Reportnet and data harvesting using INSPIRE infrastructure
(Feasibility study)

Report 2: Referencing spatial objects using INSPIRE network services

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Contents

Acknowledgements

Terms and definitions

Access point

Access point (of a Spatial Data Service) is an URL for retrieving a detailed description of a Spatial Data Service, including a list of end points to allow its execution. [1]

Catalogue Service for the Web (CSW)

 OGC® Catalogue Services support the ability to publish and search collections of descriptive information (metadata records) for geospatial data, services, and related information. Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the discovery and binding to registered information resources within an information community[1].

Direct access download service

Direct access download means a Download Service, which provides access to the spatial objects in spatial datasets, based upon a query. [2]

A direct access download service extends the functionality of a pre-defined dataset download service to include the ability to query and download subsets of datasets. The direct access download service allows more control over the download than the simple download of a pre-defined dataset or pre-defined part of a dataset. It can therefore be considered to be more „advanced" than the pre-defined dataset download. In this case, the spatial information is typically stored in a repository (e.g. a database) and only accessible through a middleware data management system (although the precise implementation may vary). The term direct access is used to mean the capability of a client application or client service to interact directly with the contents of the repository, e.g. by retrieving parts of the repository based upon a query. The query can be based upon spatial or temporal criteria, or by specific properties of the instances of the spatial object types contained in the repository. [1]

Download service

Download service is a service enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly. [3]

End point

End point (of a Spatial Data Service) is a URL used for directly calling an operation provided by the Spatial Data Service. [4]

These end points can be classified in four categories:

1. *Get Service Metadata* which provides information about the service, the available Spatial Datasets, and describes the service capabilities

2. *Get Spatial Dataset* which is an identifiable collection of spatial data

3. *Describe Spatial Dataset* which provides information describing spatial datasets making it possible to discover, inventory and use them.

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[1] https://www.opengeospatial.org/standards/cat

4. *Link Download Service* which allows the declaration of the availability of a Download Service for downloading Spatial Datasets.

Feature

'Feature' means abstraction of real world phenomena. [ISO 19101]

The INSPIRE Generic Conceptual Model[2] also provides additional explanation, as follows:
The term "(geographic) feature" as used in the ISO 19100 series of International Standards, in other specifications like IHO S-57, and in this document is synonymously with spatial object as used in this document. Unfortunately, "spatial object" is also used in the ISO 19100 series of International Standards, however with a different meaning: a spatial object in the ISO 19100 series is a spatial geometry or topology. [INSPIRE Generic Conceptual Model]

NOTE In the feasibility study, the terms 'feature' and 'spatial object' are used as synonyms.

Metadata

'Metadata' means information describing spatial datasets and spatial data services and making it possible to discover, inventory and use them. [3]

Pre-defined dataset download service

A pre-defined dataset download service provides for the simple download of pre-defined datasets (or pre-defined parts of a dataset) with no ability to query datasets or select user-defined subsets of datasets. A pre-defined dataset or a pre-defined part of a dataset could be (for example) a file stored in a dataset repository, which can be downloaded as a complete unity with no possibility to change content, whether encoding, the CRS of the coordinates, etc. [1]

Spatial data

'Spatial data' means any data with a direct or indirect reference to a specific location or geographical area. [3]

Spatial dataset

'Spatial dataset' means an identifiable collection of spatial data. [3]

Spatial data service

'Spatial data services' means the operations which may be performed, by invoking a computer application, on the spatial data contained in spatial data sets or on the related metadata. [3]

Spatial object

'Spatial object' means an abstract representation of a real-world phenomenon related to a specific location or geographical area. [3]

Web Feature Service (WFS)

WFS is a web service for geographic information specified by the International Organization for Standardization (ISO) in the standard ISO 19142 Web Feature Service (also as standard OGC Web

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Feature Service 2.0). It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions[3]. It supports ISO 19143 Filter Encoding (also as standard OGC Filter Encoding 2.0). In INSPIRE, the service could be used to implement pre-defined dataset download services and direct access download service.

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[3] https://www.iso.org/standard/42136.html

Executive summary

The feasibility study on data harvesting using INSPIRE infrastructure comes timely in view of the modernisation of the EEA's electronic infrastructure for reporting data collection, Reportnet, and contributes to the actions to streamline environmental reporting published by the European Commission as a result to the regulatory fitness check of environmental legislation. Firstly, data harvesting is proposed as a technological solution for the EU institutions to access data at national or local level without requesting Member States to actively report them. Secondly, the access to spatial data, an essential component in many environmental reporting obligations, is governed by the INSPIRE Directive adopted in 2007 that establishes the infrastructure for spatial information in Europe. INSPIRE provides the possibility to directly access spatial datasets, according to 34 INSPIRE spatial data themes, via standard web services (INSPIRE network services).

The scope of this feasibility study is therefore to explore and assess up to which extent the national services available through the INSPIRE infrastructure can actually contribute to streamline the reporting process, by automating as much as possible the collection of geospatial datasets pertaining to reporting obligations that are available through INSPIRE services.

Chapter 1 Introduction provides the wider EU policy context information behind the scope of the feasibility study. The two main objectives of the study are: (1) to demonstrate the viability of the harvesting workflow of complete datasets for reporting dataflow, and (2) to test the possibility to reference, find and download specific spatial objects required by environmental obligations through the INSPIRE infrastructure. Building on these two use cases, the methodology and results of this feasibility study are summarised in two reports:

- Data harvesting using INSPIRE network services, and
- Referencing spatial objects using INSPIRE network services.

The Natura 2000 network of sites has been selected as the thematic area due its well defined reporting data flow that also requires spatial data and due to the INSPIRE implementation roadmap, which requires Member States to make fully available (i.e. harmonised) the Natura 2000 sites through the INSPIRE infrastructure already since 2017. Furthermore, the Natura 2000 network is cross-referenced in several environmental legislative instruments, which makes it a perfect candidate for this study. In particular, protected areas reported under the Water Framework Directive and related to the Natura 2000 sites are used in this feasibility study.

The INSPIRE Geoportal has been used in the first place to identify relevant INSPIRE web services. Among all the discovered direct access download services provided as WFS (which methodology is described in the report "Data harvesting using INSPIRE network services"), a suitable sample of services was used to test the feasibility of finding and extracting specific spatial objects from the Natura 2000 sites data available in the INSPIRE infrastructure (the focus of this report).

The **Chapter 2 Information sources – data and web services** describes the three main data sources used in the feasibility study. It provides the relevant parts of data structures and data of the Natura 2000 European database, protected areas of Natura 2000 sites in the Water Framework Directive reporting obligation and the INSPIRE Protected sites datasets including

Natura 2000 sites. The list of suitable INSPIRE direct access download services (WFS) is provided in the sub-chapter 2.2.

The **Chapter 3 Referencing mechanism** describes the methodology used in detail, including different mechanisms and real examples of linking between data sources. The chapter starts with the workflow of linking the various data sources. The following sub-chapters provide general information on using WFS in INSPIRE and describe the two basic methods to access a particular spatial object by WFS: by downloading a complete dataset or by accessing directly a single spatial object. The chapter demonstrates in practice different ways of linking and extracting spatial objects by using a sample of 12 INSPIRE WFS. Here, the key finding was the wide heterogeneity in the implementations which may not prevent their actual use in harvesting and object referencing but would require further efforts and case-by-case adaptations.

The **Chapter 4 Conclusions and lessons learned** summarises the findings and propose a few recommendations aiming to increase the possibility to successfully link and directly access spatial objects in the INSPIRE infrastructure. Among these, providing better guidelines on how to encode the reference information (i.e. external object identifiers), performing adequate quality checks and ensuring timely synchronisation between the thematic and INSPIRE datasets can be considered critical for a future operationalisation of the proposed methodology.

The annexes include detailed information about the WFS requests and their results that could be reused again in further work, as follows:

Annex 1 Working with WFS – general information,

Annex 2 List of service requests and samples, and

Annex 3 GetCapabilities request.

The most relevant findings have already been included in the Requirements Catalogue for the development of Reportnet 3.0.

1 Introduction

1.1 Policy context

The European Commission's regulatory fitness and performance (REFIT) programme, which aims to ensure that EU legislation delivers results for citizens and businesses effectively, efficiently and at minimum cost, included also the fitness check of the EU environmental legislation, focusing on the reporting obligations, including the Directive for establishing an infrastructure for spatial information in the European Community (INSPIRE) [3]. Based on the REFIT outcomes[4], the European Commission defined several actions to streamline the environmental reporting [5]. Two actions (3 and 4) focus particularly on the streamlining of the reporting process, while the action 6 sets the priority for the implementation of the INSPIRE Directive to the geospatial datasets covered by the EU environmental legislation:

- Action 3: Modernise eReporting including through a more advanced Reportnet and by making best use of the existing infrastructure,

- Action 4: Develop and test tools for data harvesting at EU level, and

- Action 6: Promote full implementation of the INSPIRE Directive, giving priority to datasets most relevant for the implementation and reporting of EU environmental legislation.

These three actions act as key policy drivers behind the feasibility study on the use and harvesting INSPIRE services in Reportnet. The following sections provide details on these three actions.

Action 3 – Modernising eReporting through a more advanced Reportnet

Reportnet[5] is an infrastructure for supporting and improving data and information flows that are based on the EU environmental legislation, international agreements and the cooperation between the European Environment Agency (EEA) and the European Environment Information and Observation Network (Eionet)[6].

Reportnet has been developed since 2000 and has been in operational use since 2002. This means that initial design is now almost 20 years old. Over time, the reporting needs have changed and Reportnet has been modified to host special-cases so many times that the original design is beginning to be compromised and is reaching its capacity limits.

With the support of the European Commission, the project of Reportnet modernisation (namely Reportnet 3.0) has started in 2018 and aims, among others, to:

- Use a state of the art ICT technology for the next decade of e-reporting,

- Support the key functions of the whole data flow management lifecycle,

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[4] http://ec.europa.eu/environment/legal/reporting/fc_overview_en.htm ;

[5] https://www.eionet.europa.eu/reportnet

[6] https://www.eionet.europa.eu/

- Build upon interoperable generic modules and standards,

- Limit investment costs at national level by making use of existing IT infrastructure,

- Enhance Reportnet 2.0 functionalities,

- Reduce costs per individual data flow.

Action 4: Data harvesting tools at EU level

Data harvesting is proposed as a technological solution for the EU institutions to access data at national or local level without requesting Member States to actively report them. In principle, this would enable EU institutions to have better and more flexible access to data while minimising the administrative burden in Member States.

The European Commission, together with the EEA, have initiated projects[7] to explore the existing tools and ideas of data harvesting and to build the appropriate experiences on how this can be used more effectively in environment policy in the future.

Action 6: Promoting full implementation of the INSPIRE Directive, giving priority to datasets most relevant in environmental reporting

The development of the infrastructure for spatial information in Europe[8] (according to the INSPIRE Directive adopted in 2007) provides the possibility to directly access spatial datasets, according to 34 INSPIRE spatial data themes, via standard web services (INSPIRE network services). The spatial datasets covered by the themes in Annex I of the INSPIRE Directive (mostly reference data such as addresses, hydrography and transport network, but also protected sites) are required to be already provided through web services in a harmonised way (i.e. according to the Implementing Rules on interoperability of spatial data sets and services [6]). Spatial datasets from Annex II and III of the INSPIRE Directive shall be harmonised by 2020 and the complete INSPIRE infrastructure must be implemented by 2021 [7].

The definition of spatial datasets addressed by the INSPIRE Directive covers a wide spectrum of environmental (and other) data, from geographic reference points (e.g. location of monitoring station) to the environmental data being collected (e.g. concentration of a specific pollutant in the environment). At the same time, **most or all information reported under EU environmental legislation has a geospatial component, overlapping therefore with the INSPIRE scope.** If available through the INSPIRE infrastructure, the relevant geospatial datasets could eventually be harvested online by the corresponding reporting authorities whenever a new report is due, optimising the data flows from different organisations for EU level reporting purposes. There is therefore scope for streamlining the environmental reporting processes requiring the submission of geospatial information covered by INSPIRE, in order to avoid double reporting and address possible lack of coherence and consistency.

As a result of the mid-term evaluation of INSPIRE implementation[9] and the REFIT exercise published in 2016, the INSPIRE Maintenance and Implementation Group expert group (INSPIRE

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[7] http://www.eis-data.eu/

[8] INSPIRE web site: https://inspire.ec.europa.eu/

[9] https://www.eea.europa.eu/publications/midterm-evaluation-report-on-inspire-implementation

MIG)[10] agreed on a series of activities under their work programme 2017 – 2020 [8], which should help to simplify the implementation of INSPIRE and reinforce the INSPIRE use case in the context of environmental reporting.

One of these activities, "Priority list of datasets for e-Reporting" (2016.5), is actually included as the driver of the action 6 of the Action Plan to streamline monitoring and reporting. This action covers the identification and maintenance of a priority list of datasets[11] that are essential for monitoring and reporting of EU environment policy. The priority list of datasets for eReporting currently covers seven environmental domains (air, noise, nature, water, industrial accidents, industrial emissions, waste) and 22 EU environmental policies, and indicates the spatial data that are required under the relevant reporting obligations. The list serves as a guidance to Member States to make these datasets accessible through INSPIRE in a stepwise manner. Initially, the spatial datasets are to be provided "as is" (i.e. in their original structure and format) since most of these datasets fall under Annex III of the INSPIRE Directive and the deadline for their harmonisation according to the INSPIRE implementing rules on data and service interoperability is only in late 2020. The complete data harmonisation, including their connection with the reporting obligations, will then take place later in a stepwise approach, in line with the agreed reporting data models.

In the context of this activity, the INSPIRE Geoportal[12], established at Community level as the entry point to the Member States' (or other countries') INSPIRE infrastructures through network services, has also been revamped. Its current version presents simplified overviews of spatial datasets that are included in the priority list of datasets for e-Reporting (Priority Data Sets Viewer) or otherwise related to the INSPIRE spatial data themes (INSPIRE Thematic Viewer). These new functionalities provide simplified access to downloadable spatial datasets and their descriptions (metadata).

1.2   Scope of the feasibility study

The actions above aiming to streamline environmental reporting clearly indicate the new directions that need to be explored in order to achieve higher coherence and consistency in the geospatial information included in, or relevant to, environmental reporting obligations, avoiding double implementation and data provision and hence reducing costs for reporting.

The scope of this feasibility study is therefore to explore and assess up to which extent the national services available through the INSPIRE infrastructure can actually contribute to streamline the reporting processes, by automating as much as possible the collection of geospatial datasets pertaining to reporting obligations and which are available through INSPIRE services.

This feasibility study is supporting the Reportnet 3.0 scoping study, which will lay the foundations for the next generation of the reporting platform at the EEA.

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[10] https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=268249090
[11]

https://webgate.ec.europa.eu/fpfis/wikis/display/InspireMIG/Action+2016.5%3A+Priority+list +of+datasets+for+e-Reporting
[12] http://inspire-geoportal.ec.europa.eu/

Objectives

The specific objectives of this feasibility study on INSPIRE data harvesting are the following:

- **To demonstrate the viability of the harvesting workflow of complete datasets, including the collection of national service end points, the connection to the services and their monitoring, and the download and analysis of the geospatial data required by reporting obligations, and**

- **To test the possibility to reference, find and download specific spatial objects required by environmental obligations through the INSPIRE infrastructure.**

In order to address each of these two specific objectives, two use cases have been defined, which are further described below and from chapter 2 onwards.

Thematic context

To address the objectives of the feasibility study it was decided to pilot the harvesting of INSPIRE datasets provided as part of an existing and operational reporting data flow. It was also considered very convenient that the datasets on focus fall under INSPIRE Annex I, since for all themes covered by this Annex, harmonised spatial datasets, metadata and services should be available in the INSPIRE infrastructure since November 2017. The selected dataset was the Natura 2000 sites.

The Natura 2000 network[13] was established under the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) [9]. The network includes also special protected areas designated under the Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. The spatial data representing the Natura 2000 sites are related to the INSPIRE Protected sites spatial data theme which is included in the INSPIRE Directive Annex I. These datasets are also included in the priority list of datasets for eReporting mentioned above.

Use cases

As indicated above, the feasibility study explores two use cases:

- **Use case 1 on "Data harvesting using INSPIRE network services" explores the access and download of the complete spatial datasets of Natura 2000 sites from the INSPIRE infrastructure (harvesting of complete spatial dataset), and**

- **Use case 2 on "Referencing spatial objects using INSPIRE network services" explores how to reference, select and download only selected Natura 2000 sites from the INSPIRE infrastructure (harvesting of selected spatial objects).**

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[13] http://ec.europa.eu/environment/nature/natura2000/index_en.htm

Out of scope

The feasibility study does not aim to fully validate the conformity of datasets and services neither with the INSPIRE Directive nor with the Natura 2000 reporting obligations.

1.3 Methodology

1.3.1 Common methodology

The feasibility study relies on re-using existing tools (e.g. INSPIRE Geoportal), data (e.g. Natura 2000 reported data and datasets available in the INSPIRE infrastructure), services (national services available in the INSPIRE infrastructure) and specifications (e.g. reporting guidelines and specifications of INSPIRE components).

A pool of available and accessible INSPIRE download services providing INSPIRE spatial datasets of Natura 2000 sites is established as a common basis for more detailed and specific use and evaluation in both use cases. This initial list of service access points is established by semi-automatic and manual search in the INSPIRE Geoportal, which is then completed by creating the specific service end point requests:

- Using the INSPIRE Geoportal Priority Data Set viewer, which already provides an advanced selection of downloadable spatial datasets related to Natura 2000; the Geoportal Thematic Viewer can be further used for some additional refinements in the search if needed (e.g. INSPIRE spatial data theme Protected sites),

- Manually searching for additional downloadable spatial datasets in INSPIRE Geoportal Resource Browser,

- Compiling the list of service access points,

- Creating the specific service end point requests.

1.3.2 Methodology in use case on referencing spatial objects

In addition to the common methodology for the feasibility study, for the use case 2, the applied methodology starts with analysing the data available in different sources, continues with the analysis of the capabilities of the INSPIRE download services WFS and finally focusses on linking the datasets and using the WFS services to retrieve the requested information. In detail the different steps are:

- Analyse the WFD data with relation to Natura 2000,

- Analyse the Natura 2000 data, especially the field for INSPIRE external object identifier,

- Analyse the link between Water Framework Directive (WFD) reported data and Natura 2000 data,

- Analyse INSPIRE Protected sites datasets available through INSPIRE download services WFS,

- Analyse the link between Natura 2000 data and datasets available through INSPIRE download services WFS,

- Analyse the capabilities of available INSPIRE download services WFS with relation to direct access download services,

- Testing INSPIRE direct download services WFS for downloading all Natura 2000 features,

- Testing different linking alternatives using INSPIRE download services WFS to download a single selected Natura 2000 feature.

All tests were conducted using a standard web browser (Google Chrome).

1.4   How to read the reports of the feasibility study

Reports

The feasibility study is described in two reports, one for each use case:

- Use case on data harvesting (Use case 1) is described in the report **"Data harvesting using INSPIRE network services"**, and

- Use case on referencing spatial objects (Use case 2) is described in the report **"Referencing spatial objects using INSPIRE network services"**.

Both use cases use the common terminology, thematic context, datasets and services, and complement each other. The reports also reference each other to indicate the common elements or other exchange of related information or findings.

This report refers to data models and structures, attributes, data types, code lists and GML / XML schemas that are written in *italics* in order to distinguish those elements from other types of information, e.g. INSPIRE *ProtectedSite* spatial object, *SITE* table, *inspireID* identifier, etc.

Documenting requirements

Based on the findings in the feasibility study, a set of requirements have been developed to facilitate the inclusion of web services, in particular INSPIRE network services and data, in the development of the future reporting platform Reportnet 3.0. The priority of the requirements is provided by using the MoSCoW method[14] (M – must, S – should, C – could, W – won't).

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[14] https://en.wikipedia.org/wiki/MoSCoW_method

The requirements are provided in a common template that has the following structure: title, focus (stakeholder to whom the requirement is addressed) and description. They are included in the reports in the following form:

> **Requirement title**
> Requirement focus: <Stakeholder to whom the requirement is addressed>
> Description: <Description>

Structure of report Referencing spatial objects using INSPIRE network services

This report "Referencing spatial objects using INSPIRE network services" has the following structure:

Terms and definitions includes all terms and definitions used in the feasibility study (common to both use cases),

Chapter 1 Introduction provides background information, scope of the feasibility study and methodology,

Chapter 2 Information sources – data and web services describes the data sources and web services used in this use case.

Chapter 3 Referencing mechanism defines the mechanism for referencing spatial objects in INSPIRE infrastructure, demonstrates the examples of linking, finding and extracting spatial objects, and explains exceptions and issues.

Chapter 4 Conclusions and lessons learned summaries the study and describes the findings and experiences.

Annex 1 Working with WFS – general information briefly introduces a few information of using WFS to retrieve datasets and features.

Annex 2 List of service requests and samples includes detailed list of services and samples of WFS requests and responses.

Annex 3 GetCapabilities request provides an example of WFS GetCapabilities document.

2 Information sources – data and web services

This chapter describes data and service sources used in this use case. The European Natura 2000 database is a collection of reported data by the Member States based on the Commission Implementing Decision of 11 July 2011 concerning a site information format for Natura 2000 sites (notified under document C(2011) 4892)[15]. The Natura 2000 sites are also referenced in other reporting obligations, e.g. the Water Framework Directive, which requires a register or registers of protected areas for the protection of surface water and groundwater. The INSPIRE Directive defines the spatial data theme Protected sites that refers to Natura 2000 and promotes data sharing by using INSPIRE network services. This chapter presents options on how to link the Natura 2000 data structure and data with relevant different sources. It also gives an overview of INSPIRE direct access download services (i.e. WFS) that can be used to reference spatial information of the reported Natura 2000 sites in the INSPIRE datasets.

2.1 Data sources

2.1.1 Natura 2000

Natura 2000 is a coordinated network of protected areas stretching across all 28 EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive.[16] As stated in the Natura 2000 reporting guidelines[17] Member States report their protected sites under these directives according to the Natura 2000 Standard Data Form (SDF). The data is collected in the European Natura 2000 database.

In the current Natura 2000 reporting data flow, the Member States are requested to upload a three-parts data delivery in the country specific folder under Central Data Repository (CDR)[18] in Reportnet:

- A dataset containing the SDF for all sites (MDB or XML format),

- A spatial component containing the sites boundaries (SHP format),

- An explanatory note with all the changes.

The database related to the Natura 2000 SDF consists of more than 20 tables. The main table containing the base information for each Natura 2000 site is the *SITE* table. Other tables contain information related to the different parts of the SDF. For this exercise, the *MAP* table is important because it contains the *MAP_INSPIRE* field, which purpose is to link the Natura 2000 data to INSPIRE *ProtectedSite* spatial object (feature). The tables and properties important for this use case are shown in Figure 1.

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[15] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32011D0484

[16] http://ec.europa.eu/environment/nature/natura2000/index_en.htm

[17] https://bd.eionet.europa.eu/activities/Natura_2000/Folder_Reference_Portal/Reporting guidelines update 1.3-March 2012.pdf

[18] The Central Data Repository is part of the Reportnet infrastructure, a platform used for reporting data under the reporting obligations. https://cdr.eionet.europa.eu/

Figure 1 Relevant tables and properties in Natura 2000 database
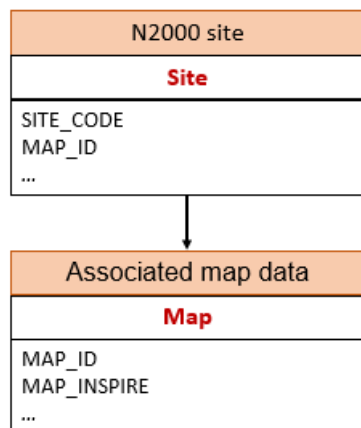
Within the shapefile that is part of the reporting data flow, each element has the *SITECODE* property, which allows one-to-one linking of geometry to the descriptive SDF data. As this use case aims at linking Natura 2000 SDF data to GML encoded INSPIRE spatial datasets by using INSPIRE download services WFS, shapefiles are not further considered in this report.

In this report the European Natura 2000 database published at the end of 2017 was used to explore the feasibility of different referencing techniques.

2.1.2   *Water Framework Directive and Natura 2000 sites*

According to Article 6 and Annex IV of the Water Framework Directive (WFD)[19], Member States shall ensure the establishment of a register or registers of all areas lying within each river basin district (RBD) which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater, or for the conservation of habitats and species directly depending on water, including the protection of Natura 2000 sites and economically significant aquatic species (e.g. shellfish)[20].

According to the surface water body (SWB) and groundwater body (GWB) schemas of the WFD reporting data model, protected areas are reported through their links to the surface and groundwater bodies they are associated with. However, if a protected area is already reported under another Directive, spatial information (i.e. geometry) is not reported again under the WFD. In the case of Natura 2000, the protected areas are identified in the WFD reporting using the Natura 2000 site code. In this case study, only the WFD protected areas identified by this Natura 2000 link are considered.

Figure 2 shows the relevant part of the WFD surface water data model: if a protected area associated with a SWB is a Natura 2000 site, the *ProtectedAreaType* of that protected area is Birds or Habitats, and the *euProtectedAreaCode* contains the Natura 2000 site code value of the area.

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[19] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060
[20] http://cdr.eionet.europa.eu/help/WFD/WFD_521_2016/GISGuidance/Clarification%20note%20protected%20areas.pdf

Figure 2 Relevant part of the WDF surface water data model
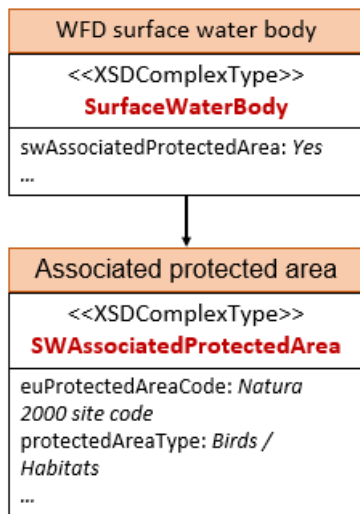
2.1.3 INSPIRE Protected sites

The INSPIRE Directive defines a spatial data theme Protected sites as "Area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives" [Directive 2007/2/EC]. According to the International Union for the Conservation of Nature (IUCN) a protected site is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.[21]

As such, the sites related to the Birds and Habitat Directives, which are also subject of the Natura 2000 reporting, are part of the INSPIRE Protected sites dataset.

Conceptually, the INSPIRE Protected sites data model includes spatial information (geometry) and a limited number of properties of a site. In accordance with the definition of a protected site, these properties are related to the legal status of the feature. Besides the INSPIRE identifier and the geometry, there is information about the name of the site, the legislation under which the site is protected, the sites designation and a classification about its protection. Figure 3 shows the content of the INSPIRE *ProtectedSite* feature type.

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[21]https://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf

Figure 3 Inspire Protected Sites feature type
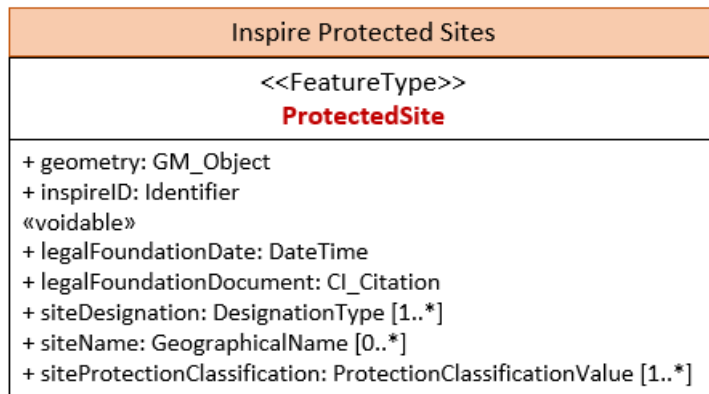
It is important to emphasize that the INSPIRE Protected sites spatial dataset can contain features protected by a diverse set of legislations, being the Birds and Habitat Directives only a subset of these. Therefore the Natura 2000 sites are only a fraction of the INSPIRE Protected sites.

In order to reference INSPIRE Protected sites spatial objects in the Natura 2000 reporting data, the *inspireID* and s*iteDesignation* attributes of the INSPIRE *ProtectedSite* feature type are of interest. According to the INSPIRE Protected sites data specifications[22], **inspireID** is the external object identifier for the unique identification of spatial objects and it shall not be changed during the life-cycle of a spatial object. This identifier "is published by the responsible body, which may be used by external applications to reference the spatial object".

The *inspireID* is of datatype *Identifier*. This is a complex type, which consists of three attributes as shown in Figure 4, namely *localId*, *namespace* and *versionId*. Attributes *localId* and *namespace* are mandatory, while *versionId* is associated with the particular version of the spatial object and is voidable.

Figure 4 Inspire Identifier data type
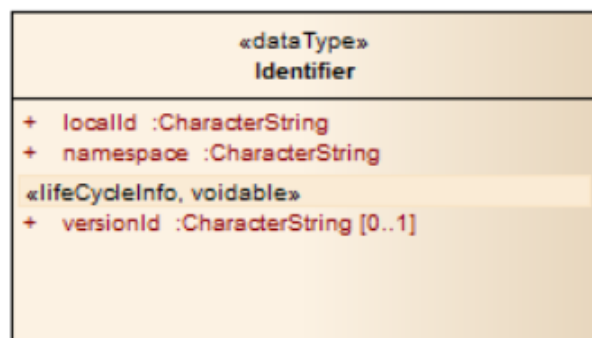
Each *ProtectedSite* spatial object has at least one **designation** assigned. This is provided in the *siteDesignation* attribute, which is of complex datatype *DesignationType* as shown in Figure 5.

---

[22]https://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf

Figure 5 Inspire Designation data type

The *DesignationType* provides information about the general classification of designation (e.g. Natura 2000, Ramsar), a more specific type of designation and which percentage of the protected site is designated.

For example, in the case of a protected site that is a Natura 2000 site, the *designationScheme* attribute would have value "natura2000" (from the code list *DesignationSchemeValue*) and the attribute *designation* would have one of the particular Natura 2000 site designations such as "specialAreaOfConservation" (from the code list *Natura2000DesignationValue*), shown in Figure 6.

Figure 6 Designation values for designation scheme "natura2000"

2.2 Natura 2000 related INSPIRE download services

Although the Natura 2000 reported data contains the field for linking the Natura 2000 site to a specific INSPIRE spatial object (feature), the reporting data flow does not include any information about the INSPIRE spatial dataset or service where this feature could be accessed.

Therefore, the starting point of the feasibility study was to create an initial list of INSPIRE download services related to Natura 2000 and/or INSPIRE Protected sites by analysing the results provided by the INSPIRE Geoportal. The initial list of services (described in the report "Data harvesting using INSPIRE network services") was prepared with the purpose to serve both use cases of the feasibility study. Among the different INSPIRE technological implementations, the WFS can be used as a direct access download service which provides access to the spatial objects in spatial datasets based upon a query. Hence, out of all the services initially discovered, only WFS were considered in this use case. The following table includes the list of WFS access points and information about the data schema used.

Table 1 List of WFS used in use case 2

Country	WFS GetCapabilities	Schema used
Czech Republic (CZ)	http://gis.nature.cz/arcgis/services/UzemniOchrana/Natura2000/MapServer/WFSServer?service=wfs&verion=2.0.0&request=getCapabilities	natura2000
Denmark (DK)	http://services.kortforsyningen.dk/service?servicename=ps_inspire_gml321&version=2.0.0&SERVICE=WFS&REQUEST=GetCapabilities	ps:ProtectedSite
Finland (FI1)	http://geoserver.ymparisto.fi/geoserver/wfs?service=wfs&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Latvia (LV1)	http://proxygds.viss.gov.lv/arcgis/rest/services/Predefined/ProtectedSitesInspireFeatDownServiceSiteProtClassLayers/MapServer/exts/InspireFeatureDownload/service?service=wfs&version=2.0.0&request=getcapabilities	protSite:psSiteS
Malta (MT2)	https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPA?service=WFS&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Malta (MT3)	https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPASCI?service=WFS&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Malta (MT4)	https://msdi.data.gov.mt/deegree/services/ps_Natura2000SCI?service=WFS&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Netherlands (NL1)	https://geodata.nationaalgeoregister.nl/inspire/ps/wfs?&service=WFS&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Netherlands (NL2)	https://geodata.nationaalgeoregister.nl/natura2000/wfs?service=wfs&version=2.0.0&request=GetCapabilities	Natura2000
Portugal (PT1)	http://wssig3.azores.gov.pt/geoserver/ps/wfs?service=wfs&version=2.0.0&request=GetCapabilities	ps:ProtectedSite
Romania (RO1)	http://gmlid.eu/RO/ENV/PADS/WFS/wfs?service=WFS&version=2.0.0&request=GetCapabilities	ps:ProtectedSite

Country	WFS GetCapabilities	Schema used
Sweden (SE1)	https://gis-services.metria.se/arcgis/rest/services/nv/InspireNV_WFS_N2K/MapServer/exts/InspireFeatureDownload/service?service=wfs&version=2.0.0&request=GetCapabilities	ps-f :ProtectedSite

During the evaluation of WFS identified in the initial list of INSPIRE download services[23], some WFS returned errors or were not suitable for further use in use case 2, as it is briefly described below:

- The WFS from Austria returns errors when executing requests,

- The WFS from Malta (MT1), *hb:Habitat*, is not used because data are returned in a different schema. Fortunately, other WFS from Malta could be used instead, and when combined, it was possible to access all Natura 2000 areas from Malta.

- The WFS from Sweden provides, besides *ps-f:ProtectedSite*, also data according to the schema *ps:ProtectedSite*, but service requests did not return any features,

- The WFS from Portugal (PT1) only contains data from the Azores, not covering all Natura 2000 areas from Portugal.

The report on Data harvesting using INSPIRE network services describe different methods for the identification of downloadable INSPIRE spatial datasets of Natura 2000 sites in the INSPIRE Geoportal. However, searching for particular INSPIRE spatial datasets related to Natura 2000 and the corresponding WFS providing spatial objects of the reported Natura 2000 sites in the expected *ps:ProtectedSite* schema is not straightforward.

> **Inspire spatial dataset and download service identification**
> Requirement focus: Requirement related to the Reportnet
> Description:
> Reportnet must include the means to provide / identify the INSPIRE dataset(s)/services that contain the correct data related to the reporting obligation in non-ambiguous way. It shall be mandatory for MS to provide this information.

---

[23] The complete initial list of identified INSPIRE download services for Natura 2000 datasets, used in the feasibility study, is described in the report Data harvesting using INSPIRE network services.

3 Referencing mechanism

The data structures illustrated in Chapter 2 include elements that support the linking between these sources. The referencing workflow relies on those elements and is built on the use of INSPIRE direct access download services implemented through WFS. The evaluation of the reported data (beyond pure data structures) revealed a heterogeneity that required investigating different mechanisms for referencing.

This chapter describes the referencing methods used and demonstrates how to use WFS to extract specific spatial objects from the INSPIRE datasets. The download options are illustrated starting from complete datasets, narrowing down to Natura 2000 sites selection and finally exploring WFS functionalities to request a specific single feature.

3.1 Workflow

As indicated already, the data structures of all three main data sources used in this study (protected areas under WFD, Natura 2000 SDF and INSPIRE Protected sites datasets) include elements that allow data linking and referencing.

The data model of the Water Framework Directive reporting obligation establishes the reference between the SWB and the protected area that is already designated as Natura 2000 site by the Natura 2000 site code.

The Natura 2000 SDF contains the *MAP_INSPIRE* field, which includes a reference to INSPIRE identifier of that spatial object.

The spatial objects in the INSPIRE spatial dataset of Natura 2000 sites (under INSPIRE Protected sites spatial data theme) include identifiers in the attribute *inspireID*.

Therefore, the referencing workflow starts at WFD reported associated protected area, continues over the Natura 2000 site to the corresponding INSPIRE spatial object as shown in Figure 7.

Figure 7 Dataflow for linking WFD to INSPIRE Protected sites
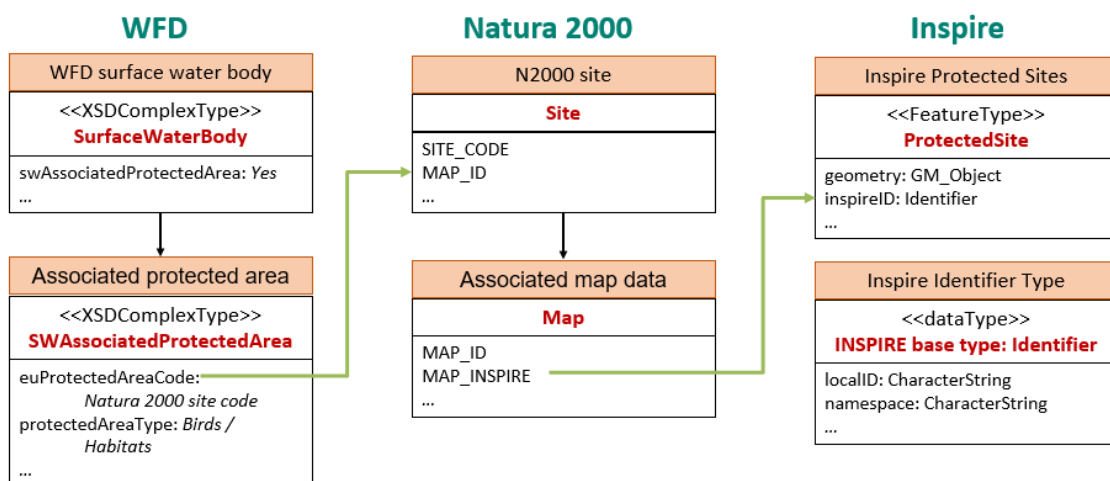
The link between the WFD and the Natura 2000 is a straightforward link between the provided datasets (e.g. relational database link).

To link the Natura 2000 data with the corresponding INSPIRE spatial objects, the correct INSPIRE download service WFS needs to be available and the applicable linking mechanism needs to be known. This results in the workflow presented in Figure 8, elaborated further in the next section:

Figure 8 Workflow for linking WFD to Inspire Protected sites by using WFS

Link WFD - SDF → Identify PS WFS service → Identify linking mechanism N2000 - PS → Build and submit WFS request → Process WFS response
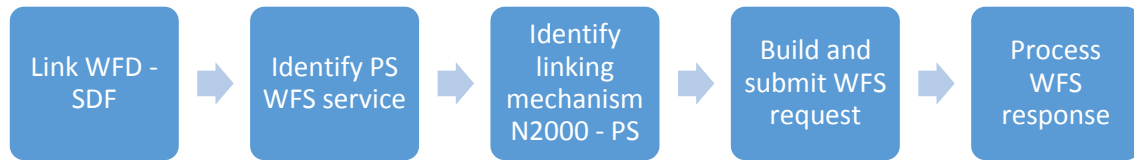
3.2 Referencing among the objects (records) in the datasets

3.2.1 WFD to Natura 2000

Protected areas associated with a SWB or GWB, and with the area corresponding to a Natura 2000 site, are identified by assigning the Natura 2000 site code to the *euProtectedAreaCode* attribute of the *SWAssociatedProtectedArea* type. Besides that, the attribute *protectedAreaType* contains the value Birds or Habitats.

Filtering the *Associated protected area* table on the values Birds and Habitats for the area type results in a list of all associated protected areas related to Natura 2000. Data used in this feasibility study contained 69.394 areas (based on the WFD 2016 reporting cycle).

Linking those areas to the Natura 2000 database (published in 2017) by linking the attributes *SWAssociatedProtectedArea.euProtectedAreaCode* and *Natura2000.SITE_CODE* was a very successful exercise (99.8%). Only in 93 cases the given *euProtectedAreaCode* (WFD) did not link to an existing Natura 2000 *SITE_CODE* (Natura 2000). One of the reasons for this mismatch in linking might be a time difference of reported data under both obligations, WFD (2016) and Natura 2000 (2017). Overall, the link between WFD and Natura 2000 can be considered reliable.

3.2.2 Natura 2000 to INSPIRE

Looking now at the link between Natura 2000 SDF data and the INSPIRE Protected sites datasets, the process becomes more complex.

INSPIRE identifier in reported Natura 2000 SDF data

According to the explanatory notes from the SDF[24], the INSPIRE identifier (*MAP_INSPIRE* in the Natura 2000 database) became obligatory as soon as the relevant INSPIRE implementing regulation came into force.

The INSPIRE Implementing Rules on interoperability of spatial data sets and services were adopted in 2010 and later amended to include spatial data themes from all INSPIRE Directive annexes (the last amendment took place in 2014). While the legal and technical basis was defined in 2010, the INSPIRE Directive also established a seven years period to provide existing datasets in conformity with the implementing rules.

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[24] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011D0484&from=EN

The analysis of the *Natura2000.MAP.MAP_INSPIRE* values in the database shows that only approximately a third of all Natura 2000 sites reported at the end of 2017 include values of INSPIRE spatial object identifiers (9902 out of 27.758 records). In general, some countries provided this information for each Natura 2000 site, while other countries left this field empty.

Structure of INSPIRE identifier

A second important issue concerning the link between the Natura 2000 SDF and the INSPIRE Protected sites dataset is the structure of INSPIRE spatial object identifier. The INSPIRE *Identifier* is a complex element composed of *localId*, *namespace* and (optionally) *versionId* [Figure 4]. In the Natura 2000 SDF data structure, *MAP_INSPIRE* is a single field. The current practice shows that INSPIRE identifier is provided in diverse ways, for example:

- Most Member States include only the *localId* part of the INSPIRE spatial object identifier, or

- Others concatenate the namespace (from INSPIRE) and site code (from Natura 2000) in the *MAP_INSPIRE* field.

The following table gives an overview of the analysis per country of the presence and structure of INSPIRE identifier in the reported Natura 2000 SDF:

Table 2 Comparing the value of INSPIRE Identifier in reported Natura 2000 SDF data

Country and country code	Records in Natura 2000 DB	*MAP_INSPIRE* filled in Natura 2000 database	Status of *MAP_INSPIRE* <> *inspireID* link	Remarks
Austria (AT)	309	90	not valid	The encoded values are not values of *inspireID*. For example, many refer to the same compressed file.
Belgium (BE)	310	2	missing	Only 2 records in Natura 2000 database include a value.
Bulgaria (BG)	339	0	missing	
Croatia (HR)	779	0	missing	
Cyprus (CY)	63	0	missing	
Czechia (CZ)	1153	1153	potentially valid	*MAP_INSPIRE* values are not related to data returned by WFS. The tested WFS does not provide data according to the INSPIRE Protected sites schema.

Country and country code	Records in Natura 2000 DB	MAP_INSPIRE filled in Natura 2000 database	Status of MAP_INSPIRE <> inspireID link	Remarks
Denmark (DK)	350	350	not valid	The values in *MAP_INSPIRE* do not match the values of *inspireID* in the WFS Protected sites data.
Estonia (EE)	567	0	missing	
Finland (FI)	1865	0	missing	
France (FR)	1773	0	missing	
Germany (DE)	5200	544	not valid	Apart from being incomplete, in some cases, the same *inspireID* is used for different Natura 2000 sites
Greece (GR)	446	0	missing	
Hungary (HU)	525	525	potentially valid	WFS was not tested in the study, *MAP_INSPIRE* values might be valid.
Ireland (IE)	604	604	valid	*MAP_INSPIRE = namespace+localId*
Italy (IT)	2613	1	missing	
Latvia (LV)	333	333	valid	*MAP_INSPIRE = localId*
Lithuania (LT)	551	0	missing	
Luxemburg (LU)	66	66	potentially valid	WFS was not tested in the study, *MAP_INSPIRE* values might be valid.
Malta (MT)	48	48	valid	*MAP_INSPIRE = localId* (with errors)
Netherlands (NL)	196	0	missing	
Poland (PL)	987	987	valid	*MAP_INSPIRE = namespace + localId*
Portugal (PT)	166	0	missing	
Romania (RO)	597	597	valid	*MAP_INSPIRE = localId*
Slovakia (SK)	683	4	missing	
Slovenia (SI)	355	355	potentially valid	WFS was not tested in the study, *MAP_INSPIRE* values might be valid.

Country and country code	Records in Natura 2000 DB	MAP_INSPIRE filled in Natura 2000 database	Status of MAP_INSPIRE <> inspireID link	Remarks
Spain (ES)	1863	159	not valid	*MAP_INSPIRE* values are all the same link to q service GetCapabilities document, not *inspireID* identifiers.
Sweden (SE)	4084	4084	valid	*MAP_INSPIRE = localId*
United Kingdom (UK)	933	0	missing	

Alternative linking

If the Natura 2000 reported data does not include a *MAP_INSPIRE* value, there are sometimes other options to link the objects in both datasets. In a few cases, data providers include the Natura 2000 site code in the *localId* part of the INSPIRE Protected site spatial object identifier. If this is the case, the correct INSPIRE feature might be discovered by matching the Natura 2000 site code and *inspireID.localId*.

Schema types used in INSPIRE Protected sites datasets

Some services in this use case provide data that does not follow the INSPIRE Protected sites Simple application schema. Analysing those different schemas shows they often contain a separate property that is directly linked to the Natura 2000 site code. Using those properties for linking was also tested in this study.

3.3   Using WFS in INSPIRE

The INSPIRE technical guidelines for Download Services[25] define two implementations: an implementation for predefined dataset download services and for direct access download services. The direct access download services are to be implemented (where practicable) following the ISO standard 19142 Geographic information - Web Feature Service[26] (and ISO 19143 Filter Encoding). ISO 19142 is also known as OGC Web Feature Service 2.0[27]. This use case is focused only on the functionalities provided by direct access download services implemented through WFS.

Two options have been tested to use INSPIRE WFS to obtain the spatial information (i.e. geometry) of reported Natura 2000 sites:

---

[25] http://inspire.ec.europa.eu/documents/Network_Services/Technical_Guidance_Download_Services_v3.1.pdf
[26] https://www.iso.org/standard/42136.html
[27] http://docs.opengeospatial.org/is/09-025r2/09-025r2.html

- Downloading all features at once and process them afterwards, or

- Requesting a single feature using the linking information available.

This section illustrates a general use of WFS for both options, i.e. by performing requests which return all (Natura 2000) features as well as by launching single feature requests. It also lists possibilities and examples of direct access download service WFS requests for INSPIRE spatial objects. Examples are given in key-value pair (KVP) notation, which can be used in URL GET requests sent to the server. Each KVP is added to the request in the form PARAMETER=value.

The general base for WFS requests, how to obtain the necessary functionalities that must be implemented on the WFS server to be INSPIRE compliant (GetCapabilities), the concept of stored queries and the generic syntax of the request used to retrieve spatial features from the service (GetFeature) are all further described in Annex 1 Working with WFS – general information.

3.4 Download a complete dataset using WFS

WFS GetFeature request

A first option to extract Natura 2000 relevant features by using WFS is by starting with the most elementary GetFeature request that results in downloading a complete dataset.

In some cases, a single WFS service serves several datasets. This means several GetSpatialDataSet (stored query) requests might be needed to get all Natura 2000 sites, while it can also be achieved with one WFS request.
To get all features from a specific feature type using a WFS service, the following GetFeature request (with the correct typenames parameter) can be used:

www.wfsserver.eu/wfs?service=WFS

&version=2.0.0
&request=GetFeature
&typenames=ps.ProtectedSite

srsName, count and startindex parameters can be added if necessary.

WFS with filter

When looking for Natura 2000 sites, stored queries or the above GetFeature request for INSPIRE spatial datasets that pertain to the INSPIRE Protected sites theme may not be optimal. The request returns the complete dataset while Natura 2000 sites may only be a part of the INSPIRE Protected sites dataset. It would therefore be useful to filter out only the Natura 2000 sites.
In the INSPIRE Protected sites dataset, the designation property gives the information needed for filtering. Natura 2000 sites have a designation scheme value "natura2000", which distinguishes them from other sites in the dataset.

In XML this value is not indicated by the string "natura2000" but as an xlink:href attribute pointing to the value in the code list[28] (published in the INSPIRE Registry[29]). This results in the following filter added to the original request:

www.wfsserver.eu/wfs?service=WFS

```
&version=2.0.0
&request=GetFeature
&typenames=ps.ProtectedSite
&filter= <Filter  xmlns=http://www.opengis.net/fes/2.0
        xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
        xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3
        xmlns:xlink="http://www.w3.org/1999/xlink">
                <PropertyIsEqualTo>
                        <ValueReference>
                        ps:siteDesignation/ps:DesignationType/
                        ps:designationScheme/@xlink:href
                        </ValueReference>
                        <Literal>
                        https://inspire.ec.europa.eu/codelist/DesignationSchemeValue
                        /natura2000
                        </Literal>
                </PropertyIsEqualTo>
        </Filter>
```

A request using this filter, while more complex in its syntax, can return exactly the targeted part of the dataset, avoiding the download of large datasets. As a way of example, using the "natura2000" filter on the INSPIRE Protected sites WFS service from the Netherlands, returns about 200 features (which corresponds with the number of sites in the Natura 2000 database); without this filter, the request for *ProtectedSite* would return more than 60.000 features.

Referencing INSPIRE code list values – different protocols in URL

During testing, it was noted that references to the INSPIRE code list values can be provided with two different protocols in the URL, i.e. http or https, as demonstrated by the two examples below.

An example from the NL1 WFS, using http:
<ps:designationScheme
xlink:href=**http://**inspire.ec.europa.eu/codelist/DesignationSchemeValue/natura2000/>

An example from PT1 WFS, using https:
<ps:designationScheme
xlink:href="**https://**inspire.ec.europa.eu/codelist/DesignationSchemeValue/natura2000"/>

---

[28] http://inspire.ec.europa.eu/codelist/DesignationSchemeValue
[29] https://inspire.ec.europa.eu/registry/

A filter in the WFS request requires the exact URL as it is encoded in the requested dataset. A workaround for supporting both notations of the protocol includes a few options:

- To create a filter looking for one of both notations, or

- To use a filter PropertyIsLike instead of PropertyIsEqualTo. (However, PropertyIsLike is significantly slower than PropertyIsEqualTo. An example of how to use PropertyIsLike is described in Section 3.5.3, Example: match through substring).

Filtering INSPIRE Protected sites spatial datasets using the designation scheme value "natura2000" is feasible and eliminates the return of thousands of unnecessary objects, but due to different notations of URL links there is not one unique filter that will work for all datasets of all Member States.

Requirements for further work on data harvesting in eReporting

Based on the findings in this use case, the following requirements can serve for further work on data harvesting in eReporting in the scope of modernisation of the reporting infrastructure Reportnet.

INSPIRE service test

Requirement focus: Requirement related to the Reportnet

Description:

If INSPIRE service is indicated in the reporting data flow, testing the availability of that service should be part of the reporting workflow. Secondly, it must be tested if the returned data follows the expected schema.

Possibility to download only data related to the reporting obligation

Requirement focus: Requirement related to the Reportnet

Description:

If an INSPIRE dataset contains features related to different reporting obligations, make sure it is possible to download only the part of the dataset related to that reporting.

3.5   WFS get a single feature

The previous exercise demonstrated that the response from the WFS server can be narrowed down to get only features of interest. This section describes how to get a response that returns a specific feature referenced in the Natura 2000 database.

A few important issues had to be taken into consideration when using this approach:

- In the Natura 2000 database used in this exercise, only a third of the Natura 2000 sites have the *MAP_INSPIRE* value filled in with the value of the INSPIRE spatial object identifier,

- The INSPIRE identifier is not provided in uniform way in Natura 2000 database, and

- The identified INSPIRE download services WFS do not always return the features in the expected INSPIRE Protected sites Simple application schema.

Since the INSPIRE spatial object identifier was not always available in the Natura 2000 database, an alternative possibility of referencing was investigated, relying on the presence of Natura 2000 site codes in the INSPIRE dataset. The results from this investigation differ from service to service and are given in detail in Annex 1, Section 1 Comparison of site identifications.

The following sections describe the different approaches used to get a specific feature by using WFS. Due to the heterogeneity in which the MS provide data, both Natura 2000 SDF (i.e. the content of *MAP_INSPIRE*) and INSPIRE datasets and services, most of the proposed solutions only worked for some of the MS data. The first two options are only usable if the INSPIRE external object identifier is reported in the Natura 2000 SDF data. Other options use instead the Natura 2000 site code for linking to related spatial objects in INSPIRE datasets.

3.5.1   Link MAP_INSPIRE and INSPIRE Protected sites gml:id

The first method is based on using the standard WFS GetFeatureById stored query, which points to the gml:id of the feature. However, there is no requirement in the INSPIRE technical guidelines[30] for this gml:id to be related with the INSPIRE identifier (*inspireID* in the INSPIRE Protected sites Simple application schema). Therefore, the GetFeatureById can only be used if the gml:id is exactly identical to the value of *MAP_INSPIRE*. In this case, the following request could be used:

www.wfsserver.eu/wfs?service=WFS
&version=2.0.0
&request=GetFeature
&&StoredQuery_ID=urn:ogc:def:query:OGC-WFS::GetFeatureById
&ID=MAP_INSPIRE

srsName, count and startindex parameters can be added if necessary.

For example, this method could be used on the INSPIRE download services WFS from Malta. A fragment of the returned result, for the Natura 2000 site with *MAP_INSPIRE* value MT.EA.MT0000110 is shown below. A more detailed description of this WFS request is presented in Annex 2, Section 2 GetFeature requests.

---

[30] https://inspire.ec.europa.eu/id/document/tg/ps or
http://inspire.ec.europa.eu/documents/Network_Services/Technical_Guidance_Download_Services_v3.1.pdf

```
<ps:ProtectedSite gml:id="MT.ERA.MT0000110" …>
        …
        <ps:geometry>
                <gml:Polygon gml:id="_21cc8e95-2672-4552-8c58-ac406f2fbc00"
        srsName="urn:ogc:def:crs:EPSG::4258">….</gml:Polygon>
        </ps:geometry>
        <ps:inspireID>
                <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                        <base:localId>MT.ERA.MT0000110</base:localId>
                        <base:namespace>Natura2000-SCIs_SPAs</base:namespace>
                </base:Identifier>
        </ps:inspireID>
        …
</ps:ProtectedSite>
```

Although this referencing technique worked correctly, it still was not possible to use it for the all Maltese Natura 2000 relevant INSPIRE spatial objects. The main reason behind were the errors in the values of the *MAP_INSPIRE* field of the Natura 2000 SDF data. In most cases, they were just typing errors. For example, the site with the site code MT0000106 had a *MAP_INSPIRE* value MT.ERA.MT106, while it should have been MT.ERA.MT0000106.

When using INSPIRE spatial datasets in the reporting data flow, such errors would result in incomplete reported data, as some of the INSPIRE spatial objects could not be found due to an incorrect referencing link. Therefore, if INSPIRE datasets were to be used as the official data source (e.g. geometry and other properties) in a reporting data flow, the links at object level would need to be checked.

Testing the references between spatial and non-spatial data

Requirement focus: Requirement related to the Reportnet

Description:

Test of each reported entry can be reached in the INSPIRE dataset through the given service(s). The Reportnet should include quality procedures to test the data and matching and to provide the notification on findings. If the INSPIRE dataset is used, it must be guaranteed that each reported entry has a corresponding feature in the INSPIRE dataset. Otherwise, the reporting cannot be complete.

3.5.2   Link MAP_INSPIRE and INSPIRE external object identifier (inspireID)

The INSPIRE data specifications define an external object identifier (*inspireID* in the INSPIRE Protected sites schema) which could be used to refer to an INSPIRE spatial object in an external dataset. This is exactly the purpose of the *MAP_INSPIRE* field in the Natura 2000 SDF data.

However, there is no predefined method to execute such request in WFS. It would be necessary to create a specific WFS GetFeature request with a filter that would compare the values of *MAP_INSPIRE* (Natura 2000) with the INSPIRE identifier (*inspireID* in INSPIRE Protected sites).

Using inspireID.localId (INSPIRE PS) in MAP_INSPIRE (Natura 2000)

If *MAP_INSPIRE* (Natura 2000) contains the value of the *inspireID.localId* (INSPIRE Protected sites) the filter can be built in the GetFeature request as follows:

```
www.wfsserver.eu/wfs?service=WFS
        &version=2.0.0
        &request=GetFeature
        &typenames=ps.ProtectedSite
        &filter= <Filter xmlns=http://www.opengis.net/fes/2.0
        xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
        xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <PropertyIsEqualTo>
                        <ValueReference>
                        ps:inspireID/base:Identifier/base:localId
                        </ValueReference>
                        <Literal>MAP_INSPIRE</Literal>
                </PropertyIsEqualTo>
        </Filter>
```

This method was used on the INSPIRE download services WFS from Romania (RO1). A fragment of the returned result for the Natura 2000 site with *MAP_INSPIRE* value **ROSCI0135** is shown below. The complete request is included in Annex 2, Section 2 GetFeature requests.

```
<ps:ProtectedSite gml:id="RO.ENV.PADS.PS.ROSCI0135">
        …
        <ps:geometry>
        <ps:inspireID>
                <base:Identifier>
                        <base:localId>ROSCI0135</base:localId>
                        <base:namespace>http://gmlid.eu/RO/ENV/PADS/PS/</base:namespace>
                </base:Identifier>
        </ps:inspireID>
</ps:ProtectedSite>
```

The testing shows that if *MAP_INSPIRE* is filled in correctly, it is possible to link the Natura 2000 site to the corresponding spatial feature in the INSPIRE dataset by INSPIRE download service WFS.

Combining localId and namespace of INSPIRE object identifier in MAP_INSPIRE (Natura 2000)

Some Member States (e.g. Poland) use the combination of two attributes of INSPIRE external object identifier, *inspireID.localId* and *inspireID.namespace*, as the value for *MAP_INSPIRE* in the Natura 2000 SDF data. Since the *localId* is indeed unique within its namespace, this could be seen as a better solution than using only the *localId* (example above). However, the encoding of this information in the Natura 2000 SDF data results into a combined text string that cannot be directly found in the INSPIRE dataset. In that case, it is not possible to create filter options to select the feature using INSPIRE download service WFS.

INSPIRE feature identification in Natura 2000 SDF

Requirement focus: Requirement related to the reporting data and service providers (MS) and specific for Natura 2000 and INSPIRE Protected sites

Description:

The way the INSPIRE external object identifier (*inspireID*) in the Natura 2000 SDF data should be filled in must be detailed, tackling the *namespace*/*localId* issue.

3.5.3 Link SITECODE and INSPIRE Protected sites inspireID

However, *MAP_INSPIRE* was only filled in for one in three Natura 2000 sites. Therefore, this section explores the alternative possibility to use the Natura 2000 site code (*SITECODE*) instead of the INSPIRE external object identifier for referencing.

There is no obligation to use the Natura 2000 site code in the INSPIRE external object identifier (*inspireID*). However, in many cases, data providers from the Member States implemented this approach by including the Natura 2000 site code in the *inspireID.localId*. Sometimes the *localId* is the same as the Natura 2000 site code, sometimes the *localId* is constructed using the code and additional pre- and/or postfixes.

Example: exact match

If the *localId* is the same as Natura 2000 site code (*SITECODE*), the construction of the query may just require the comparison operator PropertyIsEqualTo, which matches the *localId* with the Natura 2000 *SITECODE* value instead of the *MAP_INSPIRE* value (in the Literal property of the filter), as shown below:

```
www.wfsserver.eu/wfs?service=WFS
        &version=2.0.0
        &request=GetFeature
        &typenames=ps.ProtectedSite
        &filter= <Filter xmlns=http://www.opengis.net/fes/2.0
        xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
        xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <PropertyIsEqualTo>
                        <ValueReference>
                        ps:inspireID/base:Identifier/base:localId
                        </ValueReference>
                        <Literal>SITECODE</Literal>
                </PropertyIsEqualTo>
        </Filter>
```

For example, this method could be used on the INSPIRE download service WFS from Portugal. A fragment of the returned result for the Natura 2000 site with *SITECODE* value **PTJOR0013** is shown below. The exact request is presented in Annex 2, Section 2 GetFeature requests.

```
<ps:ProtectedSite gml:id="PTJOR0013">
        <ps:geometry>
        <ps:inspireID>
                <base:Identifier>
                        <base:localId>PTJOR0013</base:localId>
                        <base:namespace>http://id.igeo.pt/so/PS/ProtectedSite</base:namespace>
                        <base:versionId>2009</base:versionId>
                </base:Identifier>
        </ps:inspireID>
        …
</ps:ProtectedSite>
```

Example: match through substring

In other cases, the *inspireID.localId* is a combination of *SITECODE* and other information. Despite the differences between both values, it is still possible to establish a match by using the comparison operator PropertyisLike (combined with wildcards in the literal value) as follows:

```
www.wfsserver.eu/wfs?service=WFS
        &version=2.0.0
        &request=GetFeature
        &typenames=ps.ProtectedSite
        &filter= <Filter xmlns=http://www.opengis.net/fes/2.0
        xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
        xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                <PropertyIsLike>
                        <ValueReference>
                        ps:inspireID/base:Identifier/base:localId
                        </ValueReference>
                        <Literal>*SITECODE*</Literal>
                </PropertyIsLike>
        </Filter>
```

For example, this query could be used on the INSPIRE download service WFS from the Netherlands, e.g. the Natura 2000 site code **NL2009162** is provided in INSPIRE dataset in the *inspireID.localId* as **1_0_NL2009162**. A fragment of the returned result, for the Natura 2000 site with *SITECODE* value **NL2009162** is shown below. The actual request is presented in Annex 2, Section 2 GetFeature requests.

```
<ps:ProtectedSite gml:id="_1_0_NL2009162_">
        <ps:geometry>
        <ps:inspireID>
                <base33:Identifier>
                        <base33:localId>1_0_NL2009162_ </base33:localId>
                        <base33:namespace>nlps-natura2000</base33:namespace>
                </base33:Identifier>
        </ps:inspireID>
        …
</ps:ProtectedSite>
```

Example: no match

Despite successful examples of object referencing between Natura 2000 SDF data and INSPIRE datasets of Natura 2000 sites, the presented filter options are not applicable in all cases, as there is no current requirement to use the Natura 2000 site code in the *inspireID*. For example, the tested INSPIRE download service WFS from Denmark (DK1) delivers data according to the INSPIRE Protected site schema, but the *inspireID.localId* values have no link with Natura 2000 data, as shown in the next encoding sample:

ps:ProtectedSite gml:id="dk.ps.b1a5cf63-53a1-11e2-8ea5-00155d01e765">

        `<ps:geometry>….</ps:geometry>`
        `<ps:inspireID><base:Identifier>`
            `<base:localId>`**b1a5cf63-53a1-11e2-8ea5-00155d01e765**`</base:localId>`
            `<base:namespace>https://envi.data.gov.dk/cf11d200-9425-481a-ba9b-`
            `f5dc77f95026</base:namespace>`
        `</base:Identifier></ps:inspireID>`
        `<ps:legalFoundationDate>1799-12-31T23:00:00.000</ps:legalFoundationDate>`
        `<ps:legalFoundationDocument xsi:nil="true" nilReason="other:unpopulated"/>`
        `<ps:siteDesignation>`
            `<ps:DesignationType>`
                `<ps:designationScheme`
                `xlink:href="`**http://inspire.ec.europa.eu/codelist/DesignationScheme**
                Value/natura2000`"/>`
                `<ps:designation`
                `xlink:href="http://inspire.ec.europa.eu/codelist/Natura2000Designatio`
                `nValue/specialAreaOfConservation"/>`
            `</ps:DesignationType>`
        `</ps:siteDesignation>`
        `….`

The designation is without doubt "natura2000", but the Natura 2000 site code is not present in the INSPIRE spatial object. Furthermore, in this specific case the *MAP_INSPIRE* values in Natura 2000 data do not match either to the spatial object identifier in the INSPIRE dataset, resulting impossible to establish a link between those two datasets at the level of this particular object.

3.5.4 *Link SITECODE in alternative schemas containing a thematic identifier*

Some of the INSPIRE download services WFS tested in this use case did not return features in the expected INSPIRE Protected sites Simple application schema, but rather using other alternative (possibly nationally defined) application schemas. This requires exploring other approaches for future link scenarios.

The common characteristic of these alternative application schemas is that they all include a certain field that directly and uniquely links to the Natura 2000 site code. In such schemas, a standard filter applied on a specific field would always return the requested feature, if present. However, each of these schemas might name the element of the Natura 2000 site code differently. The following examples show how to link Natura 2000 information and INSPIRE objects by using this alternative Natura 2000 site code field.

Example: custom schema and field sitecode_h

The schema used in another INSPIRE download service WFS from the Netherlands (NL2) is *natura2000:natura2000*, which includes a field *sitecode_h* containing the Natura 2000 *SITECODE*. Since the value represents exactly the Natura 2000 site code, a request would look like the following:

www.wfsserver.eu/wfs?service=WFS

&version=2.0.0
&request=GetFeature
&typenames=**natura2000:natura2000**
&filter= <Filter xmlns=http://www.opengis.net/fes/2.0
xmlns:natura2000=http://natura2000.geonovum.nl
xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
    <PropertyIsEqualTo>
        <ValueReference>**natura2000:sitecode_h**</ValueReference>
        <Literal>**SITECODE**</Literal>
    </PropertyIsEqualTo>
</Filter>

Tested on the Natura 2000 site with site code NL2003014, this is the (partial) response:

```
<natura2000:natura2000 gml:id="natura2000.41">
    <natura2000:naam_n2k>Drouwenerzand</natura2000:naam_n2k>
    <natura2000:vhn_new>2</natura2000:vhn_new>
    <natura2000:nr>26</natura2000:nr>
    <natura2000:tranche>1</natura2000:tranche>
    <natura2000:bescherming>HR</natura2000:bescherming>
    <natura2000:status>Natura 2000-besluit 7 mei 2013</natura2000:status>
    <natura2000:sitecode_h>NL2003014</natura2000:sitecode_h>
    <natura2000:geom>
        <gml:MultiSurface srsDimension="2" srsName="urn:ogc:def:crs:EPSG::3035">…</gml:MultiSurface>
    </natura2000:geom>
</natura2000:natura2000>
```

Example: draft INSPIRE Protected sites Full application schema and field siteIdentifier

A second example uses the INSPIRE download service WFS from Sweden (SE1) that delivers the information in the INSPIRE Protected sites Full application schema *ps-f:ProtectedSite* instead of *ps:ProtectedSite* (the INSPIRE Protected sites Simple application schema). Unlike the Simple application schema, the INSPIRE Protected sites Full application schema was never endorsed and is still a draft schema that contains a *siteIdentifier* property which can be considered as a thematic identifier of a protected site. In this example, the property *siteIdentifier* contains the Natura 2000 site code. The following example uses this in a filter:

www.wfsserver.eu/wfs?service=WFS?

&version=2.0.0
&request=GetFeature
&TypeNames=**ps-f:ProtectedSite**
&filter=<Filter xmlns=http://www.opengis.net/fes/2.0
    xmlns:ps="http://inspire.ec.europa.eu/schemas/ps/4.0"
    xmlns:ps-f="urn:x-inspire:specification:gmlas:ProtectedSitesFull:3.0"
    xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
      <PropertyIsEqualTo>
        <ValueReference>
        ps-f:siteIdentifier/ps-f:SiteIdentifierType/ps-f:siteIdentifier
        </ValueReference>
        <Literal>**SE0330157**</Literal>
      </PropertyIsEqualTo>
    </Filter>

For the Natura 2000 site with the code **SE0330157**, a fragment of the return result is shown below. The exact request is presented in Annex 1, Section 2 GetFeature requests:

```
 <ps-f:siteIdentifier>
        <ps-f:SiteIdentifierType>
                <ps-f:siteIdentifier>SE0330157</ps-f:siteIdentifier>
                <ps-f:siteIdentifierScheme>natura2000</ps-f:siteIdentifierScheme>
        </ps-f:SiteIdentifierType>
</ps-f:siteIdentifier>
```

This method demonstrates the benefit of incorporating specific thematic identifiers agreed with the thematic communities in INSPIRE data models.

This has already been recognised by several implementers and users of the INSPIRE infrastructure on the INSPIRE Community Forum[31] (INSPIRE Thematic Clusters). This has led to a change proposal in the INSPIRE Implementing Rules on interoperability of datasets and services consisting of including a thematic identifier (INSPIRE data type *ThematicIdentifier*) in the INSPIRE Protected sites data model. Once adopted and implemented, it might solve several issues identified in this use case.

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[31] https://themes.jrc.ec.europa.eu/

> **Inspire feature identification - thematic identifier should be added to the INSPIRE Protected sites**
>
> Requirement focus: Requirement related to INSPIRE
>
> Description:
>
> In general, it would be very useful if the INSPIRE data models would include thematic identifiers, that would allow to relate the features to the corresponding reporting obligations. For the purpose of the Natura 2000 reporting, the thematic identifier (Natura 2000 site code) should be added to the INSPIRE Protected sites (PS) schema. Together with the designation value, this identifier will be unique.

Other requirements for further work on data harvesting in eReporting

Based on the findings of this use case, the following requirements can serve for further work on data harvesting in eReporting in the scope of modernisation of the reporting infrastructure Reportnet.

Using INSPIRE identifiers (external object identifier or thematic identifier) in the INSPIRE download service WFS requests could be simplified by creating a stored query with theme and identifier as query parameters.

> **Simple, direct and uniform INSPIRE feature extraction**
>
> Requirement focus: Requirement related to the reporting data and service providers (MS) and INSPIRE
>
> Description:
>
> INSPIRE data (spatial objects) carries identifier (*inspireId* – external object identifier). Sometimes a thematic identifier is available. It should be easy and straightforward to extract a single feature using those identifiers. This should be possible in a uniform way for all INSPIRE spatial data themes.

Successful referencing from different data sources to INSPIRE datasets relies on synchronised content. Therefore, if INSPIRE datasets and services are to be used for data harvesting in the reporting data flow, it needs to be ensured that they are synchronised and provide updated content, at object and dataset level, with regards to the related (reporting) data sources.

> **INSPIRE and reporting synchronisation**
>
> Requirement focus: Requirement related to the reporting data and service providers (MS)
>
> Description:
>
> It must be guaranteed that the features present in the Inspire dataset and downloadable by the INSPIRE services do match the data in the reporting data flow at the moment of the reporting.
>
> Responsibility to ensure this synchronisation lies with the MS. However, while checking the data, there should be a mechanism to indicate the discrepancies to the MS reporting contact person (reporter).

4 Conclusions and lessons learned

The work performed under this use case explored the different methodologies to reference, select and download specific Natura 2000 sites from the INSPIRE infrastructure, as part of the complete feasibility study on Reportnet and data harvesting using INSPIRE infrastructure. To accomplish this goal, the theoretical basis for linking and referencing datasets was tested on actual data, both reported Natura 2000 SDF data and INSPIRE datasets related to the INSPIRE Protected sites spatial data theme. Due to its nature, only INSPIRE direct access download services implemented through WFS were used.

The concept of referencing spatial features using codes or identifiers is already used by several reporting obligations, among them in Natura 2000. In this case, a reference can be established between the descriptive (SDF) and spatial information (geometry) of the Natura 2000 sites. Another reference can be used to link to other reporting obligations, e.g. WFD refers to particular Nature 2000 sites by its site code. The use of these references prevents from requesting the same spatial information in different reporting obligations. This study aimed at describing the referencing workflow from WFD to Nature 2000 and then to INSPIRE datasets using INSPIRE download services (WFS).

The applied methodology started with analysing the available data in different sources, continued with the analysis of the INSPIRE download services WFS to be tested and concluded with the retrieval of specific spatial objects from the WFS using different matching options.

The analysis of the data models used in the study data sources shows the elements supporting linking and referencing are already included. In particular, the link between WFD reported data and the Natura 2000 SDF database is successful and reliable (99.8%).

The link between Natura 2000 SDF database and INSPIRE datasets requires several types of evaluation: at object level in both data sources and the INSPIRE download services WFS. One of the first requirements is therefore to ensure the correct INSPIRE download service WFS is available, works correctly and provides the relevant dataset(s).

In this use case, tests were performed on a suitable sample of INSPIRE download services WFS identified in the common initial list of services in the feasibility study. After some analysis, only 12 INSPIRE direct access download services WFS were selected. Among them, eight services provided data according to the expected INSPIRE Protected sites Simple application schema. Four additional services provided data according to alternative schemas, but they were still useful for this test case.

The need to use different referencing mechanisms to match the Natura 2000 data and INSPIRE spatial objects reveal a wide heterogeneity in the national implementations. This would not ultimately prevent from using object referencing, but it would require a more thorough analysis of the existing data sources and a case-by-case customisation of WFS requests. The following are the summarised findings:

- When Natura 2000 data (*MAP_INSPIRE*) correctly includes the INSPIRE external object identifier (*inspireID*), it is possible to harvest the target spatial objects using the INSPIRE WFS service (i.e. the WFS request returned a single INSPIRE spatial object

linked to a specific Natura 2000 site).

- While INSPIRE defines a complex data type *Identifier* (composed of three attributes) as external object identifier, Natura 2000 SDF defines a simple single field to carry this information. Therefore, this information has been provided in Natura 2000 SDF data in diverse ways. Better guidelines on how to encode the INSPIRE identifier would reduce this heterogeneity and increase the matching probabilities.

- However, errors when providing INSPIRE spatial object identifiers in Natura 2000 data might still occur (e.g. typing errors). The reporting data flow would need include a check of the link for each individual Natura 2000 site.

- The Natura 2000 database from 2017 showed that the INSPIRE external object identifier (*inspireId*) is provided only for a third of the Natura 2000 sites. The provision of this information should increase through better reporting guidelines and quality control checks of reported data. Other referencing mechanisms can however be used to overcome this problem.

- The Natura 2000 SDF defines a unique site code (*SITECODE*) of each site that can be used as a link if included in the INSPIRE datasets (as some data providers have already done). However, the INSPIRE data specifications for Protected sites does not require the use of Natura 2000 site codes in the Simple application schema.

- Out of the 12 INSPIRE download services WFS used in this use case, only one service did not include the Natura 2000 site code in the INSPIRE dataset. Seven WFS using the INSPIRE Protected Site Simple application schema, provided data with external object identifiers (*inspireID*) containing a reference to the Natura 2000 site codes. Building on standard WFS requests using specific filters, this information can be used to link the Natura2000 sites to the INSPIRE spatial objects.

- Four WFS services provided data according to alternative schemas. Among these, the draft INSPIRE Protected sites Full application schema includes a specific thematic identifier (*siteIdentifier*) that could carry the Natura 2000 site code. In these cases, a WFS service request could be adapted (on case-by-case basis) to each individual data schema used to ensure the match between Natura 2000 site codes and the INSPIRE spatial objects.

As a way of conclusion, the results of the INSPIRE referencing methods used in this study would be improved by:

- Reporting or pointing out in the INSPIRE Geoportal to the relevant INSPIRE direct access download services;

- Providing better guidelines on how to encode the reference information on the datasets, in particular the uniform provision of INSPIRE external object identifiers in the Natura 2000 SDF reported data;

- Ensuring timely synchronisation between the Natura 2000 data and INSPIRE datasets;

- Performing adequate quality checks both at object and dataset / service level to ensure the references are correct.

List of abbreviations

Abbreviation	Name	Reference
CDR	Central Data Repository	
CRS	Coordinate reference system	
EEA	European Environment Agency	www.eea.europa.eu
GWB	Groundwater body	
INSPIRE	Infrastructure for Spatial Information in the European Community	https://inspire.ec.europa.eu/
IUCN	International Union for the Conservation of Nature	
KVP	Key-value pair	
MDB	Microsoft Access Database file format	
MS	Member State(s)	
pSCI	proposed Sites of Community Importance	
RBD	River basin district	
Reportnet	Eionet's infrastructure for supporting and improving data and information flows	https://www.eionet.europa.eu/reportnet
SAC	Special Areas of Conservation	
SCI	Sites of Community Importance	
SDF	Standard Data Form	
SPA	Special Protection Area	
SWB	Surface water body	
URL	Uniform Resource Locator	
WFD	Water Framework Directive	
WFS	Web Feature Service	
XML	Extensible Markup Language	

Annex 1 Working with WFS – general information

A WFS access point provides the necessary information to build different requests to retrieve features. This information is retrieved through a separate GetCapabilities request. It is important because it indicates which options are available for selecting spatial object(s) in the WFS request.

1 General base for WFS requests

A generic access point of a WFS could be: www.wfsserver.eu/wfs? . The actual requests can be formed by adding the necessary parameters to this URL.

The mandatory **request** parameter is used to indicate the type of operation asked from the server. Combined with the obligatory parameters from above this gives a base for all requests:

www.wfsserver.eu/wfs?service=WFS
&version=2.0.0
&request=OperationType

The types of operations relevant for this study concern requests for information about the service (metadata, request=GetCapabilities) and requests to retrieve spatial objects (request=GetFeature).

Depending on the operation type, different parameters are added to this base, separated by ampersands, to retrieve information from the service.

2 Metadata request – WFS GetCapabilities

The GetCapabilities operation returns most of the details describing the WFS service. The request doesn't need additional parameters. The complete request looks like:

www.wfsserver.eu/wfs?service=WFS
&version=2.0.0
&request=GetCapabilities

With this operation, the response of the server is a GetCapabilities XML document that contains detailed information about the service. The returned document contains metadata about the WFS service itself, about the feature types served by the WFS and about the available operations implemented on the server.

The INSPIRE technical guidelines for download services[32], combined with the version 2 of the WFS standard[33], indicates the functionalities that must be implemented on the WFS server to

---

[32]http://inspire.ec.europa.eu/documents/Network_Services/Technical_Guidance_Download_Services_v3.1.pdf
[33] http://docs.opengeospatial.org/is/09-025r2/09-025r2.html

be compliant with the direct download services definition in INSPIRE. The GetCapabilities document indicates exactly the available functionalities.

Annex 3 GetCapabilities request explains details of GetCapabilities document based on the example of INSPIRE download service WFS from Malta. Those elements were checked for all INSPIRE download services WFS tested in this use case. All services implement the necessary functionality to accept all the requests used and mentioned in this report.

3   WFS stored query

In WFS, stored queries are named parametrised query expressions defined on server side. They can be invoked in WFS requests using their name and with different values for their parameters. Stored queries can be implemented to make regularly used feature requests easier for the user, but they can also serve to optimise the processing on server side for these regular requests.

The WFS standard defines a mandatory stored query GetFeatureById. This query accepts a single argument "id" and it returns a single feature whose id is equal to the specified value for the id argument.

It is important to notice that this id refers to the id attribute as defined in the gml standard, *gml:id*[34]. There are no INSPIRE requirements or recommendations indicating that this id should reflect the INSPIRE identifier of spatial objects. However, several tested WFS services on INSPIRE spatial datasets indicate such use.

4   Requests for features

Request=GetFeature
As the name indicates this operation is used to retrieve spatial features from the service. This can be done in different ways depending on the extra parameters added to the request. The list of most common parameters used in this use case are as follows:

- typenames,

- srsName,

- count,

- startindex,

- storedquery_id,

- FeatureId,

- filter.

---

[34] https://portal.opengeospatial.org/files/?artifact_id=74183&version=2

The first parameter needed is the **typenames** parameter. The accepted values for this parameter for a specific WFS service are listed in the FeatureTypeList of the GetCapabilities document. The name value of listed FeatureType elements are valid. For the INSPIRE Protected sites dataset, the expected name is *ps:ProtectedSite*.

The **srsName** parameter indicates the spatial coordinate reference system (CRS) the returned spatial features are encoded in. If the feature type in the GetCapabilities has a DefaultCRS value, this CRS will be used if the srsName parameter is omitted in the request. The OtherCRS value(s) give alternatives to use as srsName parameter.

With the **count** and **startindex** parameters, it is possible to limit the number of features extracted with one request. This can be useful to extract smaller data portions from very large datasets. For example, for retrieving 1.000 features at a time, the following parameters can be used:

Count=1000&startindex=0

Count=1000&startindex=1000

….

The count parameter has no default value[35]. However, the WFS standard encourages to configure a count limit on server side to avoid that a request clogs the server. Such a server-side limit is advertised in the capabilities with the CountDefault parameter. In such case, if the user omits the count parameter, the server limits the number of returned features to this CountDefault.

For startindex, the default value is 0, therefore in the example the startindex=0 can be left out.

There are several options to filter the features that will be retrieved. If no extra parameters are added, the response will contain (taking into account the count parameter) all features of the given feature type.

To invoke a stored query defined on the server, the **storedquery_id** parameter is used. The valid values for this parameter are the ids of the stored queries as given in the responses to ListStoredQueries and DescribeStoredQueries. Each parameter of a stored query shall be added to the request as an additional key-value pair[36]. Here only the GetFeatureById query will be considered. This query is mandatory for a WFS download service and it has only one parameter, id.

Another option to select a single feature by id, supported by most WFS servers, is by using **FeatureId** parameter, FeatureId=id. Examples are given in Annex 2.

To have more control over the selection of retrieved features, based on more than only the gml:id, the **filter** parameter can be added to the request. The value of this parameter must be encoded as XML according to the OGC Filter Encoding standard[37]. WFS servers can implement this standard to different compliance levels, therefore checking the filter capabilities is important.

---

[35] http://docs.opengeospatial.org/is/09-025r2/09-025r2.html

[36] http://docs.opengeospatial.org/is/09-025r2/09-025r2.html

[37] http://docs.opengeospatial.org/is/09-026r2/09-026r2.html

Annex 2 List of service requests and samples

1   Comparison of Natura 2000 sites identifications

Several properties could be used in referencing mechanisms, as following:

- In the Natura 2000 SDF, both the *SITECODE* property and the *MAP_INSPIRE* property (if filled in) uniquely identify the site,

- The responses from the INSPIRE download service WFS requests are provided in GML encoding where a feature has a gml:id,

- If the INSPIRE data schema is used, it includes also an INSPIRE external object identifier, where the *localId* part of that identifier (*inspireID.localId*) might identify the Natura 2000 site,

- In some of the responses, the feature has a separate property containing the Natura 2000 site code.

The following list shows the values for these different properties in the Natura 2000 SDF data and in the INSPIRE datasets.

Country	Schema used	Property values	
Czech Republic (CZ)	*natura2000*	SDF *SITECODE* SDF *MAP_INSPIRE*	CZ0212020 CZ-AOPK-PS.N2-002584
		Gml:id *inspireID.localId* WFS Sitecode field	Evropsky_významná_lokalita__EVL_.13824 No *inspireID* *Natura2000_SITECODE*
Denmark (DK)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	DK00BY171 Dk.nst.ps.SAC71
		Gml:id *inspireID.localId* WFS Sitecode field	dk.ps.b1a5cf63-53a1-11e2-8ea5-00155d01e765 b1a5cf63-53a1-11e2-8ea5-00155d01e765 none
Finland (FI)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	FI0100001 missing
		Gml:id *inspireID.localId* WFS Sitecode field	Ps-SACFI0100001-alue SACFI0100001-alue none
Latvia (LV)	*protSite:psSiteS*	SDF *SITECODE* SDF *MAP_INSPIRE*	LV0525100 LV0525100

Country	Schema used	Property values	
		Gml:id	psSiteS.6
		inspireID.localId	LV0525100 (in *protSite:ID_LOCALID*)
		WFS Sitecode field	none
Malta (MT2, MT4)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	MT0000025 MT0000025
		Gml:id *inspireID.localId* WFS Sitecode field	MT.ERA.MT0000025 MT.ERA.MT0000025 none
Malta (MT3=SPA&SCI)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	MT0000110 MT.ERA.MT0000110
		Gml:id *inspireID.localId* WFS Sitecode field	MT.ERA.MT0000110 MT.ERA.MT0000110 none
Netherlands (NL1)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	NL2003014 Missing
		Gml:id *inspireID.localId* WFS Sitecode field	_2_1__NL2003014 2_1__NL2003014 none
Netherlands (NL2)	*Natura2000:natura2000*	SDF *SITECODE* SDF *MAP_INSPIRE*	NL2003014 missing
		Gml:id *inspireID.localId* WFS Sitecode field	natura2000.41 No *inspireID* *natura2000:sitecode_h*
Portugal (PT)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	PTJOR0013 missing
		Gml:id *inspireID.localId* WFS Sitecode field	PTJOR0013 PTJOR0013 none
Romania (RO)	*ps:ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	ROSCI0005 ROSCI0005
		Gml:id *inspireID.localId* WFS Sitecode field	RO.ENV.PADS.PS.ROSCI0005 ROSCI0005 none
Sweden (SE)	*ps-f :ProtectedSite*	SDF *SITECODE* SDF *MAP_INSPIRE*	SE0330157 SE.SWEPA.SE0330157
		Gml:id *inspireID.localId* WFS Sitecode field	psSiteS.46275 SE.SWEPA.SE0330157.1 *ps-f:SiteIdentifier*
Poland	*ps:ProtectedSite*	*SDF SITECODE* *SDF MAP_INSPIRE*	PLB020001 PL.ZIPOP.1393.N2K.PLB020001

Country	Schema used	Property values	
		Gml:id	PL.ZIPOP.1393.N2K.PLB020001.B
		inspireID.localId	N2K.PLB020001.B
		WFS Sitecode field	none

Specific examples:

- For Denmark, the *MAP_INSPIRE* values differ completely from the *inspireID.localId* values in the INSPIRE dataset.

- The example from Poland has been added in addition to demonstrate the combination of the *namespace* (PL.ZIPOP.1393) and the *localId*.

- In examples from Malta, MT2 and MT4 clearly shows a difference between the *MAP_INSPIRE* value and the *inspireID.localId*.

Besides these special cases, the table shows how differently the values of identifiers are provided in various fields.

2 GetFeature requests

This section describes full INSPIRE download service WFS requests (URLs) used as examples in this study and report.

Retrieve a single feature by gml:id using the GetFeatureById stored query

https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPASCI?
     service=WFS
     &version=2.0.0
     &request=GetFeature
     &StoredQuery_ID=urn:ogc:def:query:OGC-WFS::GetFeatureById
     &ID=**MT.ERA.MT0000110**

Retrieve a single feature by gml:id using the FeatureID parameter

https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPASCI?
     service=WFS
     &version=2.0.0
     &request=GetFeature
     & typeNames=ps:ProtectedSite
     &FeatureID=**MT.ERA.MT0000110**

Retrieve a single feature by matching MAP_INSPIRE and inspireID.localId using a filter

The site has **ROSCI0135** as MAP_INSPIRE value:

http://gmlid.eu/RO/ENV/PADS/WFS/wfs?
&service=WFS
&version=2.0.0
&request=GetFeature
&typeNames=ps:ProtectedSite
&filter=
<Filter xmlns=http://www.opengis.net/fes/2.0
xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
<PropertyIsEqualTo>
<ValueReference>
ps:inspireID/base:Identifier/base:localID
</ValueReference>
<Literal>**ROSCI0135**</Literal>
</PropertyIsEqualTo>
</Filter>

Retrieve a single feature by matching the N2000 SITECODE with inspireID

SITECODE equals localId using a filter (Portuguese site with *SITECODE* **PTJOR0013** has no *MAP_INSPIRE* filled in):

http://wssig3.azores.gov.pt/geoserver/ps/wfs?
service=wfs
&version=2.0.0
&request=GetFeature
&typeNames=ps:ProtectedSite
&srsName=urn:ogc:def:crs:EPSG::4258
&filter=<Filter xmlns=http://www.opengis.net/fes/2.0
xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
<PropertyIsEqualTo>
<ValueReference>
ps:inspireID/base:Identifier/base:localID
</ValueReference>
<Literal>**PTJOR0013**</Literal>
</PropertyIsEqualTo>
</Filter>

Retrieve a single feature by inspireID.localId similar to SITECODE using a filter

InspireID contains the *SITECODE* (Dutch site with Natura 2000 *SITECODE* **NL2009162** and *inspireID* **1_0_NL2009162_**).

https://geodata.nationaalgeoregister.nl/inspire/ps/wfs?
     service=WFS
     &version=2.0.0
     &request=GetFeature
     &TypeNames=ps:ProtectedSite
     &FILTER=<Filter xmlns=http://www.opengis.net/fes/2.0
xmlns:ps=http://inspire.ec.europa.eu/schemas/ps/4.0
xmlns:xlink=http://www.w3.org/1999/xlink>
          <PropertyIsLike wildCard="*" singleChar="." escapeChar="!">
            <ValueReference>
            ps:inspireID/base:Identifier/base:localID
            </ValueReference>
            <Literal>***NL2009162***</Literal>
          </PropertyIsLike>
        </Filter>

Retrieve a single feature by specific identifier (siteIdentifier)

Retrieve a single feature if a schema contains a separate field (here *pf-s:siteIdentifier*) that contains exactly the Natura 2000 *SITECODE*.

https://gis-services.metria.se/arcgis/rest/services/nv/InspireNV_WFS_N2K/
MapServer/exts/InspireFeatureDownload/service?
     service=wfs
     &version=2.0.0
     &request=GetFeature
     &TypeNames=ps-f:ProtectedSite
     &srsName=urn:ogc:def:crs:EPSG::3035
     &FILTER=<Filter xmlns=http://www.opengis.net/fes/2.0
xmlns:ps="http://inspire.ec.europa.eu/schemas/ps/4.0" xmlns:ps-f="urn:x-
inspire:specification:gmlas:ProtectedSitesFull:3.0"
xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
        <PropertyIsEqualTo>
          <ValueReference>
          ps-f:siteIdentifier/ps-f:SiteIdentifierType/ps-f:siteIdentifier
          </ValueReference>
          <Literal>**SE0330157**</Literal>
        </PropertyIsEqualTo>
     </Filter>

3 GetFeature responses

This section includes examples of a WFS response of a single feature using different schemas: the INSPIRE Protected sites Simple application schema (*ProtectedSite*) and alternative schemas.

INSPIRE ProtectedSite schema

The response shows the format of the data in the INSPIRE *ProtectedSite* Simple application schema, a site with both SCI and SPA designations from the request above. Details about the geometry and the site name are not included.

```
<ps:ProtectedSite gml:id="MT.ERA.MT0000110" xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:ps="http://inspire.ec.europa.eu/schemas/ps/4.0" xsi:schemaLocation="http://www.opengis.net/wfs/2.0
http://schemas.opengis.net/wfs/2.0/wfs.xsd http://www.opengis.net/gml/3.2
http://schemas.opengis.net/gml/3.2.1/gml.xsd http://inspire.ec.europa.eu/schemas/base/3.3
https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPASCI?SERVICE=WFS&VERSION=2.0.0&REQUEST=Descr
ibeFeatureType&OUTPUTFORMAT=application%2Fgml%2Bxml%3B+version%3D3.2"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
        <gml:identifier
        codeSpace="http://inspire.ec.europa.eu/ids">https://msdi.data.gov.mt/so/ps/ProtectedSite/Natura2000-
        SCIs_SPAs/MT.ERA.MT0000110
        </gml:identifier>
        <ps:geometry>
                <gml:Polygon gml:id="_21cc8e95-2672-4552-8c58-ac406f2fbc00"
        srsName="urn:ogc:def:crs:EPSG::4258">....</gml:Polygon>
        </ps:geometry>
        <ps:inspireID>
                <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3">
                        <base:localId>MT.ERA.MT0000110</base:localId>
                        <base:namespace>Natura2000-SCIs_SPAs</base:namespace>
                </base:Identifier>
        </ps:inspireID>
        <ps:legalFoundationDate xsi:nil="true"/>
        <ps:legalFoundationDocument xsi:nil="true"/>
        <ps:siteDesignation>
                <ps:DesignationType>
                        <ps:designationScheme
                xlink:href="http://inspire.ec.europa.eu/codelist/DesignationSchemeValue/natura2000"
                xmlns:xlink="http://www.w3.org/1999/xlink"/>
                        <ps:designation
                xlink:href="http://inspire.ec.europa.eu/codelist/Natura2000DesignationValue/specialProtection
                Area" xmlns:xlink="http://www.w3.org/1999/xlink"/>
                </ps:DesignationType>
        </ps:siteDesignation>
        <ps:siteDesignation>
                <ps:DesignationType>
                        <ps:designationScheme
                xlink:href="http://inspire.ec.europa.eu/codelist/DesignationSchemeValue/natura2000"
                xmlns:xlink="http://www.w3.org/1999/xlink"/>
                        <ps:designation
                xlink:href="http://inspire.ec.europa.eu/codelist/Natura2000DesignationValue/siteOfCommunity
                Importance" xmlns:xlink="http://www.w3.org/1999/xlink"/>
                </ps:DesignationType>
        </ps:siteDesignation>
        <ps:siteName>
                .......
        </ps:siteName>
        <ps:siteProtectionClassification>natureConservation</ps:siteProtectionClassification>
</ps:ProtectedSite>
```

Alternative schemas in this use case

Example from Czech Republic

The INSPIRE download service WFS from the Czech Republic (CZ1) uses a custom-made schema *Natura2000* containing a *SITECODE* property that matches the Natura 2000 SDF *SITECODE*.

```
<Natura2000:Evropsky_významná_lokalita__EVL_ gml:id="Evropsky_významná_lokalita__EVL_.13824">
        <Natura2000:KOD>2584</Natura2000:KOD>
        <Natura2000:SITECODE>CZ0212020</Natura2000:SITECODE>
        <Natura2000:KAT>EVL</Natura2000:KAT>
        <Natura2000:NAZEV>Rečkov</Natura2000:NAZEV>
        <Natura2000:ROZL>29.3347</Natura2000:ROZL>
        <Natura2000:BIOREG>c</Natura2000:BIOREG>
        <Natura2000:N_CHU></Natura2000:N_CHU>
        <Natura2000:ES>ano</Natura2000:ES>
        <Natura2000:ZMENA_G>20050101</Natura2000:ZMENA_G>
        <Natura2000:ZMENA_T>20151211</Natura2000:ZMENA_T>
        <Natura2000:SHAPE>
        …
        </Natura2000:SHAPE>
</Natura2000:Evropsky_významná_lokalita__EVL_>
```

Example from Latvia

The INSPIRE download service WFS from Latvia (LV1) uses a schema *protSite:psSiteS*. In this schema the features have properties *ID_LOCALID*, *ID_NAMESPACE* and *ID_VERSIONID*. Based on the field names, it can be assumed these fields correspond with the three-part structure of the inspire *Identifier* data type. The *ID_LOCALID* matches the values in the Natura 2000 *MAP_INSPIRE* field.

```
<protSite:psSiteS gml:id="psSiteS.6">
        <protSite:IFCID>6</protSite:IFCID>
        <protSite:ID_LOCALID>LV0525100</protSite:ID_LOCALID>
        <protSite:ID_NAMESPACE>LV.DAP.PROTECTEDSITES</protSite:ID_NAMESPACE>
        <protSite:ID_VERSIONID>2017-07-27 09:02:51</protSite:ID_VERSIONID>
        <protSite:LEGALFOUNDATIONDATE>1999-01-01T00:00:00</protSite:LEGALFOUNDATIONDATE>
        <protSite:RESOLUTION>10</protSite:RESOLUTION>
        <protSite:QUALITYANDIMPORTANCE>1</protSite:QUALITYANDIMPORTANCE>
        <protSite:OWNERSHIP_VOID>0</protSite:OWNERSHIP_VOID>
        <protSite:BEGINLIFESPANVERSION>2017-07-27T00:00:00</protSite:BEGINLIFESPANVERSION>
        <protSite:ENDLIFESPANVERSION>9999-12-31T00:00:00</protSite:ENDLIFESPANVERSION>
        <protSite:DATASOURCE>OZOLS digitalizācija </protSite:DATASOURCE>
        <protSite:AREA_>424</protSite:AREA_>
        <protSite:SITELENGTH>0.185541</protSite:SITELENGTH>
        <protSite:SITELENGTH_UOM>m</protSite:SITELENGTH_UOM>
        <protSite:STYPE>131</protSite:STYPE>
        <protSite:SHAPE>
         <gml:MultiSurface gml:id="psSiteS.6.Geom_0" srsDimension="2" srsName="urn:ogc:def:crs:EPSG::3035">
         ….
        </protSite:SHAPE>
</protSite:psSiteS>
```

Example from Sweden

The INSPIRE download service WFS from Sweden (SE1) uses the *ps-f:ProtectedSite* schema. The *siteIdentifier* property links directly to the Natura 2000 *SITECODE* value.

```
<ps-f:ProtectedSite gml:id="psSiteS.46275">
        <gml:identifier codeSpace="http://inspire.jrc.ec.europa.eu/ids">http://gis-
services.metria.se/arcgis/rest/services/nv/InspireNV_WFS_N2K/MapServer/exts/InspireFeatureDownload/service?
SERVICE=WFS&VERSION=2.0.0&REQUEST=GetFeature&STOREDQUERY_ID=urn:ogc:def:query:OGC-
WFS::GetFeatureById&id=psSiteS.46275</gml:identifier>
        <ps:geometry>
                <gml:Polygon gml:id="psSiteS.46275.Geom_0" srsDimension="2"
        srsName="urn:ogc:def:crs:EPSG::4258">
                        …
                </gml:Polygon>
        </ps:geometry>
        <ps:inspireID>
                <base:Identifier>
                        <base:localId>SE.SWEPA.SE0330157.1</base:localId>
                        <base:namespace>SE.SWEPA</base:namespace>
                        <base:versionId>1</base:versionId>
                </base:Identifier>
        </ps:inspireID>
        <ps:legalFoundationDate>1998-12-01T00:00:00</ps:legalFoundationDate>
        <ps:legalFoundationDocument xsi:nil="true"/>
        <ps:siteDesignation>
                <ps:DesignationType>
                        <ps:designationScheme>natura2000</ps:designationScheme>
                        <ps:designation>siteOfCommunityImportance</ps:designation>
                        <ps:percentageUnderDesignation>100.000000</ps:percentageUnderDesignation>
                </ps:DesignationType>
        </ps:siteDesignation>
        <ps:siteName>
                …
                <gn:spelling>
                        <gn:SpellingOfName>
                                <gn:text>Värlebo</gn:text>
                                …
                        </gn:SpellingOfName>
                </gn:spelling>
                …
        </ps:siteName>
        <ps:siteProtectionClassification>natureConservation</ps:siteProtectionClassification>
        <ps-f:siteIdentifier>
        <ps-f:SiteIdentifierType>
                <ps-f:siteIdentifier>SE0330157</ps-f:siteIdentifier>
                <ps-f:siteIdentifierScheme>natura2000</ps-f:siteIdentifierScheme>
                </ps-f:SiteIdentifierType>
        </ps-f:siteIdentifier>
        <ps-f:activitiesAndImpacts xsi:nil="true"/>
        <ps-f:siteDescription>
                <gmd:LocalisedCharacterString>The ground is a morain on a granite bedrock. The terrain is flat.
                A small deciduous forest dominated by old and hollow
                beeches.</gmd:LocalisedCharacterString>
```

```xml
        </ps-f:siteDescription>
        <ps-f:qualityAndImportance>
                <gmd:LocalisedCharacterString>One of the northernmost natural stands of old beech in the
                southeast of Sweden. High entomological and botanical values.</gmd:LocalisedCharacterString>
        </ps-f:qualityAndImportance>
        <ps-f:vulnerability xsi:nil="true"/>
        <ps-f:ownership xsi:nil="true"/>
        <ps-f:documentation xsi:nil="true"/>
        <ps-f:legalExpiryDate xsi:nil="true"/>
        <ps-f:beginLifespanVersion>2005-01-01T00:00:00</ps-f:beginLifespanVersion>
        <ps-f:endLifespanVersion xsi:nil="true"/>
        <ps-f:dataSource>Swedish EPA, www.naturvardsverket.se</ps-f:dataSource>
        <ps-f:siteLength xsi:nil="true"/>
        <ps-f:fundingSource xsi:nil="true"/>
        <ps-f:siteManagementPlan xsi:nil="true"/>
        <ps-f:natura2000Respondent xsi:nil="true"/>
        <ps-f:protectedEntity xsi:nil="true"/>
        <ps-f:presentHabitat xsi:nil="true"/>
        <ps-f:timePeriod xsi:nil="true"/>
        <ps-f:isASpeciesAggregationUnit xsi:nil="true"/>
</ps-f:ProtectedSite>
```

Annex 3 GetCapabilities request

Important GetCapabilities elements

Detailed information about the capabilities of a WFS service can be found in the GetCapabilities document as a response to a WFS GetCapabilities request.

Using one of the INSPIRE download services WFS for Malta (MT3), the following section highlights the elements of the GetCapabilities document important for this use case. The document was extracted using the following request:

https://msdi.data.gov.mt/deegree/services/ps_Natura2000SPASCI?service=WFS&version=2.0.0&request=GetCapabilities

The **OpererationsMetadata** section contains information about how the WFS operations are implemented on this server. For this exercise a special attention is paid to the following parameters and sections:

- Version,
- srsName,
- DefaultCount,
- ImplementsBasicWFS constraint,
- FeatureTypeList,
- Filter_Capabilities.

Parameter: Version

The <u>version</u> parameter, which, for a valid Inspire WFS download service must be version 2.0.0.
```
<ows:Parameter name="version">
        <ows:AllowedValues>
                <ows:Value>2.0.0</ows:Value>
                <ows:Value>1.1.0</ows:Value>
        </ows:AllowedValues>
</ows:Parameter>
```

Parameter: srsName

The <u>srsName</u> parameter lists the spatial coordinate reference systems available on the server.
```
<ows:Parameter name="srsName">
        <ows:AllowedValues>
                <ows:Value>urn:ogc:def:crs:EPSG::4258</ows:Value>
                <ows:Value>urn:ogc:def:crs:EPSG::3045</ows:Value>
        </ows:AllowedValues>
</ows:Parameter>
```

Parameter: DefaultCount

The <u>DefaultCount</u> parameter, if present, indicates the number of features returned (maximum) when a request does not contain a count parameter itself.

```
<ows:Constraint name="CountDefault">
        <ows:NoValues/>
        <ows:DefaultValue>15000</ows:DefaultValue>
</ows:Constraint>
```

Parameter: ImplementsBasicWFS constraint

The <u>ImplementsBasicWFS</u> constraint which, when having value TRUE, indicates this WFS server implements the WFS basic conformance class as defined in the WFS standard [38]. This is important for some of the WFS operations applied in this use case (e.g. the FILTER parameter). According to the INSPIRE technical guidelines for download services[39], a direct access WFS download service must implement the WFS Basic conformance class, the ImplementsBasicWFS value should be TRUE.

```
<ows:Constraint name="ImplementsBasicWFS">
        <ows:NoValues/>
        <ows:DefaultValue>TRUE</ows:DefaultValue>
</ows:Constraint>
```

Parameter: FeatureTypeList

The **FeatureTypeList** section contains all the FeatureTypes available through the service. The name of a FeatureType is needed in the GetFeature requests (typeNames parameter). Besides other additional properties, the spatial reference systems available for this feature type are also listed.

```
<FeatureTypeList>
        <FeatureType>
                <Name xmlns:ps="http://inspire.ec.europa.eu/schemas/ps/4.0"> ps:ProtectedSite</Name>
                <Abstract>The submission ….. same links.</Abstract>
                <DefaultCRS>urn:ogc:def:crs:EPSG::4258</DefaultCRS>
                <OtherCRS>urn:ogc:def:crs:EPSG::3045</OtherCRS>
                …..
        </FeatureType>
</FeatureTypeList>
```

Parameter: Filter_Capabilities

Finally, in some of the GetFeature requests in this use case a filter is applied. This gives more flexibility in the selection of features in the WFS request. The server capabilities needed for this filtering are described in the **Filter_Capabilities** section of the GetCapabilities document. It contains information about the implementation of the OGC Filter Encoding standard[40] for the

---

[38] http://docs.opengeospatial.org/is/09-025r2/09-025r2.html
[39] http://inspire.ec.europa.eu/documents/Network_Services/Technical_Guidance_Download_Services_v3.1.pdf
[40] http://docs.opengeospatial.org/is/09-026r2/09-026r2.html

encoding of query expressions. The Inspire technical guidelines [41]for download services indicate to which parts (conformance classes and/or additional functionality) of the Filter Encoding standard a direct access WFS download service must comply but here only a subset is needed. All WFS services in the list support the AdHocQuery and MinimumStandardFilter conformance classes necessary to execute the queries applied in this Use case. They also all implement the additional comparison operator PropertyIsLike, used in some of the filters applied. These values can be found in the GetCapabilities as shown in this example:

```
<fes:Filter_Capabilities>
        <fes:Conformance>
                <fes:Constraint name="ImplementsQuery">
                        <ows:NoValues/>
                        <ows:DefaultValue>TRUE</ows:DefaultValue>
                </fes:Constraint>
                <fes:Constraint name="ImplementsAdHocQuery">
                        <ows:NoValues/>
                        <ows:DefaultValue>TRUE</ows:DefaultValue>
                </fes:Constraint>
                …
                <fes:Constraint name="ImplementsMinStandardFilter">
                        <ows:NoValues/>
                        <ows:DefaultValue>TRUE</ows:DefaultValue>
                </fes:Constraint>
                <fes:Constraint name="ImplementsStandardFilter">
                        <ows:NoValues/>
                        <ows:DefaultValue>TRUE</ows:DefaultValue>
                </fes:Constraint>
                …
        </fes:Conformance>
        …
        <fes:Scalar_Capabilities>
                <fes:LogicalOperators/>
                <fes:ComparisonOperators>
                        …
                        <fes:ComparisonOperator name="PropertyIsLike"/>
                        …
                </fes:ComparisonOperators>
        </fes:Scalar_Capabilities>
        …
</fes:Filter_Capabilities>
```

Overview of GetCapabilities document

This example shows more detailed information form the GetCapabilities document.

```
<WFS_Capabilities xsi:schemaLocation="http://www.opengis.net/wfs/2.0
http://schemas.opengis.net/wfs/2.0/wfs.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml"
xmlns:fes="http://www.opengis.net/fes/2.0" xmlns:ogc="http://www.opengis.net/ogc"
xmlns:ows="http://www.opengis.net/ows/1.1" xmlns:wfs="http://www.opengis.net/wfs/2.0"
xmlns="http://www.opengis.net/wfs/2.0" version="2.0.0">
<ows:ServiceIdentification>
<ows:Title>MSDI WFS Harmonised Protected Sites Natura2000 SPA SCI</ows:Title>
<ows:Abstract>MSDI Harmonised INSPIRE WFS Protected Sites Natura2000 SPA SCI Download …
…
```

---

[41]http://inspire.ec.europa.eu/documents/Network_Services/Technical_Guidance_Download_Services_v3.1.pdf

```
</ows:ServiceIdentification>
        <ows:ServiceProvider>
        <ows:ProviderName>Malta Information Technology Agency</ows:ProviderName>
        …
</ows:ServiceProvider>
<ows:OperationsMetadata>
        …
        <ows:Parameter name="version">
                <ows:AllowedValues>
                        <ows:Value>2.0.0</ows:Value>
                        <ows:Value>1.1.0</ows:Value>
                </ows:AllowedValues>
        </ows:Parameter>
        <ows:Parameter name="srsName">
                <ows:AllowedValues>
                        <ows:Value>urn:ogc:def:crs:EPSG::4258</ows:Value>
                        <ows:Value>urn:ogc:def:crs:EPSG::3045</ows:Value>
                </ows:AllowedValues>
        </ows:Parameter>
        …
        <ows:Constraint name="ImplementsSimpleWFS">
                <ows:NoValues/>
                <ows:DefaultValue>TRUE</ows:DefaultValue>
        </ows:Constraint>
        <ows:Constraint name="ImplementsBasicWFS">
                <ows:NoValues/>
                <ows:DefaultValue>TRUE</ows:DefaultValue>
        </ows:Constraint>

        …
        <ows:Constraint name="CountDefault">
                <ows:NoValues/>
                <ows:DefaultValue>15000</ows:DefaultValue>
        </ows:Constraint>
        <ows:ExtendedCapabilities xmlns …>
                <inspire_dls:ExtendedCapabilities>
                        …
                        <inspire_dls:SpatialDataSetIdentifier>
                                <inspire_common:Code>N2000_MT_SPAsSCIs</inspire_common:Code>
                                <inspire_common:Namespace>https://era.org.mt/</inspire_common:Name
                        space>
                        </inspire_dls:SpatialDataSetIdentifier>
                </inspire_dls:ExtendedCapabilities>
        </ows:ExtendedCapabilities>
</ows:OperationsMetadata>
<FeatureTypeList>
        <FeatureType>
                <Name xmlns:ps="http://inspire.ec.europa.eu/schemas/ps/4.0">ps:ProtectedSite</Name>
                <Abstract>The submission …
                </Abstract>
                <DefaultCRS>urn:ogc:def:crs:EPSG::4258</DefaultCRS>
                <OtherCRS>urn:ogc:def:crs:EPSG::3045</OtherCRS>
                <OutputFormats>
                …
                <MetadataURL
                xlink:href="https://msdi.data.gov.mt/geonetwork/srv/eng/csw?service=CSW&request=GetReco
                rdById&version=2.0.2&id=4cc79d52-f58e-4a95-ba42-a8e8426b22d2"/>
        </FeatureType>
</FeatureTypeList>
<fes:Filter_Capabilities>
        <fes:Conformance>
                <fes:Constraint name="ImplementsQuery">
                        <ows:NoValues/>
                        <ows:DefaultValue>TRUE</ows:DefaultValue>
```

```
        </fes:Constraint>
        <fes:Constraint name="ImplementsAdHocQuery">
                <ows:NoValues/>
                <ows:DefaultValue>TRUE</ows:DefaultValue>
        </fes:Constraint>
        …
        <fes:Constraint name="ImplementsMinStandardFilter">
                <ows:NoValues/>
                <ows:DefaultValue>TRUE</ows:DefaultValue>
        </fes:Constraint>
        <fes:Constraint name="ImplementsStandardFilter">
                <ows:NoValues/>
                <ows:DefaultValue>TRUE</ows:DefaultValue>
        </fes:Constraint>
        …
    </fes:Conformance>
    …
    <fes:Scalar_Capabilities>
            <fes:LogicalOperators/>
            <fes:ComparisonOperators>
                    <fes:ComparisonOperator name="PropertyIsEqualTo"/>
                    <fes:ComparisonOperator name="PropertyIsNotEqualTo"/>
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                    <fes:ComparisonOperator name="PropertyIsGreaterThan"/>
                    <fes:ComparisonOperator name="PropertyIsLessThanOrEqualTo"/>
                    <fes:ComparisonOperator name="PropertyIsGreaterThanOrEqualTo"/>
                    <fes:ComparisonOperator name="PropertyIsLike"/>
                    <fes:ComparisonOperator name="PropertyIsNull"/>
                    <fes:ComparisonOperator name="PropertyIsNil"/>
                    <fes:ComparisonOperator name="PropertyIsBetween"/>
            </fes:ComparisonOperators>
    </fes:Scalar_Capabilities>
    <fes:Spatial_Capabilities>
            …
    </fes:Spatial_Capabilities>
    <fes:Functions>
            …
    </fes:Functions>
</fes:Filter_Capabilities>
</WFS_Capabilities>
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