Kinze Blue Vantage Prescription & Boundary File Integration Guide

Version 1.8

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Introduction

Keyhole Markup Language (KML) is an XML notation for describing geospatial data and their attributes. KML was developed for use with Google Earth and became an international standard of the Open Geospatial Consortium (OGC) in 2008. The Kinze Blue Vantage Display can read well-formatted KML prescription and boundary files.

KML was chosen because it has advantages over ESRI Shapefile and other proprietary formats. For example, KML files contain all metadata, indexes, and geometry definitions in one file. KML uses XML as its underlying format which is highly extensible. Also, KML itself does not suffer from internal naming character length limits like ESRI Shapefiles. The KML specification provides a mechanism for compression and internet-based objects. KML is an open standard and is supported by popular GIS tools and libraries such as Google Earth, Marble, QGIS and GDAL.

Ag Leader SMS/AgFiniti, Climate FieldView, and Granular AgStudio/Insights support exporting prescriptions and boundary files directly to Kinze Blue Vantage KML format. John Deere Operations Center Work Planner TELUS Agronomy Prescription Creator generated prescriptions are supported but are in TELUS Agronomy ESRI Shapefile format.

Scope

KML supports many features, but for this document's purposes the information will be limited to map-based variable rate material application prescriptions and boundaries. The following sections will provide the content formatting requirements for Kinze Blue Vantage KML prescriptions and boundary files.

KML File Contents

A KML file shall describe a field boundary or prescription. One KML file shall represent a single field and one material to be applied to that area of land. Application of seed, fertilizer and insecticide would result in 3 separate prescription files. A KML document shall contain one Schema definition for all the geometry in the file. The KML document can contain multiple geometries, but a geometry or geometry set can only have one set of attributes. For example, the KML Planting Prescription defined in Figure 2 contains a single application rate for geometry defined in the file. Geometries with the same rate are grouped together.

KML Field Boundary

A KML boundary is a file containing well-formatted geometry used to only apply material inside the shape. No material will be applied outside of the shape(s) or inside the holes or waterways of the field. A boundary file example is shown in Figure 1. In Figure 1, material would only be applied to the area in green.

Figure 1 – A KML Boundary

KML Prescription

A KML prescription expands the boundary definition by including attributes associated to the geometry to define what rate the material shall be applied inside the shape. A planting prescription file example is shown in Figure 2. In this example, a rate of 34,000 seeds/acre will be applied in the red polygon, 33,000 seeds/acre in yellow polygon, and 32,000 seeds/acre in the blue polygon.

Figure 2 – A KML Prescription

Geometry Attributes

Geometry attributes provide optional information elements for boundary and prescriptions as well as required prescription data elements. Geometry attributes are specified as custom KML schema. The geometry attributes have known names and known value types. Geometry attributes are explained further in the KML Schema & SimpleFields section.

Basic KML Structure

A KML file contains standard formatting structure to adhere to the formatting rules of XML and OGC KML. Kinze Blue Vantage KML shall follow the OGC KML Version 2.2 Specification. The following document sections will be in the order the KML shall appear in the KML file.

XML Header

The first line in every KML file shall start with the XML Header. No spaces or any other characters can appear before it in the file. Kinze supports multi-language KML files in UTF-8 character encoding only.

```
<?xml version="1.0" encoding="UTF-8"?>
```

KML Namespace Declaration

This is the second line in every KML file.

```
<kml xmlns="http://www.opengis.net/kml/2.2">
```

KML Document

The next item in a KML file is the required Document element. The Document element is a container for the custom schema and features. The Document element shall contain only 1 Schema element and 1 or more Feature elements.

```
<Document>
```

KML Schema & SimpleFields

The Schema element specifies the custom attributes used to associate typed data to KML Feature geometry. The SimpleField "Name" attribute is required. The required "Type" attribute shall define the type the SimpleField will be read as. Supported Kinze Blue Vantage KML types are string and double.

The Schema element shall contain 1 or more SimpleField elements. The SimpleField element declares the name and type of the field. The SimpleField name and type attributes must match exactly with the values in Table 1.

Name	Type	Field Value Definitions (Maximum String Length: 32 Characters)
Grower	string	The name of the farmer.
Farm	string	The name of the farm.
Field	string	The name of the field.
Crop	string	The name of the crop. Supported string values are; "Corn", "Soybeans", "Edible Beans", "Cotton", "Sorghum/Milo", "Sugar Beets", "Sunflowers", "Canola" and "Wheat".
Product	string	The crop hybrid or variety, fertilizer or insecticide name.
Year	string	The 4-digit year the prescription or boundary shall be actively used.
Operation	string	The operation type name. Supported values are "Planting Prescription", "Seed Proposal", "Fertilizing Prescription", "Treatment Prescription" or "Boundary".

TargetRate	double	The rate the material shall be applied to the area this Feature represents. Data values must be in seeds/acre for planting, gallons/acre (U.S.) for fertilizer and pounds/acre for insecticide.
Units	string	The name of the units in the TargetRate field. Supported string values are “sds/ac” for planting prescriptions, “gal/ac” for fertilizing prescriptions and “lb/ac” for insecticide treatment prescriptions.

Table 1 – Schema SimpleFields

KML boundary files do not need to contain Schema Fields.

A Kinze Blue Vantage Schema may optionally contain the Grower, Farm, Field, Crop, Product, and Year SimpleFields.

Automatic Task Generation

If any of the optional Schema Fields are found in a planting prescription, the Kinze Blue Vantage Display will automatically generate a task upon prescription or boundary import, associate the crop, product and prescription with the task as well as store any planting product names in the Products management list under the matching crop if defined.

A KML prescription must contain the Operation, TargetRate & Units fields. Below is a complete Kinze Blue Vantage Schema element definition.

```
<Schema name=”schema1”>
 <SimpleField name="Grower" type="string"/>
 <SimpleField name="Farm" type="string"/>
 <SimpleField name="Field" type="string"/>
 <SimpleField name="Crop" type="string"/>
 <SimpleField name="Product" type="string"/>
 <SimpleField name="Year" type="string"/>
 <SimpleField name="Operation" type="string"/>
 <SimpleField name="TargetRate" type="double"/>
 <SimpleField name="Units" type="string"/>
</Schema>
```

KML Folders

The Folder element is used to arrange Placemark Features hierarchically.

```
<Folder>
```

KML Features

The KML Feature contains geometry and the associated custom data. The Kinze Blue Vantage KML Feature used is the KML Placemark element. Custom attribute data is added to a Placemark element with the ExtendedData, SchemaData and SimpleData elements.

```
<Placemark>
```

The ExtendedData element is a container for the SchemaData and SimpleData elements.

The SchemaData element is used in conjunction with the Document Schema to add the typed custom data to the KML Placemark element. The actual data values or instances of the custom data are defined using the SimpleData element. String values are limited to 32 characters.

The SchemaData element must contain the schemaUrl attribute and reference the Document Schema element name.

```
<ExtendedData>
 <SchemaData schemaUrl="schema1">
  <SimpleData name="Grower">Kinze</SimpleData>
  <SimpleData name="Farm">North Liberty</SimpleData>
  <SimpleData name="Field">Liberty Center Pond</SimpleData>
  <SimpleData name="Crop">Corn</SimpleData>
  <SimpleData name="Product">Sample Hybrid</SimpleData>
  <SimpleData name="Year">2022</SimpleData>
  <SimpleData name="Operation">Planting Prescription</SimpleData>
  <SimpleData name="TargetRate">30000.00</SimpleData>
  <SimpleData name="Units">sds/ac</SimpleData>
 </SchemaData>
</ExtendedData>
```

KML Feature Geometry

The Placemark feature shall contain 1 or more closed Geometry items that can represent a geographical area. Supported Kinze Blue Vantage KML Geometry elements include MultiGeometry, LinearRing and Polygon elements. A single KML file shall contain 1500 polygons or less.

Point, LineString, gx:MultiTrack, Model and gx:Track elements are not supported.

A *MultiGeometry* element is a container for 1 or more Polygon elements. The boundaries are defined by LinearRings.

A *Polygon* is defined by an outer boundary and 0 or more inner boundaries.

A *LinearRing* element defines a closed area, typically the outer boundary of a Polygon. A LinearRing can also be used as the inner boundary of a Polygon to create holes in a Polygon as shown in Figure 3.

Figure 3 represents a KML Boundary containing 1 Placemark feature with 1 MultiGeometry element. The MultiGeometry element contains 1 Polygon with 2 LinearRing elements. The first LinearRing element represents the outer boundary of the polygon and the second LinearRing element represents the inner boundary polygon. The blue arrow points to the inner LinearRing and the red arrow points to the outer LinearRing.

Figure 3 – Polygon with 2 LinearRing Elements

The coordinate's element must contain four or more tuples, each consisting of floating-point values.

The tuple format is: ***<longitude>,< latitude>,<altitude><whitespace>***

The altitude component must be se to 0. Kinze Blue Vantage only processes 2 dimensional coordinates. Latitude, longitude, and altitude must be separated by a <comma>. Do not include whitespace inside the tuple, only between tuples.

The last coordinate tuple must be the same as the first coordinate tuple. This closes the geometry. Coordinates are expressed in decimal degrees only. Coordinates shall be expressed in EPSG:4326 which refers to WGS84 Spatial Reference System (SRS). The coordinates for polygons must be specified in counterclockwise order. Each tuple must be separated by whitespace. Recommended whitespace is a single <space> character or <newline> character.

The MultiGeometry KML for Figure 3:

```
<MultiGeometry>
 <Polygon>
  <outerBoundaryIs>
   <LinearRing>
    <coordinates>
     -91.610976581,41.750016981,0
     -91.610976580,41.749697012,0
     -91.610581778,41.749697012,0
     -91.610581777,41.750016981,0
     -91.610976581,41.750016981,0
    </coordinates>
   </LinearRing>
  </outerBoundaryIs>
  <innerBoundaryIs>
   <LinearRing>
    <coordinates>
     -91.610681763,41.749911845,0
```

```
      -91.610697159,41.749781669,0
      -91.610881906,41.749795708,0
      -91.610866511,41.749923331,0
      -91.610681763,41.749911845,0
     </coordinates>
    </LinearRing>
   </innerBoundaryIs>
  </Polygon>
</MultiGeometry>
```

Now that the Placemark feature geometry has been defined all that is left is to close the remaining open elements.

```
</Placemark>
</Folder>
</Document>
</kml>
```

Full KML Prescription Example

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
 <Document>
  <Schema name="schema1">
   <SimpleField name="Grower" type="string"/>
   <SimpleField name="Farm" type="string"/>
   <SimpleField name="Field" type="string"/>
   <SimpleField name="Crop" type="string"/>
   <SimpleField name="Product" type="string"/>
   <SimpleField name="Year" type="string"/>
   <SimpleField name="Operation" type="string"/>
   <SimpleField name="TargetRate" type="double"/>
   <SimpleField name="Units" type="string"/>
  </Schema>
  <Folder>
   <Placemark>
    <ExtendedData>
     <SchemaData schemaUrl="schema1">
      <SimpleData name="Grower">Kinze</SimpleData>
      <SimpleData name="Farm">North Liberty</SimpleData>
      <SimpleData name="Field">Liberty Center Pond</SimpleData>
      <SimpleData name="Crop">Corn</SimpleData>
      <SimpleData name="Product">Sample Hybrid</SimpleData>
      <SimpleData name="Year">2022</SimpleData>
      <SimpleData name="Operation">Planting Prescription</SimpleData>
```

```
      <SimpleData name="TargetRate">30000.00</SimpleData>
      <SimpleData name="Units">sds/ac</SimpleData>
     </SchemaData>
    </ExtendedData>
    <MultiGeometry>
     <Polygon>
      <outerBoundaryIs>
       <LinearRing>
        <coordinates>
         -91.610976581,41.750016981,0
         -91.610976580,41.749697012,0
         -91.610581778,41.749697012,0
         -91.610581777,41.750016981,0
         -91.610976581,41.750016981,0
        </coordinates>
       </LinearRing>
      </outerBoundaryIs>
      <innerBoundaryIs>
       <LinearRing>
        <coordinates>
         -91.610681763,41.749911845,0
         -91.610697159,41.749781669,0
         -91.610881906,41.749795708,0
         -91.610866511,41.749923331,0
         -91.610681763,41.749911845,0
        </coordinates>
       </LinearRing>
      </innerBoundaryIs>
     </Polygon>
    </MultiGeometry>
   </Placemark>
  </Folder>
 </Document>
</kml>
```

Full KML Boundary Example

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
 <Document>
  <Folder>
   <Placemark>
    <MultiGeometry>
     <Polygon>
      <outerBoundaryIs>
```

```
        <LinearRing>
         <coordinates>
          -91.610976581,41.750016981,0
          -91.610976580,41.749697012,0
          -91.610581778,41.749697012,0
          -91.610581777,41.750016981,0
          -91.610976581,41.750016981,0
         </coordinates>
        </LinearRing>
       </outerBoundaryIs>
       <innerBoundaryIs>
        <LinearRing>
         <coordinates>
          -91.610681763,41.749911845,0
          -91.610697159,41.749781669,0
          -91.610881906,41.749795708,0
          -91.610866511,41.749923331,0
          -91.610681763,41.749911845,0
         </coordinates>
        </LinearRing>
       </innerBoundaryIs>
      </Polygon>
     </MultiGeometry>
    </Placemark>
   </Folder>
  </Document>
</kml>
```

ESRI Shapefiles

Kinze Blue Vantage supports parsing legacy ESRI Shapefiles. It is not recommended to use ESRI Shapefiles because of their SRS variability and truncation of field names. On import, Kinze Blue Vantage will convert ESRI Shapefiles to KML for displaying preview and map layer images. The original Shapefiles are used to apply material to the area they represent.

TODO Explain the other options for supported prescriptions and boundary file exceptions.

The feature geometry (.shp) file is required for all Blue Vantage prescriptions and boundaries. The attribute format (.dbf) file is required for prescriptions. A prescription file must contain the “Operation” field, the “TargetRate” field and the “Units” field attributes to be considered a valid prescription. Prescription files without a valid .dbf file, but valid .shp file will be imported into Blue Vantage and displayed as a boundary file. See Table 1 – Schema Fields for details on the value data to populate in these required fields. If the optional schema fields defined in Table 1 are included, they will be used for automatic task and name generation.

The shape file index format (.shx) file is not required and will be re-generated automatically if not found during the import process.

ESRI Shapefiles shall be in WGS-84 Spatial Reference System.

Improved Language Support

Improved support for FMIS (Farm Management Information Systems) providers that allow multiple languages in their exported prescriptions.

Grower, Farm, Field, and Product name attribute strings in different languages are fully supported. This is well-defined through XML, and the KML specification usage of UTF-8 encoding, and Unicode character sets as noted in the XML Header section. Additional support was added for importing prescriptions with the correct crop and operation strings in different languages. Operation attribute strings in different languages could result in a failure to recognize a valid prescription. This would cause the prescription to be imported as a boundary file.

If a task is auto generated from a valid prescription or boundary file, the crop is correctly set based on supported FMIS translations. If the crop name string is unrecognized, the auto generated task crop will be set to corn. It will need to manually be configured by the end user for each task if set incorrectly.

Acronyms & Terminology

EPSG	European Petroleum Survey Group	http://www.epsg.org/ http://spatialreference.org/ref/epsg/wgs-84/
ESRI	Environmental Systems Research Institute	https://www.esri.com/en-us/home https://en.wikipedia.org/wiki/Shapefile
GIS	Geographic Information System	https://en.wikipedia.org/wiki/Geographic_information_system
KML	Keyhole Markup Language	https://www.opengeospatial.org/standards/kml https://developers.google.com/kml/
OGC	Open Geospatial Consortium	http://www.opengeospatial.org/
SRS	Spatial Reference System	https://en.wikipedia.org/wiki/Spatial_reference_system
Unicode	Universal Character Encoding Standard	https://home.unicode.org/
UTF-8	Variable Length Character Encoding Standard	https://www.utf8.com/
VRA	Variable Rate Application	https://en.wikipedia.org/wiki/Variable_Rate_Application
WGS	World Geodetic System	https://confluence.qps.nl/qinsy/en/world-geodetic-system-1984-wgs84-29855173.html

XML	Extensible Markup Language	https://www.w3schools.com/xml/xml_whatis.asp
XMLNS	Extensible Markup Language Namespace	https://www.w3schools.com/tags/att_html_xmlns.asp

Version History

Version	Change Details	Date
1.0	Initial approved version.	March 26, 2019
1.1	Added ESRI Shapefile Section	April 17, 2019
1.2	Updated Crop-Type list with Sorghum/Milo, Canola and Wheat. Noted KML character encoding is UTF-8 only. Added Version History Table.	August 12, 2019
1.3	Added note on total polygon limit Note automatic task generation only works with planting prescriptions.	January 31, 2020
1.4	Update the document title to something more appropriate	February 25, 2020
1.5	Add “Seed Proposal” to supported operation strings.	September 23, 2020
1.6	Add FMIS options for exporting Blue Vantage KML prescriptions and boundary files.	August 23, 2022
1.7	Update supported FMIS provider mentions in the Introduction. Section added for language support.	July 25, 2023
1.8	Grammar, spelling, and punctuation updates. Need updates for newly allowed boundary and prescription file types from John Deere. Describe the process for handling JD Ops Center boundaries containing different combinations of passable and impassable geometry.	May 7, 2024