

Delivering Military Advantage through multi-national geospatial interoperability

DGIWG 909

DGIWG Web Services Technical Panel Roadmap

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Abstract:	The Web Services Technical Panel (P5) Roadmap summarises the development and maintenance activities that the DGIWG P5 Web Services Technical Panel Technical Panel will be undertaking in the next 24 months as well a technical assessment of emerging trends and concepts that are relevant to the Defence Geospatial community.
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ii. Executive Summary

This document describes the aims and objectives of the DGIWG Web Services Technical Panel (P5) outlining its current and planned activities and deliverables within the short, medium, and long-term time horizons.

The document complements the DGIWG Geospatial Reference Architecture and other DGIWG Panel Roadmaps in supporting the DGIWG Program of Work.

The document is reviewed and updated annually to ensure currency.

iii. Contributing Participants

Nation	Parent Organisation
AUT	Federal Ministry of Defence, Institute of Military Geography (IMG)
DEU	Bundeswehr Geoinformation Centre (BGIC)
FIN	Finnish Defence Geospatial Centre
FRA	Institut national de l'information géographique et forestière (IGN) Direction Générale de l'Armement (DGA)
GBR	UK MOD STRATCOM, Defence Science and Technology Labs (DSTL)
SWE	Defence Materiel Administration
USA	National Geospatial-Intelligence Agency (NGA)

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v. Revision history

Date	Edition	Primary clauses modified	Description
25 October 2023	3.0 DP	Original Document	Creation (on basis of previous P5 roadmap version 2.1 and new roadmap Template) Edition 3.0 replaces edition 2.1 published in July 2019
08 February 2024	3.1 (WD1)	Moved roadmap to GitLab while updating content for 2024.	
10 October 2024	4.0 (WD2)	DGIWG Publication. All Clauses. Final draft revised and harmonized.	Edition 4.0 replaces edition 3.0 published in Oct 2023.
14 May 2025	5.0 DP	DGIWG Publication. All Clauses.	P5 Review, P0 Quality Control completed

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[1] Content of the tables in section have been extracted from the DGIWG POW [2

1 Introduction

Footnote Annex E [1]

The DGIWG Web Services Technical Panel (WSTP) (P5) fosters the discovery, retrieval, exchange, and use of geospatial data and products by creating and maintaining open standards and implementation profiles for geospatial web services. The Panel address the technical issues related to:

- Geospatial information services
- Service architectures and supporting network interfaces
- Data exchange formats
- Where possible, public domain standards based on ISO and OGC standards will be used or profiled

2 Scope

Footnote Annex E [2]

2.1 The Web Services Roadmap summarises the development and maintenance activities that the DGIWG WSTP team will be undertaking in the next 24 months as well a technical assessment of emerging trends and concepts that are relevant to the Defence Geospatial community. The technical assessment provides DGIWG a brief understanding and view of:

- What the trends are and how they work
- Potential trend benefits to the Defence Geospatial community
- Potential trend effects on the DGRA
- An indication of the maturity level of the trends i.e. is it just emerging or is mature enough to warrant further consideration and development by DGIWG.

2.2 The technical assessment takes both a medium (3-5 year) and long term (6-10 year) view of the trends, their development and potential impact on the Defence Geospatial community.

2.3 This document has the following key sections:

- **Target Architecture:** Description of what the preferred architecture for the medium term looks like and the long-term architecture might look like.
- **Current Responsibilities:** Summarising P5's maintenance responsibilities for existing DGIWG documents.
- **Current and Planned Activities**: Summary of P5's planned technical work for the next 24 months.
- Emerging Concepts and Associated Standards: An assessment of emerging technical trends and their potential benefit to the Defence Geospatial community.

3 References

3.1 DGIWG Documents

- DGIWG Requirements Tracker, 2024
- DGIWG 322, DGIWG Application Programming Interface (API) Whitepaper 08 August, 2024

3.2 DGIWG Standards

- DGIWG-114, DGIWG Metadata Foundation (DMF), Ed.2.0, 12 July 2017
- DGIWG-902, Program of Work (PoW), 2022
- DGIWG-930, Business Manual, 2022
- DGIWG-904, Defence Geospatial Standards Baseline (DGSB)
- DGIWG-933, DGIWG Geospatial Reference Architecture (DGRA), 2022

3.3 International Organization for Standardization (ISO) references

- ISO 19106:2004(E), Geographic information Profiles
- ISO 191115:2003, Geographic Information Metadata.
- ISO 19115/Cor.1:2006, Geographic information Metadata, Technical Corrigendum (Revision of ISO 19115:2003)
- ISO 19139:2007, Geographic Information Metadata XML schema implementation
- ISO 19119:2005, Geographic information Services
- ISO 19119:2005 Amd 1:2008, Geographic information Services
- ISO 19115:2013, Geographic Information Metadata
- ISO 19115-1:2014, Geographical Information Metadata Part 1: Fundamentals
- ISO 19115-2:2009, Geographic Information Metadata Part 2: Extensions for imagery and gridded data

3.4 Open Geospatial Consortium (OGC) references

- OGC Web Map Service Implementation Specification 1.3.0, 2006 (same as ISO 19128).
- OpenGIS® Web Map Tile Service Implementation Standard, Version: 1.0.0, 07-057r7, 2010-04-

06

- OpenGIS® OGC WMTS Simple Profile, OGC 13-082r2, February 19th, 2016
- Draft Revision to Axis Order Policy and Recommendations; OGC Project Document 08-038r5, March 7th, 2017
- OGC 06-004r3, v1.0.0, February 28th, 2006 Geospatial Digital Rights Management Reference Model (GeoDRM RM)
- OGC Web Service Common Implementation Specification, Version 2.0.0, OGC 06-121r9, Date: 2010-04-07
- OGC 12-128r19, OGC GeoPackage Encoding Standard, v1.4, 02-06-2024
- OGC 06-103r4, OpenGIS[®] Implementation Standard for Geographic information Simple feature access Part 1: Common architecture, v1.2.1, 28 May 2011
- OGC 12-128r18, OGC GeoPackage Encoding Standard, v1.3.1, 09-20-2021
- OGC 17-066r2, OGC GeoPackage Extension for Tiled Gridded Coverage Data, v1.1, 02-May-2022
- OGC 17-083r2,- OGC Two Dimensional Tile Matrix Set, v1.0, 06 Oct 2019
- OGC 18-000, OGC GeoPackage Related Tables Extension (RTE) , v1.0, 08 May 2019*
- OGC 12-063r5, WKT1 Standard: Geographic information Well-known text representation of coordinate reference systems, v1.0, 01 May 2015
- OpenGIS Project Document 01-009, OpenGIS[®] Implementation Specification: Coordinate Transformation Services, v1.0, 12 Jan 2001
- OGC 07-006r1 OpenGIS. Catalogue Service Implementation Specification 2.0.2, 2007
- OGC 07-045, OpenGIS. Catalogue Services Specification 2.0.2 ISO Metadata Application Profile. 2007
- OGC 04-095, OpenGIS Filter Encoding Specification 1.1
- OGC 09-110r4, OGC WCS 2.0 Interface Standard Core Corrigendum, 2.0.1
- OGC 09-147r3, OGC WCS 2.0 Interface Standard KVP Protocol Binding Extension, 1.0.1
- OGC 09-147r3, OGC WCS 2.0 Interface Standard XML/POST Protocol Binding Extension, 1.0
- OGC 09-146r2, OGC Coverage Implementation Schema "CIS", 1.0.1
- OGC 11-053r1, OGC Web Coverage Service Interface Standard CRS Extension, 1.0
- OGC 12-100r11.0, OGC GML Application Schema Coverages GeoTIFF Coverage Encoding Profile
- OGC 12-108, OGC GML Application Schema Coverages JPEG2000 Coverage Encoding Extension, 1.0

- OGC 12-039, OGC Web Coverage Service Interface Standard Scaling Extension, 1.0
- OGC 12-040, OGC Web Coverage Service Interface Standard Range Subsetting Extension, 1.0
- OGC 19-086r6, OGC API Environmental Data Retrieval Standard v1.1 (2023)
- OGC 19-072, OGC API Common Part 1: Core v1.0, (2023)
- OGC 20-024, OGC API Common Part 2: Geospatial Data v 0.0.9 (2022)
- OGC 14-110r2, OGC GML Application Schema Coverages JPEG2000/JPIP Encoding extension Best Practices, 1.0

3.5 North Atlantic Treaty Organization (NATO) references

• NATO Communications and Information Agency, Instr Tech 06.02.06, "Service Interface Profile for Messaging", R. Fiske, M., [NCIA AITech 06.02.06, 2012]

3.6 De facto standard references

None

3.7 National

None

3.8 Other standards

- Implementing INSPIREView Services Version 3.0 21/03/2011: Section 5, Technical Guidance for the Implementation of INSPIRE View Services Version 3.0
- W3C SOAP Version 1.2 Part 1, W3C SOAP Version 1.2 Part 1: Messaging Framework, W3C Recommendation, Date 2003-06-24
- W3C SOAP 1.2 Attachment Feature. W3C SOAP 1.2 Attachment Feature, W3C Working Group Note, Date 2004-06-08
- EPSG Geodetic Parameter Register, Version: 8.6.1
- HTTP Protocol Specification, IETF (rfc 2616)
- HTTPS Protocol Specification, IETF (rfc 2818)

4 Terms and Abbreviations

Table 1 - List of abbreviations and acronyms

Acronym	Definition
API	Application Programming Interface
DGIWG	Defence Geospatial Information Working Group
DGRA	Defence Geospatial Reference Architecture
EDR	Environmental Data Retrieval
ESM	Elevation Surface Model
ΝΑΤΟ	North Atlantic Treaty Organisation
OGC	Open Geospatial Consortium
PoW	Program of Work
SOA	Service Oriented Architecture
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
WPS	Web Processing Service
WSTP	Web Services Technical Panel

5 Target Vision

5.1 Target 1

Spatial information is an essential component of most decision support systems. It provides the basis for users to analyse anything based on its location on the earth. However, many information communities often find it difficult to locate and retrieve required spatial information in a reliable and acceptable form. The diverse nature of geospatial data formats and access methods poses a major challenge for geospatial information sharing especially across a large and complex user community such as the Defence Geospatial domain. With the ever-increasing need for reliable access to up-to-date geospatial information, the OGC have developed and maintained a suite of approaches and generic standards based on a Service Oriented Architecture (SOA). These enable the interoperable sharing and dissemination data using standardised web services and APIs. The OGC is itself a diverse community, and its standards therefore need to work across many different domains' functional communities. To enable this, the standards need to be flexible. However, this flexibility can lead to problems with interoperability. To overcome this, communities such as DGIWG have sought to profile ^[1] the OGC standards to ensure that they are implemented consistently throughout their community.

The DGIWG WSTP is responsible for ensuring that the Defence community has a consistent suite of interoperable standards and approaches that it can use to enable interoperability and share geospatial data/services. The panel ensures the standards and a blueprint for how they should be utilised together to enable interoperability are captured in the DGRA[1]. Without the successful implementation and widespread use of standardised approaches, and services the seamless sharing of geospatial data/services will continue to be a problem for the international defence community.

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[1] A Profile is A collection of standards, with parameters, options, classes, or subsets, necessary for building a complete computer system, application, or function. An implementation case of a more general standard or set of standards. OGC - https://www.ogc.org/ogc/glossary/p

6 Current Responsibilities

WSTP is responsible for the maintenance and update of a few of DGIWG's standards profiles and documents. A full list of these and their update date can be found in Annex A of this document.

7 Current and Planned Activities ^[1]]

This Section of the document contains a summary of the technical work being undertaken by the P5 Web Services Technical Panel.

7.1 Maintenance Work

1. The following table lists the DGIWG documents that P5 plans to review in the next 24 months.

Table 2 - Maintenance Activities

Doc ID	Name	Task summary	Document type (Standard, Guidance note, etc.)	Last time reviewed
112	Defence Profile of OGC's Web Map Service 1.3 - Revision	P5 to review and if appropriate update	Standard Profile	Annex A
119	Defence Profile of OGC's Web Coverage Service 2.0	P5 to review and if appropriate update	Standard Profile	Annex A
122	Defence profile of OGC's Web Feature Service 2.0	P5 to review and if appropriate update	Standard Profile	Annex A
124	Defence Profile of OGC's Web Map Tile Service 1.0	P5 to review and if appropriate update	Standard Profile	Annex A
125	Defence Profile of OGC's Catalogue Service for the Web 2.0	P5 to review and if appropriate update	Standard Profile	Annex A
126	Defence Profile of OGC's GeoPackage 1.4	P5 to review and if appropriate update	Standard Profile	Annex A
909	DGIWG Web Services Roadmap	P5 to review and if appropriate update	Roadmap	Annex A

7.2 Development Work

1. The following table lists the technical developments that WSTP plans to undertake in the next 24 months.

Table 3 - Development Activities

Req. No	Task Name	Task summary	Custom er	Output (Standard, Guidance note, White paper etc.)	Due Date
94	GeoPackage	Add Gridded Data Extenson support in DGIWG GeoPackage	MN/ NATO	DGIWG-126 1.1	2025/05
56	GeoPackage	Address new requirements for DGIWG GeoPackage (version 2)	MN/ NATO	TBD	2027/04
76	Web Processing Service (WPS) Profile	A profile of the OGC WPS standard	MN/ NATO	Guidance document	2026/01
NA	API White paper	Scoping the use of APIs in the military domain	DGIWG	White Paper DGIWG-322	2025/05
99	Environmental Data retrieval (EDR) profile	A profile of the OGC EDR API	MN	Profile	2026/04

8 Emerging Concepts and Associate Standards

8.1 Medium term assessment

The key trends identified by the WSTP which are in scope of its responsibilities, more mature, and therefore likely to affect the Defence Geospatial community and require further work by DGIWG in the next 3-5 years are as follows.

8.1.1 Definite Trend 1: Application Programming Interface (API)

- **Description:** According to the OGC, an interface definition that permits invoking services from application programs without knowing details of their internal implementation. The OGC is currently developing a family of standards that are based on the OGCs traditional suite of standards (WCS, WMS, WFS etc) but which define resource-centric APIs that take advantage of modern web development practices, that can't be easily accessed by traditional OGC non API standards. The OGCs API standards are being developed as building blocks that allow to assemble novel APIs for web access to geospatial content [3]. This approach leverages the OpenAPI ^[2] standard to structure its APIs and ensure that they are developed in a consistent way.
- **Benefits and relevance to the Geospatial Defence Community:** There are potentially numerous benefits when utilising API's, these include:
 - Efficiency: When access is provided to an API, the content generated can be published automatically and is available for every channel. It allows it to be shared and distributed more easily.
 - Integration: APIs allow content to be embedded from any site or application more easily. This guarantees more fluid information delivery and an integrated user experience.
 - Automation: With APIs, computers rather than people can manage the work. Through APIs, agencies can update workflows to make them quicker and more productive.
 - Cost: Tools can be delivered more quickly and cheaply than with existing, more traditional approaches.

The benefits of adopting APIs are attractive to technology reliant communities such as defence. However, defences ability to adopt new technologies can be limited as it has to balance the cost and time required for the integration exisiting systems. This will change as APIs are more widely adopted by mainstream IT and vendors. In the coming years the use of APIs will likely become the de facto approach to sharing geospatial data services and tools..

• Level of Maturity: This is a mature trend and it is ready for adoption by the defence community. DGIWG has pubclished an API whitepaper and has started developing a profile

of the OGC Environmental Data Retrieval API standard. APIs will also be adopted by the DGIWG Geospatial Reference Architecture (DGRA)

The WSTP authored an API Whitepaper to provide defence programs knowledge of the Open APIs, describe the API approach in more detail, give a short overview of the OpenAPI Specification and provides an overview of existing and planned OGC API Standards and how the military community could use them. Several OGC API standards are approved and being implemented by DGIWG member nations. WSTP continues to evaluate APIs for profiles and guidance for implementation.

8.1.2 Definite Trend 2: GeoPackage Extensions

- **Description:** GeoPackage is an OGC open standard and is a platform-independent, portable, self-describing, compact format for transferring geospatial information within a SQLite database. The primary role of a GPKG is to store multiple GIS data (layers) in a single file.
- Benefits and relevance to the Geospatial Defence Community: The existing DGIWG GeoPackage profile includes both extensions/restrictions of the underpinning OGC standard as well as system requirements in order to enable interoperability by appropriately configuring existing software. This includes descriptions for a set of conventions for storing the following data types:
 - Vector features and tiles;
 - Tiled matrix sets of imagery and raster maps at various scales;
 - Gridded Data

Additional extensions including portrayal and symbology as well as computational and dissemination mechanisms etc. are being developed and will foster the provision of geospatial information.

• Level of Maturity: DGIWG has already developed a profile of the OGC GeoPackage standard version 1.3.1 (DGIWG-126 Edition 1.0) and 1.4 (Edition 1.1). Several new requirements regarding possible extensions of this profile have been submitted to DGIWG by the community and will be addressed in the near future.

8.1.3 Definite Trend 3: Web Service Discovery Technologies

• **Description:** Providing the means to publish and search for geospatial information and services is key to utilizing the full potential of service-oriented architectures. This includes, but is not limited to, the ability to publish and search collections of descriptive information (metadata) for data, services, and related geospatial information resources in a standardized way. DGIWG has defined a profile for the OGC Catalogue Services for the Web (CSW) Standard. As new requirements and use cases for the automated publication and discovery of standardised Geospatial Metadata are being stated by the community, DGIWG

investigates and defines means to satisfy these requirements. Possible solutions are profiles of OGC API records, SpatioTemporal Asset Catalog (STAC) or portal solutions such as CKAN which is a widely used data management platform by governments and organizations for open data portals. GeoDCAT is an extension of DCAT (Data Catalog Vocabulary) designed to improve the interoperability of geospatial data. It enables metadata for spatial datasets to be described in a standardized way, making it easier to share geospatial data across different platforms and systems.

• Benefits and relevance to the Geospatial Defence Community: Having standardised interfaces and metadata will help users to publish, find and utilize geospatial data and services more efficiently.

Level of Maturity: While some solutions are already mature for DGIWG to address, there are requirements that need to be defined in more detail together with the community to find the best approach.

8.1.4 Definite Trend 4: Vector Tiles

- **Description:** Tiles are packets of geographic data, packaged into pre-defined, rectangular square shaped 'tiles' for transfer over the web. This is an emerging method for delivering styled web maps, combining certain benefits of pre- rendered raster map tiles with vector map data. As with the widely used raster tiled web maps, map data is requested by a client as a set of 'tiles' corresponding to rectangular areas of a pre-defined size and location.
- Benefits and relevance to the Geospatial Defence Community: Compared to an un-tiled vector map, the data transfer is reduced because only data within the current viewport, and at the current zoom level needs to be transferred. The GIS clipping operations can be performed in advance as the tile boundaries are pre-defined. This in turn means that tiled vector data can be packaged up and distributed, without needing any kind of GIS system available to serve data.
- Level of Maturity: Mapbox has defined a standard for vector map tiles called 'vector-tilespec' which uses Google protocol buffers for space-efficient data serialisation. With Mapbox the different licence models need to be acknowledged. MapLibre has defined an open standard for vector map tiles. Web Mercator is the projection of reference, but vector tiles may be used to represent data with any projection and tile extent scheme. Esri has also an implementation of vector tiles based on the Mapbox specification.

8.2 Long Term Assessment

The key trends identified by the WSTP which are in scope of its responsibilities, less mature, and therefore unlikely to affect the Defence geospatial community in the near term and would likely require on further work by DGIWG in the next 6-10 years are as follows.

8.2.1 Long Term 1: Cloud-Optimized Geospatial Formats

- **Description:** The volume and complexity of geospatial data are expanding at an exponential rate. Consequently, conventional approaches for accessing this data, like downloading files, are becoming less practical for meeting the requirements. As the shortcomings of these traditional methods grow more evident, the emergence of cloud-optimized formats for geospatial data offers a highly beneficial alternative.
- Benefits and relevance to the Geospatial Defence Community: Formats like Cloud Optimized GeoTIFFs (COG), GeoParquet, FlatGeobuf etc. might be a good way of delivering a big amount of directly from a cloud. This is not only a format challenge, but also a question how to get the data e.g. using Amazon S3 object storage or Microsoft Azure
- Level of Maturity: Many organizations and services that handle large geospatial datasets have adopted cloud-optimized formats. This includes government agencies, private sector companies, and open-source projects. As an example Overture Maps [https://github.com/ OvertureMaps/data/blob/main/README.md#how-to-access-overture-maps-data]

8.2.2 Long Term Trend 2: Geo Al

- **Description:** The development of Artificial Intelligence (AI) capabilities has considerably accelerated these latest years leading to the availability of AI based operational solutions in the civil domain. Geospatial data are also concerned by this technology regarding automatic interpretation and classification or generation of imagery data, detection of changes or shapes in large imagery collections and many other potential application domains that extend beyond imagery data.
- Regarding standardization, in the civil domain, OGC has led a task in Testbed-18 regarding Machine Learning Training Data (see Engineering Report: https://docs.ogc.org/per/22-017.html) and published the TrainingDML-AI Standard that provides detailed metadata for formalizing the information model of training data. In the military domain, NATO has defined an AI Strategy and is evaluating the impact of AI on JISR standards and activities.
- Benefits and relevance to the Geospatial Defence Community: The application domains of GeoAI mentioned above are of interest for Defence usages. Regarding the community, there might be some interest in sharing common practices or datasets in machine learning processes for data production or detection purposes. More generally, the evolution of Geo AI trend should be monitored at a cross-panel level.

Level of Maturity: This is an emerging trend and the development of these technologies should be monitored.

8.2.3 Long Term Trend 3: Integration with Motion Imagery

- **Description:** This topic may include Motion Imagery according to STANAG 4609 or Full Motion Video (high-fidelity digitally encoded video). OGC Testbed-16: Full Motion Video to Moving Features Engineering Report (available at https://docs.ogc.org/per/20-036.html) provides some recommendations of interest for the usage of STA, Moving Feature Sensors, SensorML, O&M, SWE (and in a wider sense also Connected Systems API as a successor for SWE) for Motion imagery or Video Moving Target Indicators, as well as Web Video Map Tracks (WebVMT) that is an open web format based on JavaScript Object Notation (JSON) and W3C Web Video Text Tracks (WebVTT).
- Integration with motion imagery is also a topic that is the base of the Next Generation of ISR Imagery Standard (NGIIS) that are developed by NGA (US) and DSTL (UK) and are intended to be the follow-on to NITF/NSIF ISR Standards. They are built on top of a common base of MPEG Standards enhanced by ontology and metadata information.
- Benefits and relevance to the Geospatial Defence Community: The dramatic spreading during the last years of video recording devices, together with the development of satellite video capture, as well as the number of Unmanned Aerial Vehicles (UAV) with these capabilities make this a relevant trend.

Level of Maturity: This is an emerging trend and the development of these technologies should be monitored

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[2] The OpenAPI Specification (OAS) (previously known as Swagger) defines a standard, language-agnostic interface to RESTful APIs which allows both humans and computers to discover and understand the capabilities of the service without access to source code, documentation, or through network traffic inspection. https://swagger.io/specification/

ANNEX A Artefact Responsibility

Table A1 contains a list of completed DGIWG documents and artefacts that the WSTP is responsible for maintaining. (**Note** *this table is extracted from the DGIWG PoW and should not be updated in isolation*)

Table A 1: Artefacts for which WSTP is responsible

Doc ID	Document Title	Published Date	Edition Date	Review Cycle	Review by Date
112	Defence Profile of OGC's Web Map Service 1.3 - Revision 3.1	2024/09/10	2024/09/10	3 years	2026/09 new version
119	Defence Profile of OGC's Web Coverage Service 2.0	2024/09/10	2017/11/28	2 years	2026/04 start review
122	Defence profile of OGC's Web Feature Service 2.0	2019/11/06	2019/10/30	2 years	2027/12 start review
124	Defence Profile of OGC's Web Map Tile Service 1.0 - Revision 2.0	2024/09/10	2024/09/10	2 years	2027/09 new version
125	Defence Profile of OGC's Catalogue Service for the Web 2.0	2018/03/09	2018/03/01	2 years	2026/04 start review
126	DGIWG GeoPackage Profile 1.4 Ed 1.1	2023/09/22	2025/05/02	2 years	2027/05 start review
909	DGIWG Web Services Roadmap	2023/10/23	2025/05/14	yearly	2026/05 new version

Annex B Footnotes and Inline References

This section contains footnotes and in-line document references from other sections of the document. Footnotes are annotated [#] in the hyperlink to this section.

[1] Footnote-text.

[2] Footnote-text.