Open Source Geospatial Software Case Study

Converting Hard Copy Engineering Records for Sanitary Sewer Networks to GIS Data Using OpenJUMP

Sewer Network Hardcopy Basemap

By Landon Blake, Neal Colwell, and Julian Padilla

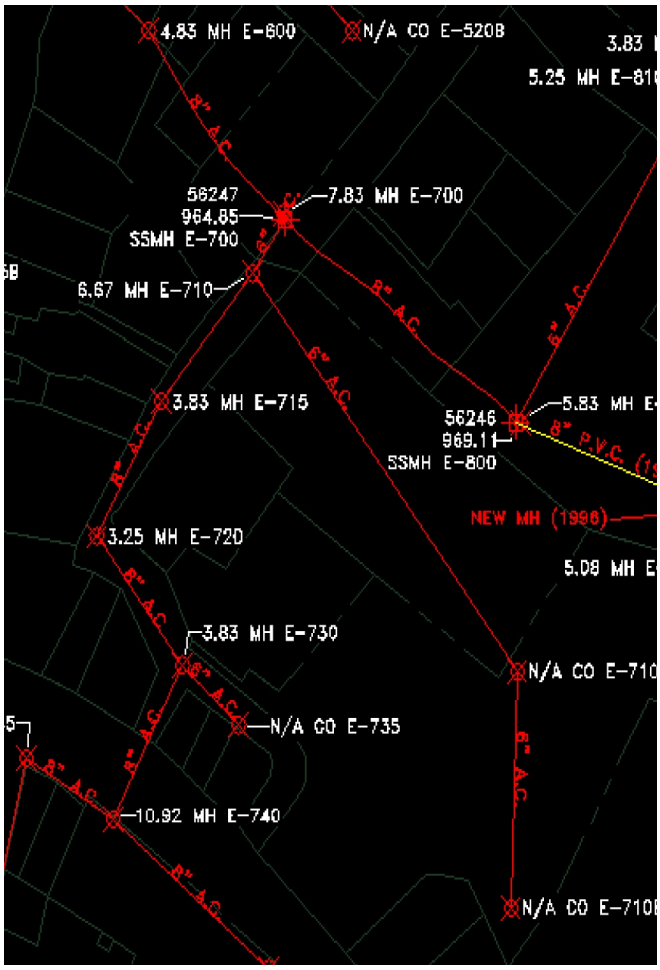
Project Background

KSN is a civil engineering and land surveying company based in Stockton, California, USA. For several decades KSN has been serving a number of small sanitary sewer utility districts in the California Central Valley and Sierra Nevada Foothills. Historically, the engineering data for each district was stored on hard copy basemaps, field notes, inspection reports and plan or profile sheets. In the past decade KSN began to help its clients convert some of these paper records to computer aided drafting (CAD) drawing files.

One limitation of CAD files is the difficulty in associating attribute data with feature geometry. (For example: Associating pipe size, pipe material, and pipe flowline elevations or inverts with a line geometry representing a

sewer pipe.) During the conversion from hardcopy records to CAD drawings, some of the attribute data can be annotated in the CAD drawings as text labels. However, there is a practical limit to the number of attributes that can be annotated in a CAD drawing in this manner. It is also difficult to perform modeling and analysis in CAD using these annotations.

In recent months KSN began a series of projects to convert the hardcopy engineering records and CAD files to GIS. A main goal of these conversion projects is to support modeling and analysis of the sewer networks using the GIS data produced as part of the conversion. The conversion projects are being performed with the help of open source geospatial software.



Sewer Network CAD Basemap Drawing File

The conversion projects are being performed with the help of open source geospatial software.

OpenJUMP

The main tool being used as part of the conversion projects is OpenJUMP. OpenJUMP is an open source desktop GIS program written in the Java programming language. OpenJUMP excels at the creation and editing of vector GIS data. It also features a pluggable architecture which allows for easy custom tool development and integration.

Why Open Source?

Why did KSN choose an open source desktop GIS for these projects? There were a number of reasons why OpenJUMP made sense for these projects. They included:

1) There was no significant upfront

investment required on the part of KSN or the sanitary districts to acquire proprietary GIS software licenses.

2) OpenJUMP is easy to learn and use, requiring little investment in staff training.

3) OpenJUMP plug-ins automate many repetitive and monotonous data entry and creation tasks.

4) OpenJUMP's pluggable architecture facilitate the development of network topology and network analysis tools that can be used with the data produced as part of the projects.

The Project Team

The conversion projects were managed and executed by three (3) key staff members at KSN.

Neal Colwell is a licensed civil engineer and project engineer for KSN. Neal has many years of sewer design, modeling, and analysis experience. He is also an experience consumer of GIS data products and immediately saw a need to convert the hardcopy records and CAD drawings for the small sanitary districts to a GIS format. Neal Colwell is managing the conversion projects and will ultimately use the GIS data produced by the projects for sewer network modeling and design on behalf of the KSN clients.

Landon Blake is a licensed land surveyor and project manager for KSN. As an advocate of open source geospatial software, Landon continually seeks a wider adoption of GIS by engineers and surveyors. He is always looking for opportunities to apply open source geospatial software tools to engineering and surveying problems, including those tackled by KSN staff. Landon is also a volunteer administrator and programmer for OpenJUMP. Landon supervises the data conversion work on the projects and is directly responsible for the creation of the network topology and network analysis plug-ins for OpenJUMP.

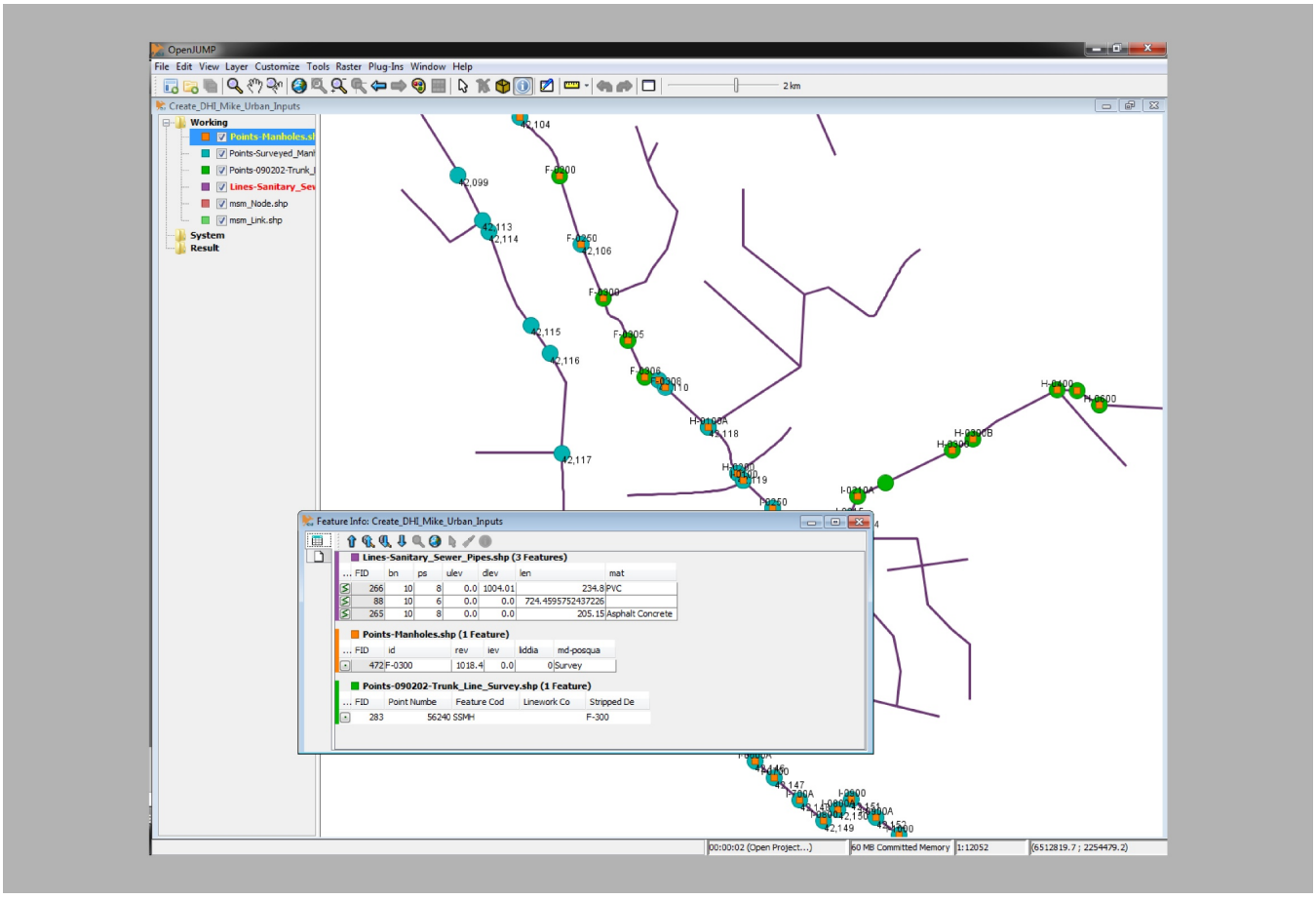
Julian Padilla is an intern at KSN and an engineering student at Delta College in Stockton, California. Julian had previous experience using OpenJUMP during a high school community service project for the California Land Surveyors Association Central Valley Chapter. This experience made him the ideal person to perform data conversion work on the projects.

Project Execution

Two (2) different approaches to project execution are necessary. The first

approach is used for sanitary sewer districts that have CAD drawings representing all or most of their sewer networks. The second approach is used for sanitary sewer districts that still have hardcopy engineering records and little or no CAD drawings.

In the first approach the sanitary sewer network is divided into smaller networks called “branch networks”. The CAD drawing entities representing sewer pipes are segregated by pipe size and branch network. A custom AutoLISP routine developed by Landon is used to export the pipe geometry into WKT format. OpenJUMP is then used to import the WKT pipe data. Once in OpenJUMP the pipe data is attributed from the CAD drawing file text labels and other hard copy records. Surveyed locations of manhole lids are then imported into OpenJUMP using a plug-in developed by Landon. Once in OpenJUMP, the survey data for the manholes is used to create manhole observation features. Manhole features are built from these observations.



Editing Sewer Network GIS Data in OpenJUMP

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Feature level metadata, feature edit history, network topology, and spatial relationships are created and maintained for pipes and manholes during the projects.

In the second approach hardcopy basemaps and other hard copy records are used to draw pipe and manhole features. Georeferrenced county GIS parcel data and aerial photography is used as a background to aid in the drawing of the sewer network in OpenJUMP. Once the vector geometry is created, attributes are added to the pipes and manholes using information in the hard copy records.

Feature level metadata, feature edit history, network topology, and spatial relationships are created and maintained for pipes and manholes during the projects. Network topology is stored in node and connector tables. The topology tables also store the branch identifier and position within the branch for all manholes and pipes.

Network Analysis and Topology Tools

Landon Blake is currently developing OpenJUMP plug-ins to create, manage, and analyze network topology data. Although these plug-ins will be initially used on these projects for sewer network topology data, they will be applicable to networks of all types. The source code for the plug-ins will be released under the GPL through the SurveyOS Project.

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Future Tasks and Opportunities

Once the initial phase of the conversion projects are complete, the KSN project team will turn its attention to additional project tasks and opportunities. These tasks and opportunities include the following:

1) Field surveys to collect high-quality survey grade positions on manholes in the sewer networks that have not yet been surveyed.

2) Development of a GIS maintenance and management plan for each sanitary sewer network.

3) Development of CAD data and reporting tools for OpenJUMP that can be applied to the sanitary sewer network GIS data.

4) Sanitary sewer network basemap production using OpenJUMP and Inkscape.

5) Improvement of sanitary sewer network operation using GIS tools.

6) Development of a network query language plug-in for OpenJUMP.

Conclusion

The sanitary sewer network conversion projects at KSN have definitely proven the concept of using open source geospatial tools in an engineering and surveying environment. OpenJUMP's ease of use and modular architecture has made it an excellent fit for KSN's GIS needs on these projects. The KSN project team looks forward to further enhancing OpenJUMP's capabilities through their own development efforts, to sharing these improvements with the larger open source community, and to finding other applications of open source geospatial software that can benefit KSN's long time clients.

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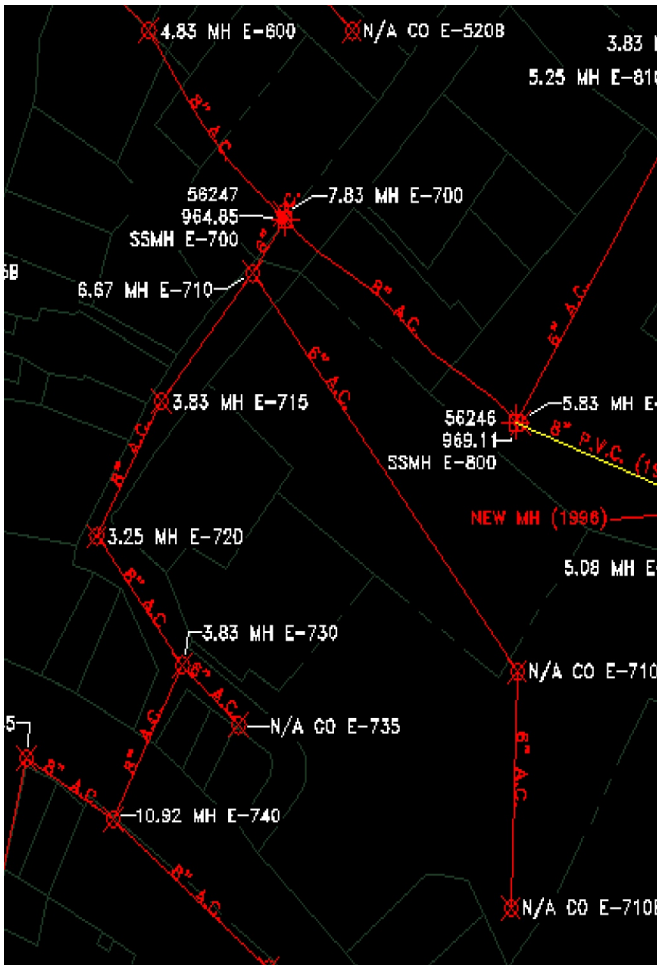

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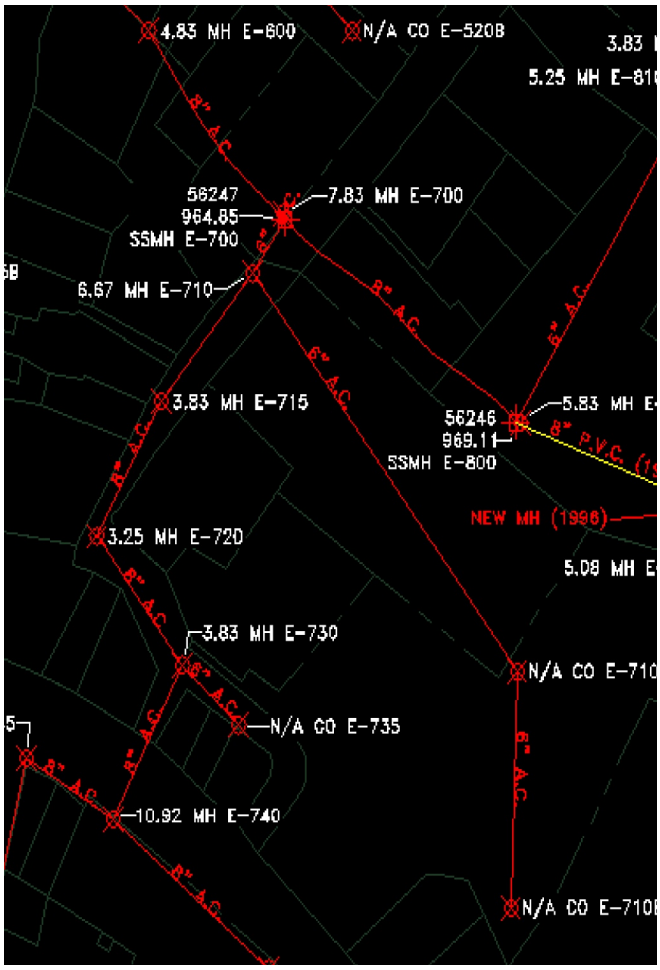

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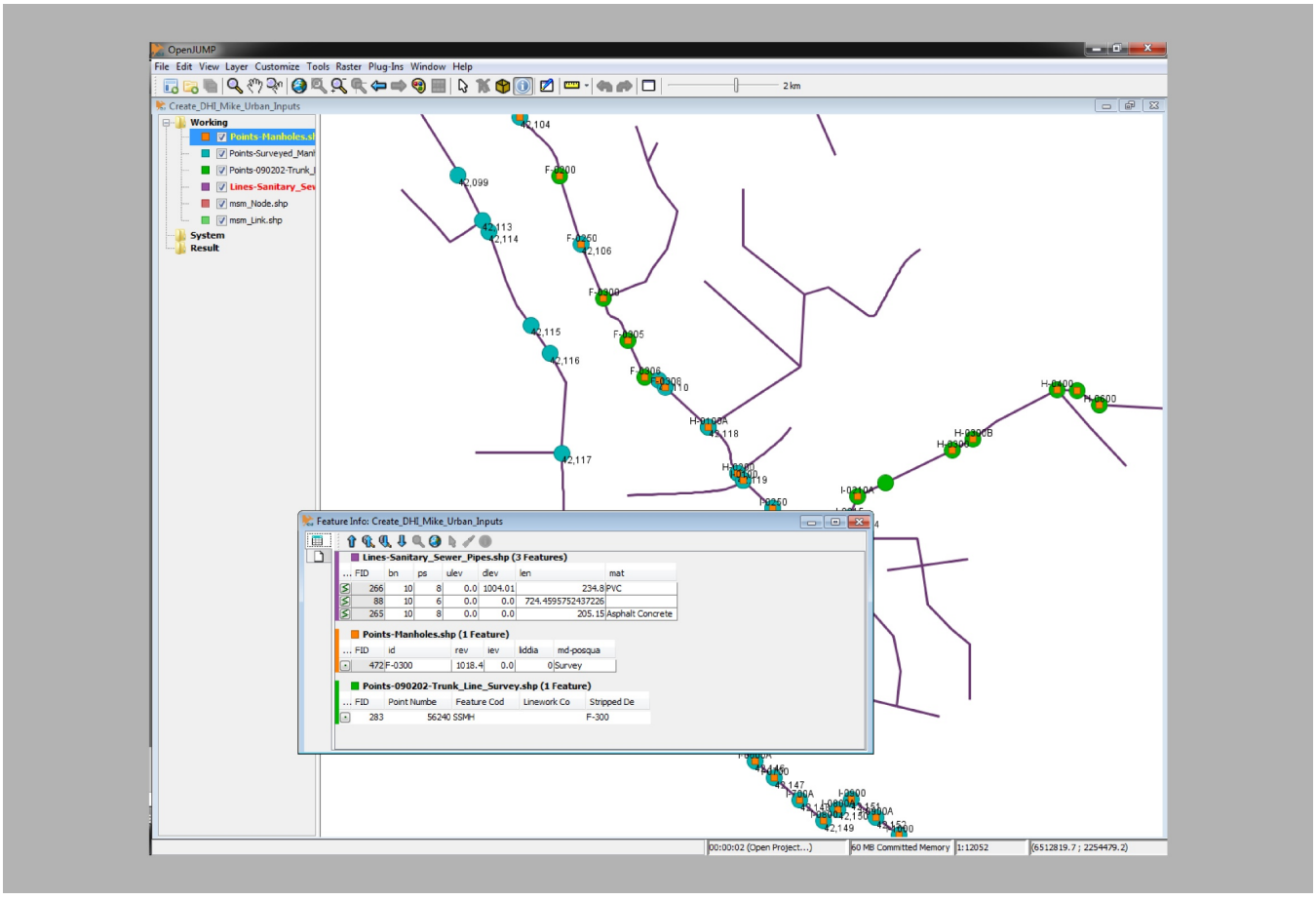

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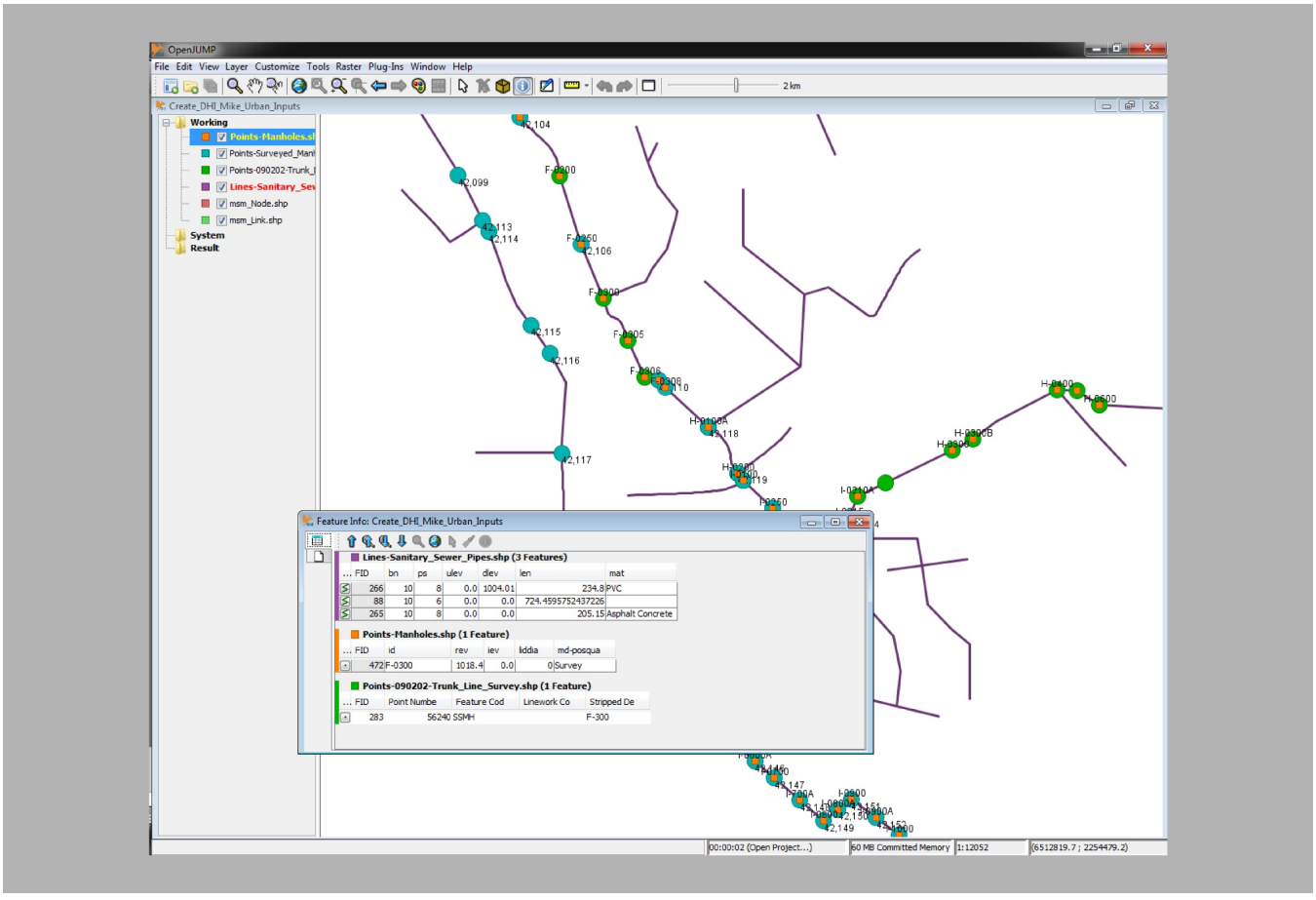

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