

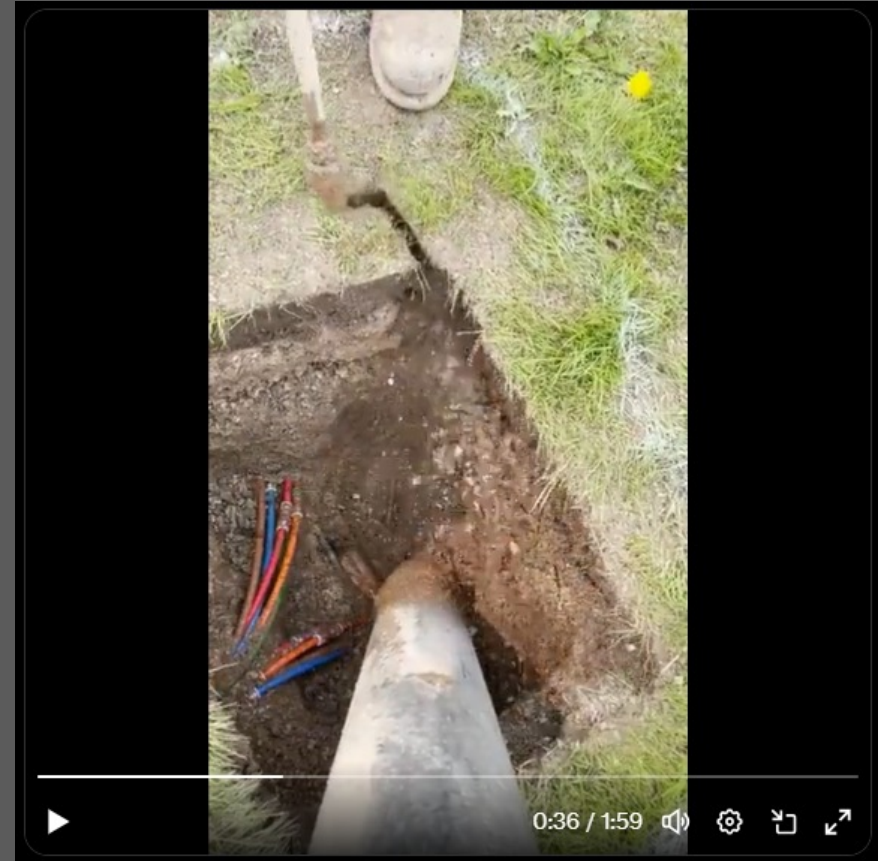
What Lies Beneath?
**Automating
Subsurface
Utility
Exploration**

What is Potholing?



- Also known as:
 - **Subsurface Utility Exploration**
 - Subsurface Utility Engineering
- Mapping **utilities** (three waters, comms, gas, etc.) at appropriate quality levels
- Historically, recording and managing subsurface data has been **widely unregulated**.

What is **Potholing**?



<https://twitter.com/Rainmaker1973/status/1659965292427071489>

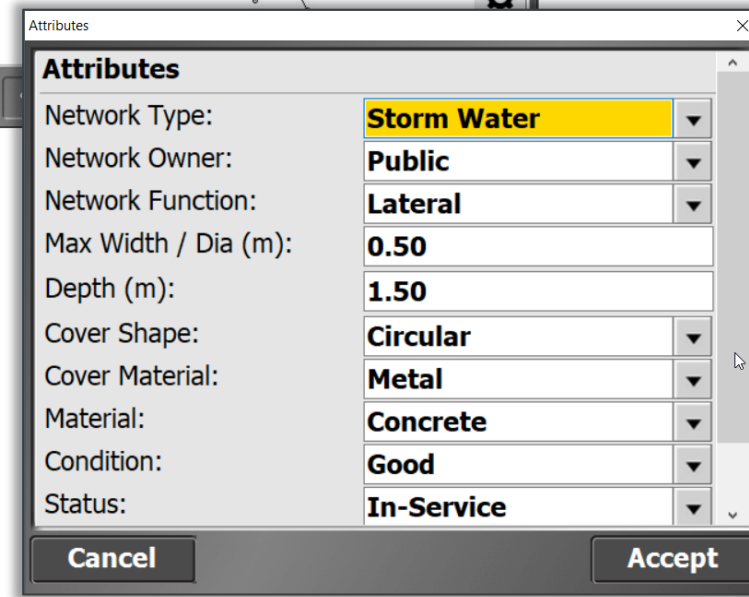
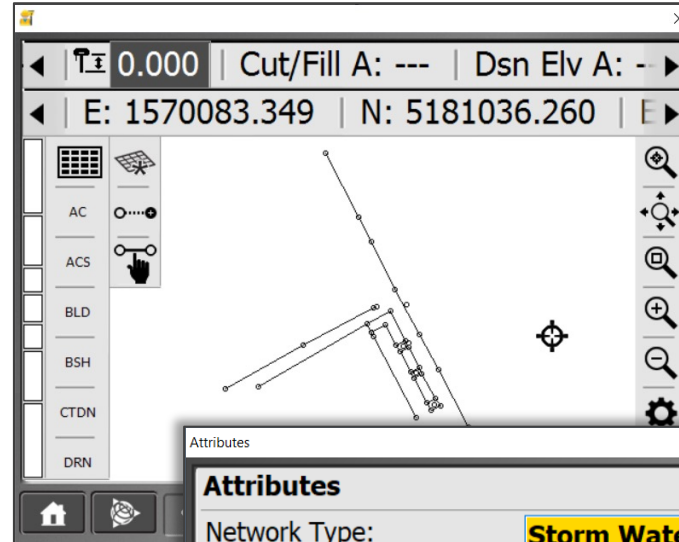
What is Potholing?



Survey Pickup



Leica



The survey data collection process is labour-intensive, manual and repetitive.

Feature:
Manhole

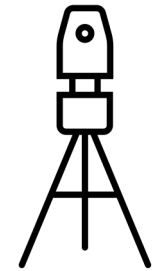
Attributes:
Quality Level A¹

Trimble

The Solution

Automate the reporting process end-to-end but **Enhanced!**

FME



Survey



abley
Enhanced Feature Capture - Generic
Import CSV/Media to Export File Geodatabase & AutoCAD Map 3D

INSTRUCTIONS
Right Click and Select Save Link As... or Open link in new tab

Only compatible FXL is the Abley Generic FXL
Right Click and Select Save Link As...

By using this Import/Export Tool, you are agreeing to Abley's Terms of Service.

Input Workorder CSV (within \Output folder)

Drop Files Here
Click To Browse

Input Media Folder ZIPPED (within \Work Order\ folder) (optional)

Drop Files Here
Click To Browse

Input FXL File (within \Project Name\ folder; next to \Designs and WorkOrders folders)

Drop Files Here
Click To Browse

Input Coordinate System

Chat



PDF

Log Sheet

.CAD

.GDB

Identify

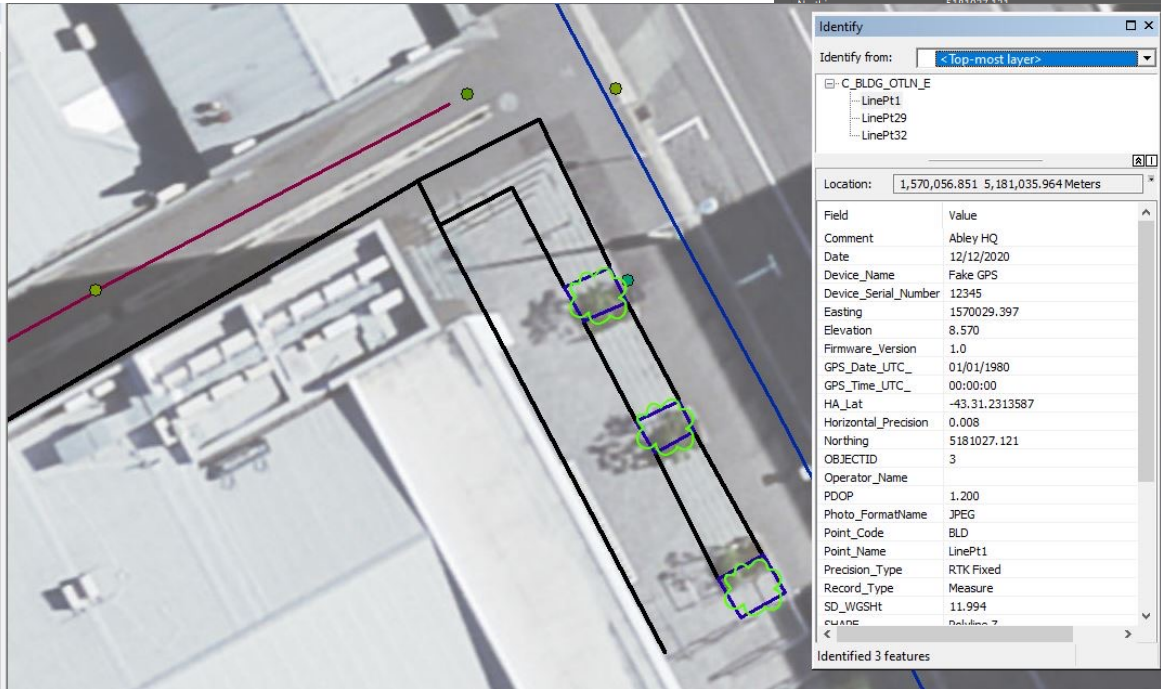
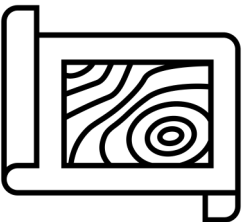
Field	Value
Comment	Abley HQ
Date	12/12/2020
Device_Name	Fake GPS
Device_Serial_Number	12345
Easting	1570256.397
Elevation	8.570
Firmware_Version	1.0
GPS_Date_UIC	01/01/1980
GPS_Time_UIC	00:00:00
HA_Lat	-40.31231587
Horizontal_Precision	0.208
Northing	518.0271.121
OBJECTID	3
Operator_Name	
POID	1.200
Photo_CommuteName	JPG
Point_Code	BLD
Point_Name	LineP15
Precision_Type	RTN Road
Record_Type	Measure
SD_WGS84	11.994
TIME	...

Digital-First

Table of Contents

- Layers
 - L_PLNT_TREE_E
 - UNCLASSIFIED_DRN_POINT_E
 - C_STRM_MHOL_E
 - C_POWR_PBOX_E
 - UNCLASSIFIED_GNRC_LINEAR_E
 - C_STRM_PIPE_LATL_E
 - C_ROAD_KERB_FLAT_E
 - C_BLDG_OTLN_E
 - Basema
 - NZ ma

.GDB



3D Polyline

General

- Color: ByLayer
- Layer: C_BLDG_OTLN_E
- Linetype: ByLayer
- Linetype scale: 1
- Plot style: ByColor
- Lineweight: ByLayer
- Transparency: ByLayer
- Hyperlink:

3D Visualization

- Material: ByLayer

Geometry

- Current Vertex: 1
- Vertex X: 1570029.4
- Vertex Y: 5181027.12
- Vertex Z: 8.57
- Length: 42.9

Misc

- Fit/Smooth: None
- Closed: No

Obj:C_BLDG_OTLN_E

- Point_Name: LinePt1

Identify

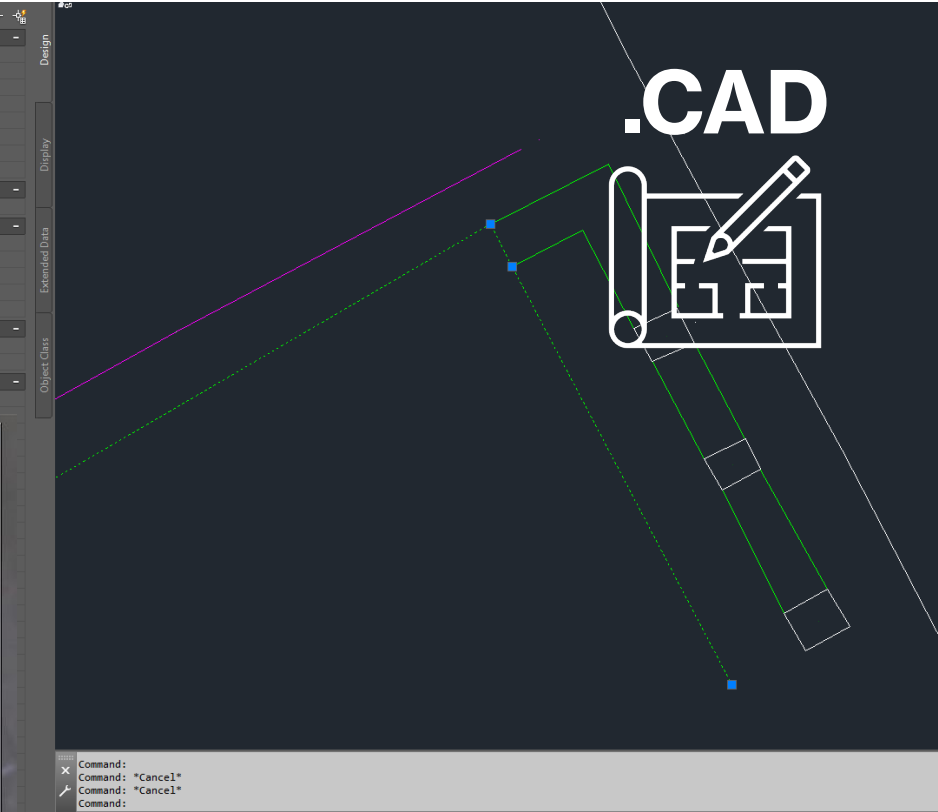
Identify from: <Top-most layer>

- C_BLDG_OTLN_E
 - LinePt1
 - LinePt29
 - LinePt32

Location: 1,570,056.851 5,181,035.964 Meters

Field	Value
Comment	Abley HQ
Date	12/12/2020
Device_Name	Fake GPS
Device_Serial_Number	12345
Easting	1570029.397
Elevation	8.570
Firmware_Version	1.0
GPS_Date_UTC_	01/01/1980
GPS_Time_UTC_	00:00:00
HA_Lat	-43.31.2313587
Horizontal_Precision	0.008
Northing	5181027.121
OBJECTID	3
Operator_Name	
PDOOP	1.200
Photo_FormatName	JPEG
Point_Code	BLD
Point_Name	LinePt1
Precision_Type	RTK Fixed
Record_Type	Measure
SD_WGS8t	11.994
Plane	Plane 7

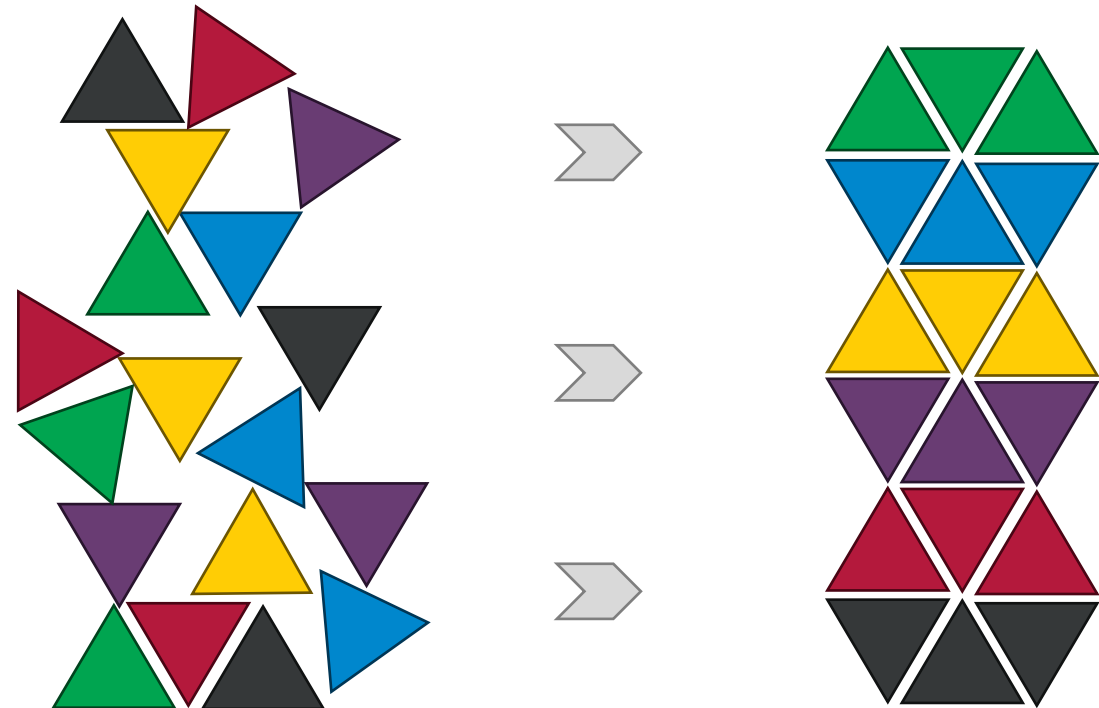
Identified 3 features



Raw, Structured Data Please

- Trimble
 - Survey Unit Schema
 - CSV Export of Data
 - Photos

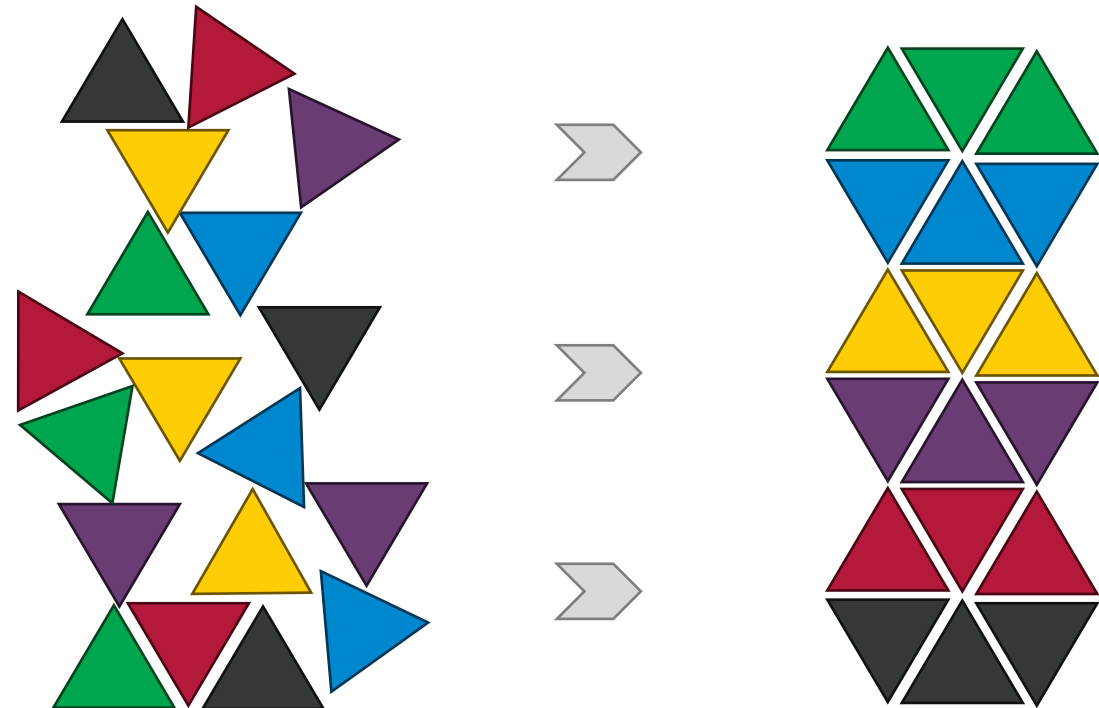
- Leica
 - CSV Export of Data
 - LandXML
 - Photos



Raw, Structured Data Please

- Trimble
 - Survey Unit Schema
 - CSV Export of Data
 - Photos

- Leica
 - CSV Export of Data
 - LandXML
 - Photos



Trimble Unit Photos

- Photos.zip



Trimble CSV Export

That's not so bad!



```
PHL-240327-MF.csv x
1 Nail-42_stk,811334.300,388877.732,26.385,LinePt1,811384.907,388818.925,26.593,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt2,811383.893,388
```

Normal text file length: 11,814 lines: 1 Ln: 1 Col: 1 Pos: 1 Windows (CR LF) UTF-8 INS

Trimble CSV Export

oh...

```

PHL-240327-MF.csv
1 Nail-42_stk,811334.300,388877.732,26.385,LinePt1,811384.907,388818.925,26.593,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt2,811383.893,
388818.098,26.501,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt3,811382.835,388817.230,26.388,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgL
inePt4,811383.039,388816.950,26.386,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt5,811384.051,388817.790,26.465,PTHL,T13,0.95,No,0,0,,PH
L-240327-MF-0.jpgLinePt6,811385.107,388818.642,26.591,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt7,811383.798,388816.076,26.388,PHREF,
T13,KRB,Back of Kerb (KRB),,PHL-240327-MF-1.jpgLinePt8,811382.227,388817.965,26.380,PHREF,T13,KRB,Back of Kerb
(KRB),,PHL-240327-MF-1.jpgLinePt9,811384.718,388818.680,26.292,PIPE,Water Supply,CCC,Sub Main,0.06,Top,1,1,Red,Asbestos,Good,Not
In-Service,,PHL-240327-MF-2.jpgLinePt10,811384.855,388818.566,26.291,PIPE,Water Supply,CCC,Sub Main,0.06,Top,1,1,Red,Asbestos,Good,Not
In-Service,,PHL-240327-MF-2.jpgLinePt11,811384.350,388818.367,26.128,CABLE,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-3.jpgLinePt12,811384.440,388818.213,26.119,CABLE,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-3.jpgLinePt13,811384.019,388818.132,25.907,CABLE1,Communications,Chorus,Co
mms
Trunk,0.04,Top,Yes,1,1,Black,Armor,Fair,In-Service,,PHL-240327-MF-4.jpgLinePt14,811384.125,388817.971,25.901,CABLE1,Communications,Chorus,
Comms
Trunk,0.04,Top,Yes,1,1,Black,Armor,Fair,In-Service,,PHL-240327-MF-4.jpgLinePt15,811383.632,388817.797,25.637,CABLE2,Power,Orion,Unknown,0.
07,Top,Yes,1,1,Orange,PVC,Good,Unknown,,PHL-240327-MF-5.jpgLinePt16,811383.758,388817.666,25.641,CABLE2,Power,Orion,Unknown,0.07,Top,Yes,1
,1,Orange,PVC,Good,Unknown,,PHL-240327-MF-5.jpgLinePt20,811365.009,388838.765,26.395,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt18,811
383.487,388817.677,25.782,CABLE3,Power,Orion,Unknown,0.07,Top,Yes,1,2,Orange,PVC,Good,Unknown,,PHL-240327-MF-6.jpgLinePt19,811383.613,3888
17.534,25.791,CABLE3,Power,Orion,Unknown,0.07,Top,Yes,1,2,Orange,PVC,Good,Unknown,,PHL-240327-MF-6.jpgLinePt21,811365.193,388838.565,26.39
9,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt22,811366.350,388839.464,26.466,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt23,811367.
452,388840.337,26.519,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt24,811367.245,388840.645,26.561,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7
.jpgLinePt25,811365.921,388839.595,26.475,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt26,811364.460,388839.393,26.405,PHREF1,T14,KRB,Ba
ck of Kerb (KRB)LinePt27,811366.201,388837.271,26.405,PHREF1,T14,KRB,Back of Kerb (KRB)LinePt28,811367.066,388840.358,26.041,PIPE1,Water
Supply,CCC,Sub Main,0.06,Top,1,1,Grey,Asbestos,Fair,Unknown,,PHL-240327-MF-8.jpgLinePt29,811367.183,388840.222,26.046,PIPE1,Water
Supply,CCC,Sub
Main,0.06,Top,1,1,Grey,Asbestos,Fair,Unknown,,PHL-240327-MF-8.jpgLinePt30,811366.570,388839.967,25.905,CABLE4,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-9.jpgLinePt31,811366.709,388839.837,25.916,CABLE4,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-9.jpgLinePt32,811366.502,388839.909,25.539,CABLE5,Communications,Enable.Co

```

Normal text file length: 11,814 lines: 1 Ln: 1 Col: 1 Pos: 1 Windows (CR LF) UTF-8 INS

Trimble CSV Export

Whew!

StringReplacer

▶ Output

Nail-*

LinePt*

```

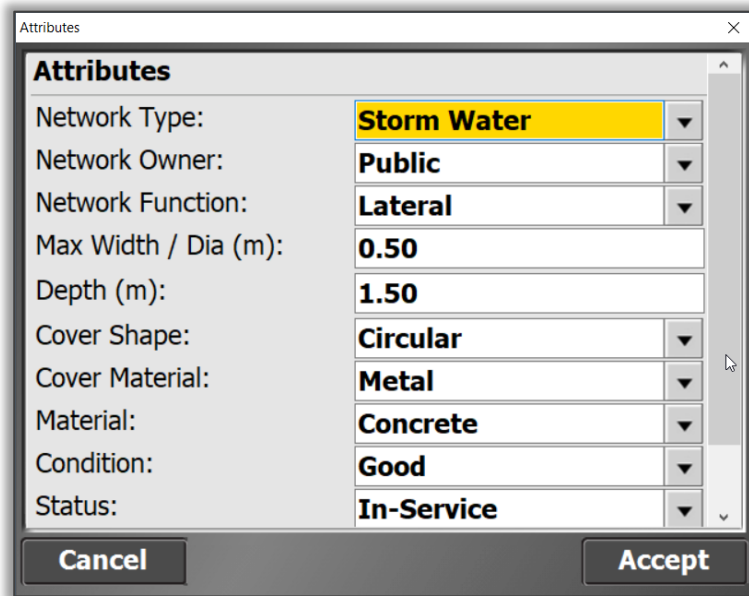
PHL-240327-MF.csv
1 Nail-42 stk,811334.300,388877.732,26.385,LinePt1,811384.907,388818.925,26.593,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt2,811383.893,
388818.098,26.501,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt3,811382.835,388817.230,26.388,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgL
inePt4,811383.039,388816.950,26.386,PTHL,T13,0.95,No,0,0,,PHL-240327-MF-0.jpgLinePt5,811384.051,388817.790,26.465,PTHL,T13,0.95,No,0,0,,PH
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T13,KRB,Back of Kerb (KRB),,PHL-240327-MF-1.jpgLinePt8,811382.227,388817.965,26.380,PHREF,T13,KRB,Back of Kerb
(KRB),,PHL-240327-MF-1.jpgLinePt9,811384.718,388818.680,26.292,PIPE,Water Supply,CCC,Sub Main,0.06,Top,1,1,Red,Asbestos,Good,Not
In-Service,,PHL-240327-MF-2.jpgLinePt10,811384.855,388818.566,26.291,PIPE,Water Supply,CCC,Sub Main,0.06,Top,1,1,Red,Asbestos,Good,Not
In-Service,,PHL-240327-MF-2.jpgLinePt11,811384.350,388818.367,26.128,CABLE,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-3.jpgLinePt12,811384.440,388818.213,26.119,CABLE,Power,Orion,Low
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mms
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Comms
Trunk,0.04,Top,Yes,1,1,Black,Armor,Fair,In-Service,,PHL-240327-MF-4.jpgLinePt15,811383.632,388817.797,25.637,CABLE2,Power,Orion,Unknown,0.
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,1,Orange,PVC,Good,Unknown,,PHL-240327-MF-5.jpgLinePt20,811365.009,388838.765,26.395,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt18,811
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.jpgLinePt25,811365.921,388839.595,26.475,PTHL1,T14,1.1,No,0,0,,PHL-240327-MF-7.jpgLinePt26,811364.460,388839.393,26.405,PHREF1,T14,KRB,Ba
ck of Kerb (KRB)LinePt27,811366.201,388837.271,26.405,PHREF1,T14,KRB,Back of Kerb (KRB)LinePt28,811367.066,388840.358,26.041,PIPE1,Water
Supply,CCC,Sub Main,0.06,Top,1,1,Grey,Asbestos,Fair,Unknown,,PHL-240327-MF-8.jpgLinePt29,811367.183,388840.222,26.046,PIPE1,Water
Supply,CCC,Sub
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Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-9.jpgLinePt31,811366.709,388839.837,25.916,CABLE4,Power,Orion,Low
Voltage,0.02,Top,No,1,1,Black,Armor,Good,Unknown,,PHL-240327-MF-9.jpgLinePt32,811366.502,388839.909,25.539,CABLE5,Communications,Enable.Co

```

Normal text file length: 11,814 lines: 1 Ln: 1 Col: 1 Pos: 1 Windows (CR LF) UTF-8 INS

Trimble Unit Schema

- FXL File
 - XML-Based



Attributes	
Network Type:	Storm Water
Network Owner:	Public
Network Function:	Lateral
Max Width / Dia (m):	0.50
Depth (m):	1.50
Cover Shape:	Circular
Cover Material:	Metal
Material:	Concrete
Condition:	Good
Status:	In-Service

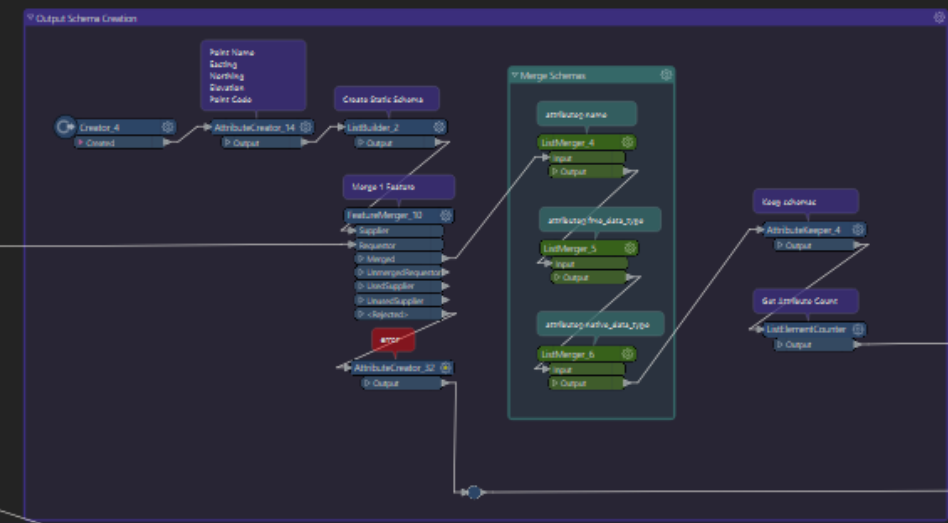
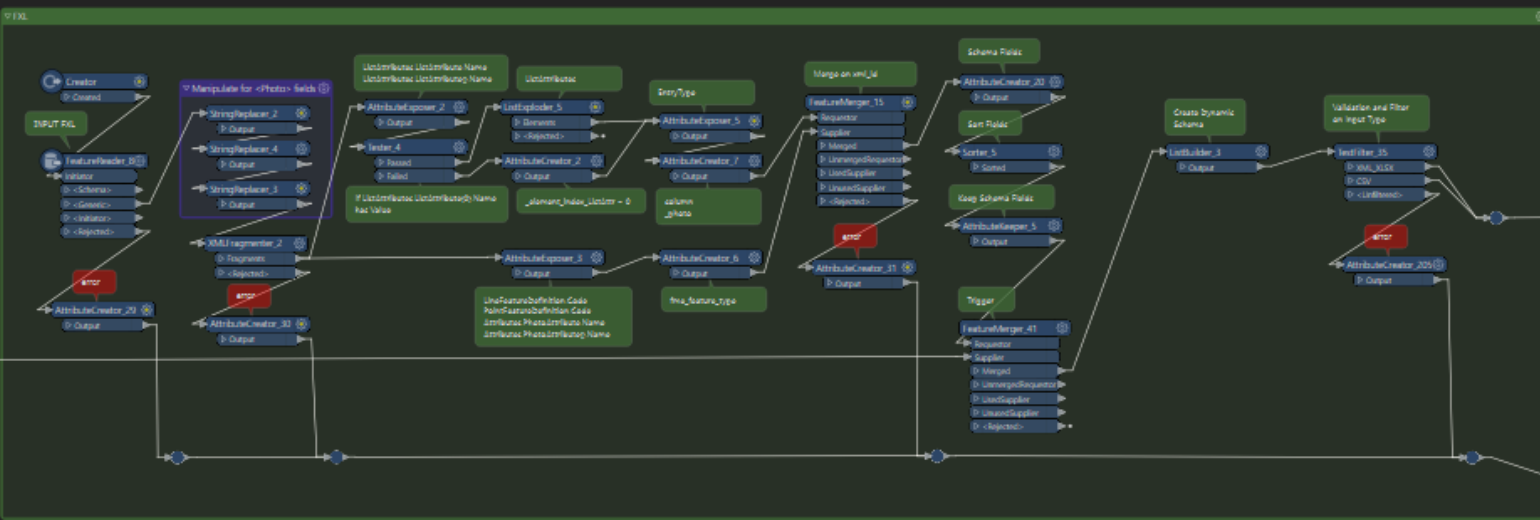
Unit Interface

```

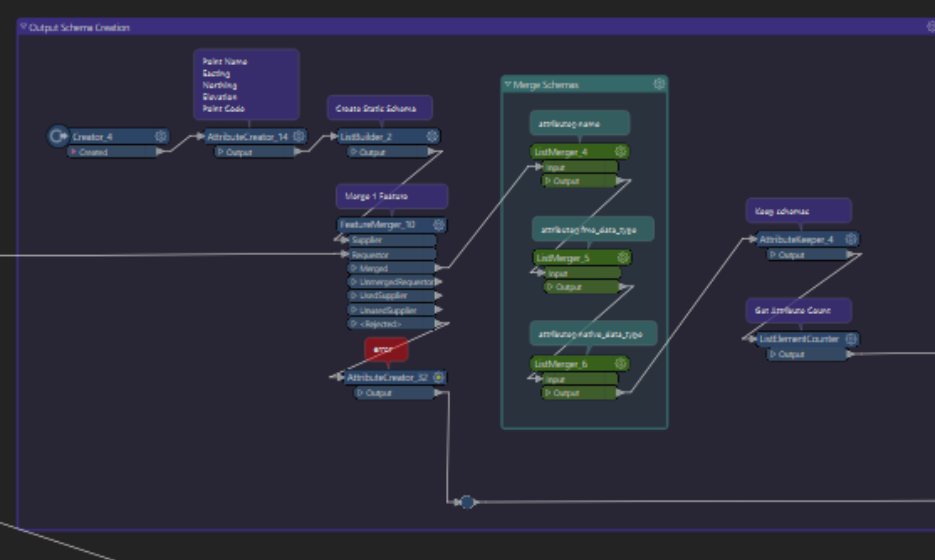
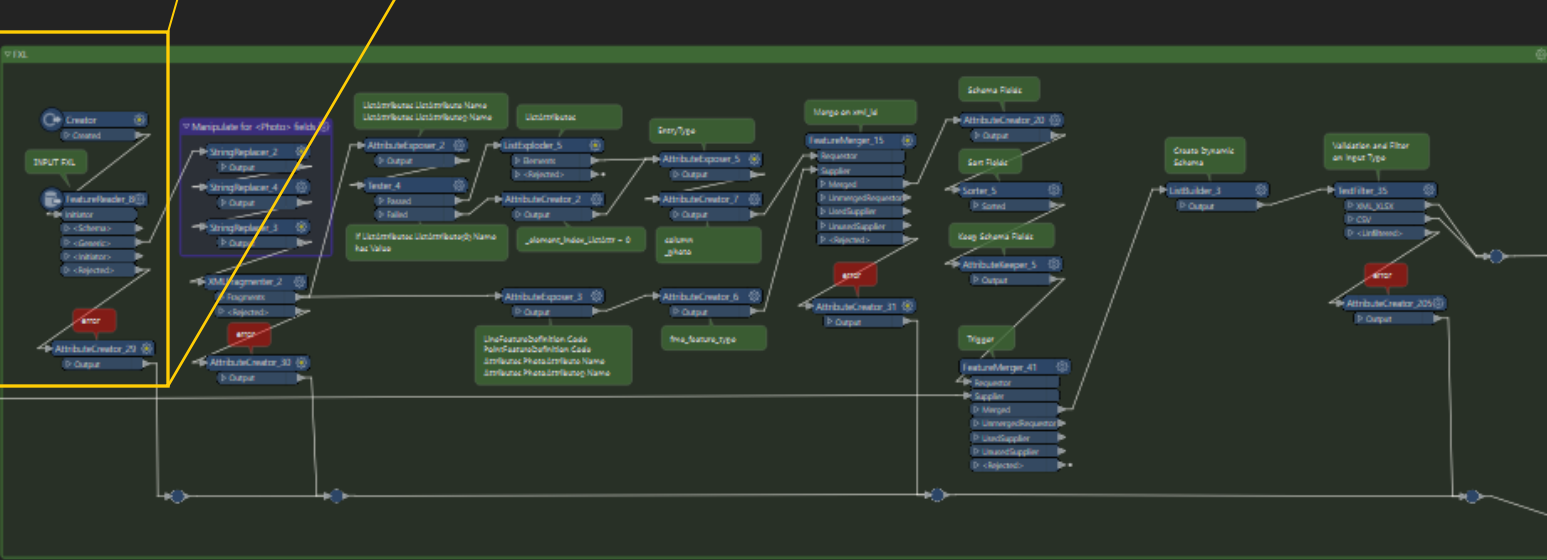
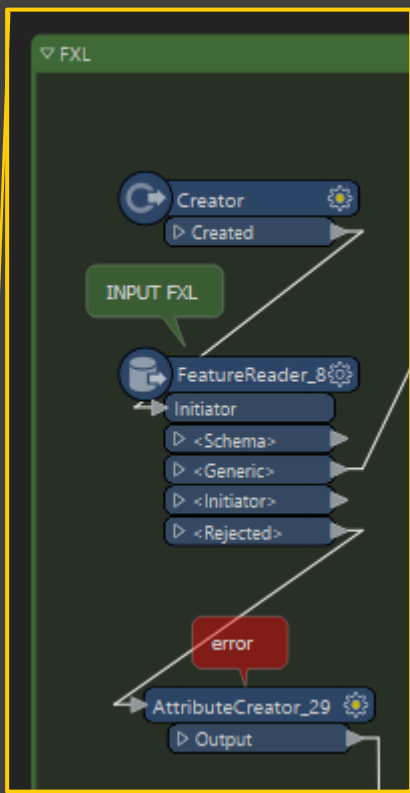
<FeatureDefinitions>
<LineFeatureDefinition Code="CABLE" Name="Cable / Duct" Category="Potholing Linear" IncludeInSurface="false" Color="FF00FF00"
Layer="SURV_SCS_UTILITIES_E" FieldLineStyle="Solid" LineStyleName="Solid" LineStyleScale="1" LineLabelStyle="Standard"
PointLabelStyle="Standard" PointLayer="0">
<Attributes>
<ListAttribute Name="Network Type" Description="Type of Utility Network" EntryMethod="Required" IsLabelVisible="true">
<ListItems>
<Item>Communications</Item>
<Item>Power</Item>
<Item>Other</Item>
<Item>Unknown</Item>
</ListItems>
</ListAttribute>
<ListAttribute Name="Network Owner" Description="Network Owner" EntryMethod="Required" IsLabelVisible="true">
<ListItems>
<Item>CCC</Item>
<Item>Orion</Item>
<Item>Chorus</Item>
<Item>One NZ</Item>
<Item>Enable</Item>
<Item>MainPower</Item>
<Item>Other</Item>
<Item>Unknown</Item>
</ListItems>
</ListAttribute>
<ListAttribute Name="Network Function" Description="Functional type or class" EntryMethod="Required" IsLabelVisible="true">
<ListItems>
<Item>Main</Item>
<Item>Sub Main</Item>
<Item>Lateral</Item>
<Item>High Voltage</Item>
<Item>Low Voltage</Item>
<Item>Comms Trunk</Item>
<Item>Comms Local</Item>
<Item>Traffic Signals</Item>
<Item>Other</Item>
<Item>Unknown</Item>
</ListItems>
</ListAttribute>

```

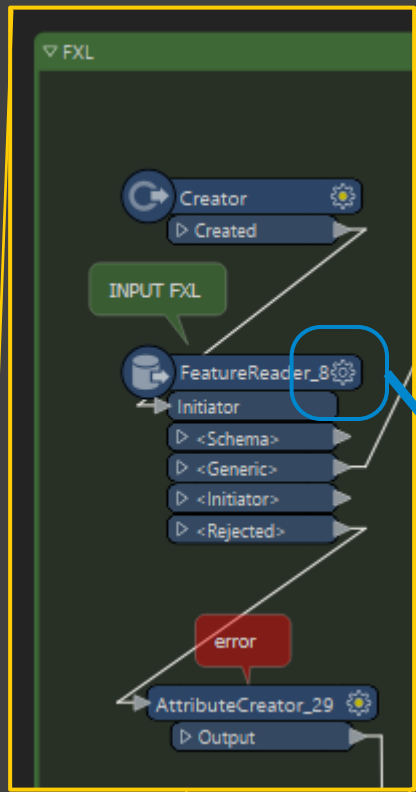
Dynamic Schema Creation



Dynamic Schema Creation



Dynamic Schema Creation



FeatureReader Parameters

Transformer Name:

Reading

Reader

Format:

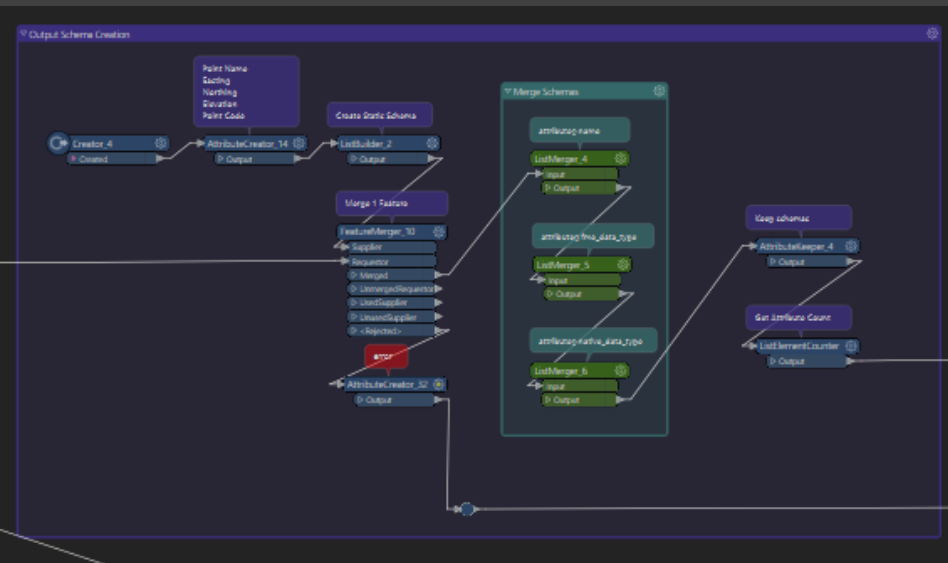
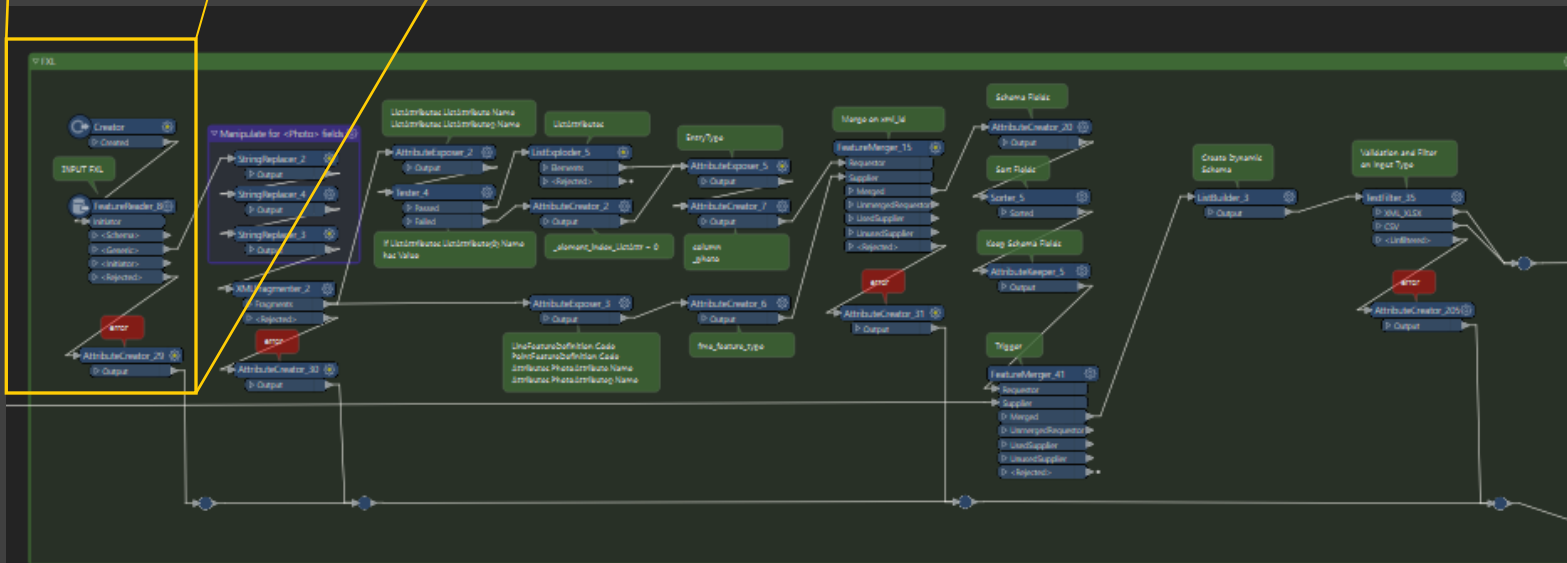
Dataset:

Parameters...

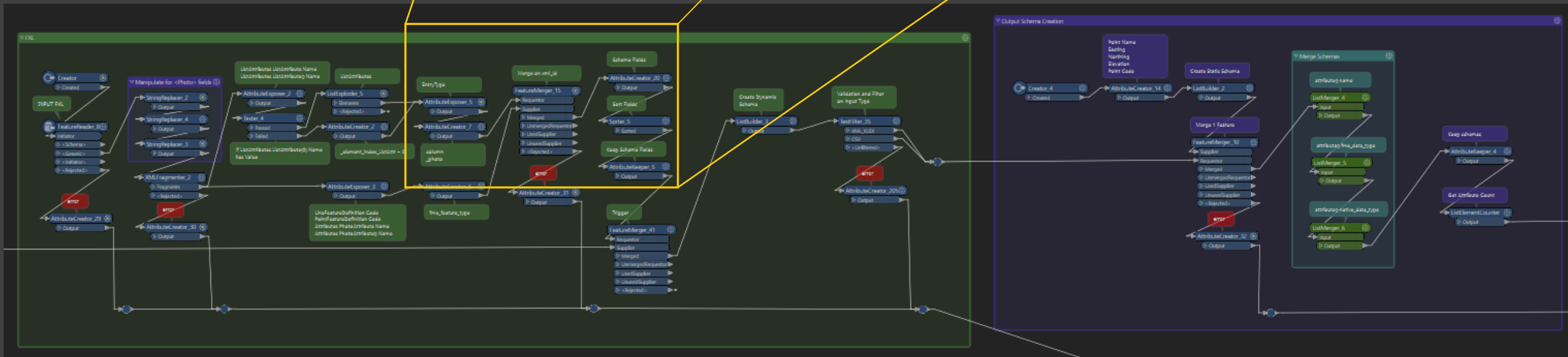
Coord. System:

Constraints

- Text Reader for XML File
- Dynamic Input



Dynamic Schema Creation



Dynamic Schema Creation

AttributeCreator Parameters

Transformer Name: AttributeCreator_7

Advanced: Attribute Value Handling

Attributes To Create

New Attribute	Value
column	2 Possible Values

Conditional Value Definition

Condition Statement

Test	Value
If Name ATTRIBUTE_HAS_A_VALUE	Name
Else If	
Else <All Other Conditions>	ListAttributes.ListAttribute.Name

XML Field Names

Value

- Name
- ListAttributes.ListAttribute.Name

Help OK Cancel



AttributeCreator Parameters

Transformer Name: AttributeCreator_20

Advanced: Attribute Value Handling

Attributes To Create

New Attribute	Value
fme_data_type	2 Possible Values
name	column
native_data_type	string

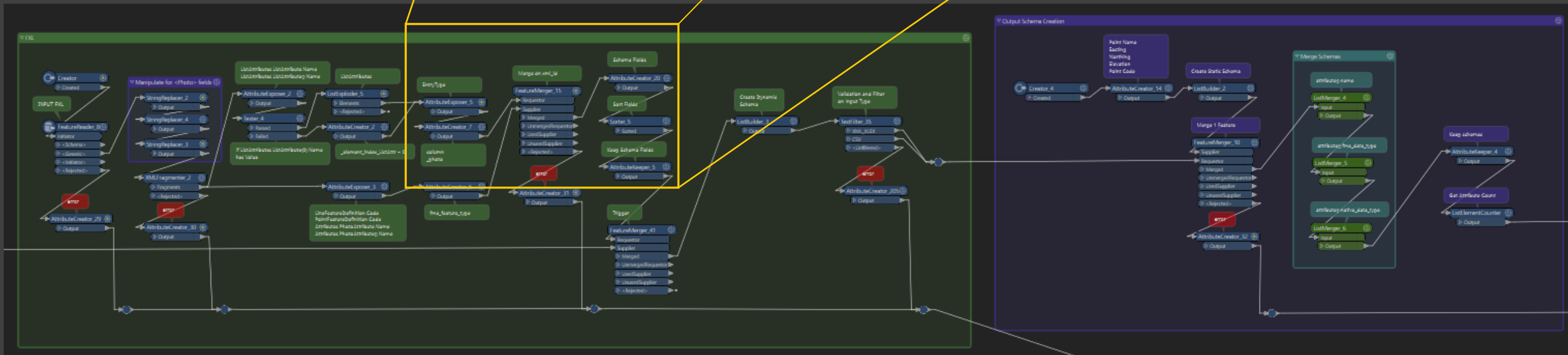
Conditional Value Definition

Condition Statement

Test	Value
If @Value(_photo) = 1	fme_binarybuffer
Else If	
Else <All Other Conditions>	fme_buffer

Output Schema Fields

Help OK Cancel



Dynamic Schema Creation



AttributeCreator Parameters

Transformer Name: AttributeCreator_20

Advanced: Attribute Value Handling

Attributes To Create

New Attribute	Value
fme_data_type	2 Possible Values
name	column
native_data_type	string

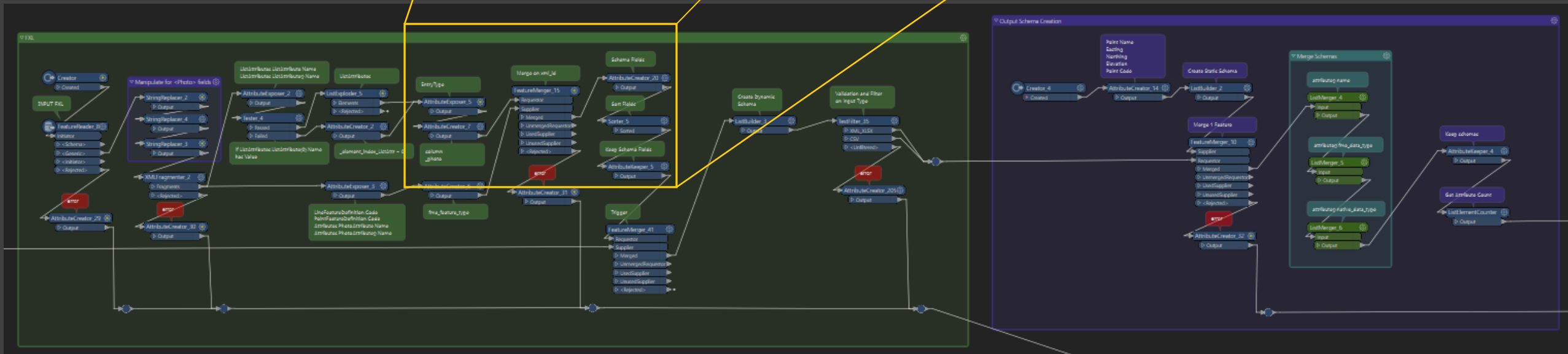
Conditional Value Definition

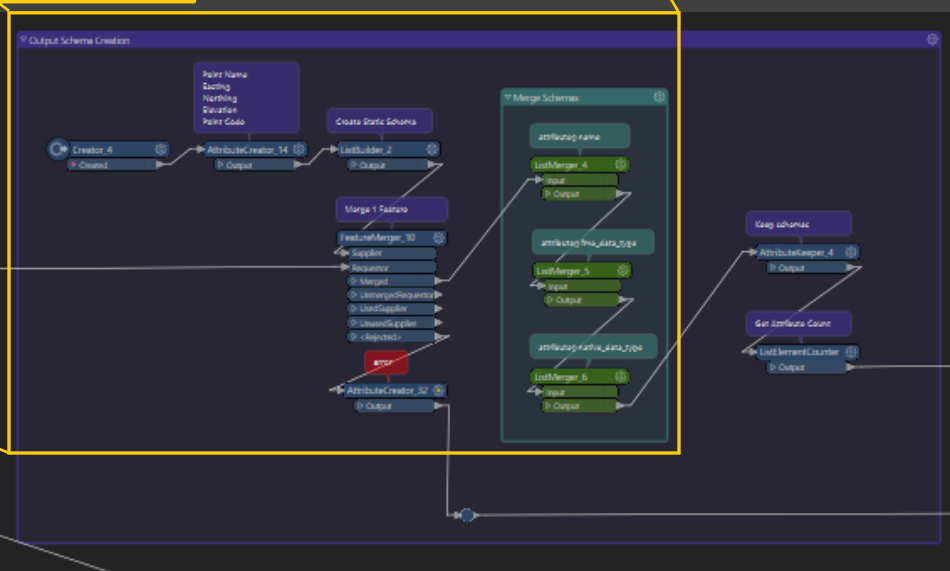
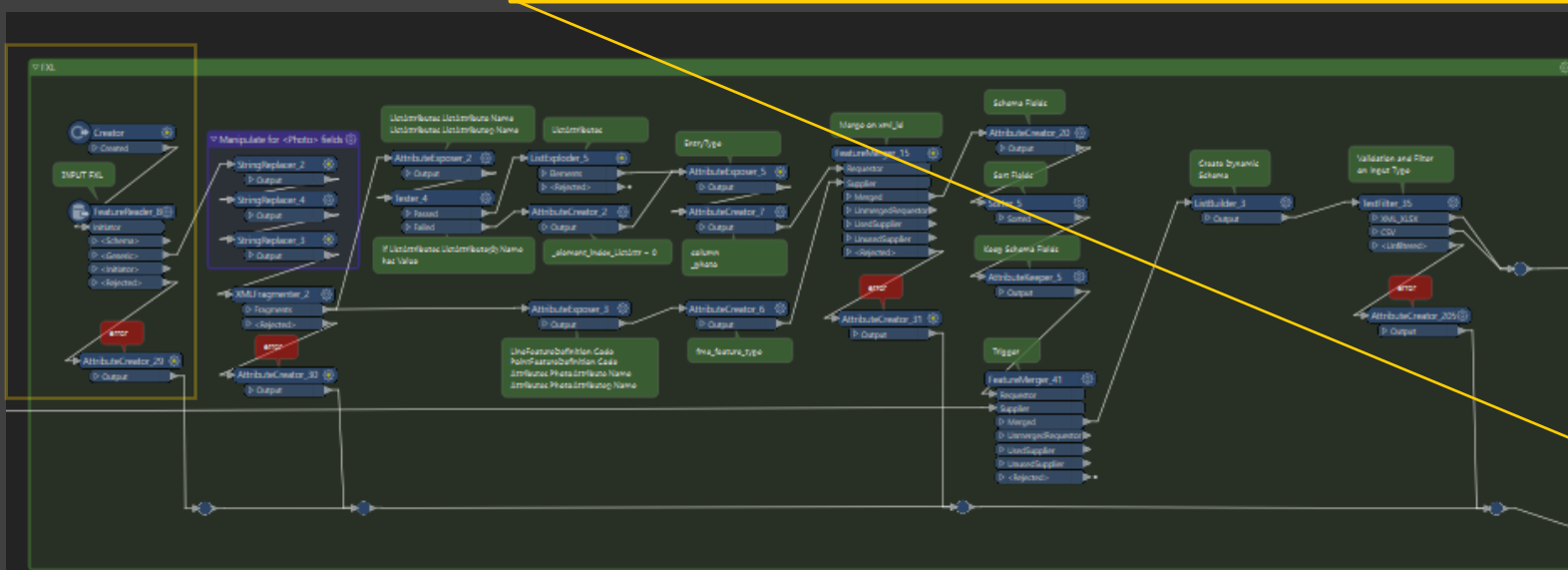
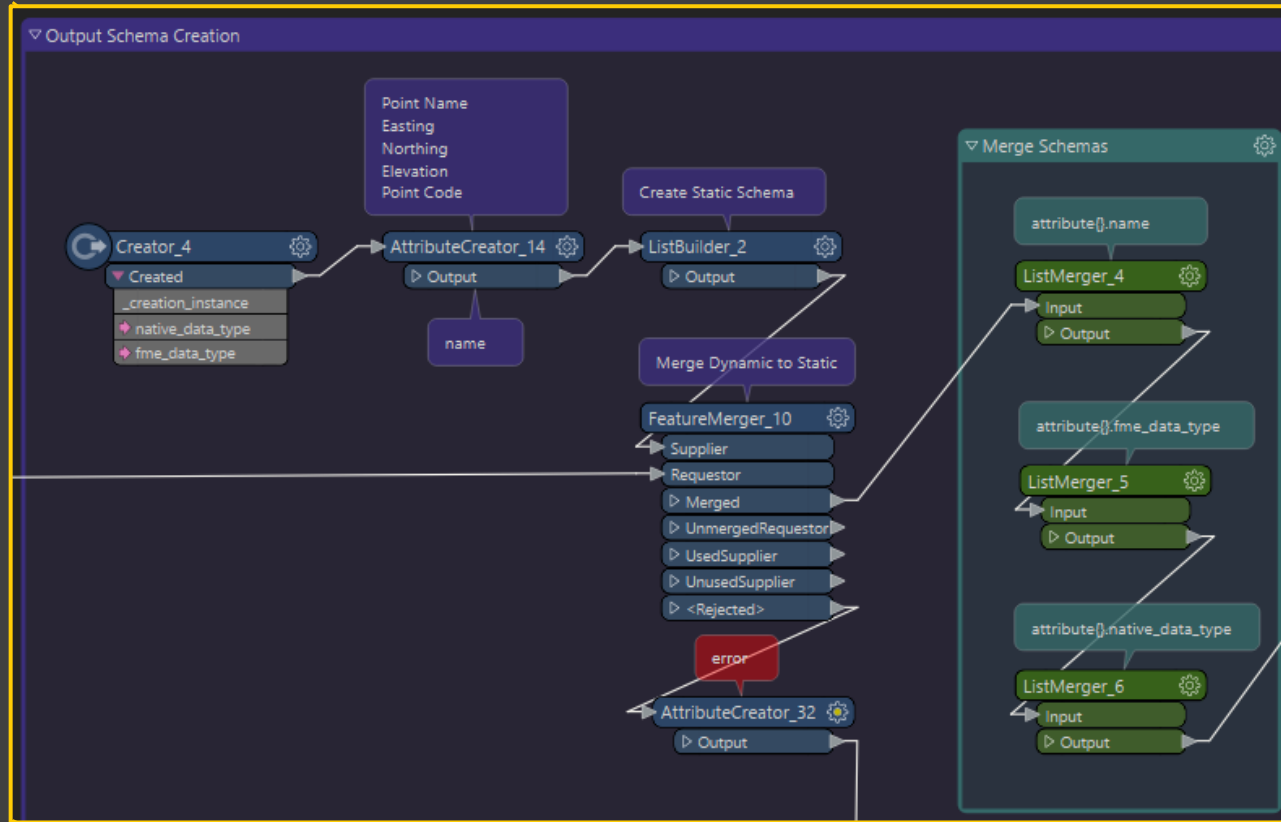
Condition Statement

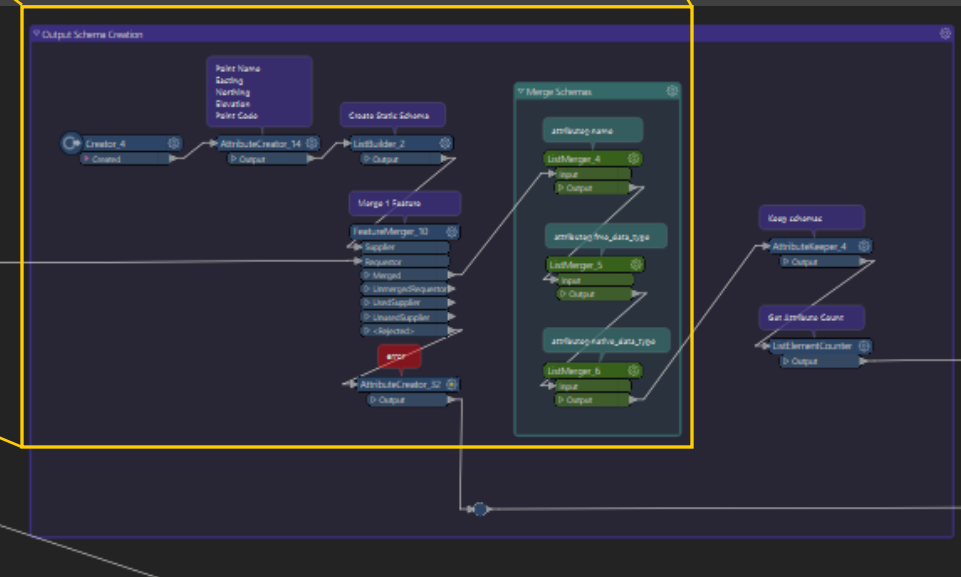
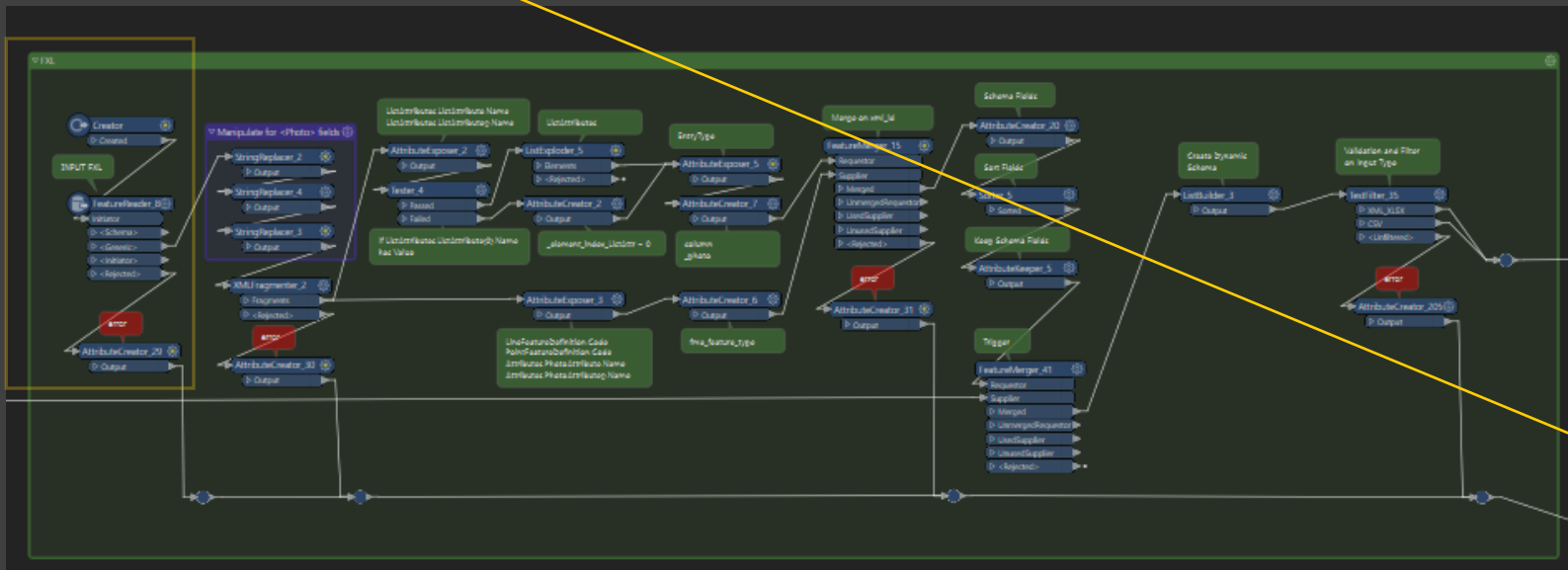
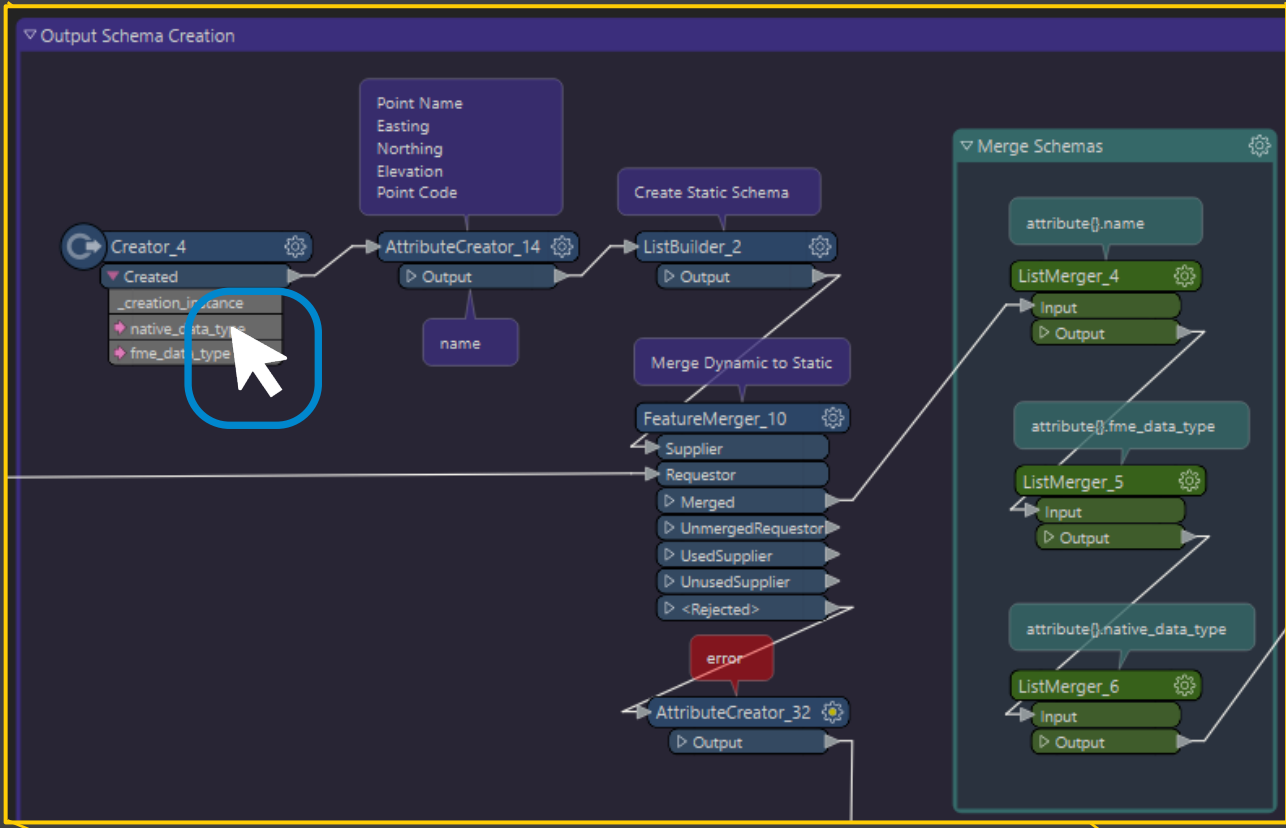
Test	Value
@Value(_photo) = 1	fme_binarybuffer
<All Other Conditions>	fme_buffer

Data Types

Help OK Cancel







Creator_4

- Created
- _creation_instance
- native_data_type
- fme_data_type

Edit Attribute... Enter

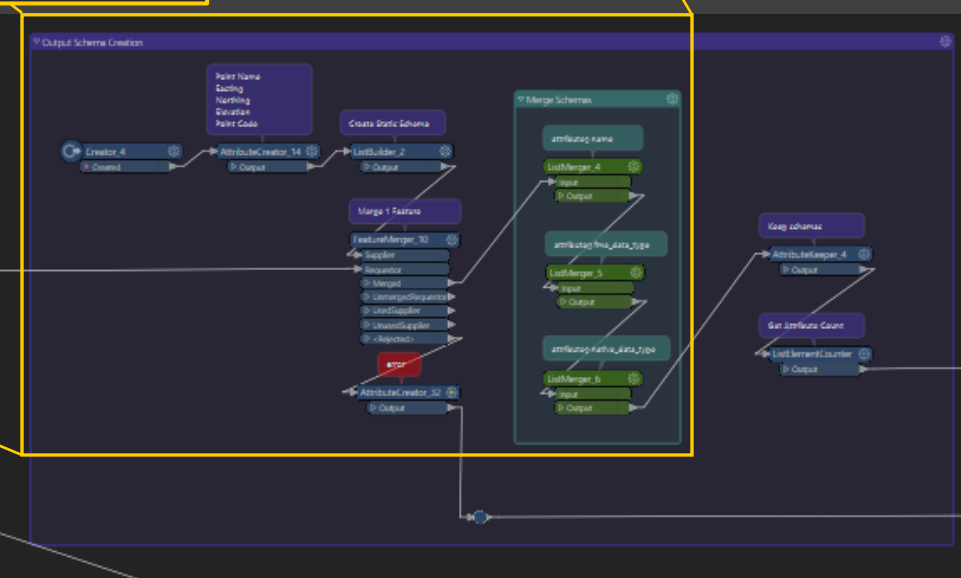
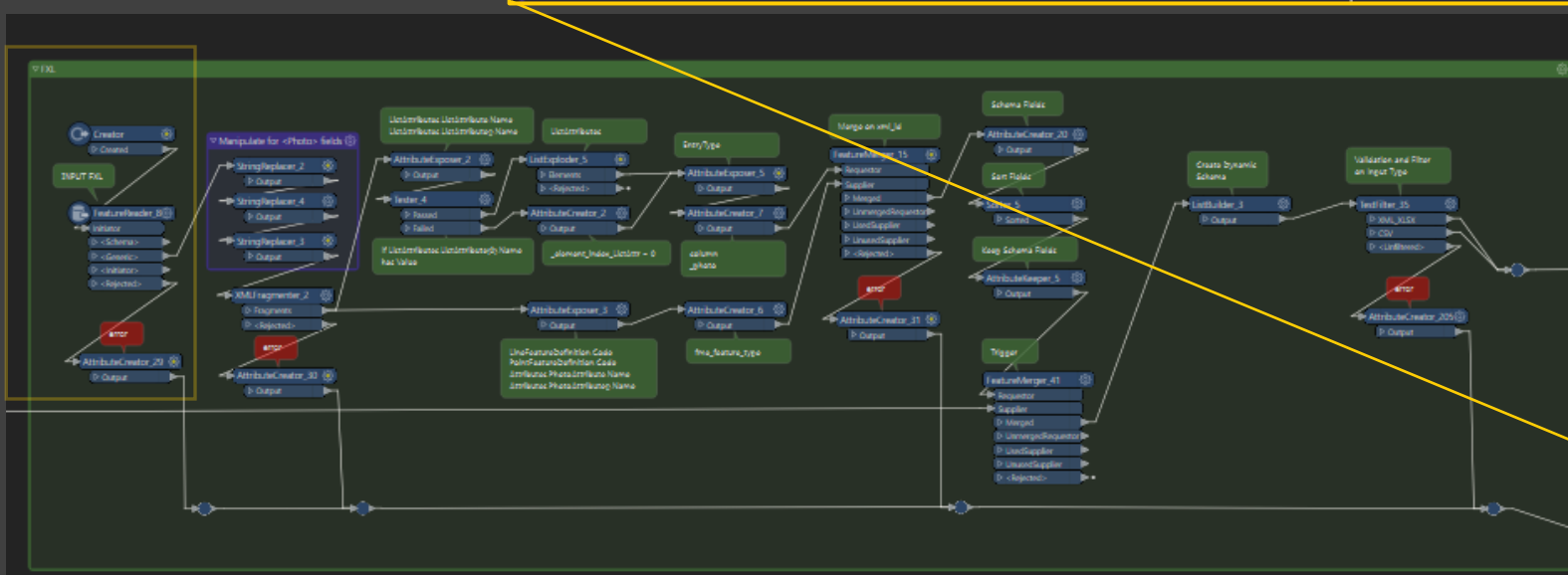
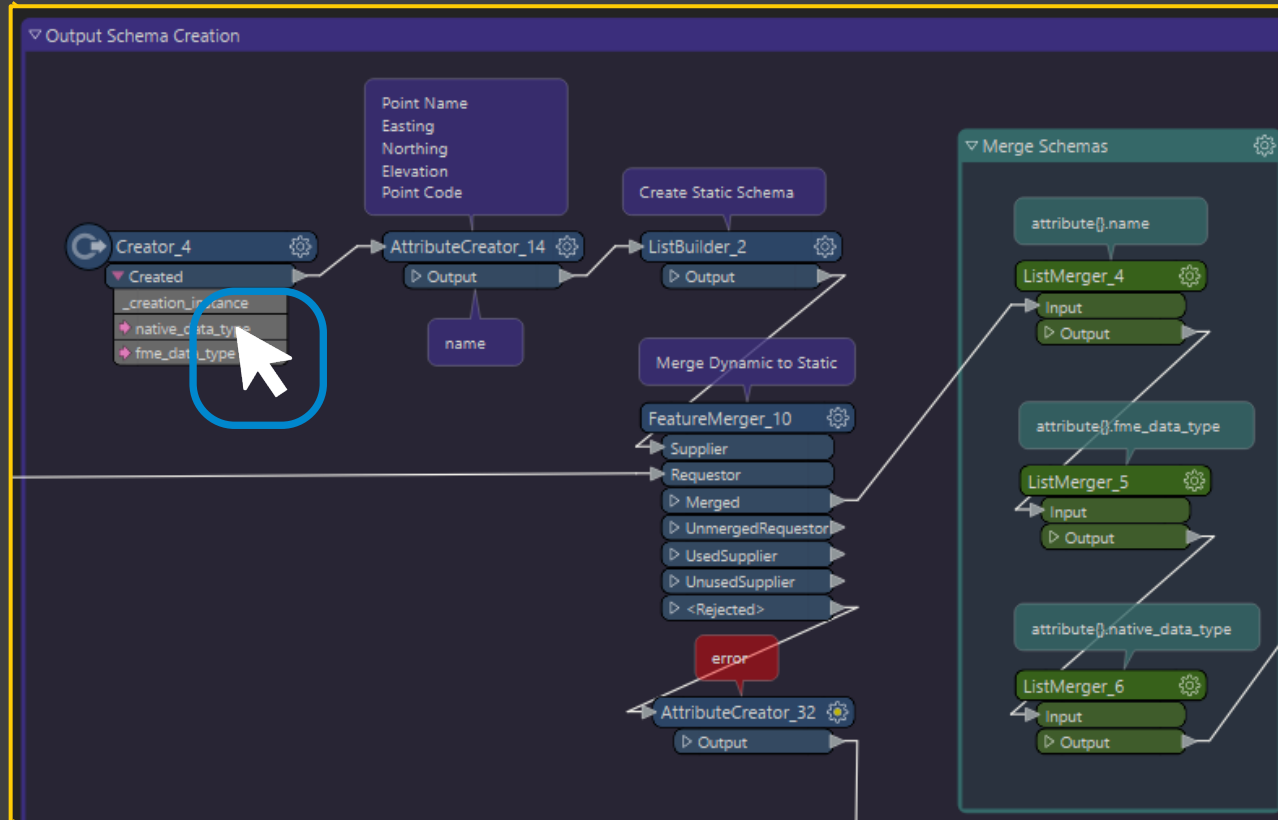
Disable Ctrl+E

Rename F2

Delete

Move up

Move down



Creator_4

- Created
 - _creation_instance
 - native_data_type
 - fme_data_type

Edit Attribute

Attribute Definition

Name:

Value:

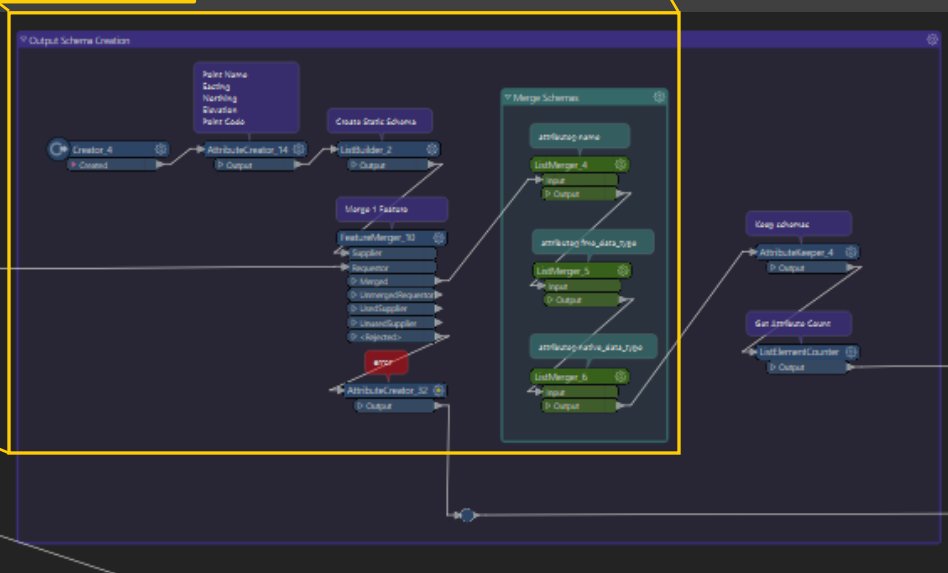
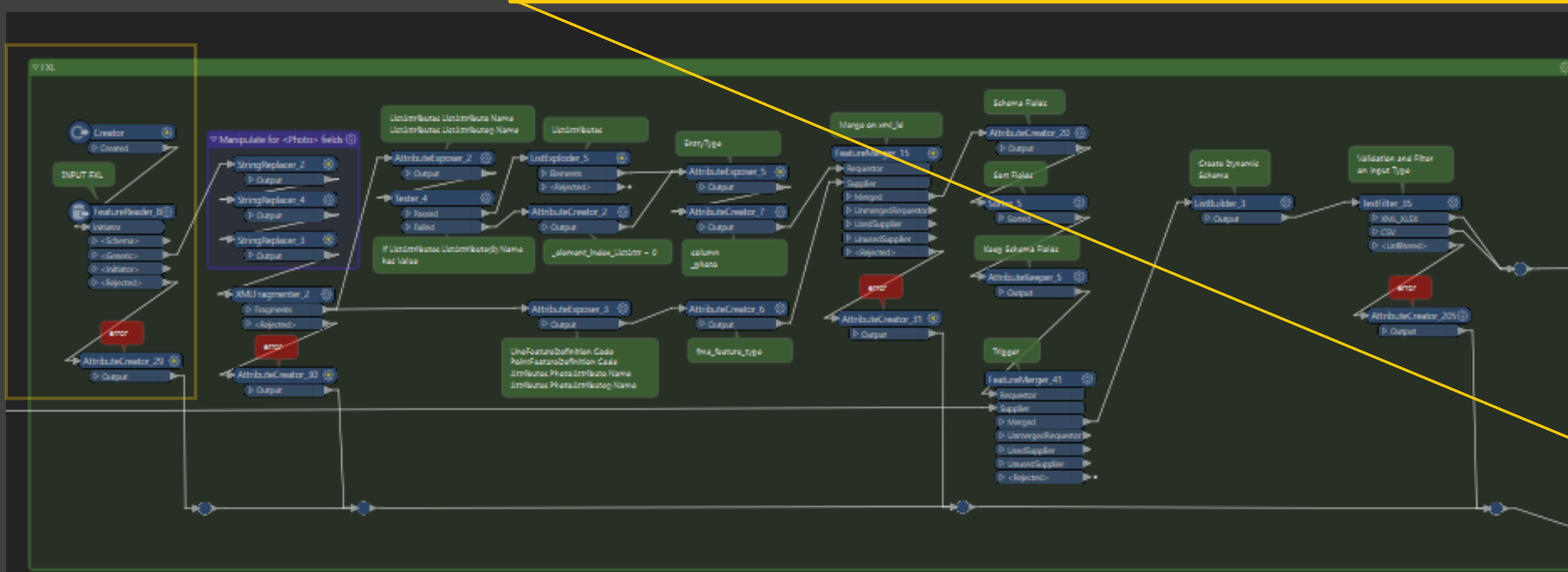
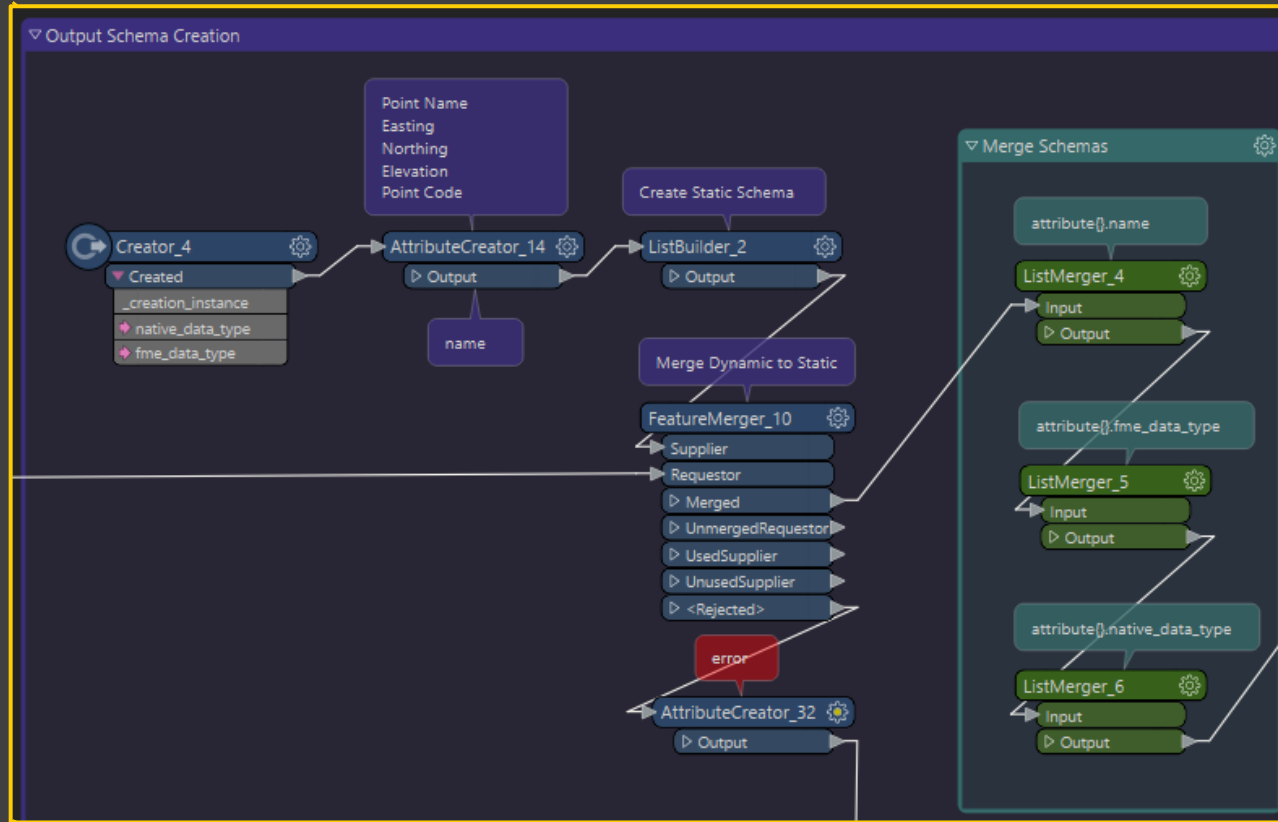
Edit Attribute

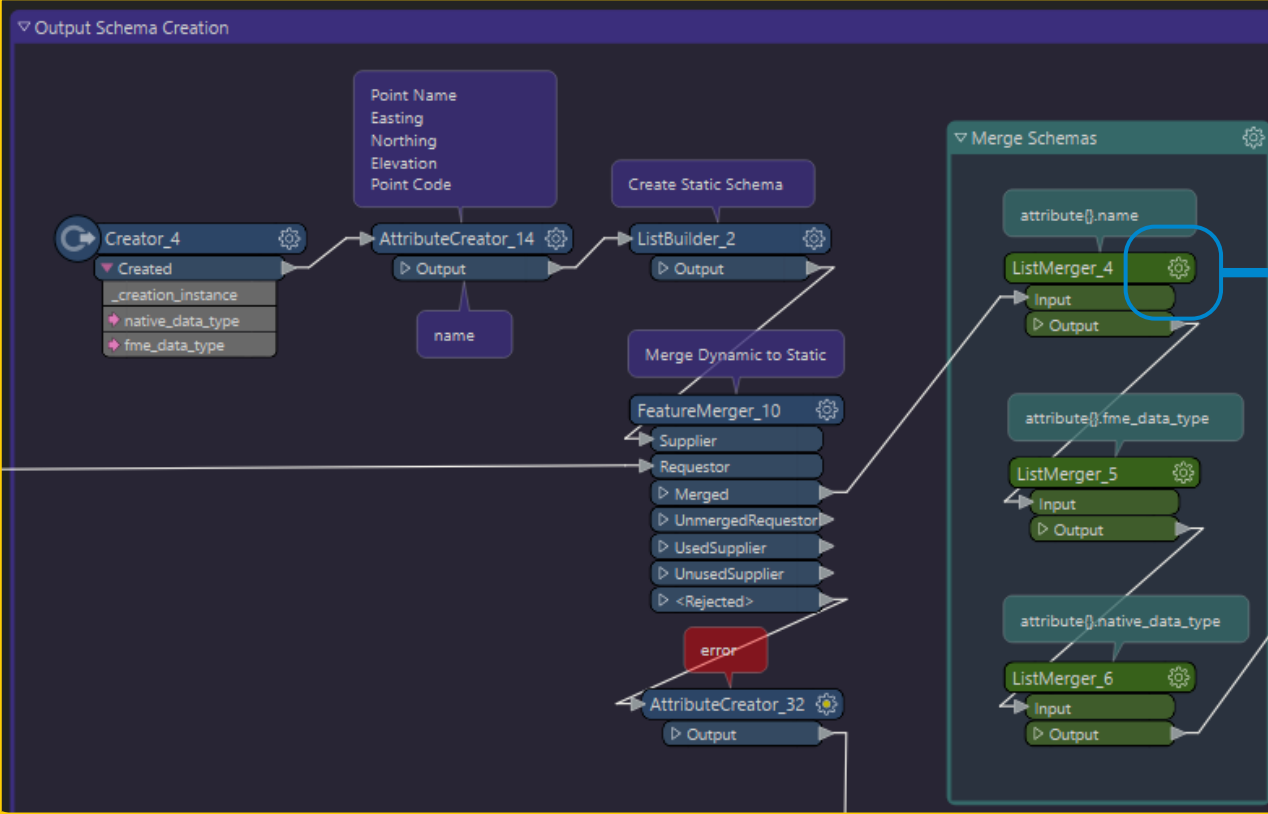
Attribute Definition

Name:

Value:

OK Cancel





ListMerger Parameters

Transformer Name:

User Parameters

Mode: Append

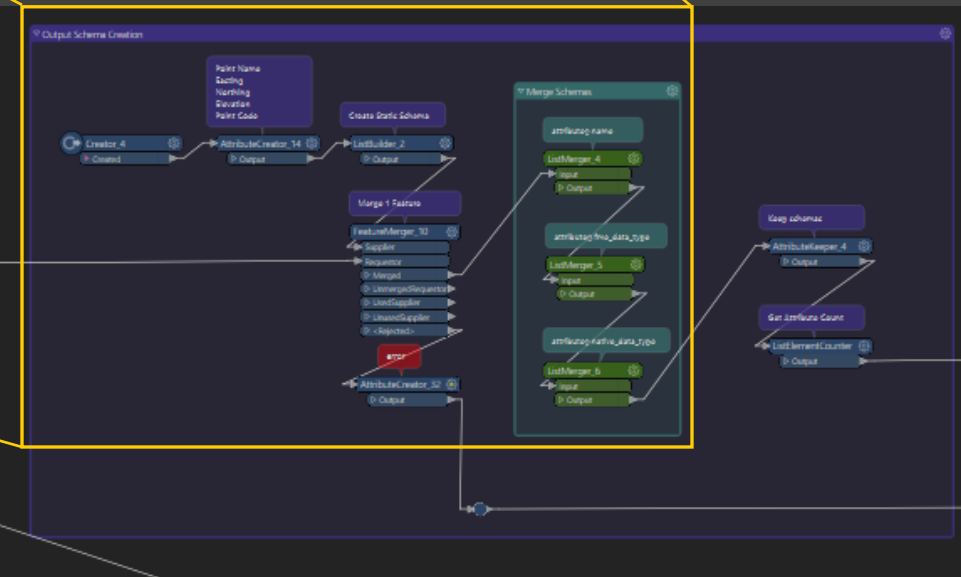
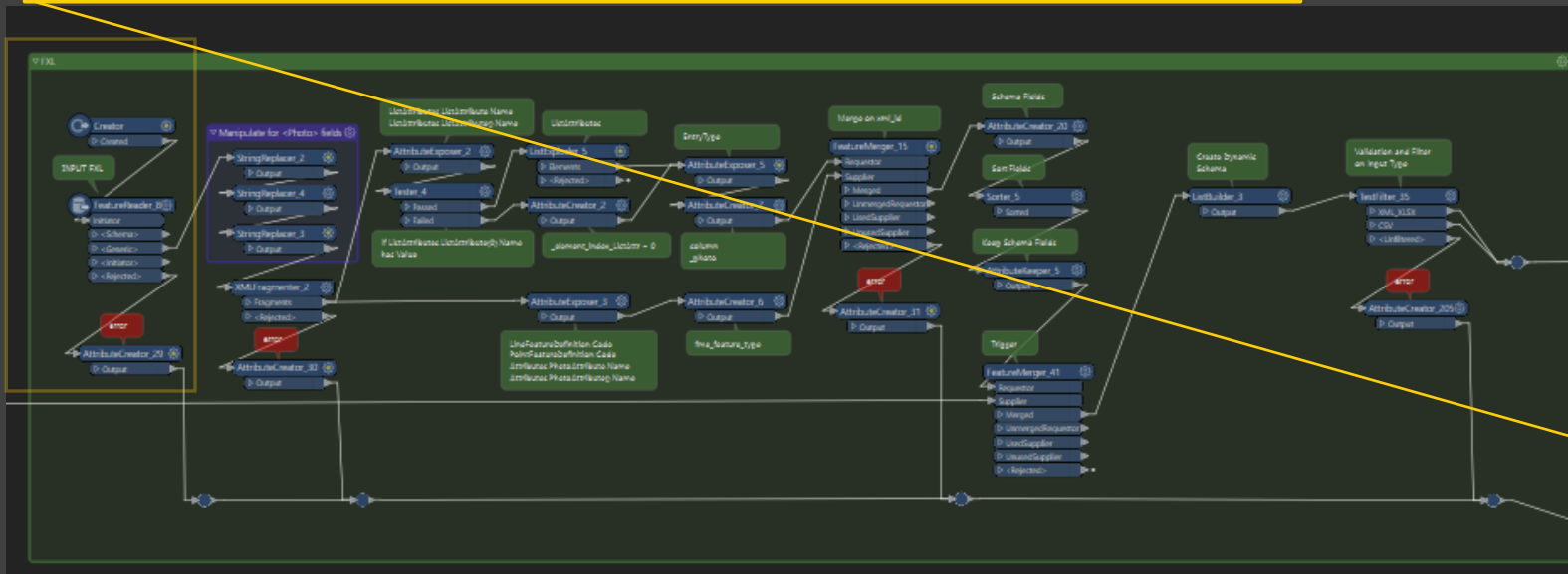
First List Attribute:

Second List Attribute:

Merged List Name:

Buttons: Help, Presets, OK, Cancel

- Merge the Attribute Lists
- Static Attributes: attribute{}.name
- Dynamic Attributes: attribute_add{}.name



Input to Output Schema

Attributes

Network Type: **Storm Water**

Network Owner: **Public**

Network Function: **Lateral**

Max Width / Dia (m): **0.50**

Depth (m): **1.50**

Cover Shape: **Circular**

Cover Material: **Metal**

Material: **Concrete**

Condition: **Good**

Status: **In-Service**

Cancel **Accept**



Unit Interface

Start x View 1 x

ListElementCounter_Output Columns...

	fme_feature_type	fxl_number_of_fields
1	GPR	11
2	CABLE	20
3	TPREF	10
4	GNRC	13
5	H2O	8
6	PTHL	12
7	LAYER	12
8	PHREF	10
9	TPIT	12
10	PIPE	19

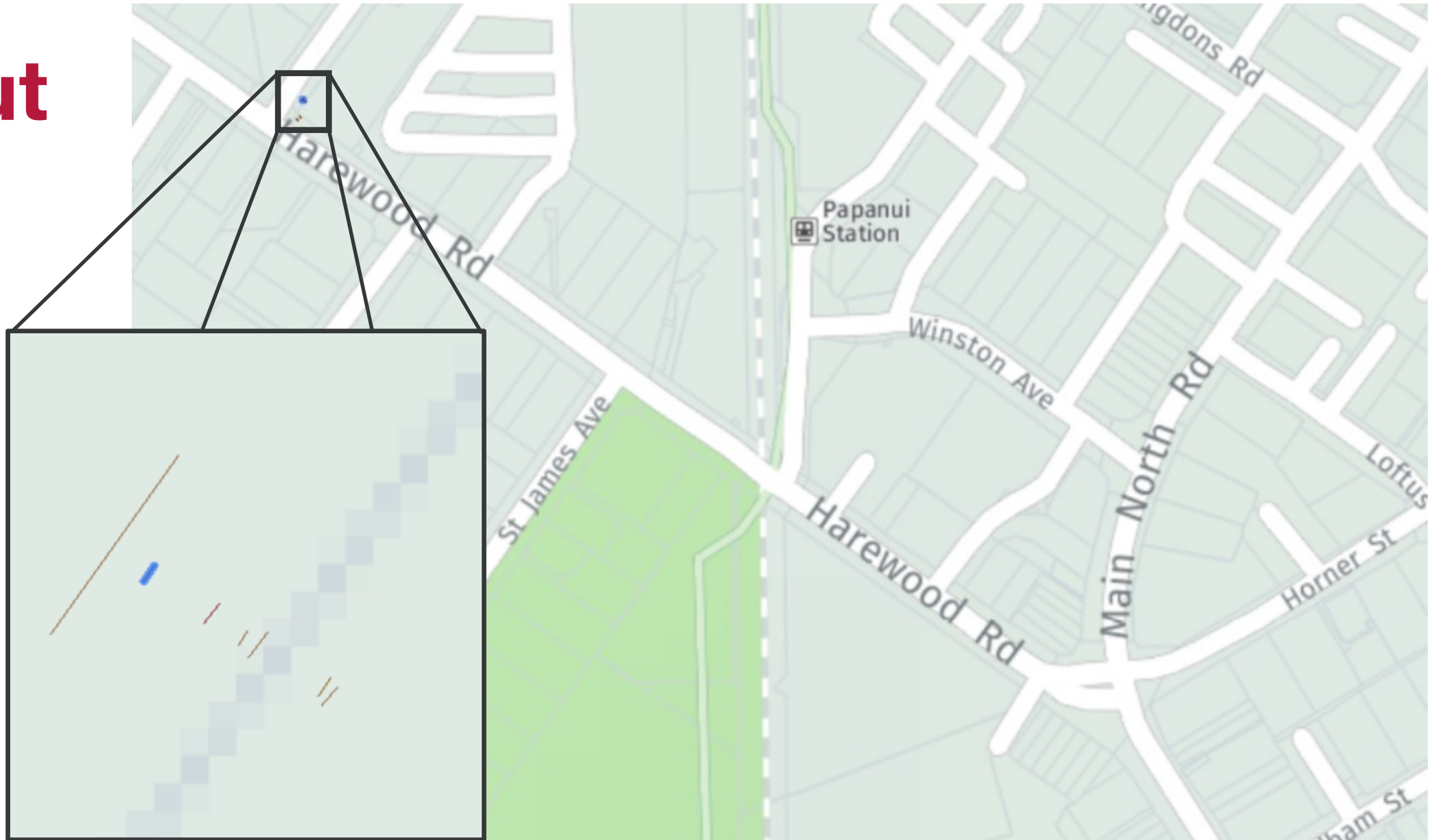
Feature Information

Features Selected: 1 of 1

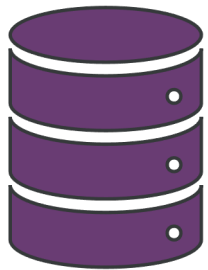
Property	Value
Exposed Attributes (62)	
fme_feature_type	va... CABLE
fxl_number_of_fields	ui... 20
attribute{} (20)	
attribute{0}	
name	va... Point Name
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{1}	
name	va... Easting
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{2}	
name	va... Northing
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{3}	
name	va... Elevation
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{4}	
name	va... Point Code
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{5}	
name	va... Network Type
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{6}	
name	va... Network Owner
native_data_type	va... string
fme_data_type	va... fme_buffer
attribute{7}	
name	va... Network Function
native_data_type	va... string
fme_data_type	va... fme_buffer

in any cr 1 selected / 10 row(s)

Output Data



Output Data

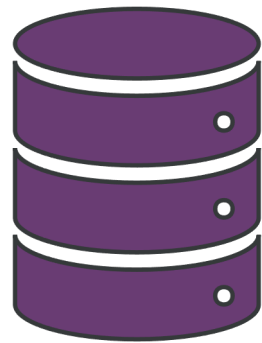


Project Database

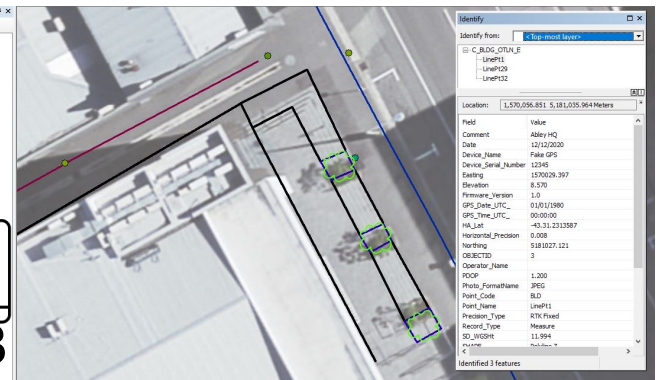
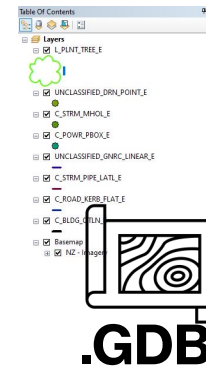
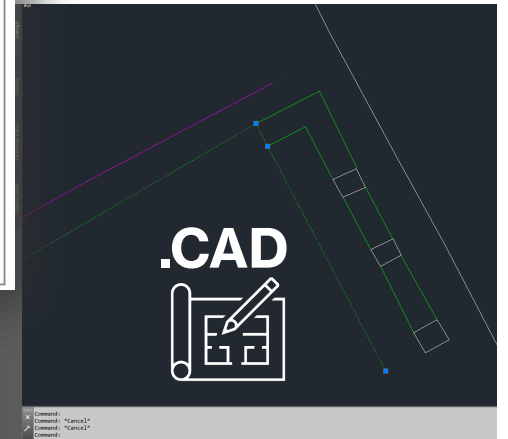
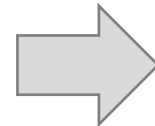
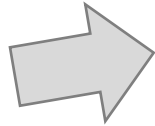
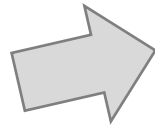
Features Selected: 1 of 1 | In: C_POWR_CABL_HIGV_E

Property	Value
Exposed Attributes (21)	
Point_Name	LinePt36
Easting	810638.299
Northing	390022.019
Elevation	22.939
Point_Code	CABLE8
Network_Type	Power
Network_Owner	Orion
Network_Function	High Voltage
Max_Width__Dia__m__	0.05
Level_Surveyed	Top
Ducted_	No
Material	Cable
Configuration__Across	1
Configuration__Deep	1
Colour	Black
Condition	Fair
Status	In-Service
Comment	<null>
Photo_of_Asset	FFD8FFE000104A46494600010100000100010000FFDB0043
Depth__m__	0.68
OBJECTID	5
Unexposed Attributes...	
filegdb_type	geodb_polyline
FME Attributes (3)	
Geometry	
Coordinate System	MOUNT PLEASANT 2000
Dimension	3D
Number of Vertices	2
Min Extents	390022.0190000003, 810638.29899999996, 22.934999999999997
Max Extents	390022.101999999996, 810638.4210000001, 22.942999999999999
Line (2 Coordinates)	

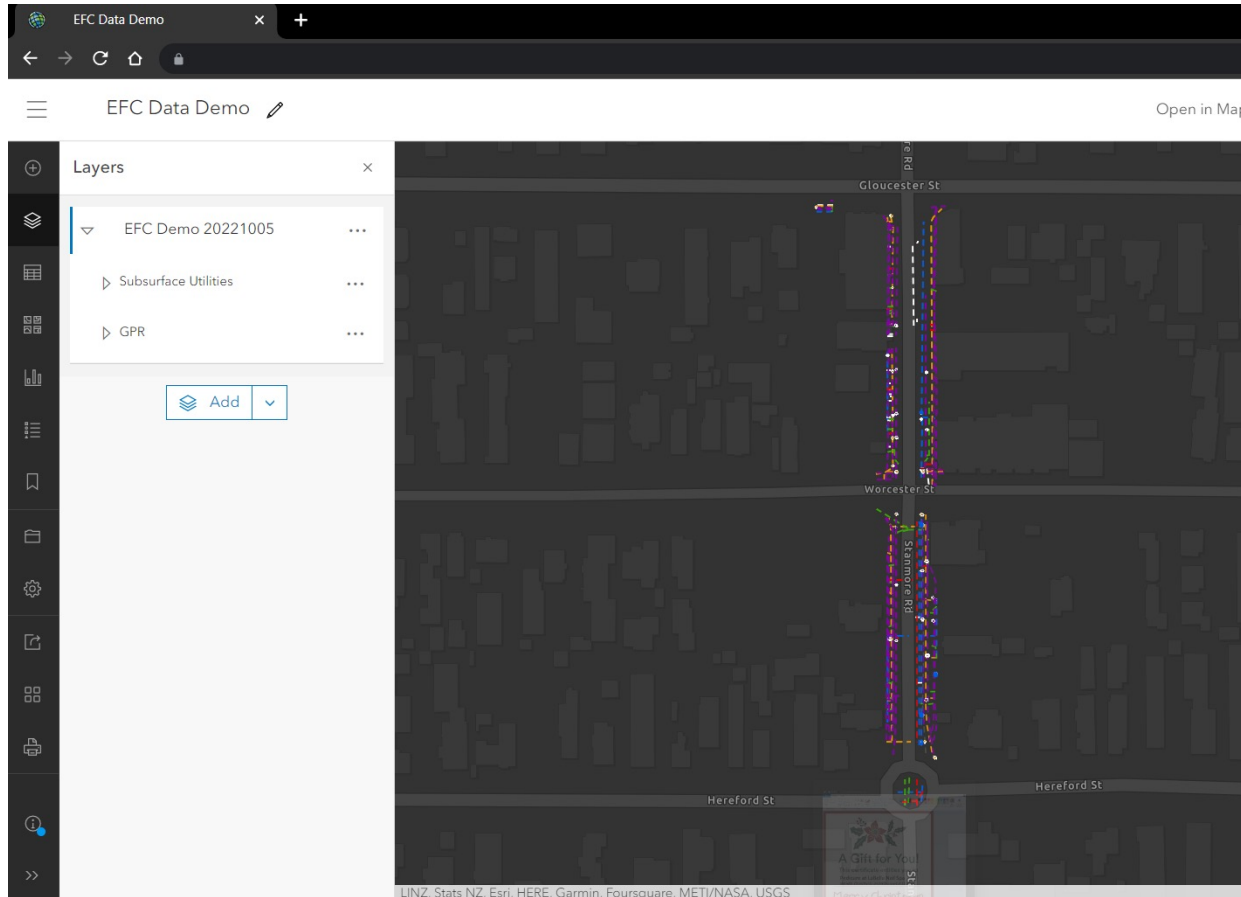
One Database to Rule Them All



Project Database



Other Online Solutions



ArcGIS Online



Client Statistics to Date

- 121 Projects
 - 35 with GPR
- ~1137 Potholes
 - ~2250-3400 hours * \$150/hr = **\$330k-\$510k saved**
- ~4000 Features
 - 2750 Utility Service
 - 1250 GPR
- Digital-First, Consistent, Efficient, Safe

Learn More

- abley.com/enhanced-feature-capture
- Case Study - abley.com/potholing-for-fulton-hogan
- FME
 - HTML Cross-section Diagrams:
<https://www.youtube.com/watch?v=63JbcW8QRqc>
 - FME Fireside:
<https://www.youtube.com/watch?v=LjG2clGXXh8>

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