex D.3.3.3 for more information.
precipitationSensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      ~~mandatory~~ deprecated
```

```
DESCRIPTION "<Definition>A reference to the row in the Module Table (See
NTCIP 1201) that indicates the manufacturer, model, and version number of the
precipitation sensor.
<DescriptiveName>PrecipitationSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.10"
::=   { essNtcipPrecip 10 }
```

~~5.9.19~~5.8.19 Number of Water Level Sensors

```
waterLevelSensorTableNumSensors OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the water level
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<DescriptiveName>WaterLevelSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.11"
::=   { essNtcipPrecip 11 }
```

~~5.9.20~~5.8.20 Water Level Sensor Table

```
waterLevelSensorTable OBJECT-TYPE
SYNTAX      SEQUENCE OF WaterLevelSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Table containing the water level sensor data fields.
<DescriptiveName>WaterLevelSensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12"
::=   { essNtcipPrecip 12 }
```

~~5.9.21~~5.8.21 Water Level Sensor

```
waterLevelSensorEntry OBJECT-TYPE
SYNTAX      WaterLevelSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Parameters for a specific water level sensor as
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>WaterLevelSensor
<Data Concept Type>Class"
INDEX { waterLevelSensorIndex }
::=   { waterLevelSensorTable 1 }
```

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```
WaterLevelSensorEntry ::= SEQUENCE {
waterLevelSensorIndex          INTEGER,
waterLevelSensorReading        INTEGER,
waterLevelSensorWarningLevel   INTEGER,
waterLevelSensorHeight         INTEGER,
waterLevelSensorLatitude       INTEGER,
waterLevelSensorLongitude      INTEGER,
waterLevelSensorLocation       DisplayString,
waterLevelSensorModelInformation  INTEGER }
```

~~5.9.21.1~~5.8.21.1 Water Level Sensor Index

```
waterLevelSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
water level sensor data.
<DescriptiveName>WaterLevelSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.1"
::= { waterLevelSensorEntry 1 }
```

~~5.9.21.2~~5.8.21.2 Water Level Sensor Reading

```
waterLevelSensorReading OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the depth of the water from a user defined
point in centimeters. This may be used for stream depth, depth of water over
a roadway for flooding, reservoir depth, or other such uses.
<DescriptiveName>WaterLevelSensor.reading:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.2"
::= { waterLevelSensorEntry 2 }
```

5.8.21.3 Water Level Sensor Warning Level

```
waterLevelSensorWarningLevel OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the depth of the water from a user defined
point in centimeters, that the water level is of concern.
<DescriptiveName>WaterLevelSensor.warningLevel:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.3"
::= { waterLevelSensorEntry 3 }
```

5.8.21.4 Water Level Sensor Height

```
waterLevelSensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition> The height of the water level sensor with respect
to the essReferenceHeight in meters.
<DescriptiveName>WaterLevelSensor.height:quantity
<Valid Value Rule>The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.4"
::= { waterLevelSensorEntry 4 }
```

5.8.21.5 Water Level Sensor Latitude

```
waterLevelSensorLatitude OBJECT-TYPE
SYNTAX       INTEGER (-90000000..90000001)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS water level
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>WaterLevelSensor.latitude:quantity
<Valid Value Rule>
The ~~ess~~waterLevelSensorLatitude at the North Pole is 90,000,000. The
waterLevelSensorLatitude~~essLatitude~~ at the South Pole is -90,000,000. The
value 90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.5"
REFERENCE    "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=    { waterLevelSensorEntry 5 }
```

5.8.21.6 Water Level Sensor Longitude

```
waterLevelSensorLongitude OBJECT-TYPE
SYNTAX       INTEGER (-180000000..180000001)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS water level sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>WaterLevelSensor.longitude:quantity
<Valid Value Rule>
The ~~ess~~waterLevelSensorLongitude of 180 degrees West shall be -180,000,000.
The waterLevelSensorLongitude~~essLongitude~~ of 180 degrees East shall be
180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.6"
REFERENCE    "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
```

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```
::=    { waterLevelSensorEntry 6 }
```

5.8.21.7 Water Level Sensor Location

```
waterLevelSensorLocation OBJECT-TYPE
SYNTAX       DisplayString (SIZE (0..255))
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
water level sensor., including a description of the reference point that the
water depth is measured against.
<SetConstraint>always
<DescriptiveName>WaterLevelSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.7"
::= { waterLevelSensorEntry 7 }
```

5.8.21.8 Water Level Sensor Model Information

```
waterLevelSensorModelInformation OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Water Level Sensor Table.
<DescriptiveName>WaterLevelSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.8"
::= { waterLevelSensorEntry 8 }
```

5.8.21.9 Water Level Sensor Reference Point

```
waterLevelSensorReferencePoint OBJECT-TYPE
SYNTAX       DisplayString (SIZE (0..255))
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>A textual string describing the location of the
reference point that the water depth is measured against.
<DescriptiveName>WaterLevelSensor.reference:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.12.9"
::= { waterLevelSensorEntry 9 }
```

5.8.22 Number of Precipitation Sensors

```
precipitationSensorTableNumSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the precipitation
sensor table.
```

```
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<DescriptiveName>PrecipitationSensorTableprecipSensorTable.numSensors:quantit
y
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.13"
::=   { essNtcipPrecip 143 }
```

5.8.23 Precipitation Sensor Table

```
precipitationSensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF PrecipitationSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the precipitation sensor data
fields.
<DescriptiveName>PrecipitationSensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14"
::=   { essNtcipPrecip 145 }
```

5.8.24 Precipitation Sensor

```
precipitationSensorEntry OBJECT-TYPE
SYNTAX       PrecipitationSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Parameters for a specific precipitation sensor as
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>PrecipitationSensor
<Data Concept Type>Class"
INDEX { precipitationSensorIndex }
::=   { precipitationSensorTable 1 }

PrecipitationSensorEntry ::= SEQUENCE {
precipitationSensorIndex                    INTEGER,
precipitationSensorHeight                   INTEGER,
precipitationSensorLatitude                 INTEGER,
precipitationSensorLongitude                INTEGER,
precipitationSensorLocation          DisplayString,
precipitationSensorModelInformationV4       INTEGER,
precipitationSensorPeriod                   INTEGER,
-- SENSOR READINGS
```

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```
precipitationSensorAdjacentSnowDepth       INTEGER,
precipitationSensorRoadwaySnowDepth        INTEGER,
precipitationSensorRoadwaySnowPackDepth    INTEGER,
precipitationSensorPrecipYesNo             INTEGER,
precipitationSensorPrecipRate              INTEGER,
precipitationSensorSnowfallAccumRate       INTEGER,
precipitationSensorPrecipSituation         INTEGER,
precipitationSensorIceThickness            INTEGER,
precipitationSensorPrecipitationStartTime INTEGER,
precipitationSensorPrecipitationEndTime    INTEGER,
precipitationSensorPrecipitationOneHour    INTEGER,
precipitationSensorPrecipitationThreeHours      INTEGER,
precipitationSensorPrecipitationSixHours   INTEGER,
precipitationSensorPrecipitationTwelveHours     INTEGER,
precipitationSensorPrecipitation24Hours    INTEGER,
precipitationSensorPrecipitationUserDefined     INTEGER
}
```

5.8.24.1 Precipitation Sensor Index

```
precipitationSensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
precipitation sensor data.
<DescriptiveName>PrecipitationSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.1"
::= { precipitationSensorEntry 1 }
```

5.8.24.2 Precipitation Sensor Height

```
precipitationSensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The height of the precipitation sensor with respect
to the essReferenceHeight in meters.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.2"
REFERENCE    "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=    { precipitationSensorEntry 2 }
```

5.8.24.3 Precipitation Sensor Latitude

```
precipitationSensorLatitude OBJECT-TYPE
SYNTAX       INTEGER (-90000000..90000001)
ACCESS       read-write~~only~~
STATUS       mandatory
```

```
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS
precipitation sensor, per WGS-84 datum.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.latitude:quantity
<Valid Value Rule>
The essprecipitationSensorLatitude at the North Pole is 90,000,000. The
essprecipitationSensorLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.3"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { precipitationSensorEntry 3 }
```

5.8.24.4 Precipitation Sensor Longitude

```
precipitationSensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS precipitation sensor location.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.longitude:quantity
<Valid Value Rule>
The essprecipitationSensorLongitude of 180 degrees West shall be -
180,000,000. The precipitationSensoressLongitude of 180 degrees East shall be
180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.4"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { precipitationSensorEntry 4 }
```

5.8.24.5 Precipitation Sensor Location

```
precipitationSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
precipitation sensor.
<SetConstraint>always
<DescriptiveName>PrecipitationSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.5"
::= { precipitationSensorEntry 5 }
```

5.8.24.6 Precipitation Sensor Model Information Version 4

```
precipitationSensorModelInformationV4 OBJECT-TYPE
SYNTAX      INTEGER (0..255)
```

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```
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>A reference to the row in the Module Table (See
NTCIP 1201) that indicates the manufacturer, model, and version number of the
precipitation sensor.
<DescriptiveName>PrecipitationSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.6"
::=    { precipitationSensorEntry 6 }
```

5.8.24.7 Total Precipitation Period

```
precipitationSensorPeriod OBJECT-TYPE
SYNTAX       INTEGER (0..86400)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The period, in seconds, that corresponds to the
length of time ~~the essTotalPrecipitation is averaged~~that the total water
equivalent is measured in precipitationSensorPrecipitationUserDefined.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.totalPrecipitationPeriod:quantity
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.7"
::=    { precipitationSensorEntry 7 }
```

5.8.24.8 Adjacent Snow Depth

```
precipitationSensorAdjacentSnowDepth OBJECT-TYPE
SYNTAX       INTEGER (0..3001)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The depth of snow in centimeters on representative
areas other than the highway pavement, avoiding drifts and plowed areas.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.adjacentSnowDepth:quantity
<Valid Value Rule>
The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.8"
::=    { precipitationSensorEntry 8 }
```

5.8.24.9 Roadway Snow Depth

```
precipitationSensorRoadwaySnowDepth OBJECT-TYPE
SYNTAX       INTEGER (0..3001)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The current depth of unpacked snow in centimeters on
the driving surface.
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.roadwaySnowDepth:quantity
<Valid Value Rule>
```

```
The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.9"
::=   { precipitationSensorEntry 9 }
```

5.8.24.10 Roadway Snow Pack Depth

```
precipitationSensorRoadwaySnowPackDepth OBJECT-TYPE
SYNTAX       INTEGER (0..3001)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The current depth of packed snow in centimeters on
the roadway surface.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.roadwaySnowPackDepth:quantity
<Valid Value Rule>
The value 3001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.10"
::=   { precipitationSensorEntry 10 }
```

5.8.24.11 Precipitation Indicator

```
precipitationSensorPrecipYesNo OBJECT-TYPE
SYNTAX       INTEGER {   precip (1),
                         noPrecip (2),
                         error (3)}
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates whether or not moisture is detected by the
sensor.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.precipitationIndicator:code
<Valid Value Rule>
precip - Moisture is currently being detected by the precipitation sensor.
0.01 inches of liquid water equivalent must be detected.
noPrecip - Moisture is not currently being detected by the precipitation
sensor
error - The sensor is either not connected, not reporting, or is indicating
an error
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.11"
::=   { precipitationSensorEntry 11 }
```

5.8.24.12 Rainfall or Water Equivalent of Snow

```
precipitationSensorPrecipRate OBJECT-TYPE
SYNTAX       INTEGER (0..65535)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The rainfall, or water equivalent of snow, rate in
tenths of grams per square meter per second (for rain, this is approximately
to 0.36 mm/hr).
```

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~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.precipitationRate:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of grams per square meter per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.12"
REFERENCE "WMO Binary Code Form FM 94 BUFR Table B item 0 13 014."
::= { precipitationSensorEntry 12 }

5.8.24.13 Snowfall Accumulation Rate

```
precipitationSensorSnowfallAccumRate OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The snowfall accumulation rate in 10^-7 meters per
second (this is equivalent to 0.36 mm/hr).
```

~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.snowfallAccumulationRate:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>10^-7 meters per second
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.13"
REFERENCE "WMO Binary Code Form FM 94 BUFR Table B item 0 13 015."
::= { precipitationSensorEntry 13 }

~~Precipitation Situation~~

```
precipitationSensorPrecipSituation OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        noPrecipitation (3),
                        unidentifiedSlight (4),
                        unidentifiedModerate (5),
                        unidentifiedHeavy (6),
                        snowSlight (7),
                        snowModerate (8),
                        snowHeavy (9),
                        rainSlight (10),
                        rainModerate (11),
                        rainHeavy (12),
                        frozenPrecipitationSlight (13),
                        frozenPrecipitationModerate (14),
                        frozenPrecipitationHeavy (15)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Describes the weather situation in terms of
precipitation.
```

~~<SetConstraint>read-only~~
~~<DescriptiveName>PrecipitationSensor.precipitationSituation:code~~
~~<Valid Value Rule>~~
~~Intensity Meaning~~
~~slight < 2mm/h water equivalent~~
~~moderate >= 2 and < 8 mm/h water equivalent~~

~~heavy >= 8 mm/h water equivalent If one exists, the corresponding BUFR value is indicated for staffed (BUFRs) and automated (BUFRa) stations. The indicated value can be found in the BUFR Table referenced below. Defined values are:~~

~~Range~~	~~BUFRa~~	~~BUFRs~~	~~Meaning~~
~~1~~			~~other~~
~~2~~			~~unknown~~
~~3~~			~~no precipitation~~
~~4~~			~~unidentified slight~~
~~5~~			~~unidentified moderate~~
~~6~~			~~unidentified heavy~~
~~7~~	~~171~~	~~85~~	~~snow slight~~
~~8~~	~~172~~	~~86~~	~~snow moderate~~
~~9~~	~~173~~	~~86~~	~~snow heavy~~
~~10~~		~~61~~	~~rain slight~~
~~11~~	~~165~~	~~63~~	~~rain moderate~~
~~12~~	~~163~~	~~65~~	~~rain heavy~~
~~13~~			~~frozen precipitation slight~~
~~14~~			~~frozen precipitation moderate~~
~~15~~			~~frozen precipitation heavy~~

~~<Data Concept Type>Data Element"~~
~~REFERENCE "The values identified in the above table for BUFRa and BUFRs can be found in WMO Binary Code Form FM 94 BUFR Table B item 0 20 003."~~
~~::= { precipitationSensorEntry 14 }~~

5.8.24.14 Ice Deposit (Thickness)

```
precipitationSensorIceThickness OBJECT-TYPE
SYNTAX       INTEGER (0..65535)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the thickness of the ice in millimeters.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.iceDeposit:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>millimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.15"
::=    { precipitationSensorEntry 15 4 }
```

5.8.24.15 Precipitation Start Time

```
precipitationSensorPrecipitationStartTime OBJECT-TYPE
SYNTAX       INTEGER (0..4294967295)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The time at which the most recent precipitation
event began, measured in seconds since 00:00:00 January 1, 1970 UTC. The
precipitation event begins when 0.01 inches of liquid water equivalent is
detected.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.precipitationStartTime:quantity
<Valid Value Rule>
As this standard has been developed long after 1970, a value of a 0 for time
should indicate to the management station that the data received is suspect.
<Data Concept Type>Data Element
```

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```
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.16"
::=   { precipitationSensorEntry 156 }
```

5.8.24.16 Precipitation End Time

```
precipitationSensorPrecipitationEndTime OBJECT-TYPE
SYNTAX      INTEGER (0..4294967295)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The time at which the most recently completed
precipitation event ended, measured in seconds since 00:00:00 January 1, 1970
UTC.
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.precipitationEndTime:quantity
<Valid Value Rule>
As this standard has been developed long after 1970, a value of 0 for the
time should indicate to the management station that the data received is
suspect.
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.17"
::=   { precipitationSensorEntry 167 }
```

5.8.24.17 Total Precipitation Past One Hour

```
precipitationSensorPrecipitationOneHour OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
hour preceding the observation in tenths of kilograms per square meter (for
rain, this is approximately tenths of millimeters).
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.oneHour:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.18"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 019."
::=   { precipitationSensorEntry 178 }
```

5.8.24.18 Total Precipitation Past Three Hours

```
precipitationSensorPrecipitationThreeHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
three hours preceding the observation in tenths of kilograms per square meter
(for rain, this is approximately tenths of millimeters).
<SetConstraint>read-only
<DescriptiveName>PrecipitationSensor.threeHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
```

```
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.19"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 020."
::=   { precipitationSensorEntry 18~~9~~ }
```

5.8.24.19 Total Precipitation Past Six Hours

```
precipitationSensorPrecipitationSixHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
six hours preceding the observation in tenths of kilograms per square meter
(for rain, this is approximately tenths of millimeters).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.sixHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.20"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 021."
::=   { precipitationSensorEntry 19~~20~~ }
```

5.8.24.20 Total Precipitation Past Twelve Hours

```
precipitationSensorPrecipitationTwelveHours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
twelve hours preceding the observation in tenths of kilograms per square
meter (for rain, this is approximately to tenths of millimeters).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.twelveHours:quantity
<Valid Value Rule>
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.21"
REFERENCE   "WMO Binary Code Form FM 94 BUFR Table B item 0 13 022."
::=   { precipitationSensorEntry 2~~1~~0 }
```

5.8.24.21 Total Precipitation Past Twenty-Four Hours

```
precipitationSensorPrecipitation24Hours OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
twenty-four hours preceding the observation in tenths of kilograms per square
meter (for rain, this is equivalent to tenths of millimeters).
~~<SetConstraint>read-only~~
<DescriptiveName>PrecipitationSensor.24Hours:quantity
<Valid Value Rule>
```

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```
The value of 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.22"
REFERENCE    "WMO Binary Code Form FM 94 BUFR Table B item 0 13 023."
::=    { precipitationSensorEntry 21~~2~~ }
```

5.8.24.22 Total Precipitation User Defined Period

```
precipitationSensorPrecipitationUserDefined OBJECT-TYPE
SYNTAX       INTEGER (0..65535)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The total water equivalent precipitation over the
precipitationSensorPeriod, in seconds, preceding the observation in tenths of
kilograms per square meter (for rain, this is equivalent to tenths of
millimeters).
<DescriptiveName>PrecipitationSensor.UserDefined:quantity
<Valid Value Rule>The value of 65535 shall indicate an error condition or
missing value.
<Data Concept Type>Data Element
<Unit>tenths of kilograms per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.14.23"
::=    { precipitationSensorEntry 22 }
```

5.8.25 Number of Humidity Sensors

```
humiditySensorTableNumSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the humidity
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
~~<SetConstraint>read-only~~
<DescriptiveName>HumiditySensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.15"
::=    { essNtcipPrecip 15~~7~~ }
```

5.8.26 Humidity Sensor Table

```
humiditySensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF HumiditySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the humidity sensor data.
<DescriptiveName>HumiditySensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16"
::=    { essNtcipPrecip 16~~8~~ }
```

5.8.27 Humidity Sensor

```
humiditySensorEntry OBJECT-TYPE
SYNTAX       HumiditySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>A humidity sensor is a sensor that reports the
relative humidity. It can be described through a number of attributes as
indicated by the following subclauses.
<DescriptiveName>HumiditySensor
<Data Concept Type>Class"
INDEX { humiditySensorIndex }
::=    { humiditySensorTable 1 }

-- ARE THERE DIFFERENT TYPES OF HUMIDITY SENSORS ???

HumiditySensorEntry ::= SEQUENCE {
      humiditySensorIndex                  INTEGER,
      humiditySensorHeight                 INTEGER,
      humiditySensorLatitude               INTEGER,
      humiditySensorLongitude              INTEGER,
      humiditySensorLocation         DisplayString,
      humiditySensorModelInformation       INTEGER,
      -- SENSOR READINGS
      humiditySensoressRelativeHumidity    ------------INTEGER,
      humiditySensorTemperatureInformation       INTEGER,
      humiditySensorWetbulbTemp            INTEGER,
      humiditySensorDewpointTemp           INTEGER}
```

5.8.27.1 Humidity Sensor Index

```
humiditySensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
humidity sensor data.
<SetConstraint>index
<DescriptiveName>HumiditySensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.1"
::= { humiditySensorEntry 1 }
```

5.8.27.2 Humidity Sensor Height

```
humiditySensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>The height of the humidity sensor with respect to
the essReferenceHeight in meters.
<SetConstraint>read-only
<DescriptiveName>HumiditySensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
```

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```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.2"
REFERENCE   "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=   { humiditySensorEntry 2 }
```

5.8.27.3 Humidity Sensor Latitude

```
humiditySensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS humidity
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>HumiditySensor.latitude:quantity
<Valid Value Rule>
The humiditySensor~~ess~~Latitude at the North Pole is 90,000,000. The
humiditySensor~~ess~~Latitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.3"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { humiditySensorEntry 3 }
```

5.8.27.4 Humidity Sensor Longitude

```
humiditySensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS humidity sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>HumiditySensor.longitude:quantity
<Valid Value Rule>
The ~~ess~~humiditySensorLongitude of 180 degrees West shall be -180,000,000. The
humiditySensor~~ess~~Longitude of 180 degrees East shall be 180,000,000. The
value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.4"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { humiditySensorEntry 4 }
```

5.8.27.5 Humidity Sensor Location

```
humiditySensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
```

```
DESCRIPTION "<Definition>A textual string indicating the location of the
humidity sensor.
<SetConstraint>always
<DescriptiveName>HumiditySensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.5"
::= { humiditySensorEntry 5 }
```

5.8.27.6 Humidity Sensor Model Information

```
humiditySensorModelInformation OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Humidity Sensor Table.
<DescriptiveName>HumiditySensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.6"
::= { humiditySensorEntry 6 }
```

5.8.27.7 Relative Humidity

```
humiditySensorRelativeHumidity OBJECT-TYPE
SYNTAX       INTEGER (0..101)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The relative humidity in percent.
<SetConstraint>read-only
<DescriptiveName>HumiditySensorTemperatureSensorTable.relativeHumidity:quanti
ty
<Valid Value Rule>
The value of 101 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>percent humidity
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.7"
REFERENCE    "WMO Binary Code Form FM 94 BUFR Table B item 0 13 003."
::=    { humiditySensorEntry 7 }
```

5.8.27.8 Humidity Sensor Temperature Information

```
humiditySensorTemperatureInformation OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the row in the essTemperatureSensorTable
that contains the temperature associated with this row of the Humidity Sensor
Table.
<DescriptiveName>HumiditySensor.TemperatureInformation:identifier
<Valid Value Rule>The value of zero indicates that this information is not
available.
<Data Concept Type>Data Element
```

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```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.8"
DEFVAL {1}
::= { humiditySensorEntry 8 }
```

5.8.27.9 Wetbulb Temperature

```
humiditySensorWetbulbTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The wet-bulb temperature in tenths of degrees
Celsius for the row of the essTemperatureSensorTable as specified by
humiditySensorTemperatureInformation for this humidity sensor. The
temperature is an instantaneous reading.
<DescriptiveName>HumiditySensor.wetBulbTemp:quantity
<Valid Value Rule>The value 1001 shall indicate an error condition or missing
value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.9"
REFERENCE   "is based on WMO Binary Code Form FM 94 BUFR Table B item 0 12
002; temperature in Kelvin is determined by adding 273.15 to this value."
::=   { humiditySensorEntry 9 }
```

5.8.27.10 Dewpoint Temperature

```
humiditySensorDewpointTemp OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The dewpoint temperature in tenths of degrees
Celsius for the row of the essTemperatureSensorTable as specified by
humiditySensorTemperatureInformation. The temperature is an instantaneous
reading.
<DescriptiveName>HumiditySensor.dewpoint:quantity
<Valid Value Rule>The value 1001 shall indicate an error condition or missing
value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.6.16.10"
REFERENCE   "Resolution is based on WMO Binary Code Form FM 94 BUFR Table B
item 0 12 003; temperature in Kelvin is determined by adding 273.15 to this
value."
::=   { humiditySensorEntry 10 }
```

~~5.10~~5.9 Radiation Objects

```
-- Contains objects used to describe the data that is collected by the
-- pavement surface sensor.
essBufrRadiation  OBJECT IDENTIFIER ::= {essBufr 14 }
essNtcipRadiation  OBJECT IDENTIFIER ::= {essNtcip 7}
```

~~5.10.1~~5.9.1 Solar Radiation

```
-- This object has been deprecated. See Annex D.1.5 for more information.
essSolarRadiation OBJECT-TYPE
```

```
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The direct solar radiation integrated over the 24
hours preceding the observation in Joules per square meter. The value of
65535 shall indicate a missing value.
<SetConstraint>read-only
<DescriptiveName>RadiationSensor.solarRadiation:quantity
<Data Concept Type>Data Element
<Unit>Joules per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.14.24"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 024."
::=   { essBufrRadiation 24 }
```

5.10.25.9.2 Total Sun

```
-- This object has been deprecated. See Annex D.3.3.4 for more information.
essTotalSun OBJECT-TYPE
SYNTAX      INTEGER (0..1441)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>The total amount of sunshine in minutes over the 24
hour period preceding the observation.
<SetConstraint>read-only
<DescriptiveName>RadiationSensor.totalSun:quantity
<Valid Value Rule>
The value of 1441 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>minutes
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.14.31"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 031."
::=   { essBufrRadiation 31 }
```

5.10.35.9.3 Cloud Cover Situation

```
-- This object has been deprecated. See Annex D.3.7 for more information.
essCloudSituation OBJECT-TYPE
SYNTAX      INTEGER {   overcast (1),
                        cloudy (2),
                        partlyCloudy (3),
                        mostlyClear (4),
                        clear (5)}
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>Describes the amount of cloud cover. The associated
percentages of cloud cover are indicated to identify the differences between
the defined values.
<SetConstraint>read-only
<DescriptiveName>RadiationSensor.cloudCoverSituation:code
<Valid Value Rule>
Defined values are:
Range  BUFRs  BUFRa   Meaning
1                   other visibility anomaly
2                   unknown
3      0     100    clear
4     44     130    Fog - not patchy
5     41     131    Patchy fog
```

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```
6     36     127    Blowing snow
7     04     104    Smoke
8     07     207    Sea Spray
9                   Vehicle Spray
10    31     127    Blowing dust or sand
11                  sun glare
12                  Swarms of insects
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.1"
::=   { essNtcipRadiation 1 }
```

~~5.10.4~~5.9.4 Terrestrial Radiation

```
-- This object has been deprecated. See Annex D.3.3.4 for more information.
essInstantaneousTerrestrialRadiation OBJECT-TYPE
SYNTAX      INTEGER (-2048..2049)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The instantaneous infrared (wavelength of 3.5 - 50
micrometers) radiation being emitted from the atmosphere in watts per square
meter.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensor.instantaneousTerrestrialRadiation:quantity
<Valid Value Rule>
The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>watts per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.14.17"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 017"
::=   { essBufrRadiation 17 }
```

~~5.10.5~~5.9.5 Solar Radiation—Version 2

```
-- This object has been deprecated. See Annex D.3.3.4 for more information.
essInstantaneousSolarRadiation OBJECT-TYPE
SYNTAX      INTEGER (-2048..2049)
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The instantaneous ultraviolet, visible, and near-
infrared (wavelength of less than 3.0 micrometers) radiation hitting the
earth's surface in watts per square meter.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensor.instantaneousSolarRadiation:quantity
<Valid Value Rule>
The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>watts per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.14.18"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 018"
::=   { essBufrRadiation 18 }
```

~~5.10.6~~5.9.6 Total Radiation

```
-- This object has been deprecated. See Annex D.3.3.4 for more information.
essTotalRadiation OBJECT-TYPE
SYNTAX      INTEGER (-2048..2049)
```

```
ACCESS       read-only
STATUS       ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The average total radiation hitting the earth's
surface in watts per square meter during the radiation period.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensor.totalRadiation:quantity
<Valid Value Rule>
The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>Joules per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.1.14.25"
REFERENCE    "WMO Code Form FM 94 BUFR Table B item 0 14 025"
::=    { essBufrRadiation 25 }
```

~~5.10.7~~5.9.7 Total Radiation Period

```
essTotalRadiationPeriod OBJECT-TYPE
SYNTAX       INTEGER (0..86400)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The rolling period, in seconds, that corresponds to
the length of time the essTotalRadiation is averaged.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensorTable.totalRadiationPeriod:quantity
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.2"
::=    { essNtcipRadiation 2 }
```

5.9.8 Number of Radiation Sensors

```
radiationSensorTableNumSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the radiation
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<DescriptiveName>RadiationSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.3"
::=    { essNtcipRadiation 3 }
```

5.9.9 Radiation Sensor Table

```
radiationSensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF RadiationSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the radiation sensor data.
<DescriptiveName>RadiationSensorTable
<Data Concept Type>Class
<TableType> static
```

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```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4"
::=    { essNtcipRadiation 4 }
```

5.9.10 Radiation Sensor

```
radiationSensorEntry OBJECT-TYPE
SYNTAX       RadiationSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>A radiation sensor is a sensor that reports the
amount of radiation detected. It can be described through a number of
attributes as indicated by the following subclauses.
<DescriptiveName>RadiationSensor
<Data Concept Type>Class"
INDEX { radiationSensorIndex }
::=    { radiationSensorTable 1 }

RadiationSensorEntry ::= SEQUENCE {
      radiationSensorIndex                INTEGER,
      radiationSensorHeight               INTEGER,
      radiationSensorLatitude             INTEGER,
      radiationSensorLongitude            INTEGER,
      radiationSensorLocation             DisplayString,
      radiationSensorModelInformation     INTEGER,
      -- SENSOR READINGS
      essTotalSunV4                       INTEGER,
      essInstantaneousTerrestrialRadiationV4    INTEGER,
      essInstantaneousSolarRadiationV4    INTEGER,
      essTotalRadiationV4                 INTEGER}
```

5.9.10.1 Radiation Sensor Index

```
radiationSensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
radiation sensor data.
<DescriptiveName>RadiationSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.1"
::= { radiationSensorEntry 1 }
```

5.9.10.2 Radiation Sensor Height

```
radiationSensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The height of the radiation sensor with respect to
the essReferenceHeight in meters.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
```

```
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.2"
REFERENCE   "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=   { radiationSensorEntry 2 essNtcipRadiation 3 }
```

5.9.10.3 Radiation Sensor Latitude

```
radiationSensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS radiation
sensor, per WGS-84 datum.
<SetConstraint>read-only
<DescriptiveName>RadiationSensor.latitude:quantity
<Valid Value Rule>
The essradiationSensorLatitude at the North Pole is 90,000,000. The
essradiationSensorLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.3"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { radiationSensorEntry 3 essNtcipRadiation 4 }
```

5.9.10.4 Radiation Sensor Longitude

```
radiationSensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS radiation sensor location.
<SetConstraint>read-only
<DescriptiveName>RadiationSensor.longitude:quantity
<Valid Value Rule>
The essradiationSensorLongitude of 180 degrees West shall be -180,000,000.
The essradiationSensorLongitude of 180 degrees East shall be 180,000,000. The
value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.4"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { radiationSensorEntry 4 essNtcipRadiation 5 }
```

5.9.10.5 Radiation Sensor Location

```
radiationSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
```

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```
DESCRIPTION "<Definition>A textual string indicating the location of the
radiation sensor.
<SetConstraint>always
<DescriptiveName>RadiationSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.5"
::= { radiationSensorEntry 5 essNtcipRadiation 6 }
```

5.9.10.6 Radiation Sensor Model Information

```
radiationSensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Radiation Sensor Table.
<DescriptiveName>RadiationSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.6"
::= { radiationSensorEntry 6 essNtcipRadiation 7 }
```

5.9.10.7 Total Sun V4

```
essTotalSunV4 OBJECT-TYPE
SYNTAX      INTEGER (0..1441)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The total amount of sunshine in minutes over the 24
hour period preceding the observation.
<DescriptiveName>RadiationSensor.totalSun:quantity
<Valid Value Rule>The value of 1441 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>minutes
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.7"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 031."
::=   { radiationSensorEntry 7 }
```

5.9.10.8 Terrestrial Radiation V4

```
essInstantaneousTerrestrialRadiationV4 OBJECT-TYPE
SYNTAX      INTEGER (-2048..2049)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The instantaneous infrared (wavelength of 3.5 - 50
micrometers) radiation being emitted from the atmosphere in watts per square
meter.
<DescriptiveName>RadiationSensor.instantaneousTerrestrialRadiation:quantity
<Valid Value Rule>The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>watts per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.8"
REFERENCE   "WMO Code Form FM 94 BUFR Table B item 0 14 017"
::=   { radiationSensorEntry 8 }
```

5.9.10.9 Solar Radiation Version 4

```
essInstantaneousSolarRadiationV4 OBJECT-TYPE
SYNTAX       INTEGER (-2048..2049)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The instantaneous ultraviolet, visible, and near-
infrared (wavelength of less than 3.0 micrometers) radiation hitting the
earth's surface in watts per square meter.
<DescriptiveName>RadiationSensor.instantaneousSolarRadiation:quantity
<Valid Value Rule>The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>watts per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.9"
REFERENCE    "WMO Code Form FM 94 BUFR Table B item 0 14 018"
::=    { radiationSensorEntry 9 }
```

5.9.10.10 Total Radiation V4

```
essTotalRadiationV4 OBJECT-TYPE
SYNTAX       INTEGER (-2048..2049)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The average total radiation hitting the earth's
surface in watts per square meter during the radiation period.
<DescriptiveName>RadiationSensor.totalRadiation:quantity
<Valid Value Rule>The value of 2049 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>Joules per square meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.4.10"
REFERENCE    "WMO Code Form FM 94 BUFR Table B item 0 14 025"
::=    { radiationSensorEntry 10 }
```

5.9.11 Cloud Cover Situation V4

essCloudSituationV4 OBJECT-TYPE
SYNTAX INTEGER (0-8)
ACCESS read-only
STATUS mandatory
DESCRIPTION "<Definition>Describes the amount of cloud cover in the sky, measured in oktas, as defined in WMO code table 2700.
~~<SetConstraint>read-only~~
<DescriptiveName>RadiationSensorTable.cloudCoverSituationV4:code
<Valid Value Rule>
Defined values are:

Oktas	Category	Definition
0	Fine	Sky clear
1	Fine	1/8 of sky covered or less, but not zero
2	Fine	2/8 of sky covered
3	Partly Cloudy	3/8 of sky covered
4	Partly Cloudy	4/8 of sky covered
5	Partly Cloudy	5/8 of sky covered
6	Cloudy	6/8 of sky covered
7	Cloudy	7/8 of sky covered or more, but not 8/8
8	Overcast	8/8 of sky completely covered, no breaks

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```
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.7.5"
::=   { essNtcipRadiation 58 }
```

5.115.10 Visibility Data Objects

```
-- Contains objects used to describe the visibility data that is
-- collected by the ess.
essNtcipVisibility  OBJECT IDENTIFIER ::= {essNtcip 8 }
```

5.11.15.10.1 Visibility

```
essVisibility OBJECT-TYPE
SYNTAX      INTEGER (0..1000001)
ACCESS      read-only
STATUS      mandatory deprecated
DESCRIPTION "<Definition>Surface visibility measured in one tenth of a meter.
<SetConstraint>read-only
<DescriptiveName>VisibilitySensor.visibility:quantity
<Valid Value Rule>
The value 1000001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>one tenth of a meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.1"
REFERENCE   "The value for WMO Code Form FM 94 BUFR Table B item 0 20 001 is
given by this value divided by 100."
::=   { essNtcipVisibility 1 }
```

5.11.25.10.2 Visibility Situation

```
essVisibilitySituation OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        clear (3),
                        fogNotPatchy (4),
                        patchyFog (5),
                        blowingSnow (6),
                        smoke (7),
                        seaSpray (8),
                        vehicleSpray (9),
                        blowingDustOrSand (10),
                        sunGlare (11),
                        swarmsOfInsects (12)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Describes the travel environment in terms of
visibility. If one exists, the corresponding BUFR value is indicated for
staffed (BUFRs) and automated (BUFRa) stations. The indicated value can be
found in the BUFR Table referenced below.
<SetConstraint>read-only
<DescriptiveName>VisibilitySensor.visibilitySituation:code
<Valid Value Rule>
Range       BUFRs       BUFRa       Meaning
      1                                   other visibility anomaly
      2                                   unknown
      3           0           100         clear
```

```
      4           44          130         Fog - not patchy
      5           41          131         Patchy fog
      6           36          127         Blowing snow
      7           04          104         Smoke
      8           07          207         Sea Spray
      9                                   Vehicle Spray
      10          31          127         Blowing dust or sand
      11                                  sun glare
      12                                  Swarms of insects
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.3"
REFERENCE   "The values identified in the above table for BUFRa and BUFRs can
be found in WMO Code Form FM 94 BUFR Table B item 0 20 003."
::=   { essNtcipVisibility 3 }
```

~~Number of Visibility Sensors~~

```
visibilitySensorTableNumSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the visibility
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>VisibilitySensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count"
::=   { essNtcipVisibility 3 }
```

~~Visibility Sensor Table~~

```
visibilitySensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF VisibilitySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the visibility sensor data.
<DescriptiveName>VisibilitySensorTable
<Data Concept Type>Class
<TableType> static"
::=   { essNtcipVisibility 4 }
```

~~Visibility Sensor~~

```
visibilitySensorEntry OBJECT-TYPE
SYNTAX       VisibilitySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>A visibility sensor is a sensor that reports degree
od visibility. It can be described through a number of attributes as
indicated by the following subclauses.
<DescriptiveName>VisibilitySensor
<Data Concept Type>Class"
```

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```
INDEX { visibilitySensorIndex }
::=    { visibilitySensorTable 1 }

-- ARE THERE DIFFERENT TYPES OF VISIBILITY SENSORS ???

VisibilitySensorEntry ::= SEQUENCE {
      visibilitySensorIndex                    INTEGER,
      visibilitySensorHeight                   INTEGER,
      visibilitySensorLatitude                 INTEGER,
      visibilitySensorLongitude                INTEGER,
      visibilitySensorLocation                 DisplayString,
      visibilitySensorModelInformation         INTEGER,
      -- SENSOR READINGS
      essVisiblity                             INTEGER}
```

Visibility Sensor Index

```
visibilitySensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
visibility sensor data.
<SetConstraint>index
<DescriptiveName>VisibilitySensor.index:identifier
<Data Concept Type>Data Element"
::= { visibilitySensorEntry 1 }
```

5.10.3 Visibility Sensor Height

```
visibilitySensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>The height of the visibility sensor with respect to
the essReferenceHeight in meters.
<SetConstraint>read-only
<DescriptiveName>VisibilitySensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.4"
REFERENCE    "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=    { essNtcipVisibility 4 visibilitySensorEntry 2 }
```

5.10.4 Visibility Sensor Latitude

```
visibilitySensorLatitude OBJECT-TYPE
SYNTAX       INTEGER (-90000000..90000001)
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS visibility
sensor, per WGS-84 datum.
<SetConstraint>read-only
```

```
<DescriptiveName>VisibilitySensor.latitude:quantity
<Valid Value Rule>
The essvisibilitySensorLatitude at the North Pole is 90,000,000. The
essvisibilitySensorLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.5"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { essNtcipVisibility 5 visibilitySensorEntry 3 }
```

5.10.5 Visibility Sensor Longitude

```
visibilitySensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS visibility sensor location.
<SetConstraint>read-only
<DescriptiveName>VisibilitySensor.longitude:quantity
<Valid Value Rule>
The essvisibilitySensorLongitude of 180 degrees West shall be -180,000,000.
The visibilitySensoressLongitude of 180 degrees East shall be 180,000,000.
The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.6"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { essNtcipVisibility 6 visibilitySensorEntry 4 }
```

5.10.6 Visibility Sensor Location

```
visibilitySensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
visibility sensor.
<SetConstraint>always
<DescriptiveName>VisibilitySensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.7"
::= { essNtcipVisibility 7 visibilitySensorEntry 5 }
```

5.10.7 Visibility Sensor Model Information

```
visibilitySensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
```

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```
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the visibility sensor associated with this row of the Visibility Sensor
Table.  If there is more than one visibility sensor, the row will indicate
the information for the primary visibility sensor.
<DescriptiveName>VisibilitySensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.8.8"
::= { essNtcipVisibility 8 visibilitySensorEntry 6 }
```

5.125.11 Pavement Sensor Objects

```
-- Contains objects used to describe the data that is collected by the
-- pavement surface sensor.
essNtcipPavement  OBJECT IDENTIFIER ::= {essNtcip 9}
```

5.12.15.11.1 Number of Pavement Sensors

```
numEssPavementSensors OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the pavement
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>PavementSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.1"
::=   { essNtcipPavement 1 }
```

5.12.25.11.2 Pavement Sensor Table

```
essPavementSensorTable OBJECT-TYPE
SYNTAX      SEQUENCE OF EssPavementSensorEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Table containing the pavement sensor data.
<DescriptiveName>PavementSensorTable
<Data Concept Type>Class
<TableType> static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2"
::=   { essNtcipPavement 2 }
```

5.12.35.11.3 Pavement Sensor

```
essPavementSensorEntry OBJECT-TYPE
SYNTAX      EssPavementSensorEntry
ACCESS      not-accessible
STATUS      mandatory
```

```
DESCRIPTION "<Definition>A pavement sensor is a sensor that reports the
temperature and moisture condition of the roadway pavement. It can be
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>PavementSensor
<Data Concept Type>Class"
INDEX { essPavementSensorIndex }
::=   { essPavementSensorTable 1 }

EssPavementSensorEntry ::= SEQUENCE {
      essPavementSensorIndex              INTEGER,
      essPavementSensorLocation           DisplayString,
      essPavementType                     INTEGER,
      essPavementElevation                INTEGER,
      essPavementExposure                 INTEGER,
      essPavementSensorType               INTEGER,
      essSurfaceStatus                    INTEGER,
      essSurfaceTemperature               INTEGER,
      essPavementTemperature              INTEGER,
      essSurfaceWaterDepth                INTEGER,
      essSurfaceSalinity                  INTEGER,
      essSurfaceConductivity              INTEGER,
      essSurfaceFreezePoint               INTEGER,
      essSurfaceBlackIceSignal            INTEGER,
      essPavementSensorError              INTEGER,
      essSurfaceIceOrWaterDepth           INTEGER,
      essSurfaceConductivityV2            INTEGER,
      pavementSensorModelInformation      INTEGER,
      pavementSensorTemperatureDepth      INTEGER,}
      pavementSensorLatitude              INTEGER,
      pavementSensorLongitude             INTEGER,
      pavementSensorSurfaceCondition      INTEGER,
      pavementSensorForecastCondition     INTEGER,
      pavementSensorFrictionCoefficient   INTEGER,
      pavementMonitorLatitude             INTEGER,
      pavementMonitorLongitude            INTEGER,
      pavementIcePercentage               INTEGER
      }
```

~~5.12.3.1~~5.11.3.1 Pavement Sensor Index

```
essPavementSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
surface sensor data.
<SetConstraint>index
<DescriptiveName>PavementSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.1"
::= { essPavementSensorEntry 1 }
```

~~5.12.3.2~~5.11.3.2 Pavement Sensor Location

```
essPavementSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
```

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```
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
pavement sensor and the location of the pavement being monitored.
<SetConstraint>always
<DescriptiveName>PavementSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.2"
::= { essPavementSensorEntry 2 }
```

5.12.3.35.11.3.3 Pavement Type

```
essPavementType OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        asphalt (3),
                        openGradedAsphalt (4),
                        concrete (5),
                        steelBridge (6),
                        concreteBridge (7),
                        asphaltOverlayBridge (8),
                        timberBridge (9)}
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the type of pavement on the roadway.
<SetConstraint>always
<DescriptiveName>PavementSensor.type:code
<Valid Value Rule>
other                 a different type of bridge deck
unknown               the data was never recorded in the system or is a
                       mobile sensor
asphalt               asphalt pavement on ground
concrete              concrete pavement on ground
steelBridgeconcrete   a concrete driving surface on a steel girder bridge
steelBridgeAsphalt    an asphalt driving surface on a steel girder bridge
steelBridge           a steel lattice driving surface on the bridge
concreteBridge        a concrete driving surface on a concrete bridge
concreteBridgeAsphalt an asphalt overlay driving surface on a concrete bridge
timberBridge          a wooden deck driving surface on the bridge
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.3"
::= { essPavementSensorEntry 3 }
```

5.12.3.45.11.3.4 Pavement Elevation

```
essPavementElevation OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>The elevation of the street surface in meters with
respect to the essReferenceHeight.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.elevation:quantity
<Valid Value Rule>
The value 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
```

```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.4"
::= { essPavementSensorEntry 4 }
```

~~5.12.3.5~~5.11.3.5 Pavement Exposure

```
essPavementExposure OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates a very rough percentage of the solar
energy which will directly hit the sensor.
<SetConstraint>always
<DescriptiveName>PavementSensor.exposure:quantity
<Valid Value Rule>
A value of 100 indicates a fully visible sky. A value of 101 shall indicate a
missing value.
<Data Concept Type>Data Element
<Unit>percent exposure
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.5"
::= { essPavementSensorEntry 5 }
```

~~5.12.3.6~~5.11.3.6 Pavement Sensor Type

```
essPavementSensorType OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        contactPassive (2),
                        contactActive (3),
                        infrared (4),
                        radar (5),
                        vibrating (6),
                        microwave (7),
                        laser (8)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A value indicating the type of pavement sensor.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.sensorType:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.6"
::= { essPavementSensorEntry 6 }
```

~~5.12.3.7~~5.11.3.7 Surface Status

```
-- This object has been deprecated. See Annex D.3.8 for more information.
essSurfaceStatus OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        error (2),
                        dry (3),
                        traceMoisture (4),
                        wet (5),
                        chemicallyWet (6),
                        iceWarning (7),
                        iceWatch (8),
                        snowWarning (9),
                        snowWatch (10),
                        absorption (11),
```

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```
                        dew (12),
                        frost (13),
                        absorptionAtDewpoint (14)}
ACCESS      read-only
STATUS      mandatorydeprecated
DESCRIPTION "<Definition>A value indicating the pavement surface status.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceStatus:code
<Valid Value Rule>
other - The value reported by the sensor is not defined by the standard. See
the manufacturer's documentation for more information.
noReport - The sensor is not providing any reading for surface status and may
not be responding
errorReport - The sensor is providing a reading for surface status, but
either the reading indicates an error code or the data has been deemed
invalid or suspect
dry - The sensor does not detect any moisture or unusual conditions.
trace - The sensor detects some moisture, but it is suspected to be isolated
absorption - A salt chemical is present that is not fully dissolved in water.
As a result, the conductivity readings will result in erroneous calculations
for amount of chemical in the mix.
wet - The sensor detects a significant amount of moisture indicating a wet
roadway.
chemically wet - The sensor detects a signaificant amount of moisture mixed
with a de-icing or anti-icing chemical
dew - The sensor detects moisture that is suspected to be from the formation
of dew
frost - The sensor detects the formation of frost
freezeAdvisory - The risk of the formation of some sort of frozen moisture on
the roadway is elevated, but its occurrence, location, and/or timing is still
uncertain
slushAdvisory - The risk of the accumulation of snow or slush on the roadway
is elevated, but its occurrence, location, and/or timing is still uncertain
iceAdvisory - The risk of the formation of ice or black ice on the roadway is
elevated, but its occurrence, location, and/or timing is still uncertain
freezeHazard - The sensor detects some sort of frozen moisture but is unable
to classify as slush or ice.
slush - The sensor detects snow or slush.
ice - The sensor detects ice or black ice. (See essSurfaceBlackIceSignal)
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.7"
::= { essPavementSensorEntry 7 }
```

~~5.12.3.8~~5.11.3.8 Surface Temperature

```
essSurfaceTemperature OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The current pavement surface temperature in tenths
of degrees Celsius.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceTemperature:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
```

```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.8"
::= { essPavementSensorEntry 8 }
```

~~5.12.3.9~~5.11.3.9 Pavement Temperature

```
essPavementTemperature OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The current pavement temperature 2-10 cm below the
pavement surface in tenths of degrees Celsius. The specific depth at which
the reading is taken is defined by pavementSensorTemperatureDepth.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.pavementTemperature:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.9"
::= { essPavementSensorEntry 9 }
```

~~5.12.3.10~~5.11.3.10 Surface Water Depth

```
-- This object has been deprecated. See Annex D.1.6 for more information.
essSurfaceWaterDepth OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>The current depth of water on the surface of the
roadway measured in millimeters. The value 255 shall indicate an error
condition or missing value.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceWaterDepth:quantity
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.10"
::= { essPavementSensorEntry 10 }
```

~~5.12.3.11~~5.11.3.11 Surface Salinity

```
essSurfaceSalinity OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The pavement salinity in parts per one hundred
thousand by weight (i.e., grams of solute per 100,000 grams of solution).
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceSalinity:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per one hundred thousand by weight
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.11"
::= { essPavementSensorEntry 11 }
```

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~~5.12.3.12~~5.11.3.12 Surface Conductivity

```
-- This object has been deprecated. See Annex D.1.7 for more information.
essSurfaceConductivity OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      deprecated
DESCRIPTION "<Definition>Indicates the conductance of the ice/liquid mixture
on the pavement as detected by the sensor, in mhos, which is the inverse of
ohms. The value –65535 shall indicate an error condition or missing value.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceConductivity:quantity
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.12"
::= { essPavementSensorEntry 12 }
```

~~5.12.3.13~~5.11.3.13 Surface Freezing Point

```
essSurfaceFreezePoint OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The temperature in tenths of degrees Celsius at
which the existing solution on the roadway will freeze.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceFreezingPoint:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.13"
::= { essPavementSensorEntry 13 }
```

~~5.12.3.14~~5.11.3.14 Surface Black Ice Signal

```
essSurfaceBlackIceSignal OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        noIce (2),
                        blackIce (3),
                        detectorError (4)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A value indicating if Black Ice is detected by the
sensor.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceBlackIce:code
<Valid Value Rule>
other - The sensor is reporting a value that is not defined by the standard.
See the manufacturer's documentation for more information.
noIce - The sensor is not currently detecting black ice.
blackIce - The sensor is currently detecting black ice.
detectorError - The sensor is not connected, is not reporting, or is
reporting an error.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.14"
::= { essPavementSensorEntry 14 }
```

~~5.12.3.15~~5.11.3.15 Pavement Sensor Error

```
essPavementSensorError OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        none (2),
                        noResponse (3),
                        cutCable (4),
                        shortCircuit (5),
                        dirtyLens (6)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A value indicating the type of pavement sensor
error.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.pavementSensorError:code
<Valid Value Rule>
other - An error has been detected that is not defined by the standard; see
the manufacturer's documentation for more information.
none - No error is detected, the sensor appears to be working properly
noResponse - The sensor is configured and is believed to be connected, but is
not responding
cutCable - The sensor is not configured, not present or not fully connected,
perhaps because the cable was cut
shortCircuit - The sensor input has detected a short-circuit.
dirtyLens - The lens of the sensor appears to be dirty.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.15"
::= { essPavementSensorEntry 15 }
```

~~5.12.3.16~~5.11.3.16 Surface Water Depth—Version 2

```
essSurfaceIceOrWaterDepth OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The current thickness of ice or depth of water on
the surface of the roadway measured in 1/10th of millimeters.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.surfaceIceOrWaterDepth:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>1/10th of millimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.16"
::= { essPavementSensorEntry 16 }
```

~~5.12.3.17~~5.11.3.17 Surface Conductivity—Version 2

```
essSurfaceConductivityV2 OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the conductivity of the ice/liquid mixture
on the pavement as detected by the sensor, in 1/10ths of milli-mhos/cm (mhos
is the inverse of ohms). This value is independent of the size or shape of
the sensor and can be directly translated into a percent concentration of
chemical (e.g. salinity) through look-up tables for a given chemical.
```

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```
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.surfaceConductivityV2:quantity
<Valid Value Rule>
The value  65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>1/10ths of milli-mhos/cm
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.17"
::= { essPavementSensorEntry 17 }
```

~~5.12.3.18~~5.11.3.18 Pavement Sensor Model Information

```
pavementSensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the Pavement Sensor Table.
<DescriptiveName>PavementSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.18"
::= { essPavementSensorEntry 18 }
```

~~5.12.3.19~~5.11.3.19 Pavement Temperature Depth

```
pavementSensorTemperatureDepth OBJECT-TYPE
SYNTAX      INTEGER (2..11)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The depth at which the pavement temperature is
detected.
<DescriptiveName>PavementSensor.temperatureDepth:quantity
<Valid Value Rule>
The value of 11 indicates that the information is not available.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.19"
::= { essPavementSensorEntry 19 }
```

5.11.3.20 Pavement Sensor Latitude

```
pavementSensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS pavement
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.latitude:quantity
<Valid Value Rule>
The ~~ess~~pavementSensorLatitude at the North Pole is 90,000,000. The
pavementSensor~~ess~~Latitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
```

```
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.20"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { pavementSensorEntry 20 }
```

5.11.3.21 Pavement Sensor Longitude

```
pavementSensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS pavement sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.longitude:quantity
<Valid Value Rule>
The ~~ess~~pavementSensorLongitude of 180 degrees West shall be -180,000,000. The
pavementSensor~~ess~~Longitude of 180 degrees East shall be 180,000,000. The
value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.21"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { pavementSensorEntry 21 }
```

5.11.3.22 Pavement Surface Condition

```
pavementSensorSurfaceCondition OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        error (2),
                        dry (3),
                        moist (4),
                        chemicallyMoist(5),
                        wet (6),
                        chemicallyWet (7),
                        standingWater (8),
                        frost (9),
                        slush (10),
                        snow (11),
                        ice (12),
                        ~~dew (13),~~
                        noReport (13~~4~~) }
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A value indicating the pavement surface status.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.surfaceStatus:code
<Valid Value Rule>
other: The value reported by the sensor is not defined by the standard. See
the manufacturer's documentation for more information
error: The sensor is providing a reading for surface status, but either the
reading indicates an error code or the data has been deemed invalid or
suspect
```

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dry: no humidity over the sensor (EN 15518-3)
moist: from 0.01 mm to 0.2 mm water film thickness over the sensor (EN 15518-3)
chemically moist: from 0.01 mm to 0.2 mm water film thickness over the sensor mixed with ~~enough~~ de-icing or anti-icing chemical~~ to prevent the mixture from freezing~~
wet: from 0.2 mm water film thickness to 2.0 mm water film thickness over the sensor (EN 15518-3)
chemically wet: from 0.2 mm water film thickness or greater mixed with ~~enough~~ de-icing or anti-icing chemical~~ to prevent the mixture from freezing~~
standing water: from 2.0 mm or greater water film thickness over the sensor (EN 15518-3)
frost: formation of frost (ice crystals) is detected over the sensor
slush: snow or ice that has been reduced to a soft water mixture by rain, warm temperature, and/or chemical treatment (Glossary of Meteorology)
snow: snow is detected over the sensor
ice: ice or black ice is detected (See essSurfaceBlackIceSignal)
~~other: The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information~~
noReport: The sensor is not providing any reading for surface status and may not be responding
~~error: The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect~~
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.22"
::= { essPavementSensorEntry 22 }

5.11.3.23 Pavement Forecasted Condition

```
pavementSensorForecastCondition OBJECT-TYPE
SYNTAX       INTEGER {    other (1),
                          error (2),
                          noAdvisoryForecasted (3),
                          iceAdvisory (4),
                          slushAdvisory(5),
                          freezeAdvisory (6),
                          freezeHazard (7),
                          noReport (8) }
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>A value indicating the pavement surface status.
<SetConstraint>read-only
<DescriptiveName>PavementSensor.surfaceStatusForecast:code
<Valid Value Rule>
```

other: The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information.
error: The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect
noAdvisory~~Forecasted~~: No frozen moisture is detected and the risk of frozen moisture is low.
iceAdvisory: The risk of the formation of ice or black ice on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
slushAdvisory: The risk of the accumulation of snow or slush on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
freezeAdvisory: The risk of the formation of some sort of frozen moisture on the roadway is elevated, but its occurrence, location, and/or timing is still uncertain
freezeHazard: The sensor detects some sort of frozen moisture but is unable to classify as slush or ice
~~other: The value reported by the sensor is not defined by the standard. See the manufacturer's documentation for more information.~~
noReport: The sensor is not providing any reading for surface status and may not be responding
~~error: The sensor is providing a reading for surface status, but either the reading indicates an error code or the data has been deemed invalid or suspect~~
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.23"
::= { essPavementSensorEntry 23 }

5.11.3.24 Pavement Surface Friction Coefficient

~~pavementSensor~~pavementSensorFrictionCoefficient OBJECT-TYPE
SYNTAX INTEGER (0..~~255~~101)
ACCESS read-only
STATUS mandatory
DESCRIPTION "<Definition>A value representing the friction coefficient of the roadway pavement in one-hundredths. A value of 100 represents a coefficient of friction of 1.00.
~~<SetConstraint>read-only~~
<DescriptiveName>PavementSensor.surfaceFriction:quantity
<Valid Value Rule>
The value 101~~255~~ shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.24
~~<Unit>~~ "
::= { essPavementSensorEntry 24 }

~~**Pavement Surface Grip**~~

~~pavementSensorSurfaceGrip OBJECT-TYPE~~
~~SYNTAX INTEGER (0..101)~~
~~ACCESS read-only~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>A value indicating the the differential, as a percentage, in roadway friction from a dry roadway pavement free from contaminants.~~
~~<SetConstraint>read-only~~
~~<DescriptiveName>PavementSensor.surfaceGrip:pct~~

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~~<Valid Value Rule>~~
~~The value 101 shall indicate an error condition or missing value.~~
~~<Data Concept Type>Data Element~~
~~<Unit>percent friction"~~
~~::= { essPavementSensorEntry 25 }~~

5.11.3.25 Pavement Monitoring Latitude

```
pavementMonitorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the location that
the ESS pavement sensor is monitoring, per WGS-84 datum.  A value of 0 for
this object and pavementMonitorLongitude indicates that the location being
monitored is the same as defined in pavementSensorLatitude and
pavementSensorLongitude.
<DescriptiveName>PavementSensorMonitor.latitude:quantity
<Valid Value Rule>The pavementMonitorLatitude at the North Pole is
90,000,000. The pavementMonitorLatitude at the South Pole is -90,000,000. The
value 90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.25"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { pavementSensorEntry 25 }
```

5.11.3.26 Pavement Monitoring Longitude

```
pavementMonitorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the location that the ESS pavement sensor is monitoring. A value
of 0 for this object and pavementMonitorLatitude indicates that the location
being monitored is the same as defined in pavementSensorLatitude and
pavementSensorLongitude.
<DescriptiveName>PavementSensorMonitor.longitude:quantity
<Valid Value Rule>The pavementMonitorLongitude of 180 degrees West shall be -
180,000,000. The pavementMonitorLongitude of 180 degrees East shall be
180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.26"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { pavementSensorEntry 26 }
```

5.11.3.27 Pavement Ice Percentage

```
pavementIcePercentage OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-only
```

```
STATUS       mandatory
DESCRIPTION "<Definition> The percentage of ice on the surface by volume.
<DescriptiveName>PavementSensor.icePercent:quantity
<Valid Value Rule>The value 101 shall indicate an error condition or missing
value.<Data Concept Type>Data Element
<Unit>percent
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.2.27"
::=   { pavementSensorEntry 27 }
```

~~5.12.4~~5.11.4 Number of Subsurface Sensors

```
numEssSubSurfaceSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the Subsurface
Sensor Table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
~~<SetConstraint>read-only~~
<DescriptiveName>SubSurfaceSensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.3"
::=   { essNtcipPavement 3 }
```

~~5.12.5~~5.11.5 Subsurface Sensor Table

```
essSubSurfaceSensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF EssSubSurfaceSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the subsurface sensor data.
<DescriptiveName>SubSurfaceSensorTable
<Data Concept Type>Class
<TableType>~~-~~static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4"
::=   { essNtcipPavement 4 }
```

~~5.12.6~~5.11.6 Subsurface Sensor

```
essSubSurfaceSensorEntry OBJECT-TYPE
SYNTAX       EssSubSurfaceSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>A subsurface sensor is a sensor that reports the
temperature and moisture condition of the roadway subsurface.  It can be
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>SubSurfaceSensor
<Data Concept Type>Class"
INDEX { essSubSurfaceSensorIndex }
::=   { essSubSurfaceSensorTable 1 }

EssSubSurfaceSensorEntry ::= SEQUENCE {
```

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```
essSubSurfaceSensorIndex                        INTEGER,
essSubSurfaceSensorLocation                     DisplayString,
essSubSurfaceType                               INTEGER,
essSubSurfaceSensorDepth                        INTEGER,
essSubSurfaceTemperature                        INTEGER,
essSubSurfaceMoisture                           INTEGER,
essSubSurfaceSensorError                        INTEGER,
essSubSurfaceMoistureOrError                    INTEGER,}
essSubSurfaceLatitude                           INTEGER,
essSubSurfaceLongitude                          INTEGER,

essSubSurfaceModelInformation                   INTEGER}
```

~~5.12.6.1~~5.11.6.1 Subsurface Sensor Index

```
essSubSurfaceSensorIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
subsurface sensor data.
<SetConstraint>index
<DescriptiveName>SubSurfaceSensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.1"
::= { essSubSurfaceSensorEntry 1 }
```

~~5.12.6.2~~5.11.6.2 Subsurface Sensor Location

```
essSubSurfaceSensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
subsurface sensor.
<SetConstraint>always
<DescriptiveName>SubSurfaceSensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.2"
::= { essSubSurfaceSensorEntry 2 }
```

~~5.12.6.3~~5.11.6.3 Subsurface Type

```
essSubSurfaceType OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        unknown (2),
                        concrete (3),
                        asphalt (4),
                        openGradedAsphalt (5),
                        gravel (6),
                        clay (7),
                        loam (8),
                        sand (9),
                        permafrost (10),
                        variousAggregates (11),
                        air (12)}
```

```
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the type of subsurface. A value of air
would indicate a bridge.
<SetConstraint>always
<DescriptiveName>SubSurfaceSensor.type:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.3"
::= { essSubSurfaceSensorEntry 3 }
```

5.12.6.45.11.6.4 Subsurface Sensor Depth

```
essSubSurfaceSensorDepth OBJECT-TYPE
SYNTAX      INTEGER (0..1001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Depth of subsurface sensor in centimeters below the
pavement surface.
<SetConstraint>always
<DescriptiveName>SubSurfaceSensor.depth:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>centimeters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.4"
::= { essSubSurfaceSensorEntry 4 }
```

5.12.6.55.11.6.5 Subsurface Temperature

```
essSubSurfaceTemperature OBJECT-TYPE
SYNTAX      INTEGER (-1000..1001)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The current subsurface temperature in tenths of
degrees Celsius.
<SetConstraint>read-only
<DescriptiveName>SubSurfaceSensor.temperature:quantity
<Valid Value Rule>
The value 1001 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>tenths of degrees Celsius
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.5"
::= { essSubSurfaceSensorEntry 5 }
```

5.12.6.65.11.6.6 Subsurface Moisture

```
essSubSurfaceMoisture OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The subsurface moisture expressed as a percentage
(e.g. 0 indicates dry, 100 indicates saturated).
<SetConstraint>read-only
<DescriptiveName>SubSurfaceSensor.moisture:quantity
<Valid Value Rule>
The value 101 indicates an error condition or missing value.
```

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```
<Data Concept Type>Data Element
<Unit>percentage
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.6"
::= { essSubSurfaceSensorEntry ~~7~~6 }
```

~~5.12.6.7~~5.11.6.7 Subsurface Sensor Error

```
essSubSurfaceSensorError OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        none (2),
                        noResponse (3),
                        cutCable (4),
                        shortCircuit (5)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A value indicating the type of sensor error.
~~<SetConstraint>read-only~~
<DescriptiveName>SubSurfaceSensor.error:code
<Valid Value Rule>
other - An error has been detected that is not defined by the standard; see
the manufacturer's documentation for more information.
none - No error is detected, the sensor appears to be working properly
noResponse - The sensor is configured and is believed to be connected, but is
not responding
cutCable - The sensor is not configured, not present or not fully connected,
perhaps because the cable was cut
shortCircuit - The sensor input has detected a short-circuit.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.7"
::= { essSubSurfaceSensorEntry 7~~8~~ }
```

5.11.6.8 Subsurface Sensor Latitude

```
essSubSurfaceSensorLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS subsurface
sensor, per WGS-84 datum.
~~<SetConstraint>read-only~~
<DescriptiveName>SubSurfaceSensor.latitude:quantity
<Valid Value Rule>
The essSubSurfaceSensorLatitude at the North Pole is 90,000,000. The
essSubSurfaceSensorLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.8"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { essSubSurfaceSensorEntry 8~~9~~ }
```

5.11.6.9 Subsurface Sensor Longitude

```
essSubSurfaceSensorLongitude OBJECT-TYPE
```

```
SYNTAX       INTEGER (-180000000..180000001)
ACCESS       read-write~~only~~
STATUS       mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS subsurface sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>SubSurfaceSensor.longitude:quantity
<Valid Value Rule>
The essSubSurfaceSensorLongitude of 180 degrees West shall be -180,000,000.
The essSubSurfaceSensorLongitude of 180 degrees East shall be 180,000,000.
The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.9"
REFERENCE    "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=    { essSubSurfaceSensorEntry 9~~10~~ }
```

5.11.6.10 Subsurface Sensor Model Information

```
essSubSurfaceSensorModelInformation OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-write
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the ~~Visibility~~SubSurface Sensor Table.
<DescriptiveName>SubSurfaceSensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.10"
::= { essSubSurfaceSensorEntry 10~~1~~ }
```

~~5.12.7~~5.11.7 Pavement Block

```
-- This object has been deprecated. See Annex D.2.10~~8~~ for more
-- information.
essPavementBlock OBJECT-TYPE
SYNTAX       OerString
ACCESS       read-only
STATUS       deprecated
DESCRIPTION "<Definition>An OER encoded string of the EssPavementData
structure as defined below. This object is used for uploading current
pavement data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssPavementData ::= SEQUENCE OF PavementSensorData
      -- for (
--    x = 1;
--    x < numEssPavementSensors.0;
--    x++)
```

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```
PavementSensorData ::= SEQUENCE {
      essPavementSensorIndex.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceStatusV2.x                OPTIONAL, -- @NTCIP1204-v03
      essSurfaceTemperature.x             OPTIONAL, -- @NTCIP1204-v03
      essPavementTemperature.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceWaterDepth.x              OPTIONAL, -- @NTCIP1204-v03
      essSurfaceSalinity.x                OPTIONAL, -- @NTCIP1204-v03
      essSurfaceConductivity.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceFreezePoint.x             OPTIONAL, -- @NTCIP1204-v03
      essSurfaceBlackIceSignal.x          OPTIONAL, -- @NTCIP1204-v03
      essPavementSensorError.x            OPTIONAL  -- @NTCIP1204-v03
}
<Informative>This object has been replaced by essPavementV3Block (See
5.11.9).
<SetConstraint>read-only
<DescriptiveName>PavementSensorTable.pavementBlock:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.5"
::=   { essNtcipPavement 5 }
```

5.12.85.11.8 Subsurface Block Object

```
essSubSurfaceBlock OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>An OER encoded string of the EssSubsurfaceData
structure as defined below. This object is used for uploading current
subsurface data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssSubSurfaceData ::= SEQUENCE OF SubSurfaceSensorData
      -- for (
--    x = 1;
--    x < numEssSubSurfaceSensors.0;
--    x++)

SubSurfaceSensorData ::= SEQUENCE {
      essSubSurfaceSensorIndex.x          OPTIONAL, -- @NTCIP1204-v03
      essSubSurfaceTemperature.x          OPTIONAL, -- @NTCIP1204-v03
      essSubSurfaceMoisture.x             OPTIONAL, -- @NTCIP1204-v03
      essSubSurfaceSensorError.x          OPTIONAL  -- @NTCIP1204-v03
      }
<SetConstraint>read-only
<DescriptiveName>SubSurfaceSensorTable.subsurfaceBlock:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.6"
::=   { essNtcipPavement 6 }
```

5.12.95.11.9 Pavement Block V3

-- This object has been deprecated. See Annex D.3.2 for more information.

```
essPavementV3Block OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      deprecatedmandatory
DESCRIPTION "<Definition>An OER encoded string of the EssPavementDataV3
structure as defined below. This object is used for uploading current
pavement data from the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

EssPavementDataV3 ::= SEQUENCE OF PavementSensorDataV3
      -- for (
--    x = 1;
--    x < numEssPavementSensors.0;
--    x++)


PavementSensorDataV3 ::= SEQUENCE {
      essPavementSensorIndex.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceStatus.x                  OPTIONAL, -- @NTCIP1204-v03
      essSurfaceTemperature.x             OPTIONAL, -- @NTCIP1204-v03
      essPavementTemperature.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceSalinity.x                OPTIONAL, -- @NTCIP1204-v03
      essSurfaceFreezePoint.x             OPTIONAL, -- @NTCIP1204-v03
      essSurfaceBlackIceSignal.x          OPTIONAL, -- @NTCIP1204-v03
      essPavementSensorError.x            OPTIONAL, -- @NTCIP1204-v03
      essSurfaceIceOrWaterDepth.x         OPTIONAL, -- @NTCIP1204-v03
      essSurfaceConductivityV2.x          OPTIONAL  -- @NTCIP1204-v03
}
<SetConstraint>read-only
<DescriptiveName>PavementSensorTable.pavementBlock:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.9.4.7"
::=   { essNtcipPavement 7 }
```

5.135.12 Mobile Platform Objects

```
-- Contains objects related to monitoring mobile platforms that act as
-- ESS (e.g., specially-equipped maintenance vehicles).
-- There has been limited use of mobile ESS platforms within the
-- surface transportation industry and as such these objects
-- should be considered experimental.
essNtcipMobile  OBJECT IDENTIFIER ::= {essNtcip 10}
```

5.13.15.12.1 Detected Friction

```
-- This object has been deprecated. See Annex D.3.3.5 for more information.
essMobileFriction OBJECT-TYPE
SYNTAX      INTEGER (0..101)
ACCESS      read-only
STATUS      deprecatedmandatory
DESCRIPTION "<Definition>Indicates measured coefficient of friction in
percent.
<SetConstraint>read-only
```

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```
<DescriptiveName>MobilePlatform.friction:quantity
<Valid Value Rule>
The value 101 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>percent friction
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.10.1"
::=   { essNtcipMobile 1 }
```

~~5.13.2~~5.12.2 Observed Ground State

```
-- This object has been deprecated. See Annex D.3.9 for more information.
essMobileObservationGroundState OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        dry (2),
                        moist (3),
                        wet (4),
                        flooded (5),
                        frozen (6),
                        glaze (7),
                        dustySandy (8),
                        veryDry (9),
                        icy (10),
                        patchyWetSnow (11),
                        moderateWetSnowCover (12),
                        fullWetSnowCover (13),
                        patchyDrySnow (14),
                        moderateDrySnowCover (15),
                        fullDrySnowCover (16),
                        driftingSnow (17),
                        unknown (18)}
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The prevailing observed ground state of the
surrounding environment as determined by the observer. This is an indicator
of past weather conditions.
~~<SetConstraint>read-only~~
<DescriptiveName>MobilePlatform.observedGroundState:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.10.2"
::=   { essNtcipMobile 2 }
```

~~5.13.3~~5.12.3 Observed Pavement State

```
-- This object has been deprecated. See Annex D.3.10 for more information.
essMobileObservationPavement OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        dry (2),
                        wet (3),
                        puddles (4),
                        shallowStandingWater (5),
                        shallowFlowingWater (6),
                        deepStandingWater (7),
                        deepFlowingWater (8),
                        dustingFreshSnow (9),
                        moderateFreshSnow (10),
                        deepFreshSnow (11),
                        plowedSnow (12),
```

```
                        slush (13),
                        packedSnowPatches (14),
                        packedSnow (15),
                        lightSnowDrifts (16),
                        moderateSnowDrifts (17),
                        heavySnowDrifts (18),
                        frost (19),
                        icePatches (20),
                        moderatelyIcy (21),
                        heavyIcing (22),
                        blackIce (23),
                        sheetIce (24),
                        frozenSlush (25)}
ACCESS      read-only
STATUS      ~~mandatory~~ deprecated
DESCRIPTION "<Definition>The prevailing observed conditions on the driving
surface as determined by the observer.
~~<SetConstraint>read-only~~
<DescriptiveName>MobilePlatform.observedPavementState:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.10.3"
::=   { essNtcipMobile 3 }
```

5.12.4 Observed Ground State - Version 4

```
essMobileObservationGroundStateV4 OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        dry (2),
                        moist (3),
                        wet (4),
                        flooded (5),
                        frozen (6),
                        glaze (7),
                        dustySandy (8),
                        veryDry (9),
                        icy (10),
                        patchyWetSnow (11),
                        moderateWetSnowCover (12),
                        fullWetSnowCover (13),
                        patchyDrySnow (14),
                        moderateDrySnowCover (15),
                        fullDrySnowCover (16),
                        driftingSnow (17),
                        unknown (18),
                        puddles (19),
                        standing water (20),
                        flowing water (21),
                        fresh snow (22),
                        plowed snow (23),
                        slush (24)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The prevailing observed ground state of the
surrounding environment as determined by the observer. This is an indicator
of past weather conditions.
<DescriptiveName>MobilePlatform.observedGroundState:code
<Data Concept Type>Data Element
```

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```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.10.4"
::=   { essNtcipMobile 4 }
```

5.12.5 Observed Pavement State - Version 4

```
essMobileObservationPavementV4 OBJECT-TYPE
SYNTAX       INTEGER {   other (1),
                         dry (2),
                         wet (3),
                         puddles (4),
                         shallowStandingWater (5),
                         shallowFlowingWater (6),
                         deepStandingWater (7),
                         deepFlowingWater (8),
                         dustingFreshSnow (9),
                         moderateFreshSnow (10),
                         deepFreshSnow (11),
                         plowedSnow (12),
                         slush (13),
                         packedSnowPatches (14),
                         packedSnow (15),
                         lightSnowDrifts (16),
                         moderateSnowDrifts (17),
                         heavySnowDrifts (18),
                         frost (19),
                         icePatches (20),
                         moderatelyIcy (21),
                         heavyIcing (22),
                         blackIce (23),
                         sheetIce (24),
                         frozenSlush (25),
                         absorption (26)
                         absorptionAtDewpoint (27),
                         bareAndDry (28),
                         bareAndWet (29),
                         blowingsnow (30),
                         chemicallyWet (31),
                         dew (32),
                         damp (33),
                         WetSlush (34)}
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The prevailing observed conditions on the driving
surface as determined by the observer.
<DescriptiveName>MobilePlatform.observedPavementState:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.10.5"
::=   { essNtcipMobile 5 }
```

~~5.14~~5.13 Pavement Treatment Objects

```
-- Contains objects that monitor the various types and amounts of
-- treatments that are spread on the pavement surface.
essNtcipTreatment OBJECT IDENTIFIER ::= { essNtcip 11 }
```

~~5.14.1~~5.13.1 Number of Treatments

```
numEssTreatments OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the Pavement
Treatment Table.
<SetConstraint>read-only
<DescriptiveName>PavementTreatmentTable.numTreatments:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.1"
::=   { essNtcipTreatment 1 }
```

~~5.14.2~~5.13.2 Pavement Treatment Table

```
essPavementTreatmentTable OBJECT-TYPE
SYNTAX      SEQUENCE OF EssPavementTreatmentEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>Table containing the pavement treatment data.
<DescriptiveName>PavementTreatmentTable
<Data Concept Type>Class
<TableType>—static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.2"
::=   { essNtcipTreatment 2 }
```

~~5.14.3~~5.13.3 Pavement Treatment

```
essPavementTreatmentEntry OBJECT-TYPE
SYNTAX      EssPavementTreatmentEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>A pavement treatment is a chemical that can be
applied to the roadway to de-ice or prevent icing of the pavement. It can be
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>PavementTreatment
<Data Concept Type>Class"
INDEX { essPavementTreatmentIndex }
::=   { essPavementTreatmentTable 1 }

EssPavementTreatmentEntry ::= SEQUENCE {
      essPavementTreatmentIndex               INTEGER,
      essPaveTreatProductType                 INTEGER,
      essPaveTreatProductForm                 INTEGER,
      essPercentProductMix                    INTEGER}
```

~~5.14.3.1~~5.13.3.1 Pavement Treatment Index

```
essPavementTreatmentIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
pavement treatment data.
```

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```
<SetConstraint>index
<DescriptiveName>PavementTreatement.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.2.1""
::= { essPavementTreatmentEntry 1 }
```

5.14.3.25.13.3.2 Pavement Treatment Product Type

```
essPaveTreatProductType OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        sand (2),
                        dirt (3),
                        gravel (4),
                        cinders (5),
                        water (6),
                        enhancedSalts (7),
                        naCl (8),
                        caCl (9),
                        mgCl (10),
                        cMA (11),
                        kAC (12),
                        naFormate (13),
                        naA (14)}
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the type of treatment being applied to the
road. An enhanced definition of some of the values are as follows: other -
any other type of treatment water - used as a diluting agent cMA - Calcium-
Magnesium Acetate kAC - Potassium-Magnesium Acetate naFormate - Sodium
Formate naA - Sodium Acetate
<Informative>Version 02 of this standard incorrectly defined the set
constraint of this read-write object to be read-only; it should be always,
however, the intent is that it would only be set by a local connection when
the new product is being loaded and that remote systems would only read this
object.
<SetConstraint>always
<DescriptiveName>PavementTreatement.type:code
<Valid Value Rule>
An enhanced definition of some of the values are as follows.
other - any other type of treatment
water - used as a diluting agent
cMA - Calcium-Magnesium Acetate
kAC - Potassium-Magnesium Acetate
naFormate - Sodium Formate
naA - Sodium Acetate
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.2.2"
::= { essPavementTreatmentEntry 2 }
```

5.14.3.35.13.3.3 Treatment Product Form

```
essPaveTreatProductForm OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        dry (2),
                        prewet (3),
                        liquid (4)}
ACCESS      read-write
```

```
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the condition of the treatment being
applied to the road.
<Informative>Version 02 and 03 of this standard incorrectly defined the set
constraint of this read-write object to be read-only; it should be always,
however, the intent is that it would only be set by a local connection when
the new product is being loaded and that remote systems would only read this
object.<SetConstraint>read-only
<DescriptiveName>PavementTreatement.form:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.2.3"
::= { essPavementTreatmentEntry 3 }
```

5.14.3.45.13.3.4 Percentage of Treatment Type in Mix

```
essPercentProductMix OBJECT-TYPE
SYNTAX      INTEGER (0..100)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the percentage of the total application
mix by weight that is of the type specified in essPaveTreatProductType.
<Informative>Version 02 of this standard incorrectly defined the set
constraint of this read-write object to be read-only; it should be always,
however, the intent is that it would only be set by a local connection when
the new product is being loaded and that remote systems would only read this
object.
<SetConstraint>read-only
<DescriptiveName>PavementTreatement.mix:quantity
<Valid Value Rule>
The sum of these percentages within the total mixture shall equal 100.
<Data Concept Type>Data Element
<Unit>percent
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.2.4"
::= { essPavementTreatmentEntry 4 }
```

5.14.45.13.4 Treatment Amount

```
essPaveTreatmentAmount OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-writeonly
STATUS      mandatory
DESCRIPTION "<Definition>Indicates quantity of the treatment being applied in
kilograms per lane kilometer.
<SetConstraint>read-only
<DescriptiveName>PavementTreatmentTable.amount:quantity
<Valid Value Rule>
The value of 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>kilograms per lane kilometer
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.3"
::=   { essNtcipTreatment 3 }
```

5.14.55.13.5 Treatment Width

```
essPaveTreatmentWidth OBJECT-TYPE
SYNTAX      INTEGER (0..255)
```

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```
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the width of the spread of treatment in
meters.
<SetConstraint>read-only
<DescriptiveName>PavementTreatmentTable.width:quantity
<Valid Value Rule>
The value of 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.4"
::=   { essNtcipTreatment 4 }
```

5.14.65.13.6 Pavement Treatment Block

```
-- This object has been deprecated. See Annex D.3.2 for more information.
pavementTreatmentBlock OBJECT-TYPE
SYNTAX       OerString
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>An OER encoded string of the Pavement Treatment
data. This object is used for uploading current pavement treatment data from
the ESS in a bandwidth efficient manner.

The OPTIONAL fields shall be present if the data is supported by the
implementation and is valid. The OPTIONAL fields shall be omitted for any
data that is invalid or not supported by the implementation.

Note:OTE: The following structure contains pts data elements in addition to
the ess data elements. Although these are not currently required to fulfill
any existing requirements, they are included to maintain backward
compatibility with the version 02 standard.

PavementTreatmentBlock ::= SEQUENCE {
      treatmentInfo     SEQUENCE OF PavementTreatmentData OPTIONAL,
      essPaveTreatmentAmount.0      OPTIONAL, -- @NTCIP1204-v03
      essPaveTreatmentWidth.0       OPTIONAL, -- @NTCIP1204-v03
      ptsOperationalMode.0          OPTIONAL, -- @NTCIP1204-v03
      ptsCommandState.0             OPTIONAL, -- @NTCIP1204-v03
      ptsSprayerState.0             OPTIONAL, -- @NTCIP1204-v03
      ptsSignalDuration.0           OPTIONAL, -- @NTCIP1204-v03
      ptsSignalEventCount.0         OPTIONAL, -- @NTCIP1204-v03
      ptsLastSignalEvent.0          OPTIONAL, -- @NTCIP1204-v03
      ptsActiveEventCount.0         OPTIONAL, -- @NTCIP1204-v03
      ptsInactiveEventCount.0       OPTIONAL, -- @NTCIP1204-v03
      ptsLastactiveEvent.0          OPTIONAL, -- @NTCIP1204-v03
      ptsLastInactiveEvent.0        OPTIONAL, -- @NTCIP1204-v03
      ptsError.0                    OPTIONAL, -- @NTCIP1204-v03
      ptsMonitoringDetectors.0      OPTIONAL  -- @NTCIP1204-v03
}

PavementTreatmentData ::=
      -- for (
      --    x = 1;
      --    x < numEssTreatments.0;
      --    x++)
SEQUENCE {
```

```
      essPavementTreatmentIndex.x         OPTIONAL, -- @NTCIP1204-v03
      essPaveTreatProductType.x           OPTIONAL, -- @NTCIP1204-v03
      essPaveTreatProductForm.x           OPTIONAL, -- @NTCIP1204-v03
      essPercentProductMix.x              OPTIONAL  -- @NTCIP1204-v03
}
<DescriptiveName>PavementTreatmentTable.block:frame
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.5"
::=   { essNtcipTreatment 5 }
```

~~5.14.7~~5.13.7 Operational Mode

```
ptsOperationalMode OBJECT-TYPE
SYNTAX      INTEGER {   off (1),
                        manual (2),
                        automatic (3)}
ACCESS      read-write
STATUS      obsolete
DESCRIPTION "<Definition>Indicates the operational mode of the Pavement
Treatment System.

When in the 'off' state, the PTS shall not trigger the sprayer even if
commanded to do so and shall always be inactive. The PTS shall transition to
the requested operational mode, upon request.

When in the 'automatic' state, the PTS shall monitor conditions and trigger
the sprayer based on a manufacturer specific algorithm. The algorithm shall
only consider input from the detectors selected in the ptsMonitoringDetectors
object. The PTS shall also trigger the sprayer if commanded to do so via the
ptsCommandState object. The PTS shall transition to the requested operational
mode, upon request.

When in the 'manual' state, the PTS shall trigger the sprayer if commanded to
do so via the ptsCommandState object. The PTS shall transition to the
requested operational mode, upon request.
~~<SetConstraint>always~~
<DescriptiveName>PTS.operationalMode.code
<Valid Value Rule>
off   When set to this value the ESS will not trigger the
      bridge sprayer

manual      When set to this value the ESS will only trigger the
      bridge sprayer when manually commanded to do
      so (e.g., see bridgeSprayerMgmtSignalState).

automatic   When set to this value the ESS will trigger the
      bridge sprayer when manually commanded to do
      so or when the internal algorithm determines
      that the sprayer should be triggered.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.6"
::=   { essNtcipTreatment 6 }
```

~~5.14.8~~5.13.8 Command State

```
ptsCommandState OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
```

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```
                        inactive (2),
                        activate (3)}
ACCESS      read-write
STATUS      obsolete
DESCRIPTION "<Definition>Indicates the operational state of the PTS. When in
the 'inactive' state, the PTS shall not be spraying. Upon entering the
'active' state, either by a manual SET of this object or through an automated
algorithm, the PTS shall trigger the sprayer and spray the chemical for a
duration as defined by the ptsSignalDuration object. Upon expiration of this
duration, the PTS shall automatically transition back to the 'inactive'
state.
<SetConstraint>always
<DescriptiveName>PTS.commandState:code
<Valid Value Rule>
other -
      read  - indicates a unknown or inital state
      write - no effect
inactive  -
      read  - indicates the ess is not signaling the bridge sprayer
      write - no effect
activate  -
      read  - indicates the ess is signaling the bridge sprayer
      write - causes the ess to signal the bridge sprayer
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.7"
::=   { essNtcipTreatment 7 }
```

5.14.95.13.9 Sprayer State

```
ptsSprayerState OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        inactive (2),
                        active (3)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>other     - indicates a unknown or initial state
             inactive  - indicates the bridge sprayer is inactive
             active    - indicates the bridge sprayer is active
<SetConstraint>read-only
<DescriptiveName>PTS.sprayerState:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.8"
::=   { essNtcipTreatment 8 }
```

5.14.105.13.10 Signal Duration

```
ptsSignalDuration OBJECT-TYPE
SYNTAX      INTEGER (0..3600000)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The number of milliseconds of a simple logic level
or state the bridge sprayer needs to detect a signal from the ESS
<SetConstraint>always.
<DescriptiveName>PTS.signalDuration:quantity
<Data Concept Type>Data Element
<Unit>milliseconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.9"
```

```
::=   { essNtcipTreatment 9 }
```

~~5.14.11~~5.13.11 Signal Event Count

```
ptsSignalEventCount OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The count of the number of Signal Events that have
occurred.
<SetConstraint>read-only
<DescriptiveName>PTS.signalEventCount:quantity
<Data Concept Type>Data Element
<Unit>milliseconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.10"
::=   { essNtcipTreatment 10 }
```

~~5.14.12~~5.13.12 Last Signal Event

```
ptsLastSignalEvent OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The number of seconds since 00:00:00 Jan 1 1970 UTC.
<SetConstraint>read-only
<DescriptiveName>PTS.lastSignalEvent:quantity
<Valid Value Rule>
The value of 0 indicates an unknown or initial value.
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.11"
::=   { essNtcipTreatment 11 }
```

~~5.14.13~~5.13.13 Active Event Count

```
ptsActiveEventCount OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The count of the number of Active Events that have
occurred.
<SetConstraint>read-only
<DescriptiveName>PTS.activeEventCount:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.12"
::=   { essNtcipTreatment 12 }
```

~~5.14.14~~5.13.14 Inactive Event Count

```
ptsInactiveEventCount OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>A count of the number of Inactive Events that have
occurred.
```

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```
<SetConstraint>read-only
<DescriptiveName>PTS.inactiveEventCount:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.13"
::=   { essNtcipTreatment 13 }
```

5.14.155.13.15 Last Active Event

```
ptsLastActiveEvent OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The number of seconds since 00:00:00 Jan 1 1970 UTC.
<SetConstraint>read-only
<DescriptiveName>PTS.lastActiveEvent:quantity
<Valid Value Rule>
The value of 0 indicates an unknown or initial value.
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.14"
::=   { essNtcipTreatment 14 }
```

5.14.165.13.16 Last Inactive Event

```
ptsLastInactiveEvent OBJECT-TYPE
SYNTAX      Counter
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The number of seconds since 00:00:00 Jan 1 1970 UTC.
<SetConstraint>read-only
<DescriptiveName>PTS.lastInactiveEvent:quantity
<Valid Value Rule>
The value of 0 indicates an unknown or initial value.
<Data Concept Type>Data Element
<Unit>seconds
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.15"
::=   { essNtcipTreatment 15 }
```

5.14.175.13.17 PTS Error Code

```
ptsError OBJECT-TYPE
SYNTAX      INTEGER { other (1),
                      ok (2),
                      genericError (3),
                      tankLow (4)}
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the status of the bridge sprayer.
<SetConstraint>read-only
<DescriptiveName>PTS.error:code
<Valid Value Rule>
other        - indicates a unknown or initial state
ok           - indicates the bridge sprayer is operational
genericError - indicates the bridge sprayer has an error
tankLow      - indicates the bridge sprayer's tank is low
```

```
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.16"
::=   { essNtcipTreatment 16 }
```

~~5.14.18~~5.13.18 Monitoring Detectors

```
ptsMonitoringDetectors OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (4))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the pavement detectors that the PTS shall
use in its algorithm that determines when the PTS will automatically trigger
the sprayer.
<DescriptiveName>PTS.monitoringDetectors:code
<Valid Value Rule>
Each bit indicates whether or not the associated pavement sensor shall be
used within the algorithm. The first (high order) bit in the bit string shall
reference the first pavement sensor. A value of one for any bit shall
indicate that the sensor input shall be considered, and a value of zero shall
mean that the input shall not be considered.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.17"
::=   { essNtcipTreatment 17 }
```

~~5.14.19~~5.13.19 Operational Mode—Version 3

```
ptsOperationalModeV3 OBJECT-TYPE
SYNTAX      INTEGER {   off (1),
                        manual (2),
                        automatic (3)}
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the operational mode of the Pavement
Treatment System.

When in the 'off' state, the PTS shall not trigger the sprayer even if
commanded to do so and shall always be inactive. The PTS shall transition to
the requested operational mode, upon request.

When in the 'automatic' state, the PTS shall monitor conditions and trigger
the sprayer based on a manufacturer specific algorithm. The algorithm shall
only consider input from the detectors selected in the ptsMonitoringDetectors
object. The PTS shall also trigger the sprayer if commanded to do so via the
ptsCommandStateV3 object. The PTS shall transition to the requested
operational mode, upon request.

When in the 'manual' state, the PTS shall trigger the sprayer if commanded to
do so via the ptsCommandStateV3 object. The PTS shall transition to the
requested operational mode, upon request.
<SetConstraint>always
<DescriptiveName>PTS.operationalMode.code
<Valid Value Rule>
off   When set to this value the ESS will not trigger the
      bridge sprayer

manual      When set to this value the ESS will only trigger the
      bridge sprayer when manually commanded to do
```

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```
      so (e.g., see ptsCommandStateV3).

automatic   When set to this value the ESS will trigger the
      bridge sprayer when manually commanded to do
      so or when the internal algorithm determines
      that the sprayer should be triggered.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.18"
::=   { essNtcipTreatment 18 }
```

~~5.14.20~~5.13.20 Command State—Version 3

```
ptsCommandStateV3 OBJECT-TYPE
SYNTAX      INTEGER {   other (1),
                        inactive (2),
                        activate (3)}
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the operational state of the PTS. When in
the 'inactive' state, the PTS shall not be signaling the sprayer. Upon
entering the 'active' state, either by a manual SET of this object or through
an automated algorithm, the PTS shall trigger the sprayer using a signal that
lasts for a duration as defined by the ptsSignalDuration object. Upon
expiration of this duration, the PTS shall automatically transition back to
the 'inactive' state.
<Informative>This object does not directly control the sprayer, rather it
merely signals an external sprayer.
<SetConstraint>always
<DescriptiveName>PTS.commandState:code
<Valid Value Rule>
other -
      read  - indicates a unknown or inital state
      write - no effect
inactive  -
      read  - indicates the ess is not signaling the bridge sprayer
      write - no effect
activate  -
      read  - indicates the ess is signaling the bridge sprayer
      write - causes the ess to signal the bridge sprayer
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.19"
::=   { essNtcipTreatment 19 }
```

5.13.21 PTS Latitude

```
essPavementTreatmentLatitude OBJECT-TYPE
SYNTAX      INTEGER (-90000000..90000001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the pavement
treatment system, per WGS-84 datum.
<DescriptiveName>PTS.latitude:quantity
<Valid Value Rule>The essPavementTreatmentLatitude at the North Pole is
90,000,000. The essPavementTreatmentLatitude at the South Pole is -
90,000,000. The value 90,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>latitude
```

```
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.20"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { essNtcipTreatment 20 }
```

5.13.22 PTS Longitude

```
essPavementTreatmentLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the pavement treatment system location.
<DescriptiveName>RadiationSensor.longitude:quantity
<Valid Value Rule>The essPavementTreatmentLongitude of 180 degrees West shall
be -180,000,000. The essPavementTreatmentLongitude of 180 degrees East shall
be 180,000,000. The value 180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.21"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { essNtcipTreatment 21 }
```

5.13.23 PTS Location

```
essPavementTreatmentLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the
pavement treatment system.
<DescriptiveName>pts.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.22"
::= { essNtcipTreatment 22 }
```

5.13.24 PTS Model Information

```
essPavementTreatmentModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the pavement treatment system.
<DescriptiveName>pts.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.11.23"
::= { essNtcipTreatment 23 }
```

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~~5.15~~5.14 Air Quality Parameters

```
-- Contains objects used for monitoring air quality conditions.
essNtcipAirQuality  OBJECT IDENTIFIER ::= { essNtcip 12 }
```

~~5.15.1~~5.14.1 Carbon Monoxide Parameter

```
essCO OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of carbon monoxide in the air,
measured in parts per million.
<SetConstraint>read-only
<DescriptiveName>AirQuality.carbonMonoxide:quantity
<Valid Value Rule>
The value 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per million
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.1"
::=   { essNtcipAirQuality 1 }
```

~~5.15.2~~5.14.2 Carbon Dioxide Parameter

```
essCO2 OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of carbon dioxide in the air,
measured in parts per billion.
<SetConstraint>read-only
<DescriptiveName>AirQuality.carbonDioxide:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per billion
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.2"
::=   { essNtcipAirQuality 2 }
```

~~5.15.3~~5.14.3 Nitrous Oxide Parameter

```
essNO OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of nitrous oxide in the air,
measured in parts per million.
<SetConstraint>read-only
<DescriptiveName>AirQuality.nitrousOxide:quantity
<Valid Value Rule>
The value 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per million
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.3"
::=   { essNtcipAirQuality 3 }
```

~~5.15.4~~5.14.4 Nitrogen Dioxide Parameter

```
essNO2 OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of nitrogen dioxide in the air,
measured in parts per billion.
<SetConstraint>read-only
<DescriptiveName>AirQuality.nitrogenDioxide:quantity
<Valid Value Rule>
The value 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per billion
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.4"
::=   { essNtcipAirQuality 4 }
```

~~5.15.5~~5.14.5 Sulfur~~Sulfer~~ Dioxide Parameter

```
essSO2 OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of sulfur dioxide in the air,
measured in parts per billion.
<SetConstraint>read-only
<DescriptiveName>AirQuality.sulfuerDioxide:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per billion
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.5"
::=   { essNtcipAirQuality 5 }
```

~~5.15.6~~5.14.6 Ozone Parameter

```
essO3 OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of ozone in the air, measured in
parts per one hundred billion.
<SetConstraint>read-only
<DescriptiveName>AirQuality.ozone:quantity
<Valid Value Rule>
The value 255 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>parts per one hundred billion
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.6"
::=   { essNtcipAirQuality 6 }
```

~~5.15.7~~5.14.7 Particulate Matter Parameter

```
essPM10 OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
```

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```
DESCRIPTION "<Definition>The concentration of small particulate matter of 10
micrometers or less in diameter in the air, measured in micrograms per cubic
meter.
<SetConstraint>read-only
<DescriptiveName>AirQuality.particulateMatter:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
<Unit>micrograms per cubic meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.7"
::=   { essNtcipAirQuality 7 }
```

5.15.85.14.8 Air Quality Block Object

```
-- This object has been deprecated. See Annex D.3.2 for more information.
essAirQualityBlock OBJECT-TYPE
SYNTAX      OerString
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>An OER encoded string of the EssAirQualityData
structure as defined below. This object is used for uploading current air
quality data from the ESS in a bandwidth efficient manner.

A GET shall return data for all of the fields in the structure (even if they
are indicated as OPTIONAL); unless the data values are not supported by the
controller or are invalid (e.g., the sensor is not attached), in which case
the values shall be omitted.

essAirQualityData ::= SEQUENCE {
      essCO.0                       OPTIONAL,   -- @NTCIP1204-v03
      essCO2.0                      OPTIONAL,   -- @NTCIP1204-v03
      essNO.0                       OPTIONAL,   -- @NTCIP1204-v03
      essNO2.0                      OPTIONAL,   -- @NTCIP1204-v03
      essSO2.0                      OPTIONAL,   -- @NTCIP1204-v03
      essO3.0                       OPTIONAL,   -- @NTCIP1204-v03
      essPM10.0                     OPTIONAL    -- @NTCIP1204-v03
      }
<SetConstraint>read-only
<DescriptiveName>AirQuality.airQualityBlock:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.8"
::=   { essNtcipAirQuality 8 }
```

5.14.9 Particulate Matter (2.5) Parameter

```
essPM25 OBJECT-TYPE
SYNTAX      INTEGER (0..65535)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>The concentration of small particulate matter of 2.5
micrometers or less in diameter in the air, measured in micrograms per cubic
meter.
<SetConstraint>read-only
<DescriptiveName>AirQuality.particulateMatter25:quantity
<Valid Value Rule>
The value 65535 shall indicate an error condition or missing value.
<Data Concept Type>Data Element
```

```
<Unit>micrograms per cubic meter
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.9"
::=   { essNtcipAirQuality 9 }
```

5.14.10 Number of Air Quality Sensors

```
airQualitySensorTableNumSensors OBJECT-TYPE
SYNTAX       INTEGER (0..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Indicates the number of entries in the air quality
sensor table.
<Informative>This value may automatically change upon connecting or
disconnecting a sensor; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>AirQualitySensorTable.numSensors:quantity
<Data Concept Type>Data Element
<Unit>count
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.10"
::=   { essNtcipAirQuality 10 }
```

5.14.11 Air Quality Sensor Table

```
airQualitySensorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF AirQualitySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>Table containing the air quality sensor data.
<DescriptiveName>AirQualitySensorTable
<Data Concept Type>Class
<TableType>-static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11"
::=   { essNtcipAirQuality 11 }
```

5.14.12 Air Quality Sensor

```
airQualitySensorEntry OBJECT-TYPE
SYNTAX       AirQualitySensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>An air quality sensor is described through a number
of attributes as indicated by the following subclauses.
<DescriptiveName>AirQualitySensor
<Data Concept Type>Class"
INDEX { airQualitySensorIndex }
::=   { airQualitySensorTable 1 }

AirQualitySensorEntry ::= SEQUENCE {
      airQualitySensorIndex                INTEGER,
      airQualitySensorHeight               INTEGER,
      airQualitySensorLatitude             INTEGER,
      airQualitySensorLongitude            INTEGER,
      airQualitySensorLocation             DisplayString,
      airQualitySensorModelInformation     INTEGER,
      -- SENSOR READINGS
```

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```
essCO                                   INTEGER,
essCO2                                  INTEGER,
essNO                                   INTEGER,
essNO2                                  INTEGER,
essSO2                                  INTEGER,
essO3                                   INTEGER,
essPM10                                 INTEGER,
essPM25                                 INTEGER }
```

5.14.12.1 Air Quality Sensor Index

```
airQualitySensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide air
quality sensor data.
<SetConstraint>index
<DescriptiveName>AirQualitySensor.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.1"
::= { airQualitySensorEntry 1 }
```

5.14.12.2 Air Quality Sensor Height

```
airQualitySensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>The height of the air quality sensor with respect to
the essReferenceHeight in meters.
<SetConstraint>read-only
<DescriptiveName>AirQualitySensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>meters
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.2"
REFERENCE    "essReferenceHeight plus this value equals the WMO Binary Code
Form FM 94 BUFR Table B item 0 07 001."
::=    { airQualitySensorEntry 2 }
```

5.14.12.3 Air Quality Sensor Latitude

```
airQualitySensorLatitude OBJECT-TYPE
SYNTAX       INTEGER (-90000000..90000001)
ACCESS       read-writeonly
STATUS       mandatory
DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS air quality
sensor, per WGS-84 datum.
<SetConstraint>read-only
<DescriptiveName>AirQualitySensor.latitude:quantity
<Valid Value Rule>
The airQualitySensoressLatitude at the North Pole is 90,000,000. The
essairQualitySensorLatitude at the South Pole is -90,000,000. The value
90,000,001 shall indicate a missing value.
```

```
<Data Concept Type>Data Element
<Unit>latitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.3"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by
dividing this value by 10."
::=   { airQualitySensorEntry 3 }
```

5.14.12.4 Air Quality Sensor Longitude

```
airQualitySensorLongitude OBJECT-TYPE
SYNTAX      INTEGER (-180000000..180000001)
ACCESS      read-write~~only~~
STATUS      mandatory
DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime
Meridian of the ESS air quality sensor location.
~~<SetConstraint>read-only~~
<DescriptiveName>AirQualitySensor.longitude:quantity
<Valid Value Rule>
The ~~ess~~airQualityLongitude of 180 degrees West shall be -180,000,000. The
~~ess~~airQualityLongitude of 180 degrees East shall be 180,000,000. The value
180,000,001 shall indicate a missing value.
<Data Concept Type>Data Element
<Unit>longitude
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.4"
REFERENCE   "Resolution based on on-going location referencing activities;
the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by
dividing this value by 10."
::=   { airQualitySensorEntry 4 }
```

5.14.12.5 Air Quality Sensor Location

```
airQualitySensorLocation OBJECT-TYPE
SYNTAX      DisplayString (SIZE (0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A textual string indicating the location of the air
quality sensor.
~~<SetConstraint>always~~
<DescriptiveName>AirQualitySensor.location:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.5"
::= { airQualitySensorEntry 5 }
```

5.14.12.6 Air Quality Sensor Model Information

```
airQualitySensorModelInformation OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP
1201) that contains information about the make, model, and version number of
the sensor associated with this row of the AirQuality Sensor Table.
<DescriptiveName>AirQualitySensor.modelInformation:identifier
<Valid Value Rule>
The value of zero indicates that this information is not available.
```

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```
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.12.11.6"
::= { airQualitySensorEntry 6 }
```

~~5.16~~5.15 Water Quality Parameters

```
--This node contains objects used for monitoring water quality
-- conditions. Reserved for future use.
essNtcipWaterQuality OBJECT IDENTIFIER ::= { essNtcip 13 }
```

~~5.17~~5.16 Snapshot Parameters

```
-- Contains objects used to describe the snapshot camera feature
essNtcipSnapshot  OBJECT IDENTIFIER ::= { essNtcip 14 }
```

~~5.17.1~~5.16.1 Number of Snapshot Cameras

```
essSnapshotNumberOfCameras OBJECT-TYPE
SYNTAX      INTEGER (0..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the number of cameras that can be utilized
for capturing snapshots on the ESS.
<Informative>This value may automatically change upon connecting or
disconnecting a camera; however, the table is still defined as a static table
since the creation/deletion of rows is not managed through SNMP logic.
<SetConstraint>read-only
<DescriptiveName>SnapshotCameraTable.numCameras:quantity
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.1"
::=   { essNtcipSnapshot 1 }
```

~~5.17.2~~5.16.2 Snapshot Camera Table

```
essSnapshotCameraTable OBJECT-TYPE
SYNTAX      SEQUENCE OF EssSnapshotCameraEntry
ACCESS      not-accessible
STATUS      mandatory
DESCRIPTION "<Definition>The snapshot camera table provides summary
information about the snapshot cameras supported by the ESS.  It can be
described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>SnapshotCameraTable
<Data Concept Type>Class
<TableType>-static
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2"
::=   { essNtcipSnapshot 2 }
```

~~5.17.3~~5.16.3 Snapshot Camera

```
essSnapshotCameraEntry OBJECT-TYPE
SYNTAX      EssSnapshotCameraEntry
ACCESS      not-accessible
STATUS      mandatory
```

```
DESCRIPTION "<Definition>A snapshot camera is a camera that is able to
capture a picture and store it within the device's memory as a file.  It can
be described through a number of attributes as indicated by the following
subclauses.
<DescriptiveName>SnapshotCamera
<Data Concept Type>Class"
INDEX { essSnapshotCameraIndex }
::=   { essSnapshotCameraTable 1 }

EssSnapshotCameraEntry ::= SEQUENCE {
      essSnapshotCameraIndex        INTEGER,
      essSnapshotCameraDescription  DisplayString,
      essSnapshotCameraStoragePath  DisplayString,
      essSnapshotCameraCommand      INTEGER,
      essSnapshotCameraError        INTEGER,
      essSnapshotCameraFilename     OCTET STRING }
```

~~5.17.3.1~~5.16.3.1 Snapshot Camera Index

```
essSnapshotCameraIndex OBJECT-TYPE
SYNTAX      INTEGER (1..255)
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the row number of this entry.
<SetConstraint>index
<DescriptiveName>SnapshotCamera.index:identifier
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.1"
::= { essSnapshotCameraEntry 1 }
```

~~5.17.3.2~~5.16.3.2 Snapshot Camera Description

```
essSnapshotCameraDescription OBJECT-TYPE
SYNTAX      DisplayString (SIZE(1..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the description of this entry. The
description should include information about the location, direction (for
fixed cameras), and subject of the camera.
<SetConstraint>read-only
<DescriptiveName>SnapshotCamera.description:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.2"
::= { essSnapshotCameraEntry 2 }
```

~~5.17.3.3~~5.16.3.3 Snapshot Camera Storage Path

```
essSnapshotCameraStoragePath OBJECT-TYPE
SYNTAX      DisplayString (SIZE(1..255))
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the storage path of snapshots taken from
this camera. The path indicated here shall be relative to the FTP login root.
This path can only include the FTP login root and its subdirectories and
cannot include any parent directories that may exist. The root is specified
```

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```
by the string '/' (one forward slash. A subdirectory from the root may be
specified by the string '/subdir'.
<SetConstraint>read-only
<DescriptiveName>SnapshotCamera.storagePath:text
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.3"
DEFVAL { "/" }
::= { essSnapshotCameraEntry 3 }
```

5.17.3.45.16.3.4 Snapshot Camera Command

```
essSnapshotCameraCommand OBJECT-TYPE
SYNTAX      INTEGER {   ready(1),
                        captureSnapshot(2) }
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>A command to control the snapshot feature of the
ESS. Setting this object to a value of captureSnapshot(2) will command the
ESS to take a snapshot and save the image to memory. A Get of this object
will return a value of captureSnapshot(2) while the ESS is in the process of
capturing and saving the image to memory. A Get of this object when the ESS
is not in the process of capturing and saving the image to memory will return
a value of ready(1). If any errors occur in the process of capturing and
saving the image they shall be noted in essSnapshotError.
<Informative>Version 02 of this standard had a typo for the ACCESS; this
object must be read-write for the camera to capture a snapshot image.
<SetConstraint> Can only be set to 'captureSnapshot' when value is currently
'ready'; any other SET shall return a genErr, including a SET to 'ready'.
<DescriptiveName>SnapshotCamera.command:code
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.4"
::= { essSnapshotCameraEntry 4 }
```

5.17.3.55.16.3.5 Snapshot Camera Error

```
essSnapshotCameraError OBJECT-TYPE
SYNTAX      INTEGER {   none(1),
                        hardware(2),
                        insufficientMemory(3) }
ACCESS      read-only
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the status of the last attempt to capture
a snapshot using essSnapshotCommand.
<SetConstraint>read-only
<DescriptiveName>SnapshotCamera.error:code
<Valid Value Rule>
none - no error was detected
hardware - an error occurred with the camera hardware when attempting to
capture a picture.
insufficientMemory - the ESS does not have sufficient memory to store the new
picture.
<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.5"
::= { essSnapshotCameraEntry 5 }
```

~~5.17.3.6~~5.16.3.6 Snapshot Camera Filename

```
-- EDITORS NOTE. In 2008, the ESS WG was considering a comment to revise the
-- syntax to OCTET STRING (SIZE (1..255)) to prevent zero-length names.
-- Also, to add a DEFVAL clause to initialize the value to 'x'.
-- A note of caution has been added to the informative subfield.
-- This revision may require deprecation of this object in a future version.

essSnapshotCameraFilename OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(0..255))
ACCESS      read-write
STATUS      mandatory
DESCRIPTION "<Definition>Indicates the filename used when storing new
snapshot images. This parameter shall only consist of upper and lower case
characters (A-Z, a-z), digits (0-9), underscores (_), periods (.), spaces,
and the following case-sensitive field names enclosed in chevrons (<>):

camera: A three digit camera number equal to essSnapshotCameraIndex.
sequence: A three digit value that increments by one each time this
      camera is used to take a picture. This value shall roll-over from '999'
      to '000'. The initial value of this field and its value after a power
      outage is manufacture dependent.
date: A six digit code indicating the UTC date in the format of YYMMDD.
time: A six digit code indicating the UTC time in the format of HHMMSS.

All implementations shall support all static character filenames with up to
eight characters in the base filename, a period, and up to three characters
in the filename extension. Support for longer filenames and the above fields
are optional.

For example, if this parameter has a value of 'latest.jpg', every snapshot
taken will be saved to 'latest.jpg' and will overwrite any previous image
saved to that filename. If this parameter has a value of '<date>
<sequence>.jpg', each snapshot will have a name (e.g., '060925 038')
indicating the date it was taken along with a relatively unique code. While
the second form prevents the inadvertent overwriting of filenames, it
increases the likelihood of consuming large amounts of field device memory
(eventually resulting in insufficientMemory errors) if not properly managed
by the management station.

<Informative>The filename does not necessarily define file format and it is
left to the users to define an appropriate filename.  For example, this
object may be set to a value of 'latest.bmp'.  All implementations would be
required to save their images with this filename; however, the image saved
may vary.  Some implementations may only save bitmapped images and the file
would have an appropriate name.  Other implementations may only save JPEG
images and the '.bmp' extension may be confusing.  Other implementations may
support both formats and use the extension in this field to select the
storage format, while yet others may support both formats but ignore the
extension assigned by this field (and use some other mechanism to select the
storage format).

A zero length filename may result in unexpected operations.  An
implementation may reject a zero length filename by responding with genErr.

~~<SetConstraint>always~~
<DescriptiveName>SnapshotCamera.filename:text
```

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<Data Concept Type>Data Element
<Object Identifier> 1.3.6.1.4.1.1206.4.2.5.2.14.2.6"
::= { essSnapshotCameraEntry 6 }

~~END~~

~~5.18~~5.17 Snapshot

A snapshot is an image captured in a computer file. It can be described through a number of attributes as indicated. However, these objects are not SNMP Objects.

~~5.18.1~~5.17.1 Filename

<Definition> The name of the file in which the snapshot image is stored.
<Descriptive Name> Snapshot.filename:text
<Data Concept Type> Data Element

~~5.18.2~~5.17.2 Image

<Definition> The graphic snapshot image. The storage format is not defined by this standard.
<DescriptiveName>~~-~~Snapshot.image:frame
<Data Concept Type> Data Element

~~Pressure Data Objects~~

~~-- Contains objects used to describe the data that is collected by the~~
~~-- atmospheric pressure sensors.~~

~~essNtcipPressure OBJECT IDENTIFIER ::= { essNtcip 16 }~~

~~Number of Pressure Sensors~~

~~essNumPressureSensors OBJECT-TYPE~~
~~SYNTAX INTEGER (0..255)~~
~~ACCESS read-only~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>Indicates the number of entries in the pressure sensor table.~~
~~<Informative>This value may automatically change upon connecting or disconnecting a sensor; however, the table is still defined as a static table since the creation/deletion of rows is not managed through SNMP logic.~~
~~<SetConstraint>read-only~~
~~<DescriptiveName>PressureSensorTable.numSensors:quantity~~
~~<Data Concept Type>Data Element~~
~~<Unit>count"~~
~~::= { essNtcipPressure 1 }~~

~~Pressure Sensor Table~~

~~essPressureSensorTable OBJECT-TYPE~~
~~SYNTAX SEQUENCE OF EssPressureSensorEntry~~
~~ACCESS not-accessible~~
~~STATUS mandatory~~

```
DESCRIPTION "<Definition>Table containing the pressure sensor data.
<DescriptiveName>PressureSensorTable
<Data Concept Type>Class
<TableType> static"
::=    { essNtcipPressure 2 }
```

Pressure Sensor

```
essPressureSensorEntry OBJECT-TYPE
SYNTAX       EssPressureSensorEntry
ACCESS       not-accessible
STATUS       mandatory
DESCRIPTION "<Definition>A pressure sensor is a sensor that reports the
atmospheric pressure. It can be described through a number of attributes as
indicated by the following subclauses.
<DescriptiveName>PressureSensor
<Data Concept Type>Class"
INDEX { essPressureSensorIndex }
::=    { essPressureSensorTable 1 }

EssPressureSensorEntry ::= SEQUENCE {
       essPressureSensorIndex                INTEGER,
       essPressureSensorHeight               INTEGER,
       essPressureSensorLatitude             INTEGER,
       essPressureSensorLongitude            INTEGER,
       essPressureSensorLocation             DisplayString,
       essPressureSensorModelInformation     INTEGER,
       -- SENSOR READINGS
       essPressureSensorAtmosphericPressure       INTEGER}
```

Pressure Sensor Index

```
essPressureSensorIndex OBJECT-TYPE
SYNTAX       INTEGER (1..255)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>Enumerated list of row entries that will provide
atmospheric pressure sensor data.
<SetConstraint>index
<DescriptiveName>PressureSensor.index:identifier
<Data Concept Type>Data Element"
::= { essPressureSensorEntry 1 }
```

Pressure Sensor Height

```
essPressureSensorHeight OBJECT-TYPE
SYNTAX       INTEGER (-1000..1001)
ACCESS       read-only
STATUS       mandatory
DESCRIPTION "<Definition>The height of the pressure sensor with respect to
the essReferenceHeight in meters.
<SetConstraint>read-only
<DescriptiveName>PressureSensor.height:quantity
<Valid Value Rule>
The value of 1001 shall indicate a missing value.
<Data Concept Type>Data Element
```

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~~<Unit>meters"~~
~~REFERENCE "essReferenceHeight plus this value equals the WMO Binary Code Form FM 94 BUFR Table B item 0 07 001."~~
~~::= { essPressureSensorEntry 2 }~~

~~Pressure Sensor Latitude~~

~~essPressureSensorLatitude OBJECT-TYPE~~
~~SYNTAX INTEGER (-90000000..90000001)~~
~~ACCESS read-only~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>The latitude in 10^-6 degrees of the ESS pressure sensor, per WGS-84 datum.~~
~~<SetConstraint>read-only~~
~~<DescriptiveName>PressureSensor.latitude:quantity~~
~~<Valid Value Rule>~~
~~The essLatitude at the North Pole is 90,000,000. The essLatitude at the South Pole is -90,000,000. The value 90,000,001 shall indicate a missing value.~~
~~<Data Concept Type>Data Element~~
~~<Unit>latitude"~~
~~REFERENCE "Resolution based on on-going location referencing activities; the WMO Binary Code Form FM 94 BUFR Table B item 0 05 001 can be obtained by dividing this value by 10."~~
~~::= { essPressureSensorEntry 3 }~~

~~Pressure Sensor Longitude~~

~~essPressureSensorLongitude OBJECT-TYPE~~
~~SYNTAX INTEGER (-180000000..180000001)~~
~~ACCESS read-only~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>The east longitude in 10^-6 degrees from the Prime Meridian of the ESS pressure sensor location.~~
~~<SetConstraint>read-only~~
~~<DescriptiveName>PressureSensor.longitude:quantity~~
~~<Valid Value Rule>~~
~~The essLongitude of 180 degrees West shall be -180,000,000. The essLongitude of 180 degrees East shall be 180,000,000. The value 180,000,001 shall indicate a missing value.~~
~~<Data Concept Type>Data Element~~
~~<Unit>longitude"~~
~~REFERENCE "Resolution based on on-going location referencing activities; the WMO Binary Code Form FM 94 BUFR Table B item 0 06 001 can be obtained by dividing this value by 10."~~
~~::= { essPressureSensorEntry 4 }~~

~~Pressure Sensor Location~~

~~essPressureSensorLocation OBJECT-TYPE~~
~~SYNTAX DisplayString (SIZE (0..255))~~
~~ACCESS read-write~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>A textual string indicating the location of the pressure sensor.~~
~~<SetConstraint>always~~
~~<DescriptiveName>PressureSensor.location:text~~

~~<Data Concept Type>Data Element"~~
~~::= { essPressureSensorEntry 5 }~~

~~**Pressure Sensor Model Information**~~

~~essPressureSensorModelInformation OBJECT-TYPE~~
~~SYNTAX INTEGER (0..255)~~
~~ACCESS read-write~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>Indicates the row in the Module Table (See NTCIP 1201) that contains information about the make, model, and version number of the sensor associated with this row of the Pressure Sensor Table.~~
~~<DescriptiveName>PressureSensor.modelInformation:identifier~~
~~<Valid Value Rule>~~
~~The value of zero indicates that this information is not available.~~
~~<Data Concept Type>Data Element"~~
~~::= { essPressureSensorEntry 6 }~~

~~**Pressure Sensor Atmospheric Pressure**~~

~~essPressureSensorAtmosphericPressure OBJECT-TYPE~~
~~SYNTAX INTEGER (0..65535)~~
~~ACCESS read-only~~
~~STATUS mandatory~~
~~DESCRIPTION "<Definition>The force per unit area exerted by the atmosphere in 1/10ths of millibars, a.k.a. tenths of hectoPascals.~~
~~<SetConstraint>read-only~~
~~<DescriptiveName>PressureSensor.atmosphericPressure:quantity~~
~~<Valid Value Rule>~~
~~A value of 65535 shall indicate an error condition or missing value.~~
~~<Data Concept Type>Data Element~~
~~<Unit>Decapascal"~~
~~REFERENCE "WMO Binary Code Form FM 94 BUFR Table B item 0 07 004."~~
~~::= { essPressureSensorEntry 7 }~~

END

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~~Annex B~~Annex A
Requirements Traceability Matrix (RTM) [Normative]

The Requirements Traceability Matrix (RTM) links the Functional Requirements as presented in Section 3 with the corresponding Dialogs (Section 4.2) on the same (gray) line. Each Functional Requirement/Dialog relates/uses one or more groups of Objects. The Objects (also known as Data Elements) are listed to the side; the formal definition of each object is contained within Section 5. Using this table, each Functional Requirement can thus be traced in a standardized way.

> Note: The INDEX objects into any of the tables are not explicitly exchanged but are used as index values for other objects that are exchanged.

The audience for this table is implementers (vendors and central system developers) and conformance testers. Additionally, other interested parties might use this table to determine how particular functions are to be implemented using the standardized dialogs, interfaces, and object definitions.

To conform to a Functional Requirement, an ESS shall implement all Objects and Dialogs traced from that Functional Requirement; a Management Station shall implement all Dialogs traced from the Functional Requirement. In order to be consistent with a Functional Requirement, a Management Station shall be able to fulfill the Functional Requirement using only Objects and Dialogs that a conforming ESS is required to support.

Section 3.6 defines Supplemental Requirements, which are refining other functional requirements. These functional requirements in turn are generally traced to design elements (e.g., rather than being directly traced to design elements). ~~The Supplemental RTM in Section A.4 below identifies and traces the implied relationships between supplemental requirements and direct requirements.~~

~~B.1~~A.1 Notation [informative]

~~B.1.1~~A.1.1 Functional Requirement Columns

The functional requirements are defined within Section 3 and the RTM is based upon the requirements within that Section. The section number and the functional requirement name are indicated within these columns.

~~B.1.2~~A.1.2 Dialog Column

The standardized dialogs are defined within Section 4 and the RTM references the traces from requirements to this dialog. The section number of the dialog is indicated within this column.

~~B.1.3~~A.1.3 Object Columns

The objects are defined within Section 5 of NTCIP 1204 v04 and Section 2 of NTCIP 1201. The RTM references the data objects that are referenced by the dialog. The section number and object name are indicated within these columns.

~~B.1.4~~A.1.4 Additional Specifications

The "Additional Specifications" column may (and should) be used to provide additional notes and requirements about the dialog or may be used by an implementer to provide any additional details about the implementation.

~~B.2~~A.2 Instructions for Completing the RTM [Informative]

To find the standardized design content for a functional requirement, search for the requirement identification number and functional requirement under the functional requirements columns. Next to the functional requirements column will be a dialog identification number, identifying either a generic dialog (found in ~~Section G.3~~Annex G) or a specified dialog (found in Section 4.2) to be used to fulfill that requirement. To the right of the dialog identification number are the identification number and name of the data objects that are referenced or used by the dialog to fulfill the functional requirement. Object definitions specific to NTCIP 1204 v04 can be found in Section 5. If an object is defined in a different standard, that standard shall be listed first, followed by the section number where the object definition can be found. The "Additional Specifications" column will provide additional notes or details about the design content.

~~B.3~~A.3 Requirements Traceability Matrix (RTM) Table

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.4	**Architectural Requirements**				
3.5	**Data Exchange and Operational Environment Requirements**				
3.5.1	ESS Manager Requirements				
3.5.1.1	ESS Configuration Requirements				
3.5.1.1.1	Retrieve ESS Characteristics	G.1			
			5.2.1	essNtcipCategory	
			5.2.2	essNtcipSiteDescription	
			5.3.1	essTypeofStation	
			5.4.1	essLatitude	
			5.4.2	essLongitude	
			5.5.1	essReferenceHeight	
3.5.1.1.2	Retrieve Compressed Station Metadata [Deprecated]	~~G.1~~			See 3.5.4.17.

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			~~5.3.8~~	~~essStationMetaDataV3Block~~	
3.5.1.1.3	Configure ESS Manager	G.3			
			5.2.2	essNtcipSiteDescription	
3.5.1.2	ESS Status Monitoring Requirements				
3.5.1.2.1	Retrieve ESS Door Status	G.1			
			5.3.2	essDoorStatus	
3.5.1.2.2	Retrieve Battery Status	G.1			
			5.3.3	essBatteryStatus	
3.5.1.2.3	Retrieve Line Volts	G.1			
			5.3.4	essLineVolts	
3.5.1.2.4	Retrieve ESS Status	G.1			
			5.3.10	essStatus	
3.5.1.3	ESS Data Retrieval Requirements				
3.5.1.3.1	Retrieve Mobile ESS Movement	G.1			
			5.4.1	essLatitude	
			5.4.2	essLongitude~~essLongitude~~	
			5.4.3	essVehicleSpeed	
			5.4.4	essVehicleBearing	
			5.4.5	essOdometer	-
			5.5.1	essReferenceHeight	
3.5.1.3.2	Retrieve Mobile Treatment Information [Obsolete]~~[Deprecated in v03]~~				
3.5.1.3.3	Retrieve Compressed Mobile ESS Data [Version 03 - Deprecated in v04]	~~G.1~~			See 3.5.4.18.
	-	-	~~5.3.75.3.7~~	~~essMobileBlock~~	
~~G.1~~3.5.1.4	ESS Control Requirements				
3.5.2	Sensor Manager Requirements				
3.5.2.1	Sensor Configuration Requirements				
3.5.2.1.1	Retrieve Atmospheric Pressure Height [Versions 01 to 03 Only - Deprecated in v04]	~~G.1~~			See 3.5.4.19.

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
		-	~~5.5.25.5.2~~	~~essPressureHeight~~	
3.5.2.1.2	Retrieve Metadata for Each Wind Sensor - Text Description	F.3.3.1		-	
			5.6.8	windSensorTableNumSensors	
			5.6.10.1	windSensorIndex	
			5.6.10.2	windSensorHeight	
			5.6.10.3	windSensorLocation	
3.5.2.1.3	Retrieve Temperature Sensor Metadata - Height	F.3.3.1			
			5.7.1	essNumTemperatureSensors	
			5.7.3.1	essTemperatureSensorIndex	
			5.7.3.2	essTemperatureSensorHeight	
3.5.2.1.4	Retrieve Pavement Sensor Metadata	F.3.3.1			
			5.11.1	numEssPavementSensors	-
			5.11.3.1	essPavementSensorIndex	-
			5.11.3.2	essPavementSensorLocation	-
			5.11.3.3	essPavementType	-
			5.11.3.4	essPavementElevation	-
			5.11.3.5	essPavementExposure	-
			5.11.3.6	essPavementSensorType	-
3.5.2.1.5	Retrieve Subsurface Sensor Metadata - Text Description	F.3.3.1			
			5.11.4	numEssSubSurfaceSensors	-
			5.11.6.1	essSubSurfaceSensorIndex	-
			5.11.6.2	essSubSurfaceSensorLocation	-
			5.11.6.3	essSubSurfaceType	-
			5.11.6.4	essSubSurfaceSensorDepth	-
3.5.2.1.6	Configure Pavement Sensor	F.3.3.3			
			5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	-
			5.11.3.2	essPavementSensorLocation	-
			5.11.3.3	essPavementType	-
			5.11.3.5	essPavementExposure	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.1.7	Configure Subsurface Sensor - Text Description	F.3.3.3			
			5.11.6.1	essSubSurfaceSensorIndex	-
			5.11.6.2	essSubSurfaceSensorLocation	-
			5.11.6.3	essSubSurfaceType	-
			5.11.6.4	essSubSurfaceSensorDepth	-
3.5.2.1.8	Configure Passive Ice Detection Logic	4.2.8			
			5.13.1	numEssTreatments	-
			5.13.3.1	essPavementTreatmentIndex	-
			5.13.3.2	essPaveTreatProductType	-
			5.13.3.3	essPaveTreatProductForm	-
			5.13.3.4	essPercentProductMix	-
3.5.2.1.9	Configure Snapshot Camera	4.2.10			
			5.16.3.1	essSnapshotCameraIndex	
			5.16.3.2	essSnapshotCameraDescription	
			5.16.3.6	essSnapshotCameraFilename	
3.5.2.1.10	Manage Atmospheric Pressure Metadata				
3.5.2.1.10.1	Retrieve Atmospheric Pressure Metadata - Location	F.3.3.1			
			5.5.51.1.1	essNumPressureSensors	-
			5.5.7.11.1.1.1	essPressureSensorIndex	-
			5.5.7.21.1.1.1	essPressureSensorHeight	-
			5.5.7.3~~5.18.3.3~~	essPressureSensorLatitude	-
			5.5.7.41.1.1.1	essPressureSensorLongitude	-
			5.5.7.51.1.1.1	essPressureSensorLocation	-
3.5.2.1.10.2	Retrieve Atmospheric Pressure Metadata - Sensor Information	F.3.3.1			
			5.5.51.1.1	essNumPressureSensors	-
			5.5.7.11.1.1.1	essPressureSensorIndex	-
			5.5.7.61.1.1.1	essPressureSensorModelInformation	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.1.10.3~~3.5.2.1.10.3~~	Configure Atmospheric Pressure Metadata - Location~~Configure Atmospheric Pressure Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.5.51.1.1~~5.18.1~~	essNumPressureSensors~~essNumPressureSensors~~	
			5.5.7.11.1.1.1~~5.18.3.1~~	essPressureSensorIndex~~essPressureSensorIndex~~	
			5.5.7.21.1.1.1~~5.18.3.2~~	essPressureSensorHeight	
			5.5.7.31.1.1.1~~5.18.3.3~~	essPressureSensorLatitude	
			5.5.7.41.1.1.1~~5.18.3.4~~	essPressureSensorLongitude	
			5.5.7.51.1.1.1~~5.18.3.5~~	essPressureSensorLocation	
3.5.2.1.11	Manage Wind Sensor Metadata				
3.5.2.1.11.1~~3.5.2.1.11.1~~	Retrieve Metadata for Each Wind Sensor - Location~~Retrieve Metadata for Each Wind Sensor - Coordinates~~	F.3.3.1~~F.3.3.1~~			
			5.6.8~~5.6.8~~	windSensorTableNumSensors	-
			5.6.10.1~~5.6.10.1~~	windSensorIndex	-
			5.6.10.11~~5.6.10.11~~	windSensorLatitude	-
			5.6.10.12~~5.6.10.12~~	windSensorLongitude	-
3.5.2.1.11.2~~3.5.2.1.11.2~~	Retrieve Metadata for Each Wind Sensor - Sensor Information~~Retrieve Metadata for Each Wind Sensor - Sensor Information~~	F.3.3.1~~F.3.3.1~~			
			5.6.8~~5.6.8~~	windSensorTableNumSensors~~windSensorTableNumSensors~~	-
			5.6.10.1~~5.6.10.1~~	windSensorIndex~~windSensorIndex~~	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.6.10.13~~5.6.10.13~~	windSensorModelInformation	-
3.5.2.1.11.3~~3.5.2.1.11.3~~	Configure Wind Sensor Metadata - Location~~Configure Wind Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.6.8~~5.6.8~~	windSensorTableNumSensors~~windSensorTableNumSensors~~	
			5.6.10.1~~5.6.10.1~~	windSensorIndex~~windSensorIndex~~	
			5.6.10.2~~5.6.10.2~~	windSensorHeight	
			5.6.10.3~~5.6.10.3~~	windSensorLocation	
			5.6.10.11~~5.6.10.11~~	windSensorLatitude~~windSensorLatitude~~	
			5.6.10.12~~5.6.10.12~~	windSensorLongitude~~windSensorLongitude~~	
3.5.2.1.12	Manage Temperature Sensor Metadata				
3.5.2.1.12.1~~3.5.2.1.12.1~~	Retrieve Temperature Sensor Metadata - Location~~Retrieve Temperature Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
			5.7.1~~5.7.1~~	essNumTemperatureSensors	-
			5.7.3.1~~5.7.3.1~~	essTemperatureSensorIndex	-
			5.7.3.2~~5.7.3.2~~	essTemperatureSensorHeight	-
			5.7.3.4~~5.7.3.4~~	essTemperatureSensorLatitude	-
			5.7.3.5~~5.7.3.5~~	essTemperatureSensorLongitude	-
			5.7.3.6~~5.7.3.6~~	essTemperatureSensorLocation	-
3.5.2.1.12.2~~3.5.2.1.12.2~~	Retrieve Temperature Sensor Metadata - Sensor Information~~Retrieve Temperature Sensor Metadata - Sensor Information~~	F.3.3.1~~F.3.3.1~~			
			5.7.1~~5.7.1~~	essNumTemperatureSensors~~essNumTemperatureSensors~~	-

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.7.3.1~~5.7.3.1~~	essTemperatureSensorIndex~~essTemperatureSensorIndex~~	-
			5.7.3.7~~5.7.3.7~~	essTemperatureSensorModelInformation	-
3.5.2.1.12.3~~3.5.2.1.12.3~~	Configure Temperature Sensor Metadata - Location~~Configure Temperature Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.7.1~~5.7.1~~	essNumTemperatureSensors~~essNumTemperatureSensors~~	
			5.7.3.1~~5.7.3.1~~	essTemperatureSensorIndex~~essTemperatureSensorIndex~~	
			5.7.3.2~~5.7.3.2~~	essTemperatureSensorHeight~~essTemperatureSensorHeight~~	
			5.7.3.4~~5.7.3.4~~	essTemperatureSensorLatitude~~essTemperatureSensorLatitude~~	
			5.7.3.5~~5.7.3.5~~	essTemperatureSensorLongitude~~essTemperatureSensorLongitude~~	
			5.7.3.6~~5.7.3.6~~	essTemperatureSensorLocation~~essTemperatureSensorLocation~~	
3.5.2.1.13	Manage Humidity Sensor Metadata				
3.5.2.1.13.1	Retrieve Humidity Sensor Metadata - Location	F.3.3.1			
			5.8.25	humiditySensorTableNumSensors	-
			5.8.27.1	humiditySensorIndex	-
			5.8.27.2	humiditySensorHeight	-
			5.8.27.3	humiditySensorLatitude	-
			5.8.27.4	humiditySensorLongitude	-
			5.8.27.5	humiditySensorLocation	-
3.5.2.1.13.2	Retrieve Humidity Sensor Metadata - Sensor Information	F.3.3.1			
			5.8.25	humiditySensorTableNumSensors	-
			5.8.27.1	humiditySensorIndex~~humiditySensorIndex~~	-
			5.8.27.6	humiditySensorModelInformation	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.1.13.3	Configure Humidity Sensor Metadata - Location	F.3.3.3			
			5.8.25	humiditySensorTableNumSensors	-
			5.8.27.1	humiditySensorIndex	-
			5.8.27.2	humiditySensorHeight	-
			5.8.27.3	humiditySensorLatitude	-
			5.8.27.4	humiditySensorLongitude	-
			5.8.27.5	humiditySensorLocation	-
3.5.2.1.14	Manage Precipitation Sensor Metadata				-
3.5.2.1.14.1	Retrieve Precipitation Sensor Metadata - Location	F.3.3.1			
			5.8.22	precipitationSensorTableNumSensors	-
			5.8.24.1	precipitationSensorIndex	-
			5.8.24.2	precipitationSensorHeight	-
			5.8.24.3	precipitationSensorLatitude	-
			5.8.24.4	precipitationSensorLongitude	-
			5.8.24.5	precipitationSensorLocation	-
3.5.2.1.14.2	Retrieve Precipitation Sensor Metadata - Sensor Information	F.3.3.1			
			5.8.22	precipitationSensorTableNumSensors	
			5.8.24.1	precipitationSensorIndex	
			5.8.24.6	precipitationSensorModelInformationV4	
3.5.2.1.14.3	Configure Precipitation Sensor Metadata - Location	F.3.3.3			
			5.8.22	precipitationSensorTableNumSensors	
			5.8.24.1	precipitationSensorIndex	
			5.8.24.2	precipitationSensorHeight	
			5.8.24.3	precipitationSensorLatitude	
			5.8.24.4	precipitationSensorLongitude	
			5.8.24.5	precipitationSensorLocation	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.1.14.4~~3.5.2.1.14.5~~	Configure Precipitation Total User Specified Period~~Configure Precipitation Total User Specified Period~~	F.3.3.3~~F.3.3.3~~			
			5.8.22~~5.8.22~~	precipitationSensorTableNumSensors~~precipitationSensorTableNumSensors~~	
			5.8.24.1~~5.8.24.1~~	precipitationSensorIndex~~precipitationSensorIndex~~	
			5.8.24.7~~5.8.24.7~~	precipitationSensorPeriod	
3.5.2.1.15~~3.5.2.1.15~~	Manage Solar Radiation Sensor Metadata~~Manage Solar Radiation Sensor Metadata~~				
3.5.2.1.15.1~~3.5.2.1.15.1~~	Retrieve Solar Radiation Sensor Metadata - Location~~Retrieve Solar Radiation Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
			5.9.10.2~~5.9.8~~	radiationSensorHeight	-
			5.9.10.3~~5.9.9~~	radiationSensorLatitude	-
			5.9.10.4~~5.9.10~~	radiationSensorLongitude	-
			5.9.10.5~~5.9.11~~	radiationSensorLocation	-
3.5.2.1.15.2~~3.5.2.1.15.2~~	Retrieve Solar Radiation Sensor Metadata - Sensor Information~~Retrieve Solar Radiation Sensor Metadata - Sensor Information~~	F.3.3.1~~F.3.3.1~~			
			5.9.10.6~~5.9.12~~	radiationSensorModelInformation	-
3.5.2.1.15.3~~3.5.2.1.15.3~~	Configure Solar Radiation Sensor Metadata - Location~~Configure Solar Radiation Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.9.10.2~~5.9.8~~	radiationSensorHeight~~radiationSensorHeight~~	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.9.10.3~~5.9.9~~	radiationSensorLatitude~~radiationSensorLatitude~~	-
			5.9.10.4~~5.9.10~~	radiationSensorLongitude~~radiationSensorLongitude~~	-
			5.9.10.5~~5.9.11~~	radiationSensorLocation~~radiationSensorLocation~~	-
3.5.2.1.16~~3.5.2.1.16~~	Manage Visibility Sensor Metadata~~Manage Visibility Sensor Metadata~~				
3.5.2.1.16.1~~3.5.2.1.16.1~~	Retrieve Visibility Sensor Metadata - Location~~Retrieve Visibility Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
-	-	-	~~5.10.35.10.3~~	~~visibilitySensorTableNumSensors~~	-
-			~~5.10.5.15.10.5.1~~	~~visibilitySensorIndex~~	-
			5.10.35.10.3~~5.10.5.2~~	visibilitySensorHeight	-
			5.10.45.10.4~~5.10.5.3~~	visibilitySensorLatitude	-
			5.10.55.10.5~~5.10.5.4~~	visibilitySensorLongitude	-
			5.10.65.10.6~~5.10.5.5~~	visibilitySensorLocation	-
3.5.2.1.16.2~~3.5.2.1.16.2~~	Retrieve Visibility Sensor Metadata - Sensor Information~~Retrieve Visibility Sensor Metadata - Sensor Information~~	G.1~~F.3.3.1~~ ~~F.3.3.1~~			
-	-	-	~~5.10.35.10.3~~	~~visibilitySensorTableNumSensors~~visibilitySensorTableNumSensors	-
-			~~5.10.5.15.10.5.1~~	~~visibilitySensorIndex~~visibilitySensorIndex	-
			5.10.75.10.7~~5.10.5.6~~	visibilitySensorModelInformation	-
3.5.2.1.16.3~~3.5.2.1.16.3~~	Configure Visibility Sensor Metadata - Location~~Configure Visibility Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.10.31.1.1~~5.10.3~~	visibilitySensorHeight~~visibilitySensorTableNumSensors~~~~visibilitySensorTableNumSensors~~	-
-			~~5.10.5.15.10.5.1~~	~~visibilitySensorIndex~~~~visibilitySensorIndex~~	-
-			~~5.10.5.25.10.5.2~~	~~visibilitySensorHeight~~~~visibilitySensorHeight~~	-
			5.10.45.10.4~~5.10.5.3~~	visibilitySensorLatitude~~visibilitySensorLatitude~~	-
			5.10.55.10.5~~5.10.5.4~~	visibilitySensorLongitude~~visibilitySensorLongitude~~	-
			5.10.65.10.6~~5.10.5.5~~	visibilitySensorLocation~~visibilitySensorLocation~~	-
3.5.2.1.17~~3.5.2.1.17~~	Manage Pavement Sensor Metadata~~Manage Pavement Sensor Metadata~~				-
3.5.2.1.17.1~~3.5.2.1.17.1~~	Retrieve Pavement Sensor Metadata - Location~~Retrieve Pavement Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
			5.11.1~~5.11.1~~	numEssPavementSensors	-
			5.11.3.1~~5.11.3.1~~	essPavementSensorIndex	-
			5.11.3.2	essPavementSensorLocation	
			5.11.3.4	essPavementElevation	
			5.11.3.20~~5.11.3.20~~	pavementSensorLatitude	-
			5.11.3.21~~5.11.3.21~~	pavementSensorLongitude	-
			5.11.3.25	pavementMonitorLatitude	
			5.11.3.26	pavementMonitorLongitude	
3.5.2.1.17.2~~3.5.2.1.17.2~~	Retrieve Pavement Sensor Metadata - Sensor Information~~Retrieve Pavement Sensor Metadata - Sensor Information~~	F.3.3.1~~F.3.3.1~~			

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.11.1~~5.11.1~~	numEssPavementSensors~~numEssPavementSensors~~	-
			5.11.3.1~~5.11.3.1~~	essPavementSensorIndex~~essPavementSensorIndex~~	-
			5.11.3.18~~5.11.3.18~~	pavementSensorModelInformation	-
3.5.2.1.17.3~~3.5.2.1.17.3~~	Configure Pavement Sensor - Location~~Configure Pavement Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.11.1~~5.11.1~~	numEssPavementSensors~~numEssPavementSensors~~	-
			5.11.3.1~~5.11.3.1~~	essPavementSensorIndex~~essPavementSensorIndex~~	
			5.11.3.2	essPavementSensorLocation	
			5.11.3.4	essPavementElevation	
			5.11.3.20~~5.11.3.20~~	pavementSensorLatitude~~pavementSensorLatitude~~	
			5.11.3.21~~5.11.3.21~~	pavementSensorLongitude~~pavementSensorLongitude~~	
			5.11.3.25	pavementMonitorLatitude	
			5.11.3.26	pavementMonitorLongitude	
3.5.2.1.18~~3.5.2.1.18~~	Manage Subsurface Sensor Metadata~~Manage Subsurface Sensor Metadata~~				
3.5.2.1.18.1~~3.5.2.1.18.1~~	Retrieve Subsurface Sensor Metadata - Location~~Retrieve Subsurface Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
			5.11.4~~5.11.4~~	numEssSubSurfaceSensors	
			5.11.6.1~~5.11.6.1~~	essSubSurfaceSensorIndex	
			5.11.6.2	essSubSurfaceSensorLocation	
			5.11.6.4	essSubSurfaceSensorDepth	
			5.11.6.8~~5.11.6.8~~	essSubSurfaceSensorLatitude	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.11.6.9~~5.11.6.9~~	essSubSurfaceSensorLongitude	
3.5.2.1.18.2~~3.5.2.1.18.2~~	Retrieve Subsurface Sensor Metadata - Sensor Information~~Retrieve Subsurface Sensor Metadata - Sensor Information~~	F.3.3.1~~F.3.3.1~~			
			5.11.4~~5.11.4~~	numEssSubSurfaceSensors~~numEssSubSurfaceSensors~~	
			5.11.6.1~~5.11.6.1~~	essSubSurfaceSensorIndex~~essSubSurfaceSensorIndex~~	
			5.11.6.105.11.6.10~~5.11.6.10~~	essSubSurfaceSensorModelInformation	
3.5.2.1.18.3~~3.5.2.1.18.3~~	Configure Subsurface Sensor - Location~~Configure Subsurface Sensor Metadata - Location~~	F.3.3.3~~F.3.3.3~~			
			5.11.4~~5.11.4~~	numEssSubSurfaceSensors~~numEssSubSurfaceSensors~~	
			5.11.6.1~~5.11.6.1~~	essSubSurfaceSensorIndex~~essSubSurfaceSensorIndex~~	
			5.11.6.2	essSubSurfaceSensorLocation	
			5.11.6.4	essSubSurfaceSensorDepth	
			5.11.6.8~~5.11.6.8~~	essSubSurfaceSensorLatitude~~essSubSurfaceSensorLatitude~~	
			5.11.6.9~~5.11.6.9~~	essSubSurfaceSensorLongitude~~essSubSurfaceSensorLongitude~~	
3.5.2.1.19~~3.5.2.1.20~~	Manage Air Quality Sensor Metadata~~Manage Air Quality Sensor Metadata~~				
3.5.2.1.19.1	Retrieve Air Quality Sensor Metadata - Location~~Retrieve Air Quality Sensor Metadata - Location~~	F.3.3.1~~F.3.3.1~~			
			5.14.10~~5.14.10~~	airQualitySensorTableNumSensors	-
			5.14.11	airQualitySensorTable	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.14.12.1~~5.14.12.1~~	airQualitySensorIndex	-
			5.14.12.2~~5.14.12.2~~	airQualitySensorHeight	-
			5.14.12.3~~5.14.12.3~~	airQualitySensorLatitude	-
			5.14.12.4~~5.14.12.4~~	airQualitySensorLongitude	-
			5.14.12.5~~5.14.12.5~~	airQualitySensorLocation	-
3.5.2.1.19.2~~3.5.2.1.20.2~~	Retrieve Air Quality Sensor Metadata - Sensor Information~~Retrieve Air Quality Sensor Metadata - Sensor Information~~	F.3.3.1~~F.3.3.1~~			
			5.14.10	airQualitySensorTableNumSensors	-
			5.14.11	airQualitySensorTable	
			5.14.12.1	airQualitySensorIndex	-
			5.14.12.6	airQualitySensorModelInformation	-
3.5.2.1.19.3	Configure Air Quality Sensor Metadata - Location	F.3.3.3			
			5.14.10	airQualitySensorTableNumSensors	
			5.14.11	airQualitySensorTable	
			5.14.12.1	airQualitySensorIndex	
			5.14.12.2	airQualitySensorHeight	
			5.14.12.3	airQualitySensorLatitude	
			5.14.12.4	airQualitySensorLongitude	
			5.14.12.5	airQualitySensorLocation	
3.5.2.1.20~~3.5.2.1.21~~	Manage Water Level Sensor Metadata				
3.5.2.1.20.1~~3.5.2.1.21.1~~	Retrieve Water Level Metadata - Location	F.3.3.1			
			5.8.19	waterLevelSensorTableNumSensors	-
			5.8.21.1	waterLevelSensorIndex	-
			5.8.21.4	waterLevelSensorHeight	
			5.8.21.5	waterLevelSensorLatitude	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.8.21.6	waterLevelSensorLongitude	-
			5.8.21.7	waterLevelSensorLocation	-
			5.8.21.9	waterLevelSensorReferencePoint	
3.5.2.1.20.2	Retrieve Water Level Metadata - Sensor Information	F.3.3.1			
			5.8.19	waterLevelSensorTableNumSensors	-
			5.8.21.1	waterLevelSensorIndex	-
			5.8.21.8	waterLevelSensorModelInformation	-
3.5.2.1.20.3	Retrieve Water Level Metadata - Warning Level	F.3.3.1			
			5.8.19	waterLevelSensorTableNumSensors	-
			5.8.21.1	waterLevelSensorIndex	-
			5.8.21.3	waterLevelSensorWarningLevel	-
3.5.2.1.20.4	Configure Water Level Metadata - Location	F.3.3.3			
			5.8.19	waterLevelSensorTableNumSensors	
			5.8.21.1	waterLevelSensorIndex	
			5.8.21.4	waterLevelSensorHeight	
			5.8.21.5	waterLevelSensorLatitude	
			5.8.21.6	waterLevelSensorLongitude	
			5.8.21.7	waterLevelSensorLocation	
			5.8.21.9	waterLevelSensorReferencePoint	
3.5.2.1.20.5	Configure Water Level Metadata - Warning Level	F.3.3.3			
			5.8.19	waterLevelSensorTableNumSensors	
			5.8.21.1	waterLevelSensorIndex	
			5.8.21.3	waterLevelSensorWarningLevel	
3.5.2.1.21	Manage Pavement Treatment System Metadata	-	-	-	-
3.5.2.1.21.1	Retrieve Pavement Treatment System Metadata - Location	F.3.3.1	-	-	
-	-	-	5.13.21	essPavementTreatmentLatitude	
-			5.13.22	essPavementTreatmentLongitude	
-	-	-	5.13.23	essPavementTreatmentLocation	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.1.21.2	Retrieve Pavement Treatment Metadata - System Information	F.3.3.1	-	-	
-	-	-	5.13.24	essPavementTreatmentModelInformation	
3.5.2.1.21.3	Configure Pavement Treatment System Metadata - Location	F.3.3.3	-	-	
-	-	-	5.13.21	essPavementTreatmentLatitude	-
-			5.13.22	essPavementTreatmentLongitude	-
-			5.13.23	essPavementTreatmentLocation	-
3.5.2.2~~3.5.2.2~~	Sensor Status Monitoring Requirements				
3.5.2.3~~3.5.2.3~~	Sensor Data Retrieval Requirements				
3.5.2.3.1	Retrieve Weather Profile with Mobile Sources [Version 03 Only - Deprecated in v04]	~~G.1~~			See 3.5.4.20.
	-	-	~~5.12.3~~5.12.3	~~essMobileObservationPavement~~	-
3.5.2.3.2	Monitor Weather Condition				
3.5.2.3.2.1	Retrieve Atmospheric Pressure [Versions 01 to 03 Only - Deprecated in v04]	~~G.1~~G.1	-	-	See 3.5.4.21.
		-	~~5.5.4~~5.5.4	~~essAtmosphericPressure~~	
3.5.2.3.2.2	Retrieve Wind Data	F.3.3.1			
			5.6.8	windSensorTableNumSensors	
			5.6.9	windSensorTable	
			5.6.10.1	windSensorIndex	
			5.6.10.4	windSensorAvgSpeed	
			5.6.10.5	windSensorAvgDirection	
			5.6.10.6	windSensorSpotSpeed	
			5.6.10.7	windSensorSpotDirection	
			5.6.10.8	windSensorGustSpeed	
			5.6.10.9	windSensorGustDirection	
			5.6.10.10	windSensorSituation	
3.5.2.3.2.3	Retrieve Air Temperature	F.3.3.1~~G.1~~			
			5.7.1	essNumTemperatureSensors	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.7.2	essTemperatureSensorTable	
			5.7.3.1	essTemperatureSensorIndex	
			5.7.3.3	essAirTemperature	
3.5.2.3.2.4	Retrieve Daily Minimum and Maximum Temperature	G.1			
			5.7.6	essMaxTemp	
			5.7.7	essMinTemp	
3.5.2.3.2.5	Retrieve Humidity [Versions 01 to 03 Only - Deprecated in v04]	~~G.1G.1~~			See 3.5.4.22.
			~~5.7.4~~	~~essWetbulbTemp~~	
-			~~5.7.5~~	~~essDewpointTemp~~	-
-	-	-	~~5.8.1~~	~~essRelativeHumidity~~	-
3.5.2.3.2.6	Monitor Precipitation				
3.5.2.3.2.6.1	Retrieve Precipitation Presence [Versions 01 to 03 Only - Deprecated in v04]	~~4.2.124.2.12~~			See 3.5.4.23.
			~~5.8.6~~	~~essPrecipYesNo~~	
-	-	-	~~5.8.18~~	~~precipitationSensorModelInformation~~	-
3.5.2.3.2.6.2	Retrieve Precipitation Rates [Versions 01 to 03 Only - Deprecated in v04]	~~G.1G.1~~	-	-	See 3.5.4.24.
		-	~~5.8.75.8.7~~	~~essPrecipRate~~	
-			~~5.8.85.8.8~~	~~essSnowfallAccumRate~~	-
-			~~5.8.115.8.11~~	~~essPrecipitationStartTime~~	-
-	-	-	~~5.8.125.8.12~~	~~essPrecipitationEndTime~~	-
3.5.2.3.2.6.3	Retrieve Precipitation Totals [Versions 01 to 03 Only - Deprecated in v04]	~~G.1G.1~~			See 3.5.4.25.
			~~5.8.135.8.13~~	~~essPrecipitationOneHour~~	
-			~~5.8.145.8.14~~	~~essPrecipitationThreeHours~~	-
-			~~5.8.155.8.15~~	~~essPrecipitationSixHours~~	-
-			~~5.8.165.8.16~~	~~essPrecipitationTwelveHours~~	-
-	-	-	~~5.8.175.8.17~~	~~essPrecipitation24Hours~~	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.3.2.6.4	Retrieve Precipitation Presence	4.2.16			~~NEW - Removed the sensor model requirement when compared with the old version (3.5.2.3.2.6.1).~~
-			5.8.22	precipitationSensorTableNumSensors	-
			5.8.23	precipitationSensorTable	
			5.8.24.1	precipitationSensorIndex	-
			5.8.24.11	precipitationSensorPrecipYesNo	-
3.5.2.3.2.6.5	Retrieve Precipitation Rates	F.3.3.1			~~NEW~~
			5.8.22	precipitationSensorTableNumSensors	-
			5.8.23	precipitationSensorTable	
			5.8.24.1	precipitationSensorIndex	-
			5.8.24.12	precipitationSensorPrecipRate	-
			5.8.24.13	precipitationSensorSnowfallAccumRate	-
			5.8.24.15	precipitationSensorPrecipitationStartTime	-
			5.8.24.16	precipitationSensorPrecipitationEndTime	-
3.5.2.3.2.6.6~~3.5.2.3.2.6.6~~	Retrieve Precipitation Totals	F.3.3.1			~~NEW~~
			5.8.22~~5.8.22~~	precipitationSensorTableNumSensors~~precipitationSensorTableNumSensors~~	
			5.8.23	precipitationSensorTable	
			5.8.24.1~~5.8.24.1~~	precipitationSensorIndex~~precipitationSensorIndex~~	
			5.8.24.17~~5.8.24.18~~	precipitationSensorPrecipitationOneHour	
			5.8.24.18~~5.8.24.19~~	precipitationSensorPrecipitationThreeHours	
			5.8.24.19~~5.8.24.20~~	precipitationSensorPrecipitationSixHours	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.8.24.20~~5.8.24.21~~	precipitationSensorPrecipitationTwelveHours	
			5.8.24.21~~5.8.24.22~~	precipitationSensorPrecipitation24Hours	
3.5.2.3.2.6.7	Retrieve Precipitation Totals - User Specified	F.3.3.2			~~NEW~~
			5.8.22	precipitationSensorTableNumSensors	
			5.8.24.1	precipitationSensorIndex	
			5.8.24.7	precipitationSensorPeriod	
			5.8.24.22	precipitationSensorPrecipitationUserDefined	
3.5.2.3.2.6.8	Retrieve Precipitation Type	G.1			
			5.8.9	essPrecipSituation	
3.5.2.3.2.7	Retrieve Solar Radiation [Versions 01 to 03 Only - Deprecated in v04]	~~4.2.13~~			See 3.5.4.26.
			~~5.9.2~~	~~essTotalSun~~	
			~~5.9.4~~	~~essInstantaneousTerrestrialRadiation~~	
			~~5.9.5~~	~~essInstantaneousSolarRadiation~~	
			~~5.9.6~~	~~essTotalRadiation~~	
			~~5.9.7~~	~~essTotalRadiationPeriod~~	
3.5.2.3.2.8	Retrieve Visibility	G.1~~G.1~~			
			5.10.1~~5.10.1~~	essVisibility	
3.5.2.3.2.9	Retrieve Compressed Weather Data [Deprecated]~~[Version 03]~~	~~G.1~~G.1			See 3.5.4.27.
			~~5.3.9~~	~~essWeatherV3Block~~	
3.5.2.3.2.10	Retrieve Atmospheric Pressure	F.3.3.1			
			5.5.5	essNumPressureSensors	
			5.5.6	essPressureSensorTable	
			5.5.7.1	essPressureSensorIndex	
			5.5.7.7	essPressureSensorAtmosphericPressure	
3.5.2.3.2.11	Retrieve Relative Humidity	F.3.3.1			
			5.8.25	humiditySensorTableNumSensors	
			5.8.26	humiditySensorTable	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.8.27.1	humiditySensorIndex	
			5.8.27.7	humiditySensorRelativeHumidity~~ess WetbulbTemp~~	
			5.8.27.8	humiditySensorTemperatureInformation	
			5.8.27.9	humiditySensorWetbulbTemp~~essDewpointTemp~~	
			5.8.27.10	humiditySensorDewpointTemp~~humiditySensorRelativeHumidity~~	
~~3.5.2.3.2.12~~	~~Retrieve Compressed Weather Data~~	~~G.1~~	-	-	~~NEW~~
-	-	-	-	-	~~This is a v04 block/design and requirement which we will complete after the other designs are complete.~~
3.5.2.3.2.12	Retrieve Solar Radiation	4.2.17	-	-	
-	-	-	5.9.7	essTotalRadiationPeriod	
			5.9.8	radiationSensorTableNumSensors	
			5.9.9	radiationSensorTable	
- ~~radiationSensorHeight~~			5.9.10.1	radiationSensorIndex	
			5.9.10.7	essTotalSunV4	
-			5.9.10.8	essInstantaneousTerrestrialRadiationV4	
-	-	-	5.9.10.9	essInstantaneousSolarRadiationV4	
-			5.9.10.10	essTotalRadiationV4	
3.5.2.3.3~~3.5.2.3.3~~	Monitor Pavement Condition~~Monitor Pavement Condition~~				
3.5.2.3.3.1	Retrieve Pavement Surface Condition [Versions 01 to 03 - Deprecated in v04]	~~4.2.14~~4.2.14	-	-	See 3.5.4.28.
		-	~~5.11.3.1~~	~~essPavementSensorIndex~~	
-			~~5.11.3.7~~	~~essSurfaceStatus~~	~~Keep for backwards compatibility.~~
-			~~5.11.3.8~~	~~essSurfaceTemperature~~	-
-			~~5.11.3.15~~	~~essPavementSensorError~~	-
-	-	-	~~5.11.3.18~~	~~pavementSensorModelInformation~~	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.3.3.2	Retrieve Conditions for Freezing Algorithms - Active	4.2.15			
			5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	
			5.11.3.8	essSurfaceTemperature	
			5.11.3.9	essPavementTemperature	
			5.11.3.13	essSurfaceFreezePoint	
			5.11.3.14	essSurfaceBlackIceSignal	
			5.11.3.15	essPavementSensorError	
			5.11.3.16	essSurfaceIceOrWaterDepth	
			5.11.3.19	pavementSensorTemperatureDepth	
3.5.2.3.3.3	Retrieve Conditions for Freezing Algorithms - Passive	4.2.6			
			5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	
			5.11.3.8	essSurfaceTemperature	
			5.11.3.9	essPavementTemperature	
			5.11.3.11	essSurfaceSalinity	
			5.11.3.13	essSurfaceFreezePoint	
			5.11.3.14	essSurfaceBlackIceSignal	
			5.11.3.15	essPavementSensorError	
			5.11.3.16	essSurfaceIceOrWaterDepth	
			5.11.3.17	essSurfaceConductivityV2	
			5.11.3.19	pavementSensorTemperatureDepth	
			5.13.1	numEssTreatments	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
3.5.2.3.3.4	Retrieve Adjacent Snow Depth [Versions 01 to 03 - Deprecated in v04]	~~G.1~~	-	-	See 3.5.4.30.
		-	~~5.8.3~~	~~essAdjacentSnowDepth~~	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.3.3.5	Retrieve Roadway Snow Depth [Versions 01 to 03 - Deprecated in v04]	~~G.1~~	-	-	See 3.5.4.31.
-	-	-	~~5.8.4~~	~~essRoadwaySnowDepth~~	-
-	-				-
3.5.2.3.3.6	Retrieve Roadway Ice Thickness [Versions 01 to 03 - Deprecated in v04]	~~G.1~~	-	-	See 3.5.4.32.
-	-	-	~~5.8.5~~	~~essRoadwaySnowPackDepth~~	-
		-	~~5.8.10~~	~~essIceThickness~~	
~~3.5.2.3.3.7~~	~~Retrieve Compressed Pavement Condition Data [Version 03]~~	~~G.1~~	-	-	-
-	-	-	~~5.11.9~~	~~essPavementV3Block~~	~~This is a v03 block/design and requirement which will needs to be kept for backward compatibility.~~
3.5.2.3.3.7	Retrieve Compressed Pavement Condition Data [Deprecated]				See 3.5.4.29.
-	-				-
3.5.2.3.3.8	Retrieve Pavement Surface Condition	F.3.3.1			~~NEW~~
~~5.11.3.9essPavementTemperature~~			5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	
			5.11.3.8	essSurfaceTemperature	
			5.11.3.15	essPavementSensorError	-
			5.11.3.22	pavementSensorSurfaceCondition	~~New object for current pavement moisture conditions to replace 5.11.3.7, essSurfaceStatus.~~
3.5.2.3.3.9	Retrieve Forecasted Pavement Surface Condition	F.3.3.1			~~NEW~~
			5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	

Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.11.3.23	pavementSensorForecastCondition	~~New object for forecasted pavement moisture conditions.~~
~~3.5.2.3.3.10~~	~~Retrieve Roadway Friction~~	-	-	-	-
3.5.2.3.3.10	Retrieve Roadway Friction Coefficient	F.3.3.2		-	~~NEW~~
-	-	-	5.11.2	essPavementSensorTable	
			5.11.3.1	essPavementSensorIndex	-
			5.11.3.24	pavementSensorFrictionCoefficient	~~New object for friction coefficient. Consider using 5.12.1 essMobileFriction.~~
3.5.2.3.3.11	Retrieve Adjacent Snow Depth	G.1	-	-	-
-	-	-	5.8.24.8	precipitationSensorAdjacentSnowDepth	-
3.5.2.3.3.12	Retrieve Roadway Snow Depth	G.1	-	-	-
-	-	-	5.8.24.9	precipitationSensorRoadwaySnowDepth	-
-	-	-	5.8.24.10	precipitationSensorRoadwaySnowPackDepth	-
3.5.2.3.3.13	Retrieve Roadway Ice Thickness	G.1	-		-
-	-	-	5.8.24.14	precipitationSensorIceThickness	-
3.5.2.3.4	Monitor Subsurface Conditions				
3.5.2.3.4.1	Retrieve Subsurface Temperature	F.3.3.2			
			5.11.5	essSubSurfaceSensorTable	
			5.11.6.1	essSubSurfaceSensorIndex	
			5.11.6.5	essSubSurfaceTemperature	
			5.11.6.7	essSubSurfaceSensorError	
3.5.2.3.4.2	Retrieve Subsurface Moisture	F.3.3.2~~F.3.3.2~~			
			5.11.5	essSubSurfaceSensorTable	
			5.11.6.1~~5.11.6.1~~	essSubSurfaceSensorIndex~~essSubSurfaceSensorIndex~~	
			5.11.6.6	essSubSurfaceMoisture	
3.5.2.3.4.3	Retrieve Compressed Subsurface Condition Data [Deprecated]	~~G.1~~G.1			See 3.5.4.33.
			~~5.11.8~~	~~essSubSurfaceBlock~~	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.3.5	Monitor Situation Assessments				
3.5.2.3.5.1	Retrieve Wind Situation	F.3.3.1			
			5.6.10.1	windSensorIndex	
			5.6.10.10	windSensorSituation	
3.5.2.3.5.2	Retrieve Precipitation Situation	G.1~~G.1~~			
			5.8.9	essPrecipSituation	
3.5.2.3.5.3~~3.5.2.3.5.3~~	Retrieve Cloud Situation [Versions 01 to 03 Only - Deprecated in v04]	~~G.1~~G.1			See 3.5.4.34.
			~~5.9.3~~	~~essCloudSituation~~	
3.5.2.3.5.4	Retrieve Visibility Situation	G.1			
			5.10.2	essVisibilitySituation	
3.5.2.3.5.5	Retrieve Ground State [Versions 01 to 03 Only - Deprecated in v04]~~Retrieve Ground State~~	G.1			See 3.5.4.35.
			~~5.12.2~~	~~essMobileObservationGroundState~~	
3.5.2.3.5.6	Retrieve Pavement State [Versions 01 to 03 Only - Deprecated in v04]	G.1			See 3.5.4.36.
			~~5.12.3~~	~~essMobileObservationPavement~~	
3.5.2.3.5.7	Retrieve Cloud Situation	G.1~~G.1~~			
			5.9.11	essCloudSituationV4	
3.5.2.3.5.8	Retrieve Ground State	G.1			
			5.12.4	essMobileObservationGroundStateV4	
3.5.2.3.5.9	Retrieve Pavement State	G.1			
			5.12.5	essMobileObservationPavementV4	
3.5.2.3.6	Monitor Air Quality and Biohazard Conditions				
3.5.2.3.6.1	Retrieve Carbon Monoxide Reading	G.1			
			5.14.1	essCO	
3.5.2.3.6.2	Retrieve Carbon Dioxide Reading	G.1			
			5.14.2	essCO2	
3.5.2.3.6.3	Retrieve Nitrous Oxide Reading	G.1			
			5.14.3	essNO	
3.5.2.3.6.4	Retrieve Nitrogen Dioxide Reading	G.1			
			5.14.4	essNO2	
3.5.2.3.6.5	Retrieve Sulfur Dioxide Reading	G.1			

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.14.5	essSO2	
3.5.2.3.6.6	Retrieve Ozone Reading	G.1			
			5.14.6	essO3	
3.5.2.3.6.7	Retrieve Small Particulate Matter Reading	G.1			
			5.14.7	essPM10	
3.5.2.3.6.8	Retrieve Compressed Air Quality Data [Deprecated]~~[Version 03]~~	~~G.1G.1~~			See 3.5.4.37.
			~~5.14.8~~	~~essAirQualityBlock~~	~~This is a v03 block/design and requirement which will needs to be kept for backward compatibility.~~
3.5.2.3.6.9	Retrieve Particulate Matter (2.5) Reading	G.1~~G.1~~			~~NEW~~
			5.14.9	essPM25	
~~3.5.2.3.6.10~~	~~Retrieve Compressed Air Quality Data~~	~~G.1~~	-	-	-
-	-	-	-	-	~~This is a v04 block/design and requirement which we will complete after the other designs are complete. Adds essPM25.~~
3.5.2.3.7	Retrieve Water Level	F.3.3.1			
			5.8.19	waterLevelSensorTableNumSensors	
			5.8.20	waterLevelSensorTable	
			5.8.21.1	waterLevelSensorIndex	
			5.8.21.2	waterLevelSensorReading	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.2.3.8	Retrieve Snapshot	4.2.2			Upon ESS delivery the FTP username shall be _____. Upon ESS delivery, the FTP password shall be _____. Note: For agencies that restrict the use of FTP, see Annex E.3 for additional information.
			5.17.1~~5.17.1~~		<not an SNMP Object> Snapshot.filename:text
			5.17.2~~5.17.2~~		<not an SNMP object> Snapshot.image:frame
3.5.2.3.9	Retrieve Snapshot Camera Configuration	4.2.11			
			5.16.1	essSnapshotNumberOfCameras	
			5.16.2	essSnapshotCameraTable	
			5.16.3.1	essSnapshotCameraIndex	
			5.16.3.2	essSnapshotCameraDescription	
			5.16.3.3	essSnapshotCameraStoragePath	
			5.16.3.6	essSnapshotCameraFilename	
3.5.2.3.10	Retrieve Sensor Profile with Mobile Sources	4.2.20			~~NEW~~
			5.4.1	essLatitude	
			5.4.2	essL~~atitude~~ongitude	
			5.4.3	essVehicleSpeed	
			5.4.4	essVehicleBearing	
			5.4.5	essOdometer	
			5.5.1	essReferenceHeight	
			5.6.8	windSensorTableNumSensors	
			5.6.10.1	windSensorIndex	
			5.6.10.4	windSensorAvgSpeed	
			5.6.10.5	windSensorAvgDirection	
			5.6.10.6	windSensorSpotSpeed	
			5.6.10.7	windSensorSpotDirection	

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Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
-			5.6.10.8	windSensorGustSpeed	-
-			5.6.10.9	windSensorGustDirection	-
-	-	-	5.6.10.10	windSensorSituation	-
			5.7.1	essNumTemperatureSensors	
-	-	-	5.7.3.1	essTemperatureSensorIndex	-
-	-	-	5.7.3.3	essAirTemperature	-
-	-	-	5.8.9	essPrecipSituation	-
-	-	-	5.8.22	precipitationSensorTableNumSensors	
-			5.8.24.1	precipitationSensorIndex	
-	-	-	5.8.24.8	precipitationSensorAdjacentSnowDepth	-
-	-	-	5.8.24.9	precipitationSensorRoadwaySnowDepth	-
-	-	-	5.8.24.10	precipitationSensorRoadwaySnowPackDepth	-
-	-	-	5.8.24.11	precipitationSensorPrecipYesNo	
-			5.8.24.12	precipitationSensorPrecipRate	
-			5.8.24.13	precipitationSensorSnowfallAccumRate	
-	-	-	5.8.24.14	precipitationSensorIceThickness	-
-			5.8.24.15	precipitationSensorPrecipitationStartTime	
-	-	-	5.8.24.16	precipitationSensorPrecipitationEndTime	
-			5.8.24.17	precipitationSensorPrecipitationOneHour	-
-			5.8.24.18	precipitationSensorPrecipitationThreeHours	-
-			5.8.24.19	precipitationSensorPrecipitationSixHours	-
-			5.8.24.20	precipitationSensorPrecipitationTwelveHours	-
-	-	-	5.8.24.21	precipitationSensorPrecipitation24Hours	-
-	-	-	5.10.1	essVisibility	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
-	-	-	5.10.2	essVisibilitySituation	-
-	-	-	5.12.4	essMobileObservationGroundStateV4	-
-	-	-	5.12.5	essMobileObservationPavementV4	-
-	-	-	5.5.5	essNumPressureSensors	
-			5.5.7.1	essPressureSensorIndex	
-	-	-	5.5.7.7	essPressureSensorAtmosphericPressure	
-	-	-	5.8.25	humiditySensorTableNumSensors	
-			5.8.27.1	humiditySensorIndex	
-	-	-	5.8.27.7	humiditySensorRelativeHumidity	
-			5.8.27.9	humiditySensorWetbulbTemp	
-			5.8.27.10	humiditySensorDewpointTemp	
			5.9.11	essCloudSituationV4	
-	-	-	5.11.3.1	essPavementSensorIndex	-
-			5.11.3.8	essSurfaceTemperature	-
			5.11.3.9	essPavementTemperature	
-			5.11.3.11	essSurfaceSalinity	-
-			5.11.3.13	essSurfaceFreezePoint	-
-			5.11.3.15	essPavementSensorError	-
-			5.11.3.16	essSurfaceIceOrWaterDepth	-
-	-	-	5.11.3.22	pavementSensorSurfaceCondition	
-	-	-	5.11.3.23	pavementSensorForecastCondition	
-	-	-	5.11.3.24	~~ess~~pavementSensor~~MobileFriction~~FrictionCoefficient	
-	-	-	-	-	~~This is a list of records. Have to think this one through. Most of these will be optional.~~
-			-	-	-
-			-	-	-
-			-	-	-
-	-	-	-	-	-
			5.11.3.27	pavementIcePercentage	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1201 v03 Sec. 2.4.1	globalTime	
			NTCIP 1201 v03 Sec. 2.4.2	globalDaylightSaving	
3.5.2.4	Sensor Control Requirements				
3.5.2.4.1	Capture Snapshot Image	4.2.1			
			5.16.3.1	essSnapshotCameraIndex	
			5.16.3.3	essSnapshotCameraStoragePath	
			5.16.3.4	essSnapshotCameraCommand	
			5.16.3.5	essSnapshotCameraError	
			5.16.3.6	essSnapshotCameraFilename	
3.5.2.4.2	Delete Snapshot	4.2.3			
			5.17.1		<not an SNMP Object> Snapshot.filename:text
			5.17.2		<not an SNMP object> Snapshot.image:frame
3.5.2.4.3	Copy Snapshot - [Obsolete]~~[Deprecated]~~	4.2.4			
			5.17.1		<not an SNMP Object> Snapshot.filename:text
			5.17.2		<not an SNMP object> Snapshot.image:frame
3.5.3	PTS Manager Requirements				
3.5.3.1	PTS Configuration Requirements				
3.5.3.1.1	Retrieve Stationary Pavement Treatment Configuration	4.2.5			
			5.13.1	numEssTreatments	
			5.13.2	essPavementTreatmentTable	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
			5.13.10	ptsSignalDuration	
			5.13.18	ptsMonitoringDetectors	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.5.3.1.2~~3.5.3.1.2~~	Configure Stationary Pavement Treatment System	4.2.7			
			5.13.1	numEssTreatments	
			5.13.2	essPavementTreatmentTable	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
			5.13.10	ptsSignalDuration	
			5.13.18	ptsMonitoringDetectors	
3.5.3.1.3	Retrieve Mobile Pavement Treatment Configuration [Versions 01 to 03 Only - Deprecated in v04]	~~G.1~~G.1			See 3.5.4.38.
			~~5.13.6~~	~~pavementTreatmentBlock~~	
3.5.3.1.4	Configure Mobile Pavement Treatment System	4.2.9			
			5.13.1	numEssTreatments	
			5.13.2	essPavementTreatmentTable	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
			5.13.4	essPaveTreatmentAmount	
			5.13.5	essPaveTreatmentWidth	
			5.13.10~~5.13.5~~	ptsSignalDuration~~essPaveTreatmentWidth~~	
3.5.3.1.5	Retrieve Mobile Pavement Treatment Configuration	4.2.18			
			5.13.1	numEssTreatments	
			5.13.2	essPavementTreatmentTable	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
			5.13.4	essPaveTreatmentAmount	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.13.5	essPaveTreatmentWidth	
3.5.3.2	PTS Status Monitoring Requirements				
3.5.3.2.1	Retrieve Pavement Treatment Status	G.1~~G.1~~			
			5.13.9	ptsSprayerState	
			5.13.11	ptsSignalEventCount	
			5.13.12	ptsLastSignalEvent	
			5.13.13	ptsActiveEventCount	
			5.13.14	ptsInactiveEventCount	
			5.13.15	ptsLastActiveEvent	
			5.13.16	ptsLastInactiveEvent	
			5.13.17	ptsError	
3.5.3.3	PTS Data Retrieval Requirements				
3.5.3.3.1	Retrieve Pavement Treatment Profile with Mobile Sources	4.2.19			
			5.4.1	essLatitude	
			5.4.2	~~essLatitude~~essLongitude	
			5.4.3	essVehicleSpeed	
			5.4.4	essVehicleBearing	
			5.4.5	essOdometer	
			5.5.1	essReferenceHeight	
			5.13.1	numEssTreatments	
			5.13.3.1	essPavementTreatmentIndex	
			5.13.3.2	essPaveTreatProductType	
			5.13.3.3	essPaveTreatProductForm	
			5.13.3.4	essPercentProductMix	
			5.13.4	essPaveTreatmentAmount	
			5.13.5	essPaveTreatmentWidth	
			NTCIP 1201 v03 Sec. 2.4.1	globalTime	
			NTCIP 1201 v03 Sec. 2.4.2	globalDaylightSaving	

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Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
			NTCIP 1201 v03 Sec. 2.4.8.1	maxDaylightSavingEntries	
			NTCIP 1201 v03 Sec. 2.4.8.2.1	dstEntryNumber	
			NTCIP 1201 v03 Sec. 2.4.8.2.2	dstBeginMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.3	dstBeginOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.4	dstBeginDayOfWeek	
			NTCIP 1201 v03 Sec. 2.4.8.2.5	dstBeginDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.6	dstBeginSecondsToTransition	
			NTCIP 1201 v03 Sec. 2.4.8.2.7	dstEndMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.8	dstEndOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.9	dstEndDayOfWeek	
			NTCIP 1201 v03 Sec. 2.4.8.2.10	dstEndDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.11	dstEndSecondToTransition	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1201 v03 Sec. 2.4.8.2.12	dstSecondsToAdjust	
3.5.3.4	PTS Control Requirements				
3.5.3.4.1	Set PTS Operational Mode	G.3~~G.3~~			
			5.13.19	ptsOperationalModeV3	
3.5.3.4.2	Manually Activate PTS Sprayer	G.3~~G.3~~			
			5.13.20	ptsCommandStateV3	
3.5.4	Backward Compatibility Requirements				
3.5.4.1	NTCIP 1204 v01 Wind Sensor Meta Data	RFC 1157			
			5.5.3	essWindSensorHeight	
3.5.4.2	NTCIP 1204 v01 Average Wind Sensor Data	RFC 1157			
			5.6.1	essAvgWindDirection	
			5.6.2	essAvgWindSpeed	
3.5.4.3	NTCIP 1204 v01 Spot Wind Sensor Data	RFC 1157			
			5.6.3	essSpotWindDirection	
			5.6.4	essSpotWindSpeed	
3.5.4.4	NTCIP 1204 v01 Wind Gust Data	RFC 1157			
			5.6.7	essMaxWindGustDir	
			5.6.6	essMaxWindGustSpeed	
3.5.4.5	NTCIP 1204 v01 Wind Situation	RFC 1157			
			5.6.5	essWindSituation	
3.5.4.6	NTCIP 1204 v01 Water Depth	RFC 1157			
			5.8.2	essWaterDepth	
3.5.4.7	NTCIP 1204 v01 Solar Radiation	RFC 1157			
			5.9.1	essSolarRadiation	
3.5.4.8	NTCIP 1204 v01 Surface Water Depth	RFC 1157			
			5.11.3.10	essSurfaceWaterDepth	
3.5.4.9	NTCIP 1204 v01 Surface Conductivity	RFC 1157			

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.11.3.12	essSurfaceConductivity	
3.5.4.10	NTCIP 1204 v02 Station Meta Data Block	G.1			
			5.3.5	essStationMetaDataBlock	
3.5.4.11	NTCIP 1204 v02 Weather Block	G.1			
			5.3.6	essWeatherBlock	
3.5.4.12	NTCIP 1204 v02 Pavement Block	G.1~~G.1~~			
			5.11.7	essPavementBlock	
3.5.4.13	NTCIP 1204 v03 Retrieve External Port Information	F.3.3.1			
			NTCIP 1201 v02 Sec. 2.8.2	auxIOTableNumAnalogPorts	
			NTCIP 1201 v02 Sec. 2.8.3.1	auxIOPortType	
			NTCIP 1201 v02 Sec. 2.8.3.2	auxIOPortNumber	
			NTCIP 1201 v02 Sec. 2.8.3.3	auxIOPortDescription	
			NTCIP 1201 v02 Sec. 2.8.3.4	auxIOPortResolution	
			NTCIP 1201 v02 Sec. 2.8.3.6	auxIOPortDirection	
3.5.4.14	NTCIP 1204 v03 Configure Port Information	F.3.3.3			
			NTCIP 1201 v02 Sec. 2.8.3.1	auxIOPortType	
			NTCIP 1201 v02 Sec. 2.8.3.2	auxIOPortNumber	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1201 v02 Sec. 2.8.3.3	auxIOPortDescription	
3.5.4.15	NTCIP 1204 v03 Monitor Status of External Device	F.3.3.1			
			NTCIP 1201 v02 Sec. 2.8.3.5	auxIOPortValue	
			NTCIP 1201 v02 Sec. 2.8.3.7	auxIOPortLastCommandedState	
3.5.4.16	NTCIP 1204 v03 Control External Device	F.3.3.3			
			NTCIP 1201 v02 Sec. 2.8.3.1	auxIOPortType	
			NTCIP 1201 v02 Sec. 2.8.3.2	auxIOPortNumber	
			NTCIP 1201 v02 Sec. 2.8.3.5	auxIOPortValue	
3.5.4.17	NTCIP 1204 v03 Station Metadata Block	G.1	-	-	-
-	-	-	5.3.8	essStationMetaDataV3Block	-
3.5.4.18	NTCIP 1204 v03 Mobile ESS Data Block	G.1~~G.1~~	-	-	-
-	-	-	5.3.7	essMobileBlock	
3.5.4.19	NTCIP 1204 v01-v03 Atmospheric Pressure Height	G.1~~G.1~~	-	-	-
-	-	-	5.5.2	essPressureHeight	
3.5.4.20	NTCIP 1204 v03 Weather Profile with Mobile Sources	G.1	-	-	-
-	-	-	5.3.9	essWeatherV3Block	-
-			5.4.1	essLatitude	-
-			5.4.2	essLongitude	-

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.4.3	essVehicleSpeed	
			5.4.4	essVehicleBearing	
			5.4.5	essOdometer	
			5.5.1	essReferenceHeight	
			5.12.1	essMobileFriction	
			5.12.2	essMobileObservationGroundState	
			5.12.3	essMobileObservationPavement	
3.5.4.21	NTCIP 1204 v01-v03 Atmospheric Pressure	G.1			
			5.5.4	essAtmosphericPressure	
3.5.4.22	NTCIP 1204 v01-v03 Humidity	G.1			
			5.7.4	essWetbulbTemp	
			5.7.5	essDewpointTemp	
			5.8.1	essRelativeHumidity	
3.5.4.23	NTCIP 1204 v01-v03 Precipitation Presence	4.2.12			
			5.8.6	essPrecipYesNo	
			5.8.18~~5.8.24.6~~	~~precipitationSensorModelInformation~~ ~~precipitationSensorModelInformation~~ precipitationSensorModelInformation	
3.5.4.24	NTCIP 1204 v01-v03 Precipitation Rates	G.1			
			5.8.7	essPrecipRate	
			5.8.8	essSnowfallAccumRate	
			5.8.11	essPrecipitationStartTime	
			5.8.12	essPrecipitationEndTime	
3.5.4.25	NTCIP 1204 v01-v03 Precipitation Totals	G.1			
			5.8.13	essPrecipitationOneHour	
			5.8.14	essPrecipitationThreeHours	
			5.8.15	essPrecipitationSixHours	
			5.8.16	essPrecipitationTwelveHours	
			5.8.17	essPrecipitation24Hours	
3.5.4.26	NTCIP 1204 v03 Solar Radiation	4.2.13~~G.1~~			
			5.9.2	essTotalSun	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			5.9.4	essInstantaneousTerrestrialRadiation	
			5.9.5	essInstantaneousSolarRadiation	
			5.9.6	essTotalRadiation	
			5.9.7	essTotalRadiationPeriod	
~~5.3.9essWeatherV3Block~~3.5.4.27	NTCIP 1204 v03 Weather Block	G.1			
			5.3.9	essWeatherV3Block	
3.5.4.28	NTCIP 1204 v01-v03 Pavement Surface Condition	4.2.14			
			5.11.3.1	essPavementSensorIndex	
			5.11.3.7	essSurfaceStatus	
			5.11.3.8	essSurfaceTemperature	
			5.11.3.15	essPavementSensorError	
			5.11.3.18	pavementSensorModelInformation	
3.5.4.29	NTCIP 1204 v03 Pavement Condition Block	G.1			
			5.11.9	essPavementV3Block	
3.5.4.30	NTCIP 1204 v01-v03 Adjacent Snow Depth	G.1			
			5.8.3	essAdjacentSnowDepth	
3.5.4.31	NTCIP 1204 v01-v03 Roadway Snow Depth	G.1			
			5.8.4	essRoadwaySnowDepth	
			5.8.5	essRoadwaySnowPackDepth	
3.5.4.32	NTCIP 1204 v01-v03 Roadway Ice Thickness	G.1			
			5.8.10	essIceThickness	
3.5.4.33	NTCIP 1204 v03 Subsurface Condition Block	G.1			
			5.11.8	essSubSurfaceBlock	
3.5.4.34	NTCIP 1204 v01-v03 Cloud Situation	G.1			
			5.9.3	essCloudSituation	
3.5.4.35	NTCIP 1204 v01-v03 Ground State	G.1			

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
-			5.12.2	essMobileObservationGroundState	
3.5.4.36	NTCIP 1204 v01-v03 Pavement State	G.1			-
-			5.12.3	essMobileObservationPavement	
3.5.4.37	NTCIP 1204 v03 Air Quality Block	G.1			-
-			5.14.8	essAirQualityBlock	
3.5.4.38	NTCIP 1204 v03 Mobile Pavement Treatment Block	G.1~~G.1~~			-
-			5.13.6	pavementTreatmentBlock	
3.6	Supplemental Non-Communications Requirements				
3.6.1	Required Number of Atmospheric Pressure Sensors				See Requirement 3.6.1 in PRL
3.6.2	Required Number of Wind Sensors				See Requirement 3.6.2 in PRL
3.6.3	Required Number of Temperature Sensors				See Requirement 3.6.3 in PRL
3.6.4	Required Number of Humidity Sensors				See Requirement 3.6.4 in PRL
3.6.5	Required Number of Precipitation Sensors				See Requirement 3.6.5 in PRL
3.6.6	Required Number of Solar Radiation Sensors				See Requirement 3.6.6 in PRL
3.6.7	Required Number of Visibility Sensors				See Requirement 3.6.7 in PRL
3.6.8	Required Number of Pavement Sensors				See Requirement 3.6.8 in PRL
3.6.9	Active Pavement Treatment Sensors				
3.6.10	Passive Pavement Treatment Sensors				
3.6.11	Required Number of Subsurface Sensors				See Requirement 3.6.11 in PRL
3.6.12	Required Number of Pavement Treatment Products				See Requirement 3.6.12 in PRL

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.6.13	Required Number of Carbon Monoxide Sensors				See Requirement 3.6.13 in PRL
3.6.14	Required Number of Carbon Dioxide Sensors				See Requirement 3.6.14 in PRL
3.6.15	Required Number of Nitrous Oxide Sensors				See Requirement 3.6.15 in PRL
3.6.16	Required Number of Nitrogen Dioxide Sensors				See Requirement 3.6.16 in PRL
3.6.17	Required Number of Sulfur Dioxide Sensors				See Requirement 3.6.17 in PRL
3.6.18	Required Number of Ozone Sensors				See Requirement 3.6.18 in PRL
3.6.19	Required Number of Small Particulate Matter Sensors				See Requirement 3.6.19 in PRL
3.6.20	Required Number of Snapshot Cameras				See Requirement 3.6.20 in PRL
3.6.21	Maximum Response Time for Requests				See Requirement 3.6.21 in PRL
3.6.22	Required Number of Water Level Sensors				See Requirement 3.6.22 in PRL
3.6.23	Support Camera Number in Filename		5.16.3.6	essSnapshotCameraFilename	This shall be the <camera> field in essSnapshotCameraFilename.
3.6.24	Support Sequence Number in Filename		5.16.3.6	essSnapshotCameraFilename	This shall be the <sequence> field in essSnapshotCameraFilename.
3.6.25~~3.6.25~~	Support Date in Filename~~Support Date in Filename~~		5.16.3.6	essSnapshotCameraFilename	This shall be the <date> field in essSnapshotCameraFilename.
3.6.26~~3.6.26~~	Support Time in Filename		5.16.3.6	essSnapshotCameraFilename	This shall be the <time> field in essSnapshotCameraFilename.

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
3.6.27	Support Long Filenames				See Requirement 3.6.27 in PRL
		-	-	-	~~See Requirement 3.6.28 in PRL~~
3.6.28	Required Number of Small Particulate Matter (2.5) Sensors				See Requirement 3.6.2~~9~~8 in PRL
F.2.1	Generic Architectural Requirements				
F.2.1.1	Support Basic Communications				
F.2.1.1.1	Retrieve Data	G.1			
F.2.1.1.2	Deliver Data	G.3			
F.2.1.1.3	Explore Data	G.2			
F.2.1.2	Support Logged Data				
F.2.1.2.1	Retrieve Current Configuration of Logging Service	F.3.1.2			
			NTCIP 1103 v0~~1~~2 Sec. A.7.3~~2~~.1	eventClassNumber	
			NTCIP 1103 v0~~1~~2 Sec. A.7.~~2~~3.2	eventClassLimit	
			NTCIP 1103 v02~~1~~ Sec. A.7.3~~2~~.3	eventClassClearTime	
			NTCIP 1103 v02~~1~~ Sec. A.7.~~2~~3.4	eventClassDescription	
			NTCIP 1103 v02~~1~~ Sec. A.7.3~~2~~.6	eventClassNumEvents	
			NTCIP 1103 v0~~1~~2 A.7.~~4~~5.1	eventConfigID	
			NTCIP 1103 v0~~1~~2 A.7.5~~4~~.2	eventConfigClass	
			NTCIP 1103 v02~~1~~ A.7.~~4~~5.3	eventConfigMode	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1103 v02~~1~~ A.7.~~4~~5.4	eventConfigCompareValue	
			NTCIP 1103 v02~~1~~ A.7.~~4~~5.5	eventConfigCompareValue2	
			NTCIP 1103 v0~~1~~2 A.7.~~4~~5.6	eventConfigCompareOID	
			NTCIP 1103 v0~~1~~2 A.7.~~5~~4.7	eventConfigLogOID	
			NTCIP 1103 v0~~1~~2 A.7.~~4~~5.8	eventConfigAction	
			NTCIP 1103 v02~~1~~ A.7.~~5~~4.9	eventConfigStatus	
F.2.1.2.2	Configure Logging Service	F.3.1.3			
			NTCIP 1103 v02~~1~~ A.7.~~2~~3.1	eventClassNumber	
			NTCIP 1103 v0~~1~~2 A.7.~~2~~3.2	eventClassLimit	
			NTCIP 1103 v02~~1~~ A.7.~~2~~3.3	eventClassClearTime	
			NTCIP 1103 v02~~1~~ A.7.~~3~~2.4	eventClassDescription	
			NTCIP 1103 v02~~1~~ A.7.~~4~~5.1	eventConfigID	
			NTCIP 1103 v0~~1~~2 A.7.~~5~~4.2	eventConfigClass	
			NTCIP 1103 v0~~1~~2 A.7.~~4~~5.3	eventConfigMode	
			NTCIP 1103 v02~~1~~ A.7.~~4~~5.4	eventConfigCompareValue	
			NTCIP 1103 v02~~1~~ A.7.~~5~~4.5	eventConfigCompareValue2	
			NTCIP 1103 v0~~1~~2 A.7.~~5~~4.6	eventConfigCompareOID	
			NTCIP 1103 v02~~1~~ A.7.~~5~~4.7	eventConfigLogOID	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1103 v02~~1~~ A.7.5~~4~~.8	eventConfigAction	
			NTCIP 1103 v0~~1~~2 A.7.5~~4~~.9	eventConfigStatus	
F.2.1.2.3	Retrieve Logged Data	F.3.1.1			
			NTCIP 1103 v0~~1~~2 A.7.~~2~~3.1	eventClassNumber	
			NTCIP 1103 v02~~1~~ A.7.3~~2~~.5	eventClassNumRowsInLog	
			NTCIP 1103 v02~~1~~ A.7.3~~2~~.6	eventClassNumEvents	
			NTCIP 1103 v0~~1~~2 A.7.7~~6~~.1	eventLogClass	
			NTCIP 1103 v0~~1~~2 A.7.7~~6~~.2	eventLogNumber	
			NTCIP 1103 v02~~1~~ A.7.7~~6~~.3	eventLogID	
			NTCIP 1103 v0~~1~~2 A.7.7~~6~~.4	eventLogTime	
			NTCIP 1103 v02~~1~~ A.7.7~~6~~.5	eventLogValue	
			NTCIP 1103 v02~~1~~ A.7.8~~7~~	numEvents	
F.2.1.2.4	Clear Log	G.3			
			NTCIP 1103 v02~~1~~ A.7.3~~2~~.1	eventClassNumber	
			NTCIP 1103 v02~~1~~ A.7.~~2~~3.3	eventClassClearTime	
F.2.1.2.5	Retrieve Capabilities of Event Logging Service	G.1			
			NTCIP 1103 v0~~1~~2 A.7.2~~1~~	maxEventClasses	
			NTCIP 1103 v02~~1~~ A.7.4~~3~~	maxEventLogConfigs	
			NTCIP 1103 v0~~1~~2 A.7.6~~5~~	maxEventLogSize	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
F.2.1.2.6	Retrieve Total Number of Logged Events	G.1			
			NTCIP 1103 v02~~1~~ A.7.3~~2~~.1	eventClassNumber	
			NTCIP 1103 v02~~1~~ A.7.3~~2~~.5	eventClassNumRowsInLog	
			NTCIP 1103 v0~~1~~2 A.7.~~2~~3.6	eventClassNumEvents	
			NTCIP 1103 v0~~1~~2 A.7.8~~7~~	numEvents	
F.2.2	Generic Functional Requirements				
F.2.2.1	Generic Configuration Requirements				
F.2.2.1.1	Retrieve Device Component Information	F.3.3.1			
			NTCIP 1201 v03~~2~~ Sec. 2.2.2	globalMaxModules	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.1	moduleNumber	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.2	moduleDeviceNode	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.3	moduleMake	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.4	moduleModel	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.5	moduleVersion	
			NTCIP 1201 v03~~2~~ Sec. 2.2.3.6	moduleType	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
F.2.2.1.2	Retrieve Device Configuration Identifier	G.1			
			NTCIP 1201 v0~~2~~3 Sec. 2.2.1	globalSetIDParameter	
F.2.2.1.3	Retrieve Supported Standards	G.1			
			NTCIP 1201 v03~~2~~ Sec. 2.2.4	controllerBaseStandards	
F.2.2.1.4	Retrieve System Name	G.1			
			RFC1213 Clause 6	sysName	
F.2.2.1.5	Manage Time				
F.2.2.1.5.1	Set Time	G.3			
			NTCIP 1201 v03 Sec. 2.4.1	globalTime	
			NTCIP 1201 v03 Sec. 2.4.2	globalDaylightSaving	
			NTCIP 1201 v03 Sec. 2.4.8.1	maxDaylightSavingEntries	
			NTCIP 1201 v03 Sec. 2.4.8.2.1	dstEntryNumber	
			NTCIP 1201 v03 Sec. 2.4.8.2.2	dstBeginMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.3	dstBeginOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.4	dstBeginDayOfWeek	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1201 v03 Sec. 2.4.8.2.5	dstBeginDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.6	dstBeginSecondsToTransition	
			NTCIP 1201 v03 Sec. 2.4.8.2.7	dstEndMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.8	dstEndOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.9	dstEndDayOfWeek	
			NTCIP 1201 v03 Sec. 2.4.8.2.10	dstEndDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.11	dstEndSecondToTransition	
			NTCIP 1201 v03 Sec. 2.4.8.2.12	dstSecondsToAdjust	
-	-	-	~~NTCIP 1201 v02 Sec. 2.4.1~~	~~globalTime~~	-
F.2.2.1.5.2	Retrieve Current Time	G.1			
-	-	-	NTCIP 1201 v03 Sec. 2.4.1	globalTime	-
			NTCIP 1201 v03 Sec. 2.4.2	globalDaylightSaving	
			NTCIP 1201 v03 Sec. 2.4.8.1	maxDaylightSavingEntries	

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Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
			NTCIP 1201 v03 Sec. 2.4.8.2.1	dstEntryNumber	
			NTCIP 1201 v03 Sec. 2.4.8.2.2	dstBeginMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.3	dstBeginOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.4	dstBeginDayOfWeek	
			NTCIP 1201 v03 Sec. 2.4.8.2.5	dstBeginDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.6	dstBeginSecondsToTransition	
			NTCIP 1201 v03 Sec. 2.4.8.2.7	dstEndMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.8	dstEndOccurrences	
			NTCIP 1201 v03 Sec. 2.4.8.2.9	dstEndDayOfWeek	
			NTCIP 1201 v03 Sec. 2.4.8.2.10	dstEndDayOfMonth	
			NTCIP 1201 v03 Sec. 2.4.8.2.11	dstEndSecondToTransition	
			NTCIP 1201 v03 Sec. 2.4.8.2.12	dstSecondsToAdjust	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
-	-	-	~~NTCIP 1201 v02 Sec. 2.4.1~~	~~globalTime~~	-
F.2.2.1.6	Retrieve External Port Information	F.3.3.1			
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.2	~~auxIOTableNumAnalogPorts~~maxAuxIOv2TableNumAnalogPorts	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.1	auxIOv2PortType	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.2	auxIOv2PortNumber	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.3	auxIOv2PortDescription	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.4	auxIOv2PortResolution	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.6	auxIOv2PortDirection	
F.2.2.1.7	Configure Port Information	F.3.3.3			
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.1	auxIOv2PortType	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.2	auxIOv2PortNumber	
			NTCIP 1201 v03~~2~~ Sec. 2.9~~8~~.3.3	auxIOv2PortDescription	
F.2.2.2	Generic Status Monitoring Requirements				
F.2.2.2.1	Monitor Status of External Device	F.3.3.1		-	

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
			NTCIP 1201 v0~~2~~3 Sec. 2.9~~8~~.3.5	auxIOv2PortValue	
			NTCIP 1201 v0~~2~~3 Sec. 2.9~~8~~.3.7	auxIOv2PortLastCommandedState	
F.2.2.3	Generic Data Retrieval Requirements				
F.2.2.4	Generic Control Requirements				
F.2.2.4.1	Control External Device	F.3.3.3			~~Note: Check NTCIP 1201 v03 - the design may have changed.~~
			NTCIP 1201 v0~~2~~3 Sec. 2.10~~8~~.3.1	auxIOPortType	
			NTCIP 1201 v03~~2~~ Sec. 2.10~~8~~.3.2	auxIOPortNumber	
			NTCIP 1201 v03~~2~~ Sec. 2.10~~8~~.3.5	auxIOPortValue	
F.2.3	Generic Supplemental Requirements				
F.2.3.1~~1~~	Supplemental Requirements for Event Monitoring				
F.2.3.1.1	Record and Timestamp Events				
F.2.3.1.2	Support a Number of Event Classes				See Requirement F.2.3.1.2 in PRL
F.2.3.1.3	Support a Number of Event Types to Monitor				See Requirement F.2.3.1.3 in PRL
F.2.3.1.4	Support Monitoring of Event Types				
F.2.3.1.4.1	Support On-Change Events				
F.2.3.1.4.2	Support Greater Than Events				
F.2.3.1.4.3	Support Less Than Events				
F.2.3.1.4.4	Support Hysteresis Events				
F.2.3.1.4.5	Support Periodic Events				

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Requirements Traceability Matrix (RTM)					
FR ID	**Functional Requirement**	**Dialog ID**	**Object ID**	**Object Name**	**Additional Specifications**
F.2.3.1.4.6	Support Bit Flag Events				
F.2.3.1.5	Support Event Monitoring on Any Data				
F.2.3.1.6	Support a Number of Events to Store in Log				See Requirement F.2.3.1.6 in PRL
F.2.3.2	Required Number of Auxiliary Ports				See Requirement F.2.3.2 in PRL

~~Requirements Traceability Matrix (RTM)~~					
~~**FR ID**~~	~~**Functional Requirement**~~	~~**Dialog ID**~~	~~**Object ID**~~	~~**Object Name**~~	~~**Additional Specifications**~~
~~3.5.1~~		~~ESS Manager Requirements~~			
~~3.5.1.1~~		~~ESS Configuration Requirements~~			
~~3.5.1.1.1~~	~~F.3.1~~	~~Retrieve ESS Characteristics~~			
~~-~~			~~5.2.1~~	~~essNtcipCategory~~	
~~-~~			~~5.2.2~~	~~essNtcipSiteDescription~~	
~~-~~			~~5.3.1~~	~~essTypeofStation~~	
~~-~~			~~5.4.1~~	~~essLatitude~~	
~~-~~			~~5.4.2~~	~~essLongitude~~	
~~-~~			~~5.5.1~~	~~essReferenceHeight~~	
~~3.5.1.1.2~~	~~F.3.1~~	~~Retrieve Compressed Station Metadata~~			
~~-~~			~~5.3.8~~	~~essStationMetaDataV3Block~~	
~~3.5.1.1.3~~	~~F.3.3~~	~~Configure ESS Manager~~			
~~-~~			~~5.2.2~~	~~essNtcipSiteDescription~~	
~~3.5.1.2~~		~~ESS Status Monitoring Requirements~~			
~~3.5.1.2.1~~	~~F.3.1~~	~~Retrieve ESS Door Status~~			
~~-~~			~~5.3.2~~	~~essDoorStatus~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.1.2.2~~	~~F.3.1~~	~~Retrieve Battery Status~~			
~~-~~			~~5.3.3~~	~~essBatteryStatus~~	
~~3.5.1.2.3~~	~~F.3.1~~	~~Retrieve Line Volts~~			
~~-~~			~~5.3.4~~	~~essLineVolts~~	
~~3.5.1.3~~		~~ESS Data Retrieval Requirements~~			
~~3.5.1.3.1~~	~~F.3.1~~	~~Retrieve Mobile ESS Movement~~			
~~-~~			~~5.4.1~~	~~essLatitude~~	
~~-~~			~~5.4.2~~	~~essLongitude~~	
~~-~~			~~5.4.3~~	~~essVehicleSpeed~~	
~~-~~			~~5.4.4~~	~~essVehicleBearing~~	
~~-~~			~~5.4.5~~	~~essOdometer~~	
~~-~~			~~5.5.1~~	~~essReferenceHeight~~	
~~3.5.1.3.3~~	~~F.3.1~~	~~Retrieve Compressed Mobile Station Data~~			
~~-~~			~~5.3.7~~	~~essMobileBlock~~	
~~3.5.1.4~~		~~ESS Control Requirements~~			
~~3.5.2~~		~~Sensor Manager Requirements~~			
~~3.5.2.1~~		~~Sensor Configuration Requirements~~			
~~3.5.2.1.1~~	~~F.3.1~~	~~Retrieve Atmospheric Pressure Height~~			
~~-~~			~~5.5.2~~	~~essPressureHeight~~	
~~3.5.2.1.2~~	~~F.4.6~~	~~Retrieve Metadata for Each Wind Sensor~~			
~~-~~			~~5.6.8~~	~~windSensorTableNumSensors~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.6.10.1~~	~~windSensorIndex~~	
-			~~5.6.10.2~~	~~windSensorHeight~~	
-			~~5.6.10.3~~	~~windSensorLocation~~	
~~3.5.2.1.3~~	~~F.4.6~~	~~Retrieve Temperature Sensor Metadata~~			
-			~~5.7.1~~	~~essNumTemperatureSensors~~	
-			~~5.7.3.1~~	~~essTemperatureSensorIndex~~	
-			~~5.7.3.2~~	~~essTemperatureSensorHeight~~	
~~3.5.2.1.4~~	~~F.4.6~~	~~Retrieve Pavement Sensor Metadata~~			
-			~~5.11.1~~	~~numEssPavementSensors~~	
-			~~5.11.3.1~~	~~essPavementSensorIndex~~	
-			~~5.11.3.2~~	~~essPavementSensorLocation~~	
-			~~5.11.3.3~~	~~essPavementType~~	
-			~~5.11.3.4~~	~~essPavementElevation~~	
-			~~5.11.3.5~~	~~essPavementExposure~~	
-			~~5.11.3.6~~	~~essPavementSensorType~~	
~~3.5.2.1.5~~	~~F.4.6~~	~~Retrieve Subsurface Sensor Metadata~~			
-			~~5.11.4~~	~~numEssSubSurfaceSensors~~	
-			~~5.11.6.1~~	~~essSubSurfaceSensorIndex~~	
-			~~5.11.6.2~~	~~essSubSurfaceSensorLocation~~	
-			~~5.11.6.3~~	~~essSubSurfaceType~~	
-			~~5.11.6.4~~	~~essSubSurfaceSensorDepth~~	
~~3.5.2.1.6~~	~~F.4.8~~	~~Configure Pavement Sensor~~			
-			~~5.11.3.1~~	~~essPavementSensorIndex~~	
-			~~5.11.3.2~~	~~essPavementSensorLocation~~	
-			~~5.11.3.3~~	~~essPavementType~~	
-			~~5.11.3.5~~	~~essPavementExposure~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.2.1.7~~	~~F.4.8~~	~~Configure Subsurface Sensor~~			
-			~~5.11.6.1~~	~~essSubSurfaceSensorIndex~~	
-			~~5.11.6.2~~	~~essSubSurfaceSensorLocation~~	
-			~~5.11.6.3~~	~~essSubSurfaceType~~	
-			~~5.11.6.4~~	~~essSubSurfaceSensorDepth~~	
~~3.5.2.1.8~~	~~4.2.8~~	~~Configure Passive Ice Detection Logic~~			
-			~~5.13.1~~	~~numEssTreatments~~	
-			~~5.13.3.1~~	~~essPavementTreatmentIndex~~	
-			~~5.13.3.2~~	~~essPaveTreatProductType~~	
-			~~5.13.3.3~~	~~essPaveTreatProductForm~~	
-			~~5.13.3.4~~	~~essPercentProductMix~~	
~~3.5.2.1.9~~	~~4.2.10~~	~~Configure Snapshot Camera~~			
-			~~5.16.3.1~~	~~essSnapshotCameraIndex~~	
-			~~5.16.3.2~~	~~essSnapshotCameraDescription~~	
-			~~5.16.3.6~~	~~essSnapshotCameraFilename~~	
~~3.5.2.2~~		~~Sensor Status Monitoring Requirements~~			
~~3.5.2.3~~		~~Sensor Data Retrieval Requirements~~			
~~3.5.2.3.1~~	~~F.3.1~~	~~Retrieve Weather Profile with Mobile Sources~~			
-			~~5.3.9~~	~~essWeatherV3Block~~	
-			~~5.4.1~~	~~essLatitude~~	
-			~~5.4.2~~	~~essLongitude~~	
-			~~5.4.3~~	~~essVehicleSpeed~~	
-			~~5.4.4~~	~~essVehicleBearing~~	
-			~~5.4.5~~	~~essOdometer~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.5.1~~	~~essReferenceHeight~~	
-			~~5.12.1~~	~~essMobileFriction~~	
-			~~5.12.2~~	~~essMobileObservationGroundState~~	
-			~~5.12.3~~	~~essMobileObservationPavement~~	
~~3.5.2.3.2~~		~~Monitor Weather Condition~~			
~~3.5.2.3.2.1~~	~~F.3.1~~	~~Retrieve Atmospheric Pressure~~			
-			~~5.5.4~~	~~essAtmosphericPressure~~	
~~3.5.2.3.2.2~~	~~F.4.6~~	~~Retrieve Wind Data~~			
-			~~5.6.8~~	~~windSensorTableNumSensors~~	
-			~~5.6.10.1~~	~~windSensorIndex~~	
-			~~5.6.10.4~~	~~windSensorAvgSpeed~~	
-			~~5.6.10.5~~	~~windSensorAvgDirection~~	
-			~~5.6.10.6~~	~~windSensorSpotSpeed~~	
-			~~5.6.10.7~~	~~windSensorSpotDirection~~	
-			~~5.6.10.8~~	~~windSensorGustSpeed~~	
-			~~5.6.10.9~~	~~windSensorGustDirection~~	
-			~~5.6.10.10~~	~~windSensorSituation~~	
~~3.5.2.3.2.3~~	~~F.4.7~~	~~Retrieve Temperature~~			
-			~~5.7.3.1~~	~~essTemperatureSensorIndex~~	
-			~~5.7.3.3~~	~~essAirTemperature~~	
~~3.5.2.3.2.4~~	~~F.3.1~~	~~Retrieve Daily Minimum and Maximum Temperature~~			
-			~~5.7.6~~	~~essMaxTemp~~	
-			~~5.7.7~~	~~essMinTemp~~	
~~3.5.2.3.2.5~~	~~F.3.1~~	~~Retrieve Humidity~~			
-			~~5.7.4~~	~~essWetbulbTemp~~	
-			~~5.7.5~~	~~essDewpointTemp~~	
-			~~5.8.1~~	~~essRelativeHumidity~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.2.3.2.6~~		~~Monitor Precipitation~~			
~~3.5.2.3.2.6.1~~	~~4.2.12~~	~~Retrieve Precipitation Presence~~			
~~-~~			~~5.8.6~~	~~essPrecipYesNo~~	
~~-~~			~~5.8.18~~	~~precipitationSensorModelInformation~~	
~~3.5.2.3.2.6.2~~	~~F.3.1~~	~~Retrieve Precipitation Rates~~			
~~-~~			~~5.8.7~~	~~essPrecipRate~~	
~~-~~			~~5.8.8~~	~~essSnowfallAccumRate~~	
~~-~~			~~5.8.11~~	~~essPrecipitationStartTime~~	
~~-~~			~~5.8.12~~	~~essPrecipitationEndTime~~	
~~3.5.2.3.2.6.3~~	~~F.3.1~~	~~Retrieve Precipitation Totals~~			
~~-~~			~~5.8.13~~	~~essPrecipitationOneHour~~	
~~-~~			~~5.8.14~~	~~essPrecipitationThreeHours~~	
~~-~~			~~5.8.15~~	~~essPrecipitationSixHours~~	
~~-~~			~~5.8.16~~	~~essPrecipitationTwelveHours~~	
~~-~~			~~5.8.17~~	~~essPrecipitation24Hours~~	
~~3.5.2.3.2.7~~	~~4.2.13~~	~~Retrieve Solar Radiation~~			
~~-~~			~~5.9.2~~	~~essTotalSun~~	
~~-~~			~~5.9.4~~	~~essInstantaneousTerrestrialRadiation~~	
~~-~~			~~5.9.5~~	~~essInstantaneousSolarRadiation~~	
~~-~~			~~5.9.6~~	~~essTotalRadiation~~	
~~-~~			~~5.9.7~~	~~essTotalRadiationPeriod~~	
~~3.5.2.3.2.8~~	~~F.3.1~~	~~Retrieve Visibility~~			
~~-~~			~~5.10.1~~	~~essVisibility~~	
~~3.5.2.3.2.9~~	~~F.3.1~~	~~Retrieve Compressed Weather Data~~			
~~-~~			~~5.3.9~~	~~essWeatherV3Block~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.2.3.3~~		~~Monitor Pavement Condition~~			
~~3.5.2.3.3.1~~	~~4.2.14~~	~~Retrieve Pavement Surface Condition~~			
~~-~~			~~5.11.3.1~~	~~essPavementSensorIndex~~	
~~-~~			~~5.11.3.7~~	~~essSurfaceStatus~~	
~~-~~			~~5.11.3.8~~	~~essSurfaceTemperature~~	
~~-~~			~~5.11.3.15~~	~~essPavementSensorError~~	
~~-~~			~~5.11.3.18~~	~~pavementSensorModelInformation~~	
~~3.5.2.3.3.2~~	~~4.2.15~~	~~Retrieve Icing Conditions—Active~~			
~~-~~			~~5.11.3.1~~	~~essPavementSensorIndex~~	
~~-~~			~~5.11.3.8~~	~~essSurfaceTemperature~~	
~~-~~			~~5.11.3.9~~	~~essPavementTemperature~~	
~~-~~			~~5.11.3.13~~	~~essSurfaceFreezePoint~~	
~~-~~			~~5.11.3.14~~	~~essSurfaceBlackIceSignal~~	
~~-~~			~~5.11.3.15~~	~~essPavementSensorError~~	
~~-~~			~~5.11.3.16~~	~~essSurfaceIceOrWaterDepth~~	
~~-~~			~~5.11.3.19~~	~~pavementSensorTemperatureDepth~~	
~~3.5.2.3.3.3~~	~~4.2.6~~	~~Retrieve Icing Conditions—Passive~~			
~~-~~			~~5.11.3.1~~	~~essPavementSensorIndex~~	
~~-~~			~~5.11.3.8~~	~~essSurfaceTemperature~~	
~~-~~			~~5.11.3.9~~	~~essPavementTemperature~~	
~~-~~			~~5.11.3.11~~	~~essSurfaceSalinity~~	
~~-~~			~~5.11.3.13~~	~~essSurfaceFreezePoint~~	
~~-~~			~~5.11.3.14~~	~~essSurfaceBlackIceSignal~~	
~~-~~			~~5.11.3.15~~	~~essPavementSensorError~~	
~~-~~			~~5.11.3.16~~	~~essSurfaceIceOrWaterDepth~~	
~~-~~			~~5.11.3.17~~	~~essSurfaceConductivityV2~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.11.3.19~~	~~pavementSensorTemperatureDepth~~	
-			~~5.13.1~~	~~numEssTreatments~~	
-			~~5.13.3.1~~	~~essPavementTreatmentIndex~~	
-			~~5.13.3.2~~	~~essPaveTreatProductType~~	
-			~~5.13.3.3~~	~~essPaveTreatProductForm~~	
-			~~5.13.3.4~~	~~essPercentProductMix~~	
~~3.5.2.3.3.4~~	~~F.3.1~~	~~Retrieve Adjacent Snow Depth~~			
-			~~5.8.3~~	~~essAdjacentSnowDepth~~	
~~3.5.2.3.3.5~~	~~F.3.1~~	~~Retrieve Roadway Snow Depth~~			
-			~~5.8.4~~	~~essRoadwaySnowDepth~~	
~~3.5.2.3.3.6~~	~~F.3.1~~	~~Retrieve Roadway Ice Thickness~~			
-			~~5.8.5~~	~~essRoadwaySnowPackDepth~~	
-			~~5.8.10~~	~~essIceThickness~~	
~~3.5.2.3.3.7~~	~~F.3.1~~	~~Retrieve Compressed Pavement Condition Data~~			
-			~~5.11.9~~	~~essPavementV3Block~~	
~~3.5.2.3.4~~		~~Monitor Subsurface Conditions~~			
~~3.5.2.3.4.1~~	~~F.4.7~~	~~Retrieve Basic Subsurface Conditions~~			
-			~~5.11.6.1~~	~~essSubSurfaceSensorIndex~~	
-			~~5.11.6.5~~	~~essSubSurfaceTemperature~~	
-			~~5.11.6.7~~	~~essSubSurfaceSensorError~~	
~~3.5.2.3.4.2~~	~~F.4.7~~	~~Retrieve Subsurface Moisture~~			
-			~~5.11.6.1~~	~~essSubSurfaceSensorIndex~~	
-			~~5.11.6.6~~	~~essSubSurfaceMoisture~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.2.3.4.3~~	~~F.3.1~~	~~Retrieve Compressed Subsurface Condition Data~~			
~~-~~			~~5.11.8~~	~~essSubSurfaceBlock~~	
~~3.5.2.3.5~~		~~Monitor Situation Assessments~~			
~~3.5.2.3.5.1~~	~~F.4.6~~	~~Retrieve Wind Situation~~			
			~~5.6.10.1~~	~~windSensorIndex~~	
~~-~~			~~5.6.10.10~~	~~windSensorSituation~~	
~~3.5.2.3.5.2~~	~~F.3.1~~	~~Retrieve Precipitation Situation~~			
~~-~~			~~5.8.9~~	~~essPrecipSituation~~	
~~3.5.2.3.5.3~~	~~F.3.1~~	~~Retrieve Cloud Situation~~			
~~-~~			~~5.9.3~~	~~essCloudSituation~~	
~~3.5.2.3.5.4~~	~~F.3.1~~	~~Retrieve Visibility Situation~~			
~~-~~			~~5.10.2~~	~~essVisibilitySituation~~	
~~3.5.2.3.5.5~~	~~F.3.1~~	~~Retrieve Ground State~~			
~~-~~			~~5.12.2~~	~~essMobileObservationGroundState~~	
~~3.5.2.3.5.6~~	~~F.3.1~~	~~Retrieve Pavement State~~			
~~-~~			~~5.12.3~~	~~essMobileObservationPavement~~	
~~3.5.2.3.6~~		~~Monitor Air Quality and Biohazard Conditions~~			
~~3.5.2.3.6.1~~	~~F.3.1~~	~~Retrieve Carbon Monoxide Reading~~			
~~-~~			~~5.14.1~~	~~essCO~~	
~~3.5.2.3.6.2~~	~~F.3.1~~	~~Retrieve Carbon Dioxide Reading~~			
~~-~~			~~5.14.2~~	~~essCO2~~	
~~3.5.2.3.6.3~~	~~F.3.1~~	~~Retrieve Nitrous Oxide Reading~~			
~~-~~			~~5.14.3~~	~~essNO~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.2.3.6.4~~	~~F.3.1~~	~~Retrieve Nitrogen Dioxide Reading~~			
~~-~~			~~5.14.4~~	~~essNO2~~	
~~3.5.2.3.6.5~~	~~F.3.1~~	~~Retrieve Sulfur Dioxide Reading~~			
~~-~~			~~5.14.5~~	~~essSO2~~	
~~3.5.2.3.6.6~~	~~F.3.1~~	~~Retrieve Ozone Reading~~			
~~-~~			~~5.14.6~~	~~essO3~~	
~~3.5.2.3.6.7~~	~~F.3.1~~	~~Retrieve Small Particulate Matter Reading~~			
~~-~~			~~5.14.7~~	~~essPM10~~	
~~3.5.2.3.6.8~~	~~F.3.1~~	~~Retrieve Compressed Air Quality Data~~			
~~-~~			~~5.14.8~~	~~essAirQualityBlock~~	
~~3.5.2.3.7~~	~~F.4.6~~	~~Retrieve Water Level~~			
~~-~~			~~5.8.19~~	~~waterLevelSensorTableNumSensors~~	
~~-~~			~~5.8.21.1~~	~~waterLevelSensorIndex~~	
~~-~~			~~5.8.21.2~~	~~waterLevelSensorReading~~	
~~3.5.2.3.8~~	~~4.2.2~~	~~Retrieve Snapshot~~		~~Upon ESS delivery the FTP username shall be _____. Upon ESS delivery, the FTP password shall be _____.~~	
~~-~~			~~5.17.1~~	~~<not an SNMP Object> Snapshot.filename:text~~	
~~-~~			~~5.17.2~~	~~<not an SNMP object> Snapshot.image:frame~~	
~~3.5.2.3.9~~	~~4.2.11~~	~~Retrieve Snapshot Camera Configuration~~			
~~-~~			~~5.16.1~~	~~essSnapshotNumberOfCameras~~	
~~-~~			~~5.16.3.1~~	~~essSnapshotCameraIndex~~	
~~-~~			~~5.16.3.2~~	~~essSnapshotCameraDescription~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.16.3.3~~	~~essSnapshotCameraStoragePath~~	
-			~~5.16.3.6~~	~~essSnapshotCameraFilename~~	
~~3.5.2.4~~		~~Sensor Control Requirements~~			
~~3.5.2.4.1~~	~~4.2.1~~	~~Capture Snapshot Image~~			
-			~~5.16.3.1~~	~~essSnapshotCameraIndex~~	
-			~~5.16.3.4~~	~~essSnapshotCameraCommand~~	
-			~~5.16.3.5~~	~~essSnapshotCameraError~~	
~~3.5.2.4.2~~	~~4.2.3~~	~~Delete Snapshot~~			
-			~~5.17.1~~	~~<not an SNMP Object> Snapshot.filename:text~~	
-			~~5.17.2~~	~~<not an SNMP object> Snapshot.image:frame~~	
~~3.5.2.4.3~~	~~4.2.4~~	~~Copy Snapshot~~			
-			~~5.17.1~~	~~<not an SNMP Object> Snapshot.filename:text~~	
-			~~5.17.2~~	~~<not an SNMP object> Snapshot.image:frame~~	
~~3.5.3~~		~~PTS Manager Requirements~~			
~~3.5.3.1~~		~~PTS Configuration Requirements~~			
~~3.5.3.1.1~~	~~4.2.5~~	~~Retrieve Stationary Pavement Treatment Configuration~~			
-			~~5.13.1~~	~~numEssTreatments~~	
-			~~5.13.3.1~~	~~essPavementTreatmentIndex~~	
-			~~5.13.3.2~~	~~essPaveTreatProductType~~	
-			~~5.13.3.3~~	~~essPaveTreatProductForm~~	
-			~~5.13.3.4~~	~~essPercentProductMix~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.13.10~~	~~ptsSignalDuration~~	
-			~~5.13.18~~	~~ptsMonitoringDetectors~~	
~~3.5.3.1.2~~	~~4.2.7~~	~~Configure Stationary Pavement Treatment System~~			
-			~~5.13.1~~	~~numEssTreatments~~	
-			~~5.13.3.1~~	~~essPavementTreatmentIndex~~	
-			~~5.13.3.2~~	~~essPaveTreatProductType~~	
-			~~5.13.3.3~~	~~essPaveTreatProductForm~~	
-			~~5.13.3.4~~	~~essPercentProductMix~~	
-			~~5.13.10~~	~~ptsSignalDuration~~	
-			~~5.13.18~~	~~ptsMonitoringDetectors~~	
~~3.5.3.1.3~~	~~F.3.1~~	~~Retrieve Mobile Pavement Treatment Configuration~~			
-			~~5.13.6~~	~~pavementTreatmentBlock~~	
~~3.5.3.1.4~~	~~4.2.9~~	~~Configure Mobile Pavement Treatment System~~			
-			~~5.13.1~~	~~numEssTreatments~~	
-			~~5.13.3.1~~	~~essPavementTreatmentIndex~~	
-			~~5.13.3.2~~	~~essPaveTreatProductType~~	
-			~~5.13.3.3~~	~~essPaveTreatProductForm~~	
-			~~5.13.3.4~~	~~essPercentProductMix~~	
-			~~5.13.4~~	~~essPaveTreatmentAmount~~	
-			~~5.13.5~~	~~essPaveTreatmentWidth~~	
~~3.5.3.2~~		~~PTS Status Monitoring Requirements~~			
~~3.5.3.2.1~~	~~F.3.1~~	~~Retrieve Pavement Treatment Status~~			
-			~~5.13.9~~	~~ptsSprayerState~~	
-			~~5.13.11~~	~~ptsSignalEventCount~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~5.13.12~~	~~ptsLastSignalEvent~~	
-			~~5.13.13~~	~~ptsActiveEventCount~~	
-			~~5.13.14~~	~~ptsInactiveEventCount~~	
-			~~5.13.15~~	~~ptsLastActiveEvent~~	
-			~~5.13.16~~	~~ptsLastInactiveEvent~~	
-			~~5.13.17~~	~~ptsError~~	
~~3.5.3.3~~		~~PTS Data Retrieval Requirements~~			
~~3.5.3.4~~		~~PTS Control Requirements~~			
~~3.5.3.4.1~~	~~F.3.3~~	~~Set PTS Operational Mode~~			
-			~~5.13.19~~	~~ptsOperationalModeV3~~	
~~3.5.3.4.2~~	~~F.3.3~~	~~Manually Activate PTS Sprayer~~			
-			~~5.13.20~~	~~ptsCommandStateV3~~	
~~3.5.4~~		~~Backwards Compatibility Requirements~~			
~~3.5.4.1~~	~~RFC 1157~~	~~Version 1 Wind Sensor Meta Data~~			
-			~~5.5.3~~	~~essWindSensorHeight~~	
~~3.5.4.2~~	~~RFC 1157~~	~~Version 1 Average Wind Sensor Data~~			
-			~~5.6.1~~	~~essAvgWindDirection~~	
-			~~5.6.2~~	~~essAvgWindSpeed~~	
~~3.5.4.3~~	~~RFC 1157~~	~~Version 1 Spot Wind Sensor Data~~			
-			~~5.6.3~~	~~essSpotWindDirection~~	
-			~~5.6.4~~	~~essSpotWindSpeed~~	
~~3.5.4.4~~	~~RFC 1157~~	~~Version 1 Wind Gust Data~~			
-			~~5.6.7~~	~~essMaxWindGustDir~~	
-			~~5.6.6~~	~~essMaxWindGustSpeed~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.5.4.5~~	~~RFC 1157~~	~~Version 1 Wind Situation~~			
~~-~~			~~5.6.5~~	~~essWindSituation~~	
~~3.5.4.6~~	~~RFC 1157~~	~~Version 1 Water Depth~~			
~~-~~			~~5.8.2~~	~~essWaterDepth~~	
~~3.5.4.7~~	~~RFC 1157~~	~~Version 1 Solar Radiation~~			
~~-~~			~~5.9.1~~	~~essSolarRadiation~~	
~~3.5.4.8~~	~~RFC 1157~~	~~Version 1 Surface Water Depth~~			
~~-~~			~~5.11.3.10~~	~~essSurfaceWaterDepth~~	
~~3.5.4.9~~	~~RFC 1157~~	~~Version 1 Surface Conductivity~~			
~~-~~			~~5.11.3.12~~	~~essSurfaceConductivity~~	
~~3.5.4.10~~	~~F.3.1~~	~~Version 2 Station Meta Data Block~~			
~~-~~			~~5.3.5~~	~~essStationMetaDataBlock~~	
~~3.5.4.11~~	~~F.3.1~~	~~Version 2 Weather Block~~			
~~-~~			~~5.3.6~~	~~essWeatherBlock~~	
~~3.5.4.12~~	~~F.3.1~~	~~Version 2 Pavement Block~~			
~~-~~			~~5.11.7~~	~~essPavementBlock~~	
~~F.2.1~~		~~Generic Architectural Requirements~~			
~~F.2.1.1~~		~~Support Basic Communications~~			
~~F.2.1.1.1~~	~~F.3.1~~	~~Retrieve Data~~			
~~F.2.1.1.2~~	~~F.3.3~~	~~Deliver Data~~			
~~F.2.1.1.3~~	~~F.3.2~~	~~Explore Data~~			
~~F.2.1.2~~		~~Support Logged Data~~			
~~F.2.1.2.1~~	~~F.4.2~~	~~Retrieve Current Configuration of Logging Service~~			

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1103 v01 Sec. A.7.2.1~~	~~eventClassNumber~~	
-			~~NTCIP 1103 v01 Sec. A.7.2.2~~	~~eventClassLimit~~	
-			~~NTCIP 1103 v01 Sec. A.7.2.3~~	~~eventClassClearTime~~	
-			~~NTCIP 1103 v01 Sec. A.7.2.4~~	~~eventClassDescription~~	
-			~~NTCIP 1103 v01 Sec. A.7.2.6~~	~~eventClassNumEvents~~	
-			~~NTCIP 1103 v01 A.7.4.1~~	~~eventConfigID~~	
-			~~NTCIP 1103 v01 A.7.4.2~~	~~eventConfigClass~~	
-			~~NTCIP 1103 v01 A.7.4.3~~	~~eventConfigMode~~	
-			~~NTCIP 1103 v01 A.7.4.4~~	~~eventConfigCompareValue~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1103 v01 A.7.4.5~~	~~eventConfigCompareValue2~~	
-			~~NTCIP 1103 v01 A.7.4.6~~	~~eventConfigCompareOID~~	
-			~~NTCIP 1103 v01 A.7.4.7~~	~~eventConfigLogOID~~	
-			~~NTCIP 1103 v01 A.7.4.8~~	~~eventConfigAction~~	
-			~~NTCIP 1103 v01 A.7.4.9~~	~~eventConfigStatus~~	
~~F.2.1.2.2~~	~~F.4.3~~	~~Configure Logging Service~~			
-			~~NTCIP 1103 v01 A.7.2.1~~	~~eventClassNumber~~	
-			~~NTCIP 1103 v01 A.7.2.2~~	~~eventClassLimit~~	
-			~~NTCIP 1103 v01 A.7.2.3~~	~~eventClassClearTime~~	
-			~~NTCIP 1103 v01 A.7.2.4~~	~~eventClassDescription~~	
-			~~NTCIP 1103 v01 A.7.4.1~~	~~eventConfigID~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1103 v01 A.7.4.2~~	~~eventConfigClass~~	
-			~~NTCIP 1103 v01 A.7.4.3~~	~~eventConfigMode~~	
-			~~NTCIP 1103 v01 A.7.4.4~~	~~eventConfigCompareValue~~	
-			~~NTCIP 1103 v01 A.7.4.5~~	~~eventConfigCompareValue2~~	
-			~~NTCIP 1103 v01 A.7.4.6~~	~~eventConfigCompareOID~~	
-			~~NTCIP 1103 v01 A.7.4.7~~	~~eventConfigLogOID~~	
-			~~NTCIP 1103 v01 A.7.4.8~~	~~eventConfigAction~~	
-			~~NTCIP 1103 v01 A.7.4.9~~	~~eventConfigStatus~~	
~~F.2.1.2.3~~	~~F.4.1~~	~~Retrieve Logged Data~~			
-			~~NTCIP 1103 v01 A.7.2.1~~	~~eventClassNumber~~	
-			~~NTCIP 1103 v01 A.7.2.5~~	~~eventClassNumRowsInLog~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1103 v01 A.7.2.6~~	~~eventClassNumEvents~~	
-			~~NTCIP 1103 v01 A.7.6.1~~	~~eventLogClass~~	
-			~~NTCIP 1103 v01 A.7.6.2~~	~~eventLogNumber~~	
-			~~NTCIP 1103 v01 A.7.6.3~~	~~eventLogID~~	
-			~~NTCIP 1103 v01 A.7.6.4~~	~~eventLogTime~~	
-			~~NTCIP 1103 v01 A.7.6.5~~	~~eventLogValue~~	
-			~~NTCIP 1103 v01 A.7.7~~	~~numEvents~~	
~~F.2.1.2.4~~	~~F.3.3~~	~~Clear Log~~			
-			~~NTCIP 1103 v01 A.7.2.1~~	~~eventClassNumber~~	
-			~~NTCIP 1103 v01 A.7.2.3~~	~~eventClassClearTime~~	
~~F.2.1.2.5~~	~~F.3.1~~	~~Retrieve Capabilities of Event Logging Service~~			
-			~~NTCIP 1103 v01 A.7.1~~	~~maxEventClasses~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1103 v01 A.7.3~~	~~maxEventLogConfigs~~	
-			~~NTCIP 1103 v01 A.7.5~~	~~maxEventLogSize~~	
~~F.2.1.2.6~~	~~F.3.1~~	~~Retrieve Total Number of Logged Events~~			
-			~~NTCIP 1103 v01 A.7.2.1~~	~~eventClassNumber~~	
-			~~NTCIP 1103 v01 A.7.2.5~~	~~eventClassNumRowsInLog~~	
-			~~NTCIP 1103 v01 A.7.2.6~~	~~eventClassNumEvents~~	
-			~~NTCIP 1103 v01 A.7.7~~	~~numEvents~~	
~~F.2.2~~		~~Generic Functional Requirements~~			
~~F.2.2.1~~		~~Generic Configuration Requirements~~			
~~F.2.2.1.1~~	~~F.4.6~~	~~Retrieve Device Component Information~~			
-			~~NTCIP 1201 v02 Sec. 2.2.2~~	~~globalMaxModules~~	
-			~~NTCIP 1201 v02 Sec. 2.2.3.1~~	~~moduleNumber~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1201 v02 Sec. 2.2.3.2~~	~~moduleDeviceNode~~	
-			~~NTCIP 1201 v02 Sec. 2.2.3.3~~	~~moduleMake~~	
-			~~NTCIP 1201 v02 Sec. 2.2.3.4~~	~~moduleModel~~	
-			~~NTCIP 1201 v02 Sec. 2.2.3.5~~	~~moduleVersion~~	
-			~~NTCIP 1201 v02 Sec. 2.2.3.6~~	~~moduleType~~	
~~F.2.2.1.2~~	~~F.3.1~~	~~Retrieve Device Configuration Identifier~~			
-			~~NTCIP 1201 v02 Sec. 2.2.1~~	~~globalSetIDParameter~~	
~~F.2.2.1.3~~	~~F.3.1~~	~~Retrieve Supported Standards~~			
-			~~NTCIP 1201 v02 Sec. 2.2.4~~	~~controllerBaseStandards~~	
~~F.2.2.1.4~~	~~F.3.1~~	~~Retrieve System Name~~			
-			~~RFC1213 Clause 6~~	~~sysName~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~F.2.2.1.5~~		~~Manage Time~~			
~~F.2.2.1.5.1~~	~~F.3.3~~	~~Set Time~~			
-			~~NTCIP 1201 v02 Sec. 2.4.1~~	~~globalTime~~	
~~F.2.2.1.5.2~~	~~F.3.1~~	~~Retrieve Current Time~~			
-			~~NTCIP 1201 v02 Sec. 2.4.1~~	~~globalTime~~	
~~F.2.2.1.6~~	~~F.4.6~~	~~Retrieve External Port Information~~			
-			~~NTCIP 1201 v02 Sec. 2.8.2~~	~~auxIOTableNumAnalogPorts~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.1~~	~~auxIOPortType~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.2~~	~~auxIOPortNumber~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.3~~	~~auxIOPortDescription~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.4~~	~~auxIOPortResolution~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
-			~~NTCIP 1201 v02 Sec. 2.8.3.6~~	~~auxIOPortDirection~~	
~~F.2.2.1.7~~	~~F.4.8~~	~~Configure Port Information~~			
-			~~NTCIP 1201 v02 Sec. 2.8.3.1~~	~~auxIOPortType~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.2~~	~~auxIOPortNumber~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.3~~	~~auxIOPortDescription~~	
~~F.2.2.2~~		~~Generic Status Monitoring Requirements~~			
~~F.2.2.2.1~~	~~F.4.6~~	~~Monitor Status of External Device~~			
-			~~NTCIP 1201 v02 Sec. 2.8.3.5~~	~~auxIOPortValue~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.7~~	~~auxIOPortLastCommandedState~~	
~~F.2.2.3~~		~~Generic Data Retrieval Requirements~~			
~~F.2.2.4~~		~~Generic Control Requirements~~			

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~F.2.2.4.1~~	~~F.4.8~~	~~Control External Device~~			
-			~~NTCIP 1201 v02 Sec. 2.8.3.1~~	~~auxIOPortType~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.2~~	~~auxIOPortNumber~~	
-			~~NTCIP 1201 v02 Sec. 2.8.3.5~~	~~auxIOPortValue~~	
~~3.6~~		~~Supplemental Requirements~~			
~~3.6.1~~		~~Required Number of Atmospheric Pressure Sensors~~		~~See Requirement 3.6.1 in PRL~~	
~~3.6.2~~		~~Required Number of Wind Sensors~~		~~See Requirement 3.6.2 in PRL~~	
~~3.6.3~~		~~Required Number of Temperature Sensors~~		~~See Requirement 3.6.3 in PRL~~	
~~3.6.4~~		~~Required Number of Humidity Sensors~~		~~See Requirement 3.6.4 in PRL~~	
~~3.6.5~~		~~Required Number of Precipitation Sensors~~		~~See Requirement 3.6.5 in PRL~~	
~~3.6.6~~		~~Required Number of Solar Radiation Sensors~~		~~See Requirement 3.6.6 in PRL~~	
~~3.6.7~~		~~Required Number of Visibility Sensors~~		~~See Requirement 3.6.7 in PRL~~	
~~3.6.8~~		~~Required Number of Pavement Sensors~~		~~See Requirement 3.6.8 in PRL~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.6.9~~		~~Active Pavement Treatment Sensors~~			
~~3.6.10~~		~~Passive Pavement Treatment Sensors~~			
~~3.6.11~~		~~Required Number of Subsurface Sensors~~		~~See Requirement 3.6.11 in PRL~~	
~~3.6.12~~		~~Required Number of Pavement Treatment Products~~		~~See Requirement 3.6.12 in PRL~~	
~~3.6.13~~		~~Required Number of Carbon Monoxide Sensors~~		~~See Requirement 3.6.13 in PRL~~	
~~3.6.14~~		~~Required Number of Carbon Dioxide Sensors~~		~~See Requirement 3.6.14 in PRL~~	
~~3.6.15~~		~~Required Number of Nitrous Oxide Sensors~~		~~See Requirement 3.6.15 in PRL~~	
~~3.6.16~~		~~Required Number of Nitrogen Dioxide Sensors~~		~~See Requirement 3.6.16 in PRL~~	
~~3.6.17~~		~~Required Number of Sulfur Dioxide Sensors~~		~~See Requirement 3.6.17 in PRL~~	
~~3.6.18~~		~~Required Number of Ozone Sensors~~		~~See Requirement 3.6.18 in PRL~~	
~~3.6.19~~		~~Required Number of Small Particulate Matter Sensors~~		~~See Requirement 3.6.19 in PRL~~	
~~3.6.20~~		~~Required Number of Snapshot Cameras~~		~~See Requirement 3.6.20 in PRL~~	
~~3.6.21~~		~~Maximum Response Time for Requests~~		~~See Requirement 3.6.21 in PRL~~	
~~3.6.22~~		~~Required Number of Water Level Sensors~~		~~See Requirement 3.6.22 in PRL~~	
~~3.6.23~~		~~Support Camera Number in Filename~~		~~See Requirement 3.6.23 in PRL~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~3.6.24~~		~~Support Sequence Number in Filename~~		~~See Requirement 3.6.24 in PRL~~	
~~3.6.25~~		~~Support Date in Filename~~		~~See Requirement 3.6.25 in PRL~~	
~~3.6.26~~		~~Support Time in Filename~~		~~See Requirement 3.6.26 in PRL~~	
~~3.6.27~~		~~Support Long Filenames~~		~~See Requirement 3.6.27 in PRL~~	
~~F.2.3~~		~~Generic Supplemental Requirements~~			
~~F.2.3.1~~		~~Supplemental Requirements for Event Monitoring~~			
~~F.2.3.1.1~~		~~Record and Timestamp Events~~			
~~F.2.3.1.2~~		~~Support a Number of Event Classes~~		~~See Requirement F.2.3.1.2 in PRL~~	
~~F.2.3.1.3~~		~~Support a Number of Event Types to Monitor~~		~~See Requirement F.2.3.1.3 in PRL~~	
~~F.2.3.1.4~~		~~Support Monitoring of Event Types~~			
~~F.2.3.1.4.1~~		~~Support On-Change Events~~			
~~F.2.3.1.4.2~~		~~Support Greater Than Events~~			
~~F.2.3.1.4.3~~		~~Support Less Than Events~~			
~~F.2.3.1.4.4~~		~~Support Hysteresis Events~~			
~~F.2.3.1.4.5~~		~~Support Periodic Events~~			
~~F.2.3.1.4.6~~		~~Support Bit-flag Events~~			
~~F.2.3.1.5~~		~~Support Event Monitoring on Any Data~~			
~~F.2.3.1.6~~		~~Support a Number of Events to Store in Log~~		~~See Requirement F.2.3.1.6 in PRL~~	

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~~Requirements Traceability Matrix (RTM)~~					
~~FR ID~~	~~Functional Requirement~~	~~Dialog ID~~	~~Object ID~~	~~Object Name~~	~~Additional Specifications~~
~~F.2.3.2~~		~~Required Number of Auxiliary Ports~~		~~See Requirement F.2.3.2 in PRL~~	

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~~Annex C~~Annex B
Object Tree [Informative]

Figure 25 provides a pictorial representation of the Environmental Sensor Station Object Tree Structure. The tree structure identifies how the object definitions are combined under specific nodes.

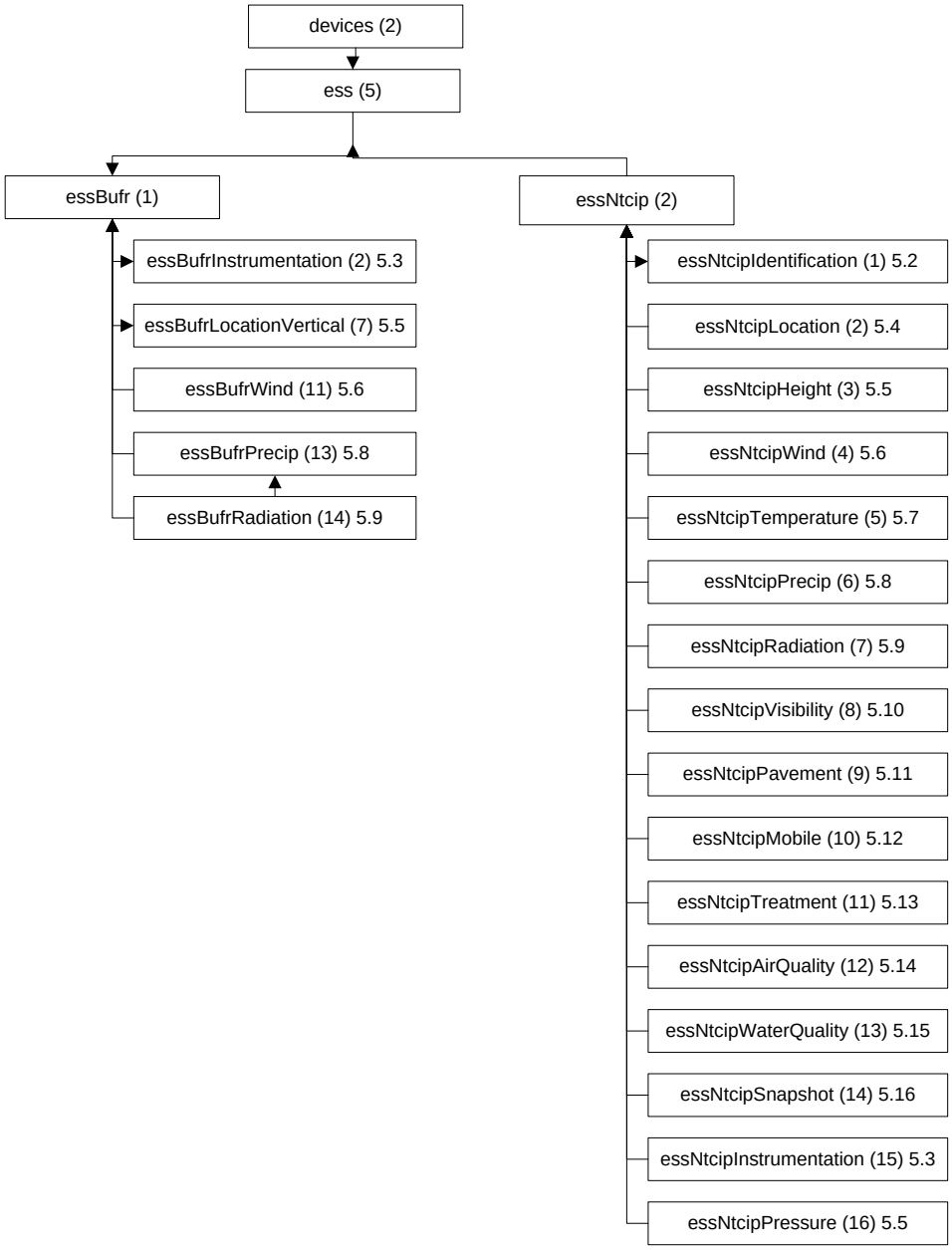

Figure 25 Object Tree for NTCIP 1204 v04

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Annex C
Test Procedures [N~~Inf~~ormative]

C.1 Purpose

Annex C defines the detailed, but generic, test procedures for testing an implementation of NTCIP 1204 v04.

C.1.1 Scope

Annex C defines test procedures in a format that is consistent with NTCIP 8007 v01and that covers the entire scope of NTCIP 1204 v04. It includes tests of some of the features defined in NTCIP 1201 v03~~:2005~~, but only to the extent that these features have been incorporated by reference in NTCIP 1204 v04.

The procedures are intended to be used as a portion of the overall set of tests that would be performed during the component testing of a device.

> Note: The NTCIP 8007 v01 test procedure format focuses on the testing of a device and is largely silent on testing a management station. Test procedures for the component testing of a management station and or test procedures for integration testing may be added at a future date.

C.1.2 Keywords

C.1.2.1 Additional Keywords

Keywords are words that are presented in all capital letters within the test procedures. Definitions of keywords are presented below. Keywords that are not defined below are defined in NTCIP 8007 v01.

Keyword	Definition
APPROPRIATE	This keyword is intended to direct the tester to ensure that the device is reporting the value provided by the sensor or set by the management station, not to test the accuracy of the sensor. The exact mechanism used to determine the appropriate value is beyond the scope of NTCIP 1204 v04, but should be defined within a test plan that references these procedures. For example, the appropriate values may be determined by using external software to check the values currently stored in the device, providing a subjective assessment of current conditions, emulating sensor inputs to create known values, etc. The mechanism chosen for a given test may be dependent upon the environment within which the device is being tested.
IF	This keyword causes the user (or application) to perform a comparison and take one action if the comparison evaluates to true and another action if the comparison evaluates to false. It is comparable to the "if…else…" expression in C.
FOR EACH	This keyword causes the user (or application) to begin a looping process that increments through a series of values. It is comparable to the "for…next" expression in C

C.1.2.2 Keyword Combinations

These test procedures frequently use the "SET-UP" and "VERIFY" keywords as defined in NTCIP 8007 v01 in the definition of a single step. When used jointly in these procedures, the failure logic of the "SET-