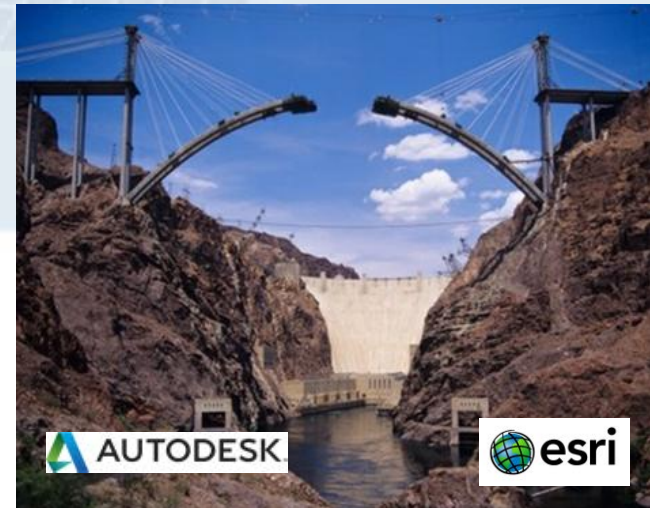


# Leveraging Oracle Spatial and Graph for Airport GIS

**Presenter:**

**Ed Maghboul**  
President, x-Spatial, LLC



# Los Angeles World Airports / x-Spatial, LLC Airport Enterprise GIS, AEGIS

## OVERVIEW

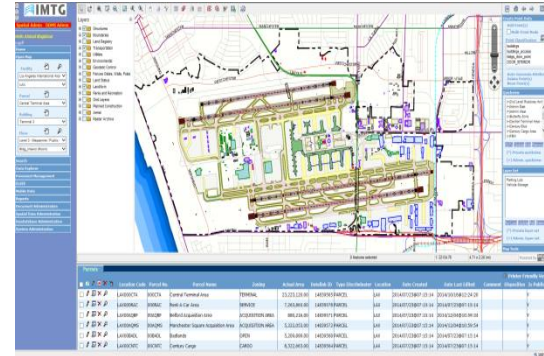
- Los Angeles World Airports (LAWA) is the City of Los Angeles department that owns and operates Los Angeles International (LAX) and Van Nuys (VNY) general aviation airports.
- Sixth busiest airport in the world and third in the United States serving over 74 millions passengers and 2 million tons of cargo in 2016.

## CHALLENGES / OPPORTUNITIES

- Create a single repository for CAD/GIS related data (single source of truth)
- Provide engineering data to a wider audience at the airport
- Support applications that have GIS integration points, e.g., CMMS, Lease Management, etc.

## SOLUTIONS

- Oracle Database 12c with Spatial and Graph option
- Adoption of a flexible data standard
- .NET Framework C#
- ColdFusion Enterprise 11
- Autodesk Infrastructure Map Server 2016
- ESRI ArcGIS Server 10.4.1



## RESULTS

- Establishment of a single source for all geospatial data
- Support for FAA A/C 5300 18b as well as National CAD Standards (no conversion required)
- Multiple platform support (Autodesk & ESRI)
- Provide geospatial data to other LAWA departments
- Over 200 feature classes representing over 2 million geometric features have been uploaded to the database

# Overview

- Introduction
- Requirements / Goals
- Data Management & Challenges
- Solution
- Hurdles
- Benefits
- Q/A

## Introduction

- **LAX** In 2016, LAX served over 74 million passengers, processed over 2 million tons of air cargo valued at over \$90 billion, and handled over 615,000 aircraft operations
  - 680 daily flights to 96 domestic cities
  - 930 weekly nonstop flights to 59 cities in 30 countries on 63 commercial air carriers.

## Requirements/Goals

- Create a single repository for CAD/GIS related data (single source of truth)
- Provide engineering data to a wider audience at the airport
- Support applications that have GIS integration points, e.g., CMMS, Lease Management, etc.
- Perform Sophisticated Model Driven Spatial Analysis and Visualization of Results
- Take advantage of the tools and technologies that are built around GIS, e.g. Spatially driven mobile applications

# Challenges

- Variety of data
  - Over 200 feature classes
  - Over 2 Million geometric features in the database
    - 1.5 Million floor plan features
    - 500 ~ 700K of SDS/FIE classified features
- Years of effort have been devoted to authoring maps and developing symbology for a “corporate look and feel”

# Challenges

**Layers**

- Buildings
  - Structure Foundation Line
  - Building
  - Existing Structure
  - Future Structure
  - Slab Area
  - Boarding Bridges
  - Tenants
- Boundaries
  - LAWA Property Line
  - State Area
- Land Registry
  - LAX LANDBASE
  - LAX Tracts 07232013
  - Ground Lease - Avisoft
  - Ground Lease
  - Acquisition Area
  - Airport Areas
- Transportation
  - Airside
    - Airfield Light Point
    - Navigational Aid Point
    - Aircraft Parking Spot
    - Service Road
    - Airfield Marking
    - Facility Maintenance Area
    - Runway
    - Taxiway
    - Taxilane
    - Apron
    - Infield
    - Airfield Surface
    - Airfield Surface Proposed
  - Landside
  - Thomas Brothers

**Layers**

- Landside
  - Road Centerline
  - Railroad Centerline
  - Surface Marking
  - Bridge Columns
  - Pedestrian Footbridge
  - Road Bridge
  - Median
  - Road Shoulder
  - Driveway
  - Road
  - Tunnel
  - Cargo Vehicle Loading Zone
  - Vehicle Parking Lot
- Thomas Brothers
  - TB-Freeway
  - TB-Freeway Connectors
  - TB-Railroad
    - Railroad
    - Rapid Transit
    - TB-Streets
- Utilities
  - Communications System
    - Manhole
    - Twisted Pair Cable
    - Fiberoptic Cable
    - Coaxial Cable
    - Other Cable
    - Antenna Line
    - Ductbank
    - Antenna Area

**Layers**

- Energy Control Monitoring System
  - Cable Line
  - Compressed Air System
    - Pipe Line
  - Electrical System
    - Cable
    - Ductbank
  - Fuel System
    - Pipe
    - Tank
  - Communication / Electrical Sites
    - Conduit Centerline
    - Substructure
  - Industrial Waste System
    - Pipe
    - Oil / Water Separator
  - Hot and Chilled Water System
    - Pipe
  - Natural Gas System
    - Pipe
    - Proposed Pipe
    - Pump Station
  - Water System
    - Hydrant
    - Pipe
    - Proposed Pipe
    - Tank
  - Sanitary Sewer System
    - Pipe
    - Oil / Water Separator
  - Storm Drain System
    - Pipe
    - Proposed Pipe
    - Open Drainage
    - Culvert

**Layers**

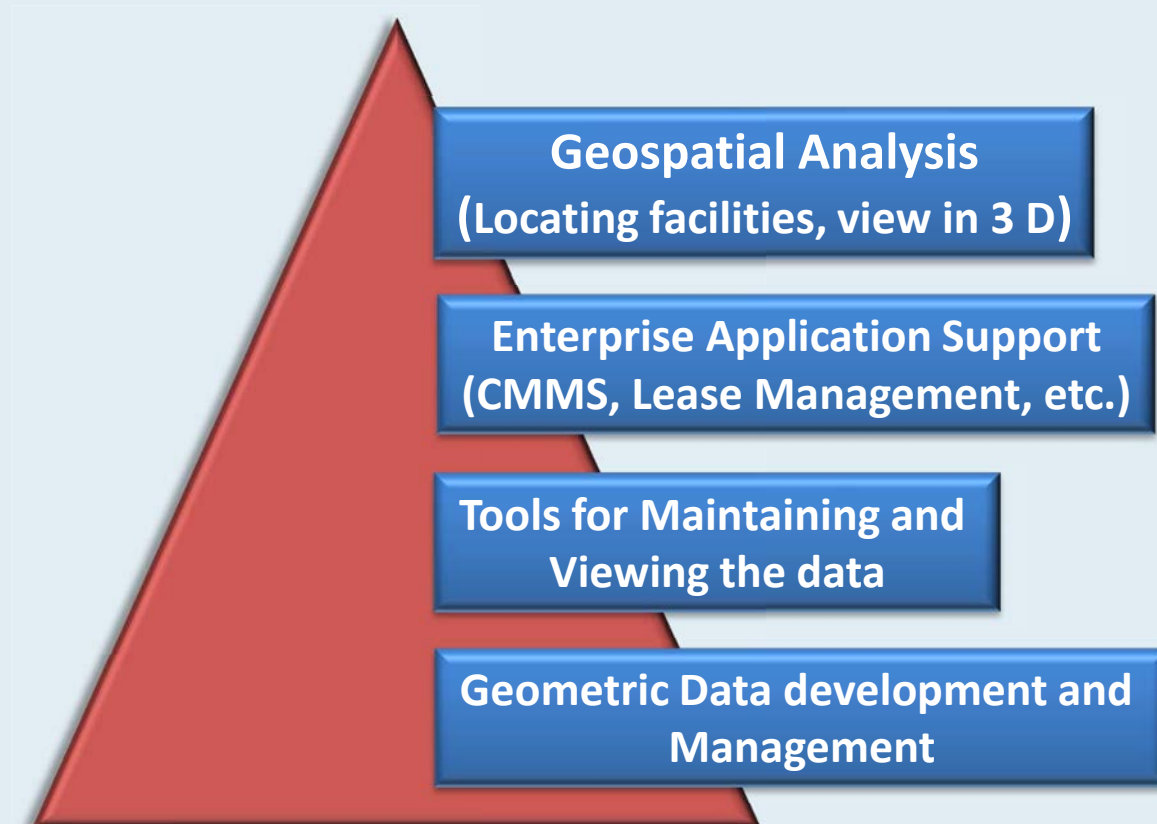
- Environmental
  - Regulated Tanks
    - Underground Tank Point
    - Above Ground Tank Site
  - Butterfly Preserve Area
    - Buckwheats
    - ESB Preserve Boundary
- Flora
  - Flora Species Site
  - Land Vegetation Area
- Geodetic
  - Survey Control
    - Control Point
- Fences Gates and Walls
  - Flagpole Post and Sign
  - Gate
  - Wall
  - Fence
  - Security Perimeter Fence
  - Miscellaneous
- Land Status
  - Construction and Other Use
    - Construction Site
    - Batch Plant
    - Concrete Material Yard
  - Dockweiler Beach
    - Dockweiler Beach
  - Land Condition
- Landform
  - Spot Elevation Point
  - Elevation Contour Line
  - Pacific Coast
- Parks and Recreation
- Grid Layers
- Aerial

# Database Organization

- Oracle Stored Procedures and Packages for
  - Spatial data classification
  - Security
  - Automatic Spatial View Creation
  - Geodatabase creation
  - Spatial Data cleanup (Geometry)
- Triggers
  - Spatial table
    - Before Insert – Auto populate fields
    - After Insert – Create & link record in the attribute table
    - Before Update Auto populate fields
    - After Update – Maintain data integrity
    - Before Delete – Clean up attribute table records

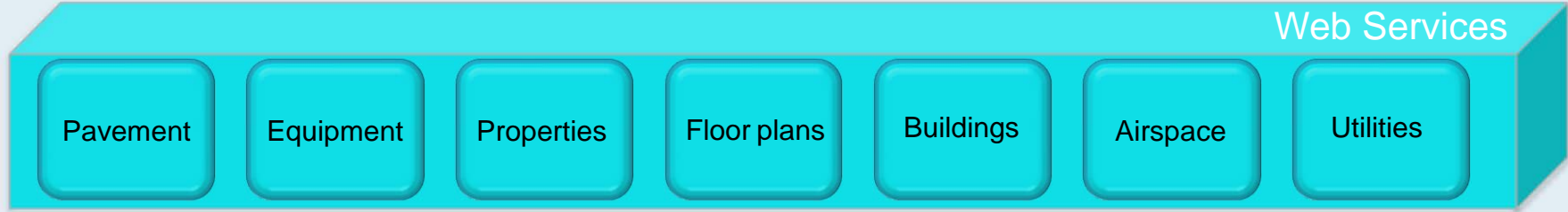


# Data Management - Foundational Blocks

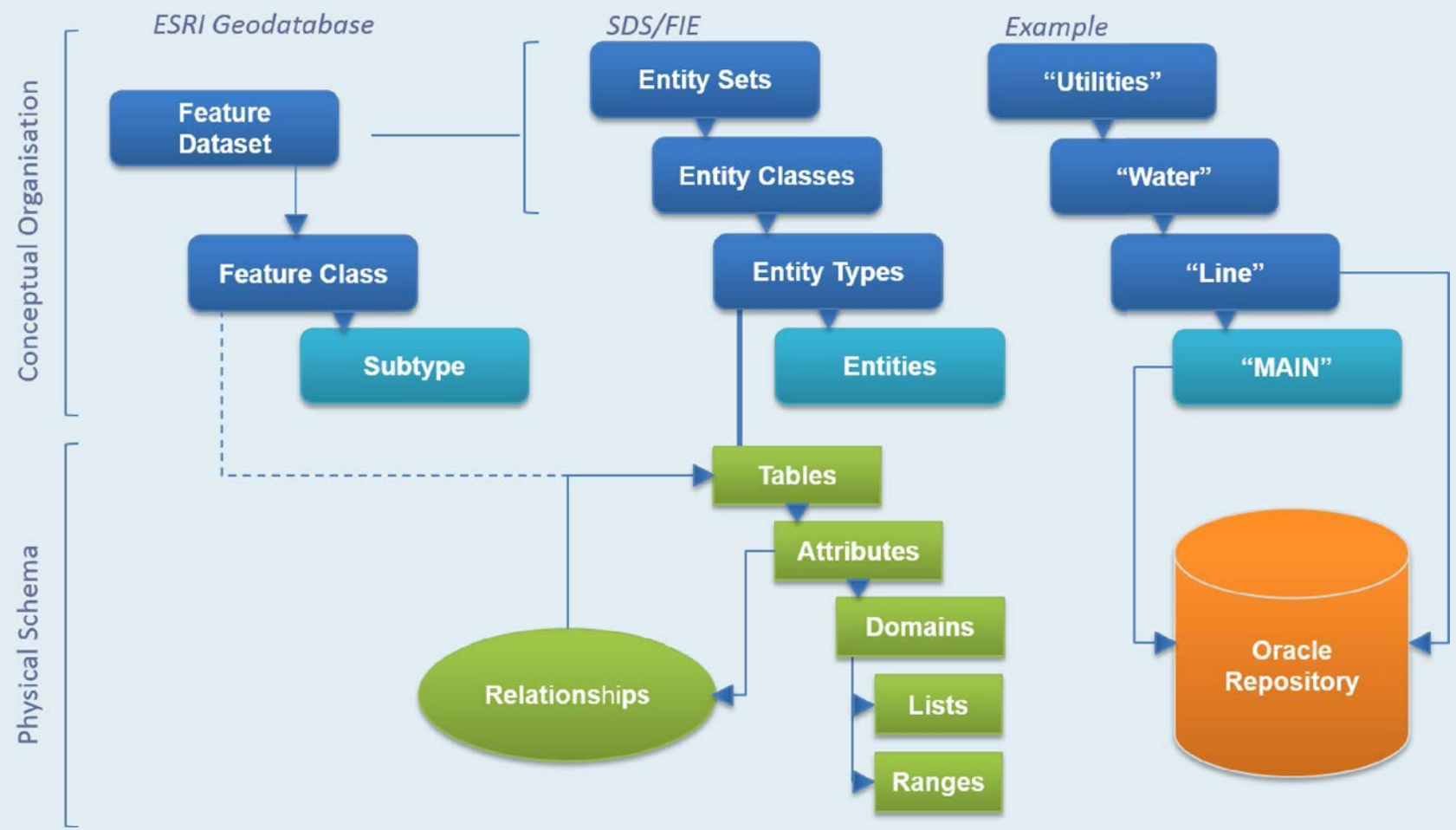


# Data Management - Organization

- Selection of an RDBMS with direct support for standardized geometry support (currently Oracle Database 12c with Spatial and Graph option)
- Adoption of a flexible data standards (SDS / FIE)
  - An existing national data standard
  - Ability to filter out relevant data for the airport
  - Open spatial data standard covering both CAD & GIS platforms
- Adopt flexible data standards to support current and future requirements
  - Support for NCS
  - Support FAA A/C-5300 18b
  - Support for multiple platforms (e.g. Autodesk, ESRI, etc.)
  - Easily customizable



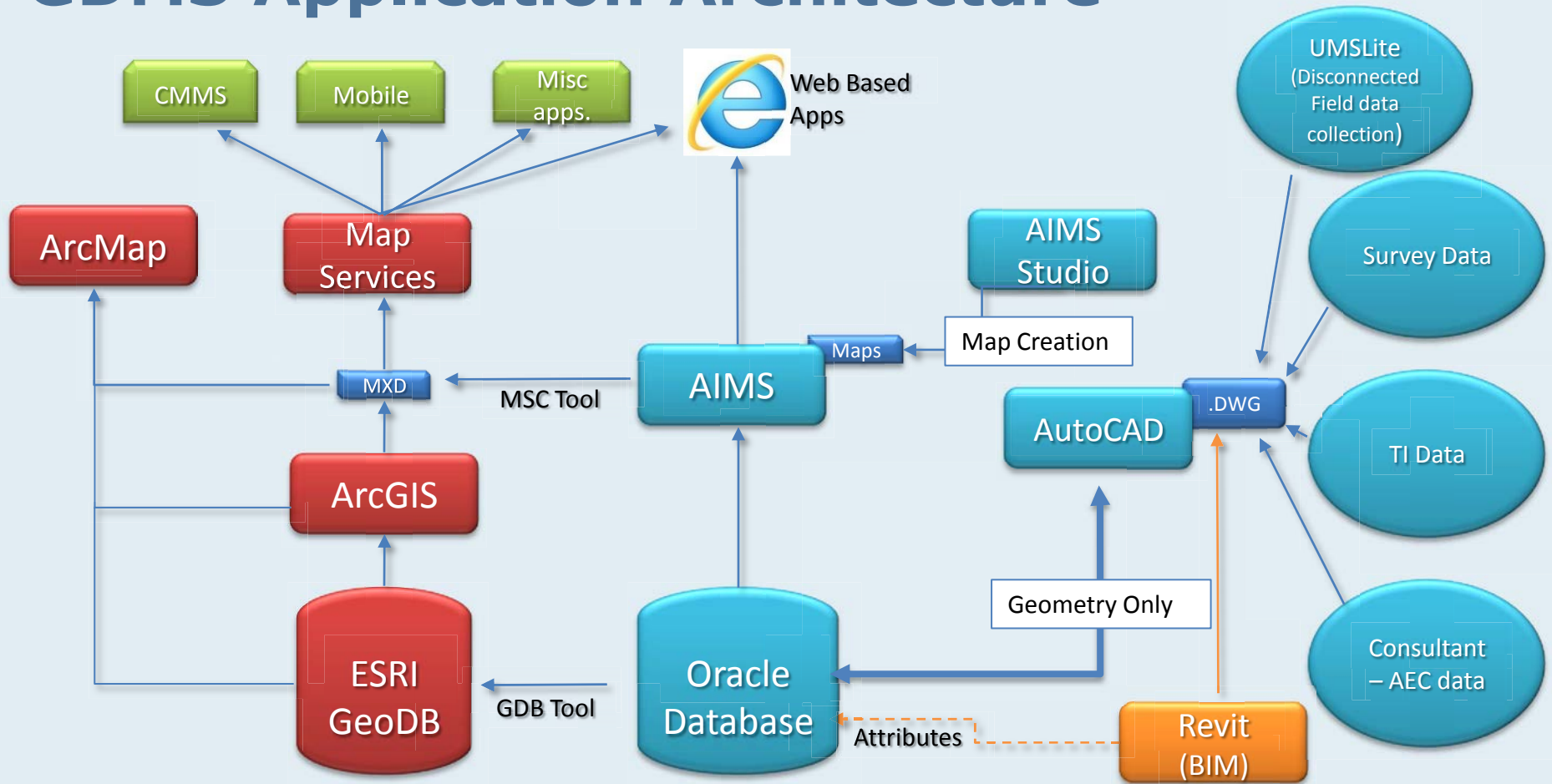
# Data Management - SDSFIE Implementation



# Database Schema

- Two Oracle Schemas
  - Spatial Data
  - Non-Spatial Data
- Single Oracle table for storing Spatial data and common attributes
  - Feature Classification information
  - Username/time stamp
- 1370 attribute tables for feature type specific information (e.g., pipe diameter, material, etc.)
- Over 36,000 attributes in the above attribute tables

# GDMS Application Architecture



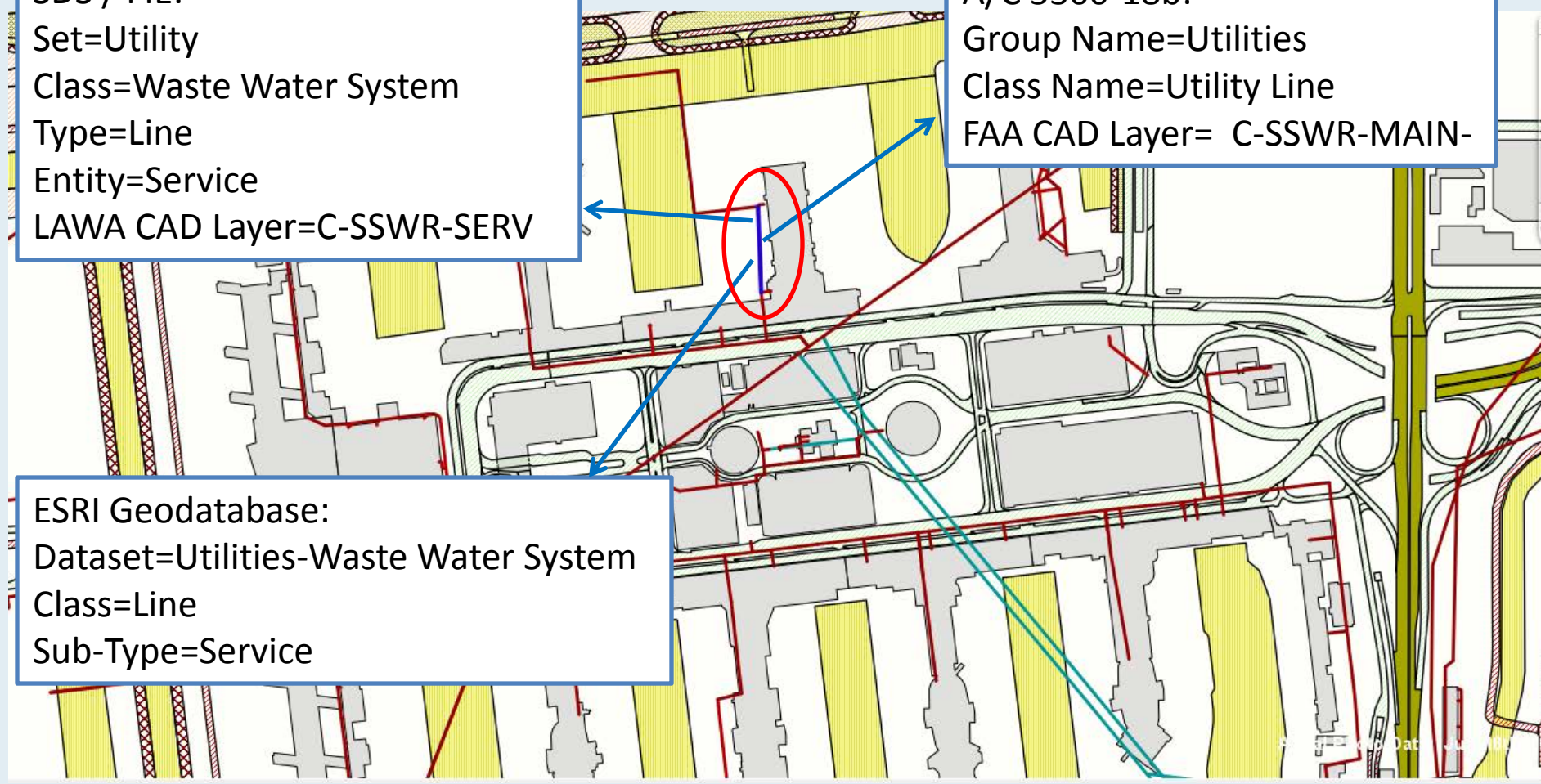
MSC & GDB Tools are software modules developed by x-Spatial to support the ESRI platform.

# Data Management - Application of standards

SDS / FIE:  
Set=Utility  
Class=Waste Water System  
Type=Line  
Entity=Service  
LAWA CAD Layer=C-SSWR-SERV

A/C 5300-18b:  
Group Name=Utilities  
Class Name=Utility Line  
FAA CAD Layer= C-SSWR-MAIN-

ESRI Geodatabase:  
Dataset=Utilities-Waste Water System  
Class=Line  
Sub-Type=Service



## Web Based Maintenance of the Database Schema

- Using the web interface to maintain the DB schema
- Defining new features using web forms rather than “GIS or CAD centric” tools.
- Easier and more Efficient
- Eliminates the need for ad-hoc programming



# Web Based Maintenance of the Database Schema

AEGIS Entity Class - Edit Record - Internet Explorer  
 https://gis2.x-spatial.com/UMS/cfscrip.../Forms/SDS\_EntityClass\_Edit.cfm?Caller=/UMS/cfscrip.../sds\_Entit

Class Name

Set Name  (Active Sets ONLY)

Is Active?  Yes  No

Geodatabase Export Options

Feature Dataset Name

Abbr. Feature Dataset Name

Snap Tolerance

Definition

OK Cancel

AEGIS Entity Types - Edit Record - Internet Explorer  
 https://gis2.x-spatial.com/UMS/cfscrip.../Forms/SDS\_EntityType\_Edit.cfm?Caller=/UMS/cfscrip.../SDS\_EntityClass.c

Entity Type Name

Entity Type Label

Class Name  (Active Classes ONLY)

FAA Class Name

Is Active?  Yes  No

Attribute Table Name

Required For FAA eALP?  Yes  No

FAA Group Name

Geometry Type

Default Discriminator

Interior Feature?  Yes  No

Mobile Use?  Yes  No

Geodatabase Export Options

Feature class Name

Abbr. Feature Class Name

Create Feature Class?  Yes  No

Participate in Geometric Network?  Yes  No

Feature Class Role

Source/Sink?  Yes  No

Definition

FAA Definition

OK Cancel

AEGIS Entity - Edit Record - Internet Explorer  
 https://gis2.x-spatial.com/UMS/cfscrip.../Forms/SDS\_Entity\_Edit.cfm?Caller=/UMS/cfscrip.../SDS\_EntityType.cfm&Start=1&Base

Entity Name

Discriminator

Is Active?  Yes  No

Mobile Use?  Yes  No

CADD Geometry type

Interior Feature?  Yes  No

CADD Layer Name

CADD Block Name

FAA CAD Layer

FAA CAD Layer Description

OK Cancel

**Note:** If you are changing the "Is Active" settings of this Entity, be sure to run the "Update AutoCAD Object Classes" command of the SDS-Administration Panel. Update the Object Classes when you are finished with changes to all Entities (including deleting)

**Note:** If you are changing the "Is Active" settings of this Entity type, make sure to run the following commands of the SDS-Administration Panel.

- **Update AutoCAD Object Classes** - To update the Object class tree control used in AutoCAD
- **Update Feature Views** - To update the feature view in Oracle

You can run these updates when you are finished with **ALL** changes to Entity types and attributes settings (including deleting)

## **Web Based Maintenance of the Database Schema**

- Allows Data Administrators to add any feature type with any set of attributes
- No programming is needed for modifying
  - User interface
  - Oracle tables and fields
- Extremely time efficient for data maintenance.

## Why Use CAD to Maintain Data?

- AutoCAD is the primary tool for data development at the airport
  - All construction / engineering / survey data is delivered in BIM / CAD format
  - AutoCAD provides a simpler & more streamlined tools for data development and maintenance
  - Communication with outside AE firms
- Data maintenance tools are currently CAD based
- CAD data requirements from other airport groups

## CAD Data Development – Floor Plans

The screenshot displays the Autodesk AutoCAD Map 3D 2014 interface. A dialog box titled "Drawing Location and ID" is open, allowing for the configuration of drawing metadata. The "Location" section includes dropdown menus for Facility (Los Angeles International Airport), Parcel (CTA), Building (Terminal 2), and Floor (Level 1 - Baggage Claim). The "Drawing" section includes a dropdown for Boundary Type (Room) and a text field for Sheet ID. The "Location ID" field contains the alphanumeric code "LAX000CTA00T201", which is highlighted with a red circle. The background shows a 3D floor plan of an airport terminal with a yellow highlighted area. The software interface includes a ribbon with various toolsets, a task pane on the right showing a tree view of the drawing's structure, and a status bar at the bottom.

Geo-locating a floor plan, prior to uploading the drawing to Oracle Database, the location code is customizable and is created during the drawing setup process.

## CAD Module – Floor plan and attribute query

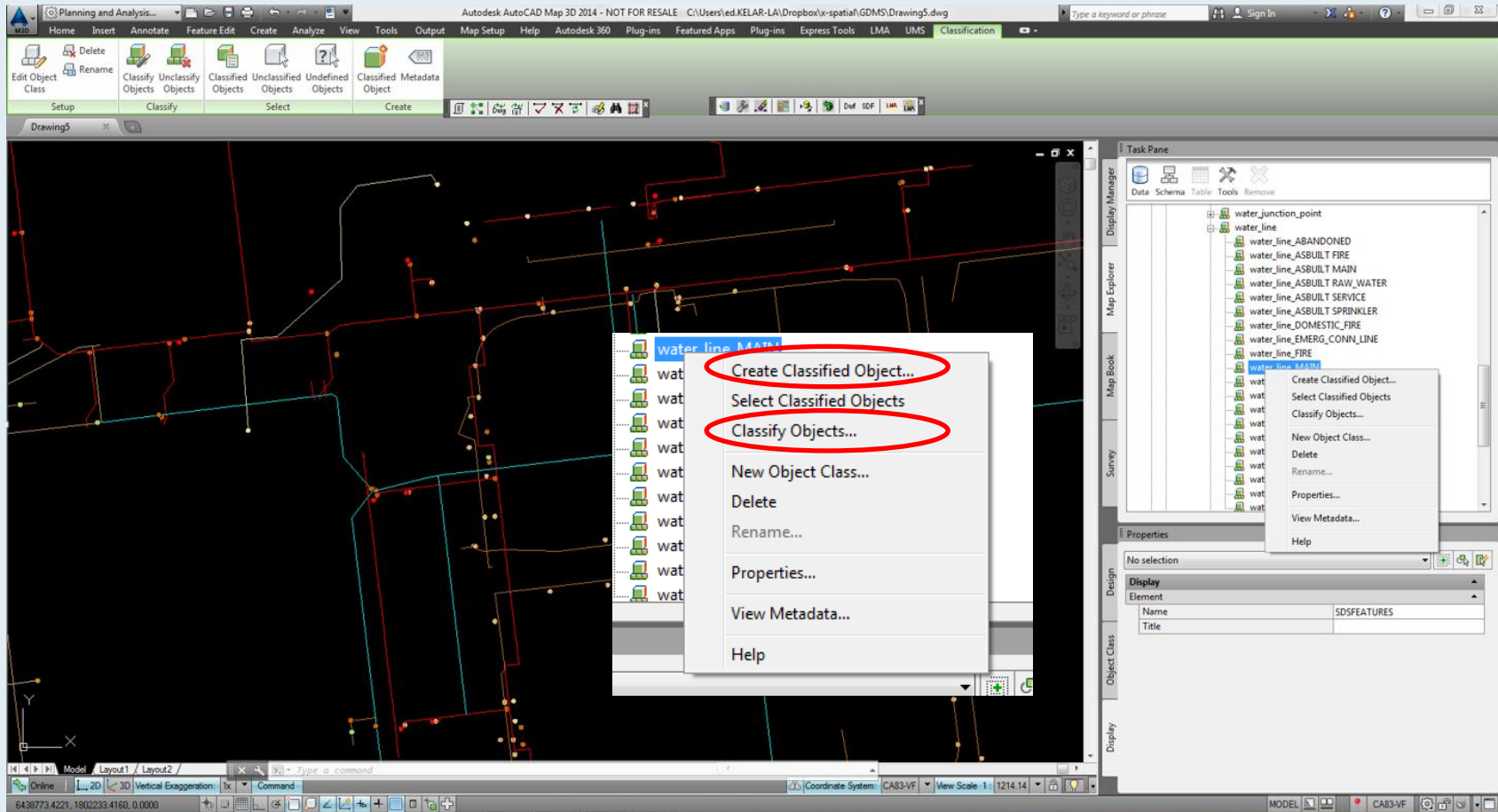
The screenshot displays the AutoCAD Map 3D 2014 interface. The main window shows a floor plan with 15 numbered spaces (1-15) overlaid on a grid. A 'Space Attributes (LAWA)' dialog box is open on the right, showing the following data:

General Information	
Revision Number	<input type="text"/>
Space No.	2
Location ID	LAX000CTA00T201010002
Use	Baggage
Type	Service
Description	Claim
Status	None
CADD Area	20177.00
Alternate Area	40.00
% diff. Area	99.80
Agreement Information	
Company Name	City of Los Angeles
Agreement No	7228
Space No	0001
Commencement Data	<input type="text"/>
Termination Data	<input type="text"/>

Buttons at the bottom of the dialog: OK, Cancel, Help.

The CAD Modules capability allows viewing lease & spatial attribute data (queried from the dB) of a space in AutoCAD Map

# CAD Module – Exterior utilities



The object classification tool, allows for creation of objects per CAD & GIS specification, while the second “converts” drawing elements submitted by outside consultants to your standards.

# CAD Module – Exterior utility query

The screenshot displays the AutoCAD Map 3D 2014 interface. The main window shows a map of utility lines and nodes. A 'Task Pane' on the right contains a legend for the 'SDSFEATURES' layer, listing various utility types with corresponding symbols. A 'Properties' window at the bottom right shows the current object's properties. A 'Map Explorer' on the right shows the current layer and feature set.

The 'Entity Attribute' window on the left displays the following data for feature ID 2732403:

Attribute	Value
Location	LAX
Created By	axmelikyan
Date Created	2008/11/06@15:12:42
Last Edited By	axmelikyan
Date Last Edited	2008/11/07@13:53:15
Reason Code	
Quality Level	
Ddms Source	0026514
Qa Status	1 - GEOMETRY ONLY
Owner Operator	
Leaseholder Name	
Comment	1982/09/08
Disposition	
Is Published	Y

The 'Properties' window shows the following settings:

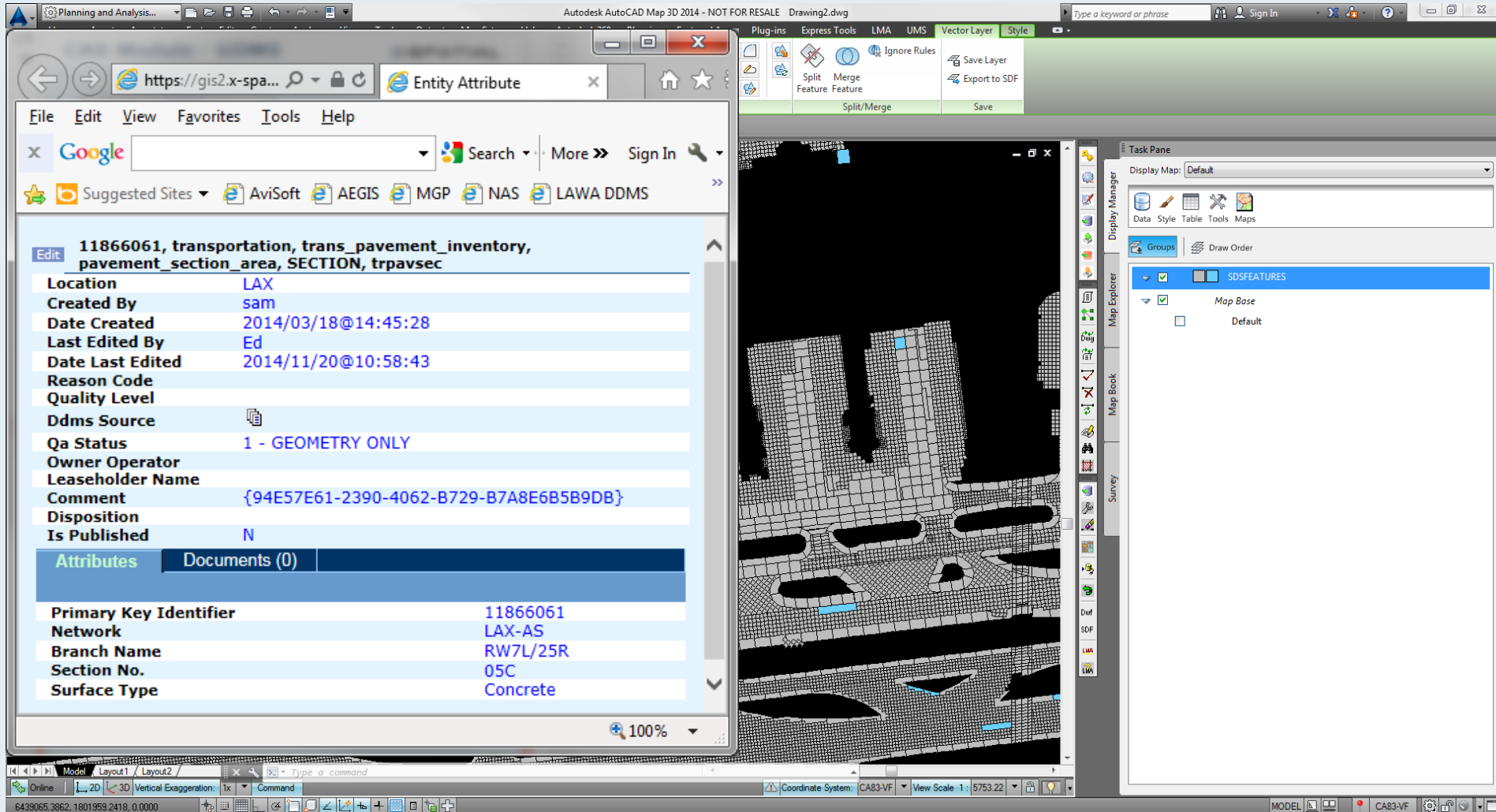
Property	Value
Color	ByLayer
Layer	0
Linetype	ByLayer
Linetype scale	1.0000
Lineweight	ByLayer
Transparency	ByLayer
Thickness	0.0000

The 'Map Explorer' shows the following details:

Property	Value
Layer	SDSFEATURES
FeatId	2732403
AS_COMMENT	1982/09/08
AS_CONTACT_INFO	NULL

GDMS' CAD Module allows viewing attribute data for a feature inside AutoCAD Map

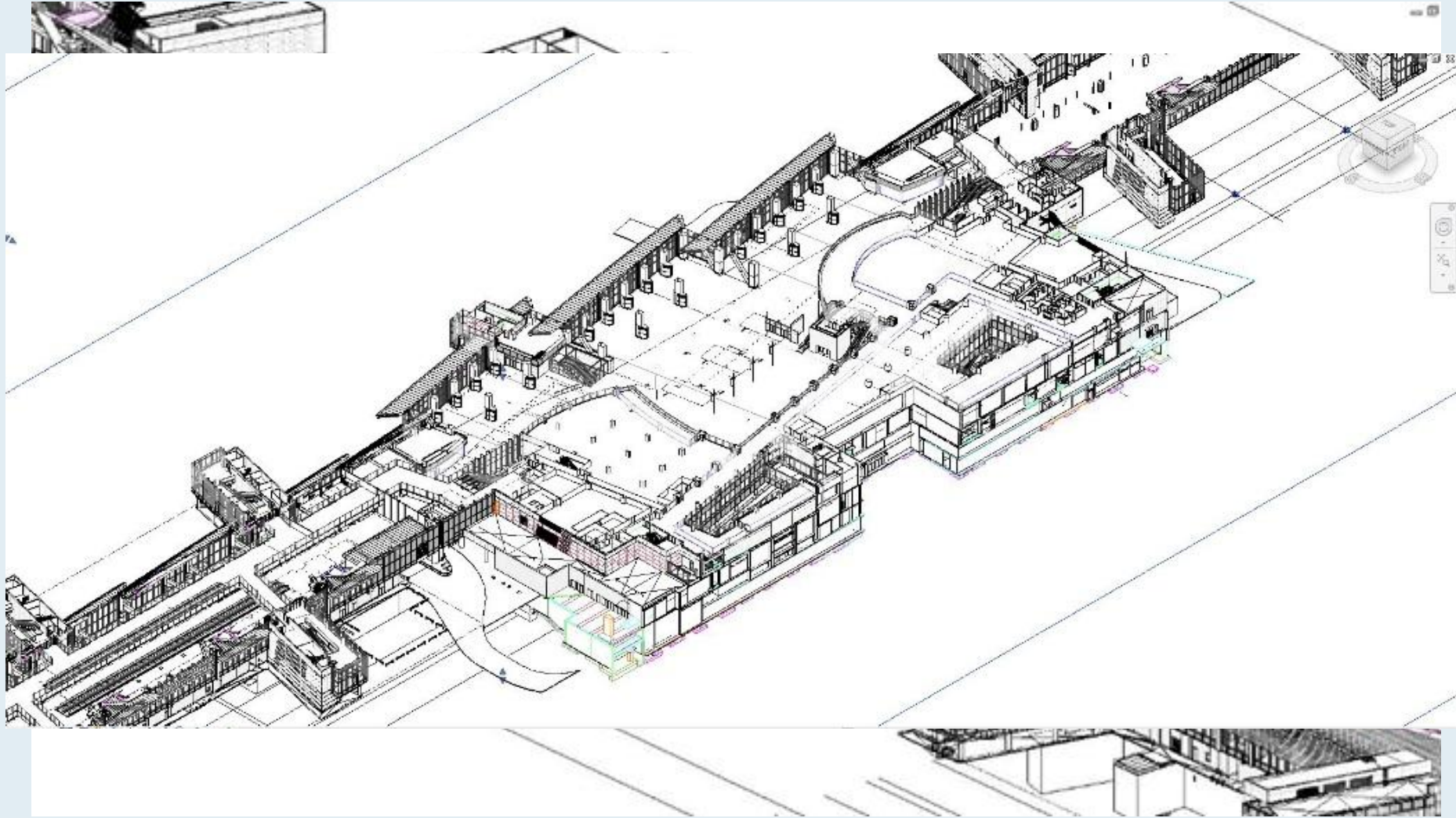
# CAD Module – Pavement Management



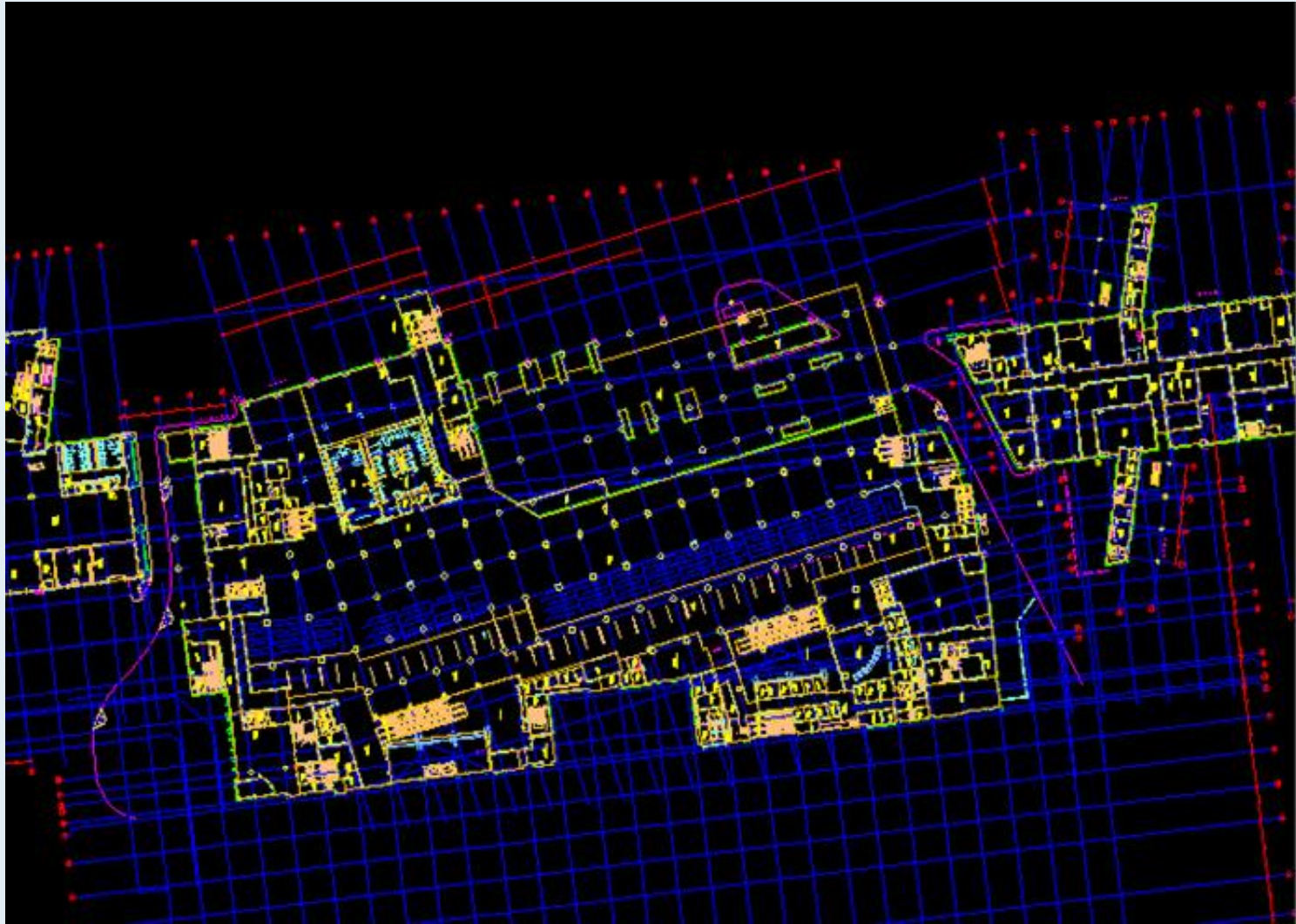
The result of querying pavement data (grey polygons) from the database



# Design



# As-Built Plans



# GIS Data

**Layers**

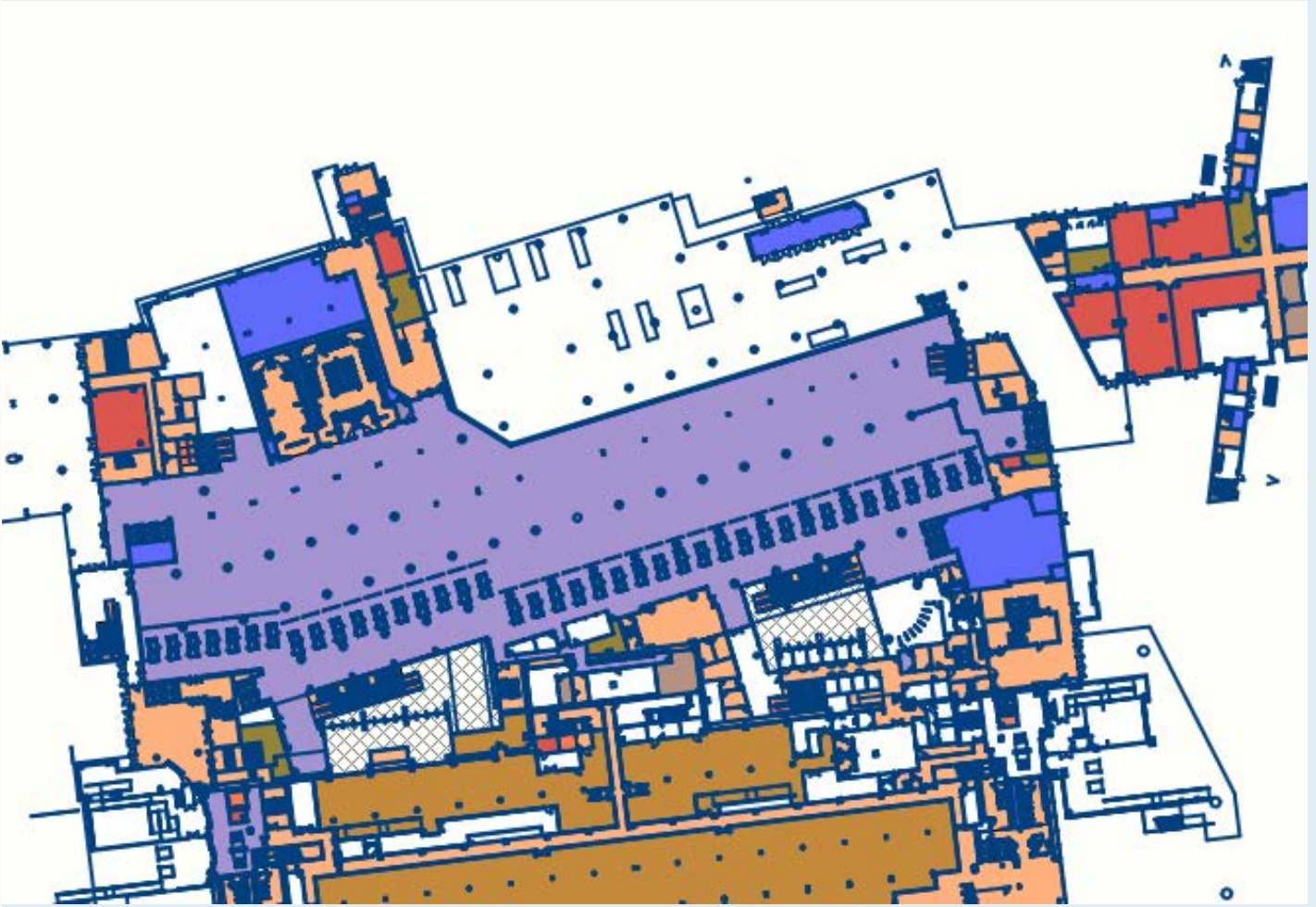
- Points
- MLE
  - Floor Plan
  - Construction Area
- Construction Area
- Security
- Cleaning Responsibility
- Space Occupant
- Space Description

- Baggage
- Boarding
- Cargo
- Concessions
- Custodial
- Equipment
- Facilities
- Lease
- Maintenance
- Miscellaneous
- Open
- Operations
- Passage
- Safety
- Security
- Service
- Ticketing
- Utilities
- Utilities - Communications
- Utilities - Electrical
- Utilities - Mechanical
- Unknown/Undefined

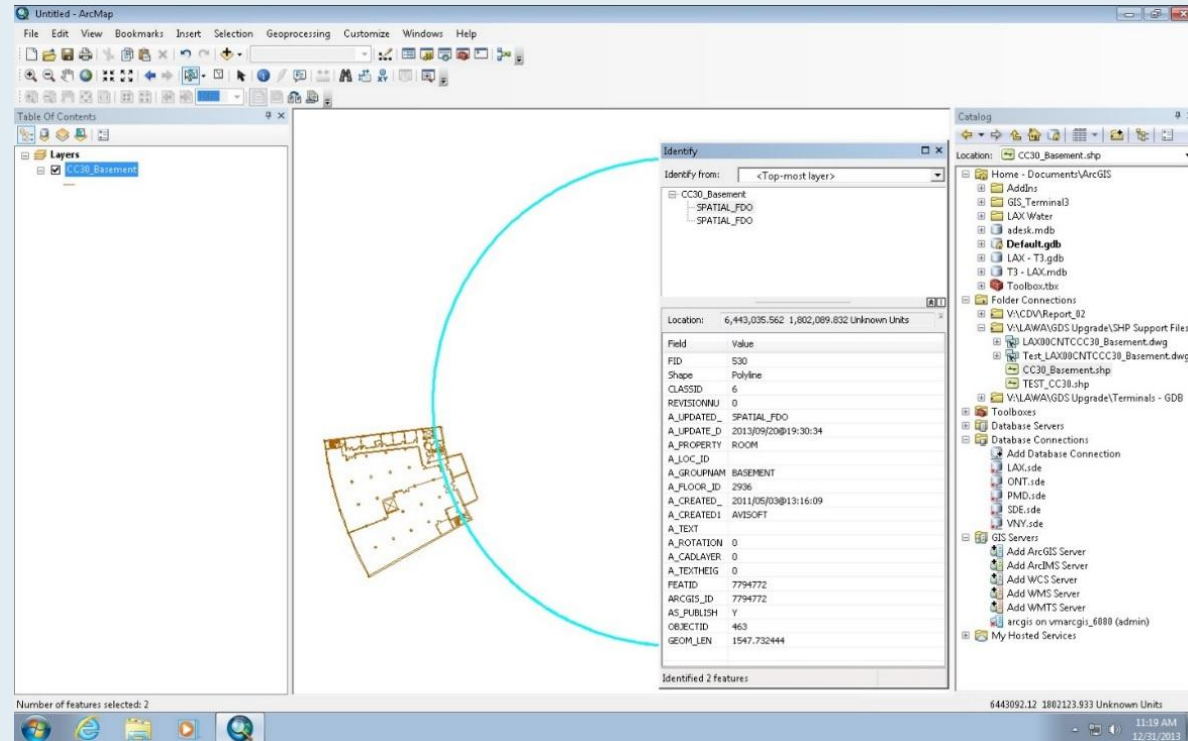
  

- Base Map



# Hurdles

- Geometry data issues
  - Incompatible Geometry types (e.g. AutoCAD Polyline with an arc segment is not supported in GIS)
  - Geodatabase feature classes are limited to a single geometry type (i.e. Point or line or polygon)



## Data clean up

- Transferring spatial data to ESRI Geodatabase requires geometry data cleanup.
- The following Geometry data cleanup are performed using Oracle SDO\_XXX utilities (packages)
  - Fix vertices order –sdo\_geom.validate\_geometry
  - Polygon overlapping itself (bowtie) - sdo\_geom.sdo\_union
  - Convert arcs to strokes , ie densify - SDO\_GEOM.SDO\_ARC\_DENSIFY

# Solution

- Development of tools for cleaning data
  - CAD geometry are not as clean as they need to be for GIS use
- Development of tools for creation of geodatabase
  - Ability to publish any SDS / FIE feature types into its corresponding Geodatabase feature class
  - Leveraged the SDS/FIE open standard to bridge data between CAD & GIS
  - Automated process for creation of a geometric network

## Geodatabase Export Dataset Feature Classes

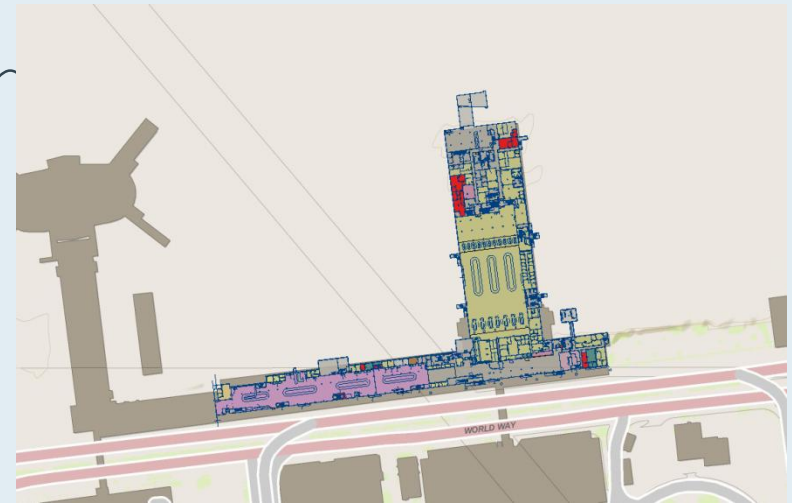
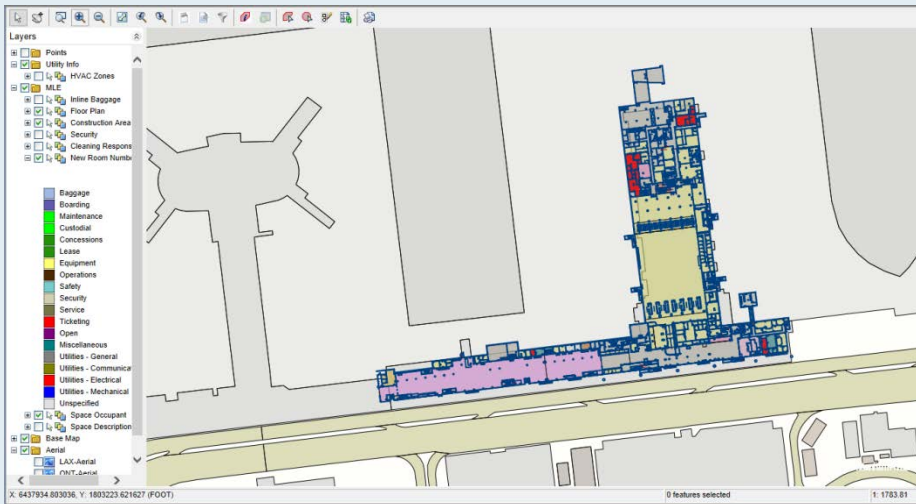
The following Feature Classes will be exported to Geodatabase.

Dataset Name [utilities\\_wastewater](#)  
 Entity Class Name(s) [utilities\\_wastewater\\_system](#)  
 Create Network  Yes  No

Feature Class Name	Network Participate?	Abbrev. FC Name	Entity Type Name
wastewater_anode_point	No	FC_201079	wastewater_anode_point
wastewater_discharge_point	No	FC_200776	wastewater_discharge_point
wastewater_disposal_tank_site	No	FC_200392	wastewater_disposal_tank_site
wastewater_downspout_area	No	utwwtdsa	wastewater_downspout_area
wastewater_downspout_point	No	FC_200375	wastewater_downspout_point
wastewater_drain_field_area	No	FC_200376	wastewater_drain_field_area

# Solution

- Development of tools for:
  - Creation of Map Services based on existing corporate thematic & symbology



## Benefits

- The automated creation of feature class definitions has greatly streamlined the geodatabase creation
- Changes to feature class definition (attributes, domains, sub-types) are automatically transferred to Geodatabase
  - No need to use ArcCatalog
- Maintain synchronicity between CAD & GIS platforms
- Leverage the best tools for solving real-time problems



# Example .. ArcMap

The screenshot displays the ArcMap interface with the following components:

- Table of Contents:** Shows a hierarchical list of layers. The 'Mezzanine' layer is expanded, showing sub-layers like 'LAX.MEZZANINE\_FLOORPLAN' and 'LAX.T1\_MEZZANINE\_TENANTS'. A legend below lists various room types such as Boarding, Concessions, and Security.
- Main Map Area:** Displays a detailed floor plan of the terminal building with different rooms and corridors highlighted in various colors corresponding to the legend.
- Catalog Pane:** Shows the project's data source structure, including folders for 'LAX.sde', 'LAX.An', 'LAX.Ter', and 'LAX.util'.
- Identify Window:** A pop-up window showing the attributes of the selected feature. It includes a table with the following data:

Field	Value
FEATID	9010718
A_CREATED_BY	BEHZAD
A_CREATED_DATE	2012/08/08@20:55:06
A_FLOOR_ID	1862
A_GROUPNAME	20100001A-08
A_LOC_ID	LAX000CTA00T103080021
A_PROPERTYTYPE	ROOM
A_UPDATE_DATE	2012/08/08@20:55:06
A_UPDATED_BY	BEHZAD
AS_PUBLISHED	Y
PROPERTYID	42741
FLOORID	1862
AREA	974
EXCLUDEDAREA	0
ROOMID	54760
LOC_ID	LAX000CTA00T103080021
ROOMNO	21
USE	Concessions
TYPE	Retail
ROOMDESCRIPTION	Food and Beverage
STATUS	<null>
RECARIA	808
BEYONDSECURITY	1
CLEAN_RESPONSID	<null>
ACTUAL_ROOMNO	<null>
CLEAN_RESPONSDESC	<null>
PROP_ORIGINDESC	<null>
SPACEFUNCTIONDESC	Concessions
SPACESUBFUNCTIONDESC	<null>
BILL	<null>
BILLQTY	2156
COMMENCEMENTDATE	<null>
CONTRACTID	856
RENTCOMMENCEMENTDATE	<null>
SPACEID	67846
SPACENO	0001

6439835: Identified 1 feature

# Example .. AutoCAD

The screenshot displays the AutoCAD Map 3D 2012 interface. The main window shows a 3D model of an airport terminal floor plan, rendered in a perspective view. The model is color-coded, with orange and green areas representing different sections of the terminal. The interface includes a Properties panel on the left, a Design and Display toolbars, and a Command window at the bottom.

**Properties Panel - Feature Properties:**

FeatId	9010718
ACTUAL_ROOMNO	<Null>
AREA	974.0000
AS_PUBLISHED	Y
A_CREATED_BY	BEHZAD
A_CREATED_DATE	2012/08/08@20:55:06
A_FLOOR_ID	1862
A_GROUPNAME	20100001A-08
A_LOC_ID	LAX000CTA00T103080021
A_PROPERTYTYPE	ROOM
A_UPDATED_BY	BEHZAD
A_UPDATE_DATE	2012/08/08@20:55:06
BEYONDSECURITY	1
CLEAN_RESPONDESC	<Null>
CLEAN_RESPONSID	<Null>
EXCLUDEDAREA	0
FLOORID	1862
FLOORYPEDESCR	<Null>
FLOORYPEID	<Null>
LOC_ID	LAX000CTA00T103080021
NOTES	<Null>
PROP_ORIGIN	<Null>
PROP_ORIGINDEX	<Null>
RECARIA	808.0000
ROOMDESCRIPTION	Food and Beverage
ROOMID	54760
ROOMNO	21
ROOMRENTABLE	<Null>
ROOMTYPEDESCR	Concessions
ROOMTYPEID	34
STATUS	<Null>
TOOLTIP	Rm# 21 = 974sf\nConcessio...

**Command Window:**

```
Command: *Cancel*
Command:
```

# Example .. Web App

The screenshot displays a web GIS application interface. On the left, there is a navigation menu with options like 'Spatial Admin', 'DDMS Admin', and 'Home'. The main area shows a detailed floor plan of a terminal building with various rooms highlighted in different colors. A 'Layers' panel on the left lists various data layers such as 'Points', 'Utility Info', 'HVAC Zones', 'Interior Doors', 'Inline Baggage', 'Floor Plan', 'Construction Area', 'Security', 'Cleaning Responsibility', 'FM Room Numbers', 'Space Occupant', and 'Space Description'. On the right, an 'Entity Attribute' window is open, displaying metadata and attributes for a selected room.

Attributes	Documents (1)
Location Code	LAX000CTA00T103080038
Actual Room No	
Aegis Room No	38
Use	Service
Room Type	Holdroom
Description	
Status	
Beyond Security	Y
Cleaning Responsibility	LAWA
Area	6919
Recorded Area	6855
Exclude Area	N
Occupant	
X Coordinate	6439993.74
Y Coordinate	1803086.54

# Example .. ArcGIS Map Services

The screenshot displays the ArcGIS web map viewer interface. The browser address bar shows the URL: [http://www.arcgis.com/home/webmap/viewer.html?url=http%3A%2F%2Fgis.microwizard.net%3A443%2Farcgis/rest/services/LAX\\_T1\\_MEZZANINE\\_FLOORPLAN/MapServer](http://www.arcgis.com/home/webmap/viewer.html?url=http%3A%2F%2Fgis.microwizard.net%3A443%2Farcgis/rest/services/LAX_T1_MEZZANINE_FLOORPLAN/MapServer). The page title is "ArcGIS - My Map".

The interface includes a search bar with the text "Google" and "Search". The main navigation area contains "ArcGIS" and "My Map". The top right corner has "New Map", "My Content", "Help", and "Sign In".

The map viewer toolbar includes "Details", "Add", "Basemap", "Save", "Share", "Print", "Measure", and "Bookmarks".

The "Contents" panel on the left shows the following layers:

- LAX Terminal 1
  - Mezzanine
    - LAX.MEZZANINE\_FLOORPLAN
      - MLE
        - LAX.T1\_MEZZANINE\_TENA
        - LAX.T1\_MEZZANINE\_ROOM
      - Boarding
      - Concessions
      - Custodial
      - Equipment
      - Maintenance
      - Miscellaneous
      - Safety
      - Security
      - Service
      - Ticketing
      - Utilities - Communications
      - Utilities - Electrical
      - Utilities - Mechanical
  - Second Level
    - LAX.SECOND\_LEVEL\_FLOORPLAN
    - MLE

The map shows a detailed floor plan of LAX Terminal 1, overlaid on a satellite-style basemap. The floor plan is color-coded according to the legend. The map includes a scale bar (0, 100, 200ft) and a north arrow. The map is titled "LAX Terminal 1" and "Mezzanine". The map is powered by Esri. The footer text reads: "State of California, County of Los Angeles, NHD, Esri, DeLorme, NAVTEQ, USGS, U. esri".

## Q/A

- For more information please contact;

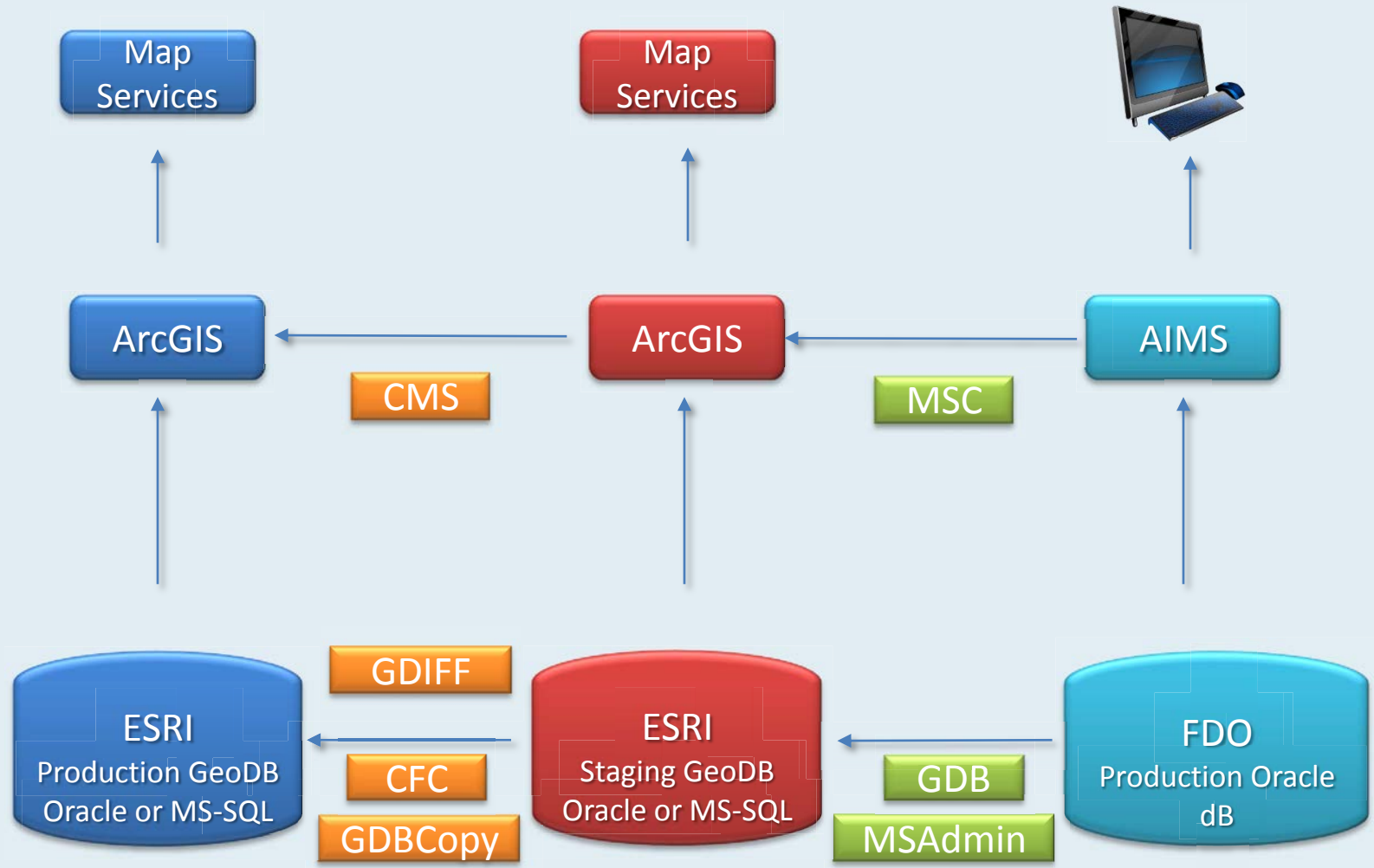
Ed Maghboul

310-862-1305

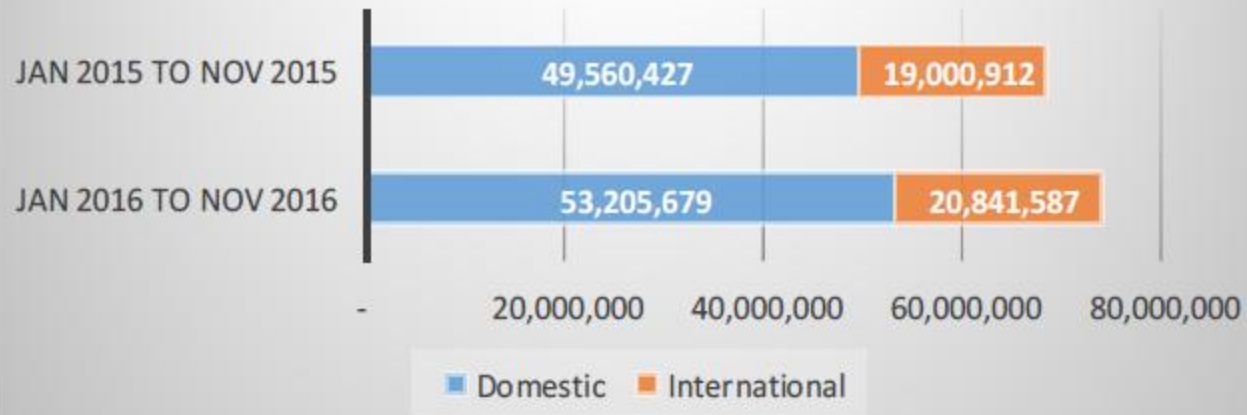
[Ed.Maghboul@x-spatial.com](mailto:Ed.Maghboul@x-spatial.com)

# Extra Slides

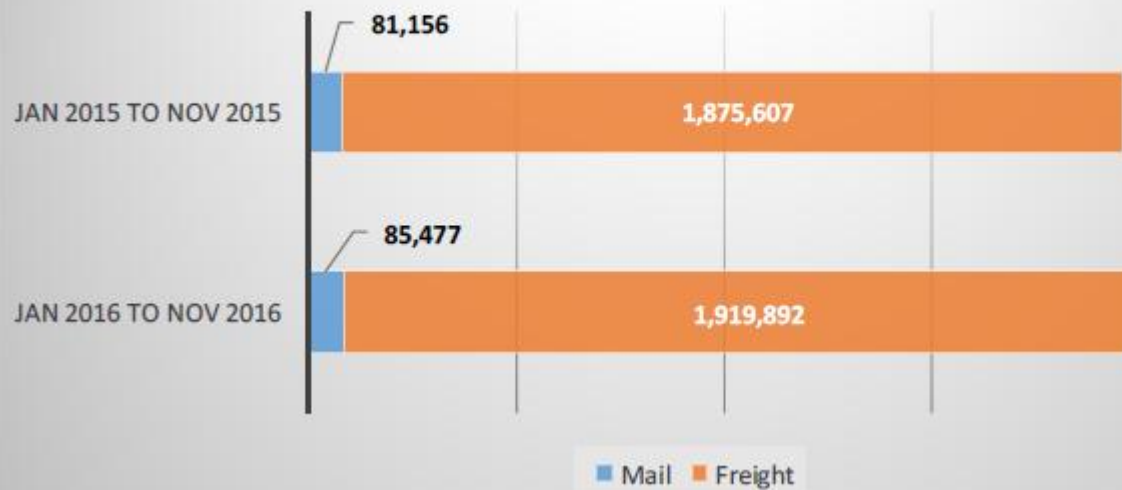
# ESRI Geodatabase Support



### LAX Passenger Volumes January 2016 - November 2016



### LAX Air Cargo Year to Date Comparison 2015 v 2016



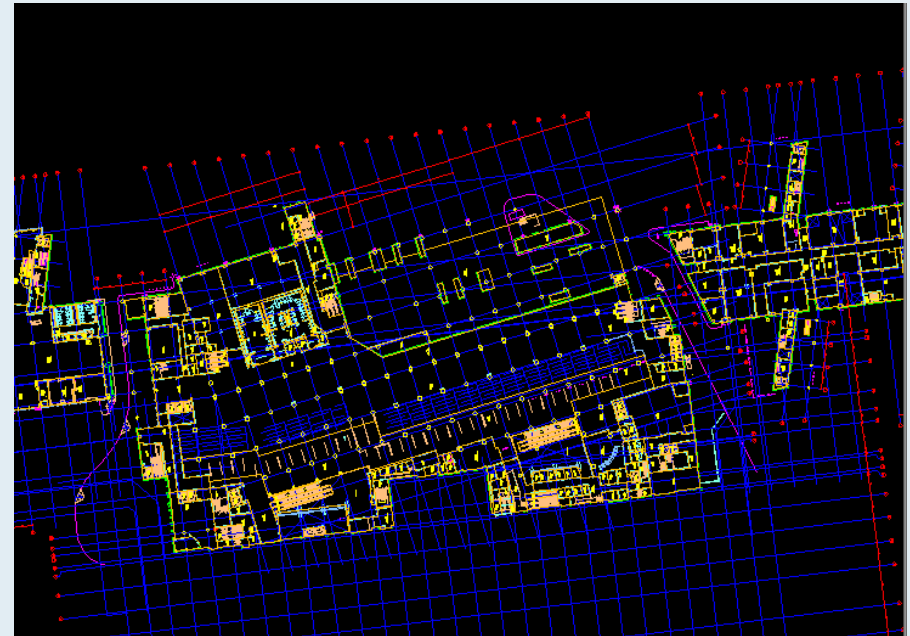
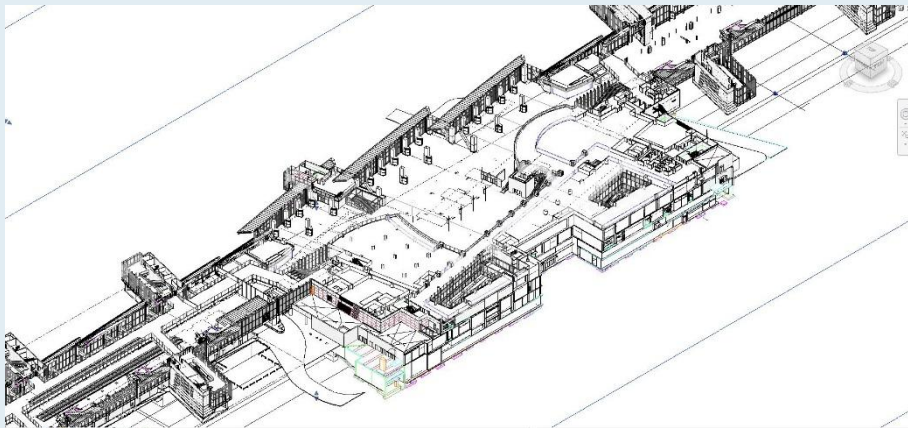
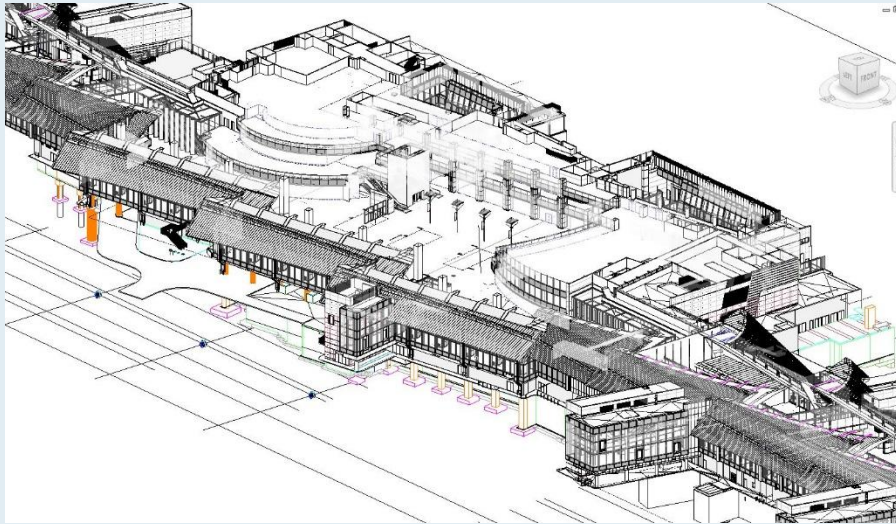


# Solution- Web Based Maintenance of the Database Schema

The image displays three overlapping browser windows from the AEGIS web-based maintenance interface. The windows show the following forms:

- Top-left window:** "AEGIS Entity Class - Edit Record - Internet Explorer". It shows a form for editing an entity class with fields for "Class Name", "Set Name" (utilities), "Is Active?" (Yes/No), "Feature Dataset Name", "Abbrev. Feature Dataset Name", "Snap Tolerance" (0.01), and "Definition".
- Middle window:** "AEGIS Entity Types - Edit Record - Internet Explorer". It shows a form for editing an entity type with fields for "Entity Type Name", "Entity Type Label", "Class Name" (utilities\_water\_syster), "FAA Class Name", "Is Active?" (Yes/No), "Required For FAA eALP?" (Yes/No), "Geometry Type" (Point/Polygon), "Interior Feature?" (Yes/No), "Attribute Table Name" (attribute\_metadata), "FAA Group Name", "Default Discriminator" (N/A), "Mobile Use?" (Yes/No), "Feature class Name", "Abbrev. Feature Class Name", "Create Feature Class?" (Yes/No), "Participate in Geometric Network?" (Yes/No), "Feature Class Role" (Simple/Advanced), "Source/Sink?" (Yes/No), "Definition", and "FAA Definition".
- Bottom-right window:** "AEGIS Entity - Edit Record - Internet Explorer". It shows a form for editing an entity with fields for "Entity Name", "Discriminator", "Mobile Use?" (Yes/No), "Is Active?" (Yes/No), "Interior Feature?" (Yes/No), "CADD Geometry type" (Polyline), "CADD Block Name" (N/A), "CADD Layer Name", "FAA CAD Layer", and "FAA CAD Layer Description".

Each window includes "OK" and "Cancel" buttons. A note at the bottom of the middle and bottom-right windows states: "Note: If you are changing the 'Is Active' settings of this Entity, be sure to run the 'Update AutoCAD Object Classes' command of the SDS-Administration Panel. Update the Object Classes when you are finished with changes to all Entities (including deleting)." The bottom-right window also includes a note: "Note: If you are changing the 'Is Active' settings of this Entity, be sure to run the 'Update AutoCAD Object Classes' command of the SDS-Administration Panel. Update the Object Classes when you are finished with changes to all Entities (including deleting)." Below this note, it says: "You can run these updates when you are finished with your settings (including deleting)".



The screenshot displays the GDMS Web Application interface. The top section shows a browser window with the URL [http://gis2.x-spatial.com/UMS/cfsnrgts/main\\_frame.cfm](http://gis2.x-spatial.com/UMS/cfsnrgts/main_frame.cfm) and the application title 'AEIGS'. The main interface is divided into three primary panels:

- Left Panel (Navigation & Tools):** Contains a navigation menu with options like 'Home', 'Open Map', 'Search', 'Data Explorer', 'Pavement Management', 'ELSEE', 'Mobile Data', 'Reports', 'Document Administration', 'Spatial Data Administration', 'Geodatabase Administration', and 'System Administration'. It also includes a 'Layers' list with categories such as Buildings, Boundaries, Land Registry, Transportation, Utilities, Environmental, and more.
- Center Panel (Map):** Displays a detailed aerial map of an airport terminal area. The map is overlaid with various colored layers representing different data types. A 'Quickview' window is visible on the right side of the map, and a 'Layer Set' window is also present.
- Bottom Panel (Data Table):** A table titled 'Parcels' displaying the following data:

	Location Code	Parcel No.	Parcel Name	Zoning	Actual Area	Datalink ID	Type Discriminator	Location	Date Created	Date Last Edited	Owner Operator	Leaseholder Name	Comment Disposition	Is Published
<input type="checkbox"/>	LAX000CTA	CTA	CTA	TERMINAL	23,223,120.00	11565485	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@15:53:51				Y
<input type="checkbox"/>	LAX000RAC	RAC	RAC	SERVICE	7,264,021.00	11565498	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34				Y
<input type="checkbox"/>	LAX00AQBF	AQBF	ACQUISITION AREA - BELFORD	ACQUISITION AREA	880,216.00	11565491	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34				Y
<input type="checkbox"/>	LAX00AQMS	AQMS	ACQUISITION AREA - MANCHESTER SQUARE	ACQUISITION AREA	5,322,053.00	11565492	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34				Y
<input type="checkbox"/>	LAX00BADL	BADL	BADLANDS	OPEN	5,209,899.00	11565488	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34				Y

The GDMS interface. The left panel provides the tools for accessing data, administrative tasks, and report. The Panel on the right provides the map interaction tools including markup, quick view, etc. The bottom panel displays all resulting tabular data.

The screenshot displays the IMTG web application interface. On the left, a sidebar contains navigation menus such as 'Home', 'Open Map', 'Search', and 'Data Explorer'. The main map area shows an aerial view of the LAX facility with a 'signage' map overlay, including taxiways (TWY), runways (R), and various signs. A 'Layers' panel on the left lists categories like 'Buildings', 'Transportation', and 'Signage'. On the right, there are panels for 'Quickview' and 'Layer Set'. At the bottom, a 'Parcels' table provides detailed information for several parcels.

	Location Code	Parcel No.	Parcel Name	Zoning	Actual Area	Datalink ID	Type Discriminator	Location	Date Created	Date Last Edited	Owner Operator	Leaseholder Name	Comment	Disposition	Is Published
<input type="checkbox"/>	LAX000CTA	CTA	CTA	TERMINAL	23,223,120.00	11565485	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@15:53:51					Y
<input type="checkbox"/>	LAX000RAC	RAC	RAC	SERVICE	7,264,021.00	11565498	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
<input type="checkbox"/>	LAX00AQBF	AQBF	ACQUISITION AREA - BELFORD	ACQUISITION AREA	880,216.00	11565491	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
<input type="checkbox"/>	LAX00AQMS	AQMS	ACQUISITION AREA - MANCHESTER SQUARE	ACQUISITION AREA	5,322,053.00	11565492	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
<input type="checkbox"/>	LAX00BADL	BADL	BADLANDS	OPEN	5,209,899.00	11565488	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y

Screen shot of LAX facility showing the “signage” map.

The screenshot displays the X-SPATIAL web application interface. The main map area shows an aerial view of the LAX facility with a yellow AutoCAD drawing overlay. The drawing includes various structures, parking lots, and infrastructure, with labels such as 'FEDERAL EXPRESS', 'LAX FUEL CORP', and 'AVIA MAINTENANCE'. The interface includes a top navigation bar with 'File', 'Edit', 'View', 'Favorites', 'Tools', and 'Help' menus. A left sidebar contains a 'Layers' panel with a tree view of map layers and a 'Parcels' panel with a table of parcel data. A bottom panel displays a table of parcel information.

Location Code	Parcel No.	Parcel Name	Zoning	Actual Area	Datalink ID	Type Discriminator	Location	Date Created	Date Last Edited	Owner Operator	Leaseholder Name	Comment	Disposition	Is Published
LAX000CTA	CTA	CTA	TERMINAL	23,223,120.00	11565485	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@15:53:51					Y
LAX000RAC	RAC	RAC	SERVICE	7,264,021.00	11565498	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
LAX000AQBF	AQBF	ACQUISITION AREA - BELFORD	ACQUISITION AREA	880,216.00	11565491	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
LAX000AQMS	AQMS	ACQUISITION AREA - MANCHESTER SQUARE	ACQUISITION AREA	5,322,053.00	11565492	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y
LAX000BADL	BADL	BADLANDS	OPEN	5,209,899.00	11565488	PARCEL	LAX	2013/07/25@18:59:51	2013/08/28@00:28:34					Y

Screen shot of LAX facility showing an overlay of an AutoCAD drawing

# Example ..Web App.

The screenshot shows a web browser window displaying a GIS application. The address bar shows the URL: [https://gis2.x-spatial.com/UMS/cfscripts/main\\_frame.cfm](https://gis2.x-spatial.com/UMS/cfscripts/main_frame.cfm). The interface includes a toolbar with navigation and editing tools, a layers panel on the left, and a map area. The layers panel is expanded to show the 'Utilities' category, with 'Water System' and 'Water Line PROPOSED' checked. The map displays a network of blue and green lines representing utility infrastructure. At the bottom left, coordinates are shown: X: 6439019.671943, Y: 1802279.977390 (FOOT). At the bottom center, a status bar indicates '1 water\_line selected'.

The screenshot shows a web browser window titled 'Entity Attribute - Windows Internet Explorer' displaying the URL: [https://gis2.x-spatial.com/UMS/cfscripts/Forms/EntityType\\_Edit](https://gis2.x-spatial.com/UMS/cfscripts/Forms/EntityType_Edit). The form displays the following information for a selected entity:

- 1232611, utilities, utilities\_water\_system, water\_line, FIRE, utwatpip**
- Location: LAX
- Created By: dfinley
- Date Created: 2007/12/19@09:13:38
- Last Edited By: dfinley
- Date Last Edited: 2008/01/24@11:25:58
- Reason Code: [Empty]
- Quality Level: [Empty]
- Ddms: 0030550
- Source: [Empty]
- Qa Status: 1 - GEOMETRY ONLY
- Owner: [Empty]
- Operator: [Empty]
- Leaseholder Name: [Empty]
- Comment: 6"; STEEL PIPE
- Disposition: [Empty]
- Is Published: Y

Below the form fields, there are sections for 'Attributes' (Documents (0)), 'Acquired Date', 'Install Date', 'Type Code' (CIRCULAR), 'Material Composition Code' (STEEL), 'Size Code' (6), 'Length Dimension Average Top Of Pipe', 'Slope', 'Disposition Code' (IN\_SERVICE), and various FAA-related fields (Name, Description, Status, Utilitytype, Directionality, Userflag, Alternative, Narrative).

# Example .. ArcMap

The screenshot displays the ArcMap interface for a project named 'LAX\_Water\_Storm\_Fuel.mxd'. The main map area shows a complex network of water lines in various colors (green, blue, purple, red) overlaid on a site plan. The interface includes a menu bar (File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, Help), a toolbar with navigation and editing tools, and several panels:

- Table Of Contents:** Lists layers for Fuel System, Storm System, and Water System. Under Water System, 'LAX.water\_line\_PROPOSED' and 'LAX.water\_line' are checked.
- Legend:** Provides a key for line types and colors, including 'AS\_DISCRIMINATOR\_VALUE', 'ABANDONED', 'DOMESTIC', 'DOMESTIC\_FIRE', 'EMERG\_CONN\_LINE', 'FIRE', 'MAIN', 'RAW\_WATER', 'SERVICE', and 'SPRINKLER'.
- Catalog:** Shows the project structure with folders for LAX.sde, LAX.A, LAX.T, and LAX.u.
- Identify:** Displays the properties of the selected feature, including its location and a list of attribute values.

Identify

Identify from: <Top-most layer>

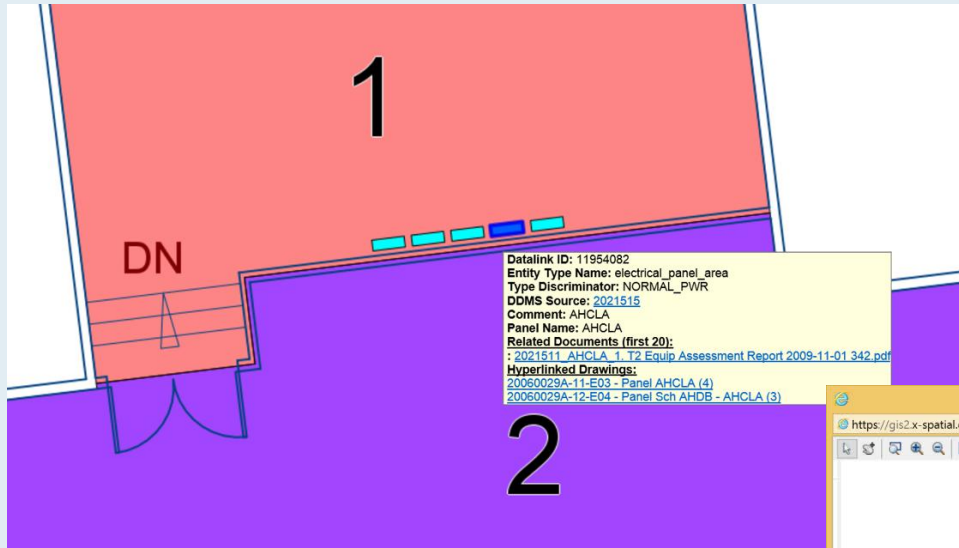
LAX.water\_line\_PROPOSED  
...water\_line\_PROPOSED - FIRE\_PROP

Location: 6,437,068.276 1,801,449.452 Feet

Field	Value
DATALINK	5246099
AS_ENTITY_SET_NAME	utilities
AS_ENTITY_CLASS_NAME	utilities_water_system
AS_ENTITY_TYPE_NAME	water_line_PROPOSED
AS_DISCRIMINATOR_VALUE	FIRE_PROP
AS_GENERAL_LOCATION	<null>
AS_FACILITY	<null>
AS_OWNER_OPERATOR	<null>
AS_CONTACT_INFO	<null>
AS_DISPOSITION	<null>
AS_PUBLISHED	N
AS_MOBILEID	<null>
AS_COMMENT	Concourse Construction Package
DATE_ACQRD	<null>
DATE_INSTALLED	<null>
DISPOSTN_D	<null>
TYPE_D	<null>
MAT_D	ductile iron
SIZE_D	24 Inch (24.0 inches)
PIPE_LGTH	<null>
INV_ELV_1	<null>
SLOPE_BOT	<null>
NAME	<null>
DESCRIPTION	<null>
STATUS	<null>
UTILITYTYPE	<null>
DIRECTIONALITY	<null>
USERFLAG	<null>
ALTERNATIVE	<null>
NARRATIVE	<null>
USER_FLAG	<null>
AS_SDS_TABLE_NAME	utwatpip
AS_CREATED_BY	axmelkyan
AS_CREATED_DATE	2010/05/19@19:17:08
AS_LAST_EDITED_BY	axmelkyan
AS_DATE_LAST_EDITED	2010/05/25@16:10:10

643901

Identified 1 feature



In this example (left) an electrical panel was selected on the map, the tool tip shows the hyperlinked documents.

The schematic diagram on the right is the result of selecting one of the hyperlinked documents, GDMS loads the drawing, and zooms to the hyperlinked region of the drawing.

