

## GeoPackage Encoding Rule for Environmental Noise Directive Reporting Data

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## Introduction

The Environmental Noise Directive 2002/49/EC (END) defines reporting obligations for assessing and managing environmental noise. The END contains several provisions which require Member States (MS) to communicate information to the European Commission (EC) concerning the preparation and publication of strategic noise maps and noise management action plans for:

- All roads, railways, airports, and industrial sites within agglomerations with more than 100.000 inhabitants
- major roads (more than 3 million vehicles a year)
- major railways (more than 30.000 trains a year)
- major airports (more than 50.000 movements a year, including small aircrafts and helicopters).

The main aim of the END is to identify noise pollution levels and to trigger the necessary action both at Member State and at EU level. To pursue its stated aims the END focuses on the determination of exposure to environmental noise, ensuring information on environmental noise and its effects is made available to the public, and preventing and reducing environmental noise where necessary, preserving environmental noise quality where it is good. This Directive applies to noise to which humans are exposed, particularly in built-up areas, in public parks or other quiet areas in an agglomeration, in quiet areas in open country, near schools, hospitals and other noise-sensitive buildings and areas. It does not apply to noise that is caused by the exposed person himself, noise from domestic activities, noise created by neighbours, noise at workplaces or noise inside means of transport or due to military activities in military areas.

The GeoPackage encoding of European Noise Directive data can be used to deliver data that fulfills the following requirements:

- It contains all information required for Noise Reporting
- It contains all necessary information to also derive compliant INSPIRE GML encoded data and thus comply with INSPIRE Implementing Rules

The underlying GeoPackage Encoding Standard has been developed by the Open Geospatial Consortium and is built on SQLite. The current version is 1.3.0 (12-128r17). The GeoPackage Encoding Standard defines the schema for a GeoPackage, including table definitions, integrity assertions, format limitations, and content constraints. The required and supported content of a GeoPackage is entirely defined in the standard.

Note: Some of the work described here re-uses concepts from the INSPIRE UML-to-GeoPackage encoding rule development version<sup>1</sup> and from the INSPIRE Action 2017.2 (Alternative Encodings) Model Transformation Rules<sup>2</sup>. As these works are not formally approved so far, they are not listed as normative references.

<sup>&</sup>lt;sup>1</sup> See <u>https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encoding-</u> rule.md

<sup>&</sup>lt;sup>2</sup> See <u>https://github.com/INSPIRE-MIF/2017.2/blob/master/model-</u> <u>transformations/TransformationRules.md</u>



## **Normative References**

- Environmental Noise Directive Data model documentation version 3.0, April 2021<sup>3</sup>
- GeoPackage Encoding Standard version 1.3.0<sup>4</sup>
- INSPIRE Transport Networks Data Specification, v. 4.0<sup>5</sup>
- INSPIRE Area management / restriction / regulation zones & reporting units, v. 4.0<sup>6</sup>
- INSPIRE Human Health and Safety Data Specification, v. 4.0<sup>7</sup>

## **Conformance Classes**

The European Noise Directive reporting mechanism contains three data flows containing spatial information. In addition, there are three other dataflows containing only tabular information. The data flows have been developed to completely fulfil the requirements of the European Noise Directive. For each data flow, a data model has been developed that re-uses concepts and types from the matching INSPIRE data specifications. In each model related to spatial information, there is at least one spatial type that inherits from different INSPIRE feature types. For each of these models, a streamlined view has been developed, which is essentially a simplified INSPIRE model.

The streamlined models are transformed to a GeoPackage logical schema, using different model transformation rules. Thus, this END encoding rule defines different conformance classes per model:

- DF1\_5 Noise Sources
  - Major Roads (extends INSPIRE TN-RO RoadLink)
  - Major Railways (extends INSPIRE TN-RA RailwayLink)
  - o Major Airports (extends INSPIRE TN-A AerodromeNode)
  - Agglomerations (extends INSPIRE AM
    - ${\it Management} Restriction Or Regulation Zone)$
- DF4\_8 Strategic noise maps
  - Noise contours for major roads (extends INSPIRE HH EnvHealthDeterminantMeasure) and noise exposure data
  - Noise contours for major railways (extends INSPIRE HH EnvHealthDeterminantMeasure) and noise exposure data
  - Noise contours for major airports (extends INSPIRE HH EnvHealthDeterminantMeasure) and noise exposure data
  - Noise contours in sgglomerations (extends INSPIRE HH EnvHealthDeterminantMeasure) and noise exposure data
- DF7\_10
  - Quiet Areas (extends INSPIRE AM ManagementRestrictionOrRegulationZone)

<sup>&</sup>lt;sup>3</sup> Currently, the draft END Data Model Documentation is available as internal working document, final version will be published for public.

<sup>&</sup>lt;sup>4</sup> See <u>http://www.geopackage.org/spec/</u>

<sup>&</sup>lt;sup>5</sup> See <u>https://inspire.ec.europa.eu/id/document/tg/tn</u>

<sup>&</sup>lt;sup>6</sup> See <u>https://inspire.ec.europa.eu/id/document/tg/am</u>

<sup>&</sup>lt;sup>7</sup> See <u>https://inspire.ec.europa.eu/id/document/tg/hh</u>



• Noise Action Plans (extends INSPIRE AM ManagementRestriction-OrRegulationZone) for noise action plan coverage areas.

A **Core** conformance class describes common rules applied to all conformance classes.

For each conformance class, the input conceptual model is represented as a UML model. The output model is represented using the hale studio schema explorer. Please note that the model transformations, especially using Default Values, can affect the given cardinality.

#### **Specific Model Transformation Rules**

To transform the streamlined or full conceptual models to logical GeoPackage schemas, several transformation rules are applied. Some have a general scope and are specified in the INSPIRE Action 2017.2 (Alternative Encodings) Model Transformation Rules, some have been refined in the INSPIRE UML-to-GeoPackage encoding rule, and others have been developed specifically in the scope of the END GeoPackage work, though they might also be applied elsewhere. The specific transformation rules are the following:

- Flatten hierarchical structures and data types with property name length limit
- Deal with INSPIRE voidable attributes
- Set default dataset properties
- Handle code list values and metadata
- Handle attributes with 1:n cardinality
- Handle associations with 1:n and n:m multiplicity
- Handle geometry types and Spatial Reference Systems

The following sections describe the specific transformation rules that are used to create END GeoPackage schemas.

#### Flatten hierarchical structures with property name limit (MT\_ENDGPK01)

This rule is based on the General Flattening rule<sup>8</sup> and the GeoPackage flattening rule<sup>9</sup>. It modifies these rules to optimize data usability in different geographic information system software. In these applications, usability is reduced when property names are long, so this rule applies a maximum length of 31 characters for property names.

To stay within this maximum property name length, this model transformation rule is often combined with:

- 1. Substitution of complex types through simpler types (Simple Citation, Simple Codelist Reference, Simple Geographical Name, Simplified Localized Character String...)
- 2. Usage of related tables for elements where the allowed cardinality is greater 1

#### Voidable attributes to Companion Table (MT\_ENDGPK02)

In INSPIRE conceptual models, there are often voidable properties. In END reporting, these will usually not be used and will clutter the primary feature table, resulting in tables where up to two thirds of all columns are always empty. However, to have a constant schema and to have compatibility with the INSPIRE conceptual model, this rule introduces a companion table to the actual primary feature table where these properties can be stored if required for a particular

<sup>&</sup>lt;sup>8</sup> See <u>https://github.com/INSPIRE-MIF/2017.2/blob/master/model-</u>

transformations/GeneralFlattening.md

<sup>&</sup>lt;sup>9</sup> See <u>https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encoding-</u> rule.md#flattening-of-nested-structures



data set. This enables END GeoPackages to be used as an "Alternative Encoding" for all related data sets.

While the rule "Dataset Default values to Dataset Default Properties Table (MT-ENDGPK03)" handles values of such properties that are constant across the whole data set, this rule (MT\_ENDGPK02) handles properties that may differ from feature to feature, such as beginLifespanVersion and other lifecycle information.

As a general rule, the companion table is always named like the primary feature table, with a Voidables postfix, e.g. MajorRoadSourceVoidables. In the companion table, a foreign key attribute with the name <PrimaryTablename>\_id is introduced to ensure that complete objects can be formed via a join or view.

Table 1 provides an example for both the primary table and the companion table:

MajorRoadSource			
id	roadId	roadNationalCode	
1	AT_1	A1	
2	AT_2	A2	
3	AT_3	A21	
4	AT_5	A22	

	MajorRoadSourceVoidables			
9	id	MajorRoadSource _id	beginLifespan- Version	
	1	4	null	
	2	3	1981-10-25	
	3	1	2002-11-08	
	4	2	null	

#### Table 1: Primary table and companion table

#### Dataset default values to DatasetDefaultProperties Table (MT\_ENDGPK03)

In INSPIRE data models, and, by extension, in the END models, there are some properties that have the same value for every object in a data set, such as the nilReason attributes, or the xlink:href and xlink:title attributes for codelist references. In INSPIRE conceptual models, voidable properties, that usually have a minimum cardinality of 1, can be left empty if a void reason is given. In all data sets encountered so far, these void reasons (encoded as a nilReason attribute on the element) have been constant over the whole data set.

Such attributes or regular properties may be encoded into a DatasetDefaultProperties table and are removed from the primary feature table. This results in a streamlined GeoPackage primary feature table structure. In some cases, the property may also be retained in the table, so that value for single features that are different from the default could be provided.

By default, this transformation rule is applied to nilReason attributes of voidable properties. In addition, each conformance class may select additional properties or attributes to factor out into the DatasetDefaultProperties table.

In contrast to the approach taken by the INSPIRE UML-to-GeoPackage encoding rule, where nilReason values are stored in the standard gpkg\_metadata table<sup>10</sup>, this transformation rule stores them in a data table called DatasetDefaultProperties. This approach was taken since the gpkg\_metadata table is usually not directly accessible by GIS users.

The structure of the table DatasetDefaultProperties is as follows (Table 2):

<sup>&</sup>lt;sup>10</sup> See <u>https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encoding-</u> rule.md#voidable



#### Table 2: DatasetDefaultProperties

tableName	propertyName	attribute	defaultValue
MajorRoadSource	beginLifespanVersion	nilReason	http://inspire.ec.eur opa.eu/codelist/VoidR easonValue/Unpopulate d

The parameters with which this model transformation function is called are defined as follows:

- tableName: Mandatory parameter, must have the name of the table from which the default value for the property has been factored out. The value of tableName will be stored in the column tableName.
- propertyName: Mandatory parameter, must have the name of the property for the default value is given. The value of propertyName will be stored in the column propertyName.
- attribute: Optional parameter that gives the name of an attribute of the property for which a default value is given. It can be used to indicate that the default given is provided for an attribute on the property, such as codeList or nilReason. If an attribute name is given, the default value applies only to that attribute, not to the property. The value of attribute will be stored in the column attribute.
- defaultValue: Mandatory parameter, gives the actual default value for the property or attribute. Note that his value may be mapped to a code list title via the rule "Handle code list values and metadata (MT-ENDGPK04)" described below. The value of defaultValue will be stored in the column defaultValue.
- retainProperty: Optional parameter, if set to true, indicates that while a default property is set, the column is retained in the output schema so that reporters can override the default value for single features. Default is false. This value is not persisted in the table.

#### Handle code list values and metadata (MT\_ENDGPK04)

In INSPIRE GML, code list values are encoded as xlinks that point to a fully qualified URL. Since these URLs contain special characters and are quite long, they are often harder to interpret, to use as labels and to use as filters for symbology. As a result, we use a specific model transformation rule:

- 1. Change the type of the property to string
- 2. In that string, write the code list value
- 3. In an extra table called CodelistProperties, store a mapping of the table and property to the fully qualified URL of the code list.

The structure of this CodelistProperties table is as follows (Table 3):

tableName	propertyName	codelist
MajorRoadSource	class	http://inspireeu/enumeration/FunctionalRoad ClassValue

#### Table 3: CodelistProperties



This table thus stores both the uniquely identifying URL of the code list and links properties to code lists. This could later be exploited to generate a fully compliant INSPIRE GML data set, but also for validation and editing purposes (Table 4).

MajorRoadSource	CodelistProperties		
class	tableName	propertyName	codelist
firstClass	MajorRoadSource	class	http://inspire.ec.europa. eu/enumeration/Functional RoadClassValue

#### Table 4: Example – primary table and CodelistProperties table

#### Handle composition attributes with multiplicity 1:n (MT ENDGPK05)

In INSPIRE, many attributes of a feature type can have more than one value. This is used both to represent associations and composition relationships in the conceptual model, but often presents a challenge in other encodings than GML.

As GeoPackages can contain many tables with foreign key relationships, such compositions and associations are handled by introducing related tables. This is only done when a property type is complex and when the maximum multiplicity of the property is > 1.

The relationship is established using the standard ID column of Geopackage as the primary key, and a column named <PrimaryTablename> id in the related table. An example for such a table will look like this (for the data type DirectedLink from INSPIRE TN specification) (Table 5):

id	MajorRoadSource_id	beginLifespanVersion	validFrom
1042	7525	2020-03-27T01:00:00Z	2020-03- 27T01:00:00Z

#### Table 5: Relationship - attributes with multiplicity 1:n

For concrete conformance classes, modelers should pay attention that the nesting depth does not exceed 3 by using simple type substitution and other rules in conjunction with this rule.

Note: The general UML-To-Geopackage specification does not have a general rule for this case, but states that "If a property has a cardinality greater than 1, a suitable mapping needs to be found on a case-by-case basis."11

#### Handle associations with a multiplicity of n:m (MT ENDGPK06)

In INSPIRE, features can have a many-to-many relationship. Such relationships can be represented in GeoPackage using a relationship table. In a relationship table, there is a primary key, as well as two foreign keys. As in the composition case, the foreign key columns are named <PrimaryTablename>\_id in the related table.

Compared to the general UML-to-Geopackage approach, this rule does not require the GeoPackage Related Tables extensions but may add it at a later point when clients support it fully.

<sup>&</sup>lt;sup>11</sup> See https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encodingrule.md#properties



As there is no example for this in the END schemas for spatial data, we will use a generic INSPIRE example – the relation between AdministrativeUnit to AdministrativeBoundary) (Table 6):

#### Table 6: Relationship - multiplicity of n:m

ID	AdministrativeUnit_id	AdministrativeBoundary_id
1943	34543	4634

Such tables are named according to the types in the relationship, ordered alphabetically: Relation\_AdministrativeBoundary\_AdministrativeUnit.

Note: the current version of the END templates does not apply this rule. The rule is included to provide a complete set of general rules, and it could be useful for future versions or other data models.

#### Handle geometry types and Spatial Reference Systems

ISO 19107 Geometry types are mapped to GeoPackage geometry types as described in the general UML-to-GeoPackage encoding rule<sup>12</sup>.

Spatial reference system information is stored as described in the general UML-to-GeoPackage encoding rule<sup>13</sup>.

For END reported data, the usage of any spatial reference system allowed by the INSPIRE data specifications that have been extended is permissible. These data specifications define the following spatial reference systems (SRS) that are recognised in GeoPackage (Table 7):

EPSG Code	Name	Notes
EPSG:3034	ETRS89-LCC	Limited support in QGIS 3.12 due to a bug in GDAL < 3.1; fixed in QGIS 3.16
EPSG:3035	ETRS89 / ETRS-LAEA	Limited support in QGIS 3.12 due to a bug in GDAL < 3.1; fixed in QGIS 3.16
EPSG:3038+	ETRS89-TM26N to ETRS89- TM39N	Limited support in QGIS 3.12 due to a bug in GDAL < 3.1; fixed in QGIS 3.16
EPSG:4258	ETRS89	
EPSG:4326	WGS 84	

Table 7 Coordinate reference systems in geoPackage

The SRS known as WGS84 Web Mercator / Pseudo-Mercator (EPSG:3857) is also supported by GeoPackage and the clients but is not listed as an INSPIRE compliant SRS.

In case of the END reporting data flows, the European ETRS89 Lambert Azimuthal Equal Area coordinate reference system (ETRS89 / ETRS-LAEA, EPSG:3035) is recommended to be used for spatial data.

<sup>&</sup>lt;sup>12</sup> See <u>https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encoding-</u> rule.md#iso-19107---geometry-types

<sup>&</sup>lt;sup>13</sup> See <u>https://github.com/IAAA-Lab/U2G/blob/master/GeoPackage/geopackage-encoding-</u> rule.md#coordinate-reference-systems



#### **Conformance Class END DF1\_5 Agglomerations**

This section describes the transformation rules and its parameters applied to the Agglomerations conceptual model, which is based on the application schema INSPIRE Area Management Restriction and Regulation Zones.

#### Input Model

The conceptual model depicted below (Figure 1) is a streamlined version of a model that extends the INSPIRE feature type ManagementRestrictionOrRegulationZone.

#### Figure 1: Data model END DF1\_5 Agglomerations

glomerationSource (DF1_5) - Streamlined View				
«featureType» Agglomeration Source	«dataType» SimpleGeographicalName		«codeList» SpecialisedZoneTypeCo	de
agglomerationId: ThematicIdentifier agglomerationName: SimpleGeographicalName size: double numberOfInhabitants: integer applicableSource: NoiseSourceValue [11]	nameEng: CharacterString     localName: CharacterString     localNameLanguage: iso639-3	+ ENDAgglomeration vocabulary = http://dd.eior	tags net.europa.eu/vocabulary/inspire/:	SpecialisedZoneTypeCode
inspireld: Identifier geometry: GM_Object zoneType: ZoneTypeCode specialisedZoneType: SpecialisedZoneTypeCode	«codeList» Noise SourceValu + agglomerationAir	e		«codeList» iso639-3
environmentalDomain: EnvironmentalDomain «voidable» designationPeriod: TM_Period competentAuthority: RelatedParty [1*] legalBasis: LegislatinortAttion [1*]	+ agglomerationIndustry + agglomerationRailway + agglomerationRoad + agglomerationMajorRoad		vocabulary = http://dd.eion	tags let.europa.eu/vocabulary/common/iso639-3/
«voidable, lifeCycleInfo» beginLifespanVersion: DateTime	+ agglomerationMajorAilvay + agglomerationMajorAirport tags vocabulary = http://dd.eionet.europa.eu/vocabular	unico Maico Source Value		
INSPIRE attributes values for the END and relevant encodi - designationPeriod will not be used. This field will be left void platform. Encoding example	ng :	SPIRE	lentifier	edataType+ Identifier + localid. CharacterString + namespace. CharacterString
Concerning the improvement of the second method of the second method method in the second method	itties information will be managed as a separate DF2 data codelist/VoidReasonValue/Unpopulated* xsinil=*true*/> f END: http://data.europa.eu/eli/dir/2002/49/gj	+ identifierScheme: Cha agglomeration1 didentifier>: unique code for the agglomer agglomeration1 d.l dentfierSch	shall be filled in with the ration defined in the guidelines	elifeCycletific, violables + versionid: CharacterString [0, 1] when possible the inspire(clocal d should be the same as agglomerationid identifier, but if the MS have already in place different rules for IMSPIRE identifiers they are free to use their own encoding.
This reference can be replaced by URL of more specific natio expected. +beginLifesponVersion It is not used for END purposes, but it is mandatony in INSFIRI • provide a date of creation of the spatial object / dataset kerve t void and provide an IRReson • unpopulated'.	E. You can	Area Management Rest Zones::Zone	triction and Regulation	«codeList» Area Management Restriction and Regulation Zones::EnvironmentalDomain
Examples below show the encoding as		ļ,		,

#### **Model Transformation**

The following rules are applied to the input model in this order:

- 1. Apply the "Flattening of hierarchical structures" rule as follows :
  - a. MT\_ENDGPK01(table: AgglomerationSource, property: inspireId, separator: '\_');
  - b. MT\_ENDGPK01(table: AgglomerationSource, property: agglomerationId, separator: '\_');
  - c. MT\_ENDGPK01(table: AgglomerationSource, property: agglomerationName, separator: '\_');
  - d. MT\_ENDGPK01(table: AgglomerationSource, property: designationPeriod, separator: '\_');
  - e. MT\_ENDGPK01(table: AgglomerationSource, property: competentAuthority, separator: '\_');
  - f. MT\_ENDGPK01(table: AgglomerationSource, property: legalBasis, separator: '\_');



#### 2. Apply the "Dataset Default values" rule as follows:

- a. MT\_ENDGPK03(table: AgglomerationSource, property: agglomerationId\_identifierScheme, defaultValue: null, http://dd.eionet.europa.eu/vocabulary/inspire/IdentifierSc heme/EUENDCode);
- b. MT\_ENDGPK03(table: AgglomerationSource, property: zoneType, property: href, defaultValue: <u>http://inspire.ec.europa.eu/codelist/ZoneTypeCode/noiseRes</u> trictionZone);
- c. MT\_ENDGPK03(table: AgglomerationSource, property: specialisedZoneType, property: href, defaultValue: http://dd.eionet.europa.eu/vocabulary/inspire/SpecialisedZ oneTypeCode/ENDAgglomeration);
- d. MT\_ENDGPK03(table: AgglomerationSource, property: environmentalDomain, property: href", defaultValue:<u>http://inspire.ec.europa.eu/codelist/Environm</u> <u>entalDomain/noise</u>);
- e. MT\_ENDGPK03(table: AgglomerationSource, property: designationPeriod","nilReason, defaultValue: http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unpop ulated);
- f. MT\_ENDGPK03(table: AgglomerationSource, property: competentAuthority, property: nilReason, defaultValue: <u>http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unpop</u> <u>ulated</u>);
- g. MT\_ENDGPK03(table: AgglomerationSource, property: legalBasis\_link, property: href, defaultValue: http://data.europa.eu/eli/dir/2002/49/oj);
- h. MT\_ENDGPK03(table: AgglomerationSource, property: legalBasis\_level, property: href, defaultValue: http://inspire.ec.europa.eu/codelist/LegislationLevelValue /european);
- i. MT\_ENDGPK03(table: AgglomerationSource, property: beginLifespanVersion, property: nilReason, defaultValue: <u>http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unpop</u> ulated);
- 3. Apply the "Extract Primitive Array" as follows:
  - a. MT002(table: AgglomerationSource, property: applicableSource, separator: ';)
- 4 . Apply the "Voidable attributes to Companion Table" rule as follows:
  - a. MT\_ENDGPK02(table: AgglomerationSource, properties: [competentAuthority\_contact, competentAuthority\_indivName, competentAuthority\_orgName, competentAuthority\_posName, competentAuthority\_role, designationPeriod\_beginPosition, designationPeriod\_endPosition, legalBasis\_level, legalBasis\_link, beginLifespanVersion]);

#### Resulting Model

The following image (Figure 2) shows the resulting model for Agglomeration Sources. Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each geoPackage model.

Figure 2: Model for END DF1\_5 Agglomerations geoPackage

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✓	✓
agglomerationId_identifier	8 AgglomerationSource_id
agglomerationName_localName	8 beginLifespanVersion (01)
agglomerationName_localNameLanguage	competentAuthority_contact (01)
agglomerationName_nameEng	competentAuthority_indivName (01)
applicableSource	competentAuthority_orgName (01)
🔯 geometry	competentAuthority_posName (01)
8 id	competentAuthority_role (01)
inspireld_localld	8 designationPeriod_beginPosition (01)
inspireld_namespace	8 designationPeriod_endPosition (01)
inspireld_versionId (01)	8 id
8 numberOfInhabitants	legalBasis_level (01)
8 size	IegalBasis_link (01)

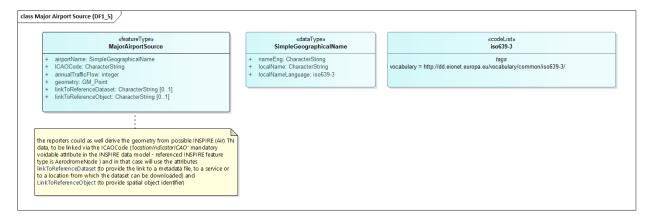
#### Conformance Class DF1\_5 Major Airport Sources

This section describes which transformation rules with which parameters are applied to the Major Airport Source specific conceptual model.

#### Input Model

In this specific streamlined model (Figure 3), similarity to the corresponding INSPIRE feature type AerodromeNode is in properties geometry and airport ICAO code, additional END specific properties are added, and some substitutions have already been applied (such as for airportName).

#### Figure 3: Data model END DF1\_5 Major airports



#### **Model Transformation**

The following rules are applied in this order:

1. Apply the "Flattening of hierarchical structures" rule as follows: MT\_ENDGPK01(table: MajorAirportSource, property: airportName, separator: '\_');

#### **Resulting Model**

The following image (Figure 4) shows the resulting model for Major Airport Sources. Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

Figure 4: Model for END DF1\_5 Major airports geoPackage



MajorAirportSource
 airportName\_localName
 airportName\_localNameLanguage
 airportName\_nameEng
 annualTrafficFlow
 geometry
 ICAOCode
 id
 linkToReferenceDataset (0..1)
 linkToReferenceObject (0..1)

#### Conformance Class DF1\_5 Major Railway Sources

This section describes which transformation rules with which parameters are applied to the Major Railway Sources conceptual model.

#### Input Model

The input model is a streamlined version of the full conceptual model, which extends the INSPIRE RailwayLink feature type (Figure 5). ). Pptional properties have been left out, and some substitutions have already been applied (such as for railName).

#### Figure 5 Data model END DF1\_5 Major railways

jor Railway Source (DF1_5) - Streamlined View	)		
+	aliNationalGode: CharacterString [01] railName: SimpleGeographicalName [01] annualTraff-Chow integer linkToReferenceDataset: CharacterString [01] inkToReferenceObject: CharacterString [01]	isc	deLists 6639.3 Tags aabulary/common/iso639-3/
It is not used for END purposes, but it is mandat provide a date of reation of the spatial bol leave it void and provide a niReason "unp Examples below show the encoding as - date and time < beginil/espan/teriaion >2018-10-15T0000002 <br - void - niReason "unpopulated". < beginil/espan/teriaion niReasons" http://inspire. xsinf="tue"/> vaidef rom The time when the transport ink started to exist it is not used for END purpose, but it is mandat void reason must be provided, as shown below: < vaidefrom / fettions indicator that the centreline geometry is a straight straight line represents the geography in the ress it is not used for END purpose, but it is mandat · Default Value- "faise" in Network: In KeiPIEE TN data model, inNetwork is a m (og a rahway, or a railway isgment) and the net for the ENPIEE TN data model, inNetwork is an (og a rahway, or a railway segment) and the net for the ENPIEE TN data model, in Network is an (og a rahway, or a railway segment) and the net for the ENPIE TN data model.	al object was inserted or changed in the spatial data set. tory in INSPIRE. You can spicet / dataset OR opulated". //eginLifesponVersion > e.ec.europa.eu/codelst/VoidReasonValue/Unpopulated" in the real world. ony in INSPIRE, thus if such information is not available, a eu/codelst/VoidReasonValue/Unpopulated" xsintl="true"> ht line with no intermediate control points - unless the obtion of the data set appropriately. tory in INSPIRE. andatory voidable association between a network element tire stabilin a network of major nalway segments thus if must be provided according to the INSPIRE specifications. to be used.	INSPIRE  cdataTypes BaseTypes::dentifier  + localid.CharacterString elifeCyclefrity.vidables + versiond:CharacterString [0.1]  when possible the inspiredLocalid can be the same as maid/dentifier, but if the X5h are already in pices different rules for INSPIRE identifies they are free to use ther own encoding.	edataTypes Base Types 2::Thematicidentifier + identifier: CharacterString + identifierScheme: CharacterString 

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#### Model Transformation

The following rules are applied in this order:

- 2. Apply the "Flattening of hierarchical structures" rule as follows :
  - a. MT\_ENDGPK01(table: MajorRailwaySource, property: inspireId, separator: ' ');
  - b. MT\_ENDGPK01(table: MajorRailwaySource, property: railId, separator: '\_');
  - c. MT\_ENDGPK01(table: MajorRailwaySource, property: railName, separator: '\_');
- 3. Apply the "Dataset Default values" rule as follows:
  - a. MT\_ENDGPK03(table: MajorRailwaySource, property: inNetwork, attribute: nilReason, defaultValue: .../Unpopulated);
  - b. MT\_ENDGPK03(table: MajorRailwaySource, property: validFrom, attribute: nilReason, defaultValue: .../Unpopulated);
  - c. MT\_ENDGPK03(table: MajorRailwaySource, property: beginLifespanVersion, attribute: nilReason, defaultValue: .../Unpopulated);
  - d. MT\_ENDGPK03(table: MajorRailwaySource, property: railId\_identifierScheme, attribute: href, defaultValue: http://dd.eionet.europa.eu/vocabulary/inspire/IdentifierSc heme/EUENDCode);
  - e. MT\_ENDGPK03(table: MajorRailwaySource, property: fictitious, attribute: null, defaultValue: false);
- 4. Apply the "Voidable attributes to Companion Table" rule as follows:
  - a. MT\_ENDGPK02(table: MajorRailwaySource, properties: [validFrom, inNetwork, beginLifespanVersion]);

#### Resulting Model

The following image (Figure 6) shows the resulting model for Major Railway Sources. Please note that the common tables (CodelistProperties, DefaultDatasetProperties) are not repeated for each geoPackage model.

Figure 6: Model for END DF1\_5 Major railways geoPackage

#### 

- 8 annualTrafficFlow
- CentrelineGeometry
- 8 id
- inspireld\_localld
- inspireld\_namespace
- inspireld\_versionId (0..1)
- 8 length
- linkToReferenceDataset (0..1)
- linkToReferenceObject (0..1)
- railld\_identifier
- railName\_localName
- railName\_localNameLanguage
- railName\_nameEng
- railNationalCode

- T MajorRailwaySourceVoidables
  - 8 beginLifespanVersion (0..1)
  - 8 id
  - inNetwork (0..1)
  - 8 MajorRailwaySource\_id
  - 8 validFrom (0..1)



#### Conformance Class DF1\_5 Major Road Sources

This section describes which transformation rules with which parameters are applied to the Major Road Sources streamlined conceptual model.

#### Input Model

The input model is a streamlined version (Figure 7) of the full conceptual model, which extends the INSPIRE RoadLink feature type, optional properties have been left out, and some substitutions have already been applied (such as for roadName).

or Road Source (DF1 5) - Streamlined View					
cfatur MajorRoa + road/a Themasicklenifier - road/lama: SimpleGeographic Reporters can optionally use link/Indeference/baset to provide the + tength: integer + length: integer	dSource itring [01] alName [01] 1]	«dataT SimpleGeogra     + nameEng: Characte     + localName: Charact     + localName: Charact     + localNameLanguage	aphicalName erString erString		
Ink to anetadata fie to a javrice or to a location from which the dataset and be downbaded and ink/hofference/bject to provide spatial object bentifier. + Ink/Rofference/bject: Chara - centrelineGeometry: GM_Cum + Gettouse: Boolaan = Talae + Inspired. Identifier + Indettouse: Location = Talae + Inspired. Identifier + Indettouse: Location = Talae + Inspired. Identifier + Indettouse: Location = Talae +	cterString [01] e	vocabulary = http://dd.ei	«codeList» iso639-3 tags onet.europa.eu/vocabulary	/common/iso639-3/	
Values of the INSPIRE attributes for the END and relevant encoding : begin ( <i>IseganVersion</i> Date and time a which this version of the spatial object was inserted or changed in the spatial data set. • • Default attrings-•	INSPIRE «dataType Base Types:idd + localid: CharacterString + namespace: CharacterString idleScyclerito.voidales	» entifier	+ identifier: Cha	rdataTypes pes 2::ThematicIdentifier reacteSting me: CharacterSting	
set to the reporting date (example <-bcg).if Eqnant/vection > 2018-10-1500:00002 ) OR provide nReason (see below) valid/rom The time when the transport link started to exist in the real world. -> OF and t settings <valid nireason="unpopulated" rom="" xsnie='true"'>    The time when the transport link started to exist in the real world. -&gt; OF and t settings <valid nireason="unpopulated" rom="" xsnie='true"'>    findtour   indicator that the centreline geometry is a straight line with no intermediate control points - unless the straight line represents the geography in the resolution of the data set appropriately. -&gt; OF analt Value Talse' in Network: this element is mandatory voidable, meaning that , if not used, it could be left</valid></valid>	<ul> <li>wersiond. CharacterString [0</li> <li>when possible the inspired the same as road.didentify the same as road.didentify have already in place differ INSPIRE identifiers they are own encoding.</li> </ul>	d.bcalld can be er, but if the MS rent rules for	the road defined in the	al be filed in with the unique code for guiddines e> shall be TUENDCode'	
unpopulated providing a niReason-> lie. <in het="" nireason-'unpopulated'ssimile="" out="" true'=""></in> Optionaly, the inketwork element can be used to link a reference Road Network (can be a WFS GetDataset request or a link to an atom)					Legend END INSPIR Notes

#### Figure 7: Data model END DF1\_5 Major roads

#### Model Transformation

The following rules are applied in this order:

- 1. Apply the "Flattening of hierarchical structures" rule as follows :
  - a. MT\_ENDGPK01(table: MajorRoadSource, property: inspireId,separator: ' ');
  - b. MT\_ENDGPK01(table: MajorRoadSource, property: roadId, separator: ' ');
  - c. MT\_ENDGPK01(table: MajorRoadSource, property: roadName, separator: '\_');
- 2. Apply the "Dataset Default values" rule as follows:



- c. MT\_ENDGPK03(table: MajorRoadSource, property: beginLifespanVersion, attribute: nilReason, defaultValue: .../Unpopulated);
- d. MT\_ENDGPK03(table: MajorRoadSource, property: roadId\_identifierScheme, attribute: href, defaultValue: http://dd.eionet.europa.eu/vocabulary/inspire/IdentifierSc heme/EUENDCode);
- 3. Apply the "Voidable attributes to Companion Table" rule as follows:
  - a. MT\_ENDGPK02(table: MajorRoadSource, properties: [validFrom, inNetwork, beginLifespanVersion]);

#### **Resulting Model**

The following image (Figure 8) shows the resulting model for Major Road Sources. Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 8: Model for END DF1\_5 Major roads geoPackage

- T MajorRoadSource
  - 8 annualTrafficFlow
  - CentrelineGeometry
  - 📑 EURoadId
  - 8 id
  - 📑 inspireld\_localld
  - 📑 inspireld\_namespace
  - inspireld\_versionId (0..1)
  - 8 length
  - linkToReferenceDataset (0..1)
  - linkToReferenceObject (0..1)
  - 📑 roadld\_identifier
  - ≡ roadName\_localName
  - ≡ roadName\_localNameLanguage
  - roadName\_nameEng
  - roadNationalCode (0..1)

- T MajorRoadSourceVoidables
  - 8 beginLifespanVersion (0..1)
  - 8 id
  - 8 inNetwork (0..1)
  - 8 MajorRoadSource\_id
  - 8 validFrom (0..1)



#### Conformance Class DF4\_8 Strategic Noise Maps - Noise Contours

All models in the DF4\_8 Conformance Classes use a single spatial type from the Human Health and Safety INSPIRE theme. To include categorical information such as noise level bands, this type (EnvHealthDeterminantMeasure) has been amended in the INSPIRE change request<sup>14</sup>. For the END reporting purpose, the noise contours are results of modelled data that can be provided as polygons with related noise dB range values, or as lines with indicated single noise dB values.

#### Input Model

Figure 9 shows the input model for DF4\_8 Strategic noise maps – noise contours.

efeatureTypes EnvHealthDeterminantMeasure		«codeList» Noise Source Type Value			
+ source: NoiseSourceTypeValue	+ roadsinAggiom				
+ category: MeasureCategoryTypeValue		udingAgglomeration	ecodeLis EnvHealthDetermin	INSPIRE code listy	ratue to use is
+ measureTime: TM Period	+ railwaysInAgolo		EnvitealthDetermin		uropa, e u/code list/Env He althDeterm in antType Value / noise
+ location: GM Object		ncludingAglomeration			
+ type: EnvHealthDeterminantTypeValue	+ airportsInAgglor	meration			
sypidables	+ majorAirportsIn	cludingAgglomeration			
+ validFrom: DateTime	+ industryInAgglo				
+ validTo: DateTime	+ allSourcesInAg	alomeration			
evoidable, lifeCycleInfox		taos			
+ beginLifespanVersion: DateTime	vocabulary = http://	dd.eionet.europa.eu/vocabulary/noise/NoiseSourceTypeVa	Je		
		1			
	1	1	MeasurecetegoryType	Value is an empty INSPIRE code list, meant to be exte	nded by a number of domain-specific
1		4	code lists.		
			For the END purposes, 4	the reference to this code list is intended as a reference	e to NoiseIndicatorRangeValue code list
e +category shall be filled in with	majorRoadsIncludingApplan	eration.	or the NoiseIndicatorVa	alue code list	
a value from the Note IndicatorRongeValue code list if the	matorRafwassIncludingAgale				
noise contours are provided as polygons, or		meration correspond to the noise			
a value from the NoiseIndicatorValue code list if the noise		infrastructure (outside and inside		·	
contours are provided as lines.	aggiomeration )			«codeList»	
				MeasureCategoryTypeValue	
					NoiseIndicatorValue
				Λ	code list is used when
PIRE attributes values and relevant encoding for the END:		NoiseIndicatorRan		Ť	line geometry is
		code list is used w			provided.
reasureTime = the period when the noise contour maps were calculated		polygon geometry			providea.
coding example (in case the period = 1 year):		provided			
ieasureTime>		L	<u> </u>		
miTimePeriod gmitid="NoiseMapCalculationPeriod1">					1
mtbeginPosition>2014-01-01					
mtendPosition>2014-12-81			ecodeLists		«codeList»
gml:TimePeriod>			NoiseIndicatorRangeValue		NoiseIndicatorValue
niceFrom and + united To		+ I der	owerThan10	+ 1 den40	
siter rom and +valle 10 s recommended to assign the period of the actual reporting cycle of strategic n		+ Lder		+ Lden45	
s recommended to assign the period of the actual reporting cycle of strategic n lidity period validFrom / validTo or to provide voidable information.	noise maps - noise contours as	+ Lder		+ 1.den50	
iony period valuerium y value o orto provide voldade information.		+ Lder	054	+ Lden55	
L		+ Lder	559	+ Lden60	
the next reporting cycle the following dates are recommended:		+ Lder	064	+ Lden65	
slidf rom> 2022-12-31723:00:00 000		+ Lder	569	+ Lden70	
didTo>2027-12-30T23:00:00:000//wildTo>		+ Lder		+ Lden75	
			GreaterThan75	+ Lnight40	
case you don't want to provide specific dates, provide void value with niReas	son "Unpopulated" as follows		tLowerThan40	+ Lnight45	
alidf rom niReason="https://inspire.ec.europa.eu/code/ist/VoidReasonValue/		+ Lnig		+ Lnight50	
ald from>		+ Lnig		+ Lnight55	
alidTo niReason="https://inspire.ec.europa.eu/codelist/VoidReasonValue/Ur	npopulated" xsi; nil="true">	+ Lnig		+ Lnight50	
xald7o >		+ Lnig		+ Lnight65	
		+ Lnig		+ Lnight70	
eginLifespanVersion		+ Lnig			tecs
not used for END purposes, but it is mandatory in INSPIRE. You can		+ Lnig	lGreaterThan70	1	tegs http://dd.eionet.europa.eu/vocabulary/noise/NoiseIndicatorValue
provide a date of creation of the spatial object / dataset OR			tacs	vocaudraly - I	ingen die einer eine geweinen vorderendig inforser vorserning dater varbe
leave it void and provide a niReason "unpopulated".		verabula	y = http://dd.eionet.europa.eu/vocabulary/noise/Noise	aindicatorRangeValue	
amples below show the encoding as					
ste and time sginLifesponVersion>2018-10-15T00:00:00Z					
vid e nillee son 'unormulated'					
aid + niReason 'un populated'. egin Lifespan Version niReason = "http://inspire.ec.europa.eu/codelist/VoidRea	asonValue/Unpopulated*				

#### Figure 9: Data model END DF4\_8 Strategic noise maps – noise contours

#### **Model Transformation**

The following rules are applied in this order:

- 1. Apply the "Flattening of hierarchical structures" rule as follows :
  - a. MT\_ENDGPK01(table: EnvHealthDeterminantMeasure, property: measureTime, separator: '\_');
- 2. Apply the "Dataset Default values" rule as follows:
  - a. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: type, attribute: href, defaultValue:
    - http://inspire.ec.europa.eu/codelist/EnvHealthDeterminantT

<sup>&</sup>lt;sup>14</sup> See <u>http://www.epsilon-italia.it/public/2019.07.02.Change\_Proposal\_HH.schema.v1.0.docx</u>. Change proposals of the INSPIRE application schemas (UML and XSD) are governed by the common procedure and documented in the INSPIRE MIF GitHub repository. The change proposal for the INSPIRE HH is published at: <u>https://github.com/INSPIRE-MIF/application-schemas/issues/6</u>.



- b. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: measureTime\_beginPosition, attribute: null, defaultValue: 2021-01-01T01:00:00Z);
- c. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: measureTime\_endPosition, attribute: null, defaultValue: 2021-12-31T23:00:00Z);
- d. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: validFrom, attribute: null, defaultValue: 2022-12-31T01:00:00Z);
- e. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: validTo, attribute: null, defaultValue: 2027-12-30T23:00:00Z);
- f. MT\_ENDGPK03(table: EnvHealthDeterminantMeasure, property: beginLifespanVersion, attribute: nilReason, defaultValue: ...//Unpopulated");
- 3. Apply the "Voidable attributes to Companion Table" rule as follows:
  - a. MT\_ENDGPK02(table: EnvHealthDeterminantMeasure, properties: [validFrom, validTo, beginLifespanVersion]);

Furthermore, when used in the context of the END DF4\_8 geoPackage templates, the primary table corresponding to the noise contour maps is renamed and copies are created for each applicable noise source (see code list <code>NoiseSourceTypeValue</code>, Figure 9), as well as for noise indicators  $L_{den}$  and  $L_{night}$ , resulting into several primary tables. This approach is specific to END reporting and data processing mechanisms and should not be seen as a general model transformation rule. In this case, we use a common <code>Voidables</code> table for all primary tables.

#### Resulting Model

The following figure (Figure 10) shows an example of a model applied to the Strategic noise maps – noise contours in agglomerations data flow.

Note that while the table created from EnvHealthDeterminantMeasure is called NoiseContours\_roadsInAgglomeration\_Lnight, the Voidables table is just called like that. Please note that the common tables (CodelistProperties, Dataset-DefaultProperties) are not repeated for each GeoPackage model.

#### Figure 10: Model for END DF4\_8 Noise contours in agglomerations geoPackage

- - category
  - 8 id
  - location
  - 8 measureTime\_beginPosition
  - 8 measureTime\_endPosition source

- ✓ T Voidables
  - 8 beginLifespanVersion (0..1)
  - 8 id
    - 8 PrimaryTable\_id
    - tableName
    - 8 validFrom (0..1)
    - 8 validTo (0..1)

Figure 11: Example – Noise contours for agglomerations - primary tables and Voidables table in geoPackage (QGIS)



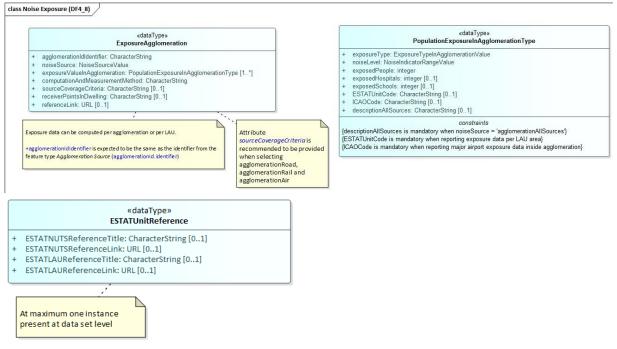
📰 Vo	idables
$\checkmark$	NoiseContours_roadsInAgglomeration_Lnight
$\checkmark$	NoiseContours_roadsInAgglomeration_Lden
$\checkmark$	NoiseContours_railwaysInAgglomeration_Lnight
$\checkmark$	NoiseContours_railwaysInAgglomeration_Lden
$\checkmark$	NoiseContours_industryInAgglomeration_Lnight
$\checkmark$	NoiseContours_industryInAgglomeration_Lden
$\checkmark$	NoiseContours_allSourcesInAgglomeration_Lnight
$\checkmark$	NoiseContours_allSourcesInAgglomeration_Lden
$\checkmark$	NoiseContours_airportsInAgglomeration_Lnight
$\checkmark$	NoiseContours_airportsInAgglomeration_Lden

## Conformance Class DF4\_8 Strategic Noise Maps - Noise Exposure Agglomerations

#### Input Model

**Error! Reference source not found.** shows the input model for DF4\_8 Strategic noise maps – noise exposure in agglomerations.

#### Figure 12: Data model END DF4\_8 Strategic noise maps – noise exposure - agglomerations



Note: there is an additional relevant type in the model called ESTATUnitReference. This table is transformed to GeoPackage without any model transformations. No technical foreign key relationship is established; instead, the relationship is built on the domain key property ESTATUnitCode (if provided) in ExposureValueInAgglomeration.

#### Model Transformation

The following rules are applied in this order:

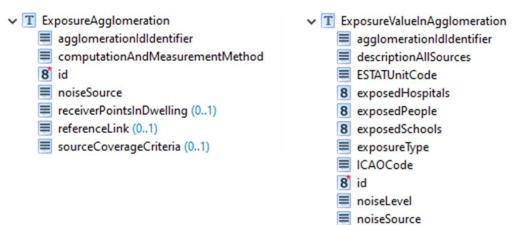
- 1. Apply the "Handle composition attributes with multiplicity 1:n" rule as follows:
  - a. MT\_ENDGPK05(mainTable: ExposureAgglomeration, mainProperty: exposureValueInAgglomeration, subTableName: PopulationExposureInAgglomeration)



The following image (**Error! Reference source not found.**) shows the resulting model for Strategic noise maps – noise exposure in agglomerations.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 13: Model for END DF4\_8 Noise exposure in agglomerations geoPackage

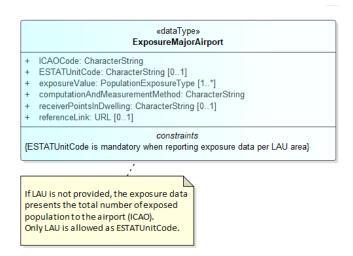


## Conformance Class DF4\_8 Strategic Noise Maps - Noise Exposure Major Airports

#### Input Model

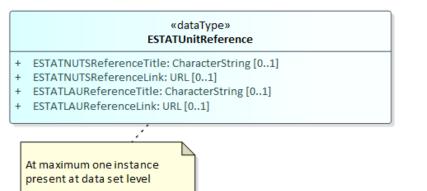
**Error! Reference source not found.** shows the input model for DF4\_8 Strategic noise maps – noise exposure due to major airports.

Figure 14: Data model END DF4\_8 Strategic noise maps – noise exposure – major airports





	«dataType» PopulationExposureType				
+	exposureType: ExposureTypeValue				
+	noiseLevel: MeasureCategoryTypeValue				
+	exposedPeople: integer				
+	exposedArea: double [01]				
+	exposedDwellings: integer [01]				
+	exposedHospitals: integer [01]				
+	exposedSchools: integer [01]				
{\/	<i>constraints</i> /hen selecting mostExposedFacadeIncludingAgglomeration, exposedArea and exposedDwellings are mandatory}				



Note: There is an additional relevant type in the model called *ESTATUnitReference*. This table is transformed to GeoPackage without any model transformations. No technical foreign key relationship is established; instead, the relationship is built on the domain key property *ESTATUnitCode* (if provided) in *ExposureMajorAirport*.



#### **Model Transformation**

The following rules are applied in this order:

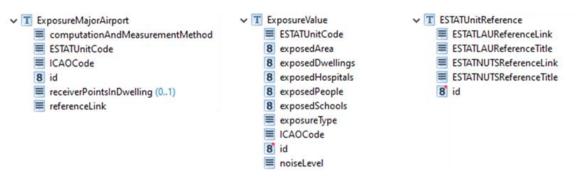
- 1. Apply the "Handle composition attributes with multiplicity 1:n" rule as follows:
  - a. MT\_ENDGPK05(mainTable: ExposureMajorAirport, mainProperty: exposureValue, subTableName: PopulationExposure)

#### **Resulting Model**

The following image (**Error! Reference source not found.**) shows the resulting model for Strategic noise maps – noise exposure due to major airports.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 15: Model for END DF4\_8 Noise exposure major airports geoPackage



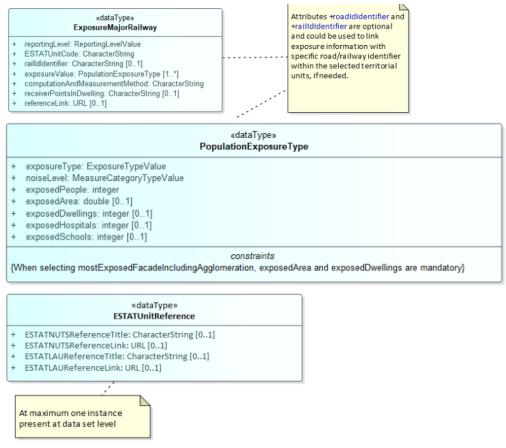


## Conformance Class DF4\_8 Strategic Noise Maps - Noise Exposure Major Railways

#### Input Model

**Error! Reference source not found.** shows the input model for DF4\_8 Strategic noise maps – noise exposure due to major railways.

Figure 16: Data model END DF4\_8 Strategic noise maps – noise exposure – major railways



Note: there is an additional relevant type in the model called *ESTATUnitReference*. This table is transformed to GeoPackage without any model transformations. No technical foreign key relationship is established; instead, the relationship is built on the domain key property *ESTATUnitCode* in *ExposureMajorRailway*.

#### **Model Transformation**

The following rules are applied in this order:

- 1. Apply the "Handle composition attributes with multiplicity 1:n" rule as follows:
  - a. MT\_ENDGPK05(mainTable: ExposureMajorRailway, mainProperty: exposureValue, subTableName: PopulationExposure)



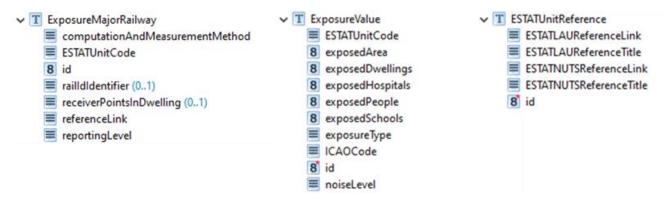




The following image (**Error! Reference source not found.**) shows the resulting model for Strategic noise maps – noise exposure due to major railways.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 17: Model for END DF4\_8 Noise exposure major railways geoPackage

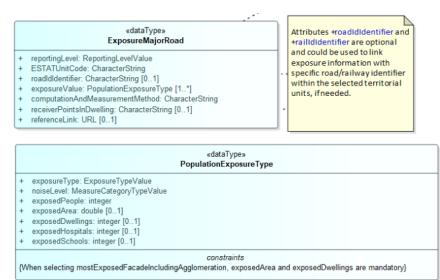


## Conformance Class DF4\_8 Strategic Noise Maps - Noise Exposure Major Roads

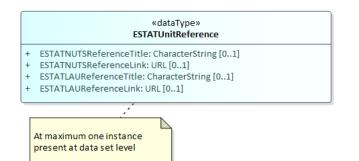
#### Input Model

**Error! Reference source not found.** shows the input model for DF4\_8 Strategic noise maps – noise exposure due to major roads.

#### Figure 18: Data model END DF4\_8 Strategic noise maps – noise exposure – major roads







Note: there is an additional relevant type in the model called ESTATUnitReference. This table is transformed to GeoPackage without any model transformations. No technical foreign key relationship is established; instead, the relationship is built on the domain key property ESTATUnitCode in ExposureMajorRoad.

#### Model Transformation

The following rules are applied in this order:

- 1. Apply the "Handle composition attributes with multiplicity 1:n" rule as follows:
  - a. MT\_ENDGPK05(mainTable: ExposureMajorRoad, mainProperty: exposureValue, subTableName: PopulationExposure)

#### **Resulting Model**

The following image (**Error! Reference source not found.**) shows the resulting model for Strategic noise maps – noise exposure due to major roads.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 19: Model for END DF4\_8 Noise exposure major roads geoPackage



▼ I ESTATUnitReference
 ■ ESTATLAUReferenceLink
 ■ ESTATLAUReferenceTitle
 ■ ESTATNUTSReferenceLink
 ■ ESTATNUTSReferenceTitle
 8 id



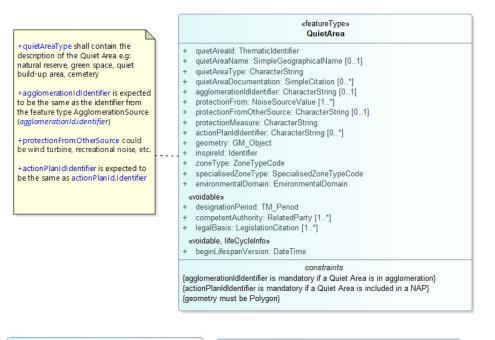
#### Conformance Class DF7\_10 Quiet Areas

The DF7\_10 data flow includes quiet areas in agglomerations or in open country.

#### Input Model

The QuietArea type extends ManagementRestrictionOrRegulationZone feature type from the INSPIRE Area Management, Restriction and Regulation Zones theme (see Figure 20). Quiet area documentation (quietAreaDocumentation) is provided according to the simplified data type SimpleCitation.

#### Figure 20: Data model END DF7\_10 Quiet areas



# «dataType» «dataType» SimpleCitation simpleGeographicalName + citationDate: Date [0..1] simpleGeographicalName + citationLink: CharacterString + nameEng: CharacterString + citationName: CharacterString [0..1] + localName: CharacterString + citationType: CitationTypeValue + localNameLanguage: iso639-3

#### **Model Transformation**

The following rules are applied in this order:

- 1. Apply the "Flattening of hierarchical structures" rule as follows :
  - a. MT\_ENDGPK01(table: QuietArea, property: quietAreaId, separator: ' ');
  - b. MT\_ENDGPK01(table: QuietArea, property: quietAreaName, separator: ' ');
  - c. MT\_ENDGPK01(table: QuietArea, property: inspireId, separator: ' ');
  - d. MT\_ENDGPK01(table: QuietArea, property: designationPeriod, separator: '\_');

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- f. MT\_ENDGPK01(table: QuietArea, property: legalBasis, separator: '\_');
- g. MT\_ENDGPK01(table: QuietAreaDocumentation, property: quietAreaId, separator: '\_');
- 2. Apply the "Extract Primitive Array" rule as follows:
  - a. MT002(table: QuietArea, property: protectionFrom, separator: ';)
- 3. Apply the "Handle composition attributes with multiplicity 1:n" rule as follows:
  - a. MT\_ENDGPK05(table: QuietArea, property: quietAreaDocumentation, pk: quietAreaId\_identifier, fk: quietAreaId\_identifier)
- 4. Apply the "Dataset Default values" rule as follows:
  - a. MT\_ENDGPK03(table: QuietArea, property: competentAuthority, attribute: nilReason, defaultValue: .../Unpopulated);

  - c. MT\_ENDGPK03(table: QuietArea, property: legalBasis\_link, attribute: href, defaultValue: http://data.europa.eu/eli/dir/2002/49/oj);
  - d. MT\_ENDGPK03(table: QuietArea, property: legalBasis\_level, attribute: href, defaultValue: https://inspire.ec.europa.eu/codelist/LegislationLevelValu e/european);
  - e. MT\_ENDGPK03(table: QuietArea, property: beginLifespanVersion, attribute: nilReason, defaultValue: .../Unpopulated);
  - f. MT\_ENDGPK03(table: QuietArea, property: zoneType, attribute: href, defaultValue: http://inspire.ec.europa.eu/codelist/ZoneTypeCode/noiseRes trictionZone);
  - g. MT\_ENDGPK03(table: QuietArea, property: environmentalDomain, attribute: href, defaultValue: http://inspire.ec.europa.eu/codelist/EnvironmentalDomain/n oise);
  - h. MT\_ENDGPK03(table: QuietArea, property: quietAreaId\_identifierScheme, attribute: href, defaultValue: http://dd.eionet.europa.eu/vocabulary/inspire/IdentifierSc heme/EUENDCode);
- 5. Apply the "Voidable attributes to Companion Table" rule as follows:
  - a. MT\_ENDGPK02(table: QuietArea, properties: [competentAuthority\_contact, competentAuthority\_indivName, competentAuthority\_orgName, competentAuthority\_posName, competentAuthority\_role, designationPeriod\_beginPosition, designationPeriod\_endPosition, legalBasis\_link, legalBasis level, beginLifespanVersion]);

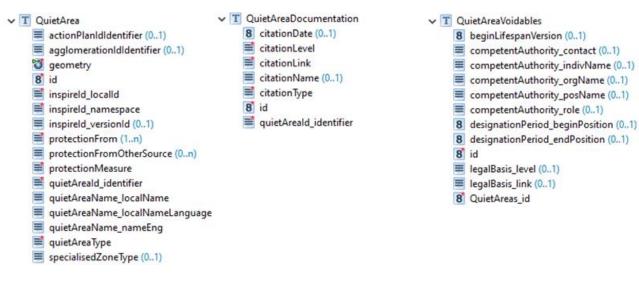
#### Resulting Model

The following image (Error! Reference source not found.) shows the resulting model for Quiet areas.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.



#### Figure 21: Model for END DF7\_10 Quiet areas geoPackage

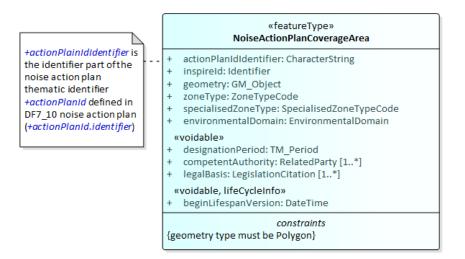


#### Conformance Class DF7\_10 Noise Action Plans Coverage Areas

The DF7\_10 data flows are special, since most non-spatial data is stored in other file formats (e.g. Microsoft Excel files supplied by the Member States), instead of in additional tables in GeoPackage. The parts described here are only those that are stored in GeoPackage. The END conceptual data model includes noise action plans for agglomerations, major airports, major railways, and major roads. All these types of noise action plans include a noise action plan coverage area spatial data. The same data model of noise action plan coverage area applies to all noise action plan types, therefore only one example is presented in this document.

#### Input Model

The NoiseActionPlanCoverageArea type extends the ManagementRestriction-OrRegulationZone feature type from the application schema INSPIRE Area Management Restriction and Regulation Zones (see Error! Reference source not found.).



#### Figure 22: Data model END DF7\_10 Noise action plan coverage area

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#### **Model Transformation**

The following rules are applied in this order:

- 1. Apply the "Flattening of hierarchical structures" rule as follows:
  - a. MT\_ENDGPK01(table: NoiseActionPlanCoverageArea, property: inspireId, separator: ' ');
  - b. MT\_ENDGPK01(table: NoiseActionPlanCoverageArea, property: designationPeriod, separator: '\_');

  - d. MT\_ENDGPK01(table: NoiseActionPlanCoverageArea, property: legalBasis, separator: '\_');
- 2. Apply the "Dataset Default values" rule as follows:
  - a. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: competentAuthority, attribute: nilReason, defaultValue: .../Unpopulated);
  - b. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: designationPeriod, attribute: nilReason, defaultValue: .../Unpopulated);
  - c. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: legalBasis\_link, attribute: href, defaultValue: http://data.europa.eu/eli/dir/2002/49/oj);
  - d. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property:
     legalBasis\_level, attribute: href, defaultValue:
     https://inspire.ec.europa.eu/codelist/LegislationLevelValu
     e/european);
  - e. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: beginLifespanVersion, attribute: nilReason, defaultValue: .../Unpopulated);
  - f. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: zoneType, attribute: href, defaultValue: http://inspire.ec.europa.eu/codelist/ZoneTypeCode/noiseRes trictionZone);
  - g. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: specialisedZoneType, attribute: href, defaultValue: http://dd.eionet.europa.eu/vocabulary/inspire/SpecialisedZ oneTypeCode/noiseActionPlanArea);
  - h. MT\_ENDGPK03(table: NoiseActionPlanCoverageArea, property: environmentalDomain, attribute: href, defaultValue: http://inspire.ec.europa.eu/codelist/EnvironmentalDomain/n oise);
- 3. Apply the "Voidable attributes to Companion Table" rule as follows:

a. MT\_ENDGPK02(table: NoiseActionPlanCoverageArea, properties: [competentAuthority\_contact, competentAuthority\_indivName, competentAuthority\_orgName, competentAuthority\_posName, competentAuthority\_role, designationPeriod\_beginPosition, designationPeriod\_endPosition, legalBasis\_link, legalBasis level, beginLifespanVersion]);



#### **Resulting Model**

The following image (**Error! Reference source not found.**) shows the resulting model for Noise action plans – coverage area.

Please note that the common tables (CodelistProperties, DatasetDefaultProperties) are not repeated for each GeoPackage model.

#### Figure 23: Model for END DF7\_10 Noise action plan coverage area geoPackage

✓ ▼ NoiseActionPlanCoverageArea	✓
actionPlanIdIdentifier (01)	8 beginLifespanVersion (01)
🔯 geometry	competentAuthority_contact (01)
8 id	competentAuthority_indivName (01)
inspireld_localld	competentAuthority_orgName (01)
inspireld_namespace	competentAuthority_posName (01)
inspireld_versionId (01)	competentAuthority_role (01)
	8 designationPeriod_beginPosition (01)
	8 designationPeriod_endPosition (01)
	8 id
	legalBasis_level (01)
	legalBasis_link (01)

8 NoiseActionPlanCoverageArea\_id



## List of abbreviations

Abbreviation	Name	Reference
AM	Area Management and Regulation Zones (INSPIRE Theme)	
EC	European Commission	
EEA	European Environment Agency	www.eea.europa.eu
END	Environmental Noise Directive (Directive 2002/49/EC)	http://data.europa.eu/eli/dir /2002/49/oj
GML	Geography Markup Language	
НН	Human Health and Safety (INSPIRE Theme)	
INSPIRE	Infrastructure for spatial information in European Community (Directive 2007/2/EC)	https://inspire.ec.europa.eu/
MS	Member State(s) (European Union)	
SRS	Spatial reference systems	
TN-A	Transport Networks – Air (INSPIRE Schema)	
TN-RA	Transport Networks – Railways (INSPIRE Schema)	
TN-RO	Transport Networks – Road (INSPIRE Schema)	
UAB	Universitat Autònoma de Barcelona	
UML	Unified Modelling Language	



# Annex 1 Overview of transformation rules in END GeoPackage templates

END data flow noise sources (DF1\_5)

Data model and feature type / table	DF1-5 Agglomerations	DF1_5 Major Airports	DF1_5 Major Railways	DF1_5 Major Roads
Transformation rule	Agglomeration- Source	MajorAirport- Source	MajorRailway- Source	MajorRoadSource
MT_ENDGPK01: Flattening of hierarchical structures	х	х	x	х
MT_ENDGPK02: Voidable attributes to Companion Table	х		x	х
MT_ENDGPK03: Dataset Default values	х		x	х
MT_ENDGPK0: Handle code list values and metadata	х	х	x	х
MT_ENDGPK05: Handle composition attributes with multiplicity 1:n				
MT_ENDGPK06: Handle associations with a multiplicity of n:m				
MT002: Extract Primitive Array	Х			



Data model and feature type / table	DF4_8 Strategic Noise Maps – Noise Contours (applicable to all noise sources)	DF4_8 Strategic Noise Maps - Noise Exposure Agglomerations	DF4_8 Strategic Noise Maps - Noise Exposure Major Airports	DF4_8 Strategic Noise Maps - Noise Exposure Major Railways	DF4_8 Strategic Noise Maps - Noise Exposure Major Roads
Transformation rule	EnvHealthDetermin antMeasure (for environmental noise)	Exposure- Agglomeration	ExposureMajor Airport	ExposureMajor Railway	ExposureMajor Road
MT_ENDGPK01: Flattening of hierarchical structures	х				
MT_ENDGPK02: Voidable attributes to Companion Table	х				
MT_ENDGPK03: Dataset Default values	Х				
MT_ENDGPK0: Handle code list values and metadata	Х	х	х	х	x
MT_ENDGPK05: Handle composition attributes with multiplicity 1:n		х	х	х	х
MT_ENDGPK06: Handle associations with a multiplicity of n:m					
MT002: Extract Primitive Array					

#### END data flow strategic noise maps (DF4\_8)

#### END data flow of quiet areas and coverage area part of noise action plans (DF7\_10)

Data model and feature type / table	DF7_10 Quiet Areas	DF7_10 Noise Action Plans Coverage Area (applicable to noise action plans for all noise sources)
Transformation rule	QuietArea	NoiseActionPlanCoverageArea
MT_ENDGPK01: Flattening of hierarchical structures	х	x
MT_ENDGPK02: Voidable attributes to Companion Table	х	x
MT_ENDGPK03: Dataset Default values	Х	Х
MT_ENDGPK0: Handle code list values and metadata	х	x
MT_ENDGPK05: Handle composition attributes with multiplicity 1:n	х	
MT_ENDGPK06: Handle associations with a multiplicity of n:m		
MT002: Extract Primitive Array	Х	