



EU-CIRCLE

A pan-European framework for strengthening Critical Infrastructure resilience to climate change

D5.5 CIRP As Built document

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Statement

This report presents the As-Built document of the **Climate Infrastructure Resilience Platform (CIRP)**. More specifically the various likelihood, impact and risk analyses are presented as well as the data type schemas utilized by these analyses (input / outputs).

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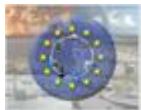
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**Preparation Slip**

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**Abbreviations List**

Term	Description
CA	Cellular Automata
CSV	Comma Separated Values
DEM	Digital Elevation Model
FWI	Fire Weather Index
GIS	Geographical Information System
IDF	Intensity Duration Frequency
MCM	Multicolor Map
NetCDF	Network Common Data Form
RCP	Representative Concentration Pathways
XML	Extensible Markup Language



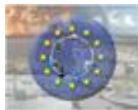
Executive Summary

This deliverable accompanies WP5 deliverables D5.1 and D5.4 and presents the final list of analyses provided by the CIRP analysis toolbox. CIRP is an innovative modular and expandable software platform that assesses potential impacts due to climate hazards and allows CI policy-makers, decision makers and scientists have access to diverse simulation, modelling and risk assessment algorithms in a homogenised environment. This allows both the development of risk reduction strategies and the implementation of mitigation actions to minimize the impact of climate change on Cis.

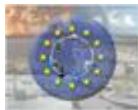


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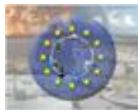
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1 Introduction

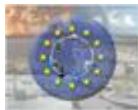
CIRP is a user-friendly GIS based environment that provides its users with the ability to analyse what-if scenarios: leveraging model selection, climate data repositories and CI inventories in order to calculate impact for any kind of climate hazard and CI. In this way, users will be able to understand the impact of various adaptation strategies or quantify the potential impact of a catastrophic event on society.

CIRP's software detail design has been documented in D5.1 along with key design considerations, design strategies and decisions, architecture and detailed description of the platform modules. In D5.4 (final integrated release) the software capabilities from the user point of view were presented.

In this last deliverable of WP5 the final set of analyses offered by the CIRP analysis toolbox are presented along with their inputs and outputs (references to other deliverables or scientific papers are also included).

This deliverable is structured as follows: The following section provides an overview of the CIRP analyses, Section 3 enlists the supported dataset types and associated file types that an analysis can import or export and Section 4 presents every analysis of the CIRP toolbox.

Type “electrSubstationsServiceIdSource”



2 System Overview

CIRP's primary goal is to provide a multi-user web based software that is able to analyse CI's vulnerabilities and impacts due to climate change in the form not only of physical damages but also service impacts, interdependencies, societal costs, environmental effects, and economic costs due to suspended activities. The CIRP Analysis Toolbox is a set of diverse analysis that have resulted from the needs of the various EU-Circle Case Studies and WP2, WP3 and WP4 work. In CIRP each analysis is categorized according to the dataset that processes (consumes or produces) and/or its Critical Infrastructure applicability. The following analysis categories are supported.

- Building
- Climate Data
- Decision Support
- GIS
- Hazard
- Lifeline
- Socioeconomic

The following Figure depicts the various analyses in each category and their interconnection (blue arrow lines).

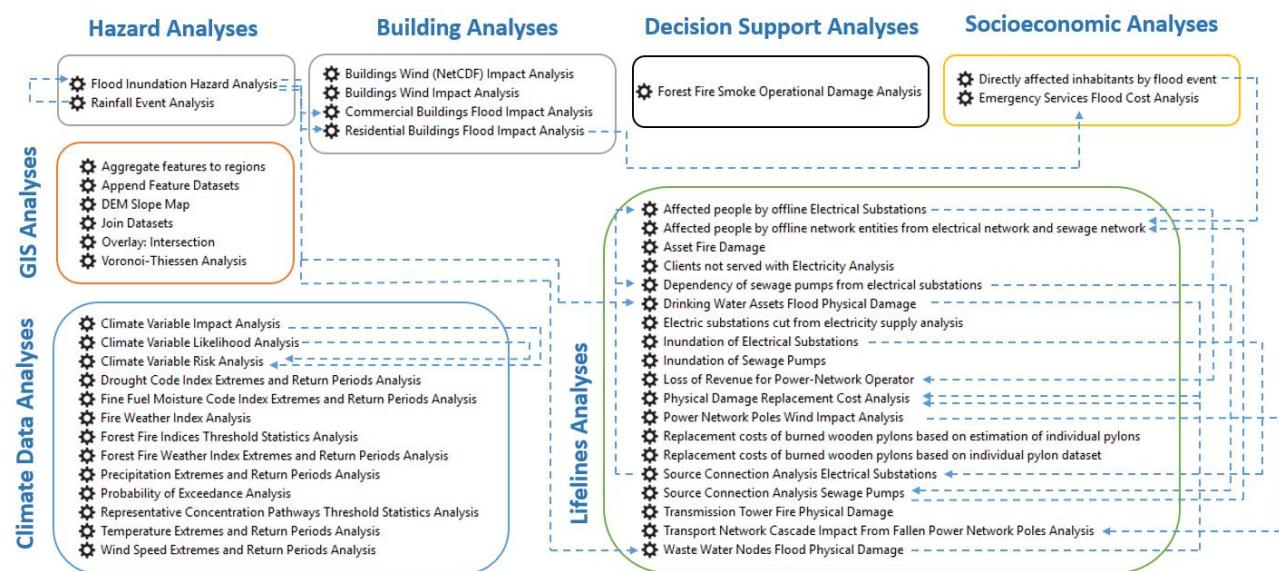


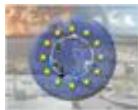
Figure 1: The CIRP analyses toolbox



3 Supported Input and Output Datasets

The following list presents the datasets and file formats supported by CIRP v3:

- Feature Datasets – Shapefiles
- Raster Datasets – ASCII Grid
- Grid Datasets – NetCDF
- Table Datasets – CSV
- Damage/Fragility Curves Datasets – XML
- Damage/Fragility Curve Mapping Datasets - XML

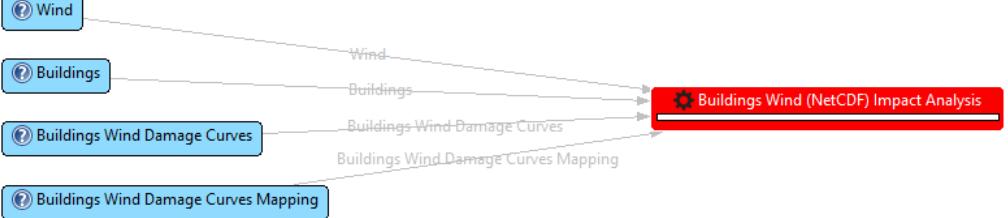


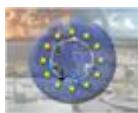
4 The CIRP Analysis Toolbox

In the following Tables the various analyses supported by CIRP (version 3.0) are documented.

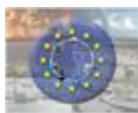
4.1 Building Analyses

Table 1. CIRP Building Analyses

BA.1 Building Wind (NetCDF) Impact Analysis			
Description	This analysis computes the wind impact on buildings in various time steps by using as input a NetCDF file, a buildings inventory and damage curves and associated mapping XML file (all previously ingested into a CIRP Data Repository). The output is the input Shapefile with additional attributes according to the <i>buildingsWindDamagedV1</i> type specification.		
References	D3.2 Section 4.6 [5], D3.3 Section 4.1 [6]		
Graph			
Input Dataset	Type: windNetCDF	File Type: NetCDF	Cardinality: Single
Input Dataset	Type: buildingsV1	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: buildingWindDamageCurvesV1	File Type: XML	Cardinality: Single
Input Dataset	Type: buildingWindDamageCurvesMappingV1	File Type: XML	Cardinality: Single
Output Dataset	Type: buildingsWindDamagedV1	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
BA.2 Building Wind Impact Analysis			
Description	This analysis computes the wind impact on buildings in various time steps by using as input a NetCDF file (from the filesystem), a buildings inventory and damage curves and associated mapping XML file (ingested into a CIRP data repository). The output is the input shapefile with additional attributes according to the <i>buildingsWindDamagedV1</i> type specification.		
References	D3.3 Section 4.1 [6]		



Graph	<pre>graph LR; Wind[Wind] --> Impact[Buildings Wind (NetCDF) Impact Analysis]; Buildings[Buildings] --> Impact; BWDCurves[Buildings Wind Damage Curves] --> Impact; BWDCurvesMapping[Buildings Wind Damage Curves Mapping] --> Impact;</pre>		
Plugin Provider	Satways Ltd.		
Input Parameter	NetCDF File Path	Value Type: String	Cardinality: Single
Input Dataset	Type: buildingsV1	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: buildingWindDamageCurvesV1	File Type: XML	Cardinality: Single
Input Dataset	Type: buildingWindDamageCurvesMappingV1	File Type: XML	Cardinality: Single
Output Dataset	Type: buildingsWindDamagedV1	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
BA.3	Residential Buildings Flood Impact Analysis		
Description	This analysis estimates the flood impact (cost) on residential buildings based on the Multicolor Map (MCM).		
References	D3.3 Section 4.1.6 [6]		
Graph	<pre>graph LR; ResidentialBuildings[Residential Buildings] --> Impact[Residential Buildings Flood Impact Analysis]; Flood[Hazard] --> Impact;</pre>		
Input Parameter	Type: mcmResidentialBuildingsV1.0	Value Type: String	Cardinality: Single
Input Parameter	Dehumidifiers cost per property (min)	Value Type: double	Cardinality: Single
Input Parameter	Dehumidifiers cost per property (max)	Value Type: double	Cardinality: Single
Input Parameter	Dehumidifiers flood threshold	Value Type: double	Cardinality: Single
Input Parameter	Heating Costs per Property	Value Type: double	Cardinality: Single
Input Parameter	Health Costs	Value Type: double	Cardinality: Single

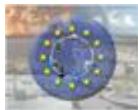


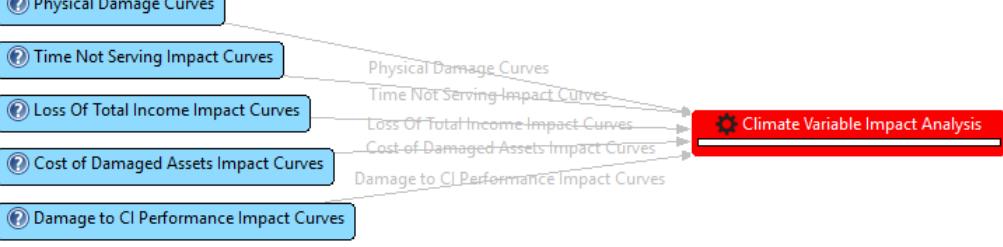
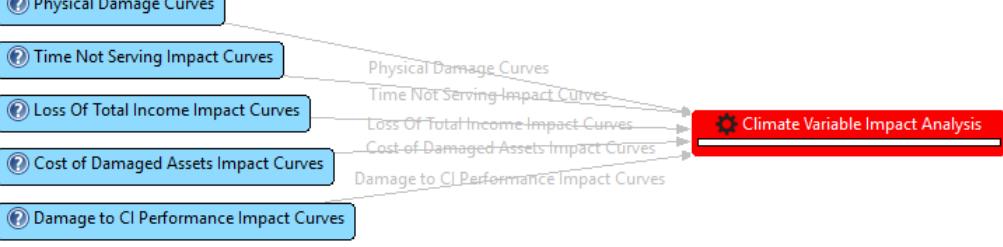
Input Dataset	Type: mcmResidentialDirectFloodCostsCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: mcmResidentialDirectFloodCostCurvesMapping	File Type: XML	Cardinality: Single
Input Dataset	Type: floodMaximumWaterDepth	File Type: ASCII Grid	Cardinality: Single
Output Dataset	Type: mcmResidentialBuildingsFloodCost	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
BA.4	Commercial Buildings Flood Impact Analysis		
Description	This analysis estimates the flood impact (cost) on commercial buildings based on the Multicolor Map (MCM).		
References	D3.3 / 4.1.6 [6]		
Graph	<pre> graph LR CB[Commercial Buildings] --> CBFIA[Commercial Buildings Flood Impact Analysis] FMFDH[Flood Maximum Flow Depth Hazard] --> CBFIA </pre>		
Input Dataset	Type: mcmCommercialBuildingsV1.0	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: mcmCommercialFloodCostsCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: mcmCommercialFloodCostsCurvesMapping	File Type: XML	Cardinality: Single
Output Dataset	Type: mcmBuildingsFloodCost	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		

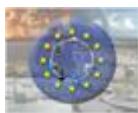
4.2 Climate Data Analyses

Table 2. CIRP Climate Data Analyses

CA.1	Climate Variable Impact Analysis
Description	Calculates the impact of temperature (min, max), wind gust speed or precipitation on various consecutive days on Critical Infrastructure elements with the use of impact curves.
References	D3.5 / Section 3.3 [8]



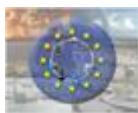
 Graph			
 <pre>graph TD; PD[Physical Damage Curves] --> CVIA[Climate Variable Impact Analysis]; TN[Time Not Serving Impact Curves] --> CVIA; LTI[Loss Of Total Income Impact Curves] --> CVIA; CDI[Cost of Damaged Assets Impact Curves] --> CVIA; DCI[Damage to CI Performance Impact Curves] --> CVIA;</pre>			
Input Parameter	Climate Variable	Value Type: String (selection from Combo box)	Cardinality: Single
Input Parameter	Climate Variable Value	Value Type: double	Cardinality: Single
Input Dataset	Type: climatePhysicalDamageCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: timeCINotServingImpactCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: costOfDamagedAssetsImpactCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: damageToCIPerformanceImpactCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: lossOfTotalIncomeImpactCurves	File Type: XML	Cardinality: Single
Output Dataset	Type: impactTempMaxMinDailyRainWindGust	File Type: CSV	Cardinality: Single
Plugin Provider	Satways Ltd.		
CA.2	Climate Variable Likelihood Analysis		
Description	Calculates the probability of occurrence temperature (min, max), wind gust speed or precipitation on various consecutive days.		
Reference	D2.3 [3], D3.2 [5] / Section 5 [3]		
 Graph			
	 <pre>graph TD; CDT[Climate Data Timeseries] --> CVLA[Climate Variable Likelihood Analysis];</pre>		
Input Dataset	Type: rcpTempMaxMinDailyRainWindGust	File Type: CSV	Cardinality: Single
Input	Climate Variable	Value Type: String (selection from Combo box)	Cardinality: Single
Input	Climate Variable Value	Value Type: double	Cardinality: Single
Input Parameter	Probability Distribution	Value Type: String (selection from Combo	Cardinality: Single



		box)	
Output	Type: probabilityOccurrenceTempMaxMinDailyRainWindGust	File Type: CSV	Cardinality: Single
Plugin Provider	Satways Ltd. (R Script by NCSRDI		
CA.3	Climate Variable Risk Analysis		
Description	This analysis computes the final risk from the results of the Climate Variable Impact and Likelihood analyses		
Reference	D3.5 / Section 3.4 [8]		
Graph	<pre>graph LR; A[Climate Variable Likelihood] -- "Climate Variable Likelihood" --> B[Climate Variable Risk Analysis]; C[Climate Variable Impact] -- "Climate Variable Impact" --> B</pre>		
Input Dataset	Type: probabilityOccurrenceTempMaxMinDailyRainWindGust	Type: CSV	Cardinality: Single
Input Dataset	Type: impactTempMaxMinDailyRainWindGust	Type: CSV	Cardinality: Single
Output	User Interface Risk Matrix	Type: User Interface Dialog	Cardinality: -
Plugin Provider	Satways Ltd.		
CA.4	Drought Code Index Extremes and Return Period Analysis		
Description	Calculates the Drought Code Index extreme values and return periods of 10, 20, 25, 50, 100 and 500 years		
Reference	D2.3 / Section 3 [3]		
Graph	<pre>graph LR; A[Forest Fire Indices] -- "Forest Fire Indices" --> B[Drought Code Index Extremes and Return Periods Analysis]</pre>		
Input Parameter	Return Periods	Value: String (multiple selection from combo box)	Cardinality: Multiple
Input Dataset	Type: forestFireIndices	File Type: CSV	Cardinality: Single
Input Parameter	Probability Distribution	Value Type: String (selection from Combo box)	Cardinality: Single
Output	Type: droughtCodeExtremesReturnPeriods	File Type: CSV	Cardinality:



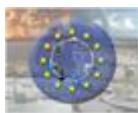
			Single
Plugin Provider	Satways Ltd. (R Script by NCSRDI)		
CA.5	Fine Fuel Moisture Code Index Extremes and Return Period Analysis		
Description	Calculates the Fine Fuel Moisture Code Index extreme values and return periods of 10, 20, 25, 50, 100 and 500 years		
Reference	D2.3 / Section 3 [3]		
Graph			
Input Parameter	Return Periods	Value: String (multiple selection from combo box)	Cardinality: Multiple
Input Dataset	Type: forestFireIndices	File Type: CSV	Cardinality: Single
Input Parameter	Probability Distribution	Value Type: String (selection from Combo box)	Cardinality: Single
Output Dataset	Type: fineFuelMoistureCodeExtremesReturnPeriods	File Type: CSV	Format: Table
Plugin Provider	Satways Ltd. (R Script by NCSRDI)		
CA.6	Fire Weather Index Analysis		
Description	Calculates the Canadian Fire Weather Index (FWI) from multiple cordex datasets		
Reference	[1]		
Graph			
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple
Output Dataset	Type: fireWeatherIndex	File Type: CSV	Cardinality: Single
Plugin Provider	Satways Ltd.		
CA.7	Forest Fire Indices Threshold Statistics Analysis		
Description	Calculates the number of days that a Forest Fire Index or Draught Code or Fine Fuel Moisture Code exceeds or not a given threshold value. It requires as input Forest Fire Indices datasets and produces a point shapefile.		
References	D2.3 [3]		
Graph			



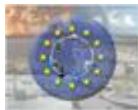
Input Parameter	Comparison operator	Value: string (choice from combo box)	Cardinality: Single		
Input Parameter	Index	Value: string (choice from combo box)	Cardinality: Single		
Input Parameter	Threshold Value	Value: double	Cardinality: Single		
Input Dataset	Type: forestFireIndices	File Type: CSV	Cardinality: Multiple		
Output	Type: ffiTimeThresholdStatistics	File Type: Shapefile	Cardinality: Single		
Plugin Provider	Satways Ltd (R script by NCSRDI				
CA.8	Forest Fire Weather Index Extremes and Return Period Analysis				
Description	Calculates the Forest Fire Weather Index extreme values and return periods of 10, 20, 25, 50, 100 and 500 years				
References	D2.3 / Section 3 [3], D3.2 / Section 5 [5]				
Graph	<pre>graph LR; A[Forest Fire Indices] --> B[Forest Fire Weather Index Extremes and Return Periods Analysis]</pre>				
Input Parameter	Return period list	value: string	Cardinality: Multiple		
Input Dataset	Type: forestFireIndices	File Type: CSV	Cardinality: Multiple		
Input Parameter	Probability distribution	Value: string	Cardinality: Single		
Input Parameter	Alpha	Value: double	Cardinality: Single		
Output	Type: fwiExtremesReturnPeriods	File Type: Shapefile	Cardinality: Single		
Plugin Provider	Satways Ltd (R script by NCSRDI				
CA.9	Precipitation Extremes and Return Period Analysis				
Description	Calculates the precipitation extreme values and return periods of 10, 20, 25, 50, 100 and 500 years				
References	D2.3 / Section 3 [3], D3.2 / Section 5 [5]				
Graph	<pre>graph LR; A[Representative Concentration Pathways] --> B[Precipitation Extremes and Return Periods Analysis]</pre>				
Input Parameter	Return period list	value: string	Cardinality: Multiple		
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple		



Input Parameter	Probability distribution	Value: string	Cardinality: Single
Input Parameter	Alpha	Value: double	Cardinality: Single
Output Dataset	Type: precipitationExtremesReturnPeriods	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd (R script by NCSRD)		
CA.10	Probability of Exceedance Analysis		
Description	Calculate the probability of exceedance for a certain climate variable		
References	D2.3 / Section 3 [3], D3.2 / Section 5 [5]		
Graph	<pre>graph LR; A[Representative Concentration Pathways] --> B[Probability of Exceedance Analysis]</pre>		
Input Parameter	Variable	Value: string (selection of either temperature, wind or precipitation).	Cardinality: Single
Input	Value	Value: double	Cardinality: Single
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple
Input Parameter	Probability distribution	Value: string	Cardinality: Single
Input Parameter	Alpha	Value: double	Cardinality: Single
Output	Probability of exceedance	Value: UI dialog	Cardinality: -
Plugin Provider	Satways Ltd (R script by NCSRD)		
CA.11	Representative Concentration Pathways Threshold Statistics Analysis		
Description	Calculates the number of days that a climate variable (temperature, wind speed etc.) exceeds or not a given threshold value. It requires as input cordex datasets and produces a Point shapefile.		
References	D2.3 [3]		
Graph	<pre>graph LR; A[Representative Concentration Pathways] --> B[Representative Concentration Pathways Threshold Statistics Analysis]</pre>		
Input Parameter	Comparison operator	Value: string (selection from combo box)	Cardinality: Single
Input Parameter	Variable	Value: string (selection from combo box)	Cardinality: Single
Input Parameter	Threshold Value	Value: double	Cardinality:



			Single
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple
Output	Type: rcpTimeThresholdStatistics	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd (R script by NCSRDI		
CA.12	Temperature Extremes and Return Period Analysis		
Description	Calculates the temperature (min, max, median) extreme values and return periods of 10, 20, 25, 50, 100 and 500 years		
References	D2.3 / Section 3 [3], D3.2 / Section 5 [5]		
Graph			
Input Parameter	Temperature	Value: string (choice from Max, Min or Median)	Cardinality: Single
Input Parameter	Return period list	value: string	Cardinality: Multiple
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple
Input Parameter	Probability distribution	Value: string	Cardinality: Single
Input Parameter	Alpha	Value: double	Cardinality: Single
Output	Type: temperatureExtremesReturnPeriods	File type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd (R script by NCSRDI		
CA.13	Wind Speed Extremes and Return Period Analysis		
Description	Calculates the wind speed extreme values and return periods of 10, 20, 25, 50, 100 and 500 years		
References	D2.3 / Section 3 [3], D3.2 / Section 5 [5]		
Graph			
Input Parameter	Return period list	value: string	Cardinality: Multiple
Input Dataset	Type: representativeConcentrationPathways	File Type: CSV	Cardinality: Multiple
Input Parameter	Probability distribution	Value: string	Cardinality:



			Single
Input Parameter	Alpha	Value: double	Cardinality: Single
Output	Type: windspeedExtremesReturnPeriods	File type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd (R script by NCSRDI		

4.3 Decision Support Analyses

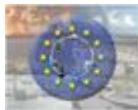
Table 3. CIRP Decision Support Analyses

DA.1. Forest Fire Smoke Operational Damage Analysis			
Description	Estimates which power network assets should be manually set out of service based on the forest fire smoke concentration		
References	D6.2 [10]		
Graph	<pre> graph LR A[Power Network Links] --> C[Forest Fire Smoke Operational Damage Analysis] B[Fire Smoke Hazard] --> C </pre>		
Input Dataset	Type: powerNetworkLinksV1.0 or powerlines	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: fireSmokeV1.0	File Type: Shapefile	Cardinality: Single
Input Parameter	Smoke Concentration Threshold	Value: Integer	Cardinality: Single
Output Dataset	Type: powerNetworkLinksSmokeDamaged	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		

4.4 GIS Analyses

Table 4. GIS Analyses

GA.1. Voronoi-Thiessen Analysis	
Description	Calculates Voronoi-Thiessen polygons for point assets
References	-

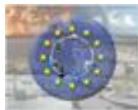


Graph	Assets → Voronoi-Thiessen Analysis		
Input Dataset	Type: genericPointAssetsV1	File Type: Shapefile	Cardinality: Single
Output Dataset	Type: voronoiThiessenPolygonsV1	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		

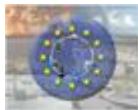
4.5 Hazard Analyses

Table 5. Hazard Analyses

HA.1.	Flood Inundation Hazard Analysis		
Description	Performs a 2D pluvial flood inundation simulation using cellular automata (CA) techniques instead of solving the classic shallow water equations.		
References	D2.3 / Section 4.1 [3]		
Graph	Digital Elevation Model → Rainfall Event Dataset → Overtopping Rates Dataset → Overtopping Locations Dataset → Flood Inundation Hazard Analysis		
Input Parameter	Use GPU	value: boolean	Cardinality: Single
Input Dataset	Digital Elevation Model	File Type: raster	Cardinality: Single
Input Dataset	Type: rainfallEventDataset	File Type: CSV	Cardinality: Single
Input Dataset	Type: overtoppingRatesDataset (Optional)	File Type: CSV	Cardinality: Single
Input Dataset	Type: overtoppingLocationsDataset	Type: CSV	Cardinality: Single
Input Parameter	Include Inflows	Value: boolean	Cardinality: Single
Input Parameter	Time Start (sec)	Value: integer	Cardinality: Single
Input Parameter	Time End (sec)	Value: integer	Cardinality: Single



Input Parameter	Max DT (sec)	Value: integer	Cardinality: Single
Input Parameter	Min DT (sec)	Value: integer	Cardinality: Single
Input Parameter	Update DT (sec)	Value: integer	Cardinality: Single
Input Parameter	Slope Tolerance (%)	Value: double	Cardinality: Single
Input Parameter	Max Iterations	Value: integer	Cardinality: Single
Input Parameter	Roughness Global	Value: double	Cardinality: Single
Input Parameter	Ignore WD (meter)	Value: double	Cardinality: Single
Input Parameter	Tolerance (meter)	Value: double	Cardinality: Single
Input Parameter	Boundary Ele (Hi/Closed-Lo/Open)	Value: double	Cardinality: Single
Input Parameter	Output Period (sec)	Value: integer	Cardinality: Single
Input Parameter	Check Volumes	Value: boolean	Cardinality: Single
Input Parameter	Raster WD Tolerance (meter)	Value: double	Cardinality: Single
Input Parameter	Update Peak Every DT	Value: boolean	Cardinality: Single
Input Parameter	Expand Domain	Value: boolean	Cardinality: Single
Input Parameter	Ignore Upstream	Value: boolean	Cardinality: Single
Input Parameter	Upstream Reduction (meter)	Value: double	Cardinality: Single
Output Dataset	Type: floodMaximumWaterDepth	File Type: raster	Cardinality: Single
Plugin Provider	Satways Ltd. (CA code by UNEXE)		
HA.2.	Rainfall Event Analysis		
Description	Computes Rainfall Events from Intensity-Duration-Frequency curves		
References	-		

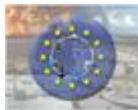


Graph			
Input Parameter	Return Period	Value: integer	Cardinality: Single
Input Parameter	Event Duration	Value: double	Cardinality: Single
Input Parameter	Time Step	Value: double	Cardinality: Single
Input Parameter	IDF θ	Value: double	Cardinality: Single
Input Parameter	IDF n	Value: double	Cardinality: Single
Input Parameter	IDF k	Value: double	Cardinality: Single
Input Parameter	IDF ψ	Value: double	Cardinality: Single
Input Parameter	IDF λ'	Value: double	Cardinality: Single
Input Parameter	IDF ψ'	Value: double	Cardinality: Single
Output Dataset	Type: rainfallEventDataset	File Type: CSV	Cardinality: Single
Plugin Provider	Satways Ltd.		

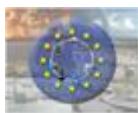
4.6 Lifeline Analyses

Table 6. Lifeline Analyses

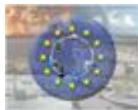
LA.1.	Affected People by Offline Electrical Substations		
Description	Calculates the number of affected inhabitants by offline Electrical Substations per service areas of the substations.		
References	D3.3 [6] / D6.10 [12]		
Graph	<pre> graph TD SA[Service areas of Electrical substations] --> SBI[Statistical blocks with number of inhabitants] SBI --> ESI[Electrical substations (inundated, network connected)] ESI --> AP[Affected people by offline Electrical Substations] </pre>		
Input	Type: electrSubstationsServiceIdSource	File Type: Shapefile	Cardinality: Single



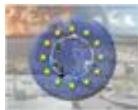
Input	Type: statisticalBlocks	File Type: Shapefile	Cardinality: Single
Input	Type: servAreaElectricalSubstations	File Type: Shapefile	Cardinality: Single
Output	Type: servAreaAffectedElectr	File Type: Shapefile	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.2.	Affected People by Offline Network Entities from Electrical Network and Sewage Network		
Description	Plugin calculates the number of affected inhabitants by offline network entities from electrical and sewage networks.		
References	D3.3 [6] / D6.10 [12]		
Graph	<pre>graph LR; A[Electrical Substations (inundated, network connected)] --> B[Sewage pumps (inundated, powered, downstream connected)]; B --> C[Service areas of sewage pumps]; C --> D[Service areas of electrical substations]; D --> E[Statistical blocks with number of inhabitants]; E --> F[Affected people by offline network entities from electrical network and sewage network]</pre>		
Input	Type: electrSubstationsServiceIdSource	File Type: Shapefile	Cardinality: Single
Input	Type: sewagePumpsServiceIdSource	File Type: Shapefile	Cardinality: Single
Input	Type: servAreaSewagePumps	File Type: Shapefile	Cardinality: Single
Input	Type: servAreaElectricalSubstations	File Type: Shapefile	Cardinality: Single
Input	Type: statisticalBlocksAffectedInundation	File Type: Shapefile	Cardinality: Single
Output	Type: servAreaAffectedElectr	File Type: Shapefile	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.3.	Asset Fire Damage		
Description	This analyses intersects fire contours given as user input with assets given as user input. All assets that intersect at least one fire contour are assumed to be completely damaged (damage = 1). All other assets are assumed not be damaged at all (damage = 0).		
References	D3.3 [6] / D6.10 [12]		



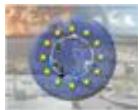
Graph	<pre>graph LR; Assets[Assets] -- Assets --> AFDA[Asset Fire Damage]; FireContours[Fire Contours] -- Fire Contours --> AFDA;</pre>		
Input	Type: asset	File Type: Shapefile	Cardinality: Single
Input	Type: firecontours	File Type: Shapefile	Cardinality: Multiple
Output	Type: damage	File Type: Shapefile	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.4.	Clients not Served with Electricity Analysis		
Description	This analysis is an economic impact analysis. It analyses the loss of revenue for an electricity operator due to non-serving energy to customers. For this purpose the loss of not served energy to customers due to damaged electricity stations is computed. The number of clients connected to each electricity station and the state of each electricity station (damage yes/no?) need to be known as an input. The power station out of work time, energy cost per hour and average power consumption per client are parameters that have to be entered by the user. The analysis calculates the energy losses due to power station not working time by multiplying the total number of clients retrieved from the electricity stations dataset by power station not working time and average power consumptions of clients. The loss of revenue parameter is calculated by multiplying energy losses by energy price per hour. The result values are added to the columns LOSSOFREV and LOSS_ENERG of power stations attribute table		
References	D3.3 [7] / D6.2 [10]		
Graph	<pre>graph LR; ES[Electricity Substations] -- Electricity Substations --> CNEA[Clients not served with Electricity Analysis];</pre>		
Input	Type: electricitysubstation	Type: Shapfile	Cardinality: Single
Input	Type: outofworktime	Value: String	Cardinality: Single
Input	Type: priceperhour	Value: String	Cardinality: Single
Input	Type: averpowcons	Value: String	Cardinality: Single
Output	Type: electricitysubstationloss	Value: String	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.5.	Dependency of sewage pumps from electrical substations		



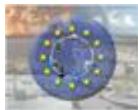
Description	Calculates which sewage pump is connected to which substation and sets pumps service column to 0, if there is no power supply and to 1, if there is power supply.		
References	D3.1 [4] / D6.10 [12]		
Graph			
Input	Type: electrSubstationsServiceIdSource	File Type: Shapefile	Cardinality: Single
Input	Type: sewagePumpsService	File Type: Shapefile	Cardinality: Single
Input	Type: dependenciesElectricalSewage	File Type: Shapefile	Cardinality: Single
Output	Type: sewagePumpsServiceIdSourceConnection	File Type: Shapefile	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.6.	Drinking Water Assets Flood Physical Damage		
Description	Estimates drinking water assets damage from maximum flow depth.		
References	[2] / D3.3 [6]		
Graph			
Input	Type: DRINKING_WATER_NODES_V1.0	File Type: Shapefile	Cardinality: Single
Input	Type: DRINKING_WATER_FLOOD_DAMAGE_CURVES	Type: XML	Cardinality: Single
Input	Type: DRINKING_WATER_FLOOD_DAMAGE_CURVES_MAPPING	Type: XML	Cardinality: Single
Input	Type: floodMaximumWaterDepth	File Type: Raster (ASCII Grid)	Cardinality: Single
Output	Type: inventoryPhysicallyDamaged	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		



LA.7.	Electric Substations Cut from Electricity Supply Analysis		
Description	<p>This analysis takes power lines, electricity stations and fire contour datasets a user input. The power line data sets needs to have topological information, i.e. the ids of the electricity stations that are connected by this power line (including electricity flow direction indicated by source and target id). Power lines can be both types, aboveground/aerial or buried. It is analysed, if electricity station is connected to the electricity network by power line that is burned during fire incident or that is connected to another electricity substation that is connected to the electricity network by power line that is burned then remaining capacity of current substation is reduced to the value proportional to the whole network capacity loss value and the number of non-served clients will consequently increase. The result values are added to the columns REMCAPACIT and NOTSERVEDC of the attribute table.</p>		
References	D6.2 [10]		
Graph	<pre>graph LR; A[Power Lines with Topology Information] --> B[Electricity Power Stations with ID and number of clients]; B --> C[Fire Contours]; C --> D[Electric substations cut from electricity supply analysis]</pre>		
Input	Type: powerlinestopolgy	File Type: Shapefile	Cardinality: Multiple
Input	Type: substations_id_clients	File Type: Shapefile	Cardinality: Single
Input	Type: firecontours	File Type: Shapefile	Cardinality: Multiple
Output	Type: substations_loss_of_capacity	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.8.	Inundation of Electric Substations		
Description	Calculates damaged/offline/out of order infrastructure entities due to hazard by electrical substations analysis.		
References	D3.3 / Section 4.1 [6]		
Graph	<pre>graph LR; A[Inundation depth] --> B[Electrical Substations]; B --> C[Inundation of Electrical Substations]</pre>		
Input	Type: inundationDepth	Type: raster	Cardinality: Single
Input	Type: electrSubstations	File Type: Shapefile	Cardinality: Single



Input	Type: inunThreshold	Value: String	Cardinality: Single
Output	Type: electrSubstationsService	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.9.	Inundation of Sewage Pumps		
Description	Calculates damaged/offline/out of order infrastructure entities due to hazard by sewage pumps analysis.		
References	D3.3 / Section 4.1 [6]		
Graph	<pre>graph LR; A[Inundation level] -- "Inundation level" --> B[Inundation of Sewage Pumps]; C[Sewage pumps] -- "Sewage pumps" --> B</pre>		
Input	Type: inundationDepth	Type: raster	Cardinality: Single
Input	Type: sewagePumps	File Type: Shapefile	Cardinality: Single
Input	Type: inunThreshold	Value: String	Cardinality: Single
Output	Type: sewagePumpsService	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.10.	Loss of Revenue for Power-Network Operator		
Description	Calculates loss of revenue due to non-served electricity in the following way: Loss of revenue = average power consumption per inhabitant per year * estimated duration of flood event * number of affected inhabitants * average revenue per kWh		
References	D3.3 / Section 4.3 [6], D4.7 [9]		
Graph	<pre>graph LR; A[Service Areas of E-substations with number of affected people] <--> B[Service Areas of E-substations with number of affected people]; A --> C[Loss of Revenue for Power-Network Operator]</pre>		
Input	Type: servAreaAffectedElectr	File Type: Shapefile	Cardinality: Single
Input	Type: powConsumption	Value: String	Cardinality: Single
Input	Type: duration	Value: String	Cardinality: Single
Input	Type: avRevenue	Value: String	Cardinality: Single



Output	Type: lossOfRevenue	File Type: Shapefile	Cardinality: Single
Plugin Provider	Fraunhofer		
LA.11.	Physical Damage Replacement Cost Analysis		
Description	This analysis calculates the replacement costs of physically damaged CI assets		
References	D4.7 [9]		
Graph			
Input Dataset	Type: inventoryPhysicallyDamaged	File Type: Shapefile	Cardinality: Single
Output Dataset	Type: inventoryReplacementCosts	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
LA.12.	Power Network Poles Wind Impact Analysis		
Description	Estimates the impact of power network poles due to wind in multiple time steps.		
References	D6.8 [11]		
Graph			
Input Dataset	Type: powerNetworkPolesV1	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: powerNetworkPolesWindDamageCurvesV1	File Type: XML	Cardinality: Single
Input Dataset	Type: powerNetworkPolesWindDamageCurvesMappingV1	File Type: XML	Cardinality: Single
Input Parameter	NetCdf File Path	Value: string	Cardinality: Single
Output Dataset	Type: powerNetworkPolesWindFallenV1	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
LA.13.	Replacement Costs of Burned Wooden Pylons Based on Estimation of Individual Pylons		
Description	This analysis calculates the replacement costs of wooden pylons that have been burned during a fire incident. For this purpose, it is assumed that the average distance		



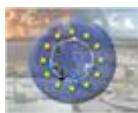
	<p>between two adjacent pylons is known by the user. In the analysis it is tested, if a given fire contour intersects with an individual powerline segment. If there is an intersection, it is assumed that all pylons of this segments need complete replacement. The number of pylons per segment is estimated by dividing the length of the segment of the average distance of two adjacent pylons. All other pylons do not have associated replacement costs. The replacement costs per pylon have to be entered as a user input.</p>		
References	D4.7 [9]		
Graph	<pre>graph LR; A["Power Lines (without Topology Information)"] --> B["Fire Contours"]; A --> C["Replacement costs of burned wooden pylons based on estimation of individual pylons"]; B --> C;</pre>		
Input	Type: powerlines	File Type: Shapefile	Cardinality: Single
Input	Type: firecontours	File Type: Shapefile	Cardinality: Multiple
Input	Type: averagePylonDistance	Value: String	Cardinality: Single
Input	Type: costPerWoodenPylon	Value: String	Cardinality: Single
Output	Type: EstimatedNumberAndReplacementCost	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.14.	Replacement Costs of Burned Wooden Pylons Based on Individual Pylon Dataset		
Description	<p>This analysis calculates the replacement costs of wooden pylons that have been burned during a fire incident. For this purpose, it is assumed that the exact location of each individual wooden pylon is known. In the analysis it is tested, if a given fire contour intersects with each individual pylon. If there is an intersection, it is assumed the pylon needs complete replacement. All other pylons do not have associated replacement costs. The replacement costs per pylon have to be entered as a user input.</p>		
References	D4.7 [9]		
Graph	<pre>graph LR; A["Assets"] --> B["Fire Contours"]; A --> C["Replacement costs of burned wooden pylons based on individual pylon dataset"]; B --> C;</pre>		
Input	Type: asset	File Type: Shapefile	Cardinality: Single
Input	Type: firecontours	File Type: Shapefile	Cardinality: Multiple

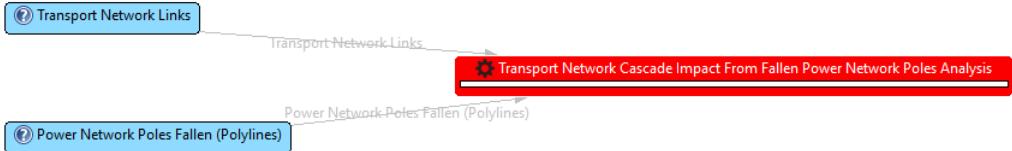
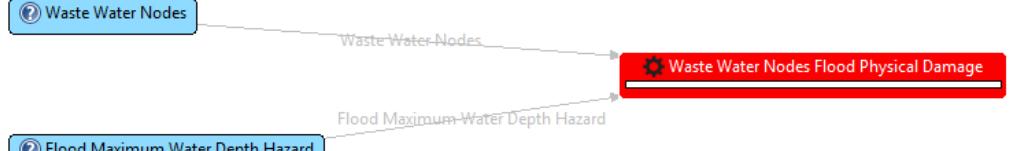


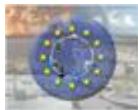
Input	Type: costPerWoodenPylon	Value: String	Cardinality: Single
Output	Type: ReplacementCost	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.15.	Source Connection Analysis Electrical Substations		
Description	Calculates damaged/offline/out of order infrastructure entities due to lost supply from service source by electrical substations analysis		
References	D6.10 [12]		
Graph	<pre>graph LR; A[Electrical Substations] --> B[Source Connection Analysis Electrical Substations]; C[Electrical network links] --> B</pre>		
Input	Type: electrSubstationsService	File Type: Shapefile	Cardinality: Single
Input	Type: networkLinksElectrical	File Type: Shapefile	Cardinality: Single
Output	Type: electrSubstationsServicelIdSource	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.16.	Source Connection Analysis Sewage Pumps		
Description	Calculates damaged/offline/out of order infrastructure entities due to lost supply from service source by sewage pumps analysis		
References	D6.10 [12]		
Graph	<pre>graph LR; A[Sewage Pumps] --> B[Source Connection Analysis Sewage Pumps]; C[Sewage network links] --> B</pre>		
Input	Type: sewagePumpsServicelIdSourceConnection	File Type: Shapefile	Cardinality: Single
Input	Type: networkLinksSewage	File Type: Shapefile	Cardinality: Single
Output	Type: sewagePumpsServicelIdSource	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		



LA.17.	Transmission Tower Fire Physical Damage		
Description	Calculates the Physical Impact of Fire to Electric Network Steel Towers		
References	D3.3 [6] / D6.2 [10]		
Graph	<p>The diagram illustrates the data flow for the 'Transmission Tower Fire Physical Damage' calculation. It starts with several input nodes: 'Transmission Towers (Assets)', 'Fireline Intensity (kW/m)', 'Rate of Spread (m/min)', 'Strength-Temperature Damage Curves', 'Strength-Temperature Damage Curves Mapping', 'FireDuration High Exposure Damage Curves', 'FireDuration High Exposure Damage Curves Mapping', 'FireDuration Medium Exposure Damage Curves', and 'FireDuration Medium Exposure Damage Curves Mapping'. Arrows point from these inputs to a central node labeled 'Transmission Tower Fire Physical Damage'. This central node is highlighted in red, indicating it is the primary output of the process.</p>		
Input Dataset	Type: asset	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: fli	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: ros	File Type: Shapefile	Cardinality: Single
Input Parameter	Ambient Temperature	Value: string	Cardinality: Single
Input Parameter	Height above ground	Value: string	Cardinality: Single
Input Parameter	Cost per pylon	Value: string	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresTemperatureStrengthDamageCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresTemperatureStrengthDamageCurvesMapping	File Type: XML	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresDurationHighExposureDamageCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresDurationHighExposureDamageCurvesMapping	File Type: XML	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresDurationMediumExposureDamageCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: transmissionTowerForestFiresDurationMediumExposureDamageCurvesMapping	File Type: XML	Cardinality: Single



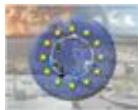
Output	Type: damagefactor	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd. / Fraunhofer		
LA.18.	Transport Network Cascade Impact from Power Network Poles Analysis		
Description	Estimates the blocked transport network links due to fallen power network poles caused by strong winds		
References	D6.8 [11]		
Graph			
Input Dataset	Type: transportNetworkLinksV1	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: powerNetworkPolesWindFallenV1	File Type: Shapefile	Cardinality: Single
Output Dataset	Type: transportNetworkLinksBlockedV1	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		
LA.19.	Waste Water Nodes Physical Damage Analysis		
Description	Estimates waste water nodes physical damage from flood		
References	[2] / D3.3 / Section 4.2 [6]		
Graph			
Input Dataset	Type: wasteWaterNodesV1.0	File Type: Shapefile	Cardinality: Single
Input Dataset	Type: wasteWaterFloodDamageCurves	File Type: XML	Cardinality: Single
Input Dataset	Type: wasteWaterFloodDamageCurvesMapping	File Type: XML	Cardinality: Single
Input Dataset	Type: floodMaximumWaterDepth	File Type: raster (ASCII Grid)	Cardinality: Single
Output Dataset	Type: inventoryFloodPhysicallyDamaged	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		



4.7 Socioeconomic Analyses

Table 7. Socioeconomic Analyses

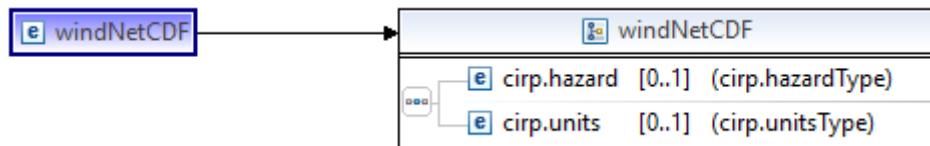
LA.20.	Directly Affected Inhabitants by Flood Event		
Description	Analysis calculates inundated buildings and affected inhabitants. Analysis identifies spatial intersection between inundated area and statistical blocks, computes the share of inundated areas of the whole area of statistical block (assume population is homogenously distributed in statistical block) and determines number of affected people per block by multiplying share of inundated area by total inhabitants in block.		
References	D3.4 [7]		
Graph			
Input	Type: inundationArea	File Type: Shapefile	Cardinality: Multiple
Input	Type: statisticalBlocks	File Type: Shapefile	Cardinality: Single
Output	Type: statisticalBlocksAffectedInundation	File Type: Shapefile	Format: Shapefile
Plugin Provider	Fraunhofer		
LA.21.	Emergency Services Flood Cost Analysis		
Description	Estimates the flood costs for Emergency Services		
References	D3.4 [7]		
Graph			
Input Dataset	Type: mcmBuildingsFloodCost or mcmResidentialBuildingsFloodCost	File Type: Shapefile	Cardinality: Single
Input Parameter	Emergency Services actions cost percentage	Value: double	Cardinality: Single
Output Dataset	Type: emergencyServicesFloodCosts	File Type: Shapefile	Cardinality: Single
Plugin Provider	Satways Ltd.		



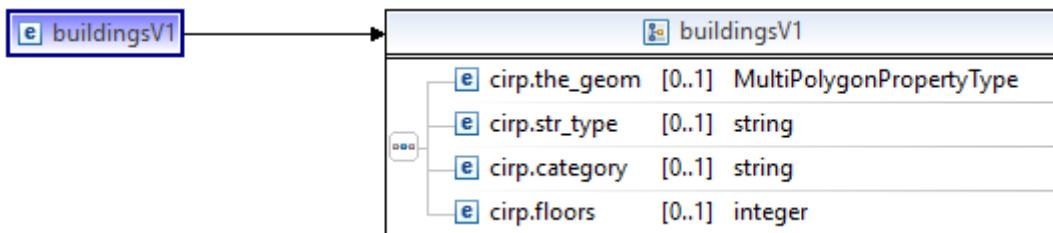
5 Definition of Data Types

In this section the various elements of the XSD schemas are presented for each data type used in the aforementioned analyses. These schemas may represent feature, raster, table/CSV, fragilities/damage curves or fragilities/damage curve mapping files.

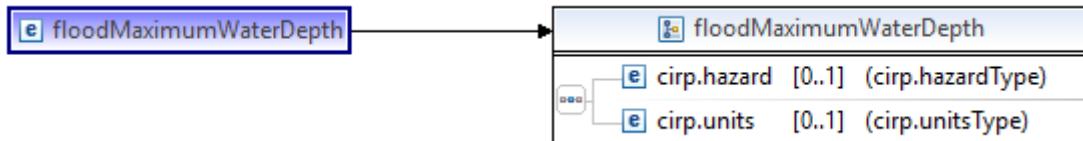
5.1 Type “windNetCDF”



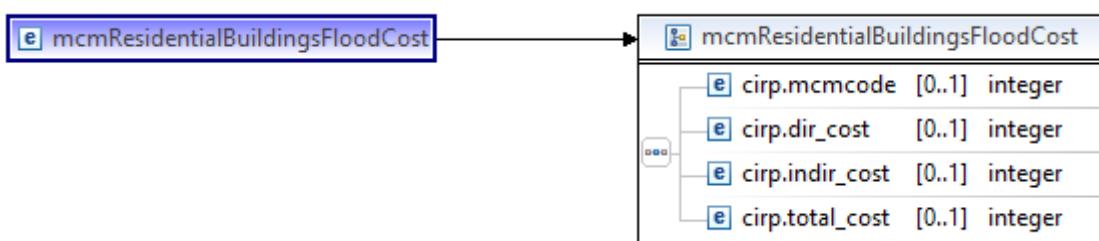
5.2 Type “buildingsV1”



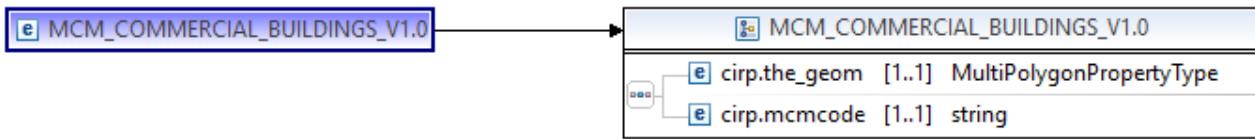
5.3 Type “floodMaximumWaterDepth”

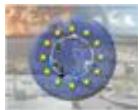


5.4 Type “mcmResidentialBuildingsFloodCost”

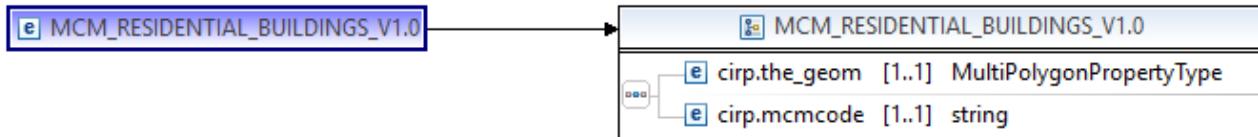


5.5 Type “mcmCommercialBuildingsV1.0”

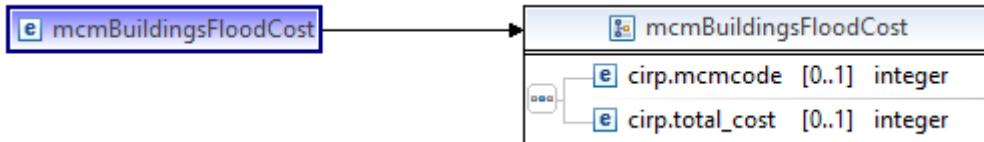




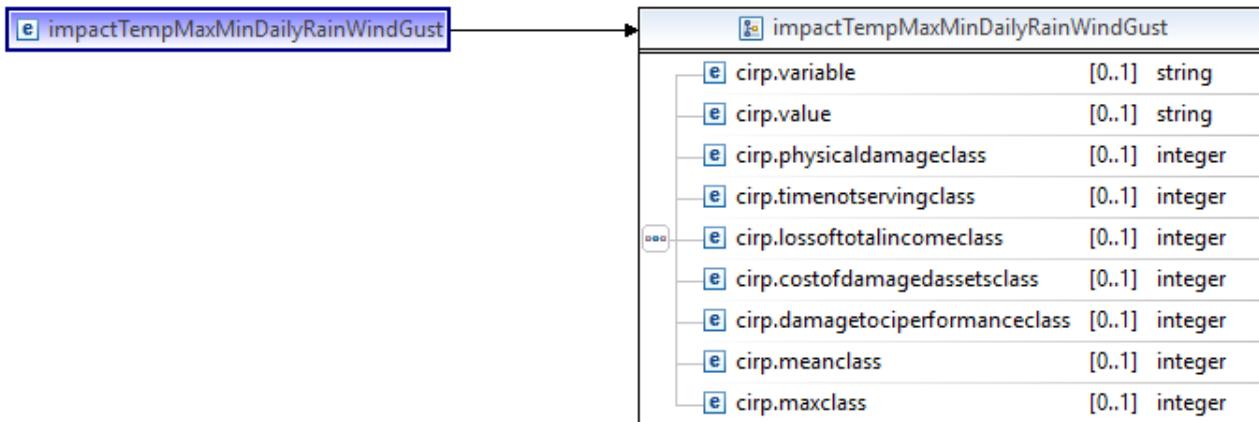
5.6 Type "mcmResidentialBuildingsV1.0"



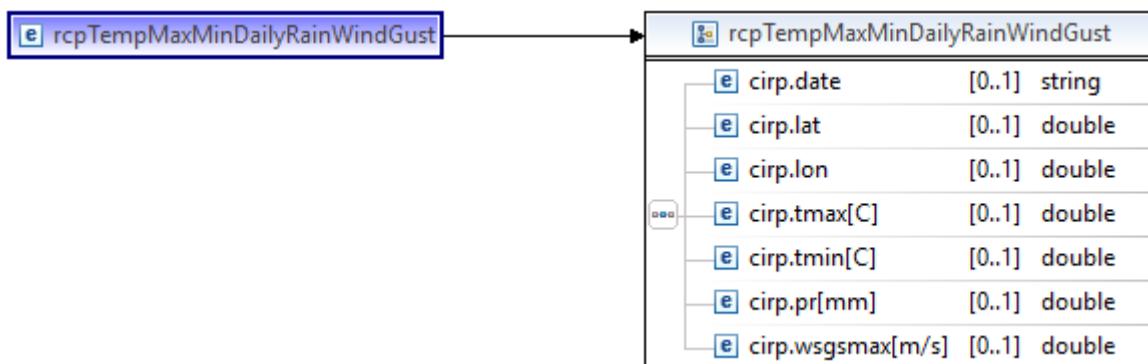
5.7 Type "mcmBuildingsFloodCost"

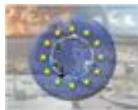


5.8 Type "impactTempMaxMinDailyRainWindGust"

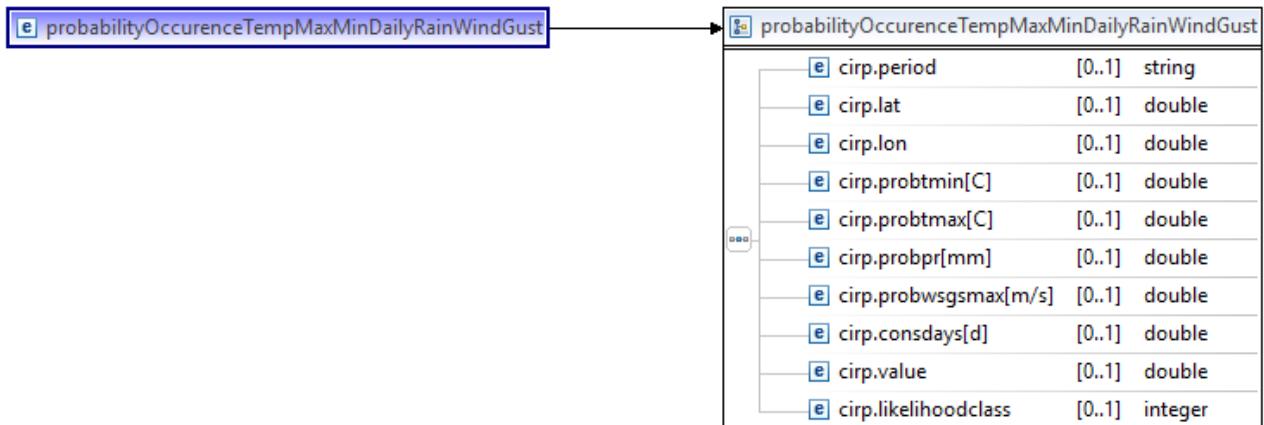


5.9 Type "rcpTempMaxMinDailyRainWindGust"

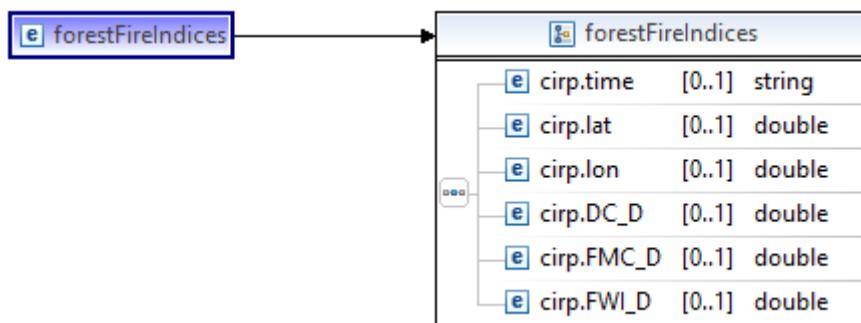




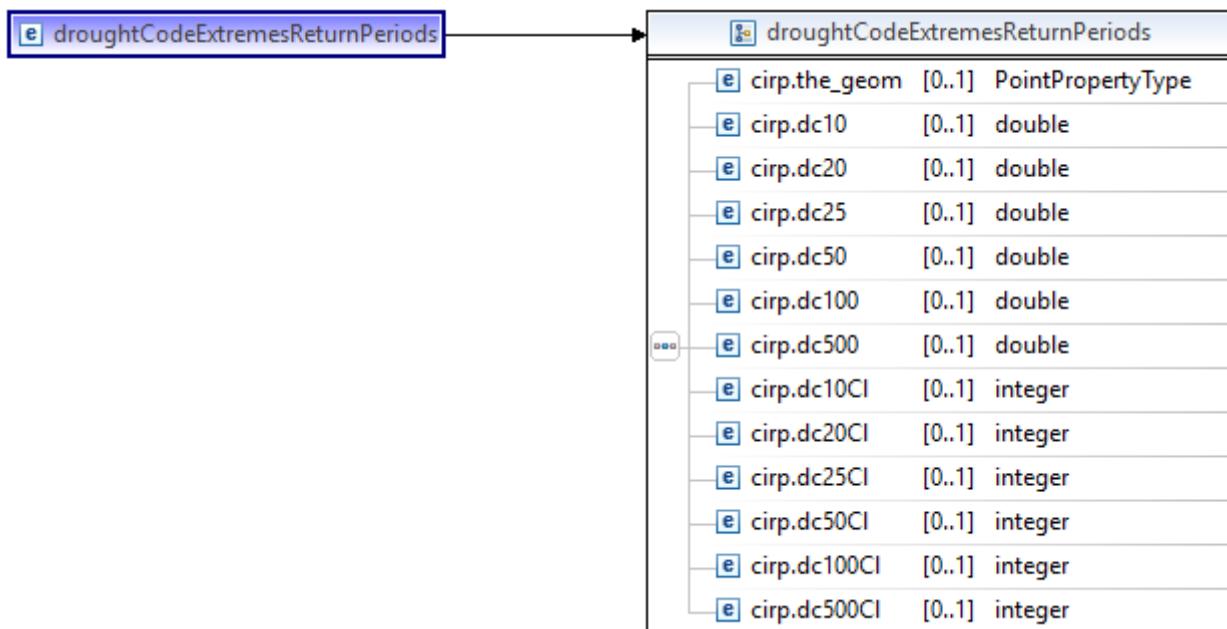
5.10 Type “probabilityOccurrenceTempMaxMinDailyRainWindGust”

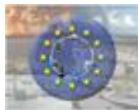


5.11 Type “forestFireIndices”

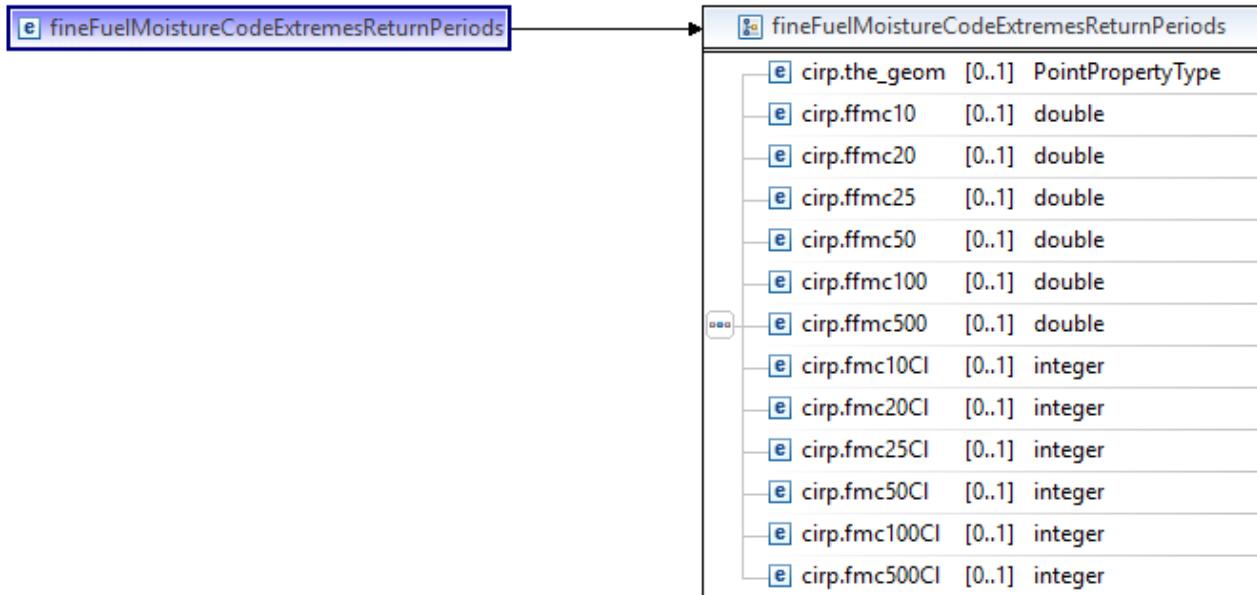


5.12 Type “droughtCodeExtremesReturnPeriods”

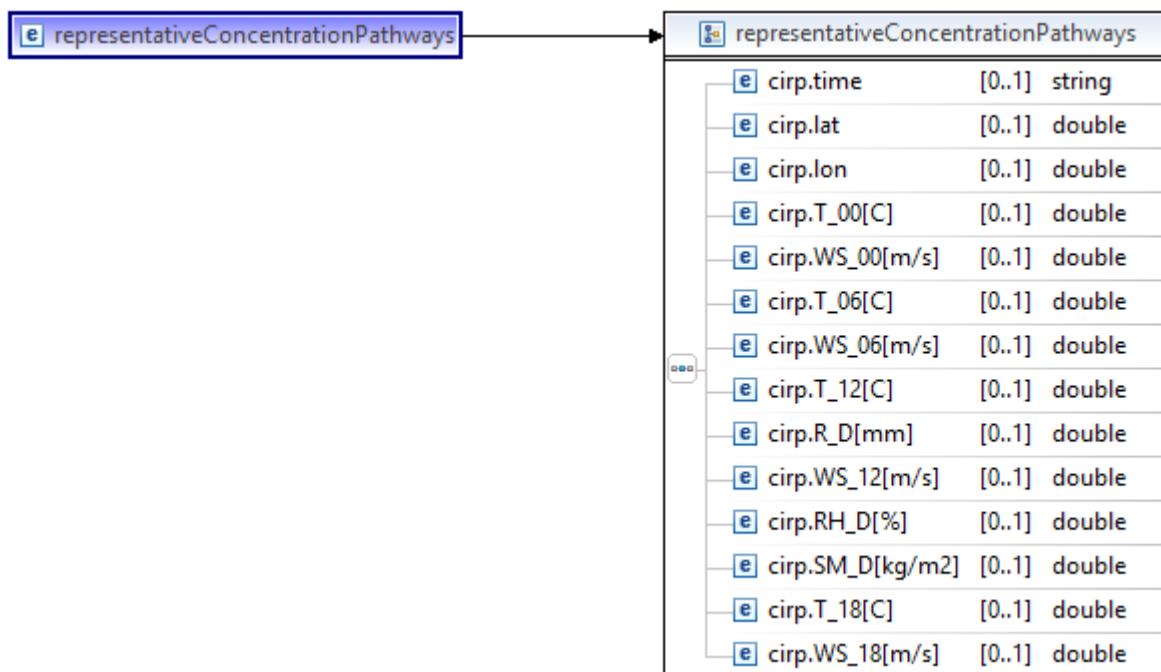




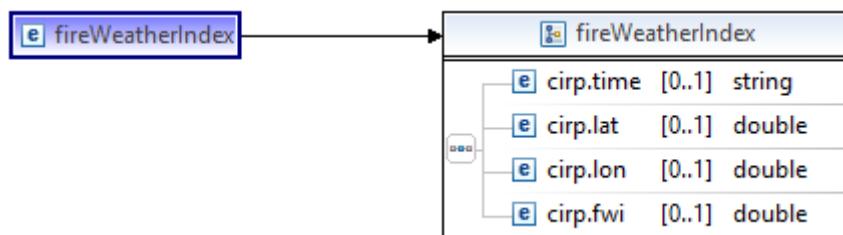
5.13 Type “fineFuelMoistureCodeExtremesReturnPeriods”



5.14 Type “representativeConcentrationPathways”

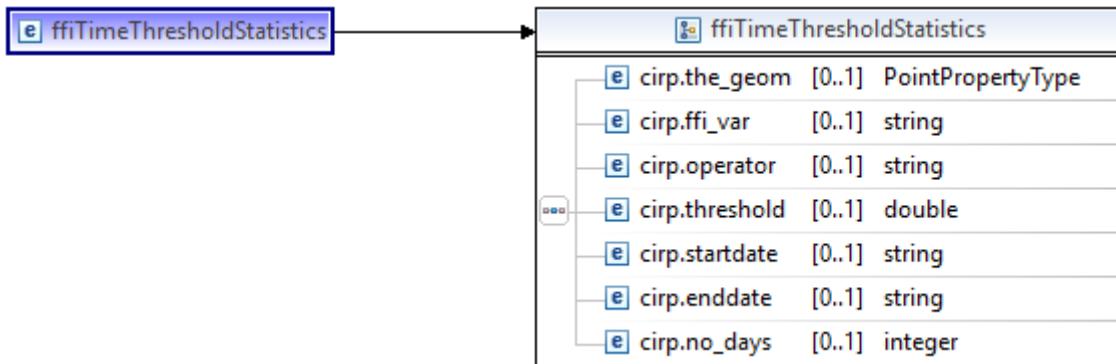


5.15 Type “fireWeatherIndex”

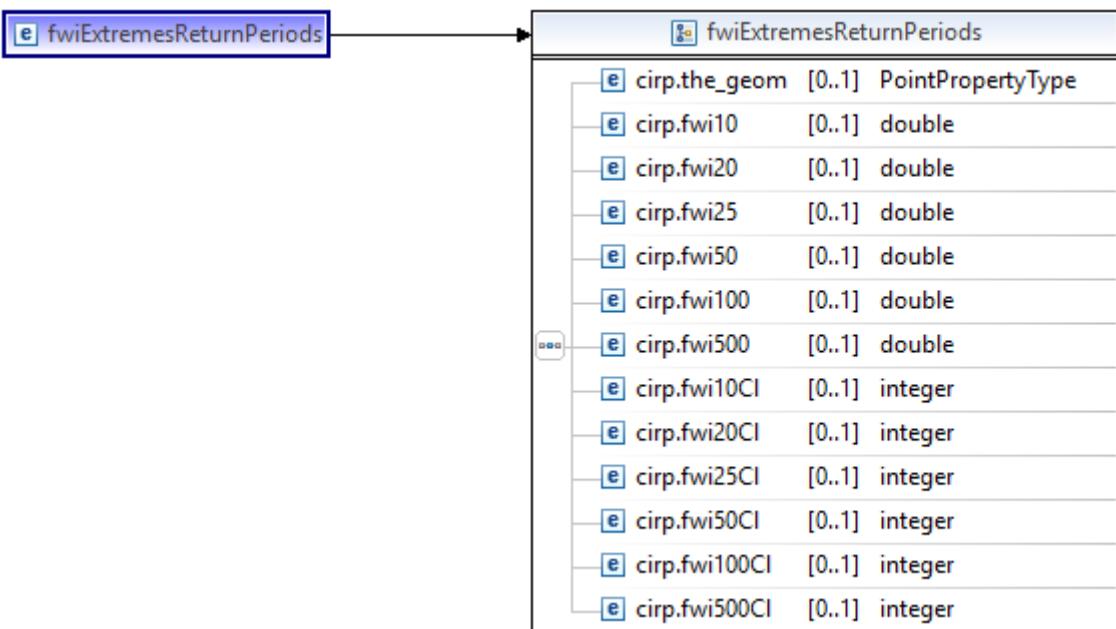




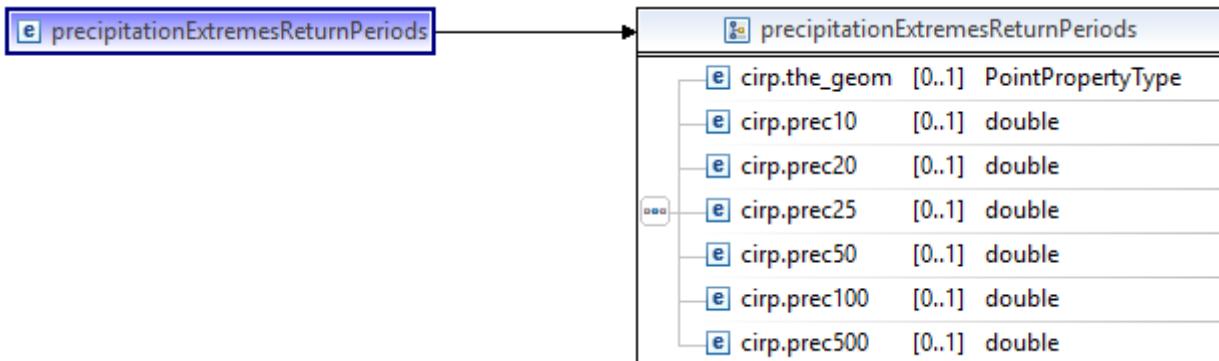
5.16 Type “ffiTimeThresholdStatistics”

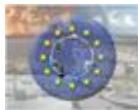


5.17 Type “fwiExtremesReturnPeriods”

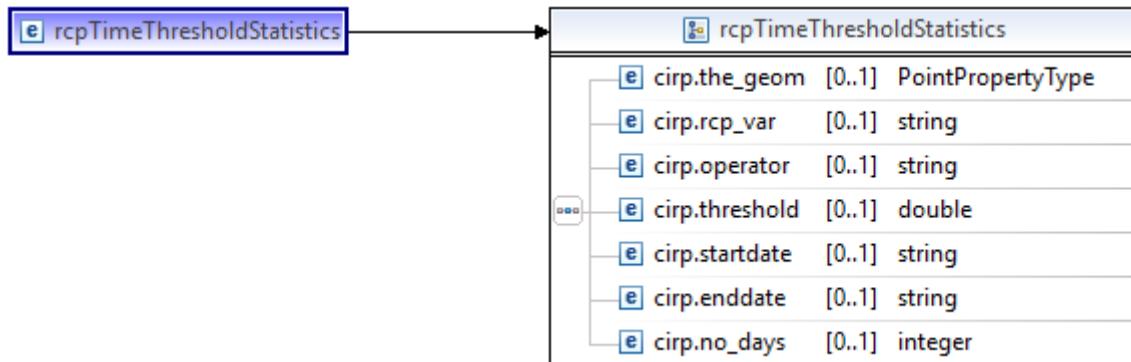


5.18 Type “precipitationExtremesReturnPeriods”

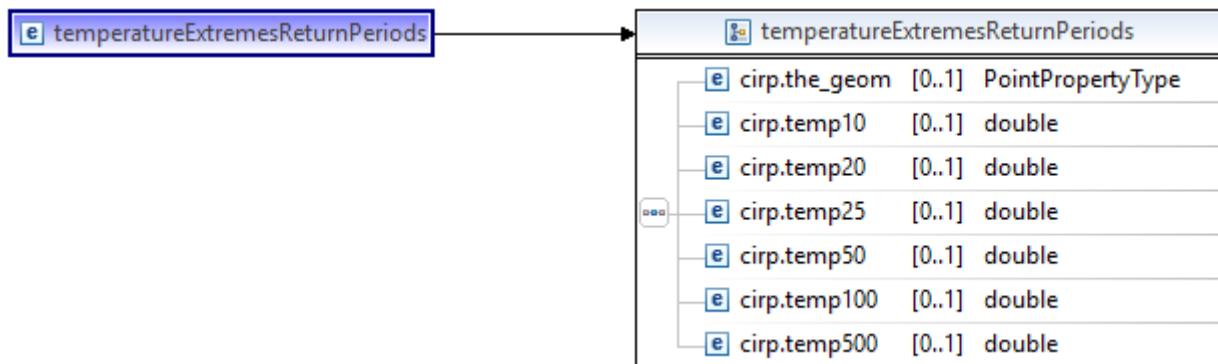




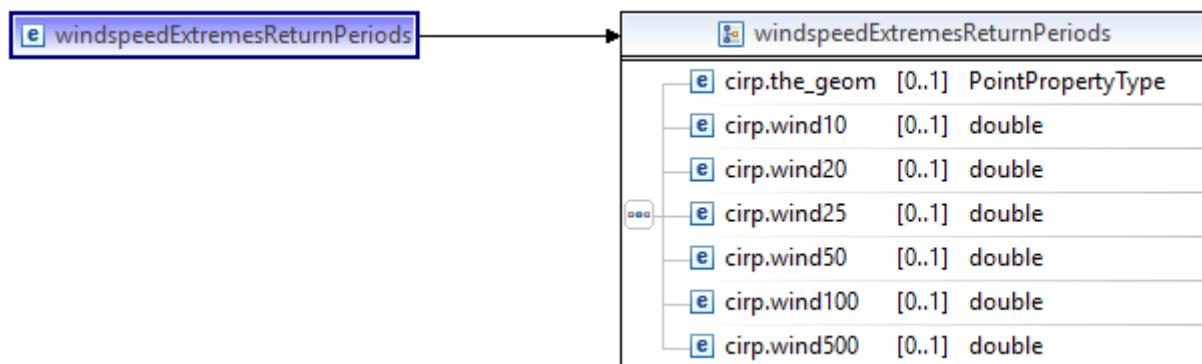
5.19 Type “rcpTimeThresholdStatistics”



5.20 Type “temperatureExtremesReturnPeriods”



5.21 Type “windspeedExtremesReturnPeriods”

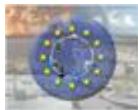


5.22 Type “powerNetworkLinksV1.0”



5.23 Type “fireSmokeV1.0”





5.24 Type “powerNetworkLinksSmokeDamaged”



5.25 Type “genericPointAssetsV1”



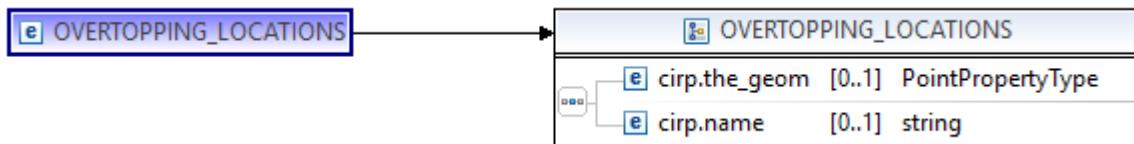
5.26 Type “voronoiThiessenPolygonsV1”



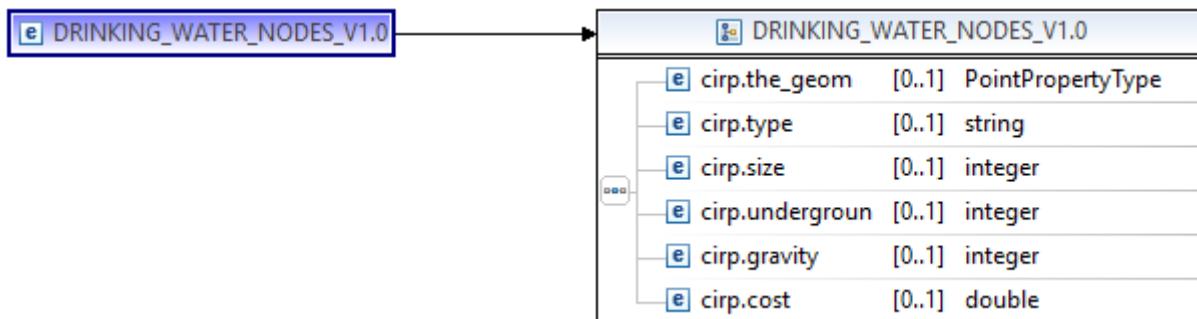
5.27 Type “overtoppingRatesDataset”



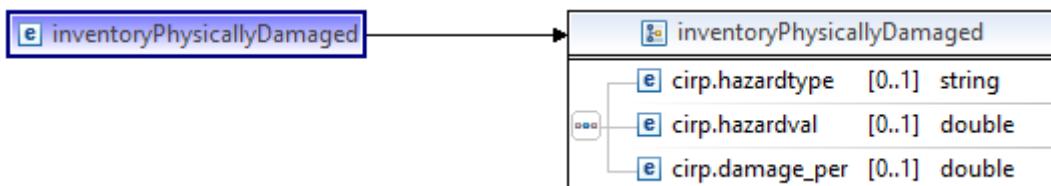
5.28 Type “overtoppingLocationsDataset”

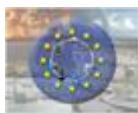


5.29 Type “drinkingWaterNodesV1.0”

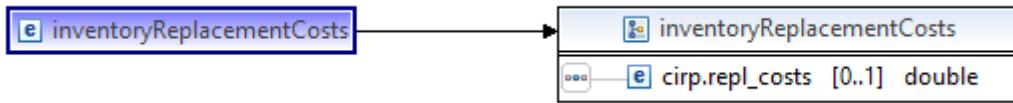


5.30 Type “inventoryPhysicallyDamaged”

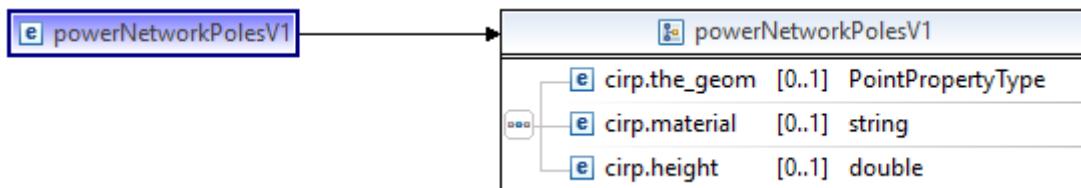




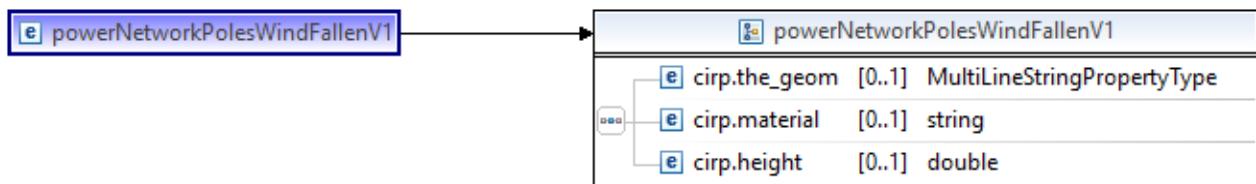
5.31 Type “inventoryReplacementCosts”



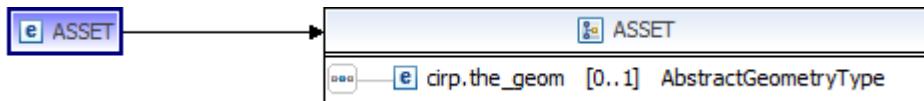
5.32 Type “powerNetworkPolesV1”



5.33 Type “powerNetworkPolesWindFallenV1”



5.34 Type “asset”



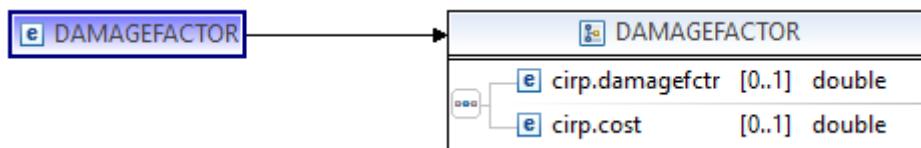
5.35 Type “fli”



5.36 Type “ros”

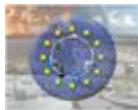


5.37 Type “damagefactor”

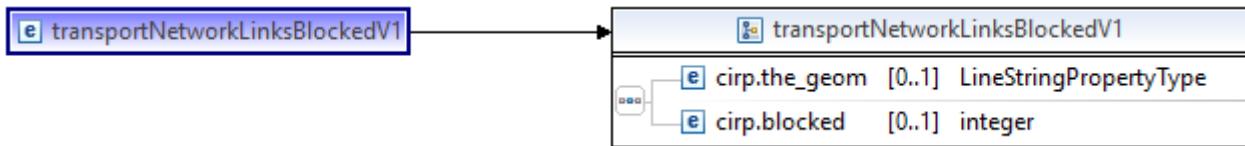


5.38 Type “transportNetworkLinksV1”

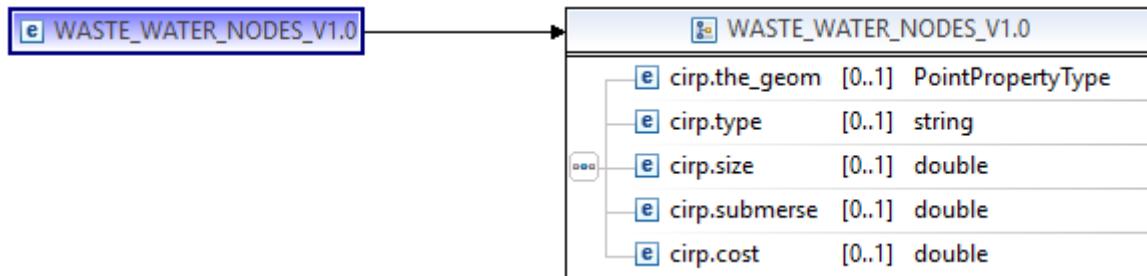




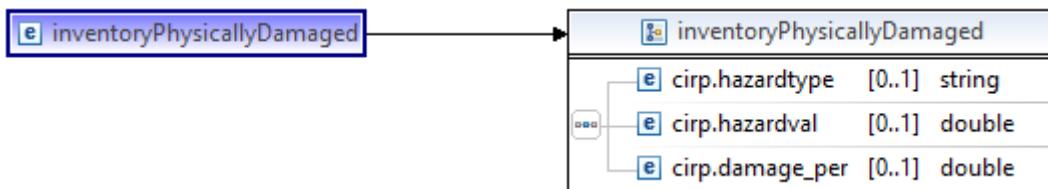
5.39 Type “transportNetworkLinksBlockedV1”



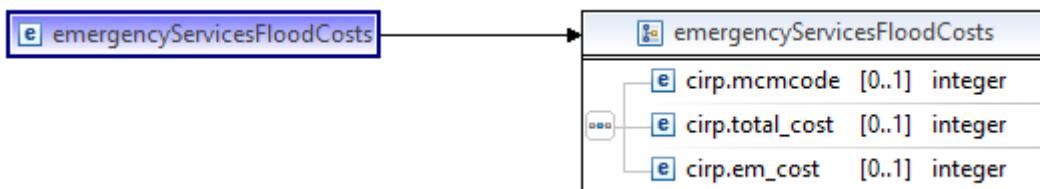
5.40 Type “wasteWaterNodesV1.0”



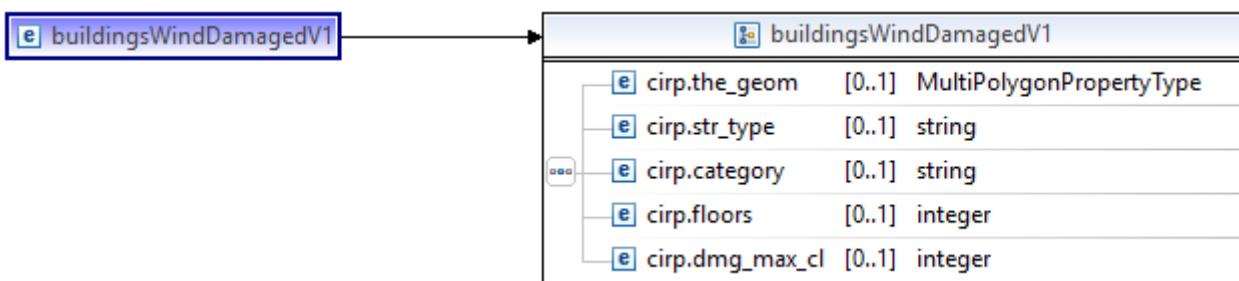
5.41 Type “inventoryFloodPhysicallyDamaged”



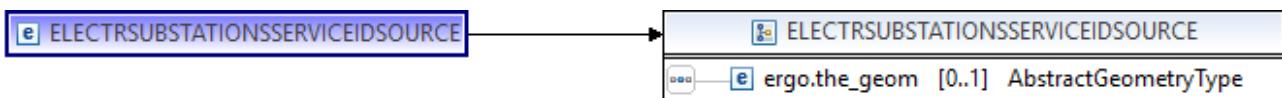
5.42 Type “emergencyServicesFloodCosts”

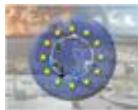


5.43 Type “buildingsWindDamagedV1”



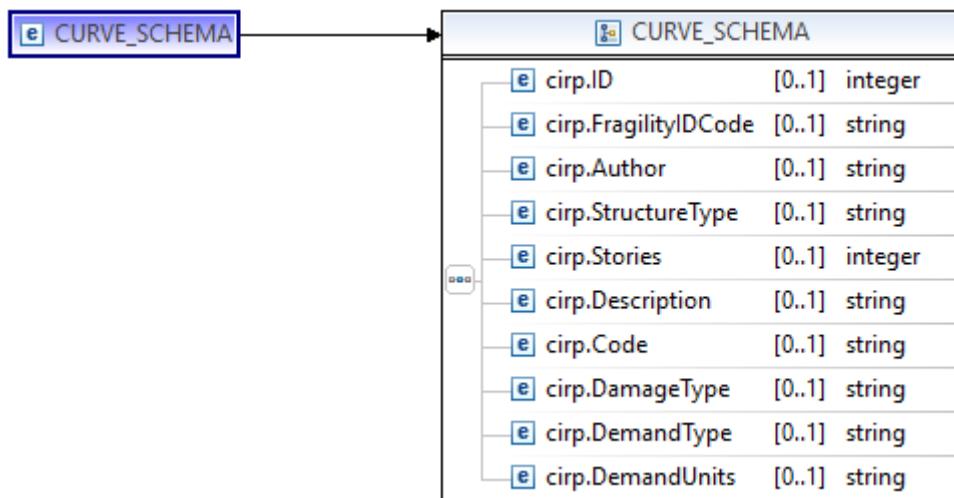
5.44 Type “electrSubstationsServiceIdSource”



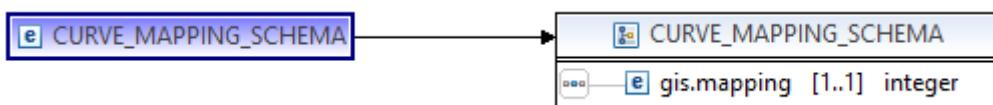


5.45 Curves Types

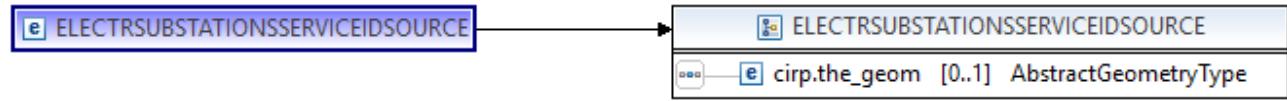
The following XSD schema defines a damage/fragility/impact curve data type.



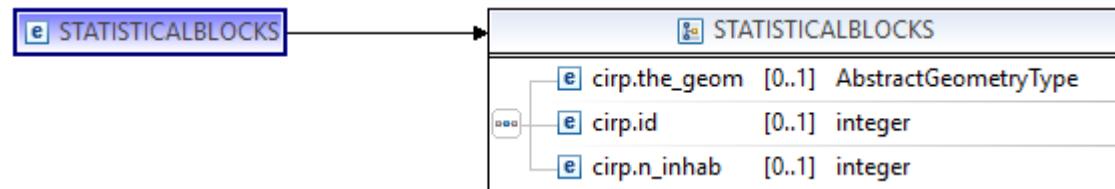
5.46 Curves Mapping Types



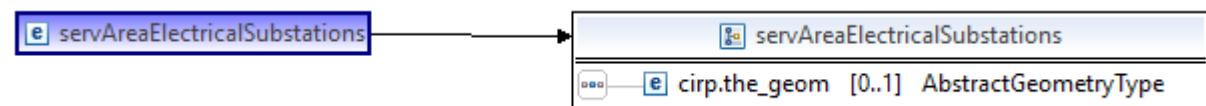
5.47 Type "electrSubstationsServiceIdSource"



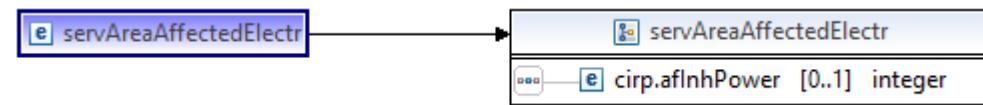
5.48 Type "statisticalBlocks"

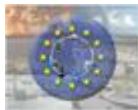


5.49 Type "servAreaElectricalSubstations"

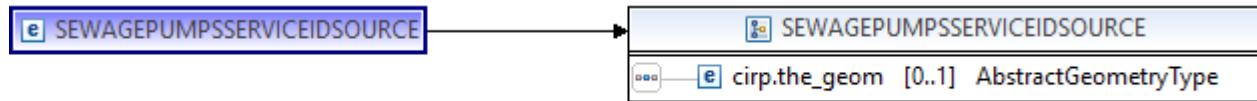


5.50 Type "servAreaAffectedElectr"





5.51 Type "sewagePumpsServiceIdSource"



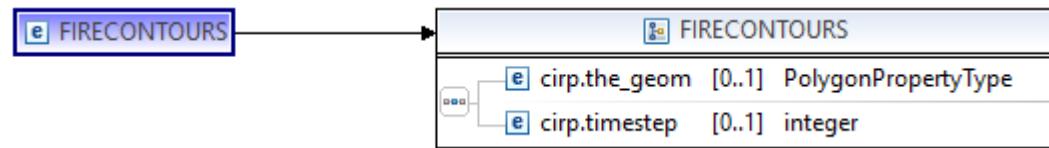
5.52 Type "servAreaSewagePumps"



5.53 Type "statisticalBlocksAffectedInundation"



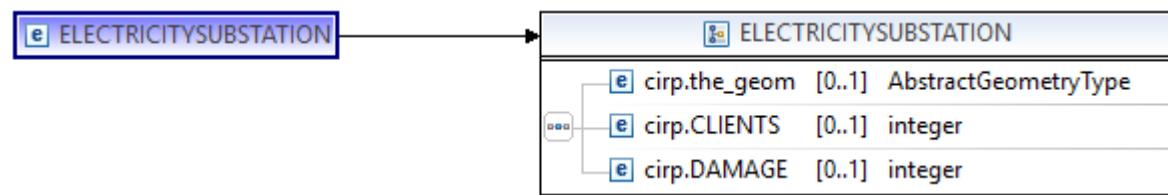
5.54 Type "firecontours"



5.55 Type "damage"



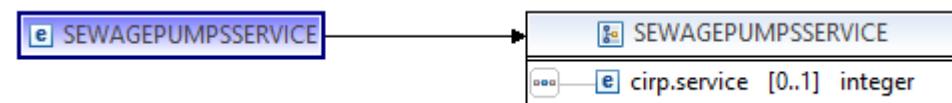
5.56 Type "electricitysubstation"

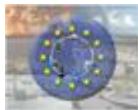


5.57 Type "dependenciesElectricalSewage"

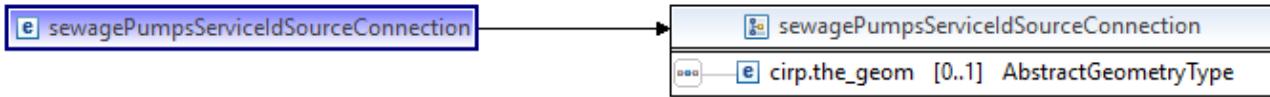


5.58 Type "sewagePumpsService"

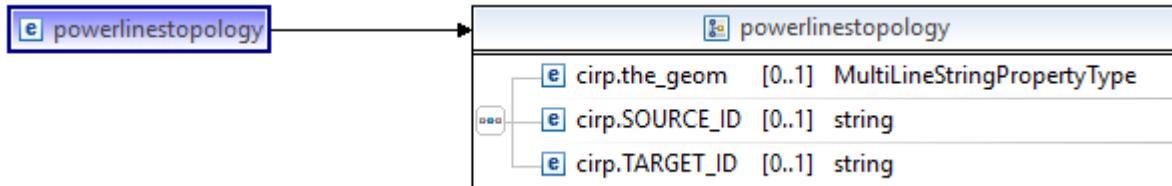




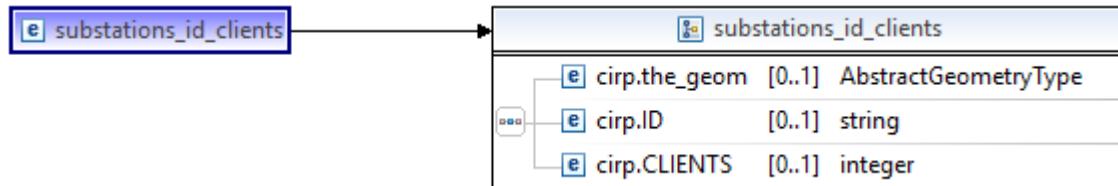
5.59 Type “sewagePumpsServiceIdSourceConnection”



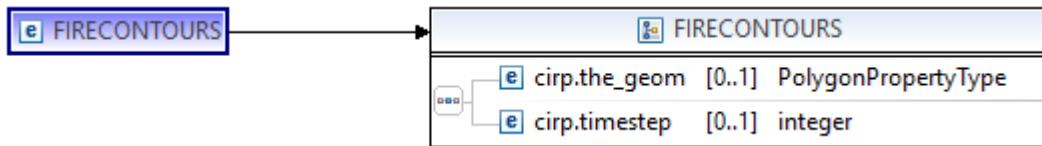
5.60 Type “powerlinestopology”



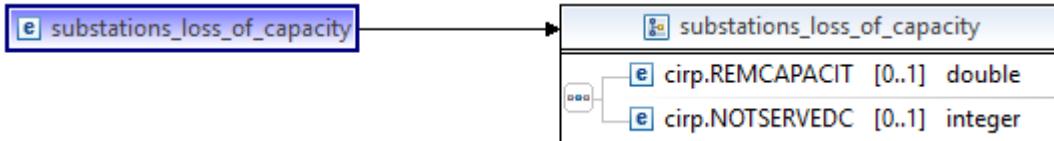
5.61 Type “substations_id_clients”



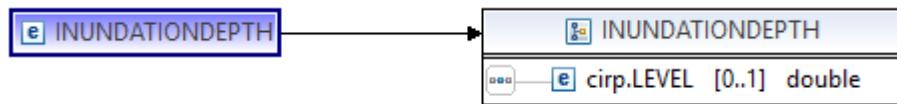
5.62 Type “firecontours”



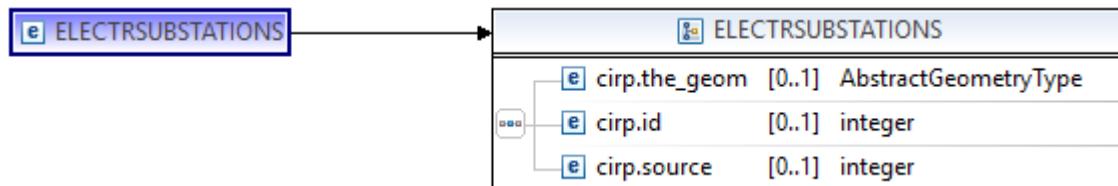
5.63 Type “substations_loss_of_capacity”

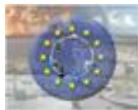


5.64 Type “inundationDepth”



5.65 Type “electrSubstations”

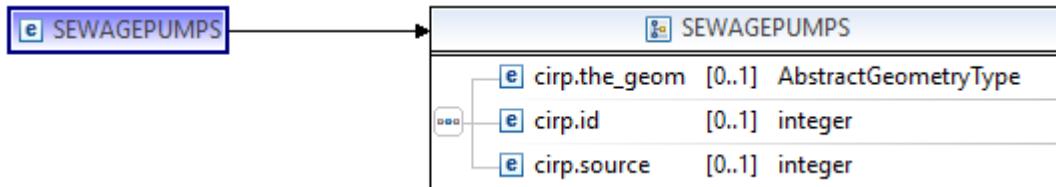




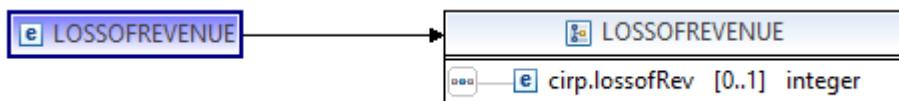
5.66 Type “electrSubstationsService”



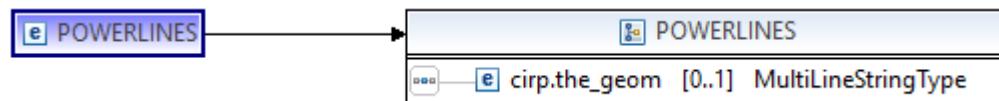
5.67 Type “sewagePumps”



5.68 Type “lossOfRevenue”



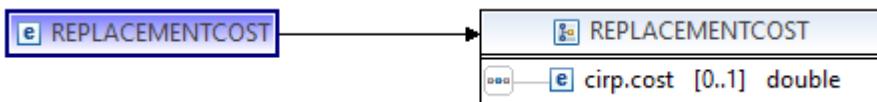
5.69 Types “powerlines”



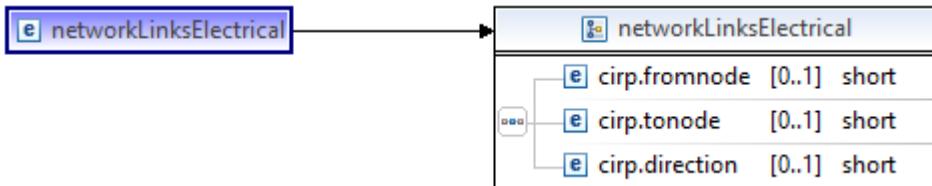
5.70 Type “EstimatedNumberAndReplacementCost”

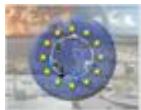


5.71 Type “ReplacementCost”

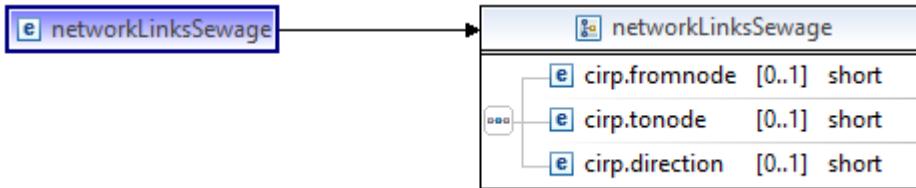


5.72 Type “networkLinksElectrical”

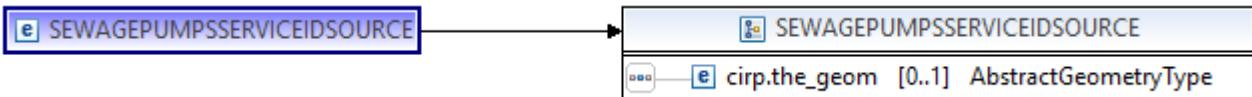




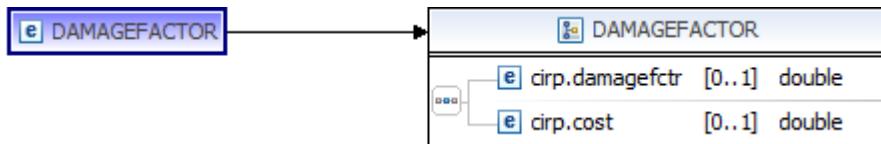
5.73 Type “networkLinksSewage”



5.74 Type “sewagePumpsServiceIdSource”



5.75 Type “damagefactor”



5.76 Type “inundationArea”



5.77 Type “statisticalBlocksAffectedInundation”



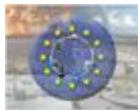




6 Conclusions

The document accompanies the CIRP Detail design and Integrated environment final software release and describes the analyses provided through the CIRP analyses toolbox and their associated datasets.

The CIRP analysis toolbox environment provides the capability to execute diverse analyses (climate, building, hazard, lifelines etc.) in a what-if scenario fashion. With the selection of model chains, climate data, and CI inventories the CIRP platform provides a user friendly environment to enable the intuitive design and analysis of modelling scenarios created for any combination of climate hazard and CI assets.



7 Bibliography

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- [2] Jeroen Admiraal, "Flood Damage to port industry. Case study: vulnerability of the port of Rotterdam to climate change", Master Thesis, 2011.
- [3] D2.3 - Tools For Processing Climate Hazards Information, EU-Circle project - 653824
- [4] D3.1 – Registry of Assets, EU-Circle project - 653824
- [5] D3.2 – Report of Climate Related Critical Event Parameters, EU-Circle project - 653824
- [6] D3.3 – Impact Assessment, EU-Circle project - 653824
- [7] D3.4 – Holistic Risk Assessment, EU-Circle project - 653824
- [8] D3.5 - Risk model metadata, EU-Circle project - 653824
- [9] D4.7 – Cost Effectiveness Analysis, EU-Circle project - 653824
- [10] D6.2 - Case Study 1 FR: Conduction, EU-Circle project - 653824
- [11] D6.8 - Case Study 4 INT: Conduction, EU-Circle project - 653824
- [12] D6.10 - Case Study 5 DE: Conduction, EU-Circle project - 653824