Open Geospatial Consortium

OGC InfraGML 1.0: Part 6 – LandInfra Survey - Encoding Standard

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i.   Abstract

This OGC InfraGML Encoding Standard presents the implementation-dependent, GML encoding of concepts supporting land and civil engineering infrastructure facilities specified in the OGC Land and Infrastructure Conceptual Model Standard (LandInfra), OGC 15-111r1. Conceptual model subject areas include land features, facilities, projects, alignment, road, railway, survey (including equipment, observations, and survey results), land division, and condominiums.

InfraGML is published as a multi-part standard. This Part 6 addresses the Survey, Equipment, Observations and Survey Results Requirements Classes from LandInfra.

ii.   Keywords

The following are keywords to be used by search engines and document catalogues.

OGC document, LandInfra, InfraGML, infrastructure, civil, survey, observation, measurements

iii.   Preface

In order to achieve consensus on the concepts supporting land and civil engineering infrastructure facilities, a UML Conceptual Model, LandInfra, was approved as an OGC standard in August, 2016. This model provides a unifying basis for encodings including but not limited to InfraGML, including similar work in buildingSMART International. It can also provide a framework for discussing how other software standards relate to LandInfra.

As an OGC standard, LandInfra follows the OGC modular specification standard, OGC 08-131r3. Because of the breadth of LandInfra, its subject areas are divided into separate Requirements Classes. This InfraGML encoding similarly is divided into Requirements Classes which are then grouped into Parts. A Part may address multiple LandInfra Requirements Classes but each Requirements Class is addressed in a single part. Because Requirements Classes may depend on other Requirements Classes (see LandInfra Figure 1, "Requirements Classes as UML Packages with their dependencies"), the reader of this InfraGML Part may need to conform to Requirements Classes in other Parts as well.

Note that this InfraGML encoding standard is a target of LandInfra and therefore this standard conforms to the Requirements Classes in LandInfra. On the other hand, an application claiming conformance to this InfraGML encoding standard must conform to the Requirements Classes contained in this InfraGML standard.

There are several reasons for separating InfraGML into Parts. Because they are likely to have separate authors, the rate at which each Part is completed may vary. It would not be advisable to wait until all Parts complete before any can be released as separate OGC standards. Multiple Parts will also allow each subject to have its own standards life cycle. One Part can be updated independent of other Parts, subject to dependency

constraints. And of course, it should be easier for the application software developer to only deal with Parts relevant to their application.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

iv.   Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

Bentley Systems, Inc.

Leica Geosystems

Swedish Transport Administration

Trimble, Inc.

Autodesk

v.   Submitters

All questions regarding this submission should be directed to the editor or the submitters:

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Lars Wikström	Swedish Transport Administration
Leif Granholm	Trimble Inc.
Johnny Jensen	Trimble Inc.
Thomas Liebich	buildingSMART International
Orest Halustchak	Autodesk

1. Scope

InfraGML is a GML encoding standard of the LandInfra Conceptual Model standard, OGC 15-111r1. InfraGML is provided as a set of individual though inter-dependent Parts, each of which is a GML standard.

The overall scope of this InfraGML Encoding Standard is infrastructure facilities and the land on which they are constructed. Also included is the surveying necessary for the setting out and as-built recording of these facilities and land interests. Primarily having a civil engineering point of view, InfraGML is relevant across all life cycle phases of a facility. Subject areas include land features, facilities, projects, alignment, road, railway, survey (including equipment, observations, and survey results), land division, and condominiums.

The scope of this Part 6 of InfraGML addresses the following subject area(s): survey, observations, equipment, survey results. The InfraGML Survey, Observations, Equipment and Survey Results Requirements Classes are included. It is optional in that an application can conform to InfraGML without supporting any of these, for example by only supporting the LandDivision Requirements Classes in Part 7. However, to claim support for Survey, an application must also support the InfraGML Core Requirements Class. To claim support for Equipment, an application must also support the InfraGML Core and Survey Requirements Classes. To claim support for Observations, an application must also support the InfraGML Core and Survey Requirements Classes and may choose to support the Equipment and also the Survey Results Requirements Class. To claim support for Survey Results, an application must also support the InfraGML Core and Survey Requirements Classes and may choose to also support the Observations and also the Equipment Requirement Class. To claim support for Sampling, an application must also support the InfraGML Survey, Observations, and Core Requirements Classes and may optionally support Equipment and Survey Results.

2. Conformance

The InfraGML encoding standard defines requirements, grouped into Requirements Classes, for applications which read and write information about infrastructure facilities and the land on which they are constructed, including the surveying necessary for the setting out and as-built recording of these facilities and land interests.

The OGC modular specification (OGC 08-131r3) defines "standardization target" as the entity to which requirements of a standard apply. It further notes that the standardization target is the entity which may receive a certificate of conformance for a requirements class. The standardization target type for this standard is therefore:

- software applications which read/write data instances, i.e. XML documents that encode land, infrastructure facility, and survey data for exchange

Conformance with this standard shall be checked using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site[1].

In order to conform to this OGC encoding standard, a standardization target shall choose to implement the core conformance class and any of the other conformance classes with their dependencies. Conformance classes are based on Requirements Classes which are specified in this and possibly other Parts of the InfraGML standard.

All requirements classes and conformance classes described in this document are owned by the standard(s) identified. Note that Conformance Classes for this Part of InfraGML may require conformance with Conformance Classes from other Parts of InfraGML.

3. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this Part of InfraGML. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC: OGC 07-036, *OpenGIS® Geography Markup Language (GML) Encoding Standard,* v3.2.1, 2007

OGC: OGC 10-129r1, *OGC® Geography Markup Language (GML) — Extended schemas and encoding rules*, v3.3, 2012

OGC: OGC 15-111r1, *OGC Land and Infrastructure Conceptual Model Standard (LandInfra)*, v1.0, 2016.

OGC : OGC 16-100, *OGC InfraGML 1.0: Part 0 – LandInfra Core – Encoding Standard*, v1.0, 2017

4. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word "shall" (not "must") is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

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1 www.opengeospatial.org/cite

The LandInfra standard contains a long list of terms and definitions relevant to the scope of InfraGML. As these will not be repeated here, the reader is directed to Clause 4 of LandInfra. Only terms not already appearing there are listed below.

5. Conventions

5.1 Abbreviations

In this document the following abbreviations and acronyms are used or introduced:

GML   Geography Markup Language

ISO   International Organization for Standardization

OGC   Open Geospatial Consortium

UML   Unified Modeling Language

XML   eXtensible Markup Language

5.2 UML Package and Class Diagrams

The LandInfra standard contains UML diagrams for the concepts supported by InfraGML. As these will not be repeated here, the reader is directed to Clause 7 of LandInfra. UML will only appear in InfraGML in the rare cases where LandInfra is extended by InfraGML.

5.3 Requirements

When referred to in a Requirement or Requirements Class, the boxes contained in the LandInfra UML figures may all be called "Classes" even if they are data types, enumerations, code lists, unions etc. In most cases, these will be encoded as XML elements in InfraGML.

When an InfraGML Requirement states that "A conforming application shall support the [Requirements Class] XML elements listed in Table <n> in accordance with the GML XSD in this standard.", the XSD was developed to support the UML for the corresponding LandInfra Requirements Class as follows:

a) all classes shown as blue boxes for the corresponding LandInfra Requirements Class UML diagrams;

b) all attributes, attribute cardinalities, and attribute data types of these classes (usually shown in subsequent diagrams);

c) all associations, navigation, roles, and role cardinalities connected to the blue classes;

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d) all classes shown as beige boxes (another Requirements Class) in the diagrams connected to the blue box classes by association or used as attribute data types; and

e) all classes shown as pink boxes (another Standard) in the figure connected to the blue box classes by association or used as attribute data types.

Note that, in rare cases, the OGC 15-111r1 UML may be altered. In such cases, the alterations are declared in the first subclause of each Requirements Class, entitled "Implementation decisions regarding OGC 15-111r1 UML". Logical Model UML diagrams may be included if the implementation constraints of GML (or XML) dictate that the Conceptual Model cannot be implemented directly as shown in OGC 15-111r1.

In most cases, the InfraGML XML derived from the LandInfra UML follows the rules in OGC 07-036, GML, Annex E, UML-to-GML application schema encoding rules.

The only normative version of the GML XSD (XML schema definition) for all Parts of the InfraGML Encoding Standard is available from the official OGC XML schema repository at http://schemas.opengis.net. Any occurrences of all or part of this XSD contained within this document are to be considered to be informative only.

The URI base for the LandInfra Conceptual Model standard is http://www.opengis.net/spec/landinfra/1.0. All URIs of Requirements Classes, Requirements, and Conformance Classes contained in that standard are relative to this base.

The URI base for this InfraGML encoding standard is http://www.opengis.net/spec/infragml/part6/1.0. All URIs of Requirements Classes, Requirements, and Conformance Classes contained in this standard are relative to this base.

6. InfraGML Parts

The InfraGML encoding standard has been divided into Parts. These Parts enable the grouping of LandInfra subject areas (Requirements Classes) into individual OGC encoding standards. All of these InfraGML encoding standards have a similar name: "OGC 16-10n, OGC® InfraGML 1.0: Part n - <part name> Encoding Standard", where Part numbers and names are as follows:

N	<part name>
0	LandInfra Core
1	LandInfra LandFeatures
2	LandInfra Facilities and Projects
3	LandInfra Alignments
4	LandInfra Roads

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5	LandInfra Railways
6	LandInfra Survey
7	LandInfra LandDivision

Some InfraGML Parts depend upon other parts:
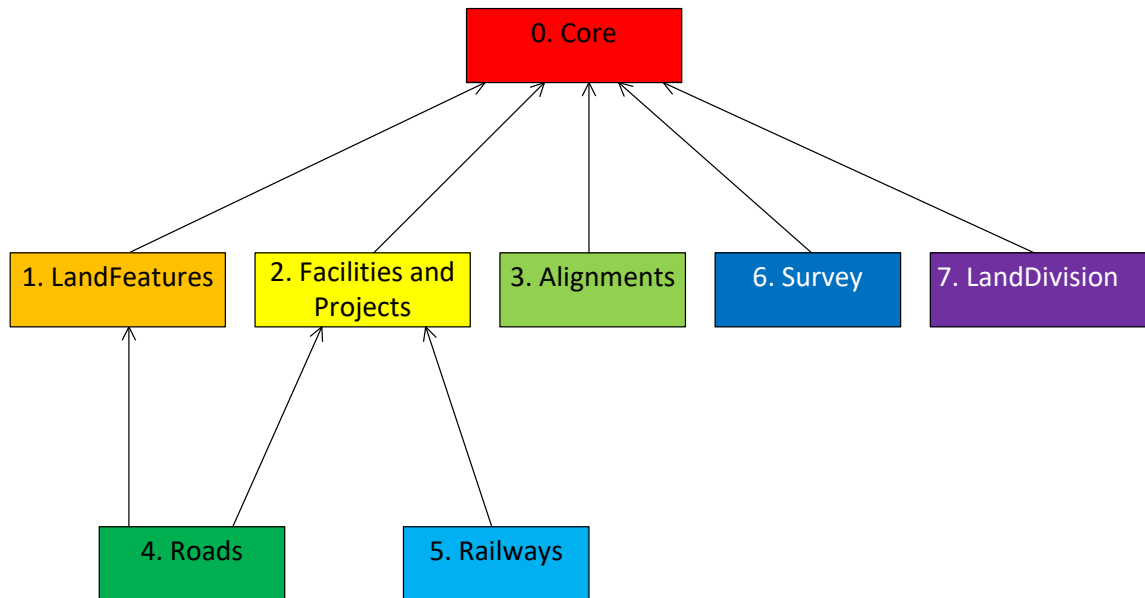
Figure 1. InfraGML Part Dependencies

The boxes above represent InfraGML Parts. Arrows show Part dependencies.

The Part dependencies derive from the dependencies of the InfraGML Requirements Classes contained in these Parts. The reader should rely more on the InfraGML Requirements Class dependencies and only use the Part dependencies as a guide for knowing which InfraGML Part standards to consider.

InfraGML Parts include the following LandInfra 1.0 Requirements Classes (UML Packages):
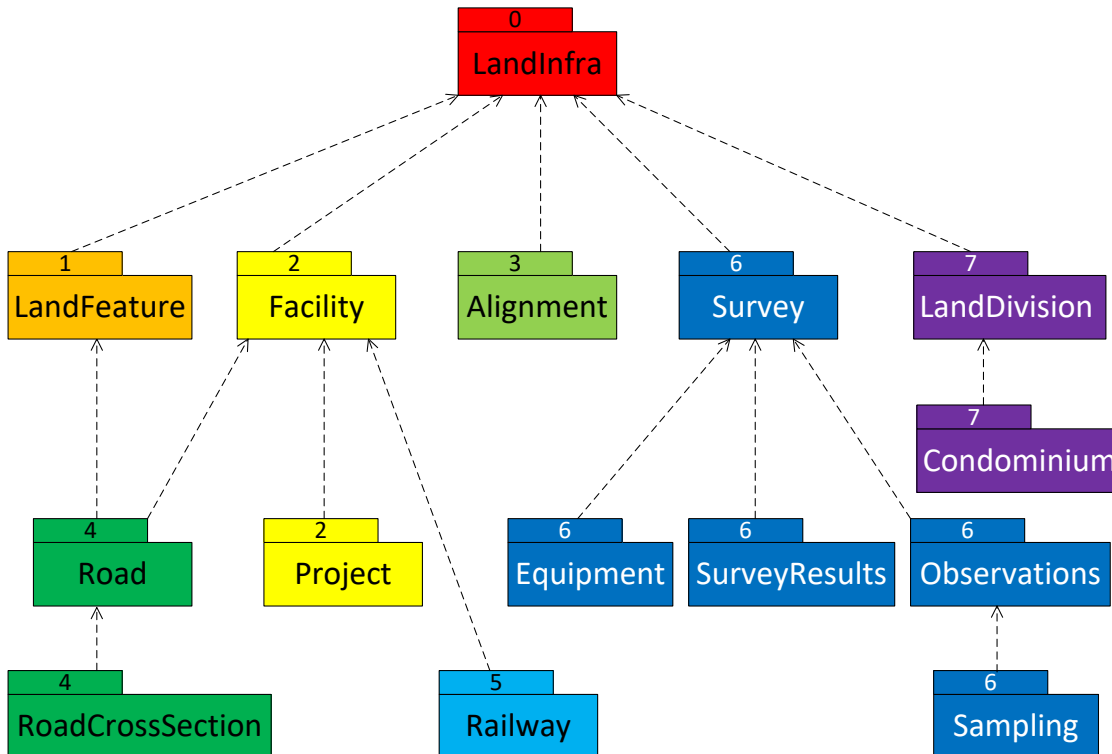
Figure 2. LandInfra Requirements Classes grouped into InfraGML Parts

The boxes above and their names represent LandInfra Requirements Classes. The numbers are InfraGML Part numbers. Dependency arrows shown above are dependencies between LandInfra Requirements Classes.

7. Requirements Classes for this Part

7.1 Structural Overview of Requirements Classes

The Requirements Classes for this Part of the InfraGML encoding standard (shown in blue in Figure 3 below) are defined in this Clause 7. Requirements Classes from other Parts upon which this Part's Requirements Classes are dependent (shown in beige in Figure 3 below) are listed here but defined in the documentation of their respective Parts. External OGC and ISO standards on which Requirements Classes in this Standard depend (shown in pink in Figure 3 below) are also listed. Below is a brief summary of the function of each of these Requirements Classes.

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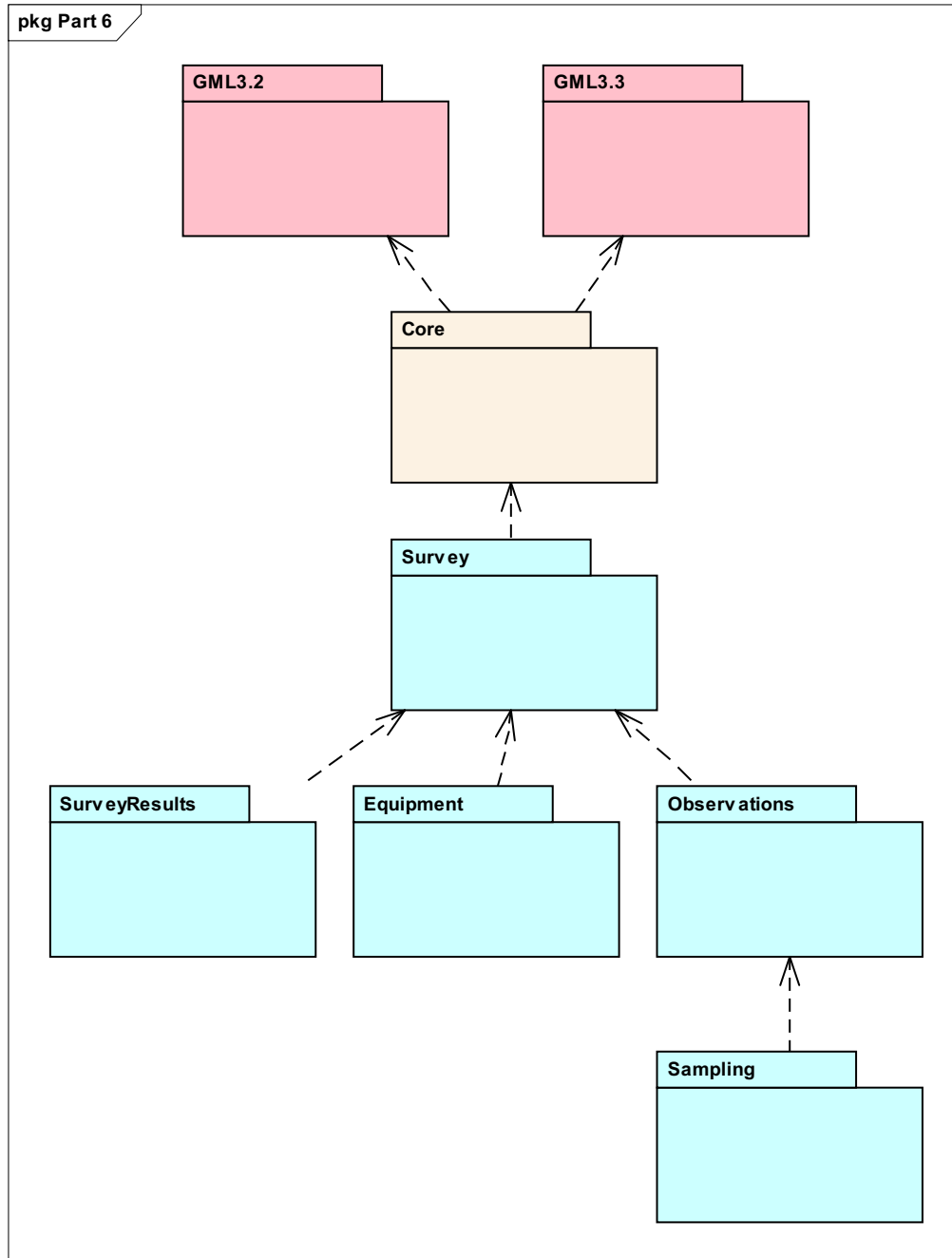
Figure 3. Requirements Classes for this Part and their Dependencies

In the OGC 15-111r1UML model the Survey LandInfra Requirement Classes had the dependeny to OGC 07-022r1, OGC® Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, OGC® Observations and Measurements — Part 2 — Sampling Features. However in GML 3.2 there is already an observation encoding with the schema observation (urn:x-ogc:specification:gml:schema-xsd:observation:3.2.1) defined. Therefore it was decided to use the GML observation for the encoding of the InfraGML Requirement Classes in this part. Details on the

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differences and the resulting differences to the OGC 11-111r1 UML model are listed in section **Error! Reference source not found.**.

7.1.1 Requirement Classes Defined in This Part

Survey

The Survey Requirement Class supports those use cases to hold the observations, processes and their results for the acquisition of points, lines, surfaces and properties of features of interest. The primary focus of this package is to have the possibility of recording and reprocessing the observations of the acquired objects.

The present Survey Requirement Class contains header information for the surveys, as the survey package has been divided in sub- packages because of the number of classes in the Observations, SurveyResults and Equipment packages.

Equipment

The Equipment Requirements Class describes the equipment, sensors, and observation processes. The purpose of a Survey Process is to generate a survey result, and it holds all the information about the sensors used for the measurements.

Observations

The Observations Requirements Class contains all measurements in a structured way to enable later reprocessing.

Survey Results

The SurveyResults Requirement Class contains the estimate of the value(s) of a geometry or property of the feature of interest.

Sampling

The Sampling Requirement Class dercribes the observational strategy and contains the observation protocol including the related observation, the observation process and their results.

Part 0. LandInfra Core

LandInfra is the core Requirements Class and is the only mandatory Requirements Class. This class contains information about the Land and Infrastructure dataset that can contain information about facilities, land features, land division, documents, survey marks, surveys, sets, and feature associations. LandInfra also contains the definition of types common across other Requirements Classes, such as the Status CodeList.

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7.1.2 Other Standards upon which the Requirement Classes of this Part Depend

For external OGC and ISO standards on which Requirements Classes in this Standard depend, a brief summary of the function of each of these Standards is described below.

GML 3.2

OGC 07-036, OpenGIS® Geography Markup Language (GML) Encoding Standard, v3.2 provides most of the geometry types (e.g., Point, LineString, Polygon) used for spatial representations in this Standard. Defines Coordinate Reference Systems. Supports the General Feature Model upon which this Standard is based.

GML 3.3

OGC 10-129r1, OGC® Geography Markup Language (GML) — Extended schemas and encoding rules, v3.3 defines the linear referencing concepts (e.g., linear element, distance along, Linear Referencing Methods) used for linearly referenced locations in this Standard.

7.1.3 OGC® GML Observation and OGC® Observations and Measurements

The Figure 3 (figure 42 in OGC 15-111r) shows the dependency between OGC 07-022r1, OGC® Observations and Measurements — Part 1 — and LandInfra SurveyObservations and the associated LandInfra classes.

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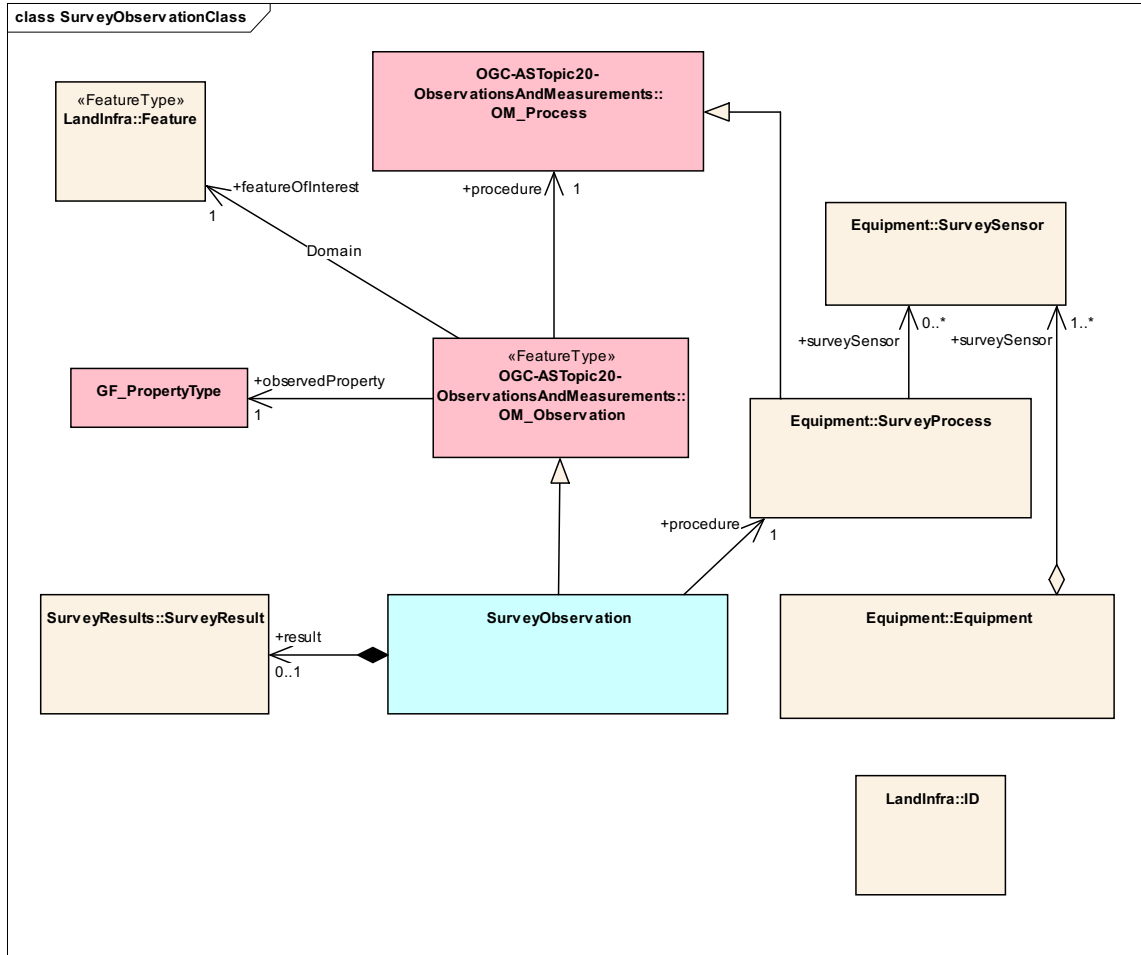
Figure 4. SurveyObservation and OGC Abstract Specification Topic20

Similar to the OM_Observation the observation class of GML 3.2 has an assoiciation to a procedure (using), and association to a feature of interest (target) and an association to the result of the observation (resultOf).
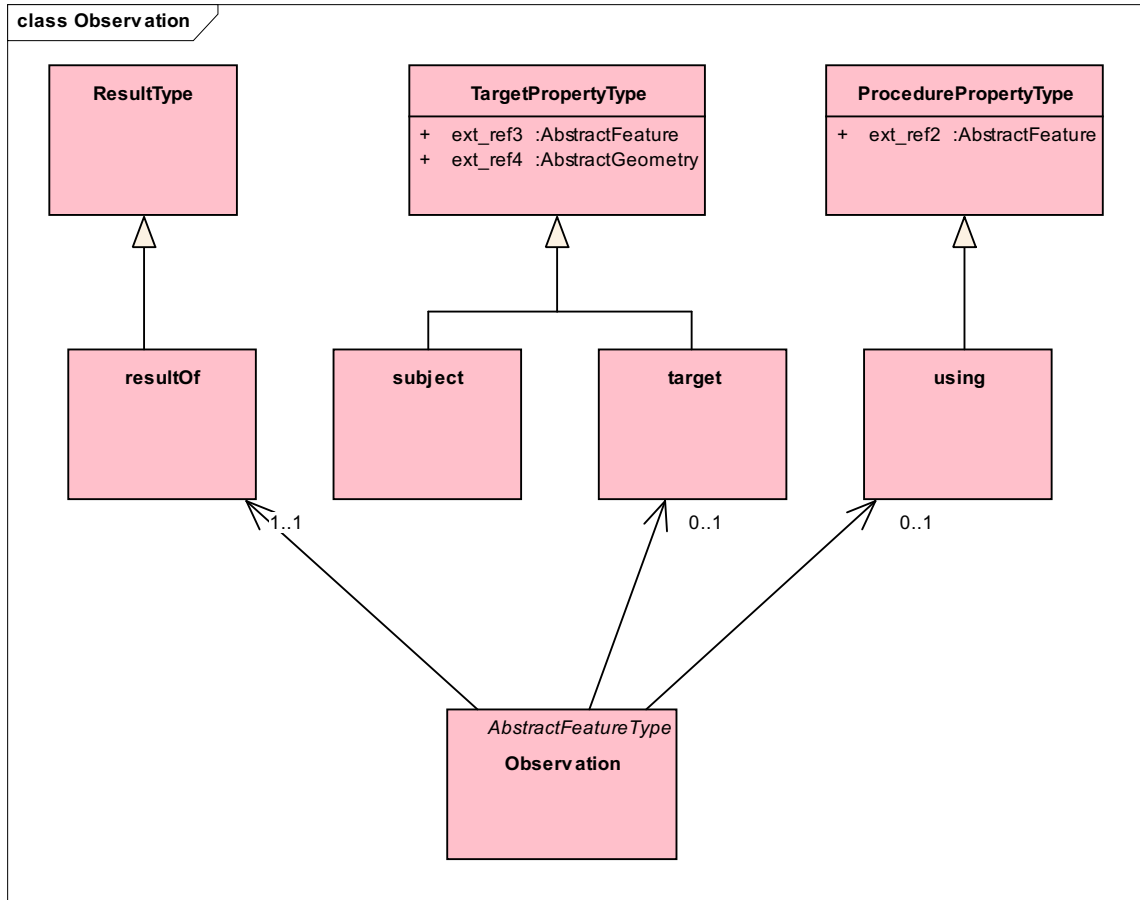
Figure 5. GML 3.2.1 Observation

For the realization of Sampling a new requirement class for introduced in InfraGML to also be able to support the sampling functionality defined in OGC® Observations and Measurements — Part 2 — Sampling Features.

Using this model now allows us to remove the dependencies between Equipment, Observations and SurveyResults. Therefore an application can choose if they just want to support one of these Requirement Classes (for example the application is just interested in the SurveyResults, or another application just wants to reprocess the results internally). However to cover the observation procedure Oberservations, Equipment and SurveyResults ave to be supported by the application.

7.2 Requirements Class: Survey

Requirements Class	
/req/survey	
Target type	Conforming application
Name	Survey
Dependency	**/req/core** (from InfraGML Part 0)
Requirement	**/req/survey/elements**

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7.2.1 Implementation decisions regarding OGC 15-111r1 UML

The following implementation decisions have been made regarding the OGC 15-111r1 LandInfra Requirements Class UML:

1. New association for surveyProcess has been added because of the change to have this class as individual class with the link to SurveySensors instead of deriving SurveySensors from gml:: ProcedurePropertyType – therefore SurveyProcess would not have a home inside Equipment.
2. New association for sampling has been added - Sampling would not have a home inside Survey.

7.2.2 Specific Requirements for this Requirements Class

Requirement	/req/survey/elements
	A conforming application shall support the Survey XML elements listed in Table 1 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/survey.xsd.

An application conforming to this standard shall support the Survey XML elements listed below in Table 1 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/survey.xsd. Survey XML element names are shown with a XML namespace prefix of "lis". Corresponding LandInfra UML classes are shown with their LandInfra Requirements Class prefix of "Survey".

InfraGML XML element	LandInfra UML Class
lis:Survey	Survey::Survey

Table 1. InfraGML Survey XML elements with corresponding LandInfra UML classes

7.3 Requirements Class: Equipment

Requirements Class	
/req/equipment	
Target type	Conforming application
Name	Equipment
Dependency	/req/survey
Requirement	/req/equipment/elements
Requirement	/req/equipment/observation-correction

7.3.1 Implementation decisions regarding OGC 15-111r1 UML

1. In OGC 15-111r1 the equipment requirement class depends on OGC 07-022r1, OGC® Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, OGC® Observations and Measurements — Part 2 — Sampling Features. However GML 3.2 already defines an observation encoding (urn:x-

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ogc:specification:gml:schema-xsd:observation:3.2.1). InfraGML uses the GML 3.2 schema as the foundation for the LandInfra equipment schema. The O&M and GML encodings are similar, only differing in association names and cardinalities. This decision avoids depending on another external encoding.

2. LandInfra SurveyProcess is derived from OM_Process, which is a Feature Type, and most of the classes in the Equipment requirement class are derived from it. Change #1 above means that Antenna has to be made a Feature Type

3. Correction::type was set to optional- The type is then not needed for dervived classes and makes the resulting xml file clener.

4. Equipment : equivalent to #2

5. SurveyProcess is derive from gml:ProcedurePropertyType instead of OM_Process

6. SurveySensor - equivalent to #2.

7. SurveySensor:attribute type set to optional because it is then not needed for dervived classes.

8. In the SurveySensorTpye enumeration a new type "other" was added and the unused "tilt" entry was removed.

9. Figure 6 shows the encoding of camera related information based on the ISO – 1930-ImagarySensors concetional model.
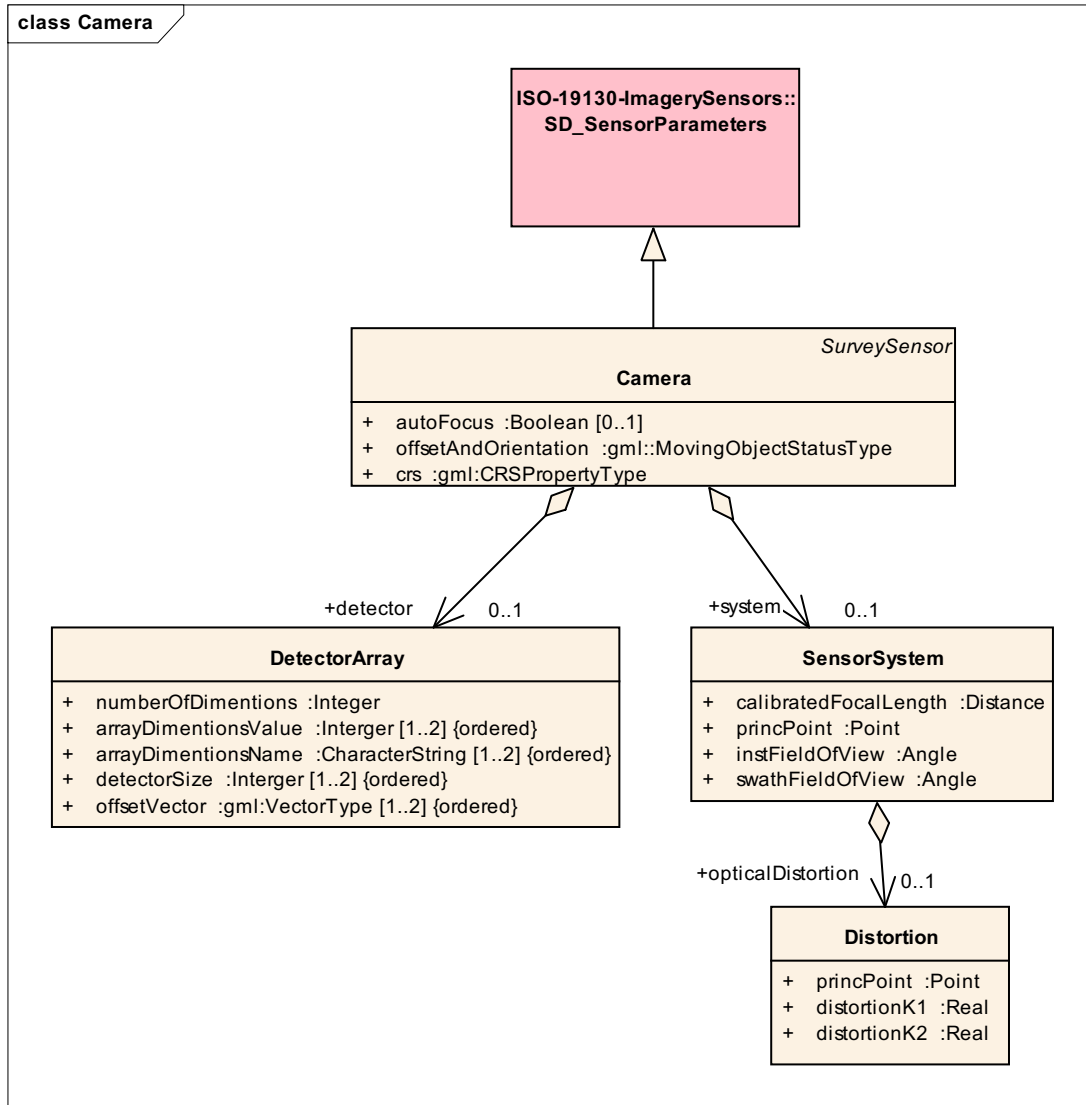
Figure 6. Camera Class encoding for ISO-19130

7.3.2 Specific Requirements for this Requirements Class

Requirement	/req/equipment/elements
	A conforming application shall support the Survey XML elements listed in Table 2 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/equipment.xsd. An application shall decide which SurveySensor types it will support and then include appropriate elements accordingly.

An application conforming to this standard shall support the Equipment XML elements listed below in Table 2 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/equipment.xsd. Equipment XML element names are shown with a XML namespace prefix of "lise". Corresponding LandInfra UML classes are shown with their LandInfra Requirements Class prefix of "Equipment".

InfraGML XML element	LandInfra UML Class
lise:AngularCorrection	Equipment::AngularCorrection
lise:Antenna	Equipment::Antenna
lise:Camera	Equipment::Camera
lise:Correction	Equipment::Correction
lise:DetectionArray	ISO-19130-SD_DetectionArray
lise:DistanceCorrection	Equipment::DistanceCorrection
lise:Distortion	ISO-19130-SD_Distortion
lise:EDM	Equipment::EDM
lise:Equipment	Equipment::Equipment
lise:GNSS	Equipment::GNSS
lise:GenericAngle	Equipment::GenericAngle
lise:GenericDistance	Equipment::GenericDistance
lise:InteriorOrientation	Equipment::InteriorOrientation
lise:LaserScanner	Equipment::LaserScanner
lise:Level	Equipment::Level
lise:ObservationCorrections	Equipment::ObservationCorrections
lise:Offset	Equipment::Offset
lise:SensorSystem	ISO-19130-SD_SensorSystem
lise:SurveyProcess	Equipment::SurveyProcess
lise:SurveySensor	Equipment::SurveySensor
lise:Tps	Equipment::Tps
lise:Transformation	Equipment::Transformation

Table 2. InfraGML Equipmnent XML elements with corresponding LandInfra UML classes

Requirement	**/req/equipment/observation-correction**
	If an application allows corrections to be applied to the raw observations

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	then that application shall support the ObservationCorrections element. The application shall specify which correction types it supports.

7.4 Requirements Class: Observations

Requirements Class	
/req/observations	
Target type	Conforming application
Name	Observations
Dependency	**/req/survey**
Requirement	**/req/observations/elements**

7.4.1 Implementation decisions regarding OGC 15-111r1 UML

The implementation follows the OGC 15-111r1Survey Requirements Class UML.

1. In OGC 15-111r1 the observations requirement class depends on OGC 07-022r1, OGC® Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, OGC® Observations and Measurements — Part 2 — Sampling Features. However GML 3.2 already defines an observation encoding (urn:x-ogc:specification:gml:schema-xsd:observation:3.2.1). InfraGML uses the GML 3.2 schema as the foundation for the LandInfra equipment schema. The O&M and GML encodings are similar, only differing in association names and cardinalities. This decision avoids depending on another external encoding.
2. LandInfra SurveyObject is derived from OM_Observation, which is a Feature Type, and most of the classes in the Survey requirement class are derived from it. Change #1 above means that PanoramaImage and Setup have to be made Feature types.
3. ImageObservations and PanoramaImage has been added as optional attributes to SurveyObservation. All observation classes derived from SurveyObservation can now include references to images (example: PointCloudObservation has a link to an image to colorize the pointcloud).

7.4.2 Specific Requirements for this Requirements Class

Requirement	**/req/observations/elements**
	A conforming application shall support the Survey XML elements listed in
	liso:InstrumentPoint Observations::InstrumentPoi
	liso:LevelObservation Observations::LevelObservat
	liso:PanoramaImage Observations::PanoramaImag
	liso:PointCloudObservation Observations::PointCloudObs
	liso:RtkInfo Observations::RtkInfo

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	liso:SatelliteInfo	Observations::SatelliteInfo	
	liso:Setup	Observations::Setup	
	liso:SurveyObservation	Observations::SurveyObservation	
	liso:TpsObservation	Observations::TpsObservation	

Table 3 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/observations.xsd. An application shall decide which Observation types it will support and then include appropriate elements accordingly.

An application conforming to this standard shall support the Observations XML elements listed below in

liso:InstrumentPoint	Observations::InstrumentPoint
liso:LevelObservation	Observations::LevelObservation
liso:PanoramaImage	Observations::PanoramaImage
liso:PointCloudObservation	Observations::PointCloudObservation
liso:RtkInfo	Observations::RtkInfo
liso:SatelliteInfo	Observations::SatelliteInfo
liso:Setup	Observations::Setup
liso:SurveyObservation	Observations::SurveyObservation
liso:TpsObservation	Observations::TpsObservation

Table 3 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/observations.xsd. Observations XML element names are shown with a XML namespace prefix of "liso". Corresponding LandInfra UML classes are shown with their LandInfra Requirements Class prefix of "Observations".

InfraGML XML element	LandInfra UML Class
liso:AngularObservation	Observations::AngularObservation
liso:DistanceObservation	Observations::DistanceObservation
liso:ExteriorOrientation	Observations::ExteriorOrientation
liso:GF_PropertyType	Observations::GF_PropertyType
liso:GnssObservation	Observations::GnssObservation
liso:GnssQuality	Observations::GnssQuality

liso:ImageObservation	Observations::ImageObservation
liso:InstrumentPoint	Observations::InstrumentPoint
liso:LevelObservation	Observations::LevelObservation
liso:PanoramaImage	Observations::PanoramaImage
liso:PointCloudObservation	Observations::PointCloudObservation
liso:RtkInfo	Observations::RtkInfo
liso:SatelliteInfo	Observations::SatelliteInfo
liso:Setup	Observations::Setup
liso:SurveyObservation	Observations::SurveyObservation
liso:TpsObservation	Observations::TpsObservation

Table 3. InfraGML Observations XML elements with corresponding LandInfra UML classes

7.5 Requirements Class: SurveyResults

Requirements Class	
/req/survey-results	
Target type	Conforming application
Name	SurveyResults
Dependency	**/req/survey**
Requirement	**/req/survey-results/elements**

7.5.1 Implementation decisions regarding OGC 15-111r1 UML

The implementation follows the OGC 15-111r1Survey Requirements Class UML.

1. In OGC 15-111r1 the observations requirement class depends on OGC 07-022r1, OGC® Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, OGC® Observations and Measurements — Part 2 — Sampling Features. However GML 3.2 already defines an observation encoding (urn:x-ogc:specification:gml:schema-xsd:observation:3.2.1). InfraGML uses the GML 3.2 schema as the foundation for the LandInfra equipment schema. The O&M and GML encodings are similar, only differing in association names and cardinalities. This decision avoids depending on another external encoding.

7.5.2 Specific Requirements for this Requirements Class

Requirement	**/req/survey-results/elements**
	A conforming application shall support the Survey XML elements listed in
		lisr: UserDefined	SurveyResults:: UserDefined	

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	lisr: Value	SurveyResults:: Value	
	Table 4 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/survey-results.xsd. An application shall decide which SurveyResults types it will support and then include appropriate elements accordingly.		

An application conforming to this standard shall support the SurveyResults XML elements listed below in

lisr: UserDefined	SurveyResults:: UserDefined
lisr: Value	SurveyResults:: Value

Table 4 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/ Survey-results.xsd. SurveyResults XML element names are shown with a XML namespace prefix of "lisr". Corresponding LandInfra UML classes are shown with their LandInfra Requirements Class prefix of "SurveyResults".

InfraGML XML element	LandInfra UML Class
lisr:Average	SurveyResults::Average
lisr: AveragePoint	SurveyResults:: AveragePoint
lisr: DesignPoint	SurveyResults:: DesignPoint
lisr: Image	SurveyResults:: Image
lisr: PointCloud	SurveyResults:: PointCloud
lisr: PointQuality	SurveyResults:: PointQuality
lisr: Stakeout	SurveyResults:: Stakeout
lisr: String	SurveyResults:: String
lisr: SurveyResult	SurveyResults:: SurveyResult
lisr: TargetPoint	SurveyResults:: TargetPoint
lisr: UserDefined	SurveyResults:: UserDefined
lisr: Value	SurveyResults:: Value

Table 4. InfraGML SurveyResults XML elements with corresponding LandInfra UML classes

7.6 Requirements Class: Sampling

Requirements Class	
/req/sampling	
Target type	Conforming application

Name	Sampling
Dependency	**/req/observations**
Requirement	**/req/sampling/elements**

7.6.1 Implementation decisions regarding OGC 15-111r1 UML

The implementation follows the OGC 15-111r1Survey Requirements Class UML.

1. Sampling Features is defined in OGC® Observations and Measurements — Part 2 — Sampling Features. The decision to use the observation encoding (urn:x-ogc:specification:gml:schema-xsd:observation:3.2.1) of GML it is necessary to add this Requirement Class to also support Sampling.

7.6.2 Specific Requirements for this Requirements Class

Requirement	**/req/sampling/elements**
	A conforming application shall support the Survey XML elements listed in Table 5 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/sampling.xsd.

An application conforming to this standard shall support the Sampling XML elements listed below in Table 5 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/sampling.xsd. Sampling XML element names are shown with a XML namespace prefix of "liss". There are no corresponding LandInfra UML classes because Sampling was imported in LandInfra from OGC® Observations and Measurements — Part 2 — Sampling Features.

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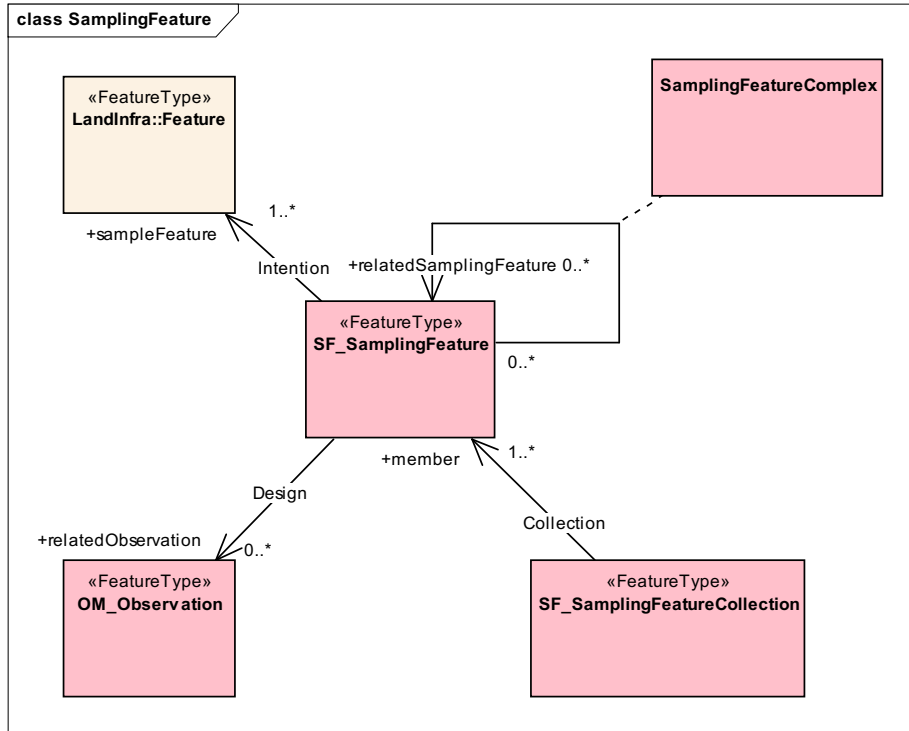
Figure 7. OGC Abstract Specification Topic 20 – Sampling Feature

InfraGML XML element	LandInfra UML Class
liss: SamplingFeature	sam: SF_SamplingFeature
liss: SamplingFeatureComplex	sam: SamplingFeatureComplex
liss: SamplingFeatureCollection	sam: SF_SamplingFeatureCollection

Table 5. InfraGML Sampling XML elements with corresponding LandInfra UML classes

8. Media Types for any data encoding(s)

Data for all Parts of the InfraGML encoding standard is encoded in GML-conformant XML documents. The standard MIME-type and sub-type for GML data should be used to indicate the encoding in internet exchange, as specified in MIME Media Types for GML, namely 'application/gml+xml'.

Annex A: Conformance Class Abstract Test Suite (Normative)

A.1 Conformance class: Survey

/conf/survey		
Requirements	**/req/survey**	
Dependency	**/conf/core** (from InfraGML Part 0)	
Test	**/conf/survey/elements**	
	Requirement	**/req/survey/elements**
	Test purpose	Verify that the conforming application supports the Survey XML elements listed in Table 1 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/survey.xsd.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability

A.2 Conformance class: Equipment

/conf/equipment		
Requirements	/req/equipment	
Dependency	**/conf/survey**	
Test	**/conf/equipment/elements**	
	Requirement	**/req/equipment/elements**
	Test purpose	Verify that the conforming application supports the Equipment XML elements listed in Table 2 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/equipment.xsd.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability
Test	**/conf/equipment/observation-correction**	
	Requirement	**/req/equipment/elements**
	Test purpose	Verify that the conforming application specifies which correction types it supports, if any.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability

A.3 Conformance class: Observations

/conf/observations		
Requirements	/req/observations	
Dependency	**/conf/survey**	
Test	**/conf/observations/elements**	

	Requirement	**/req/observations/elements**
	Test purpose	Verify that the conforming application supports the Observations XML elements listed in Table 3 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/observations.xsd.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability

A.4 Conformance class:SurveyResults

/conf/survey-results		
Requirements	/req/survey-results	
Dependency	**/conf/survey**	
Test	**/conf/survey-results/elements**	
	Requirement	**/req/survey-results/elements**
	Test purpose	Verify that the conforming application supports the SurveyResults XML elements listed in Table 4 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/survey-results.xsd.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability

A.5 Conformance class:Sampling

/conf/sampling		
Requirements	/req/sampling	
Dependency	**/conf/observations**	
Test	**/conf/sampling/elements**	
	Requirement	**/req/sampling/elements**
	Test purpose	Verify that the conforming application supports the Sampling XML elements listed in Table 5 in accordance with the GML XSD specified in http://schemas.opengis.net/infragml/part6/1.0/sampling.xsd.
	Test method	Inspect the GML output to verify the above requirement.
	Test type	Capability

Annex B: Sample XML (Informative)

B. 1   Survey

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/survey/1.0 Part6Survey0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <name>Sample Part6 Dataset</name>
  <description>LandInfra dataset to test all possible content for Part6 Survey</description>
  <dateTime>2016-10-19T10:00:00</dateTime>
  <datasetVersion>1.0</datasetVersion>
  <application>manual</application>
  <author>Hans-Christoph Gruler, Leica Geosystems AG</author>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <abstractData>
    <lis:Survey gml:id="S1">
      <gml:description>sample survey definition required content</gml:description>
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
        </lis:ID>
      </lis:surveyID>
    </lis:Survey>
  </abstractData>
  <abstractData>
    <lis:Survey gml:id="S2">
      <gml:description>sample survey definition all possible content</gml:description>
      <gml:name>Survey 1 Survey</gml:name>
      <propertySet>
        <PropertySet gml:id="PS1">
          <property>
            <Property gml:id="P1">
              <valueType xsi:type="gml:StringOrRefType"></valueType>
              <value></value>
            </Property>
          </property>
          <property>
            <Property gml:id="P2">
              <valueType></valueType>
              <value></value>
            </Property>
```

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```xml
        </property>
      </PropertySet>
    </propertySet>
    <lis:surveyID>
      <lis:ID>
        <identifier>Survey2</identifier>
        <scope>OGC LandInfraSWG</scope>
      </lis:ID>
    </lis:surveyID>
    <lis:landSurveyor>
      <Professional gml:id="p1">
        <li:fullName>Surveyor1</li:fullName>
        <li:type xlink:href="http://example.com/professionalType#landSurveyor"
          xlink:title="Land Surveyor"/>
        <li:company>LandSurveyors Inc.</li:company>
        <li:registration>SR12345678</li:registration>
        <li:licensingCountry>Switzerland</li:licensingCountry>
      </Professional>
    </lis:landSurveyor>
    <lis:purposeOfSurvey>Determination of new Parcel Boundery</lis:purposeOfSurvey>
    <lis:type  xlink:href="http://example.com/surveyType#surveyed"  xlink:title="Surveyed"/>
    <lis:document>
      <Document gml:id="D1">
        <documentID>
          <ID>
            <identifier>20160004</identifier>
          </ID>
        </documentID>
        <documentType>Survey Marking</documentType>
        <documentContent>http://city.net/survey/documents.pdf</documentContent>
      </Document>
    </lis:document>
  </lis:Survey>
 </abstractData>
</LandInfraDataset>
```

B. 2 Equipment

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:lise="http://www.opengis.net/infragml/equipment/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/equipment/1.0 Part6Equipment0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <name>Sample Part6 Dataset</name>
  <description>LandInfra dataset to test all possible content for Part6 Survey Equipment
</description>
  <dateTime>2016-10-19T10:00:00</dateTime>
  <datasetVersion>1.0</datasetVersion>
  <application>manual</application>
  <author>Hans-Christoph Gruler, Leica Geosystems AG</author>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <abstractData>
    <lis:Survey gml:id="S1">
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
          <scope>OGC LandInfraSWG</scope>
        </lis:ID>
      </lis:surveyID>
      <lis:equipment>
        <lise:Equipment gml:id="E1">
          <gml:description>sample survey equipment definition required content all possible
            sensors</gml:description>
          <lise:surveySensor>
            <lise:Camera gml:id="SC1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>Camera1</identifier>
                </lise:ID>
              </lise:surveySensorID>
            </lise:Camera>
          </lise:surveySensor>
          <lise:surveySensor>
            <lise:EDM gml:id="SE1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>EDM1</identifier>
                </lise:ID>
              </lise:surveySensorID>
```

```xml
      </lise:EDM>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:GenericAngle gml:id="SGA1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>GenAng1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:GenericAngle>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:GenericDistance gml:id="SGD1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>GenDist1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:GenericDistance>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:GNSS gml:id="SG1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>GNSS1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:GNSS>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:LaserScanner gml:id="SS1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>Scanner1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:LaserScanner>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:Level gml:id="SL1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>Level1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:Level>
   </lise:surveySensor>
   <lise:surveySensor>
      <lise:Tps gml:id="ST1">
         <lise:surveySensorID>
            <lise:ID>
               <identifier>TPS1</identifier>
            </lise:ID>
         </lise:surveySensorID>
      </lise:Tps>
   </lise:surveySensor>
```

```xml
        </lise:Equipment>
      </lis:equipment>
    </lis:Survey>
  </abstractData>
  <abstractData>
    <lis:Survey gml:id="S2">
      <gml:description>sample survey definition all possible content</gml:description>
      <gml:name>Survey 1 Survey</gml:name>
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey2</identifier>
          <scope>OGC LandInfraSWG</scope>
        </lis:ID>
      </lis:surveyID>
      <lis:landSurveyor>
        <Professional gml:id="p1">
          <li:fullName>Surveyor1</li:fullName>
          <li:type xlink:href="http://example.com/professionalType#landSurveyor"
xlink:title="Land Surveyor"/>
          <li:company>LandSurveyors Inc.</li:company>
          <li:registration>SR12345678</li:registration>
          <li:licensingCountry>Switzerland</li:licensingCountry>
        </Professional>
      </lis:landSurveyor>
      <lis:purposeOfSurvey>Determination of new Parcel Boundery</lis:purposeOfSurvey>
      <lis:type xlink:href="http://example.com/surveyType#surveyed" xlink:title="Surveyed"/>
      <lis:equipment>
        <lise:Equipment gml:id="E2">
          <gml:description>sample survey equipment definition all possible
            sensors</gml:description>
          <gml:name>Equipment 12 Crew2</gml:name>
          <lise:serialID>12345678</lise:serialID>
          <lise:dataCollector>Survey Datacollector</lise:dataCollector>
          <lise:controlSoftware>Software for Surveyors</lise:controlSoftware>
          <lise:softwareVersion>1.97 Build 34</lise:softwareVersion>
          <lise:surveySensor>
            <lise:SurveySensor gml:id="SSB1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>BarCode Scanner</identifier>
                </lise:ID>
              </lise:surveySensorID>
              <lise:type xlink:href="http://example.com/surveySensorType#other"
                xlink:title="Other Sensor"/>
              <lise:manufacture>ScanFactory</lise:manufacture>
              <lise:model>Model X1</lise:model>
              <lise:serialID>254</lise:serialID>
              <lise:softwareVersion>2.03</lise:softwareVersion>
            </lise:SurveySensor>
          </lise:surveySensor>
          <lise:surveySensor>
            <lise:Camera gml:id="SC2">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>Camera2</identifier>
                </lise:ID>
```

```xml
    </lise:surveySensorID>
    <lise:autoFocus>true</lise:autoFocus>
    <lise:offsetAndOrientation>
        <lise:OffsetAndOrientation gml:id="OFSET1">
            <gml:validTime>
                <gml:TimeInstant gml:id="TIM1">
                    <gml:timePosition>2016-10-19T10:00:00</gml:timePosition>
                </gml:TimeInstant>
            </gml:validTime>
            <gml:position>
                <gml:Point gml:id="OFSETP1">
                    <gml:pos>0.00013 0.254 0.136</gml:pos>
                </gml:Point>
            </gml:position>
            <gml:bearing>
                <gml:DirectionString>relative</gml:DirectionString>
            </gml:bearing>
        </lise:OffsetAndOrientation>
    </lise:offsetAndOrientation>
    <lise:crs>
        <gml:ImageCRS gml:id="CCRS1">
            <gml:identifier codeSpace="Crs Camera2"></gml:identifier>
            <gml:scope></gml:scope>
            <gml:usesCartesianCS></gml:usesCartesianCS>
            <gml:usesImageDatum>
                <gml:ImageDatum gml:id="ID1">
                    <gml:identifier codeSpace="SC2ID1"></gml:identifier>
                    <gml:scope></gml:scope>
                    <gml:pixelInCell codeSpace="1258"></gml:pixelInCell>
                </gml:ImageDatum>
            </gml:usesImageDatum>
        </gml:ImageCRS>
    </lise:crs>
    <lise:detector>
        <lise:DetectorArray gml:id="SC2DA1">
            <lise:numberOfDimensions>2</lise:numberOfDimensions>
            <lise:arrayDimensionsValue>1246</lise:arrayDimensionsValue>
            <lise:arrayDimensionsValue>758</lise:arrayDimensionsValue>
            <lise:arrayDimensionsName>array1</lise:arrayDimensionsName>
            <lise:arrayDimensionsName>array2</lise:arrayDimensionsName>
            <lise:detectorSize>528</lise:detectorSize>
            <lise:detectorSize>256</lise:detectorSize>
            <lise:offsetVector>0 0.00006</lise:offsetVector>
        </lise:DetectorArray>
    </lise:detector>
    <lise:interiorOrientation>
        <lise:InteriorOrientation gml:id="SC2IO1">
            <lise:principalPointX uom="Pixel">508</lise:principalPointX>
            <lise:principalPointY uom="Pixel">248</lise:principalPointY>
            <lise:focalLength uom="m">2.082550E-002</lise:focalLength>
            <lise:crossHairPosX uom="Pixel">0</lise:crossHairPosX>
            <lise:crossHairPosY uom="Pixel">0</lise:crossHairPosY>
            <lise:virtualCameraConstant>0</lise:virtualCameraConstant>
        </lise:InteriorOrientation>
    </lise:interiorOrientation>
    <lise:gNSS>
```

```xml
<lise:GNSS gml:id="SC2GNSS">
  <lise:surveySensorID>
    <lise:ID>
      <identifier>Integrated GPS</identifier>
    </lise:ID>
  </lise:surveySensorID>
</lise:GNSS>
</lise:gNSS>
<lise:system>
  <lise:SensorSystem gml:id="SC2SS1">
    <lise:calibratedFocalLength uom="m">2.082550E-002
    </lise:calibratedFocalLength>
    <lise:princPoint>
      <gml:Point gml:id="SC2PP1">
        <gml:pos>254 190</gml:pos>
      </gml:Point>
    </lise:princPoint>
    <lise:instFieldOfView uom="deg">1.3</lise:instFieldOfView>
    <lise:swathFieldOfView uom="deg">0.9</lise:swathFieldOfView>
    <lise:opticalDistortion>
      <lise:Distortion gml:id="SC2DI1">
        <lise:princPoint>
          <gml:Point gml:id="SC2PP2">
            <gml:pos>254 190</gml:pos>
          </gml:Point>
        </lise:princPoint>
        <lise:distortionK1>0.123</lise:distortionK1>
        <lise:distortionK2>0.456</lise:distortionK2>
      </lise:Distortion>
    </lise:opticalDistortion>
  </lise:SensorSystem>
</lise:system>
</lise:Camera>
</lise:surveySensor>
<lise:surveySensor>
  <lise:EDM gml:id="SE2">
    <lise:surveySensorID>
      <lise:ID>
        <identifier>EDM2</identifier>
      </lise:ID>
    </lise:surveySensorID>
    <lise:accuracy uom="m">0.001</lise:accuracy>
    <lise:carrierWavelength uom="nm">1.12345</lise:carrierWavelength>
  </lise:EDM>
</lise:surveySensor>
<lise:surveySensor>
  <lise:GenericAngle gml:id="SGA2">
    <lise:surveySensorID>
      <lise:ID>
        <identifier>GenAng2</identifier>
      </lise:ID>
    </lise:surveySensorID>
    <lise:accuracy uom="deg">0.000123</lise:accuracy>
  </lise:GenericAngle>
</lise:surveySensor>
<lise:surveySensor>
```

```xml
<lise:GenericDistance gml:id="SGD2">
  <lise:surveySensorID>
    <lise:ID>
      <identifier>GenDist2</identifier>
    </lise:ID>
  </lise:surveySensorID>
  <lise:accuracy uom="m">0.0001</lise:accuracy>
</lise:GenericDistance>
</lise:surveySensor>
<lise:surveySensor>
  <lise:GNSS gml:id="SG2">
    <lise:surveySensorID>
      <lise:ID>
        <identifier>GNSS2</identifier>
      </lise:ID>
    </lise:surveySensorID>
    <lise:posAccuracy uom="m">0.002</lise:posAccuracy>
    <lise:hgtAccuracy uom="m">0.005</lise:hgtAccuracy>
    <lise:camera>
      <lise:Camera gml:id="GNSSC1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>GNSS Camera1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:Camera>
    </lise:camera>
    <lise:antenna>
      <lise:Antenna gml:id="GNSS2A1">
        <lise:antennaID>
          <lise:ID>
            <identifier>GNSS2 Antenna</identifier>
          </lise:ID>
        </lise:antennaID>
        <lise:iGSName>GNSS ANTENNA</lise:iGSName>
        <lise:horizzontalOffset uom="m">0.123</lise:horizzontalOffset>
        <lise:verticallOffset uom="m">0.234</lise:verticallOffset>
        <lise:l1phaseOffset uom="m">0.345</lise:l1phaseOffset>
        <lise:l2phaseOffset uom="m">0.456</lise:l2phaseOffset>
      </lise:Antenna>
    </lise:antenna>
    <lise:reference>
      <lise:GNSS gml:id="SG3">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>Reference</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:GNSS>
    </lise:reference>
  </lise:GNSS>
</lise:surveySensor>
<lise:surveySensor>
  <lise:LaserScanner gml:id="SS2">
    <lise:surveySensorID>
      <lise:ID>
```

```xml
            <identifier>Scanner2</identifier>
          </lise:ID>
        </lise:surveySensorID>
        <lise:horizontalAngle>
          <lise:GenericAngle gml:id="LSGA1">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>Scanner HZ Angle</identifier>
              </lise:ID>
            </lise:surveySensorID>
            <lise:accuracy uom="deg">0.003</lise:accuracy>
          </lise:GenericAngle>
        </lise:horizontalAngle>
      </lise:LaserScanner>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:Level gml:id="SL2">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>Level2</identifier>
          </lise:ID>
        </lise:surveySensorID>
        <lise:accuracy uom="m">0.0005</lise:accuracy>
        <lise:staff1>9876543</lise:staff1>
        <lise:staff2>76543</lise:staff2>
      </lise:Level>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:Tps gml:id="ST2">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>TPS2</identifier>
          </lise:ID>
        </lise:surveySensorID>
        <lise:horizontalAngle>
          <lise:GenericAngle gml:id="TPSHZGA2">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>TPS Hz Angle</identifier>
              </lise:ID>
            </lise:surveySensorID>
          </lise:GenericAngle>
        </lise:horizontalAngle>
        <lise:vericalAngle>
          <lise:GenericAngle gml:id="TPSVGA2">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>TPS V Angle</identifier>
              </lise:ID>
            </lise:surveySensorID>
          </lise:GenericAngle>
        </lise:vericalAngle>
        <lise:compLongitudinal uom="deg">0.000030814891377</lise:compLongitudinal>
        <lise:compTransversal uom="deg">-0.000485202964925</lise:compTransversal>
        <lise:camera>
          <lise:Camera gml:id="TPSCA1">
```

```xml
<lise:surveySensorID>
  <lise:ID>
    <identifier>TPS OV Camera1</identifier>
  </lise:ID>
</lise:surveySensorID>
<lise:autoFocus>true</lise:autoFocus>
<lise:offsetAndOrientation>
  <lise:OffsetAndOrientation gml:id="OFSET2">

    <gml:validTime>
      <gml:TimeInstant gml:id="TIM2">
        <gml:timePosition>2016-10-19T10:00:00</gml:timePosition>
      </gml:TimeInstant>
    </gml:validTime>
    <gml:position>
      <gml:Point gml:id="OFSETP2">
        <gml:pos>0.00013 0.254 0.136</gml:pos>
      </gml:Point>
    </gml:position>
    <gml:bearing>
      <gml:DirectionString>relative</gml:DirectionString>
    </gml:bearing>
  </lise:OffsetAndOrientation>
</lise:offsetAndOrientation>
<lise:crs>
  <gml:ImageCRS gml:id="CCRS2">
    <gml:identifier codeSpace="Crs Camera3"></gml:identifier>
    <gml:scope></gml:scope>
    <gml:usesCartesianCS></gml:usesCartesianCS>
    <gml:usesImageDatum>
      <gml:ImageDatum gml:id="ID2">
        <gml:identifier codeSpace="SC2ID2"></gml:identifier>
        <gml:scope></gml:scope>
        <gml:pixelInCell codeSpace="1258"></gml:pixelInCell>
      </gml:ImageDatum>
    </gml:usesImageDatum>
  </gml:ImageCRS>
</lise:crs>
<lise:detector>
  <lise:DetectorArray gml:id="SC2DA2">
    <lise:numberOfDimensions>2</lise:numberOfDimensions>
    <lise:arrayDimensionsValue>1246</lise:arrayDimensionsValue>
    <lise:arrayDimensionsValue>758</lise:arrayDimensionsValue>
    <lise:arrayDimensionsName>array1</lise:arrayDimensionsName>
    <lise:arrayDimensionsName>array2</lise:arrayDimensionsName>
    <lise:detectorSize>528</lise:detectorSize>
    <lise:detectorSize>256</lise:detectorSize>
    <lise:offsetVector>0 0.00006</lise:offsetVector>
  </lise:DetectorArray>
</lise:detector>
<lise:interiorOrientation>
  <lise:InteriorOrientation gml:id="SC2IO2">
    <lise:principalPointX uom="Pixel">508</lise:principalPointX>
    <lise:principalPointY uom="Pixel">248</lise:principalPointY>
    <lise:focalLength uom="m">2.082550E-002</lise:focalLength>
    <lise:crossHairPosX uom="Pixel">0</lise:crossHairPosX>
```

```xml
                    <lise:crossHairPosY uom="Pixel">0</lise:crossHairPosY>
                    <lise:virtualCameraConstant>0</lise:virtualCameraConstant>
                  </lise:InteriorOrientation>
                </lise:interiorOrientation>
                <lise:gNSS>
                  <lise:GNSS gml:id="SC3GNSS">
                    <lise:surveySensorID>
                      <lise:ID>
                        <identifier>Integrated camera GPS</identifier>
                      </lise:ID>
                    </lise:surveySensorID>
                  </lise:GNSS>
                </lise:gNSS>
                <lise:system>
                  <lise:SensorSystem gml:id="SC2SS2">
                    <lise:calibratedFocalLength uom="m">2.082550E-002
                    </lise:calibratedFocalLength>
                    <lise:princPoint>
                      <gml:Point gml:id="SC2PP3">
                        <gml:pos>254 190</gml:pos>
                      </gml:Point>
                    </lise:princPoint>
                    <lise:instFieldOfView uom="deg">1.3</lise:instFieldOfView>
                    <lise:swathFieldOfView uom="deg">0.9</lise:swathFieldOfView>
                    <lise:opticalDistortion>
                      <lise:Distortion gml:id="SC2DI2">
                        <lise:princPoint>
                          <gml:Point gml:id="SC2PP4">
                            <gml:pos>254 190</gml:pos>
                          </gml:Point>
                        </lise:princPoint>
                        <lise:distortionK1>0.123</lise:distortionK1>
                        <lise:distortionK2>0.456</lise:distortionK2>
                      </lise:Distortion>
                    </lise:opticalDistortion>
                  </lise:SensorSystem>
                </lise:system>
              </lise:Camera>
            </lise:camera>
          </lise:Tps>
        </lise:surveySensor>
      </lise:Equipment>
    </lis:equipment>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:SurveyProcessType">
        <lise:surveyProcessID>
          <lise:ID>
            <identifier>SP1</identifier>
          </lise:ID>
        </lise:surveyProcessID>
        <lise:surveySensor xlink:href="SGA1"></lise:surveySensor>
        <lise:surveySensor xlink:href="SS2"></lise:surveySensor>
      </lis:SurveyProcess>
    </lis:surveyProcess>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
```

```xml
                <lise:surveyProcessID>
                  <lise:ID>
                    <identifier>SP2</identifier>
                  </lise:ID>
                </lise:surveyProcessID>
                <lise:correction>
                  <lise:Correction gml:id="OC1">
                    <lise:correctionID>
                      <lise:ID>
                        <identifier>Generic Observation correction</identifier>
                      </lise:ID>
                    </lise:correctionID>
                    <lise:type  xlink:href="http://example.com/observationCorrectionType#userDefined"
                      xlink:title="User Defined"/>
                  </lise:Correction>
                </lise:correction>
              </lis:SurveyProcess>
            </lis:surveyProcess>
            <lis:surveyProcess>
              <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
                <lise:surveyProcessID>
                  <lise:ID>
                    <identifier>SP3</identifier>
                  </lise:ID>
                </lise:surveyProcessID>
                <lise:surveySensor xlink:href="SGD1">
                </lise:surveySensor>
                <lise:correction>
                  <lise:DistanceCorrection gml:id="DC1">
                    <lise:correctionID>
                      <lise:ID>
                        <identifier>Distance Corr1</identifier>
                      </lise:ID>
                    </lise:correctionID>
                    <lise:projectionDistortion uom="m">0.9996</lise:projectionDistortion>
                    <lise:individualScale uom="m">1.0006</lise:individualScale>
                  </lise:DistanceCorrection>
                </lise:correction>
              </lis:SurveyProcess>
            </lis:surveyProcess>
            <lis:surveyProcess>
              <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
                <lise:surveyProcessID>
                  <lise:ID>
                    <identifier>SP4</identifier>
                  </lise:ID>
                </lise:surveyProcessID>
                <lise:surveySensor xlink:href="SGD1">
                </lise:surveySensor>
                <lise:correction>
                  <lise:Offset gml:id="OCO1">
                    <lise:correctionID>
                      <lise:ID>
                        <identifier>Offset1</identifier>
                      </lise:ID>
                    </lise:correctionID>
```

```xml
        <lise:crossOffset uom="m">1.123</lise:crossOffset>
        <lise:lengthOffset uom="m">2.345</lise:lengthOffset>
      </lise:Offset>
    </lise:correction>
  </lis:SurveyProcess>
</lis:surveyProcess>
<lis:surveyProcess>
  <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
    <lise:surveyProcessID>
      <lise:ID>
        <identifier>SP5</identifier>
      </lise:ID>
    </lise:surveyProcessID>
    <lise:surveySensor xlink:href="SGA1">
    </lise:surveySensor>
    <lise:correction>
      <lise:AngularCorrection gml:id="OCA1">
        <lise:correctionID>
          <lise:ID>
            <identifier>Angular Correction1</identifier>
          </lise:ID>
        </lise:correctionID>
        <lise:rotation uom="deg">0.234</lise:rotation>
      </lise:AngularCorrection>
    </lise:correction>
  </lis:SurveyProcess>
</lis:surveyProcess>
<lis:surveyProcess>
  <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
    <lise:surveyProcessID>
      <lise:ID>
        <identifier>SP6</identifier>
      </lise:ID>
    </lise:surveyProcessID>
    <lise:surveySensor xlink:href="ST2">
    </lise:surveySensor>
    <lise:correction>
      <lise:Transformation gml:id="OCTR1">
        <lise:correctionID>
          <lise:ID>
            <identifier>Trafo1</identifier>
          </lise:ID>
        </lise:correctionID>
        <lise:deltaX uom="m">1.0</lise:deltaX>
        <lise:deltaY uom="m">2.0</lise:deltaY>
        <lise:deltaZ uom="m">3.0</lise:deltaZ>
        <lise:scaleX uom="s">1.0</lise:scaleX>
        <lise:scaleY uom="s">0.9996</lise:scaleY>
        <lise:scaleZ uom="s">1.123</lise:scaleZ>
        <lise:rotX uom="deg">0</lise:rotX>
        <lise:rotY uom="deg">0</lise:rotY>
        <lise:rotZ uom="deg">45.0</lise:rotZ>
      </lise:Transformation>
    </lise:correction>
  </lis:SurveyProcess>
</lis:surveyProcess>
```

```
    </lis:Survey>
  </abstractData>
</LandInfraDataset>
```

B. 3   Equipment and SurveyProcess

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:lise="http://www.opengis.net/infragml/equipment/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/equipment/1.0 Part6Equipment0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <name>Sample Part6 Dataset</name>
  <description>LandInfra dataset to test all possible content for Part6 Survey Equipment
</description>
  <dateTime>2016-10-19T10:00:00</dateTime>
  <datasetVersion>1.0</datasetVersion>
  <application>manual</application>
  <author>Hans-Christoph Gruler, Leica Geosystems AG</author>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <abstractData>
    <lis:Survey gml:id="S1">
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
          <scope>OGC LandInfraSWG</scope>
        </lis:ID>
      </lis:surveyID>
      <lis:equipment>
        <lise:Equipment gml:id="E1">
          <gml:description>sample survey equipment definition required content all possible
            sensors</gml:description>
          <lise:surveySensor>
            <lise:Camera gml:id="SC1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>Camera1</identifier>
                </lise:ID>
              </lise:surveySensorID>
            </lise:Camera>
          </lise:surveySensor>
          <lise:surveySensor>
            <lise:EDM gml:id="SE1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>EDM1</identifier>
                </lise:ID>
              </lise:surveySensorID>
```

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```xml
      </lise:EDM>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:GenericAngle gml:id="SGA1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>GenAng1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:GenericAngle>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:GenericDistance gml:id="SGD1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>GenDist1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:GenericDistance>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:GNSS gml:id="SG1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>GNSS1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:GNSS>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:LaserScanner gml:id="SS1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>Scanner1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:LaserScanner>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:Level gml:id="SL1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>Level1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:Level>
    </lise:surveySensor>
    <lise:surveySensor>
      <lise:Tps gml:id="ST1">
        <lise:surveySensorID>
          <lise:ID>
            <identifier>TPS1</identifier>
          </lise:ID>
        </lise:surveySensorID>
      </lise:Tps>
    </lise:surveySensor>
```

```xml
        </lise:Equipment>
      </lis:equipment>
    </lis:Survey>
</abstractData>
<abstractData>
  <lis:Survey gml:id="S2">
    <gml:description>sample survey definition all possible content</gml:description>
    <gml:name>Survey 1 Survey</gml:name>
    <lis:surveyID>
      <lis:ID>
        <identifier>Survey2</identifier>
        <scope>OGC LandInfraSWG</scope>
      </lis:ID>
    </lis:surveyID>
    <lis:landSurveyor>
      <Professional gml:id="p1">
        <li:fullName>Surveyor1</li:fullName>
        <li:type xlink:href="http://example.com/professionalType#landSurveyor"
          xlink:title="Land Surveyor"/>
        <li:company>LandSurveyors Inc.</li:company>
        <li:registration>SR12345678</li:registration>
        <li:licensingCountry>Switzerland</li:licensingCountry>
      </Professional>
    </lis:landSurveyor>
    <lis:purposeOfSurvey>Determination of new Parcel Boundery</lis:purposeOfSurvey>
    <lis:type  xlink:href="http://example.com/surveyType#surveyed"  xlink:title="Surveyed"/>
    <lis:equipment>
      <lise:Equipment gml:id="E2">
        <gml:description>sample survey equipment definition all possible
          sensors</gml:description>
        <gml:name>Equipment 12 Crew2</gml:name>
        <lise:serialID>12345678</lise:serialID>
        <lise:dataCollector>Survey Datacollector</lise:dataCollector>
        <lise:controlSoftware>Software for Surveyors</lise:controlSoftware>
        <lise:softwareVersion>1.97 Build 34</lise:softwareVersion>
        <lise:surveySensor>
          <lise:SurveySensor gml:id="SSB1">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>BarCode Scanner</identifier>
              </lise:ID>
            </lise:surveySensorID>
            <lise:type  xlink:href="http://example.com/surveySensorType#other"
              xlink:title="Other Sensor"/>
            <lise:manufacture>ScanFactory</lise:manufacture>
            <lise:model>Model X1</lise:model>
            <lise:serialID>254</lise:serialID>
            <lise:softwareVersion>2.03</lise:softwareVersion>
          </lise:SurveySensor>
        </lise:surveySensor>
        <lise:surveySensor>
          <lise:Camera gml:id="SC2">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>Camera2</identifier>
              </lise:ID>
```

```xml
</lise:surveySensorID>
<lise:autoFocus>true</lise:autoFocus>
<lise:offsetAndOrientation>
    <lise:OffsetAndOrientation gml:id="OFSET1">
        <gml:validTime>
            <gml:TimeInstant gml:id="TIM1">
                <gml:timePosition>2016-10-19T10:00:00</gml:timePosition>
            </gml:TimeInstant>
        </gml:validTime>
        <gml:position>
            <gml:Point gml:id="OFSETP1">
                <gml:pos>0.00013 0.254 0.136</gml:pos>
            </gml:Point>
        </gml:position>
        <gml:bearing>
            <gml:DirectionString>relative</gml:DirectionString>
        </gml:bearing>
    </lise:OffsetAndOrientation>
</lise:offsetAndOrientation>
<lise:crs>
    <gml:ImageCRS gml:id="CCRS1">
        <gml:identifier codeSpace="Crs Camera2"></gml:identifier>
        <gml:scope></gml:scope>
        <gml:usesCartesianCS></gml:usesCartesianCS>
        <gml:usesImageDatum><gml:ImageDatum gml:id="ID1">
            <gml:identifier codeSpace="SC2ID1"></gml:identifier>
            <gml:scope></gml:scope>
            <gml:pixelInCell codeSpace="1258">
            </gml:pixelInCell>
        </gml:ImageDatum>
        </gml:usesImageDatum>
    </gml:ImageCRS></lise:crs>
<lise:detector>
    <lise:DetectorArray gml:id="SC2DA1">
        <lise:numberOfDimensions>2</lise:numberOfDimensions>
        <lise:arrayDimensionsValue>1246</lise:arrayDimensionsValue>
        <lise:arrayDimensionsValue>758</lise:arrayDimensionsValue>
        <lise:arrayDimensionsName>array1</lise:arrayDimensionsName>
        <lise:arrayDimensionsName>array2</lise:arrayDimensionsName>
        <lise:detectorSize>528</lise:detectorSize>
        <lise:detectorSize>256</lise:detectorSize>
        <lise:offsetVector>0 0.00006</lise:offsetVector>
    </lise:DetectorArray>
</lise:detector>
<lise:interiorOrientation>
    <lise:InteriorOrientation gml:id="SC2IO1">
        <lise:principalPointX uom="Pixel">508</lise:principalPointX>
        <lise:principalPointY uom="Pixel">248</lise:principalPointY>
        <lise:focalLength uom="m">2.082550E-002</lise:focalLength>
        <lise:crossHairPosX uom="Pixel">0</lise:crossHairPosX>
        <lise:crossHairPosY uom="Pixel">0</lise:crossHairPosY>
        <lise:virtualCameraConstant>0</lise:virtualCameraConstant>
    </lise:InteriorOrientation>
</lise:interiorOrientation>
<lise:gNSS>
    <lise:GNSS gml:id="SC2GNSS">
```

```xml
<lise:surveySensorID>
  <lise:ID>
    <identifier>Integrated GPS</identifier>
  </lise:ID>
</lise:surveySensorID>
    </lise:GNSS>
  </lise:gNSS>
  <lise:system>
    <lise:SensorSystem gml:id="SC2SS1">
      <lise:calibratedFocalLength uom="m">2.082550E-002
      </lise:calibratedFocalLength>
      <lise:princPoint>
        <gml:Point gml:id="SC2PP1">
          <gml:pos>254 190</gml:pos>
        </gml:Point>
      </lise:princPoint>
      <lise:instFieldOfView uom="deg">1.3</lise:instFieldOfView>
      <lise:swathFieldOfView uom="deg">0.9</lise:swathFieldOfView>
      <lise:opticalDistortion>
        <lise:Distortion gml:id="SC2DI1">
          <lise:princPoint>
            <gml:Point gml:id="SC2PP2">
              <gml:pos>254 190</gml:pos>
            </gml:Point>
          </lise:princPoint>
          <lise:distortionK1>0.123</lise:distortionK1>
          <lise:distortionK2>0.456</lise:distortionK2>
        </lise:Distortion>
      </lise:opticalDistortion>
    </lise:SensorSystem>
  </lise:system>
  </lise:Camera>
</lise:surveySensor>
<lise:surveySensor>
  <lise:EDM gml:id="SE2">
    <lise:surveySensorID>
      <lise:ID>
        <identifier>EDM2</identifier>
      </lise:ID>
    </lise:surveySensorID>
    <lise:accuracy uom="m">0.001</lise:accuracy>
    <lise:carrierWavelength uom="nm">1.12345</lise:carrierWavelength>
  </lise:EDM>
</lise:surveySensor>
<lise:surveySensor>
  <lise:GenericAngle gml:id="SGA2">
    <lise:surveySensorID>
      <lise:ID>
        <identifier>GenAng2</identifier>
      </lise:ID>
    </lise:surveySensorID>
    <lise:accuracy uom="deg">0.000123</lise:accuracy>
  </lise:GenericAngle>
</lise:surveySensor>
<lise:surveySensor>
  <lise:GenericDistance gml:id="SGD2">
```

```xml
          <lise:surveySensorID>
            <lise:ID>
              <identifier>GenDist2</identifier>
            </lise:ID>
          </lise:surveySensorID>
          <lise:accuracy uom="m">0.0001</lise:accuracy>
        </lise:GenericDistance>
      </lise:surveySensor>
      <lise:surveySensor>
        <lise:GNSS gml:id="SG2">
          <lise:surveySensorID>
            <lise:ID>
              <identifier>GNSS2</identifier>
            </lise:ID>
          </lise:surveySensorID>
          <lise:posAccuracy uom="m">0.002</lise:posAccuracy>
          <lise:hgtAccuracy uom="m">0.005</lise:hgtAccuracy>
          <lise:camera>
            <lise:Camera gml:id="GNSSC1">
              <lise:surveySensorID>
                <lise:ID>
                  <identifier>GNSS Camera1</identifier>
                </lise:ID>
              </lise:surveySensorID>
            </lise:Camera>
          </lise:camera>
          <lise:antenna>
            <lise:Antenna gml:id="GNSS2A1">
              <lise:antennaID>
                <lise:ID>
                  <identifier>GNSS2 Antenna</identifier>
                </lise:ID>
              </lise:antennaID>
              <lise:iGSName>GNSS ANTENNA</lise:iGSName>
              <lise:horizzontalOffset uom="m">0.123</lise:horizzontalOffset>
              <lise:verticallOffset uom="m">0.234</lise:verticallOffset>
              <lise:l1phaseOffset uom="m">0.345</lise:l1phaseOffset>
              <lise:l2phaseOffset uom="m">0.456</lise:l2phaseOffset>
            </lise:Antenna>
          </lise:antenna>
          <lise:reference><lise:GNSS gml:id="SG3">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>Reference</identifier>
              </lise:ID>
            </lise:surveySensorID>
          </lise:GNSS>
          </lise:reference>
        </lise:GNSS>
      </lise:surveySensor>
      <lise:surveySensor>
        <lise:LaserScanner gml:id="SS2">
          <lise:surveySensorID>
            <lise:ID>
              <identifier>Scanner2</identifier>
            </lise:ID>
```

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```xml
            </lise:surveySensorID>
            <lise:horizontalAngle>
              <lise:GenericAngle gml:id="LSGA1">
                <lise:surveySensorID>
                  <lise:ID>
                    <identifier>Scanner HZ Angle</identifier>
                  </lise:ID>
                </lise:surveySensorID>
                <lise:accuracy uom="deg">0.003</lise:accuracy>
              </lise:GenericAngle>
            </lise:horizontalAngle>
          </lise:LaserScanner>
        </lise:surveySensor>
        <lise:surveySensor>
          <lise:Level gml:id="SL2">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>Level2</identifier>
              </lise:ID>
            </lise:surveySensorID>
            <lise:accuracy uom="m">0.0005</lise:accuracy>
            <lise:staff1>9876543</lise:staff1>
            <lise:staff2>76543</lise:staff2>
          </lise:Level>
        </lise:surveySensor>
        <lise:surveySensor>
          <lise:Tps gml:id="ST2">
            <lise:surveySensorID>
              <lise:ID>
                <identifier>TPS2</identifier>
              </lise:ID>
            </lise:surveySensorID>
            <lise:compLongitudinal uom="deg">0.000030814891377</lise:compLongitudinal>
            <lise:compTransversal uom="deg">-0.000485202964925</lise:compTransversal>
          </lise:Tps>
        </lise:surveySensor>
      </lise:Equipment>
    </lis:equipment>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:SurveyProcessType">
        <lise:surveyProcessID>
          <lise:ID>
            <identifier>SP1</identifier>
          </lise:ID>
        </lise:surveyProcessID>
        <lise:surveySensor xlink:href="SGA1">
        </lise:surveySensor>
        <lise:surveySensor xlink:href="SS2">
        </lise:surveySensor>
      </lis:SurveyProcess>
    </lis:surveyProcess>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
        <lise:surveyProcessID>
          <lise:ID>
            <identifier>SP1</identifier>
```

```xml
          </lise:ID>
        </lise:surveyProcessID>
        <lise:correction>
          <lise:Correction gml:id="OC1">
            <lise:correctionID>
              <lise:ID>
                <identifier>Generic Observation correction</identifier>
              </lise:ID>
            </lise:correctionID>
            <lise:type  xlink:href="http://example.com/observationCorrectionType#userDefined"
              xlink:title="User Defined"/>
          </lise:Correction>
        </lise:correction>
      </lis:SurveyProcess>
    </lis:surveyProcess>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
        <lise:surveyProcessID>
          <lise:ID>
            <identifier>SP3</identifier>
          </lise:ID>
        </lise:surveyProcessID>
        <lise:surveySensor xlink:href="SGD1">
        </lise:surveySensor>
        <lise:correction>
          <lise:DistanceCorrection gml:id="DC1">
            <lise:correctionID>
              <lise:ID>
                <identifier>Distance Corr1</identifier>
              </lise:ID>
            </lise:correctionID>
            <lise:individualScale uom="m">1.0006</lise:individualScale>
          </lise:DistanceCorrection>
        </lise:correction>
      </lis:SurveyProcess>
    </lis:surveyProcess>
    <lis:surveyProcess>
      <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
        <lise:surveyProcessID>
          <lise:ID>
            <identifier>SP4</identifier>
          </lise:ID>
        </lise:surveyProcessID>
        <lise:surveySensor xlink:href="SGD1">
        </lise:surveySensor>
        <lise:correction>
          <lise:Offset gml:id="OCO1">
            <lise:correctionID>
              <lise:ID>
                <identifier>Offset1</identifier>
              </lise:ID>
            </lise:correctionID>
            <lise:crossOffset uom="m">1.123</lise:crossOffset>
            <lise:lengthOffset uom="m">2.345</lise:lengthOffset>
          </lise:Offset>
        </lise:correction>
```

```xml
          </lis:SurveyProcess>
        </lis:surveyProcess>
        <lis:surveyProcess>
          <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
            <lise:surveyProcessID>
              <lise:ID>
                <identifier>SP5</identifier>
              </lise:ID>
            </lise:surveyProcessID>
            <lise:surveySensor xlink:href="SGA1">
            </lise:surveySensor>
            <lise:correction>
              <lise:AngularCorrection gml:id="OCA1">
                <lise:correctionID>
                  <lise:ID>
                    <identifier>Angular Correction1</identifier>
                  </lise:ID>
                </lise:correctionID>
                <lise:rotation uom="deg">0.234</lise:rotation>
              </lise:AngularCorrection>
            </lise:correction>
          </lis:SurveyProcess>
        </lis:surveyProcess>
        <lis:surveyProcess>
          <lis:SurveyProcess xsi:type="lise:ObservationCorrectionsType">
            <lise:surveyProcessID>
              <lise:ID>
                <identifier>SP6</identifier>
              </lise:ID>
            </lise:surveyProcessID>
            <lise:surveySensor xlink:href="ST2">
            </lise:surveySensor>
            <lise:correction>
              <lise:Transformation gml:id="OCTR1">
                <lise:correctionID>
                  <lise:ID>
                    <identifier>Trafo1</identifier>
                  </lise:ID>
                </lise:correctionID>
                <lise:deltaX uom="m">1.0</lise:deltaX>
                <lise:deltaY uom="m">2.0</lise:deltaY>
                <lise:deltaZ uom="m">3.0</lise:deltaZ>
                <lise:scaleX uom="s">1.0</lise:scaleX>
                <lise:scaleY uom="s">0.9996</lise:scaleY>
                <lise:scaleZ uom="s">1.123</lise:scaleZ>
                <lise:rotX uom="deg">0</lise:rotX>
                <lise:rotY uom="deg">0</lise:rotY>
                <lise:rotZ uom="deg">45.0</lise:rotZ>
              </lise:Transformation>
            </lise:correction>
          </lis:SurveyProcess>
        </lis:surveyProcess>
      </lis:Survey>
    </abstractData>
</LandInfraDataset>
```

B. 4 Observations

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:liso="http://www.opengis.net/infragml/observations/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/observations/1.0
Part6Observations0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <name>Sample Part0 Dataset</name>
  <description>LandInfra dataset to test all possible content for Part6 Observations</description>
  <dateTime>2016-12-02T10:00:00</dateTime>
  <datasetVersion>1.0</datasetVersion>
  <application>manual</application>
  <author>Paul Scarponcini, Bentley Systems, Inc.</author>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <featureAssociation>
    <FeatureAssociation gml:id="fa1">
      <gml:description>associates document 20160004 with Survey Mark
        1001</gml:description>
      <gml:name>survey marking</gml:name>
      <fromFeature xlink:href="d1"/>
      <fromRole>documentation for</fromRole>
      <toFeature xlink:href="sm1"></toFeature>
      <toRole>documented survey mark</toRole>
    </FeatureAssociation>
  </featureAssociation>
  <feature>
    <Document gml:id="d1">
      <documentID>
        <ID>
          <identifier>20160004</identifier>
        </ID>
      </documentID>
      <documentType>Survey Marking</documentType>
      <documentContent>http://city.net/survey/documents.pdf"</documentContent>
    </Document>
  </feature>
  <abstractData>
    <lis:Survey gml:id="S1">
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
        </lis:ID>
```

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```xml
</lis:surveyID>
<lis:setup>
  <liso:Setup gml:id="SET1">
    <gml:description>sample survey observation definition required content all possible
      observations</gml:description>
    <liso:instrumentHeight uom="m">1.50</liso:instrumentHeight>
    <liso:validTime>
      <gml:TimePeriod gml:id="SET1T1">
        <gml:beginPosition>2016-08-24T09:00:00</gml:beginPosition>
        <gml:endPosition>2016-08-24T09:30:00</gml:endPosition>
      </gml:TimePeriod>
    </liso:validTime>
    <liso:observations>
      <liso:Observations>
        <liso:surveyObservation>
          <liso:SurveyObservation gml:id="SO1">
            <gml:validTime>
              <gml:TimePeriod gml:id="SO1TP1">
                <gml:beginPosition>2016-08-24T09:01:00</gml:beginPosition>
                <gml:endPosition>2016-08-24T09:01:05</gml:endPosition>
              </gml:TimePeriod>
            </gml:validTime>
            <gml:using>
              <Feature gml:id="SP1">
                <gml:description>Standard process for SO1</gml:description>
              </Feature>
            </gml:using>
            <gml:target>
              <SurveyMark gml:id="sm1">
                <spatialRepresentation>
                  <SpatialRepresentation>
                    <geometry>
                      <gml:Point gml:id="p1">
                        <gml:pos>105 230</gml:pos>
                      </gml:Point>
                    </geometry>
                  </SpatialRepresentation>
                </spatialRepresentation>
                <identification>1001</identification>
              </SurveyMark>
            </gml:target>
            <gml:resultOf>
              <gml:description>Result of SO1</gml:description>
            </gml:resultOf>
            <liso:resultTime>
              <gml:TimeInstant gml:id="SO1RT1">
                <gml:timePosition>2016-08-24T09:01:04</gml:timePosition>
              </gml:TimeInstant>
            </liso:resultTime>
            <liso:type  xlink:href="http://example.com/observationType#calculated"
              xlink:title="Calculated"/>
            <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
          </liso:SurveyObservation>
        </liso:surveyObservation>
        <liso:surveyObservation>
          <liso:AngularObservation gml:id="AO1">
```

```xml
        <gml:validTime>
          <gml:TimePeriod gml:id="AO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <gml:resultOf>
          <gml:Point gml:id="AO1POS1">
            <gml:pos>50 0 0</gml:pos>
          </gml:Point>
        </gml:resultOf>
        <liso:resultTime>
          <gml:TimeInstant gml:id="AO1RT1">
            <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
          </gml:TimeInstant>
        </liso:resultTime>
        <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
        <liso:angle uom="deg">123.45</liso:angle>
      </liso:AngularObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
      <liso:DistanceObservation gml:id="DO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="DO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <gml:resultOf>
          <gml:Point gml:id="DO1POS1">
              <gml:pos>50 0 0</gml:pos>
            </gml:Point>
        </gml:resultOf>
        <liso:resultTime>
          <gml:TimeInstant gml:id="DO1RT1">
            <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
          </gml:TimeInstant>
        </liso:resultTime>
        <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
        <liso:distance uom="meter">12.345</liso:distance>
      </liso:DistanceObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
      <liso:TpsObservation gml:id="TO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="TO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <gml:resultOf>
          <gml:Point gml:id="TO1POS1">
              <gml:pos>50 0 0</gml:pos>
            </gml:Point>
        </gml:resultOf>
        <liso:resultTime>
```

```xml
          <gml:TimeInstant gml:id="TO1RT1">
            <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
          </gml:TimeInstant>
        </liso:resultTime>
        <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
        <liso:reflectorHeight uom="m">1.65</liso:reflectorHeight>
        <liso:directFace>true</liso:directFace>
        <liso:meanFace>false</liso:meanFace>
        <liso:horizontalAngle uom="deg">254.123</liso:horizontalAngle>
        <liso:verticalAngle uom="deg">89.523</liso:verticalAngle>
      </liso:TpsObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:LevelObservation gml:id="LO1">
      <gml:validTime>
        <gml:TimePeriod gml:id="LO1TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="LO1POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="LO1RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:deltaHeight uom="m">1.123</liso:deltaHeight>
    </liso:LevelObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:GnssObservation gml:id="GO1">
      <gml:validTime>
        <gml:TimePeriod gml:id="GO1TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="GO1POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="GO1RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:antennaHeight uom="m">2.000</liso:antennaHeight>
    </liso:GnssObservation>
  </liso:surveyObservation>
```

```xml
<liso:surveyObservation>
  <liso:ImageObservation gml:id="IO1">
    <gml:validTime>
      <gml:TimePeriod gml:id="IO1TP1">
        <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
        <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
      </gml:TimePeriod>
    </gml:validTime>
    <gml:resultOf>
      <gml:File>
        <gml:rangeParameters>
          <gml:name>Image01</gml:name>
        </gml:rangeParameters>
        <gml:fileName>Image1234.jpg</gml:fileName>
        <gml:fileStructure>binary</gml:fileStructure>
      </gml:File>
    </gml:resultOf>
    <liso:resultTime>
      <gml:TimeInstant gml:id="IO1RT1">
        <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
      </gml:TimeInstant>
    </liso:resultTime>
    <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
  </liso:ImageObservation>
</liso:surveyObservation>
<liso:surveyObservation>
<liso:PointCloudObservation gml:id="PO1">
  <gml:validTime>
    <gml:TimePeriod gml:id="PO1TP1">
      <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
      <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
    </gml:TimePeriod>
  </gml:validTime>
  <gml:resultOf>
    <gml:File>
      <gml:rangeParameters/>
      <gml:fileName>PointCloud1234.las</gml:fileName>
      <gml:fileStructure>ASCII</gml:fileStructure>
    </gml:File>
  </gml:resultOf>
  <liso:resultTime>
    <gml:TimeInstant gml:id="PO1RT1">
      <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
    </gml:TimeInstant>
  </liso:resultTime>
  <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
</liso:PointCloudObservation>
</liso:surveyObservation>
</liso:Observations>
</liso:observations>
<liso:setupObservations>
  <liso:SetupObservations>
    <liso:setupObservation>
      <liso:SurveyObservation gml:id="SETO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="SETO1TP1">
```

```xml
                    <gml:beginPosition>2016-08-24T09:01:00</gml:beginPosition>
                    <gml:endPosition>2016-08-24T09:01:05</gml:endPosition>
                  </gml:TimePeriod>
                </gml:validTime>
                <gml:resultOf>
                  <gml:Point gml:id="SETO1POS1">
                    <gml:pos>0 50 0</gml:pos>
                  </gml:Point>
                </gml:resultOf>
                <liso:resultTime>
                  <gml:TimeInstant gml:id="SETO1RT1">
                    <gml:timePosition>2016-08-24T09:01:04</gml:timePosition>
                  </gml:TimeInstant>
                </liso:resultTime>
                <liso:type  xlink:href="http://example.com/observationType#calculated"
                    xlink:title="Calculated"/>
                <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
              </liso:SurveyObservation>
            </liso:setupObservation>
            <liso:setupObservation>
              <liso:DistanceObservation gml:id="SDO1">
                <gml:validTime>
                  <gml:TimePeriod gml:id="SDO1TP1">
                    <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                    <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
                  </gml:TimePeriod>
                </gml:validTime>
                <gml:resultOf>
                  <gml:Point gml:id="SDO1POS1">
                    <gml:pos>50 0 0</gml:pos>
                  </gml:Point>
                </gml:resultOf>
                <liso:resultTime>
                  <gml:TimeInstant gml:id="SDO1RT1">
                    <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
                  </gml:TimeInstant>
                </liso:resultTime>
                <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
                <liso:distance uom="meter">12.345</liso:distance>
              </liso:DistanceObservation>
            </liso:setupObservation>
          </liso:SetupObservations>
        </liso:setupObservations>
      </liso:Setup>
    </lis:setup>
    <lis:setup>
      <liso:Setup gml:id="SET2">
        <gml:description>sample survey observation definition all possible content of
          observations</gml:description>
        <gml:name>Setup 2</gml:name>
        <liso:instrumentHeight uom="m">1.50</liso:instrumentHeight>
        <liso:instrumentPoint>
          <liso:InstrumentPoint gml:id="S2IP1">
            <gml:location>
              <gml:Point gml:id="S2IPNT1">
                <gml:pos>100 200 10</gml:pos>
```

```xml
          </gml:Point>
        </gml:location>
      </liso:InstrumentPoint>
    </liso:instrumentPoint>
  <liso:validTime>
    <gml:TimePeriod gml:id="SET2T1">
      <gml:beginPosition>2016-08-24T09:00:00</gml:beginPosition>
      <gml:endPosition>2016-08-24T09:30:00</gml:endPosition>
    </gml:TimePeriod>
  </liso:validTime>
  <liso:observations>
    <liso:Observations>
      <liso:surveyObservation>
        <liso:SurveyObservation gml:id="SO2">
          <gml:validTime>
            <gml:TimePeriod gml:id="SO2TP1">
              <gml:beginPosition>2016-08-24T09:01:00</gml:beginPosition>
              <gml:endPosition>2016-08-24T09:01:05</gml:endPosition>
            </gml:TimePeriod>
          </gml:validTime>
          <gml:using>
            <Feature gml:id="PI2">
              <gml:description>This can be a standard description of the process if
                  equipment information is not available</gml:description>
            </Feature>
          </gml:using>
          <gml:resultOf>
            <gml:Point gml:id="SO2POS1">
              <gml:pos>0 50 0</gml:pos>
            </gml:Point>
          </gml:resultOf>
          <liso:resultTime>
            <gml:TimeInstant gml:id="SO2RT1">
              <gml:timePosition>2016-08-24T09:01:04</gml:timePosition>
            </gml:TimeInstant>
          </liso:resultTime>
          <liso:type  xlink:href="http://example.com/observationType#calculated"
              xlink:title="Calculated"/>
          <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
        </liso:SurveyObservation>
      </liso:surveyObservation>
      <liso:surveyObservation>
        <liso:AngularObservation gml:id="AO2">
          <gml:validTime>
            <gml:TimePeriod gml:id="AO2TP1">
              <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
              <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
            </gml:TimePeriod>
          </gml:validTime>
          <gml:resultOf>
            <gml:Point gml:id="AO2POS1">
              <gml:pos>50 0 0</gml:pos>
            </gml:Point>
          </gml:resultOf>
          <liso:resultTime>
            <gml:TimeInstant gml:id="AO2RT1">
```

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```xml
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:angle uom="deg">123.45</liso:angle>
      <liso:angularType  xlink:href="http://example.com/angularType#azimuth"
        xlink:title="Azimuth"/>
      <liso:angularQuality uom="deg">0.05</liso:angularQuality>
    </liso:AngularObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:DistanceObservation gml:id="DO2">
      <gml:validTime>
        <gml:TimePeriod gml:id="DO2TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="DO2POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="DO2RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:distance uom="meter">12.345</liso:distance>
      <liso:distanceType  xlink:href="http://example.com/distanceType#azimuth"
        xlink:title="Slope"/>
      <liso:distanceQuality uom="m">0.005</liso:distanceQuality>
    </liso:DistanceObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:TpsObservation gml:id="TO2">
      <gml:validTime>
        <gml:TimePeriod gml:id="TO2TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="TO2POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="TO2RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:reflectorHeight uom="m">1.65</liso:reflectorHeight>
      <liso:directFace>true</liso:directFace>
```

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```xml
            <liso:meanFace>false</liso:meanFace>
            <liso:horizontalAngle uom="deg">254.123</liso:horizontalAngle>
            <liso:hzAngleQuality uom="deg">0.0001</liso:hzAngleQuality>
            <liso:verticalAngle uom="deg">89.523</liso:verticalAngle>
            <liso:vAngleQuality uom="deg">0.0001</liso:vAngleQuality>
            <liso:slopeDistance uom="m">10.123</liso:slopeDistance>
            <liso:sDistanceQuality uom="m">0.001</liso:sDistanceQuality>
            <liso:azimuth uom="deg">250.123</liso:azimuth>
            <liso:azQuality uom="deg">0.0001</liso:azQuality>
            <liso:horizontalDistance uom="m">9.995</liso:horizontalDistance>
            <liso:hDistanceQuality uom="m">0.002</liso:hDistanceQuality>
            <liso:inclinationLength uom="deg">-0.000008</liso:inclinationLength>
            <liso:inclLengthQuality uom="deg">0.0001</liso:inclLengthQuality>
            <liso:inclinationCross uom="deg">0.000005</liso:inclinationCross>
            <liso:inclCrossQuality uom="deg">0.00001</liso:inclCrossQuality>
        </liso:TpsObservation>
    </liso:surveyObservation>
    <liso:surveyObservation>
        <liso:LevelObservation gml:id="LO2">
            <gml:validTime>
                <gml:TimePeriod gml:id="LO2TP1">
                    <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                    <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
                </gml:TimePeriod>
            </gml:validTime>
            <gml:resultOf>
                <gml:Point gml:id="LO2POS1">
                    <gml:pos>50 0 0</gml:pos>
                </gml:Point>
            </gml:resultOf>
            <liso:resultTime>
                <gml:TimeInstant gml:id="LO2RT1">
                    <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
                </gml:TimeInstant>
            </liso:resultTime>
            <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
            <liso:deltaHeight uom="m">1.123</liso:deltaHeight>
            <liso:deltaHeightQuality uom="m">0.0005</liso:deltaHeightQuality>
        </liso:LevelObservation>
    </liso:surveyObservation>
    <liso:surveyObservation>
        <liso:GnssObservation gml:id="GO2">
            <gml:validTime>
                <gml:TimePeriod gml:id="GO2TP1">
                    <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                    <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
                </gml:TimePeriod>
            </gml:validTime>
            <gml:resultOf>
                <gml:Point gml:id="GO2POS1">
                    <gml:pos>50 0 0</gml:pos>
                </gml:Point>
            </gml:resultOf>
            <liso:resultTime>
                <gml:TimeInstant gml:id="GO2RT1">
                    <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
```

```xml
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
      <liso:antennaHeight uom="m">2.000</liso:antennaHeight>
      <liso:quality>
        <liso:GnssQuality gml:id="DOPS1">
          <liso:hDOP>1.100000</liso:hDOP>
          <liso:gDOP>2.406242</liso:gDOP>
          <liso:pDOP>2.024846</liso:pDOP>
          <liso:vDOP>1.700000</liso:vDOP>
          <liso:tDOP>1.300000</liso:tDOP>
        </liso:GnssQuality>
      </liso:quality>
      <liso:rtkInfo>
        <liso:RtkInfo gml:id="RTK1">
          <liso:networkSolution>true</liso:networkSolution>
          <liso:networkType xlink:href="http://example.com/networkType#vRS"
            xlink:title="VRS"/>
          <liso:dataFormat>RTCM3.3</liso:dataFormat>
          <liso:insideRTKNetwork>true</liso:insideRTKNetwork>
          <liso:mountpoint>MOUNTPNT1</liso:mountpoint>
          <liso:numNetworkReferences>12</liso:numNetworkReferences>
          <liso:numRtkPositionsUsed>5</liso:numRtkPositionsUsed>
        </liso:RtkInfo>
      </liso:rtkInfo>
      <liso:satInfo>
        <liso:SatelliteInfo gml:id="SATGP1">
          <liso:systemType xlink:href="http://example.com/systemType#gps"
            xlink:title="GPS"/>
          <liso:numSatsTracked>10</liso:numSatsTracked>
          <liso:numSatsUsed>8</liso:numSatsUsed>
        </liso:SatelliteInfo>
      </liso:satInfo>
      <liso:satInfo>
        <liso:SatelliteInfo gml:id="SATGL1">
          <liso:systemType xlink:href="http://example.com/systemType#glonass"
            xlink:title="GLONASS"/>
          <liso:numSatsTracked>6</liso:numSatsTracked>
          <liso:numSatsUsed>4</liso:numSatsUsed>
        </liso:SatelliteInfo>
      </liso:satInfo>
      <liso:satInfo>
        <liso:SatelliteInfo gml:id="SATGA1">
          <liso:systemType xlink:href="http://example.com/systemType#galileo"
            xlink:title="Galileo"/>
          <liso:numSatsTracked>3</liso:numSatsTracked>
          <liso:numSatsUsed>0</liso:numSatsUsed>
        </liso:SatelliteInfo>
      </liso:satInfo>
      <liso:satInfo>
        <liso:SatelliteInfo gml:id="SATBD1">
          <liso:systemType xlink:href="http://example.com/systemType#beidou"
            xlink:title="BeiDou"/>
          <liso:numSatsTracked>5</liso:numSatsTracked>
          <liso:numSatsUsed>2</liso:numSatsUsed>
        </liso:SatelliteInfo>
```

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```xml
        </liso:satInfo>
      </liso:GnssObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:ImageObservation gml:id="IO2">
      <gml:validTime>
        <gml:TimePeriod gml:id="IO2TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:File>
          <gml:rangeParameters>
            <gml:name>Image01</gml:name>
          </gml:rangeParameters>
          <gml:fileName>Image1234.jpg</gml:fileName>
          <gml:fileStructure>binary</gml:fileStructure>
        </gml:File>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="IO2RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:illuminationElevationAngle uom="deg">0.5
      </liso:illuminationElevationAngle>
      <liso:cloudCoverPercentage>70.00</liso:cloudCoverPercentage>
      <liso:triangulationIndicator>true</liso:triangulationIndicator>
      <liso:radiometricCalibrationDataAvailability>false
      </liso:radiometricCalibrationDataAvailability>
      <liso:cameraCalibrationInformationAvailability>false
      </liso:cameraCalibrationInformationAvailability>
      <liso:filmDistortionInformationAvailability>false
      </liso:filmDistortionInformationAvailability>
      <liso:lensDistortionInformationAvailability>false
      </liso:lensDistortionInformationAvailability>
      <liso:exteriorOrientation>
        <liso:ExteriorOrientation gml:id="EORI1">
          <liso:projectionCenterX uom="m">2.051058</liso:projectionCenterX>
          <liso:projectionCenterY uom="m">-0.411609</liso:projectionCenterY>
          <liso:projectionCenterZ uom="m">2.643776</liso:projectionCenterZ>
          <liso:phi uom="deg">239.659557929903800</liso:phi>
          <liso:theta uom="deg">96.498259821404559</liso:theta>
          <liso:kappa uom="deg">0.000000000000000</liso:kappa>
        </liso:ExteriorOrientation>
      </liso:exteriorOrientation>
    </liso:ImageObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:PointCloudObservation gml:id="PO2">
      <gml:validTime>
        <gml:TimePeriod gml:id="PO2TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
```

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```xml
                    </gml:TimePeriod>
                </gml:validTime>
                <gml:resultOf>
                    <gml:File>
                        <gml:rangeParameters>
                            <gml:name>PointCloud02</gml:name>
                        </gml:rangeParameters>
                        <gml:fileName>PointCloud2345.las</gml:fileName>
                        <gml:fileStructure>ASCII</gml:fileStructure>
                    </gml:File>
                </gml:resultOf>
                <liso:resultTime>
                    <gml:TimeInstant gml:id="PO2RT1">
                        <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
                    </gml:TimeInstant>
                </liso:resultTime>
                <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
                <liso:image xlink:href="IO1"></liso:image>
                <liso:image xlink:href="IO2"></liso:image>
                <liso:panoImage xlink:href="POI1"></liso:panoImage>
                <liso:numberPoints>20000000000</liso:numberPoints>
                <liso:maxSNR>3177</liso:maxSNR>
                <liso:minSNR>29</liso:minSNR>
                <liso:maxIntensity>52771</liso:maxIntensity>
                <liso:minIntensity>978</liso:minIntensity>
                <liso:maxDistance uom="m">3.693400</liso:maxDistance>
                <liso:minDistance uom="m">3.164200</liso:minDistance>
                <liso:maxNorthing uom="m">0.350678</liso:maxNorthing>
                <liso:minNorthing uom="m">-0.090125</liso:minNorthing>
                <liso:maxEasting uom="m">0.416469</liso:maxEasting>
                <liso:minEasting uom="m">-0.241113</liso:minEasting>
                <liso:maxElevation uom="m">0.001460</liso:maxElevation>
                <liso:minElevation uom="m">-0.460276</liso:minElevation>
            </liso:PointCloudObservation>
        </liso:surveyObservation>
      </liso:Observations>
    </liso:observations>
    <liso:panoImage>
      <liso:PanoramaImage gml:id="POI1">
        <liso:panoramaImageID>Panorama 1</liso:panoramaImageID>
        <liso:image xlink:href="IO1"></liso:image>
        <liso:image xlink:href="IO2"></liso:image>
      </liso:PanoramaImage>
    </liso:panoImage>
    </liso:Setup>
  </lis:setup>
 </lis:Survey>
 </abstractData>
</LandInfraDataset>
```

B. 5   SurveyResults

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:lisr="http://www.opengis.net/infragml/surveyresults/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/surveyresults/1.0
Part6SurveyResults0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <dateTime>2016-08-24T10:00:00</dateTime>
  <datasetVersion/>
  <application/>
  <author/>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <abstractData>
    <lis:Survey gml:id="S1">
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
        </lis:ID>
      </lis:surveyID>
      <lis:purposeOfSurvey>String</lis:purposeOfSurvey>
      <lis:type  xlink:href="http://example.com/surveyType#surveyed"  xlink:title="Surveyed"/>
      <lis:surveyResult>
        <lisr:SurveyResult gml:id="SR1">
          <gml:description>sample survey result definition all content of results</gml:description>
          <lisr:surveyResultID>
            <lisr:ID>
              <identifier>UserDefined</identifier>
            </lisr:ID>
          </lisr:surveyResultID>
          <lisr:type  xlink:href="http://example.com/surveyResultType#userdefined"
            xlink:title="User Defined"/>
          <lisr:featureOfInterest>
            <Feature gml:id="FOI1">
              <gml:descriptionReference
                xlink:href="http://example.com/surveyResultFOI#Feature1"/>
            </Feature>
          </lisr:featureOfInterest>
        </lisr:SurveyResult>
      </lis:surveyResult>
      <lis:surveyResult>
        <lisr:TargetPoint gml:id="SRT1">
          <lisr:surveyResultID>
```

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```xml
        <lisr:ID>
          <identifier>TargetP1</identifier>
        </lisr:ID>
      </lisr:surveyResultID>
      <lisr:featureOfInterest>
        <SurveyMark gml:id="sm1">
          <spatialRepresentation>
            <SpatialRepresentation>
              <geometry>
                <gml:Point gml:id="p1">
                  <gml:pos>105 230</gml:pos>
                </gml:Point>
              </geometry>
            </SpatialRepresentation>
          </spatialRepresentation>
          <identification>1001</identification>
        </SurveyMark>
      </lisr:featureOfInterest>
      <lisr:geometry>
        <gml:Point gml:id="SRTP1">
          <gml:pos>10 0 10</gml:pos>
        </gml:Point>
      </lisr:geometry>
      <lisr:isComplete>true</lisr:isComplete>
      <lisr:quality>
        <lisr:PointQuality gml:id="Q1">
          <lisr:meanError uom="m">1.123</lisr:meanError>
          <lisr:qxx>0.0000076011</lisr:qxx>
          <lisr:qxy>0.0000035428</lisr:qxy>
          <lisr:qxz>-0.0000003152</lisr:qxz>
          <lisr:qyy>0.0000016799</lisr:qyy>
          <lisr:qyz>-0.0000001474</lisr:qyz>
          <lisr:qzz>0.0000000367</lisr:qzz>
        </lisr:PointQuality>
      </lisr:quality>
    </lisr:TargetPoint>
  </lis:surveyResult>
  <lis:surveyResult>
    <lisr:TargetPoint gml:id="SRT2">
      <lisr:surveyResultID>
        <lisr:ID>
          <identifier>TargetP2</identifier>
        </lisr:ID>
      </lisr:surveyResultID>
      <lisr:featureOfInterest>
        <!--reference to a feature in the document-->
      </lisr:featureOfInterest>
      <lisr:geometry>
        <gml:Point gml:id="SRTP2">
          <gml:pos>10 10 0</gml:pos>
        </gml:Point>
      </lisr:geometry>
      <lisr:isComplete>true</lisr:isComplete>
    </lisr:TargetPoint>
  </lis:surveyResult>
  <lis:surveyResult>
```

```xml
          <lisr:String gml:id="SRS1">
            <lisr:surveyResultID>
              <lisr:ID>
                <identifier>String1</identifier>
              </lisr:ID>
            </lisr:surveyResultID>
            <lisr:featureOfInterest><!--reference to a feature in the document-->
            </lisr:featureOfInterest>
            <lisr:targetPoint xlink:href="SRT1"/>
            <lisr:targetPoint xlink:href="SRT2"/>
          </lisr:String>
        </lis:surveyResult>
        <lis:surveyResult>
          <lisr:Stakeout gml:id="SRSKT1">
            <lisr:surveyResultID>
              <lisr:ID>
                <identifier>StakeResult1</identifier>
              </lisr:ID>
            </lisr:surveyResultID>
            <lisr:diffNorthing uom="m">0.013</lisr:diffNorthing>
            <lisr:diffEasting uom="m">-0.02</lisr:diffEasting>
            <lisr:diffElevation uom="m">0.032</lisr:diffElevation>
            <lisr:targetPoint xlink:href="SRT1"/>
            <lisr:designPoint>
              <lisr:DesignPoint gml:id="SRSKT1D1">
                <lisr:geometry>
                  <gml:Point gml:id="SRSKT1D1P">
                    <gml:pos>10 10 0</gml:pos>
                  </gml:Point>
                </lisr:geometry>
                <lisr:quality>
                  <lisr:PointQuality  gml:id="Q3">
                    <lisr:meanError uom="m">1.123</lisr:meanError>
                    <lisr:qxx>0.0000076011</lisr:qxx>
                    <lisr:qxy>0.0000035428</lisr:qxy>
                    <lisr:qxz>-0.0000003152</lisr:qxz>
                    <lisr:qyy>0.0000016799</lisr:qyy>
                    <lisr:qyz>-0.0000001474</lisr:qyz>
                    <lisr:qzz>0.0000000367</lisr:qzz>
                  </lisr:PointQuality>
                </lisr:quality>
              </lisr:DesignPoint>
            </lisr:designPoint>
          </lisr:Stakeout>
        </lis:surveyResult>
        <lis:surveyResult>
          <lisr:Average gml:id="SRA1">
            <lisr:surveyResultID>
              <lisr:ID>
                <identifier>Average1</identifier>
              </lisr:ID>
            </lisr:surveyResultID>
            <lisr:averagePoint>
              <lisr:AveragePoint gml:id="SRA1P">
                <lisr:geometry>
                  <gml:Point gml:id="SRA1G">
```

```xml
                    <gml:pos>10 10 0</gml:pos>
                  </gml:Point>
                </lisr:geometry>
                <lisr:quality>
                  <lisr:PointQuality  gml:id="Q2">
                    <lisr:meanError uom="m">1.123</lisr:meanError>
                    <lisr:qxx>0.0000076011</lisr:qxx>
                    <lisr:qxy>0.0000035428</lisr:qxy>
                    <lisr:qxz>-0.0000003152</lisr:qxz>
                    <lisr:qyy>0.0000016799</lisr:qyy>
                    <lisr:qyz>-0.0000001474</lisr:qyz>
                    <lisr:qzz>0.0000000367</lisr:qzz>
                  </lisr:PointQuality>
                </lisr:quality>
                <lisr:targetPoint xlink:href="SRT1"/>
                <lisr:targetPoint xlink:href="SRT2"/>
              </lisr:AveragePoint>
            </lisr:averagePoint>
          </lisr:Average>
        </lis:surveyResult>
        <lis:surveyResult>
          <lisr:Image gml:id="SRI1">
            <lisr:surveyResultID>
              <lisr:ID>
                <identifier>Image1</identifier>
              </lisr:ID>
            </lisr:surveyResultID>
            <lisr:file>
              <lisr:File>
                <gml:rangeParameters>
                <gml:name>Image01</gml:name>
                </gml:rangeParameters>
                <gml:fileName>Image1234.jpg</gml:fileName>
                <gml:fileStructure>binary</gml:fileStructure>
              </lisr:File>
            </lisr:file>
          </lisr:Image>
        </lis:surveyResult>
        <lis:surveyResult>
          <lisr:PointCloud gml:id="SRPC1">
            <lisr:surveyResultID>
              <lisr:ID>
                <identifier>PointCloud1</identifier>
              </lisr:ID>
            </lisr:surveyResultID>
            <lisr:file>
              <lisr:File>
                <gml:rangeParameters>
                  <gml:name>PointCloud02</gml:name>
                </gml:rangeParameters>
                <gml:fileName>PointCloud2345.las</gml:fileName>
                <gml:fileStructure>ASCII</gml:fileStructure>
              </lisr:File>
            </lisr:file>
          </lisr:PointCloud>
        </lis:surveyResult>
```

```
        </lis:Survey>
      </abstractData>
   </LandInfraDataset>
```

B. 6   Sampling

```xml
<?xml version="1.0" encoding="UTF-8"?>
<LandInfraDataset xmlns="http://www.opengis.net/infragml/core/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lis="http://www.opengis.net/infragml/survey/1.0"
xmlns:liso="http://www.opengis.net/infragml/observations/1.0"
xmlns:liss="http://www.opengis.net/infragml/sampling/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/infragml/sampling/1.0 Part6Sampling0410.xsd" >
  <datasetID>
    <ID>
      <identifier>DS6</identifier>
      <scope>OGC LandInfraSWG</scope>
    </ID>
  </datasetID>
  <dateTime>2016-08-24T10:00:00</dateTime>
  <datasetVersion/>
  <application/>
  <author/>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <feature>
    <SurveyMark gml:id="sm1">
      <spatialRepresentation>
        <SpatialRepresentation>
          <geometry>
            <gml:Point gml:id="p1">
              <gml:pos>105 230</gml:pos>
            </gml:Point>
          </geometry>
        </SpatialRepresentation>
      </spatialRepresentation>
      <identification>1001</identification>
    </SurveyMark>
  </feature>
  <abstractData>
    <lis:Survey gml:id="S1">
      <lis:surveyID>
        <lis:ID>
          <identifier>Survey1</identifier>
        </lis:ID>
      </lis:surveyID>
      <lis:purposeOfSurvey>String</lis:purposeOfSurvey>
      <lis:type  xlink:href="http://example.com/surveyType#surveyed"  xlink:title="Surveyed"/>
      <lis:setup>
        <liso:Setup gml:id="SET1">
          <gml:description>sample survey observation definition required content all possible
            observations</gml:description>
          <liso:instrumentHeight uom="m">1.50</liso:instrumentHeight>
          <liso:validTime>
            <gml:TimePeriod gml:id="SET1T1">
```

```xml
            <gml:beginPosition>2016-08-24T09:00:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:30:00</gml:endPosition>
          </gml:TimePeriod>
      </liso:validTime>
      <liso:observations>
        <liso:Observations>
          <liso:surveyObservation>
            <liso:SurveyObservation gml:id="SO1">
              <gml:validTime>
                <gml:TimePeriod gml:id="SO1TP1">
                  <gml:beginPosition>2016-08-24T09:01:00</gml:beginPosition>
                  <gml:endPosition>2016-08-24T09:01:05</gml:endPosition>
                </gml:TimePeriod>
              </gml:validTime>
              <gml:using>
                <Feature gml:id="SP1">
                  <gml:description>Standard process for SO1</gml:description>
                </Feature>
              </gml:using>
              <gml:target>
                <SurveyMark gml:id="sm2">
                  <spatialRepresentation>
                    <SpatialRepresentation>
                      <geometry>
                        <gml:Point gml:id="p2">
                          <gml:pos>105 230</gml:pos>
                        </gml:Point>
                      </geometry>
                    </SpatialRepresentation>
                  </spatialRepresentation>
                  <identification>1001</identification>
                </SurveyMark>
              </gml:target>
              <gml:resultOf>
                <gml:description>Result of SO1</gml:description>
              </gml:resultOf>
              <liso:resultTime>
                <gml:TimeInstant gml:id="SO1RT1">
                  <gml:timePosition>2016-08-24T09:01:04</gml:timePosition>
                </gml:TimeInstant>
              </liso:resultTime>
              <liso:type  xlink:href="http://example.com/observationType#calculated"
                  xlink:title="Calculated"/>
              <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
            </liso:SurveyObservation>
          </liso:surveyObservation>
          <liso:surveyObservation>
            <liso:AngularObservation gml:id="AO1">
              <gml:validTime>
                <gml:TimePeriod gml:id="AO1TP1">
                  <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                  <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
                </gml:TimePeriod>
              </gml:validTime>
              <gml:resultOf>
                <gml:Point gml:id="AO1POS1">
```

```xml
      <gml:pos>50 0 0</gml:pos>
    </gml:Point>
  </gml:resultOf>
  <liso:resultTime>
    <gml:TimeInstant gml:id="AO1RT1">
      <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
    </gml:TimeInstant>
  </liso:resultTime>
  <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
  <liso:angle uom="deg">123.45</liso:angle>
    </liso:AngularObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:DistanceObservation gml:id="DO1">
      <gml:validTime>
        <gml:TimePeriod gml:id="DO1TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="DO1POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="DO1RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:distance uom="meter">12.345</liso:distance>
    </liso:DistanceObservation>
  </liso:surveyObservation>
  <liso:surveyObservation>
    <liso:TpsObservation gml:id="TO1">
      <gml:validTime>
        <gml:TimePeriod gml:id="TO1TP1">
          <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
          <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <gml:resultOf>
        <gml:Point gml:id="TO1POS1">
          <gml:pos>50 0 0</gml:pos>
        </gml:Point>
      </gml:resultOf>
      <liso:resultTime>
        <gml:TimeInstant gml:id="TO1RT1">
          <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
        </gml:TimeInstant>
      </liso:resultTime>
      <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
      <liso:reflectorHeight uom="m">1.65</liso:reflectorHeight>
      <liso:directFace>true</liso:directFace>
      <liso:meanFace>false</liso:meanFace>
```

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```xml
          <liso:horizontalAngle uom="deg">254.123</liso:horizontalAngle>
          <liso:verticalAngle uom="deg">89.523</liso:verticalAngle>
        </liso:TpsObservation>
    </liso:surveyObservation>
    <liso:surveyObservation>
      <liso:LevelObservation gml:id="LO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="LO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <gml:resultOf>
          <gml:Point gml:id="LO1POS1">
              <gml:pos>50 0 0</gml:pos>
            </gml:Point>
        </gml:resultOf>
        <liso:resultTime>
          <gml:TimeInstant gml:id="LO1RT1">
            <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
          </gml:TimeInstant>
        </liso:resultTime>
        <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
        <liso:deltaHeight uom="m">1.123</liso:deltaHeight>
      </liso:LevelObservation>
    </liso:surveyObservation>
    <liso:surveyObservation>
      <liso:GnssObservation gml:id="GO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="GO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <gml:resultOf>
          <gml:Point gml:id="GO1POS1">
              <gml:pos>50 0 0</gml:pos>
            </gml:Point>
        </gml:resultOf>
        <liso:resultTime>
          <gml:TimeInstant gml:id="GO1RT1">
            <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
          </gml:TimeInstant>
        </liso:resultTime>
        <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
        <liso:antennaHeight uom="m">2.000</liso:antennaHeight>
      </liso:GnssObservation>
    </liso:surveyObservation>
    <liso:surveyObservation>
      <liso:ImageObservation gml:id="IO1">
        <gml:validTime>
          <gml:TimePeriod gml:id="IO1TP1">
            <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
            <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
```

```xml
              <gml:resultOf>
                <gml:File>
                  <gml:rangeParameters>
                    <gml:name>Image01</gml:name>
                  </gml:rangeParameters>
                  <gml:fileName>Image1234.jpg</gml:fileName>
                  <gml:fileStructure>binary</gml:fileStructure>
                </gml:File>
              </gml:resultOf>
              <liso:resultTime>
                <gml:TimeInstant gml:id="IO1RT1">
                  <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
                </gml:TimeInstant>
              </liso:resultTime>
              <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
            </liso:ImageObservation>
          </liso:surveyObservation>
          <liso:surveyObservation>
          <liso:PointCloudObservation gml:id="PO1">
            <gml:validTime>
              <gml:TimePeriod gml:id="PO1TP1">
                <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
              </gml:TimePeriod>
            </gml:validTime>
            <gml:resultOf>
              <gml:File>
                <gml:rangeParameters/>
                <gml:fileName>PointCloud1234.las</gml:fileName>
                <gml:fileStructure>ASCII</gml:fileStructure>
              </gml:File>
            </gml:resultOf>
            <liso:resultTime>
              <gml:TimeInstant gml:id="PO1RT1">
                <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
              </gml:TimeInstant>
            </liso:resultTime>
            <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
          </liso:PointCloudObservation>
        </liso:surveyObservation>
      </liso:Observations>
    </liso:observations>
    <liso:setupObservations>
      <liso:SetupObservations>
        <liso:setupObservation>
          <liso:SurveyObservation gml:id="SETO1">
            <gml:validTime>
              <gml:TimePeriod gml:id="SETO1TP1">
                <gml:beginPosition>2016-08-24T09:01:00</gml:beginPosition>
                <gml:endPosition>2016-08-24T09:01:05</gml:endPosition>
              </gml:TimePeriod>
            </gml:validTime>
            <gml:resultOf>
              <gml:Point gml:id="SETO1POS1">
                <gml:pos>0 50 0</gml:pos>
              </gml:Point>
```

```xml
            </gml:resultOf>
            <liso:resultTime>
              <gml:TimeInstant gml:id="SETO1RT1">
                <gml:timePosition>2016-08-24T09:01:04</gml:timePosition>
              </gml:TimeInstant>
            </liso:resultTime>
            <liso:type  xlink:href="http://example.com/observationType#calculated"
              xlink:title="Calculated"/>
            <liso:bInstrumentPoint>false</liso:bInstrumentPoint>
          </liso:SurveyObservation>
        </liso:setupObservation>
        <liso:setupObservation>
          <liso:DistanceObservation gml:id="SDO1">
            <gml:validTime>
              <gml:TimePeriod gml:id="SDO1TP1">
                <gml:beginPosition>2016-08-24T09:05:00</gml:beginPosition>
                <gml:endPosition>2016-08-24T09:05:05</gml:endPosition>
              </gml:TimePeriod>
            </gml:validTime>
            <gml:resultOf>
              <gml:Point gml:id="SDO1POS1">
                <gml:pos>50 0 0</gml:pos>
              </gml:Point>
            </gml:resultOf>
            <liso:resultTime>
              <gml:TimeInstant gml:id="SDO1RT1">
                <gml:timePosition>2016-08-24T09:05:04</gml:timePosition>
              </gml:TimeInstant>
            </liso:resultTime>
            <liso:bInstrumentPoint>true</liso:bInstrumentPoint>
            <liso:distance uom="meter">12.345</liso:distance>
          </liso:DistanceObservation>
        </liso:setupObservation>
      </liso:SetupObservations>
    </liso:setupObservations>
  </liso:Setup>
</lis:setup>
<lis:sampling>
  <liss:SamplingFeature gml:id="SAM1">
    <liss:sampledFeature xlink:href="sm2"/>
    <liss:relatedObservation xlink:href="TO1"/>
    <liss:relatedObservation xlink:href="TO2"/>
  </liss:SamplingFeature>
</lis:sampling>
<lis:sampling>
  <liss:SamplingFeature gml:id="SAM2">
    <liss:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-
      OM/2.0#Sampling Point"  xlink:title="Sampling Point"/>
    <liss:sampledFeature xlink:href="sm2"/>
    <liss:relatedObservation xlink:href="TO1"/>
    <liss:relatedObservation xlink:href="TO2"/>
    <liss:relatedSamplingFeature>
      <liss:SamplingFeatureComplex xsi:type="liss:SamplingFeatureComplexType">
        <liss:role  xlink:href="http://my.survey.custodian.org/roles"
          xlink:title="Sampling Role"/>
        <liss:relatedSamplingFeature
```

```
                    xlink:href="http://my.survey.custodian.org/projects/2017/pr1" xlink:title="PR1"/>
                </liss:SamplingFeatureComplex>
              </liss:relatedSamplingFeature>
            </liss:SamplingFeature>
          </lis:sampling>
        </lis:Survey>
      </abstractData>
    </LandInfraDataset>
```

Annex C: Revision history

Date	Release	Author	Paragraph modified	Description
20170321	1.0r1	Hans-Christoph Gruler	Figures 2 and 3	RC dependency changes in Part 6
20170321	1.0r1	Hans-Christoph Gruler	7.1.3	Add chapter GML & OM Observations
20170321	1.0r1	Hans-Christoph Gruler	7.3.1 & 7.4.1 & 7.5.1	Minor editoral changes
20170321	1.0r1	Hans-Christoph Gruler	7.5.1 & 7.6	Move Sampling out of SurveyResults into new RC
20170410	1.0r2	Paul Scarponcini	Annex B	Fixed GML striping

Annex D: Bibliography

[1] OGC: OGC 08-131r3 The Specification Model — A Standard for Modular specifications, Open Geospatial Consortium, 2009