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D2.5 Service Specification for GeoLocator

References

Ref.	Title/Version/Publication Date/Author
[1]	Gazetteer Service – Application Profile of the Web Feature Service Best Practice / version 1.0 / 30 Jan, 2012 / Harrison, J., Vretanos, P. A. (ed) https://portal.opengeospatial.org/files/?artifact_id=46964
[2]	Core Location Vocabulary / - / 17. Feb 2012 / Archer, Phil https://joinup.ec.europa.eu/asset/core_location/description
[3]	Web Feature Service Implementation Specification / version 1.1.0 / 3 May, 2005 / Vretanos, P.A. (ed.) http://portal.opengeospatial.org/files/?artifact_id=8339
[4]	OpenGIS Web Map Tile Service Implementation Standard / 1.0.0 / 6 April, 2010 / Maso, J., Pomakis. K. and Núria, J. http://portal.opengeospatial.org/files/?artifact_id=35326

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I Executive summary

The purpose of the deliverable “Service specification for GeoLocator” (D2.5) is to provide specification document that describes the architecture, data contents and functionalities of the ELF GeoLocator service (D3.4).

The ELF GeoLocator service is a georeferencing service that serves multilingual European geographical names data that has been collected from several European countries. In addition to the geographical names data, the ELF GeoLocator service also makes use of data that has been collected from the INSPIRE/ELF themes Addresses (AD) and Administrative Units (AU). The main use cases for the ELF GeoLocator service are

- Use case A: a place name, address and administrative unit search functionality that can support for instance a web map application. The web map user interface may contain a name search form where users can type place names, addresses or administrative unit names. The queries are transferred to the ELF GeoLocator service that returns the coordinate location for the queried name. When the web map application receives the answer, it pans the map to the received location.
- Use case B: a web map application where user clicks a selected location on a map. The coordinates of the clicked location are transferred to the ELF GeoLocator service that returns the place name or address that is nearest to the clicked location. The administrative unit that contains the clicked point is returned if the administrative unit search mode is set on. The administrative unit hierarchy can be obtained by following the parent links that are included in the returned feature.
- Use case C: the place name content of the ELF GeoLocator is visualized on top of other content.

The ELF GeoLocator service provides functionalities for performing geocoding (use case A) and reverse geocoding (use case B). Geocoding refers to the process of finding the coordinates of a feature on the basis of a given feature name or address. The reverse geocoding refers to the process of finding the place name that is located nearest to the given coordinate point. The geocoding functionalities of the ELF GeoLocator Service include ordinary geocoding, administrative unit -limited geocoding and fuzzy name search-based geocoding. The reverse geocoding contains two functionalities, ordinary reverse geocoding and administrative unit-limited reverse geocoding.

The ordinary geocoding functionality is provided for geographical names-, addresses- and administrative unit-based data. The administrative unit-based geocoding functionality focuses the name search queries to a specific administrative unit names. The fuzzy name search-based geocoding functionality returns results that are near matches for the queried name. The reverse geocoding functionality can be used for finding the nearest place name or address for a selected coordinate point. For AU-based data, the GeoLocator service provides AU-based reverse geocoding where the clients can find the administrative unit, including the whole administrative unit hierarchy, in which the coordinate point is located.

The main output format of the GeoLocator service is the GML output that is compliant with the schema defined in the Open Geospatial Consortium’s (OGC) Gazetteer Service Application Profile of the Web Feature Service (WFS-G AP) Best Practice document [1]. The output of the GeoLocator service is provided mainly as SI_LocationInstance features, defined in the Gazetteer Service AP. Other supported GML-based output forms are the INSPIRE/ELF GN output and the Core Location Vocabulary (CLV) output [2]. Other supported output formats are JavaScript Object Notation (JSON), Keyhole Markup Language (KML). The place name contents of the GeoLocator Service are also provided in visual form as a Web Map Tile Service (WMTS) [4] (Figure 1).

The INSPIRE specification takes note of the gazetteer service information model in the INSPIRE Generic Conceptual Model that contains a reference to the WFS-G best practice document. In general, the INSPIRE documentation does not contain any gazetteer service specification.

2 Service Architecture

The ELF GeoLocator service environment consists of the following components (Figure 1).

- Service database (PostgreSQL / PostGIS)
- deegree WFS application
- Custom front-end WFS application (adds support for language-specific queries and additional service operations and produces the WFS-G, the INSPIRE/ELF GN and the CLV outputs)
- GeoServer (produces the JSON and the KML outputs)
- MapServer & MapCache (produces the WMTS output)

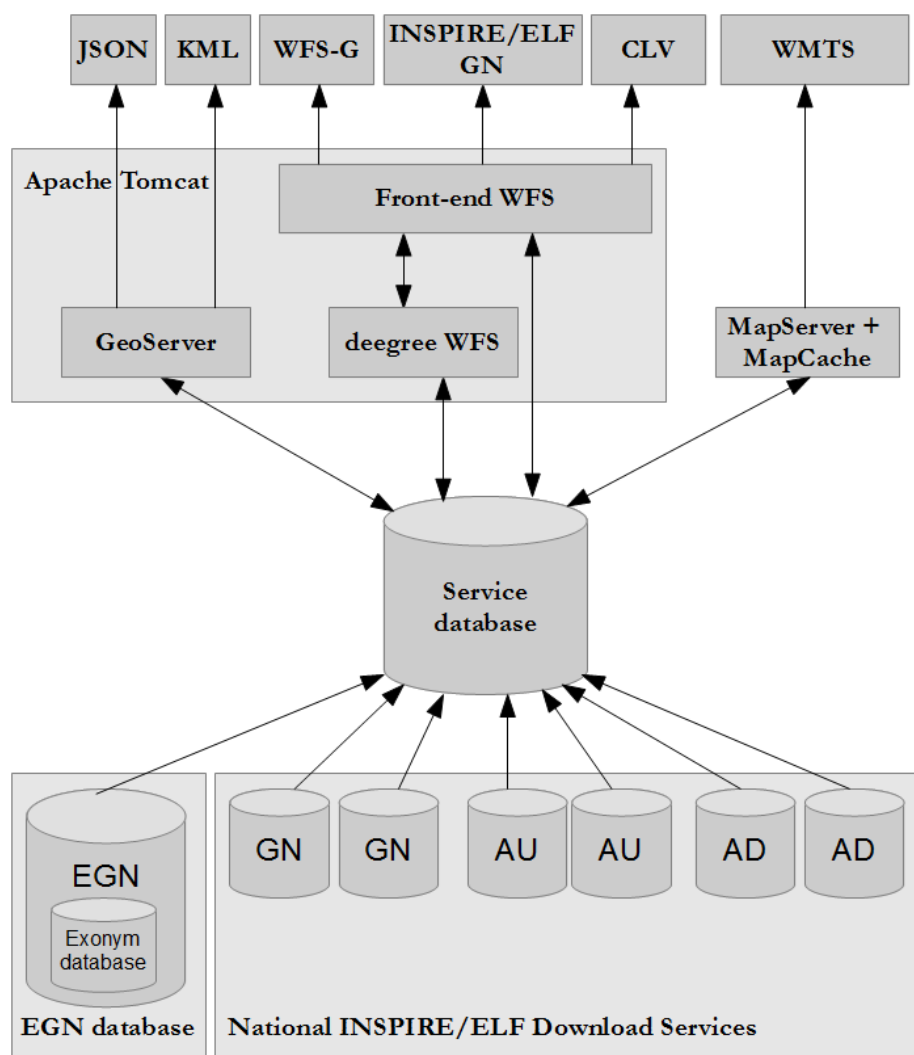


Figure 1. The architecture of the ELF GeoLocator service with different outputs

3 Data Sources

The ELF GeoLocator service utilizes the data contents of the EuroGeoNames (EGN) database that contains also the data contents of the EGN exonym database (Figure 1). The EGN database was the first version of the GeoLocator service database. In addition the ELF GeoLocator service contains data from the following INSPIRE/ELF data themes

- Addresses (AD)
- Administrative Units (AU)
- Geographical Names (GN), for new countries

The imported data is linked together so that it forms an administrative unit hierarchy. The hierarchy is created by linking the AD and EGN/GN data into the AU instance containing the AD or EGN/GN feature. After that, the rest of the administrative unit hierarchy will be formed by linking each administrative unit instance to the administrative unit instance that contains it in the next hierarchy level. The whole administrative unit hierarchy can be found out by traversing the parent links.

The ELF Geolocator data is maintained in the database in the ETRS89 Coordinate Reference System that has the EPSG code EPSG:4258.

4 Service database

The database schema of the ELF GeoLocator database consists of 6 tables that are presented in Figure 2.

The *si_location_instance* and the *alternative_geographic_identifier* tables are the main tables of the database and they contain the EGN/GN, AD and AU feature information. The *si_location_instance* table contains the data that are related to the location instance objects and the *alternative_geographic_identifier* table contains the names that are related to these location instance objects. One *si_location_instance* instances can have many associated *alternative_geographic_identifier* instances.

The *si_location_type* table contains information about the location types that are supported by the ELF Geolocator Service. These location types are listed in Annex 1. The *si_gazetteer* table contains information about the gazetteer itself. The *gazetteer_location_type* and the *location_type_link* tables are supporting tables that assist in managing the location type information.

The *si_location_instance* features differ to some extent between EGN/GN, AD and AU –based data. The differences are related to columns

- *national_level*
- *parent*
- *postcode*

The *national_level* column contains the level of the AU–based feature in the administrative unit hierarchy. The *national_level* column is populated only for the AU-based features.

The *parent* column contains the identifier of the AU-based feature that is the parent of the *si_location_instance* in the administrative unit hierarchy. The *parent* column is left unpopulated for AU-elements that don't have any parent features. The parent information can be used for forming the administrative unit hierarchy.

The *postcode* column indicates the postcode of the postal area, in which the AD-based features are located. The *postcode* column is populated only for the AD-based features.

5 Service functionalities

The ELF GeoLocator service contains functionalities for performing ordinary geocoding, administrative unit–based geocoding, fuzzy name search–based geocoding and reverse geocoding.

5.1 Service operations

The ELF GeoLocator service supports the WFS specification version 1.1.0 [3] with operations

- GetCapabilities
- DescribeFeatureType
- GetFeature

In addition, the GeoLocator service supports the following custom GeoLocator operations

- GetFeatureInAU
- FuzzyNameSearch
- ReverseGeocode (2 modes)
 - o Ordinary reverse geocoding
 - o Administrative unit-limited reverse geocoding

5.2 GetCapabilities operations

The *GetCapabilities* operation returns the service metadata. The use and the parameters of the *GetCapabilities* operation are described in the WFS specification [3].

5.3 DescribeFeatureType operation

The *DescribeFeatureType* operation returns detailed information on the specified feature type. The use and the parameters of the *DescribeFeatureType* operation are described in the WFS specification [3].

5.4 GetFeature operation

The *GetFeature* operation returns the requested features. The output is available in WFS-G [1], INSPIRE/ELF GN and CLV [2] formats. The default output format is WFS-G. The INSPIRE/ELF GN and CLV output formats can be requested by using the WFS parameter OUTPUTFORMAT. The *GetFeature* operation supports the OGC filter encoding specification. More details about the supported filter operations can be found at the *GetCapabilities* response document. The use and the parameters of the *GetFeature* operation are described in the WFS specification [3].

In addition to the WFS specification-defined parameters, the ELF GeoLocator service contains a custom LANGUAGE parameter for the *GetFeature* operation that can be used for requesting feature classification information in a specific language. The available languages are displayed in the *GetCapabilities* operation's response document.

5.4.1 Service output

The output formats that the ELF GeoLocator service supports are presented in Figure 1. The main output format is an XML-encoded message in the OGC's WFS Gazetteer Service Application Profile (WFS-G AP) schema [1]. The UML model of the WFS-G AP schema is presented in Figure 3. The INSPIRE/ELF GN, AD and AU –based features are outputted mainly as WFS-G AP schema's SI_LocationInstance features. The SI_LocationType features contain information about the supported location types. The SI_Gazetteer feature contains information about the Gazetteer Service itself.

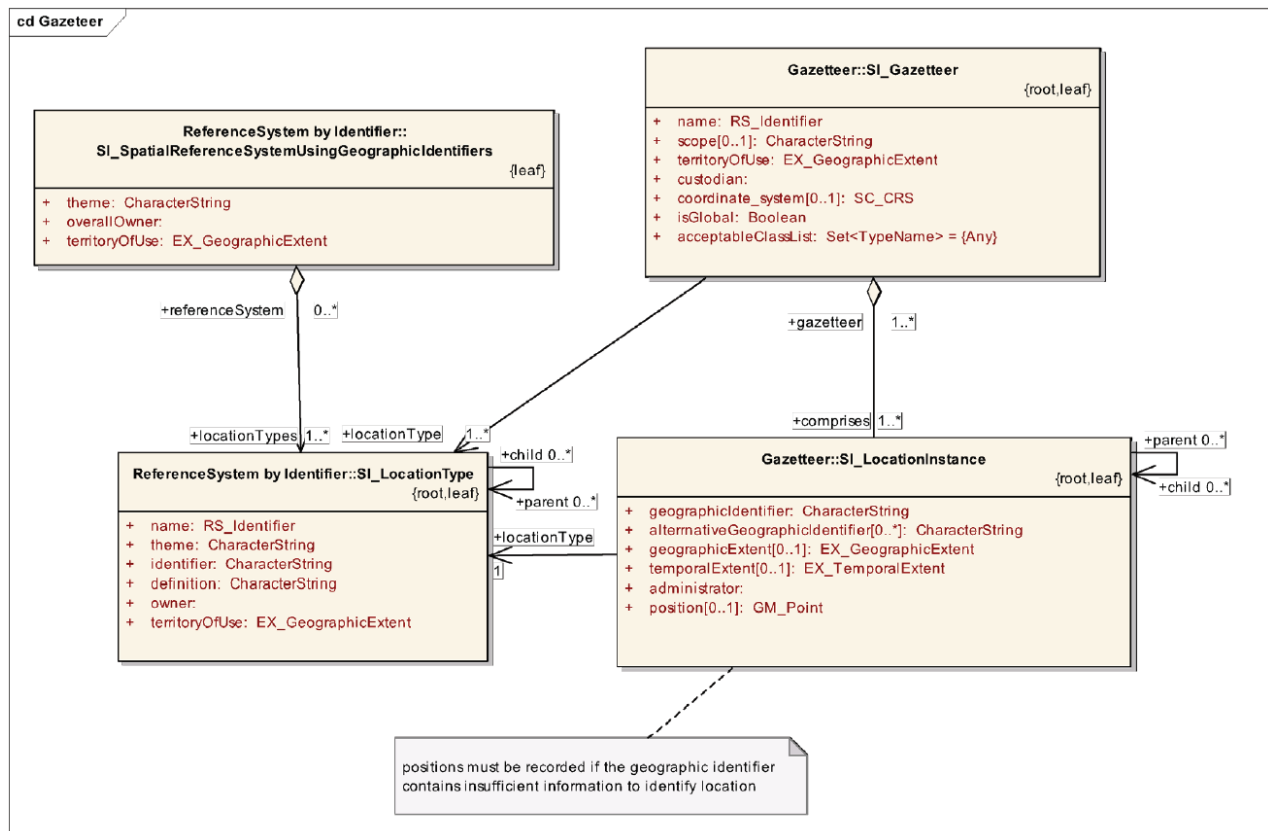


Figure 3. The UML model of the WFS-G Application Profile schema [1]

Other supported output formats in the ELF GeoLocator service are the INSPIRE/ELF GN output and the Core Location Vocabulary output [2]. In addition, the JSON and the KML output formats are provided through the GeoServer application. The geographical names are also provided in a visual form via the WMTS interface [4] as tiled PNG images with transparent background.

5.4.2 WFS-G output example

The (Figure4) presents an example of the output of the GeoLocator Service according to the WFS-G schema, in which the place names content is modeled as 'SI_LocationInstance' features. The schema is based on the information model originally introduced by the ISO standard 19112 Geographic information – Spatial referencing by geographical identifiers. The content of the individual elements are:

- *iso19112:SI_LocationInstance* : the root element of the feature
- *gml:boundedBy* : the feature's bounding rectangle
- *iso19112:geographicIdentifier* : the feature's unique identifier
- *iso19112:alternativeGeographicIdentifiers* : the names of the feature. One feature can contain several names.
 - *iso19112:alternativeGeographicIdentifier* : a name of the feature and other information related to that name
 - *iso19112:name* : the name of the feature
 - *xml:lang* attribute : the language of the name
 - *iso19112:nameID* : the unique name identifier
 - *iso19112:type* : the type of the name. The type is either *official* or *variant*
 - *iso19112:primary* : a Boolean value that indicates whether the name is primary or not
- *iso19112:position* : a coordinate point indicating the location of the feature

- *srsName* attribute : the used coordinate reference system
- *iso19112:geographicExtent* : the geographic extent of the feature
- *iso19112:dateModified* : the last update date of the feature
- *iso19112:administrator* : the name of the feature's administrator.
- *iso19112:spatialObject* : feature's unique identifier
- *iso19112:parent* : the name of and the link to the feature's parent feature. One parent element is created for each name of the parent feature
 - *xlink:title* attribute : the name of feature's parent and the used language in parenthesis
 - *xlink:href* attribute : the link to the parent feature
- *iso19112:locationType* : the link to the location type feature and also the name of the location type in a given language (if the language is specified in the service query, otherwise in the default language)
 - *xlink:title* attribute : the name of the location type. Language can be selected by the LANGUAGE parameter in the GeoLocator operations
 - *xlink:href* attribute : the link to the location type feature

[illegible]

Figure 4. Example of the WFS-G schema's SI LocationInstance output

5.4.3 Geocoding

The main geocoding functionality of the ELF GeoLocator service is available through the WFS *GetFeature* operation. The geocoding queries are executed by making *GetFeature* queries containing feature name filters that are specified according to the OGC filter encoding. The result of the query is a *SI_LocationInstance* feature (Figure 4) where the coordinates are located in the *iso19112:position* element. The queryable names are located in the *iso19112:alternativeGeographicIdentifiers/iso19112:alternativeGeographicIdentifier/iso19112:name* elements.

For AD and EGN/GN-based data the geocoding functionality returns the coordinate point of the address or the geographical name. For AU-based data the geocoding returns the center point of the administrative unit's geometry.

5.5 GetFeatureInAU operation

The *GetFeatureInAU* operation performs administrative unit-limited geocoding where the name search queries can be focused to a specific administrative unit. The *GetFeatureInAU* operation returns *SI_LocationInstance* features that match the queried name and are located within the specified administrative unit.

The Table 1 shows the parameters for the *GetFeatureInAU* operation.

GetFeatureInAU operation		
Parameter	Description	Mandatory / Optional
NAME	Name to be searched	Mandatory
AU	Name of the AU element where the query will be focused	Mandatory
LANGUAGE	Language that is used for displaying the feature type name in the <i>SI_LocationInstance</i> output	Optional

Table 1: The parameters of the *GetFeatureInAU* operation

5.6 FuzzyNameSearch operation

The *FuzzyNameSearch* operation performs geocoding by executing name search functionality that returns *SI_LocationInstance* features whose names are at least near matches for the queried name. The *FuzzyNameSearch* operation can find features based on slightly misspelled input. It can also be used for example to request features whose names contain diacritics or other special characters that are not available on the user's keyboard. The *FuzzyNameSearch* operation returns the maximum amount of 10 features whose names matches best the given query name.

The Table 2 shows the parameters for the *FuzzyNameSearch* operation.

FuzzyNameSearch operation		
Parameter	Description	Mandatory / Optional
NAME	Name to be searched	Mandatory
LANGUAGE	Language that is used for displaying the feature type name in the <i>SI_LocationInstance</i> output	Optional

Table 2: The parameters of the *FuzzyNameSearch* operation

5.7 ReverseGeocode operation

The ELF GeoLocator service contains reverse geocoding functionality for AD, AU and EGN/GN data. The reverse geocoding functionality has two modes

- Ordinary reverse geocoding
- Administrative unit-based reverse geocoding

The administrative unit-based reverse geocoding can be selected by using the MODE parameter with the fixed value 'AU'. If the MODE=AU parameter value is omitted from the query then the ordinary reverse geocoding is performed.

The result of the *ReverseGeocode* operation is a SI_LocationInstance feature. The ordinary reverse geocoding returns the address or the name that is nearest to the given coordinate point. The administrative unit-based reverse geocoding returns the AU-based SI_LocationInstance feature that contains the given coordinate point in its area.

The clients can obtain the whole administrative unit hierarchy by following the parent links that are included in the service's WFS-G output's *iso19112:parent* elements (Figure 4).

The Table 3 shows the parameters for the *ReverseGeocode* operation.

ReverseGeocode operation		
Parameter	Description	Mandatory / Optional
LAT	Latitude (in EPSG:4258)	Mandatory
LON	Longitude (in EPSG:4258)	Mandatory
MODE	Reverse geocoding mode. The fixed value 'AU' indicates AU based reverse geocoding If the MODE parameter is not used, then the standard reverse geocoding is performed	Optional
LANGUAGE	Language that is used for displaying the feature type name in the SI_LocationInstance output	Optional

Table 3: The parameters of the ReverseGeocode operation

6 Query Examples

6.1.1 GetFeature (HTTP GET)

Example of a HTTP GET *GetFeature* query that executes geocoding with a name "Masala".

```
[DOMAIN]/GeolocatorService?SERVICE=WFS&REQUEST=GetFeature&NAMESPACE=xmlns(iso19112=
http://www.isotc211.org/19112)&TYPENAME=SI_LocationInstance&Version=1.1.0&MAXFEATURES=1
0&language=eng&FILTER=<ogc:Filter xmlns:ogc="http://www.opengis.net/ogc"
xmlns:iso19112="http://www.isotc211.org/19112"><ogc:PropertyIsEqualTo><ogc:PropertyName>iso
19112:alternativeGeographicIdentifiers/iso19112:alternativeGeographicIdentifier/iso19112:name</o
gc:PropertyName><ogc:Literal>Masala</ogc:Literal></ogc:PropertyIsEqualTo></ogc:Filter>
```

6.1.2 GetFeature (HTTP POST)

Example of HTTP POST *GetFeature* query executes geocoding with the name filter "Masala".


```

<wfs:GetFeature version="1.1.0" outputFormat="text/xml; subtype=gml/3.1.1" xmlns:wfs="http://www.opengis.net/wfs"
  xmlns:ogc="http://www.opengis.net/ogc" xmlns:gml="http://www.opengis.net/gml" language="eng">
  <wfs:Query typeName="iso19112:SI_LocationInstance" srsName="EPSG:4258">
    <ogc:Filter>
      <ogc:PropertyIsEqualTo>
        <ogc:PropertyName xmlns:iso19112="http://www.isotc211.org/19112">
          iso19112:alternativeGeographicIdentifiers/iso19112:alternativeGeographicIdentifier/iso19112:name
        </ogc:PropertyName>
        <ogc:Literal>Masala</ogc:Literal>
      </ogc:PropertyIsEqualTo>
    </ogc:Filter>
  </wfs:Query>
</wfs:GetFeature>

```

Figure 5. Example of a GetFeature query (HTTP POST)

6.1.3 GetFeatureInAU (HTTP GET)

[Domain]/GeolocatorService?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetFeatureInAu&NAME=Masala&AU=Kirkkonummi&LANGUAGE=eng

6.1.4 GetFeatureInAU (HTTP POST)

```

<elf:GetFeatureInAu version="1.1.0" xmlns:elf="http://www.elfproject.eu/"
  outputFormat="text/xml; subtype=gml/3.1.1" language="eng">
  <elf:Query name="Masala" au="Kirkkonummi"> </elf:Query>
</elf:GetFeatureInAu>

```

Figure 6. Example of a GetFeatureInAU query (HTTP POST)

6.1.5 FuzzyNameSearch (HTTP GET)

Example of a FuzzyNameSearch query where the queried name “ceske budejovice” is misspelled from the proper form “České Budějovice”.

[Domain]/GeolocatorService?SERVICE=WFS&REQUEST=FuzzyNameSearch&NAME=ceske%20budejovice

6.1.6 FuzzyNameSearch (HTTP POST)

```

<elf:FuzzyNameSearch version="1.1.0" xmlns:elf="http://www.elfproject.eu/"
  outputFormat="text/xml; subtype=gml/3.1.1" language="eng">
  <elf:Query name="ceske budejovice"/>
</elf:FuzzyNameSearch>

```

Figure 7. Example of a FuzzyNameSearch query (HTTP POST)

6.1.7 ReverseGeocode (HTTP GET)

[Domain]/GeolocatorService?SERVICE=WFS&REQUEST=ReverseGeocode&LAT=60.4848175&LON=22.4390926&LANGUAGE=eng

6.1.8 ReverseGeocode (HTTP POST)

```
<elf:ReverseGeocode version="1.1.0" outputFormat="text/xml; subtype=gml/3.1.1"
  xmlns:elf="http://www.elfproject.eu/" language="eng">
  <elf:Query lat="61.4848175" lon="22.6390926"/>
</elf:ReverseGeocode>
```

Figure 8. Example of a ReverseGeocode query (HTTP POST)

6.1.9 ReverseGeocode (MODE=AU) (HTTP GET)

[Domain]/GeolocatorService?SERVICE=WFS&REQUEST=ReverseGeocode&LAT=60.4848175&LON=22.4390926&LANGUAGE=eng&MODE=au

6.1.10 ReverseGeocode (MODE=AU) (HTTP POST)

```
<elf:ReverseGeocode version="1.1.0" outputFormat="text/xml; subtype=gml/3.1.1"
  xmlns:elf="http://www.elfproject.eu/" language="eng">
  <elf:Query lat="61.4848175" lon="22.6390926" mode="au"/>
</elf:ReverseGeocode>
```

Figure 9. Example of an administrative unit-based ReverseGeocode query (HTTP Post)

Annex I – List of the supported location types in the ELF GeoLocator service

List of the location types in the ELF GeoLocator service	
1	COUNTRIES, ADMINISTRATIVE UNITS AND OTHER AREAS
2	Country
3	Administrative units
4	Other non-administrative units
5	POPULATED PLACES
6	Administrative capitals
7	Other populated places
8	Houses
9	NON-RESIDENTIAL STRUCTURES AND BUILDINGS
10	Economic activity facilities
11	Social facilities, administrative buildings and monuments
12	Other non-residential structures
13	TRANSPORT AND TELECOMMUNICATION FEATURES
14	Air transport
15	Waterborne transport
16	Land transport
17	Telecommunication
18	TERRAIN FEATURES
19	Island
20	Coastal and shore relieves
21	Elevation
22	Natural terrain areas or regions
23	Point terrain features
24	HYDROGRAPHIC FEATURES
25	Seas or part of them
26	Standing water features
27	Flowing water features
28	Hydrographic point features
29	Diverse hydrographic structures
30	Other hydrographic and underwater features
31	CONSERVATION AREAS
32	World Heritage Sites
33	Conservation areas of natural environment
34	MISCELLANEOUS

Figure 10. List of the supported location types in the ELF GeoLocator service