IMKL Update 3.0
Workshop 2

14/05/2024

Practical arrangements

Sound of audience is **muted** by default

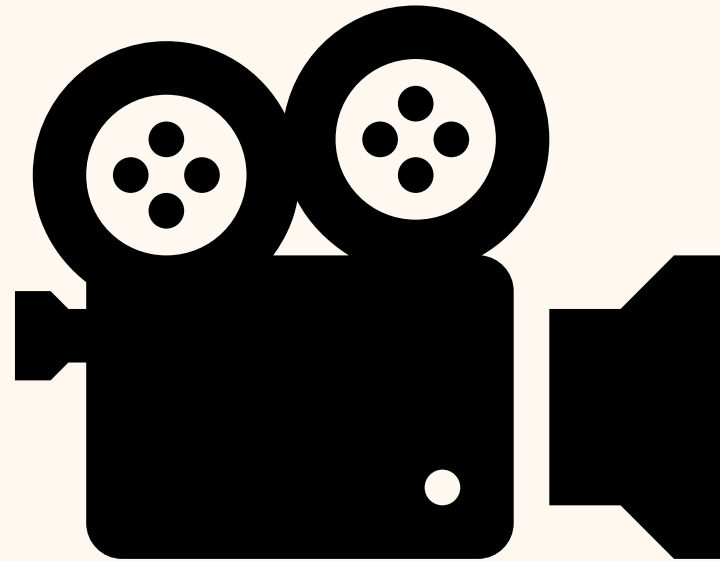Use the **hand** icon if you want to say something. Collaboration is greatly appreciated!

Questions, comments and suggestions can be shared via the chat function. Interaction is encouraged!

Leading language will be **English,** questions can be asked in mother tongue (NL/FR)

Recording?

Agenda

- Introduction: From a semantic model to implementation

- Geometry representation in IMKL 3:
    - Geometry for UtilityNode and UtilityNodeContainer (Point geometry)
    - Geometry for UtilityLinkSet and UtilityLink (Line geometry)
    - Relative depth and TAW/DNG level
    - Standard vertical position
    - 2.5D
    - UtilityLinkSequences
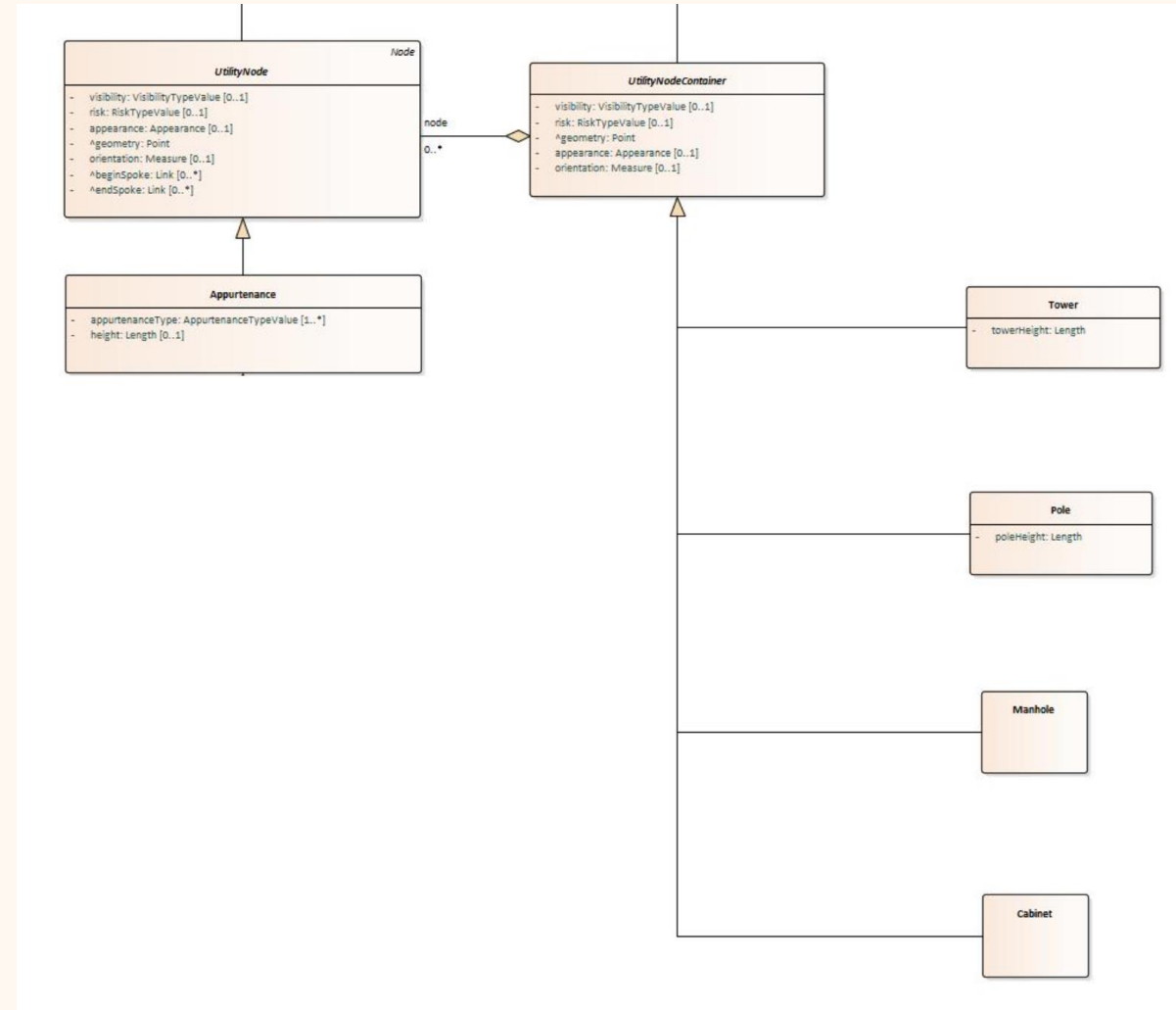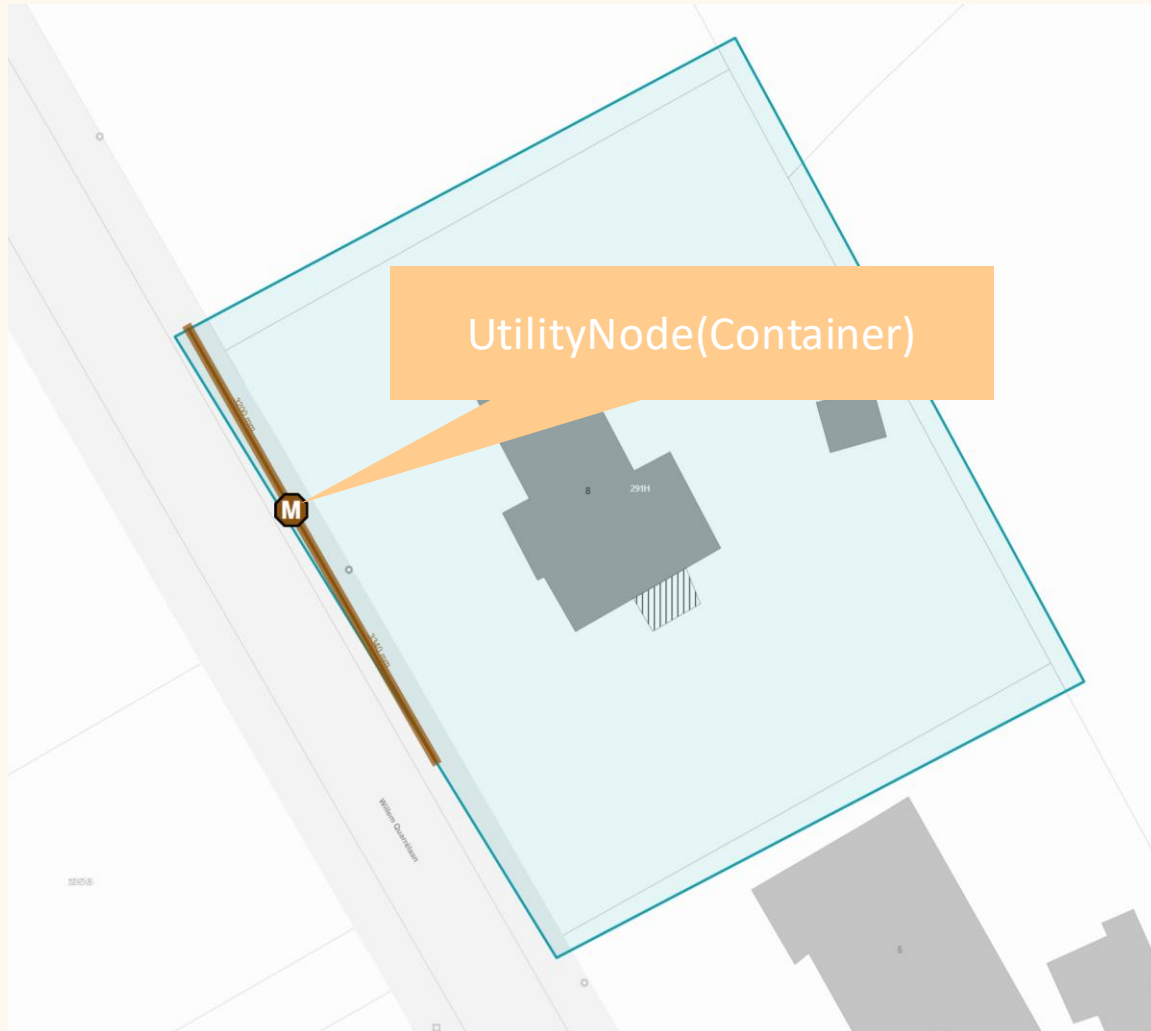   - Multi curves for UtilityLinks

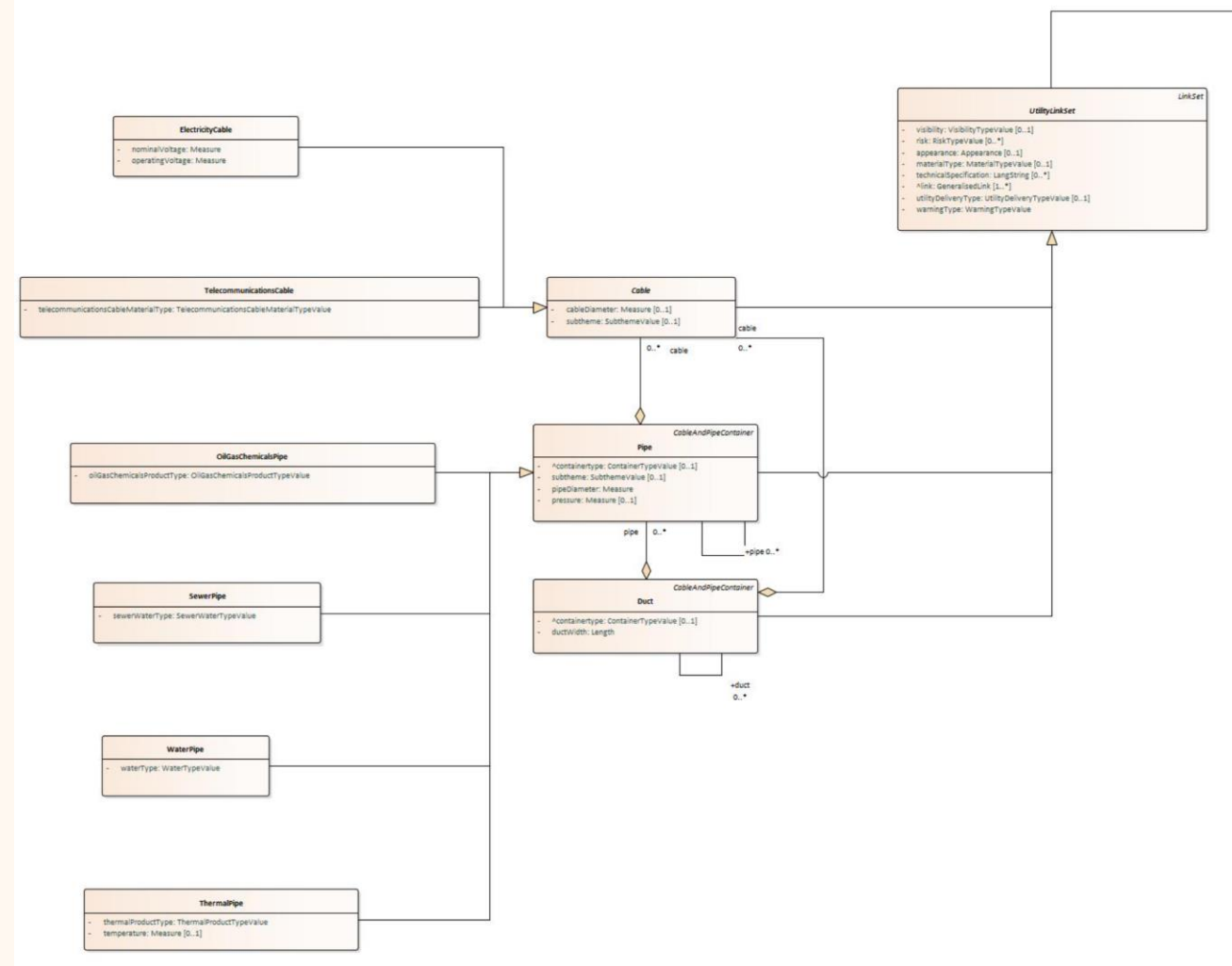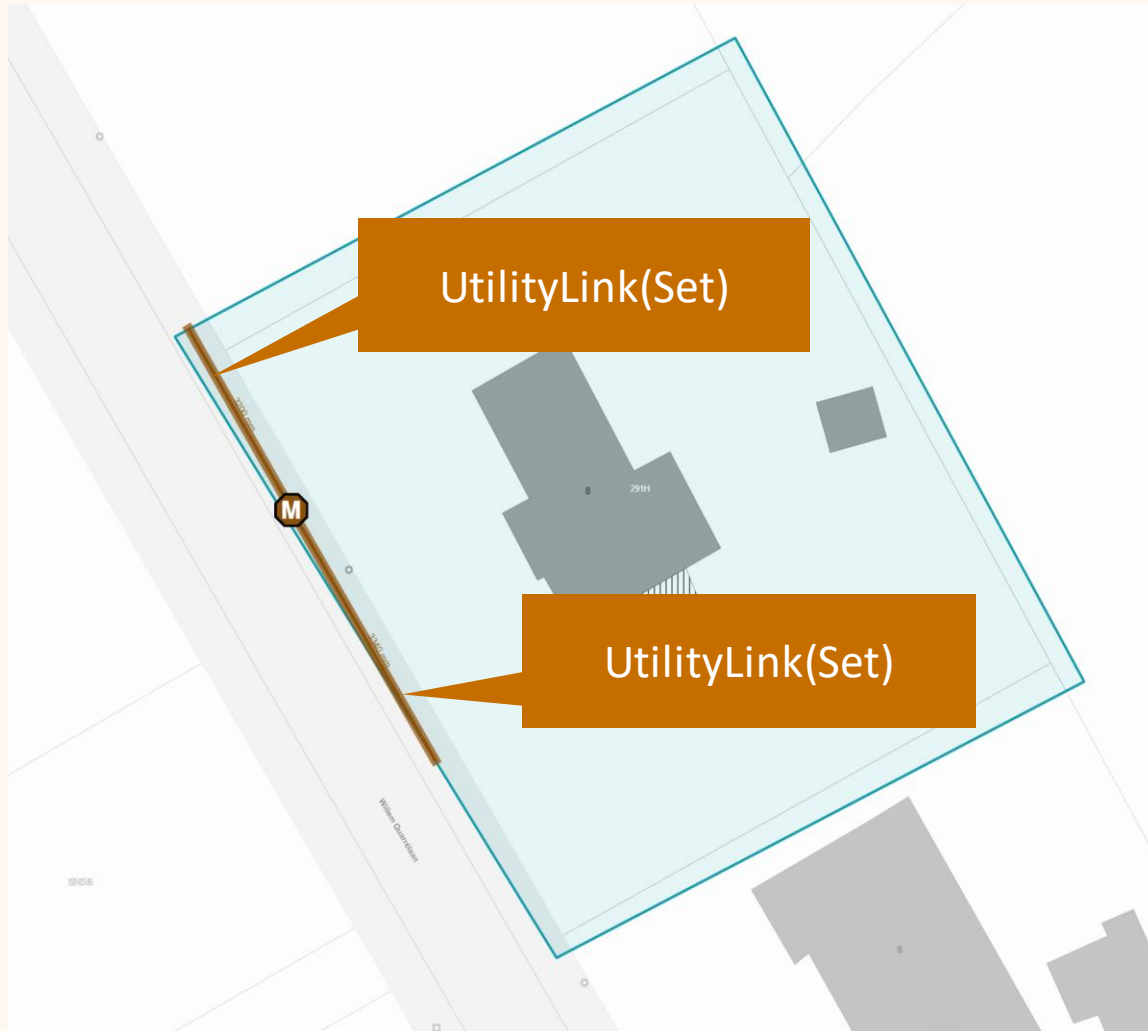- Next steps

Introduction

Utility Network
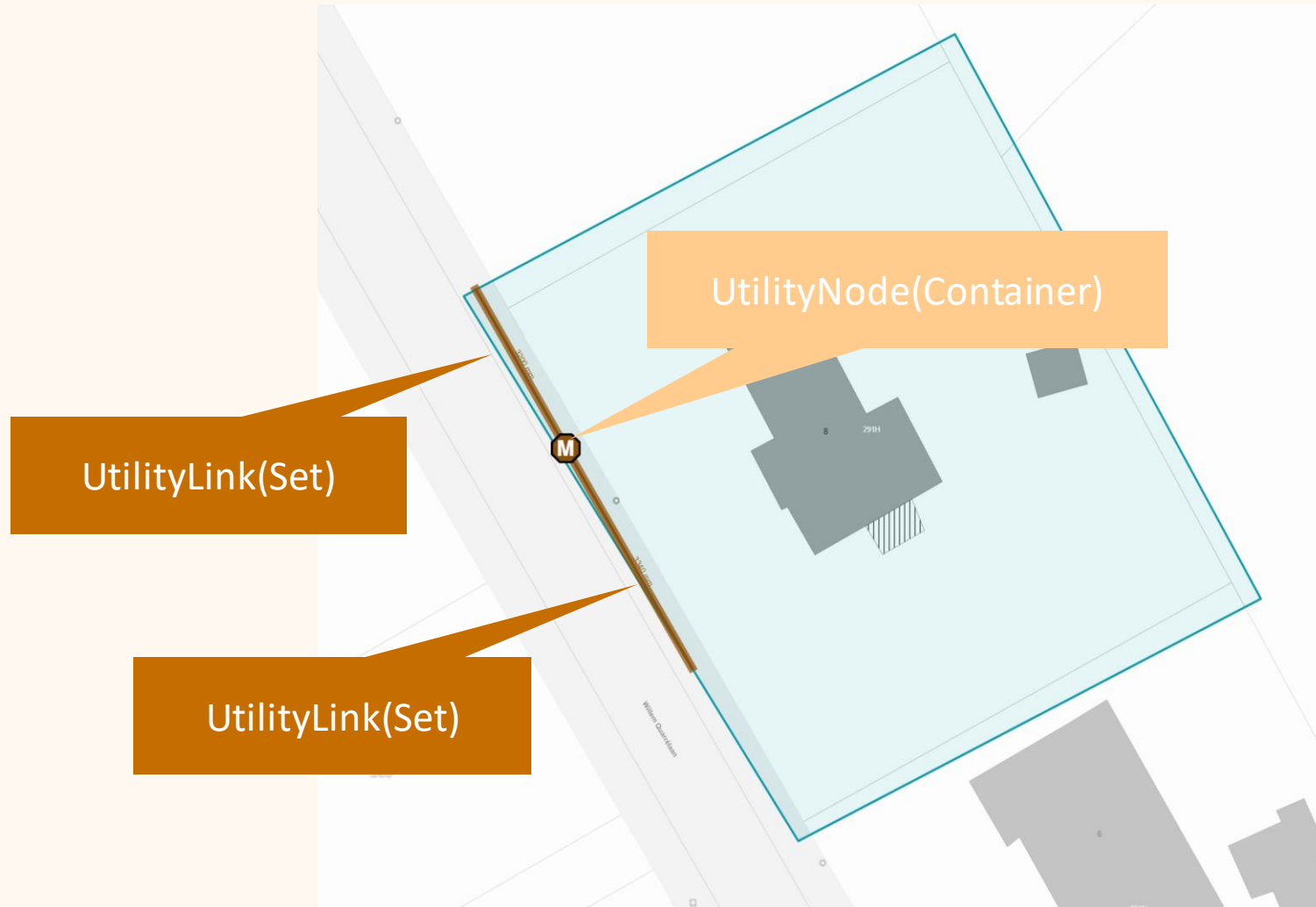
Utility Network

UtilityNode(Container)

Utility Network

UtilityLink(Set)

From a semantic model to implementation

The IMKL 3 data model describes the **what:**

- What are the entities, their properties and relationships that are relevant for IMKL?

- It ensures a shared agreement on the definitions of these concepts (e.g. Manhole, Mangat, Troud'Homme)

The implementation describes the **how**:

- How is the information exchanged between the operator, the platform and the map requestor?

- The goal is to exhange information in a structured and machine readable way

- The exchange format for IMKL is XML

XML

Key concepts

```
<?xml version="1.0"?>
```
Header

```
<bookstore>
```
Root element

```
    <book>
```
Opening tag
Child element

```
        <title lang="en">The Hobbit</title>
        <author>J.R.R. Tolkien</author>
        <year>1937</year>
        <price>39.95</price>
    </book>
```
Closing tag

```
    <book>
        <title lang="en">The Fellowship of the Ring</title>
```
Attribute
Value

```
        <author>J.R.R. Tolkien</author>
        <year>1954</year>
        <price>39.95</price>
    </book>
</bookstore>
```

XSD

XML

```xml
<?xml version="1.0" encoding="UTF-8"?>
<bookstore>
  <book>
    <title lang="en">The Hobbit</title>
    <author>J.R.R. Tolkien</author>
    <year>1937</year>
    <price>39.95</price>
  </book>
  <book>
    <title lang="en">The Fellowship of the Ring</title>
    <author>J.R.R. Tolkien</author>
    <year>1954</year>
    <price>39.95</price>
  </book>
</bookstore>
```
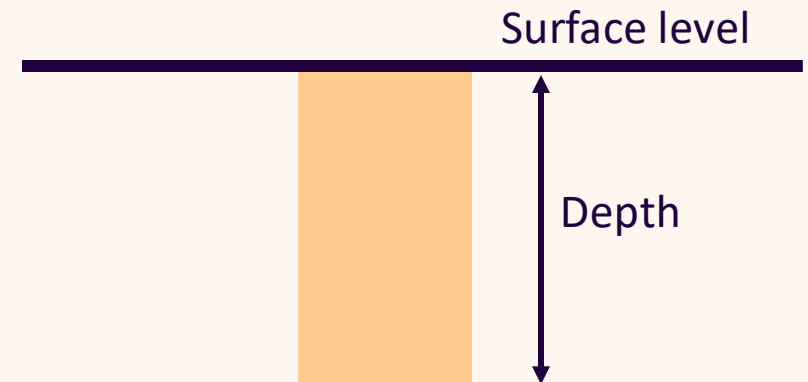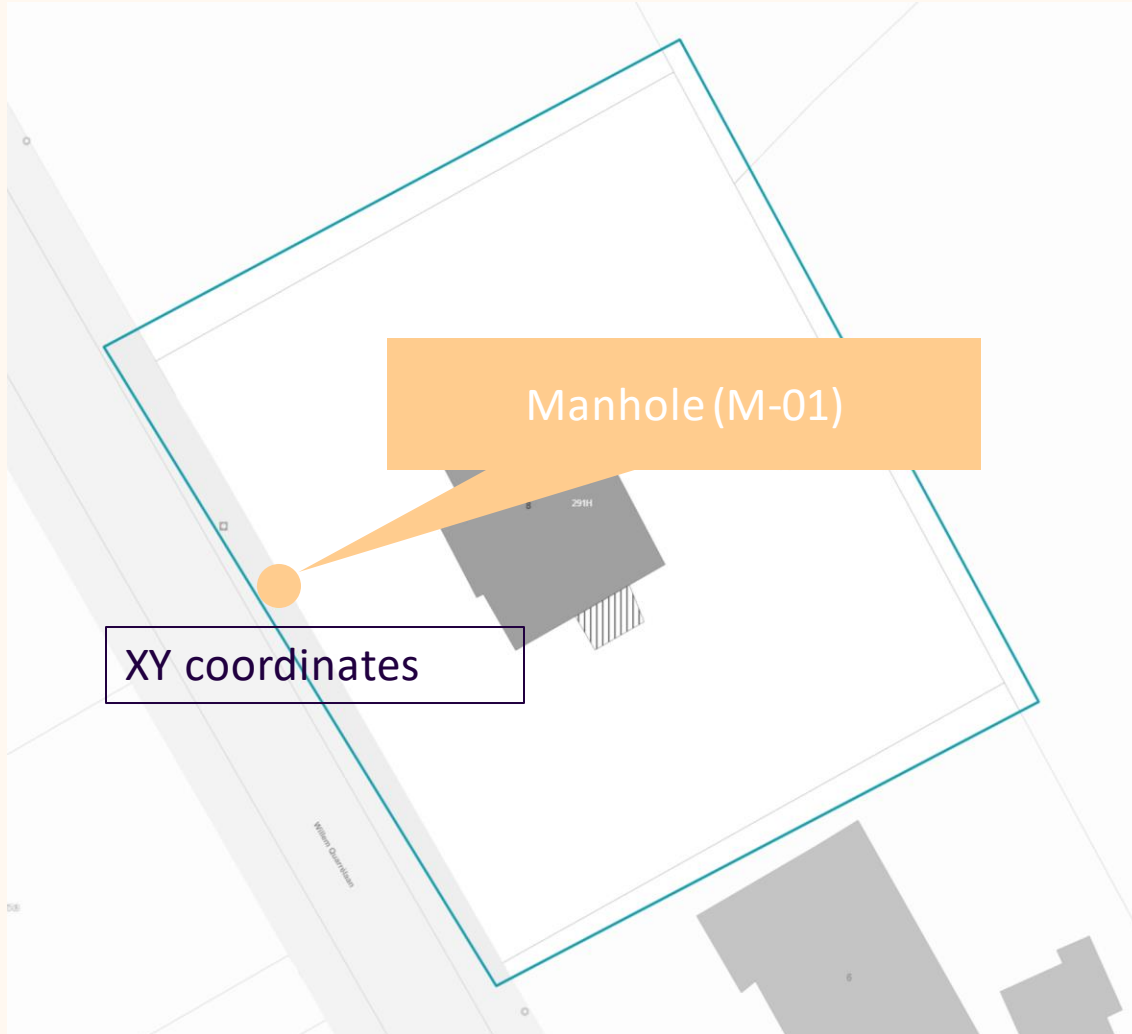
An XSD specifies the structure and rules for validating XML documents.

XSD

```xml
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="bookstore">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="book" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="title" type="xs:string" />
              <xs:element name="author" type="xs:string" />
              <xs:element name="year" type="xs:integer" />
              <xs:element name="price" type="xs:decimal" />
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

UtilityNode & UtilityNodeContainer

Example - Manhole

Manhole (M-01)

XY coordinates

Surface level

Depth

Example - Manhole

Manhole (M-01)

XY coordinates

```
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:localId>
        <base:namespace>Demo</base:namespace>
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
  </imkl:manhole>
</imkl:featureMember>
```
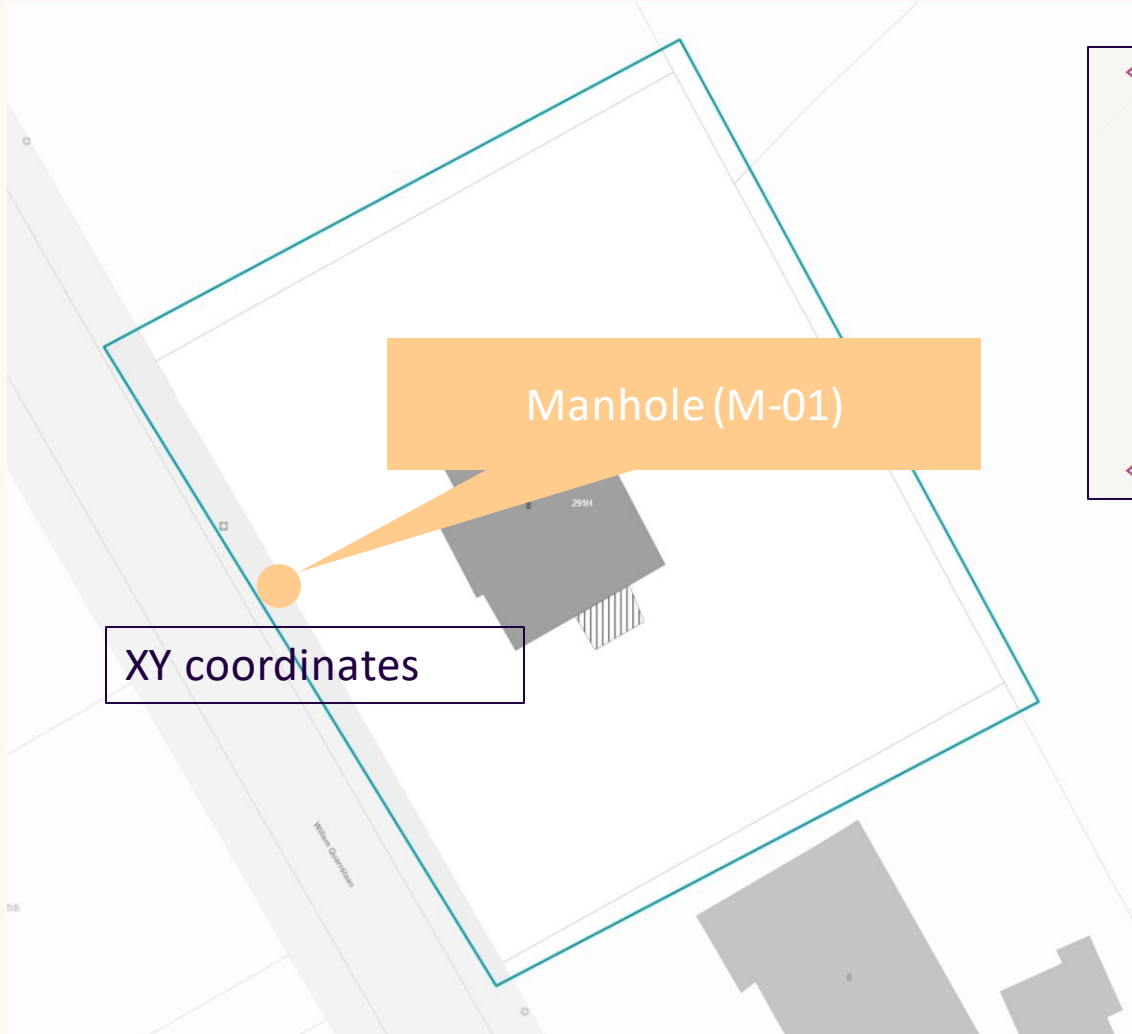
Example - Manhole

verticalPosition

The verticalPosition gives a general indication of the vertical position of the element.

It is a codelist with the following options:
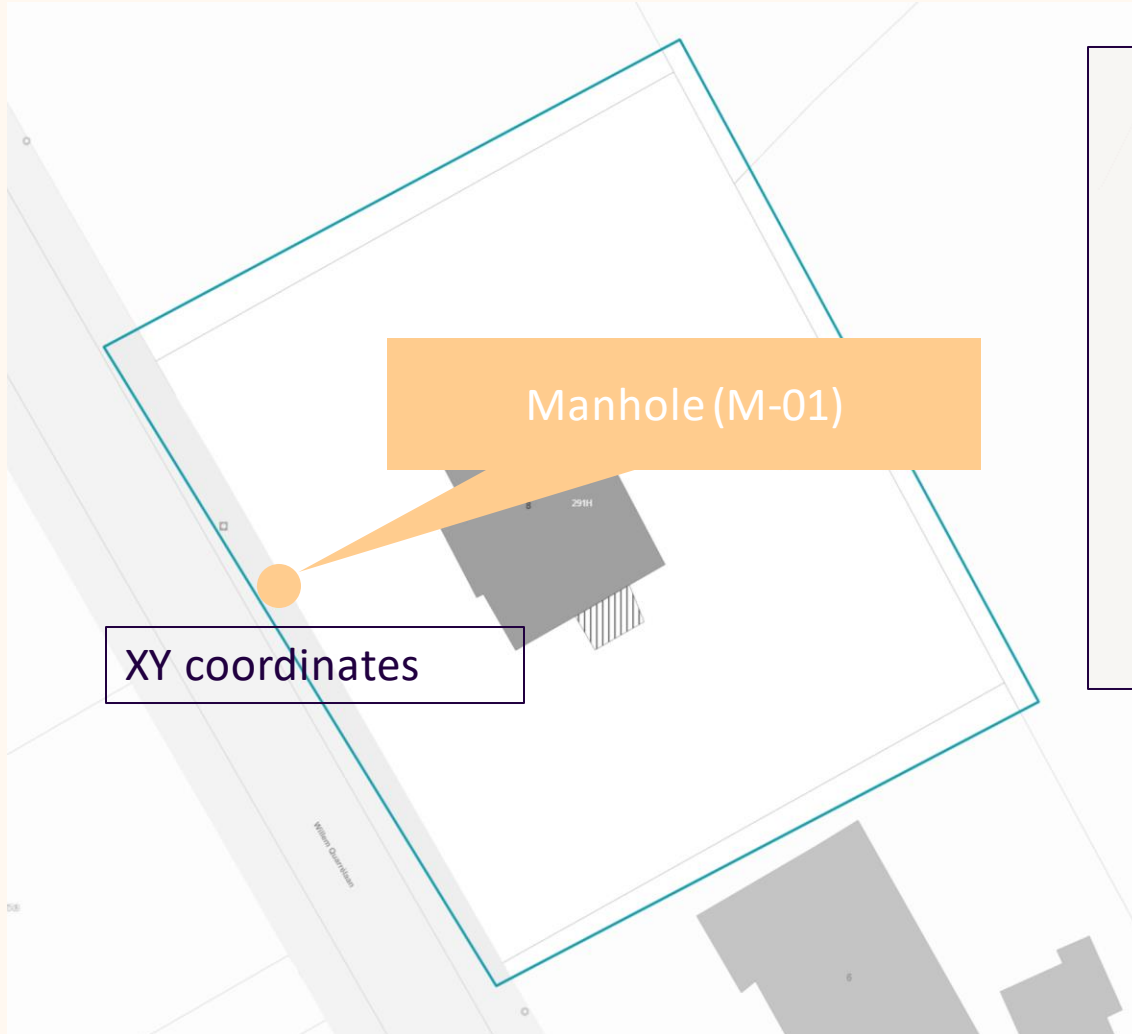
- **onGroundSurface:** The object is on ground level
- **suspendedOrElevated:** The object is suspended or elevated
- **underground:** The object is underground

Source: https://inspire.ec.europa.eu/enumeration/VerticalPositionValue

Example - Manhole

XY Coordinates

Manhole (M-01)

XY coordinates

Lambert 2008

```
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:localId>
        <base:namespace>Demo</base:namespace>
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
      <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
        <gml:pos>103674.885 192127.454</gml:pos>
      </gml:Point>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
  </imkl:manhole>
</imkl:featureMember>
```
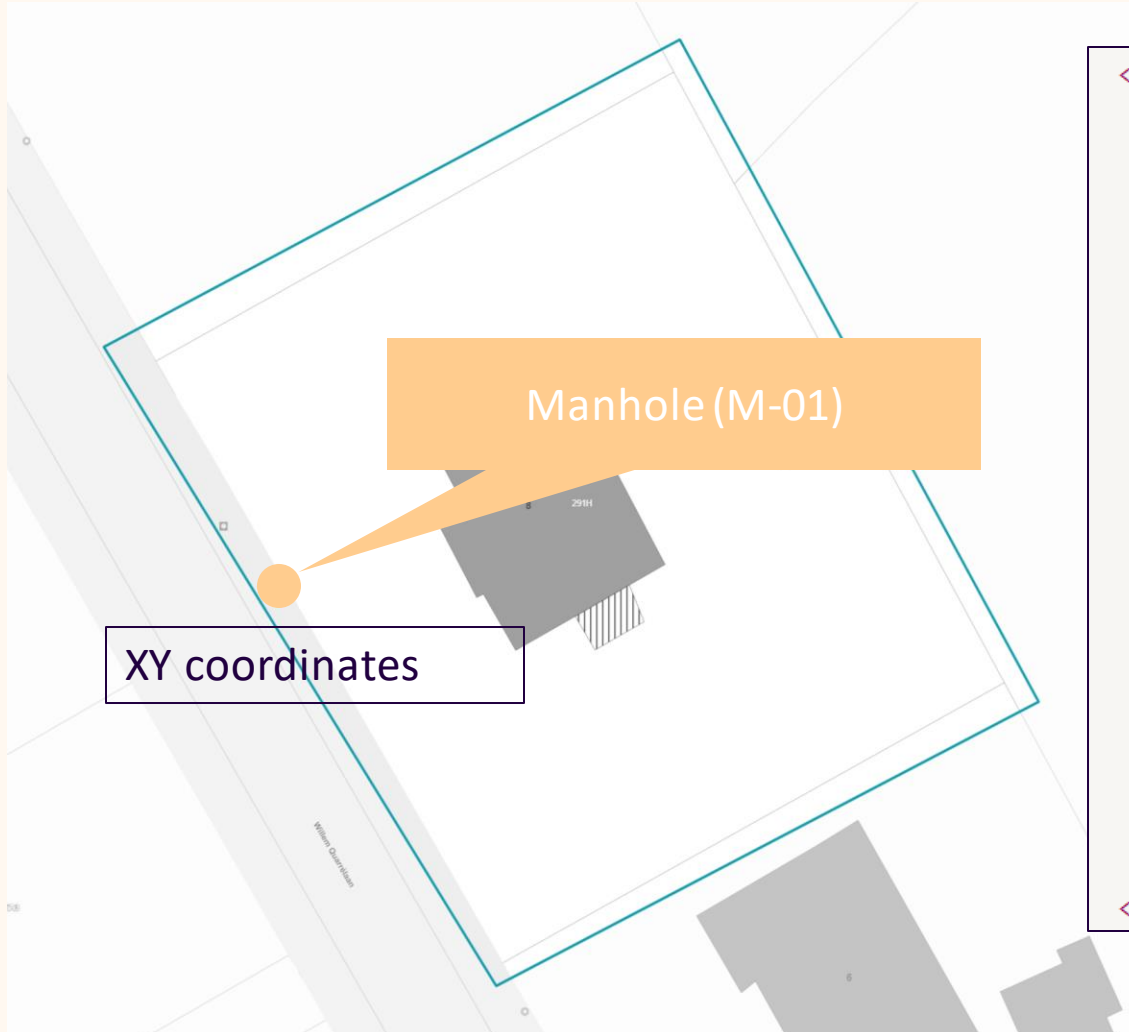
Example - Manhole

Survey


```
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
        <base:Identifier>
            <base:localId>M-01</base:localId>
            <base:namespace>Demo</base:namespace>
        </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
        <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
            <gml:pos>103674.885 192127.454</gml:pos>
        </gml:Point>
        <imkl:survey>
            <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
            <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
            <imkl:date>2024-01-01T12:00:00</imkl:date>
            <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
        </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
  </imkl:manhole>
</imkl:featureMember>
```

Manhole (M-01)

XY coordinates

Survey

It describes the way the geometry was determined.

recordedBy (Optional):

Agent who carried out the survey
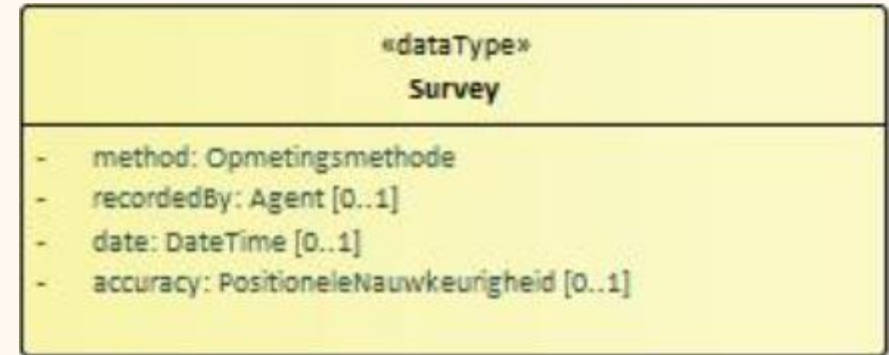
date (Optional):

The moment at which the survey took place

method (Mandatory):

Codelist describing the survey method
e.g. digitized plan, total station, GPS

Contents of the codelist to be discussed in next workshop.

Mandatory, but *nilReason* possible.

«dataType»
Survey

- method: Opmetingsmethode
- recordedBy: Agent [0..1]
- date: DateTime [0..1]
- accuracy: PositioneleNauwkeurigheid [0..1]

NilReason

```
<imkl:method nilReason="missing" xsi:nil="true" />
```

Explanation for a void value.

It is a codelist with the following options:

- **inapplicable:** There is no value
- **missing:** The correct value is not readily available, however a correct value probably exists
- **unknown:** The correct value is not known
- **withheld:** The value is not divulged
- **template:** The value will be available later

Survey

It describes the way the geometry was determined.

accuracy (Mandatory):

Describes the positional accuracy of the survey
e.g. 30cm, 50cm, 100cm

Mandatory, but *nilReason* possible.

More flexibility compared to IMKL 2.3:

```
«dataType»
Survey

-   method: Opmetingsmethode
-   recordedBy: Agent [0..1]
-   date: DateTime [0..1]
-   accuracy: PositioneleNauwkeurigheid [0..1]
```

IMKL 3:
```
<imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
```

IMKL 2.3:
```
<imkl:liggingNauwkeurigheid xlink:href="http://mir.agiv.be/cl/IMKL/v2/NauwkeurigheidValue/tot30cm" />
```

Should we limit the uom (unit of measure) to a fixed unit (e.g. always cm)?
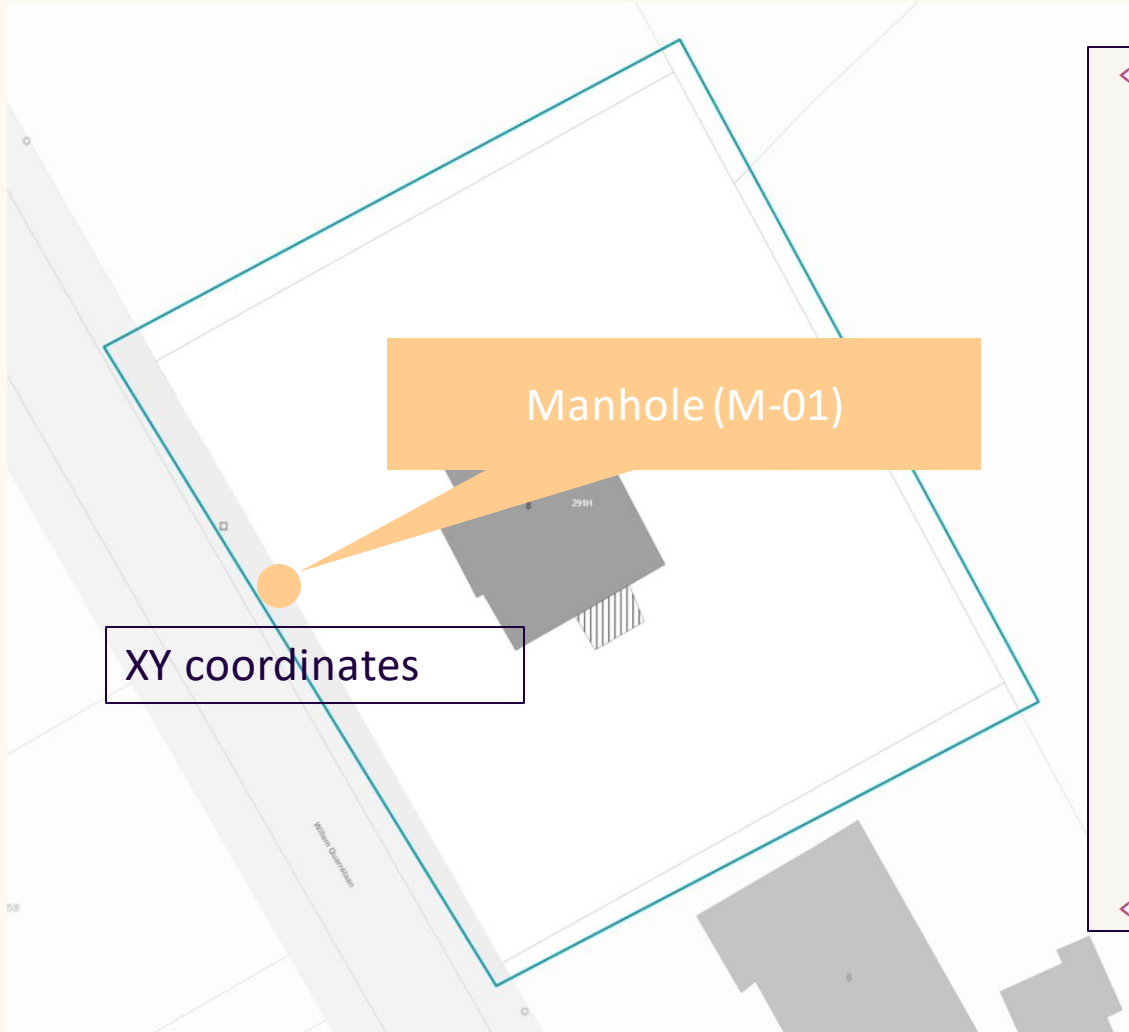
Survey

Survey in IMKL 3 replaces the following concepts of IMKL 2.3:

- Elements:
    - liggingNauwkeurigheid
- RelatieveDiepte:
    - diepteNauwkeurigheid
    - datumOpmetingDieptePeil
- TAWDiepte:
    - diepteNauwkeurigheid
    - datumOpmetingDieptePeil
    - datumOpmetingMaaiveldPeil

Example - Manhole

Survey

Manhole (M-01)

XY coordinates

```xml
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:loc...
        <base:namespace>Demo</base:n...
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
      <gml:Point srsName="http://spati...erence.org/ref/epsg/3812/" srsDimension="2">
        <gml:pos>103674.885 192127...04</gml:pos>
      </gml:Point>
      <imkl:survey>
        <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
        <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
        <imkl:date>2024-01-01T12:00:00</imkl:date>
        <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
      </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
  </imkl:manhole>
</imkl:featureMember>
```
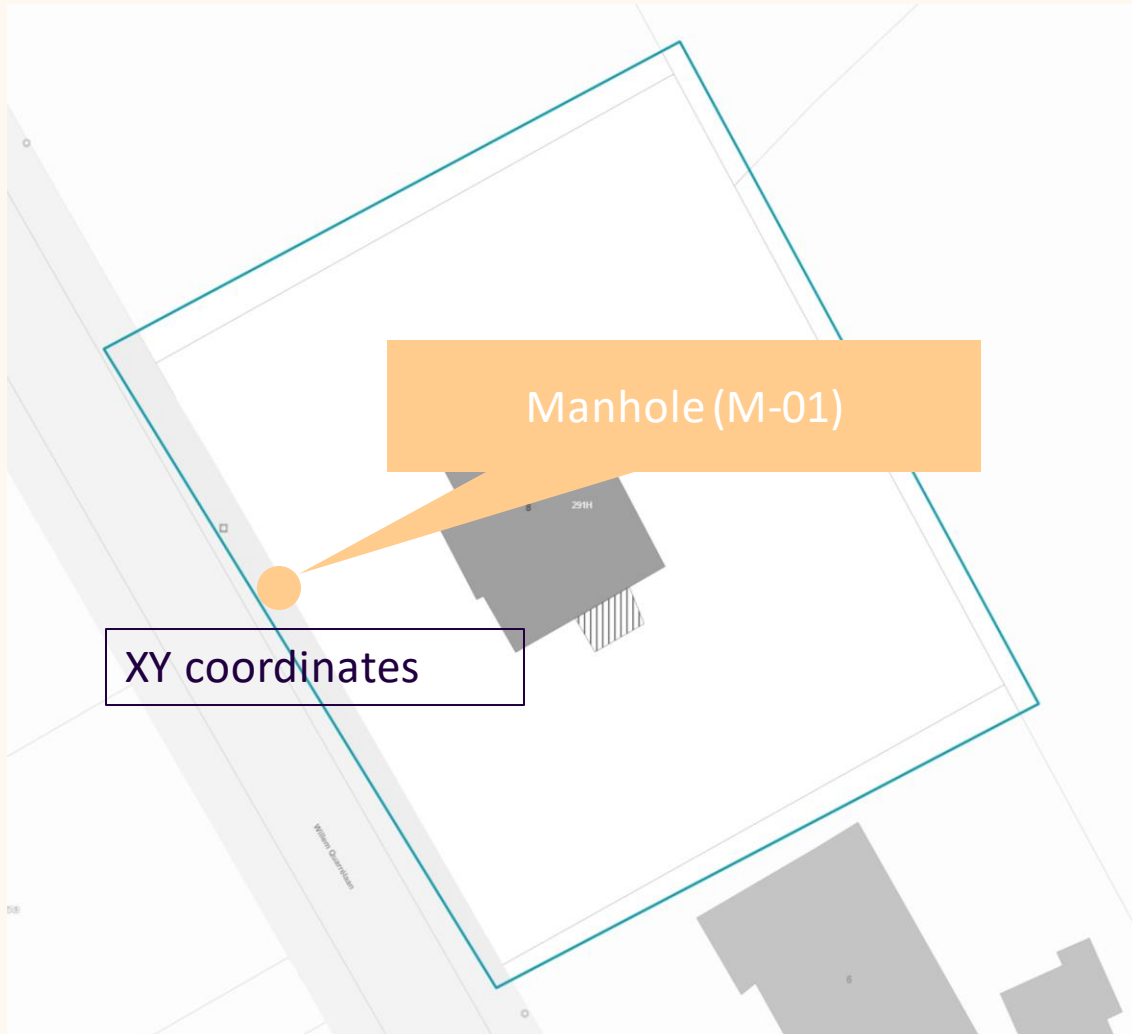
This survey is only applicable to the XY coordinates of this manhole

Example - Manhole

Relative depth – TAW/DNG Level

Manhole (M-01)

XY coordinates

Surface level

Depth

TAW/DNG Level

TAW 0 / DNG 0

TAW: Tweede Algemene Waterpassing
DNG: Deuxième nivellement général

Example - Manhole

Relative depth

Surface level

Depth

```xml
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:localId>
        <base:namespace>Demo</base:namespace>
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
      <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
        <gml:pos>103674.885 192127.454</gml:pos>
      </gml:Point>
      <imkl:survey>
        <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
        <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
        <imkl:date>2024-01-01T12:00:00</imkl:date>
        <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
      </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
    <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
  </imkl:manhole>
</imkl:featureMember>
```
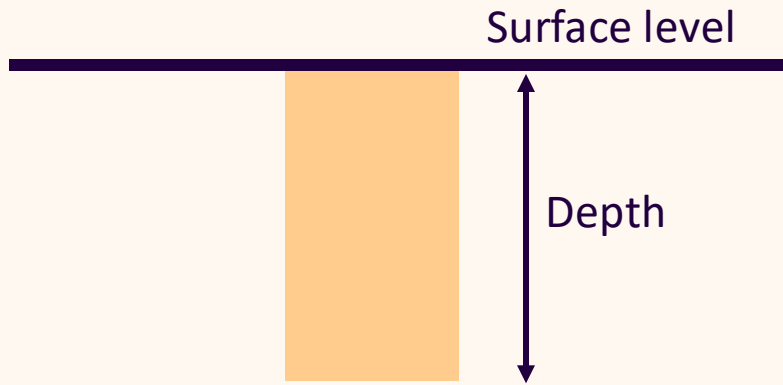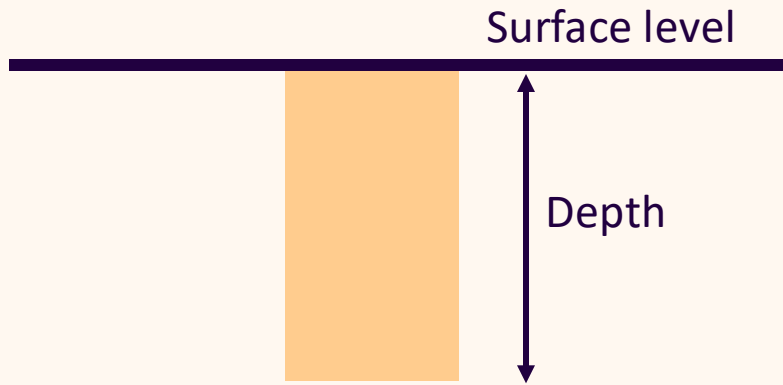
Example - Manhole

Relative depth

Surface level

Depth

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">1</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:M-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```

Depth: For elements with a *point* geometry the depth is the lowest point of the element (below the surface level).

Should we limit the uom (unit of measure) to a fixed unit (e.g. always cm)?

Example - Manhole

Relative depth

Surface level

Depth

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">1</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:M-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
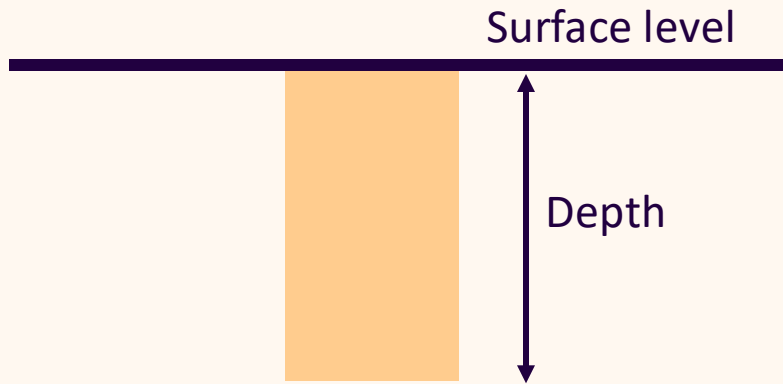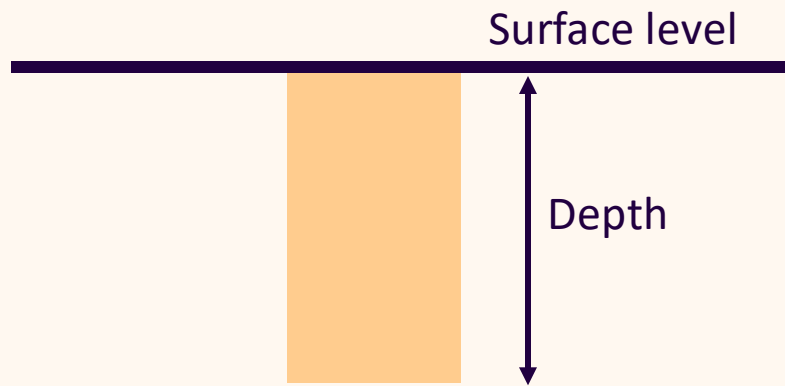
Within the *verticalPositionDetail* element the *referenceSurface* is mandatory.

When using the *relative depth* option the referenceSurface should only contain a type element with value SurfaceLevel.

Example - Manhole

Relative depth

Note:

The possibility to add a *survey* for the depth information is not yet included in the IMKL 3 semantic model.

To be **discussed** with Digitaal Vlaanderen.

In IMKL 2.3 this was possible via *diepteNauwkeurigheid* and *datumOpmetingDieptePeil*.

Example – Tower/Pole

Tower (T-01)

XY coordinates

Height

Surface level

Depth

Example – Tower/Pole

Height

Surface level

Depth

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">5</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:T-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
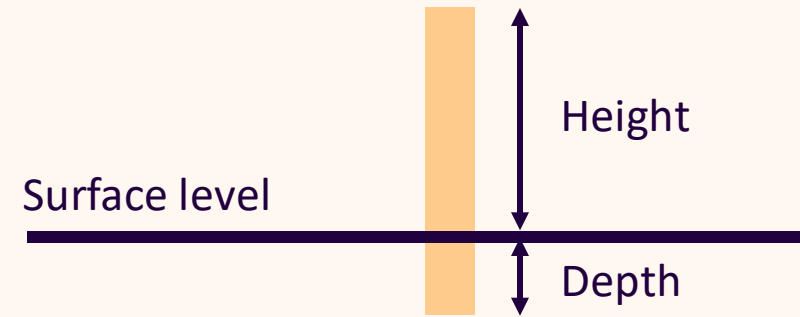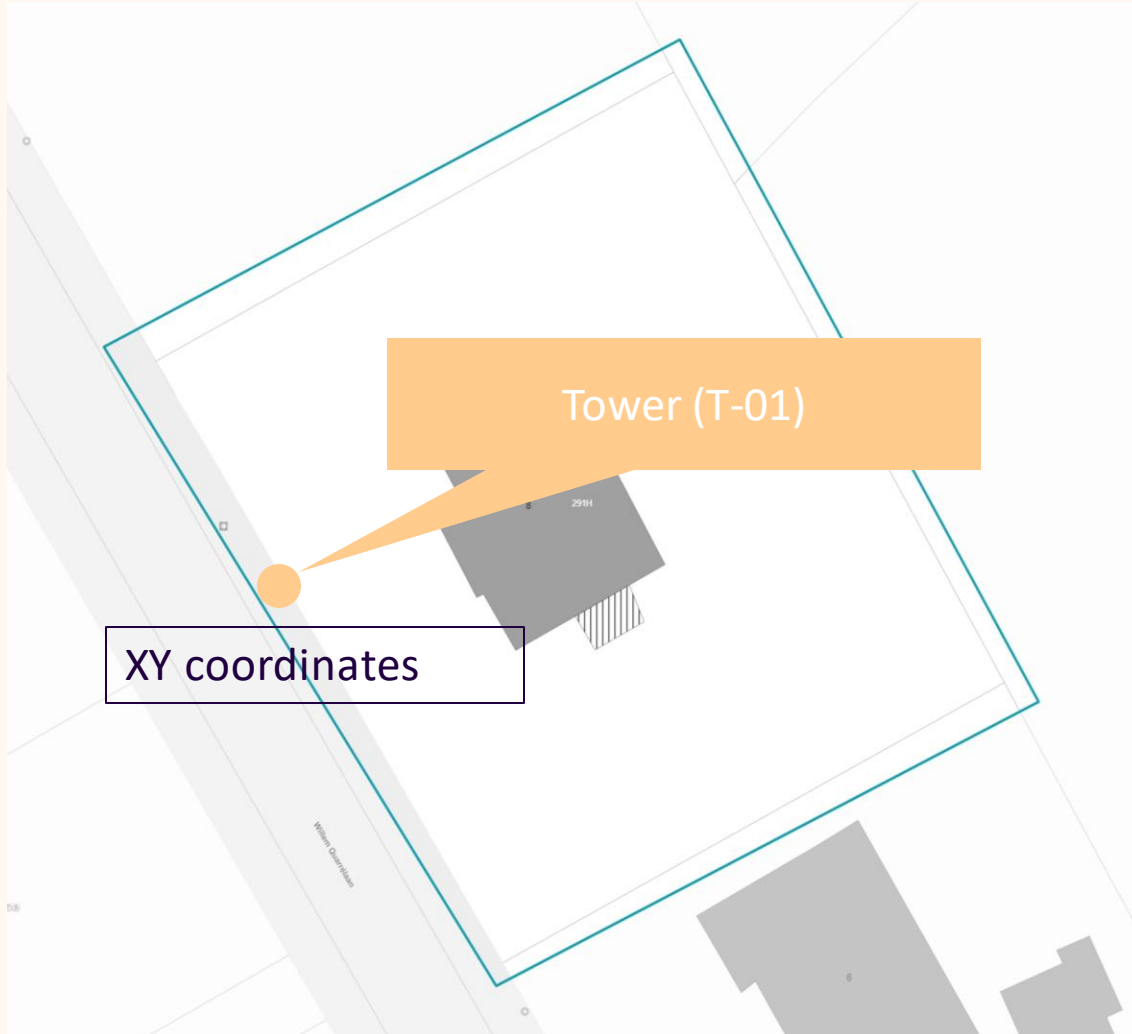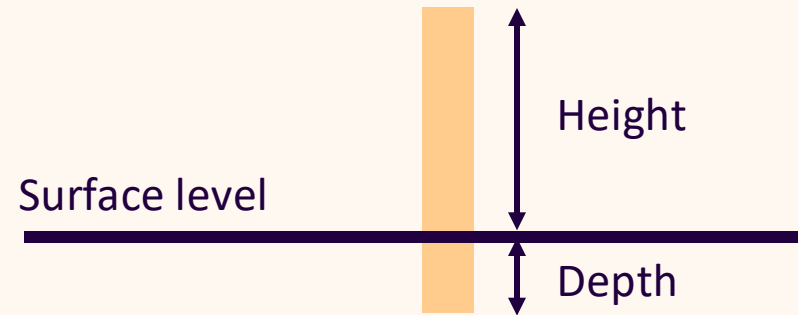
Example – Tower/Pole

Height

Surface level

Depth

towerHeight and poleHeight are mandatory.
Do we allow a nilReason?

```xml
<imkl:featureMember>
  <imkl:tower>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:localId>
        <base:namespace>Demo</base:namespace>
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
      <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
        <gml:pos>103674.885 192127.454</gml:pos>
      </gml:Point>
      <imkl:survey>
        <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
        <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
        <imkl:date>2024-01-01T12:00:00</imkl:date>
        <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
      </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
    <us-net-common:towerHeight uom="urn:ogc:def:uom:OGC::m">15</us-net-common:towerHeight>
    <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
  </imkl:tower>
</imkl:featureMember>
```
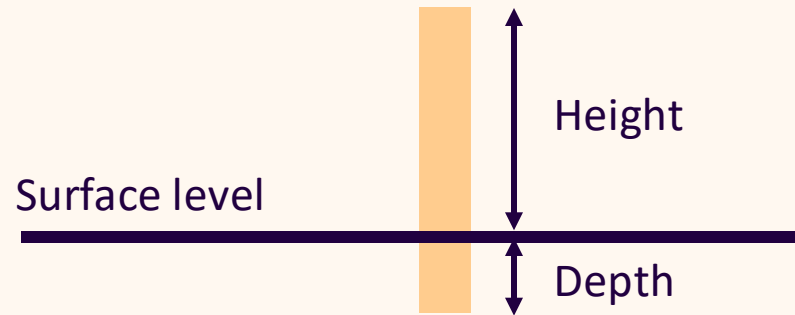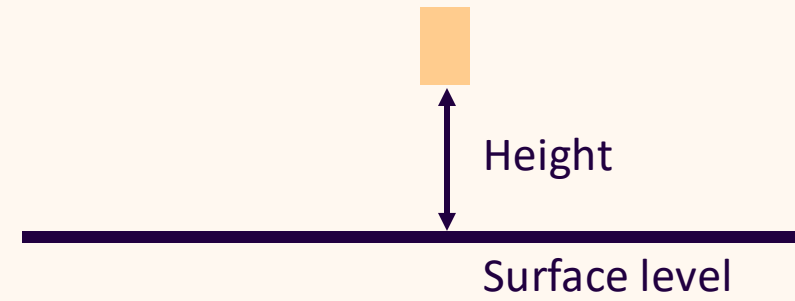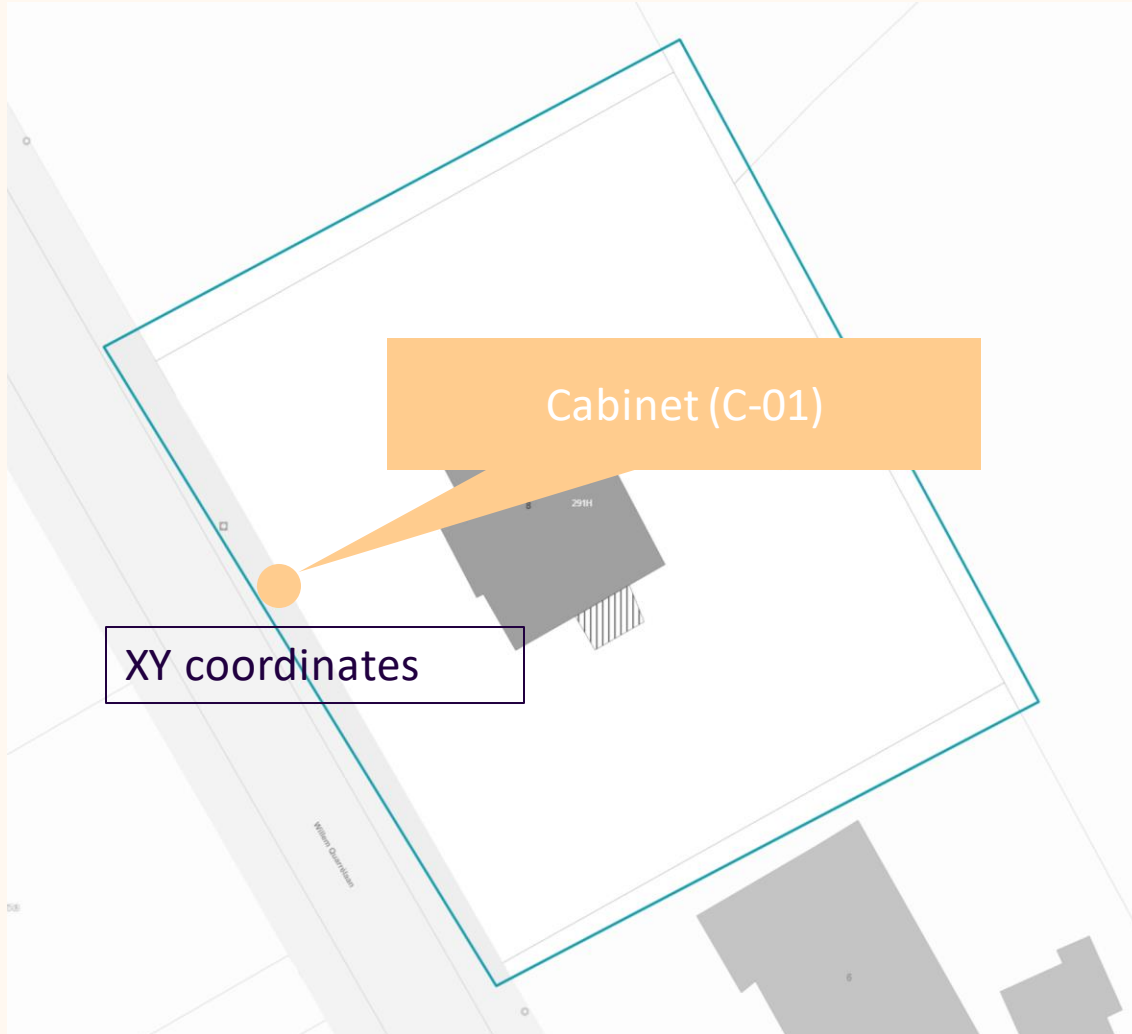
Example - Cabinet

Cabinet (C-01)

XY coordinates

Height

Surface level

Example - Cabinet

Relative height


```
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:height uom="urn:ogc:def:uom:OGC::m">1</imkl:height>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:C-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
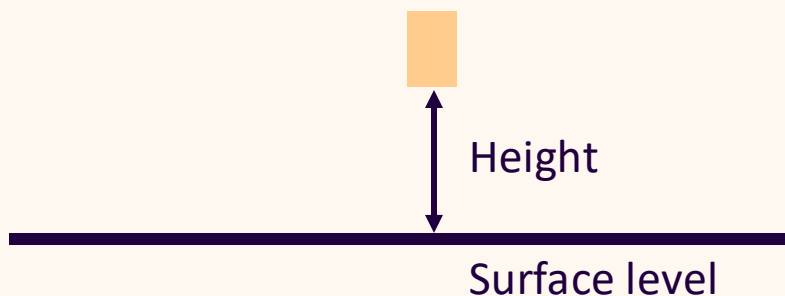
Height: For elements with a *point* geometry the height is the lowest point of the element (above the surface level).

Is the option to give height above surface level needed?

Summary

UtilityNode & UtilityNodeContainer – IMKL 2.3 vs. IMKL 3

- **Coordinate reference system:** Lambert 72 replaced with Lambert 2008

- **VerticalPosition:** No changes (changes to codelist to be discussed in the next workshop)

- **Survey:** The *survey* replaces *liggingNauwkeurigheid*

- **VerticalPositionDetail***:*
  - Replaces *relatieveDiepte*

  - Survey for verticalPositionDetail: To be discussed (replacing *diepteNauwkeurigheid, datumOpmetingDieptePeil*)

  - *Depth* or *Height* replace *dieptePeil*

  - ReferenceSurface added

UtilityLinkSet & UtilityLink

Example - SewerPipe

SewerPipe (SP-01)

Surface level

Depth

Example - SewerPipe

SewerPipe (SP-01)

```
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```

Example - SewerPipe

SewerPipe (SP-01)

```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```

Example - SewerPipe

SewerPipe (SP-01)

(0, 0)

(10, 0)

```xml
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00:00.0Z</net:beginLifespanVersion>
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:posList>0 0 10 0</gml:posList>
            </gml:LineString>
        </net:centrelineGeometry>
    </us-net-                    k>
</imkl:featur
```
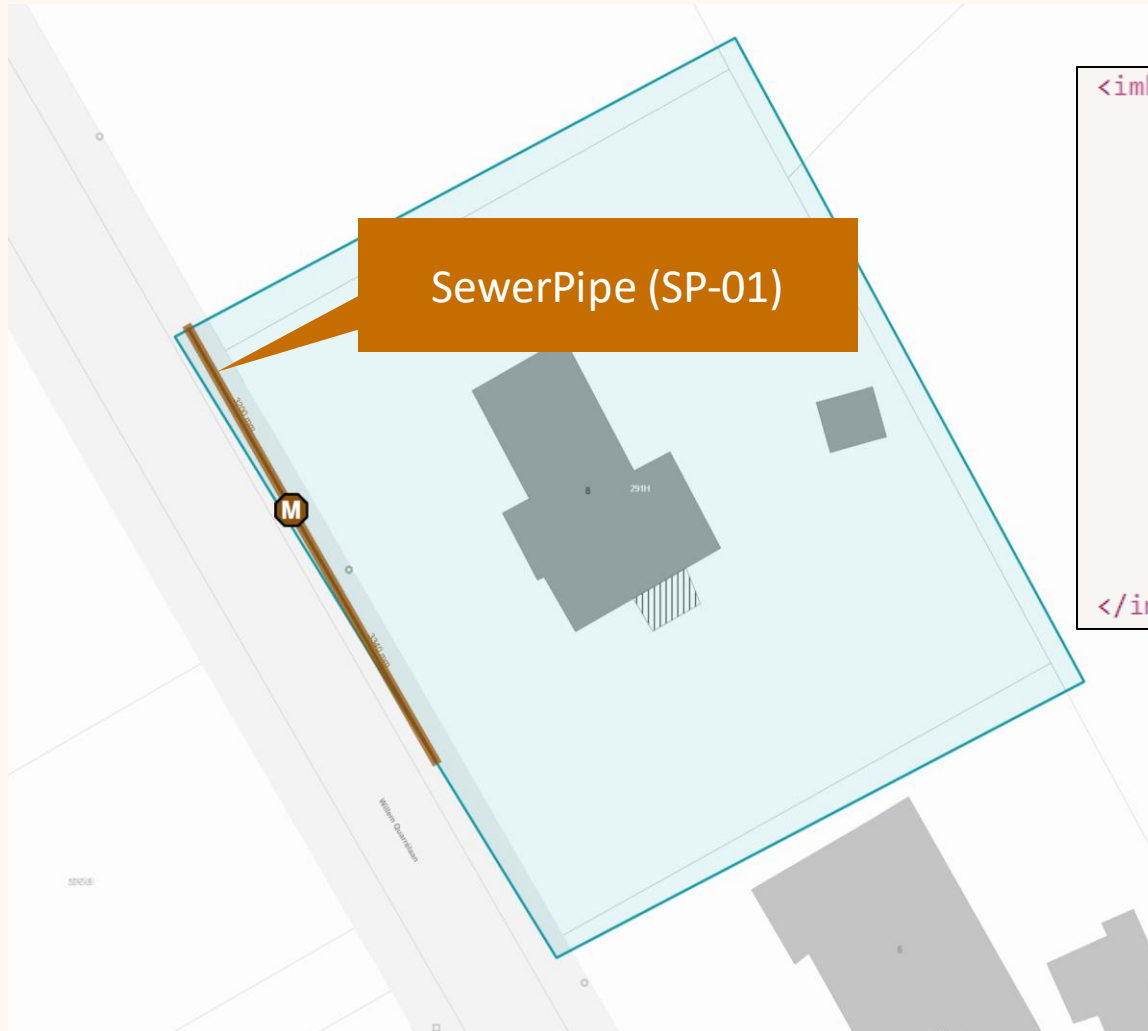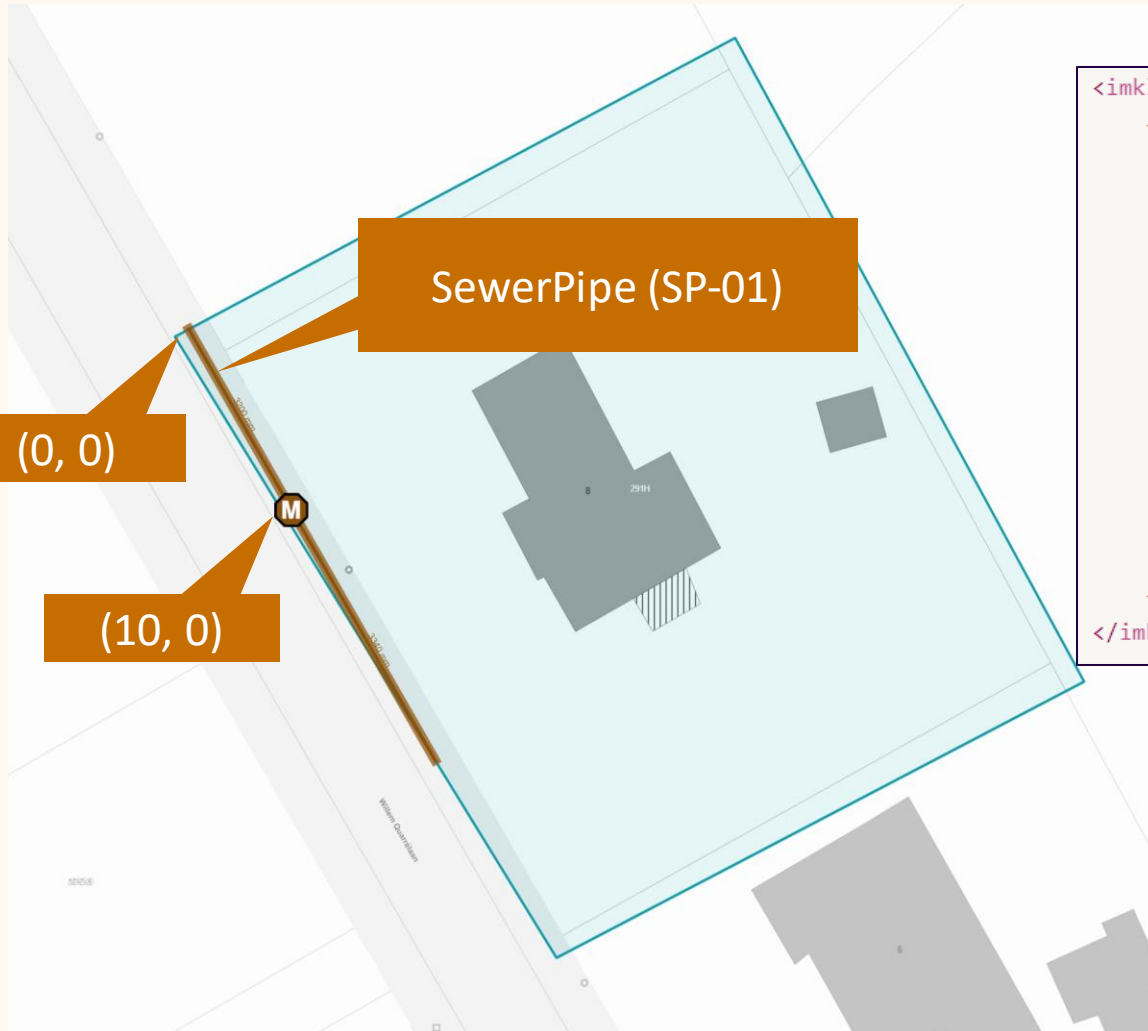
(0, 0)   (10, 0)

Example - SewerPipe

Example - SewerPipe

SewerPipe (SP-01)

Surface level

Depth

Example - SewerPipe

2 VerticalPositionDetails with Point Geometry

Surface level

Depth

Depth

VPD-2

VPD-1

```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-2"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```
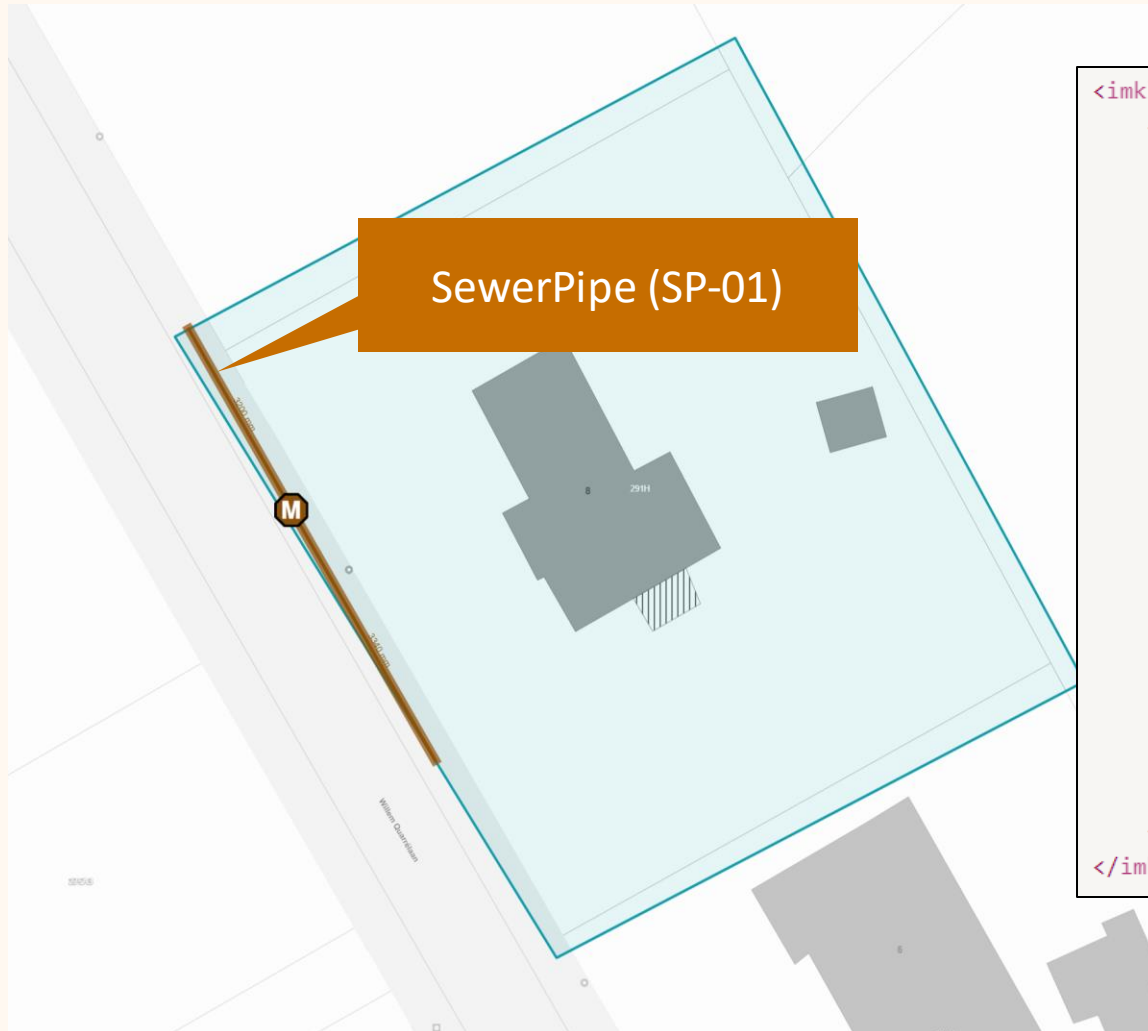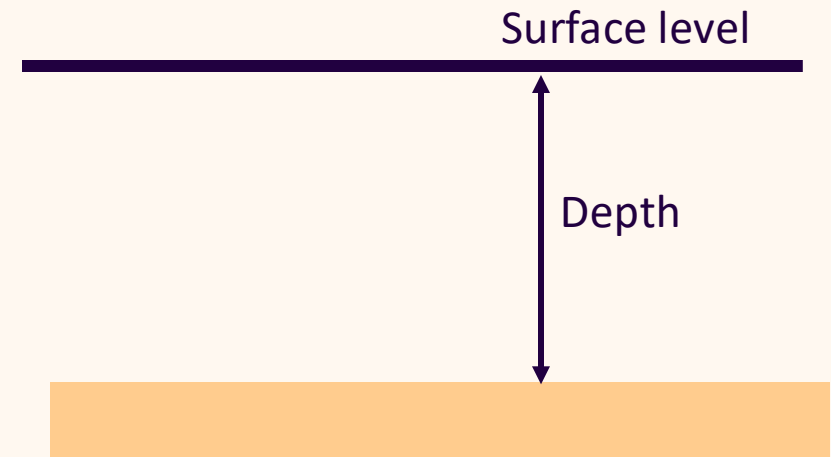
Example - SewerPipe


```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>
            <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:pos>0 0</gml:pos>
            </gml:Point>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:location>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">1</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:L-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
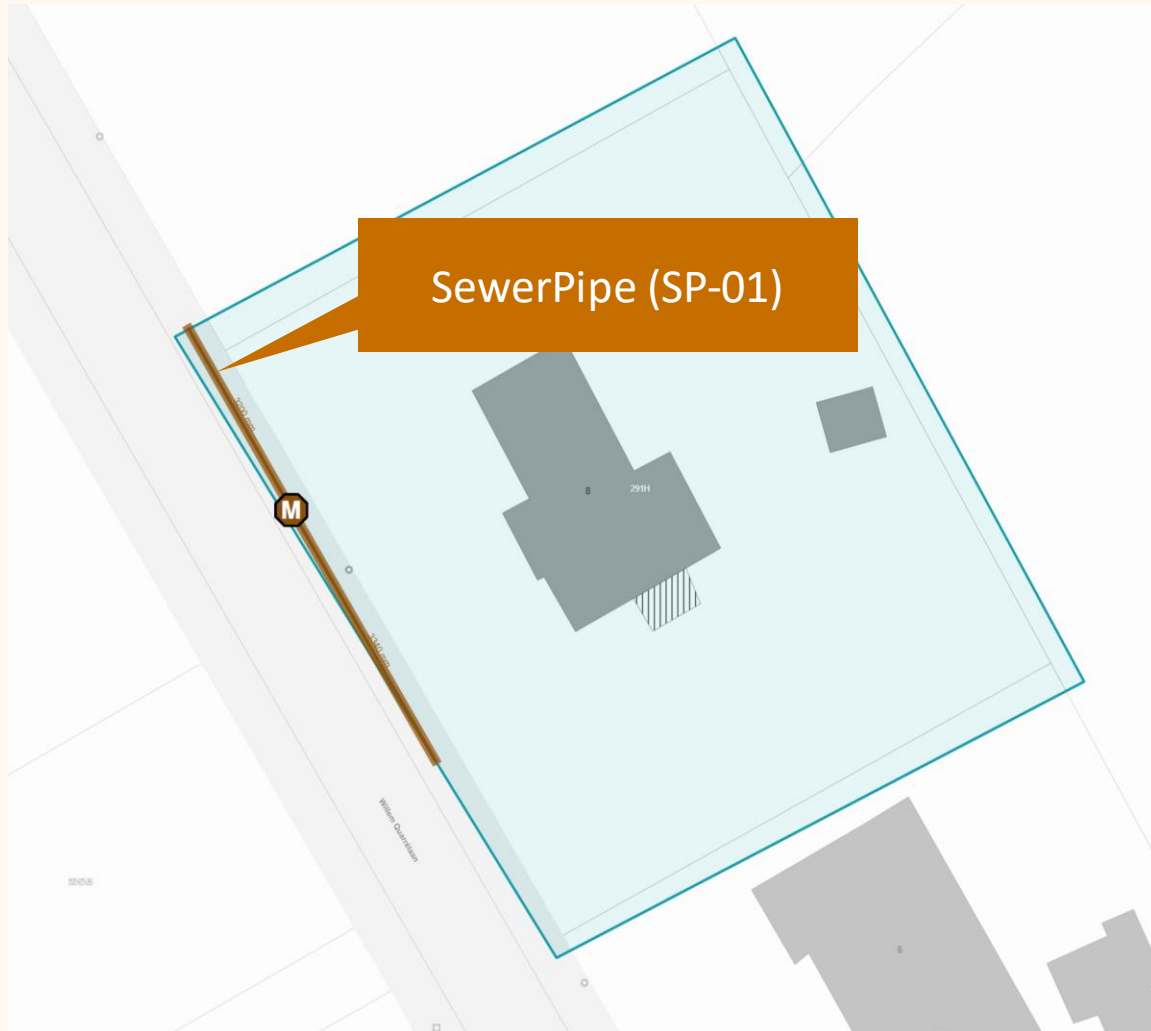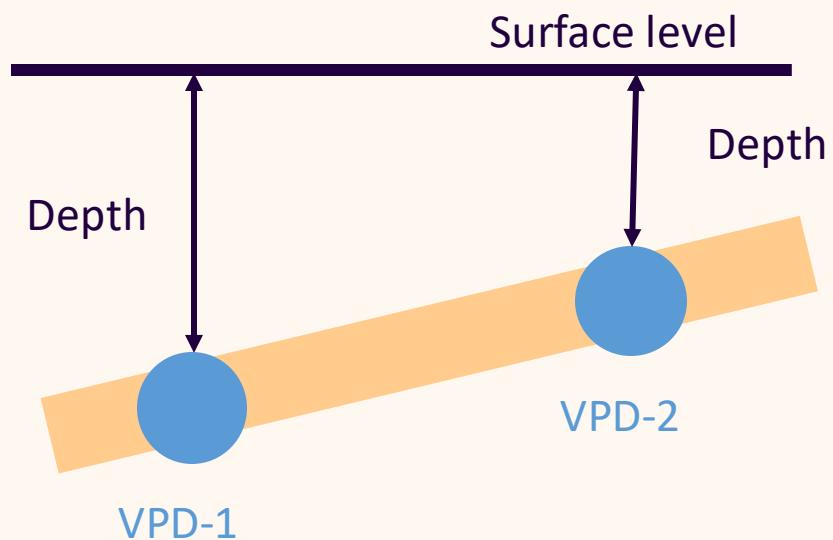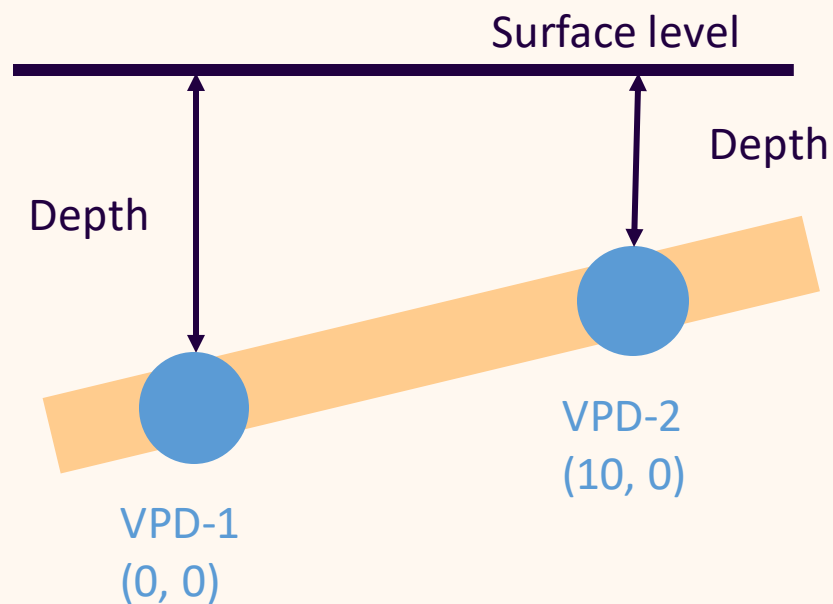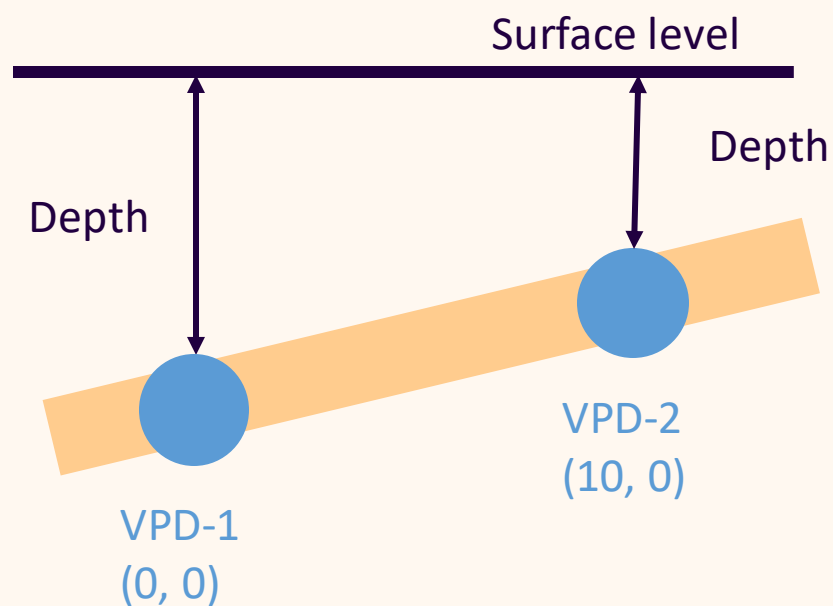
Example - SewerPipe


```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-2</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>
            <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:pos>10 0</gml:pos>
            </gml:Point>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:location>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">0.80</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:L-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
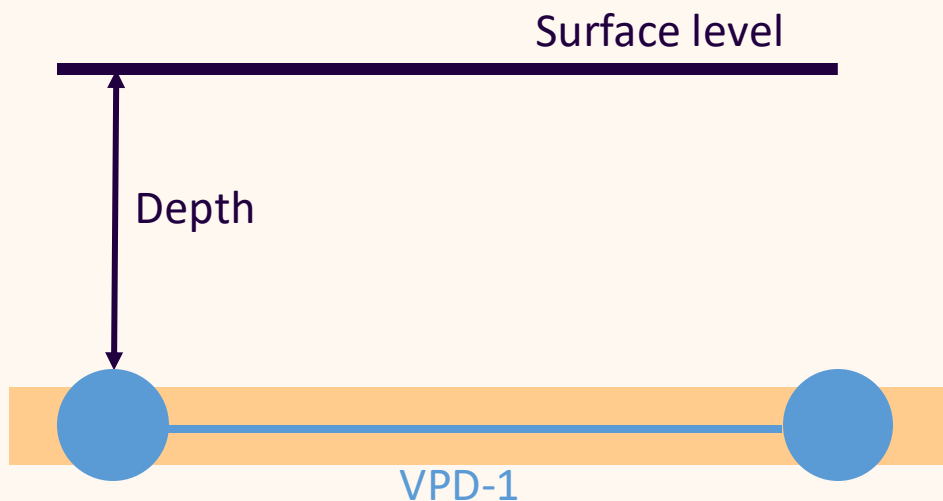
Example - SewerPipe

1 VerticalPositionDetail with Line Geometry

If the depth of consecutive points is the same, they can be combined in a single VerticalPositionDetail with a Line geometry.


```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```

Example - SewerPipe


```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:posList>0 0 10 0</gml:posList>
            </gml:LineString>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:location>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">1</imkl:depth>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:L-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
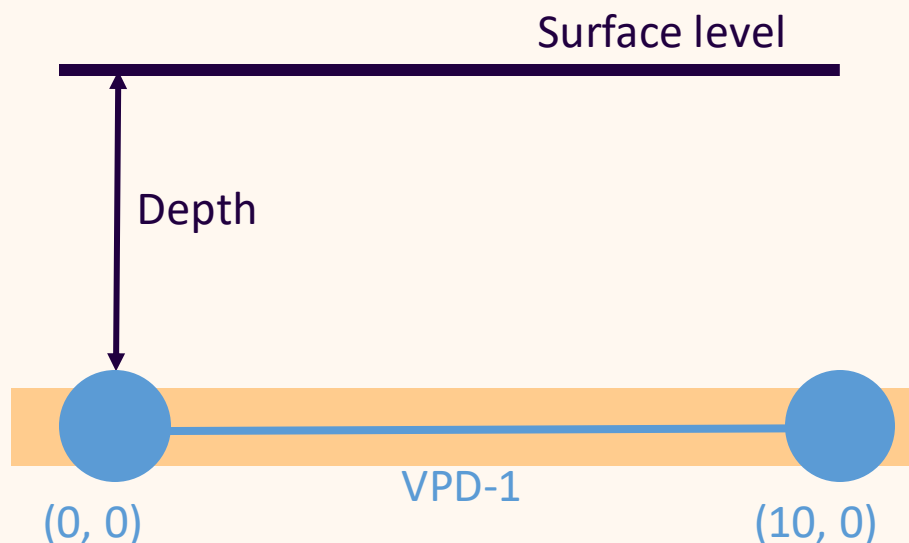
Surface level

Depth

VPD-1

(0, 0)   (10, 0)

UtilityLinkSet vs UtilityLink

UtilityLinkSet
link [1..*]
verticalPosition [1]
verticalPositionDetail (+ survey) [0..*]

UtilityLink
centrelineGeometry (+ survey)

The centrelineGeometry of a UtilityLinkSet is part of the UtilityLink to be compatible with the INSPIRE xsd.

All other properties (including those related to vertical position) are part of UtilityLinkSet.

The properties related to vertical position could be moved to UtilityLink as well. There are no clear advantages to this change, hence we propose to keep these properties in UtilityLinkSet (as was the case in IMKL 2.3).

Summary

- **Coordinate reference system:** Lambert 72 replaced with Lambert 2008

- **VerticalPosition:** No changes (changes to codelist to be discussed in the next workshop)

- **Survey:** The *survey* replaces *liggingNauwkeurigheid*

- **VerticalPositionDetail*:***
  - Replaces *relatieveDiepte*

  - Location can be Point or Line. Survey for describing the accuracy of this location.

  - Survey for verticalPositionDetail: To be discussed (replacing *diepteNauwkeurigheid, datumOpmetingDieptePeil*)

  - *Depth* or *Height* replace *dieptePeil*

  - ReferenceSurface added
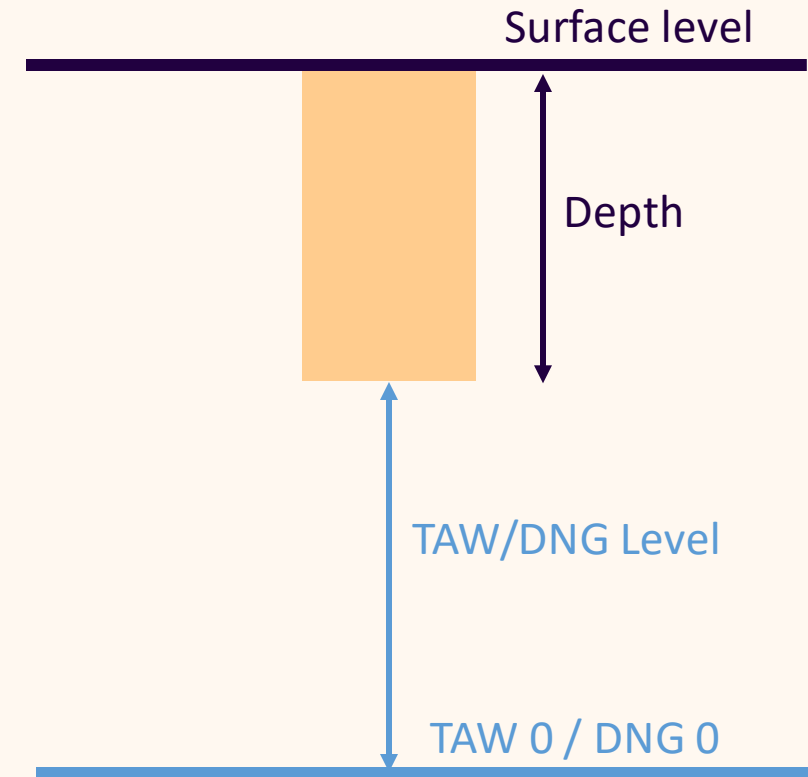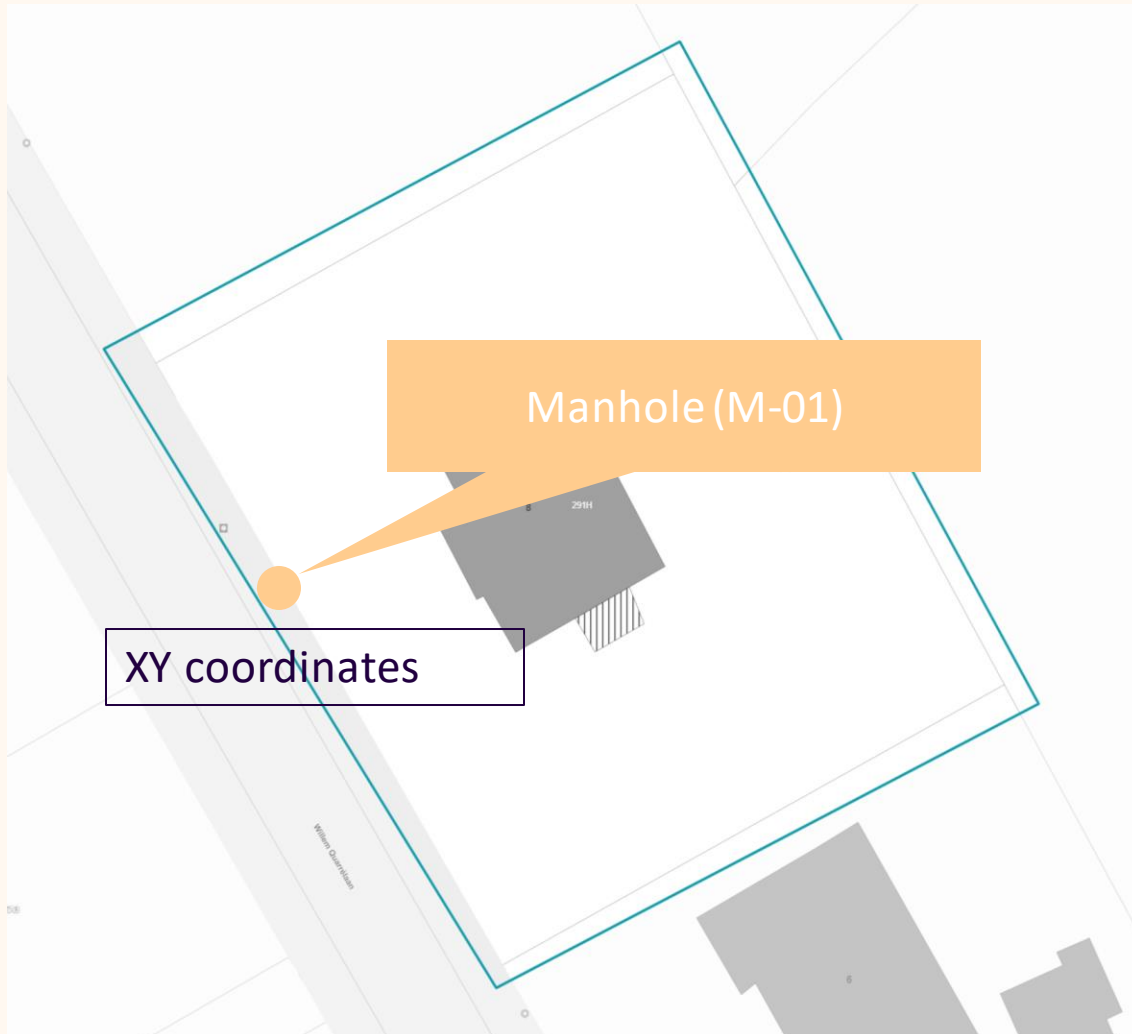
TAW/DNG Level

Example - Manhole

Relative depth – TAW/DNG Level

Manhole (M-01)

XY coordinates

Surface level

Depth

TAW/DNG Level

TAW 0 / DNG 0

TAW: Tweede Algemene Waterpassing
DNG: Deuxième nivellement général

Example - Manhole

TAW/DNG Level

Surface level

TAW/DNG Level

TAW 0 / DNG 0

```xml
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
      <base:Identifier>
        <base:localId>M-01</base:localId>
        <base:namespace>Demo</base:namespace>
      </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
      <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
        <gml:pos>103674.885 192127.454</gml:pos>
      </gml:Point>
      <imkl:survey>
        <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
        <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
        <imkl:date>2024-01-01T12:00:00</imkl:date>
        <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
      </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
    <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
  </imkl:manhole>
</imkl:featureMember>
```

Example - Manhole

TAW/DNG Level

Example - SewerPipe

2 VerticalPositionDetails with Point Geometry


```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-2"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```

Surface level

VPD-2

VPD-1

TAW/DNG Level

TAW/DNG Level

TAW 0 / DNG 0

Exam


```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>
            <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:pos>0 0</gml:pos>
            </gml:Point>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:location>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">0.80</imkl:depth>
        <imkl:verticalPosition>
            <imkl:pos srsName="http://spatialreference.org/ref/epsg/5710/" srsDimension="1">21</imkl:pos>
            <imkl:survey>
                <imkl:method nilReason="missing" xsi:nil="true" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:verticalPosition>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:M-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
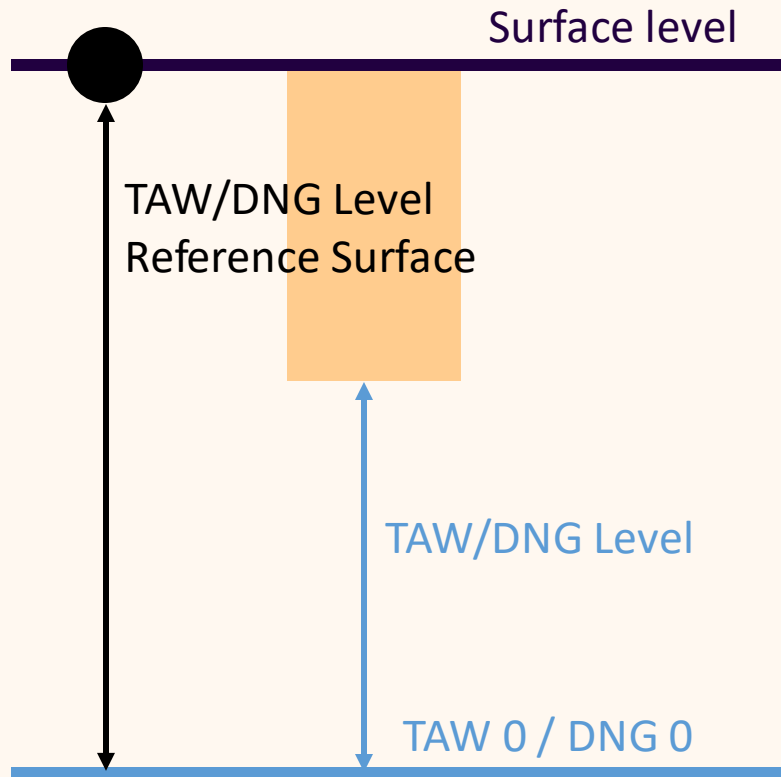
Surface level

VPD-2

VPD-1

TAW/DNG Level

TAW/DNG Level

TAW 0 / DNG 0

Example - SewerPipe

1 VerticalPositionDetail with Line Geometry

If the TAW/DNG Level of consecutive points is the same, they can be combined in a single VerticalPositionDetail with a Line geometry.


```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <imkl:verticalPositionDetail
            xlink:href="http:/TODO/verticalPositionDetail/Demo:VPD-1"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        <!-- + subtheme, sewerWaterType, ... -->
    </imkl:sewerPipe>
</imkl:featureMember>
```
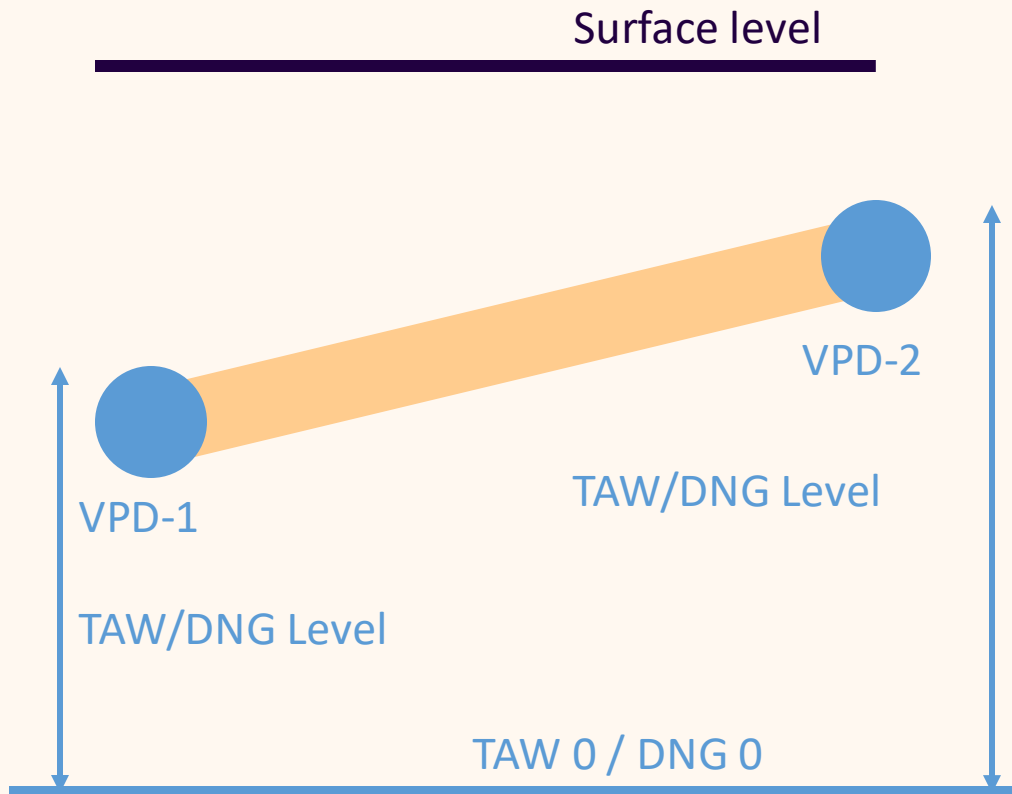
Surface level

Depth

VPD-1

Exam

Surface level

Depth

VPD-1

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>
            <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:pos>0 0 10 0</gml:pos>
            </gml:Point>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:location>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">0.80</imkl:depth>
        <imkl:verticalPosition>
            <imkl:pos srsName="http://spatialreference.org/ref/epsg/5710/" srsDimension="1">21</imkl:pos>
            <imkl:survey>
                <imkl:method nilReason="missing" xsi:nil="true" />
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01" />
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </imkl:verticalPosition>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:M-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```
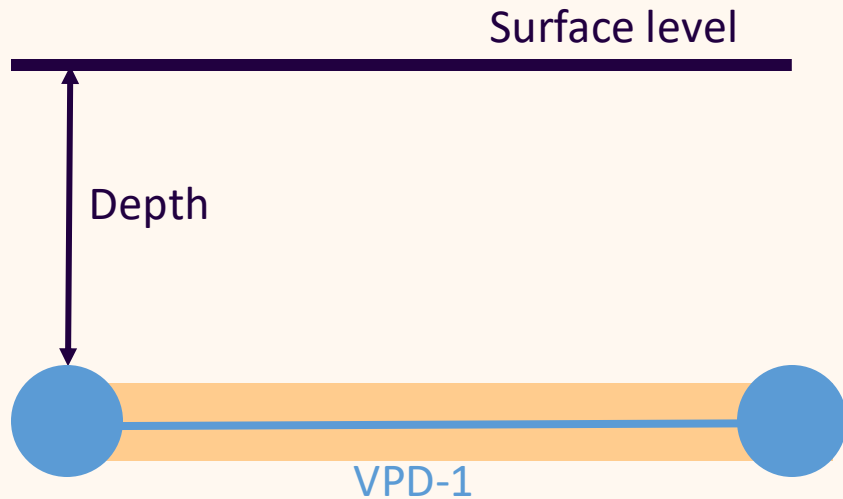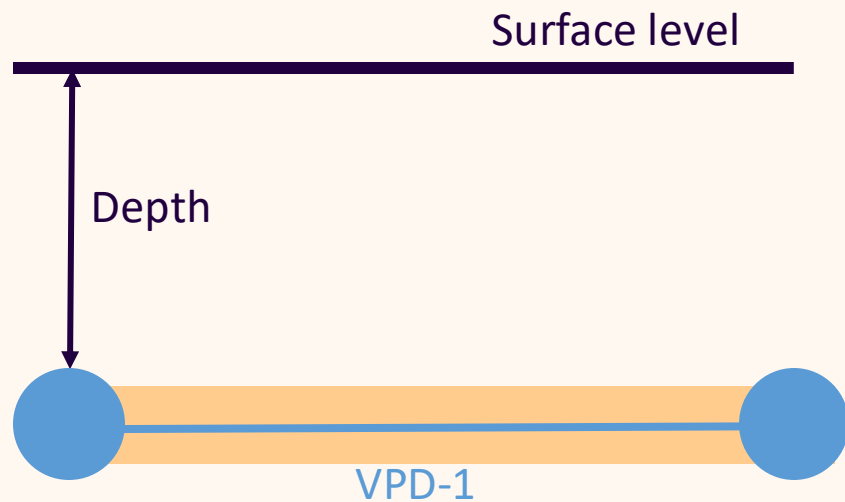
Summary

- **Coordinate reference system:** Lambert 72 replaced with Lambert 2008

- **VerticalPosition:** No changes (changes to codelist to be discussed in the next workshop)

- **Survey:** The *survey* replaces *liggingNauwkeurigheid*

- **VerticalPositionDetail*:***
  - Replaces *TAWDiepte:*
    - *Pos* replaces *dieptePeil*
    - *Location* replaces *ligging.* Location can be Point or Line. Survey for accuracy of this location.

  - Survey for verticalPositionDetail: replaces *dieptNauwkeurigheid*, *datumOpmetingDieptePeil*

  - ReferenceSurface added
    - *Pos* replaces *maaiveldPeil*
    - *Survey* replaces *datumOpmetingMaaiveldPeil*

Other topics

Standard VerticalPositionDetail

- Optional VerticalPositionDetail for the whole network.

- Gets overruled by element specific verticalPositionDetail if present.

- **Max 1** standard verticalPositionDetail allowed (either relative depth or TAW/DNG level).

  Are there situations where more than 1 standard verticalPositionDetail is useful?

- Replaces **standaardDekking** from IMKL 2.3.
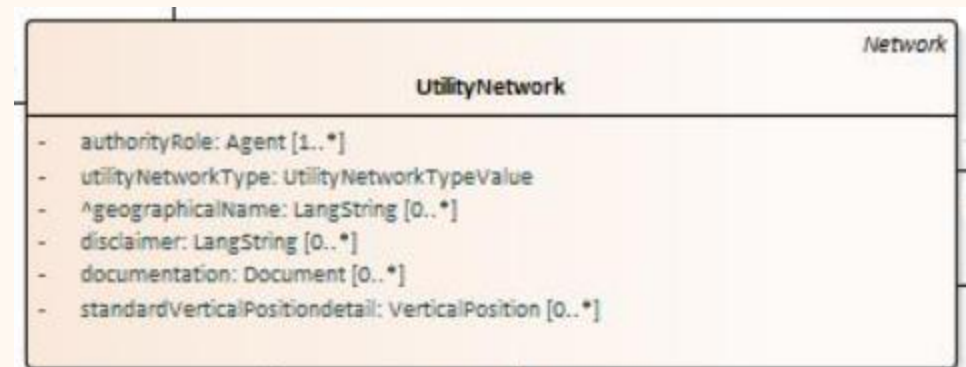
Standard VerticalPositionDetail

Relative Depth

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:referenceSurface>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
        </imkl:referenceSurface>
        <imkl:depth uom="urn:ogc:def:uom:OGC::m">1</imkl:depth>
    <imkl:utilityNetwork
        xlink:href="http://TODO/UtilityNetwork/Demo:UN-01"
        xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```

Standard VerticalPositionDetail

TAW/DNG Level

```xml
<imkl:featureMember>
    <imkl:verticalPositionDetail>
        <imkl:imklId>
            <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <base:localId>VPD-1</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </imkl:imklId>
        <imkl:location>...</imkl:location>
        <imkl:referenceSurface>
            <imkl:verticalPosition>
                <imkl:pos srsName="http://spatialreference.org/ref/epsg/5710/" srsDimension="1">
                    22</imkl:pos>
                <imkl:survey>...</imkl:survey>
            </imkl:verticalPosition>
            <imkl:type xlink:href="http://TODO/ReferenceSurfaceTypeValue/SurfaceLevel" />
            <imkl:location>
                <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                    <gml:pos>103674.885 192127.454</gml:pos>
                </gml:Point>
                <imkl:survey>...</imkl:survey>
            </imkl:location>
        </imkl:referenceSurface>
        <imkl:beginLifespanVersion>2000-10-05T00:00:00</imkl:beginLifespanVersion>
        <imkl:verticalPosition>
            <imkl:pos srsName="http://spatialreference.org/ref/epsg/5710/" srsDimension="1">21</imkl:pos>
            <imkl:survey>...</imkl:survey>
        </imkl:verticalPosition>
        <imkl:hasUtilityNetworkElement
            xlink:href="http://TODO/manhole/Demo:M-01"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
    </imkl:verticalPositionDetail>
</imkl:featureMember>
```

The surface level is at 22m at the given location

Standard TAW/DNG level is 21m

2.5D

Z coordinates will be allowed.

Manhole

```xml
<imkl:featureMember>
  <imkl:manhole>
    <us-net-common:inspireId>
        <base:Identifier>
            <base:localId>M-01</base:localId>
            <base:namespace>Demo</base:namespace>
        </base:Identifier>
    </us-net-common:inspireId>
    <us-net-common:geometry>
        <gml:Point srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="3">
            <gml:pos>103674.885 192127.454 50.0</gml:pos>
        </gml:Point>
        <imkl:survey>
            <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
            <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
            <imkl:date>2024-01-01T12:00:00</imkl:date>
            <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
        </imkl:survey>
    </us-net-common:geometry>
    <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
  </imkl:manhole>
</imkl:featureMember>
```

2.5D

Z coordinates will be allowed.

UtilityLink

```xml
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00:00.0Z</net:beginLifespanVersion>
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="3">
                <gml:posList>103674.885 192127.454 50.0 103684.885 192127.454 52.0</gml:posList>
            </gml:LineString>
            <imkl:survey>
                <imkl:method xlink:href="http://TODO/SurveyMethodValue/TotalStation"/>
                <imkl:recordedBy xlink:href="http://TODO/Agent/Demo:A-01"/>
                <imkl:date>2024-01-01T12:00:00</imkl:date>
                <imkl:accuracy uom="urn:ogc:def:uom:OGC::cm">100</imkl:accuracy>
            </imkl:survey>
        </net:centrelineGeometry>
    </us-net-common:UtilityLink>
</imkl:featureMember>
```

2.5D

- The Z coordinates will not be used for visualisation in the KLIP viewer. Hence, (standard) verticalPositionDetail remains relevant.

- The Z coordinates could be used in other applications (e.g. impact analysis).

- No validation of consistency of Z coordinates and verticalPositionDetail will be done (i.e. do the Z coordinates match with the given verticalPositionDetail?).

- Attribute srsDimension will become mandatory to distinguish between 2 or 2.5D.

```
<gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
    <gml:posList>103674.885 192127.454 103684.885 192127.454</gml:posList>
</gml:LineString>
```

```
<gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="3">
    <gml:posList>103674.885 192127.454 50.0 103684.885 192127.454 52.0</gml:posList>
</gml:LineString>
```

2.5D

Interpretation of Z coordinates

Manhole
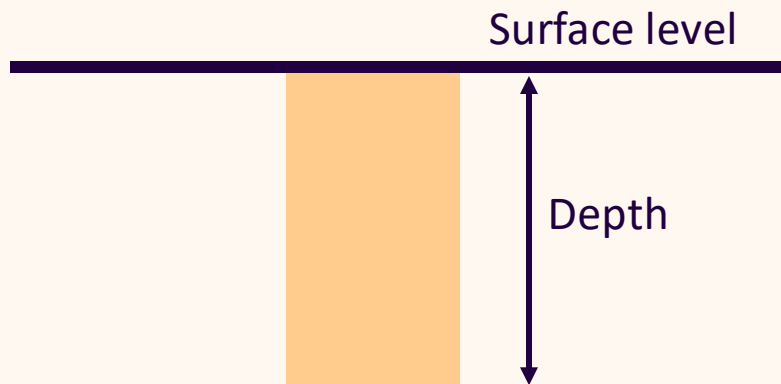
UtilityLink

Surface level

Surface level

Depth

Depth

UtilityLinkSequence

A UtilityLinkSequence is a **sorted collection** of **directed** links.

UtilityLinkSequences can be useful to describe a UtilityLinkSet with a specific flow direction.

UtilityLink

UtilityLinkSequence

UtilityLinkSequence

A UtilityLinkSequence is a **sorted collection** of **directed** links.

UtilityLinkSequences can be useful to describe a UtilityLinkSet with a specific flow direction.

For the use cases of IMKL the direction of the link is not relevant.

Hence, we suggest to not use UtilityLinkSequences. This was already the case in IMKL 2.3.

UtilityLink – Multi curve
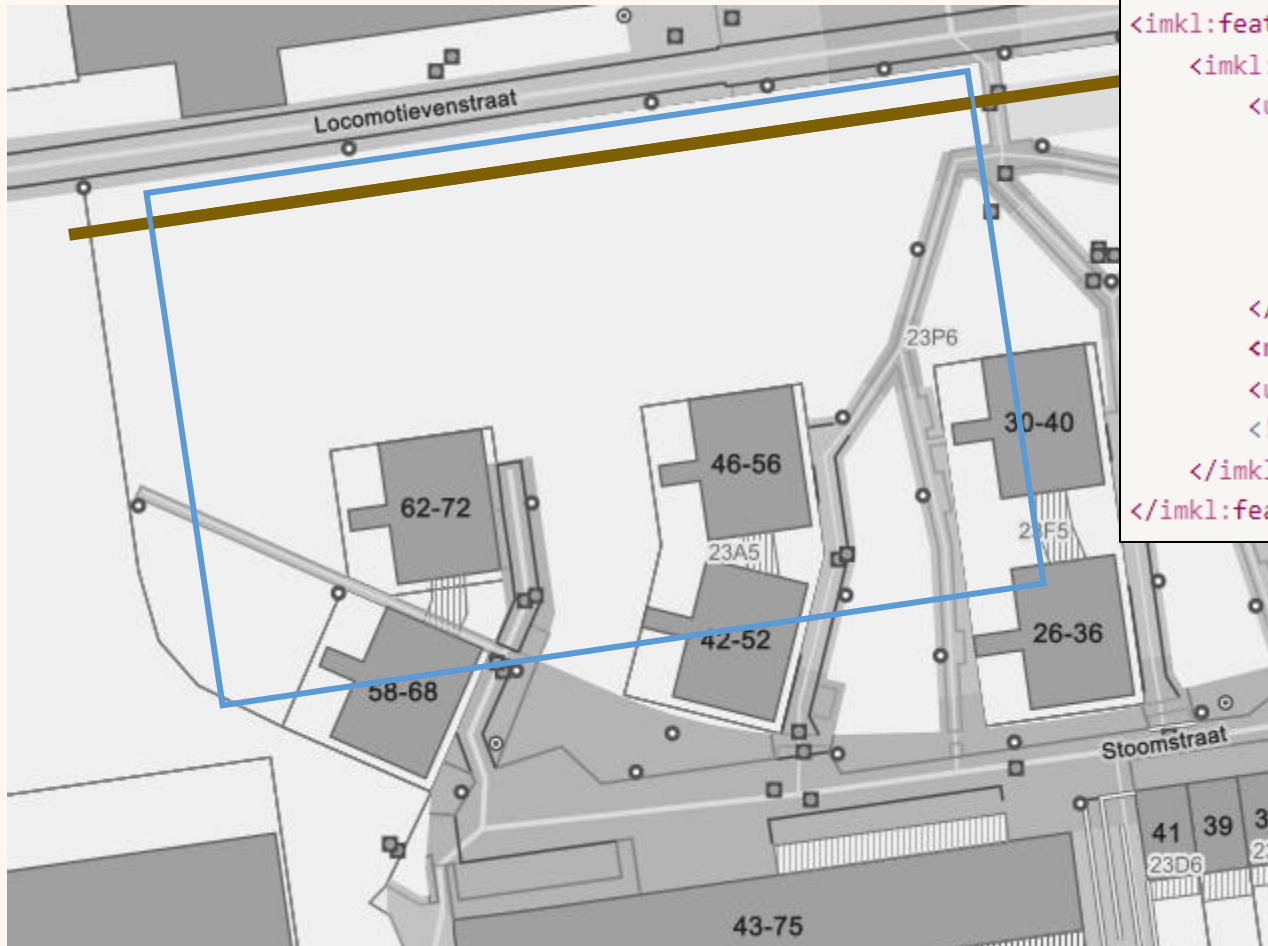

```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <!-- + subtheme, sewerWaterType, ... --
    </imkl:sewerPipe>
</imkl:featureMember>
```

1 UtilityLink

UtilityLink – Multi curve

1 UtilityLink

```xml
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00...02</net:beginLifespanVersion>
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:posList>0 0 10 0</gml:posList>
            </gml:LineString>
        </net:centrelineGeometry>
    </us-net-common:UtilityLink>
</imkl:featureMember>
```
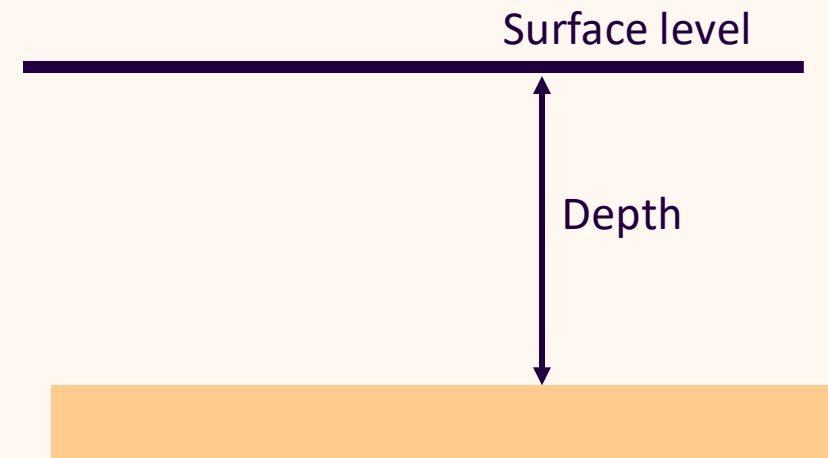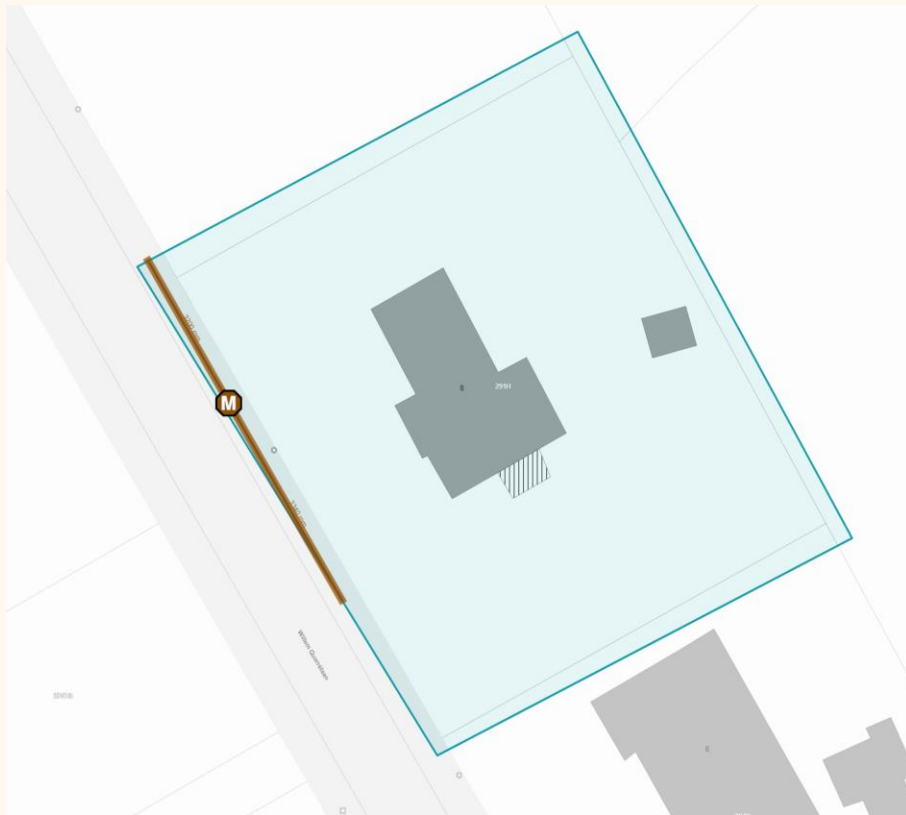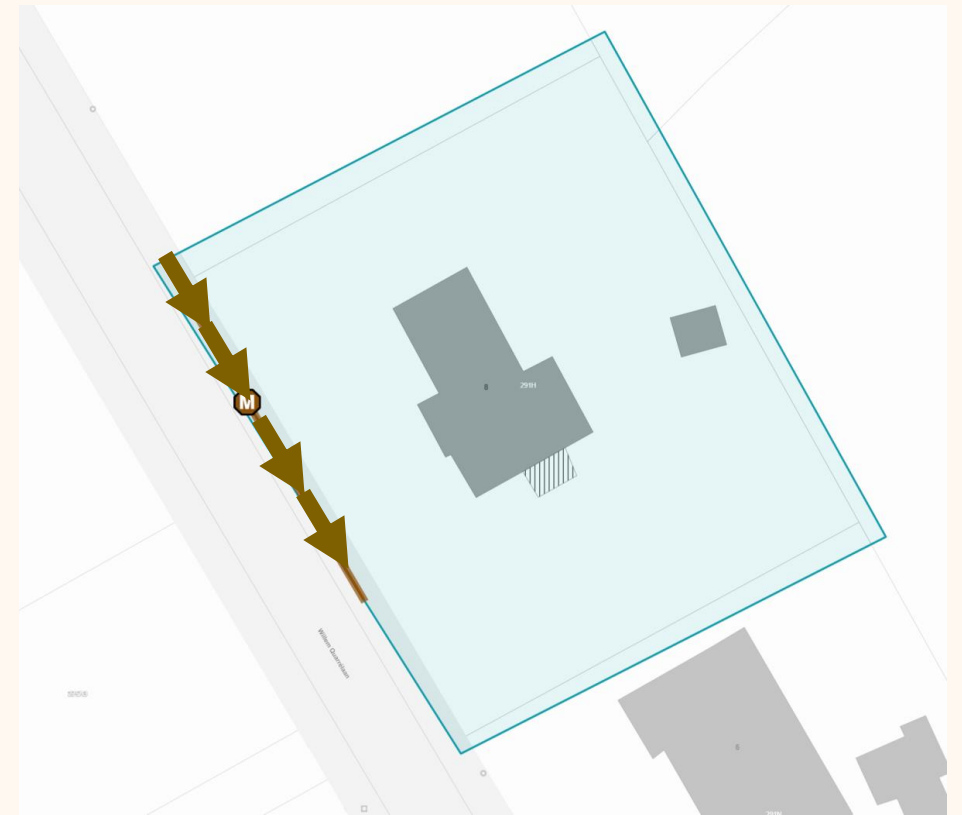
UtilityLink – Multi curve


```xml
<imkl:featureMember>
    <imkl:sewerPipe>
        <us-net-common:inspireId>
            <base:Identifier>
                <base:localId>SP-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </us-net-common:inspireId>
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-01" />
        <net:link xlink:href="http://TODO/UtilityLink/Demo:L-02" />
        <us-net-common:verticalPosition>underground</us-net-common:verticalPosition>
        <!-- + subtheme, sewerWaterType, ... -
    </imkl:sewerPipe>
</imkl:featureMember>
```

2 UtilityLinks

UtilityLink – Multi curve

UtilityLink L-01

UtilityLink L-02

```xml
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00:00
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:posList>0 0 4 0</gml:posList>
            </gml:LineString>
        </net:centrelineGeometry>
    </us-net-common:UtilityLink>
</imkl:featureMember>
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00:00
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-02</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:LineString srsName="http://spatialreference.org/ref/epsg/3812/" srsDimension="2">
                <gml:posList>6 0 10 0</gml:posList>
            </gml:LineString>
        </net:centrelineGeometry>
    </us-net-common:UtilityLink>
</imkl:featureMember>
```
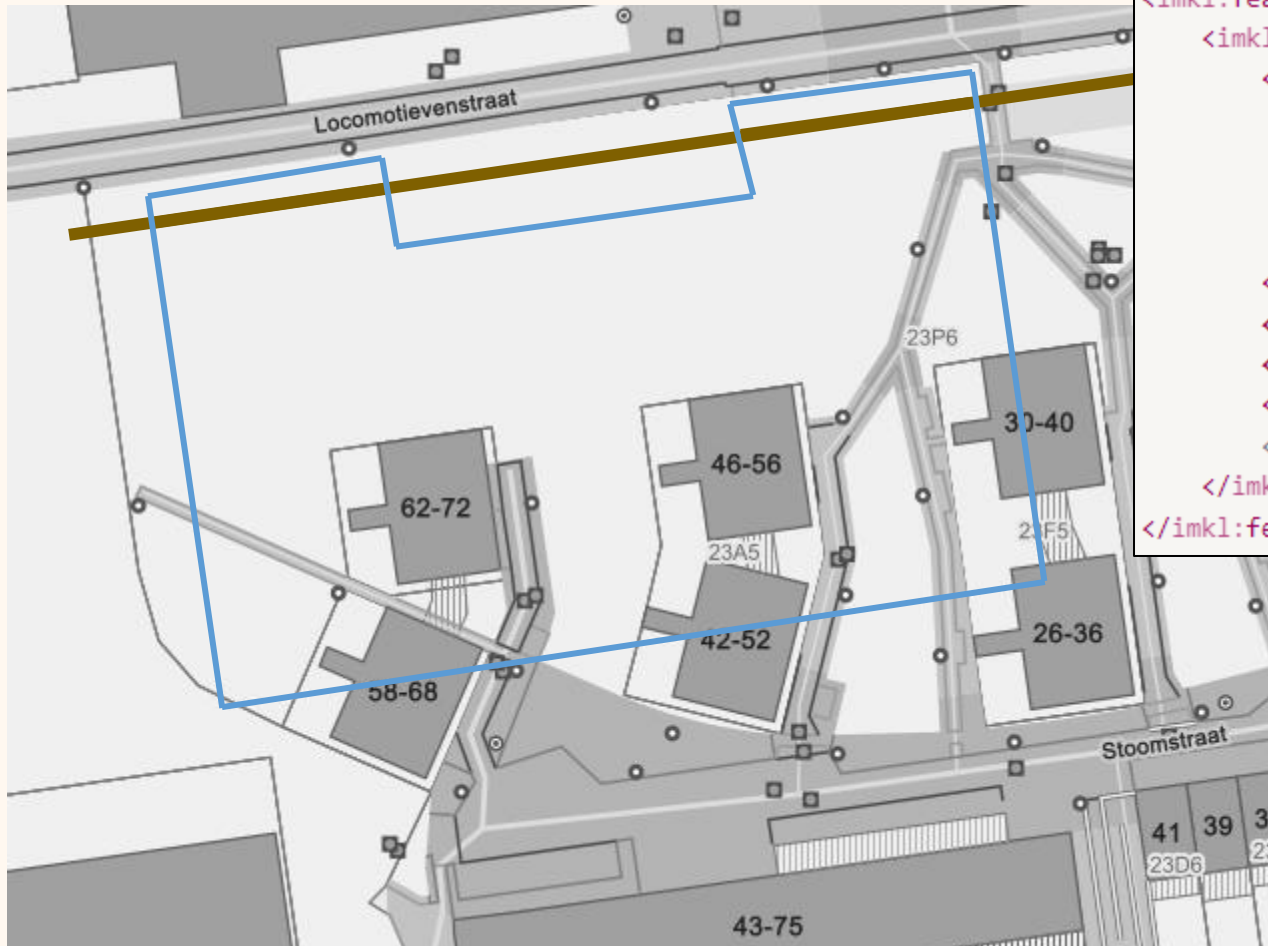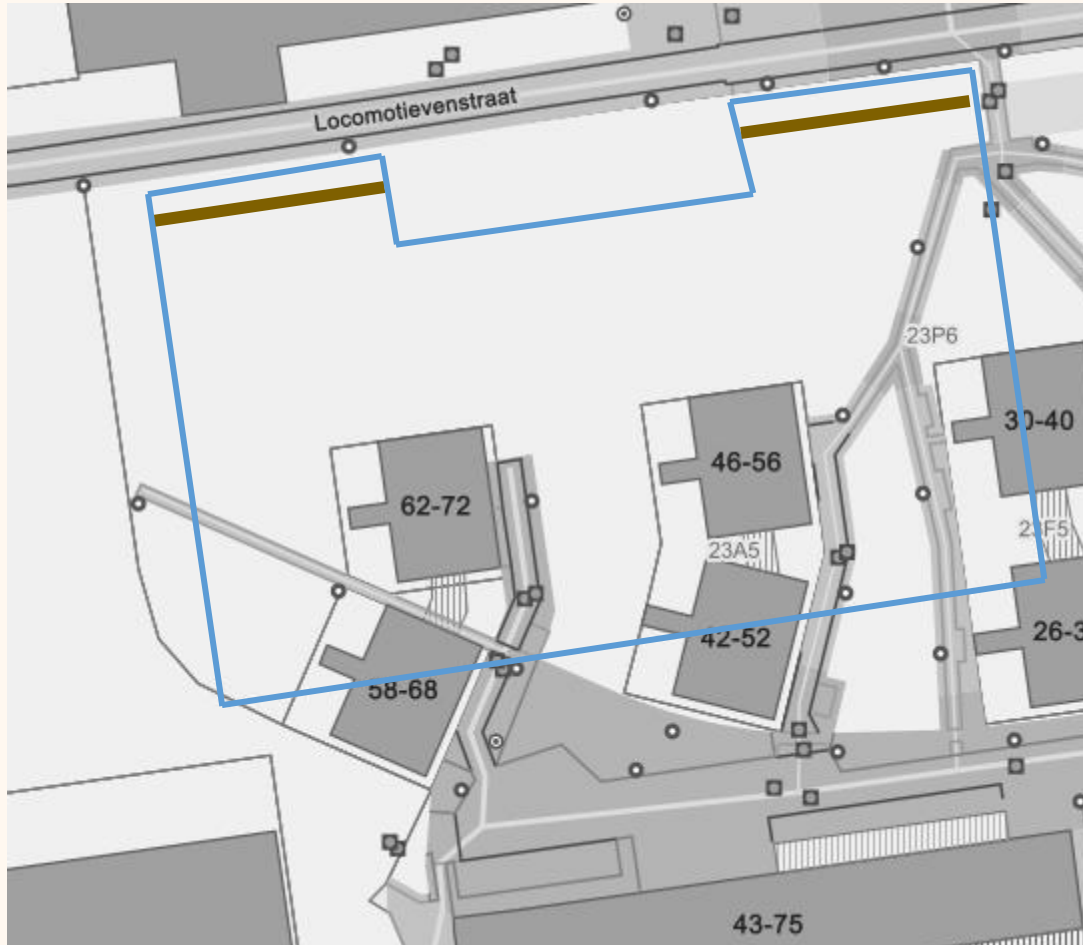
UtilityLink – Multi curve

Problem:

2 UtilityLinks (with unique ID's) need to be created for what was only 1 UtiltyLink in the source dataset.

This means **new ID's need to be generated** that do not match with ID's in the source dataset.

Possible solution:

Allow MultiCurve as centrelineGeometry for UtilityLinks.

UtilityLink – Multi curve

Example of MultiCurve

```xml
<imkl:featureMember>
    <us-net-common:UtilityLink>
        <net:beginLifespanVersion>2024-01-01T12:00:00.0Z</net:beginLifespanVersion>
        <net:inspireId>
            <base:Identifier>
                <base:localId>L-01</base:localId>
                <base:namespace>Demo</base:namespace>
            </base:Identifier>
        </net:inspireId>
        <net:centrelineGeometry>
            <gml:MultiCurve srsDimension="2">
                <gml:curveMember>
                    <gml:LineString>
                        <gml:posList>0 0 4 0</gml:posList>
                    </gml:LineString>
                </gml:curveMember>
                <gml:curveMember>
                    <gml:LineString>
                        <gml:posList>6 0 10 0</gml:posList>
                    </gml:LineString>
                </gml:curveMember>
            </gml:MultiCurve>
        </net:centrelineGeometry>
    </us-net-common:UtilityLink>
</imkl:featureMember>
```

UtilityLink – Multi curve

Problem:

2 UtilityLinks (with unique ID's) need to be created for what was only 1 UtiltyLink in the source dataset.

This means **new ID's need to be generated** that do not match with ID's in the source dataset.

Possible solution:

Allow MultiCurve as centrelineGeometry for UtilityLinks.

Advantages:

• No need to generate new ID's

Disadvantages:

• This solution is **not** in accordance with the INSPIRE guidelines. Hence, the same data transformation **can not** be used for both INSPIRE and KLIP (for network operators where this is applicable).

Other object types

To be discussed in one of the following workshops:

- Activity Complex
- Protected Area
- Topographical Element
- Annotation
- Plan

Next steps

Next working groups

- 30/05/2024: Codelists, documents and plans

- 13/06/2024: To be defined

- 25/06/2024: To be defined

- 12/09/2024: Validation

Actions

Preparation for next working group (14/05/2024):

- When will your organisation be ready for Lambert 2008?

- Does your organisation have 2.5D information (XYZ coordinates) and will it include the Z coordinate in the IMKL response?

Preparation for the third working group (30/05/2024) – **input by 17/05/2024**:

- Go over the list of currently available codelist values and
    - Indicate which values are still relevant for your organisation
    - Add values that are missing

Niels.gabriels@athumi.eu

Contact info

Planning and organisation:

ivy.vandekerchove@vlaanderen.be

Data model and implementation:

niels.gabriels@athumi.eu

liesbeth.rombouts@athumi.eu