Release Notes for OGC GeoPackage Encoding Standard v1.2

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Revision Notes

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Preface

This document provides the set of revision notes for the existing GeoPackage version 1.2 (OGC 12-128r13) and does not modify that standard.

This document was approved by the OGC membership on approval date. As a result of the OGC Standards Working Group (SWG) process, there were a number of edits and enhancements made to this standard. This document provides the details of those edits, deficiency corrections, and enhancements. It also documents those items that have been deprecated. Finally, this document provides implementations details related to issues of backwards compatibility.

Chapter 1. Introduction

1.1. Scope

GeoPackage is an open, standards-based, platform-independent, portable, self-describing, compact format for transferring geospatial information.

Over the course of 2016, the GeoPackage Standards Working Group (SWG) made a number of changes to the GeoPackage Encoding Standard Version 1.1 (OGC 12-128r12). These changes have been aggregated into version 1.2 of the GeoPackage Encoding Standard (12-128r13).

GeoPackage 1.2 is a minor revision to version 1.1. The minor revision designation is being used because of a number of substantive changes that alter conformance requirements. However, all of these changes were carefully considered for impact on existing implementations. Changes that were considered to have a significant impact were rejected or recast in order to limit their impact.

All changes were all managed via the GeoPackage GitHub repository. All substantive issues and most administrative issues were raised in the GitHub Issue Tracker and discussed by the SWG. Once the issue was resolved, a pull request was generated and merged into the repository. Some administrative issues such as typos were corrected directly through a commit on the master branch.

A large number of the changes in this version were initiated through official change requests. In addition, a new extension was added as a result of the GeoPackage Elevation Extension Interoperability Experiment (see [B1]).

1.2. Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

Table 1. Contacts

Name	Organization
Jeff Yutzler	Image Matters

1.3. Future Work

No future work is planned to this document.

1.4. Foreword

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Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might

be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Chapter 2. References

The following normative documents are referenced in this document.

NOTE: Only normative standards are referenced here, e.g. OGC, ISO or other SDO standards. All other references are listed in the bibliography.

- OGC 12-128r13, OGC® GeoPackage Encoding Standard, version 1.2

Chapter 3. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard [OGC 06-121r9] and in OGC® Abstract Specification Topic TBD: TBD shall apply. In addition, the following terms and definitions apply.

3.1. administrative change

An administrative change is a change that does not alter the abstract tests for any requirements. It includes typographical errors, changes in wording to improve clarity or consistency, and perfunctory changes like changes in version numbers.

3.2. critical Change

A critical change is a change that alters requirements in a way that is known to cause reverse compatibility issues.

3.3. substantive change

A substantive change is a change that alters requirements in a way that is not deemed to have a high risk for causing reverse compatibility issues.

3.4. Abbreviated terms

- CITE Compliance, Interoperability, Testing, and Experimentation
- CRS Coordinate Reference System
- DDL Database Definition Language
- GPKG GeoPackage
- SQL Structured Query Language
- SWG Standards Working Group
- WKT Well Known Text

Chapter 4. Change Log

4.1. KEY

- Issue#: Issue in GitHub
- PR#: Pull Request in GitHub (or commit number if no PR was made)
- Type:
  - A=Administrative
  - S=Substantive
  - C=Critical

See Description of Critical Changes for more information on critical changes and Description of Substantive Changes for more information on substantive changes.

- Section: Section number in the updated document
- Description: Brief text describing the change
- Purpose: the reason for the change, such as:
  - Clarity
  - Consistency
  - Interoperability
  - Perfunctory
  - Readability
  - Usability

4.2. Change Table 1 - Pre-Comment Period

Table 2. Change Log

Issue#	PR#	Type	Section	Description	Purpose
209	91006 d3	A	1.1.1.1.1	Clarify that GeoPackage header is null-terminated	Clarity
213	227	A	Annex B.2	Add new terms and definitions	Clarity
214	219	A	Annex B.11-13	Update UML diagrams to show DATETIME where appropriate	Consistency
221	251	S	2.4	Adding "attributes" section to describe use of non-spatial data	Addition

Issue#	PR#	Type	Section	Description	Purpose
222	224	A	1.1.3	Rewrite description of gpkg_contents table	Clarity
228	240	A	Annex F.8	Simplify triggers to avoid failures on row-level entries	Usability
231	236	A	Annex F.9	Correct wording in Table #42	Clarity
234	239	S	Annex F.1	Deprecate Requirement #69	Usability
235	239	S	Annex F.2,4,5	Deprecate extensions F.2, F.4, F.5	Interoperability
237	236	A	2.2.7.1.2	Rewrite Requirement #53	Clarity
238 et. al.	236 et. al.	A	Various	Typography	Readability
241	244	A	2.3.2.1.1	Update description for `definition` column	Usability
~~242, et. al.~~	~~248, et. al.~~	~~S~~	~~F.11~~	~~Add Elevation extension to standard~~	~~Addition~~
243	ef2a9a0	A	F.8	Add default to SQL DDL	Consistency
245	267	A	Annex B.5-6	Change Log	Perfunctory
254	268	A	2.3.2.1.1	Updating rules for extensions in Requirement 58	Clarity
255, 266	264, 273	S	1.1.1.1.1, Annex A	Update versioning mechanism, allow for version increments in SQLite header	Interoperability
258	236	S	Annex F.10	Correct column name for CRS WKT Extension	Consistency
260	263	A	Annex F.9	Correct *min/max_is_inclusive* in abstract tests	Consistency
261	264	A	1.1.1.1.2	Eliminate .gpkx option	Usability

4.3. Change Table 2 - Post-Comment Period

Table 3. Change Log 2

Issue#	PR#	Type	Section	Description	Purpose
279 et. al.	280 et. al.	A	Annex A	Update abstract tests to align with requirements	Consistency
282	283	A	Annex A, Annex D.2	Update DDL to enforce that primary keys are not null	Consistency
286	292	A	2.1.5.1.1, Annex A	Add Null column to Table 7, update ATS to use PRAGMAs instead of SQL inspection	Consistency
295	296	S	2.2.6.1.2, 2.2.7.1.2, Annex A	Remove "tiles" stipulation in Requirements 39/43 so that extensions can use the tiles tables	Extensibility
301	302 et. al.	S	Various	Comments from Carl Reed, including but not limited to clarifications on extension mechanism	Clarity, Consistency, Readability, Interoperability
309	312	S	1.1.1.2.2, Annex A	Remove Requirement 9 because it is is a software capability, not a file encoding capability	Consistency
314	315, 324	A	2, Annex F	Use registered requirements numbers instead of auto-generated ones.	Consistency
319	320	S	F.8	Editorial review of Metadata Extension	Consistency
322	326	A	2.2.3.1.1 Table 11, 2.2.3.1.2	Rewrite Requirement 60, specify that columns are jointly unique	Clarity
332	334	A	F.10, Table 26	Add a default in case extension is present in a file used by an application that doesn't understand it	Interoperability
336	337	S	F.9	Editorial review of Schema Extension	Consistency
341	342	A	F.3	Editorial review of RTree Spatial Index Extension	Consistency

Issue#	PR#	Type	Section	Description	Purpose
345	346	A	F.7	Editorial review of WebP Extension	Consistency
347	348	A	F.1	Editorial review of Non-Linear Geometry Types Extension	Consistency
351	352	A	2.2.1	Editorial review of Tiles introduction, including adding explicit reference to WMTS in response to official comment from Keith Ryden	Consistency
356	357	A	Annex I	Updating reference to ISO 19115	Perfunctory
358	371	A	2.2.8.1.1	Editing Table 10 to remove default values for zoom_level, tile_column, and tile_row	Consistency
362	368	A	2.2.5, Annex F.7	Editing Requirement 92, adding notes indicating that PNG/JPG tiles (or WebP) can be mixed and matched	Clarity
363	369	S	Annex F.10	Adding requirement for gpkg_extensions when CRS WKT extension is in use	Consistency
375	378	A	2.3.2.1.2, Annex A.2.3.1.1	Adding explanatory text regarding table name case sensitivity	Clarity
366	367	S	2.2.1	Clarifying role of extents in gpkg_contents vs. gpkg_tile_matrix_set	Clarity
N/A	376	A	3	Added new security consideration related to SQLite	Perfunctory

Chapter 5. Description of Critical Changes

There are no critical changes in this release.

Chapter 6. Description of Substantive Changes

6.1. Pre-Comment Period

6.1.1. 221 Adding Attributes Section (2.4)

Non-spatial attribute data are sets (or tuples or rows) of observations that may not have an explicit geometry property. A strict read of GeoPackage v1.1 does not allow non-spatial attribute values. However, in practice data providers routinely need to deliver data that does not contain geometry properties. Requiring any GeoPackage that contains non-spatial tables to be declared and documented as an "Extended GeoPackage" is not reasonable and does not promote interoperability. Therefore, the standard has been modified to allow this data to be stored in user-define attribute tables as part of a basic GeoPackage. This change is considered to be low-risk because it creates a new encoding option that would be ignored by previous versions of the standard.

6.1.2. 234 Deprecate Requirement #69 (Annex F.1)

It was determined that it is difficult, if not impossible, to comply with Req 69 "SQL functions that operate on GeoPackageBinary geometries as specified in other extensions SHALL operate correctly on the non-linear geometries specified in this extension." because the functions could have been loaded via an extension such SpatiaLite which cannot be changed, and does not support the non-linear geometries. The removal of this requirement will allow for interoperable storage and retrieval of the geometries, while not requiring but allowing existing functions to work with the geometries.

6.1.3. 235 Deprecate Extensions F.2, F.4, and F.5

The GeoPackage SWG agreed to remove the "User Defined Geometry Types Extension of GeoPackageBinary Geometry Encoding" extension from the encoding standard for the following reasons:

- The geometry encoding is not specified in the extension and therefore a supplemental document explaining the encoding would be required. In the absence of this document, there is no way for an application developer to support this extension and therefore it is not interoperable.

- Multiple developers could implement the encoding of a new, but similar geometry type such as EllipiticalCurve in different ways.

- Existing spatial functions will not work with the new geometry types and could potentially cause errors or skip data if used.

The SWG also agreed to remove two addition extensions, "Geometry Type Triggers" and "Geometry SRS ID Triggers", from the encoding standard as they directly relate to User-Defined Geometry Types Extension and will no longer be required.

The SWG believes that content contained in these extensions would be better suited in a best

practice document. This document could outline how to create a complete and interoperable User Defined Geometry Type Extension, including the details of the geometry encoding and how it can be used with existing spatial functions. This would allow two independent developers to create User-Defined Geometry Type extensions that follow the same template and make it easier for clients of the extensions to adopt.

6.1.4. ~~242 Add Elevation Extension to Standard (Annex F.11)~~

~~After successful completion of the GeoPackage Elevation Extension Interoperability Experiment (see [B1]), the SWG agreed to add a new extension to the standard. The "Tiled Gridded Elevation Data" extension stores tiled gridded elevation data in a GeoPackage. The tiles contain elevation values and may be 16-bit PNG files or 32-bit TIFF files. The extension defines two ancillary data tables, one for coverages and one for tiles. When using the PNG encoding, a scale and offset may be applied. The extension also allows for a TIFF encoding but it constrains many of the TIFF options that are available to simplify development.~~ The Elevation Extension was removed from GeoPackage 1.2 so that it could be advanced as a separate document.

6.1.5. 255 Update versioning mechanism, allow for version increments in SQLite header (1.1.1.1.1)

In GeoPackage 1.1 and earlier, Requirement 2 specifies an exact string as the application identifier. This string is also supposed to be added to SQLite's magic.txt file ([B3]). The SWG determined that updating this file is unsustainable. Instead, GeoPackage will now use the original application ID (GPKG) and use the user_version header to indicate the version. In addition, it is reasonable to for clients designed to comply with a specific version of the standard to interoperate with GeoPackages that comply with a later version. In response, Requirement 2 was reworded to allow for version increments and the associated abstract test was updated. This change should improve interoperability as well as make it more reasonable for GeoPackage producers to pass CITE tests.

6.1.6. 258 Column Name for WKT for Coordinate Reference Systems (Annex F.10)

The "WKT for Coordinate Reference Systems" extension was designed to align to a new OGC Encoding Standard, OGC 12-063r5 (see [B2]). The text in GPKG 1.1 (including the column name) incorrectly references "12-163" instead. This change corrects all references to the proper "12-063". The GeoPackage SWG regrets the error. This change is considered to be low-risk. At worst, implementers may need to populate a redundant column to satisfy clients that use this extension but only support GPKG 1.1.

6.2. Post-Comment Period

6.2.1. 295 Remove "tiles" Stipulation on Requirements #39 and #43 (2.2.6.1.2, 2.2.7.1.2)

The way these requirements were originally written, if they were read in a strict way it was not possible to use these tables for a data type other than *tiles*. This prevented certain extensions from being possible. By removing the *tiles* stipulation, any data type may use these tables (if appropriate)

and there must be traceability back to `gpkg_contents`.

6.2.2. 301 Clarifications on Extension Mechanism and Requirements #4 and #17 (1.1.1.1.3, 2, 2.3.1)

Dr. Reed provided comments on a wide range of topics. The substantive changes primarily concerned the interoperability of extensions. With the changes to Requirement #4, a **GeoPackage** is now defined as a file conforming to to core standard but with no extensions. An **Extended GeoPackage** is now defined as a file conforming to the core standard and one or more OGC-endorsed extensions. Implementers are still free to produce extensions if they feel they must do so to meet requirements, but externally-produced extensions cannot be endorsed by OGC and therefore GeoPackages containing these extensions will not be considered OGC-compliant.

This change caused the SWG to reconsider the purpose of Requirement #17. While the intent was to ensure interoperability, this requirement had the side-effect of prohibiting an empty "template" GeoPackage and forced producers to add tile or feature data when providing data in using the elevation extension. Because the terms "GeoPackage" and "Extended GeoPackage" were clarified, Requirement #17 was deemed unnecessary and was removed.

6.2.3. 309 Deprecate Requirement #9 (1.1.1.2.2)

This requirement pertains to capabilities of the software library using the GeoPackage. This requirement is out of scope for the GeoPackage Encoding Standard and was therefore deprecated. The associated abstract test was removed.

6.2.4. 319, 336, 363 Adding Requirements for Metadata Extension (Annex F.8), Schema Extension (Annex F.9), and CRS WKT Extension (Annex F.10)

In GeoPackage 1.1, the Metadata and Schema sections were demoted to extensions. However, when this was done no requirement was added to specify the rows in `gpkg_extensions` to declare that the extensions are in use. Similarly, no requirement was added when the CRS WKT Extension was added. This version corrects this oversight by adding requirements #140, #141, and #145 respectively. This is considered a low impact change because most implementers were doing this already.

6.2.5. 366 Clarifying Role of Extents in gpkg_contents vs. gpkg_tile_matrix_set

In the past there has been confusion over the role of the extents in these two tables. In addition to adding informative notes (an administrative change), Requirement #144 was added to mandate that all tiles fall within the extents of the tile matrix set as defined. If this is not done the GeoPackage is not usable anyway so this is a low impact change.

Chapter 7. Future Work

7.1. Multi-resolution Vector Data (220)

An approach has been developed for storing geometries for multiple resolutions. However, it was determined to be premature to add this approach to the standard as an extension. It is being considered for OGC Testbed 13.

7.2. Breaking Changes

Changes that were considered to be "breaking" or had great risk to interoperability were rejected for this release. These issues may be found in GitHub at https://github.com/opengeospatial/geopackage/milestone/11.

- 229: Inconsistent naming gpkg_contents(identifier) / gpkg_data_columns (name)
- 230: `gpkg_contents` should have title column

Appendix A: Revision History

Table 4. Revision History

Date	Release	Editor	Primary clauses modified	Descriptions
August 30, 2016	J. Yutzler	.1	all	initial version
October 16, 2016	J. Yutzler	.2	all	migration to Asciidoc
October 18, 2016	J. Yutzler	.3	3, 4, 6	feedback from 10/17 SWG
October 19, 2016	J. Yutzler	.4	0, 1, 4	review
December 13, 2016	J. Yutzler	.5	4, 6	late additions
March 1, 2017	J. Yutzler	.6	4, 6	approvals from 2/27 SWG
April 18, 2017	J. Yutzler	.7	4, 6	approvals prior to SWG vote to return to OAB
April 19, 2017	J. Yutzler	.8	4, 6	splitting change log into "pre-comment period" and "post-comment period"
June 2, 2017	J. Yutzler	.9	4, 6	approvals from 6/2 SWG
June 27, 2017	J. Yutzler	.91	4, 6	strikethrough of Elevation Extension, adding item #358
July 18, 2017	J. Yutzler	.92	4	adding item #376
Auugust 1, 2017	J. Yutzler	.93	4	adding item #375

Appendix B: Bibliography

[B1] OGC GeoPackage Elevation Extension Interoperability Report, OGC 16-094r3. (2016).

[B2] Well-known text representation of coordinate reference systems, version 1.0, OGC 12-063r5. (2015).

[B3] SQLite magic.txt, http://www.sqlite.org/src/artifact/8273bf49ba3b0c85, June 16, 2014.