

# Statewide Geography and Spatial Computing in SQL Server

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**Albuquerque SQL Server  
User Group**

# About me

## Quick Bio:

Currently Database Administrator – State of NM  
SQL Server DBA since 1992 version 3.8  
ESRI user since 1985 version 1

## Contact Info:

blog: [www.kkarnsdba.com](http://www.kkarnsdba.com)  
twitter: @kevinkarns



Payson, AZ is where I call home – photo: Spirit Rock trail.

# Agenda

## Part 1

- Background about New Mexico land and the PLSS.
- Applications that consume spatial data in SQL Server. (brief)
- ETL challenges with the PLSS and SQL Server spatial data. (very brief)
- GIS security challenges. (brief)
- SQL Server spatial features overview: Spatial tables, Views, Indexes, OGC Method calls

## Part 2

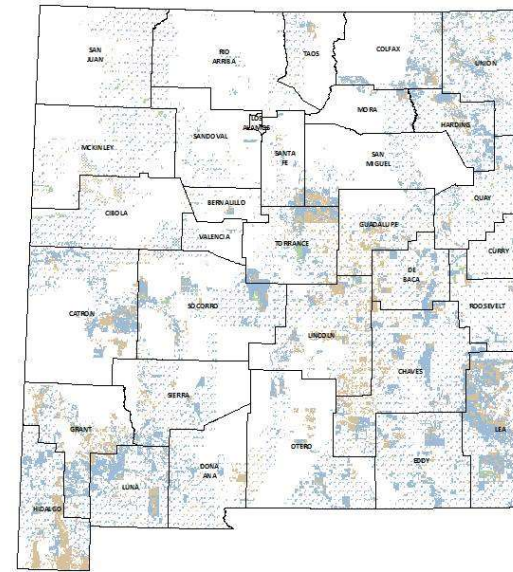
Drilling into a spatial database performance lesson from a DBA's viewpoint:  
Look at index maintenance plans, Python, traditional indexes, spatial indexes, ending with tools available for spatial index diagnostics.

# Disclaimer

## Arizona A few remaining queries



## New Mexico State Trust Land Overview Performance & Tuning Lessons



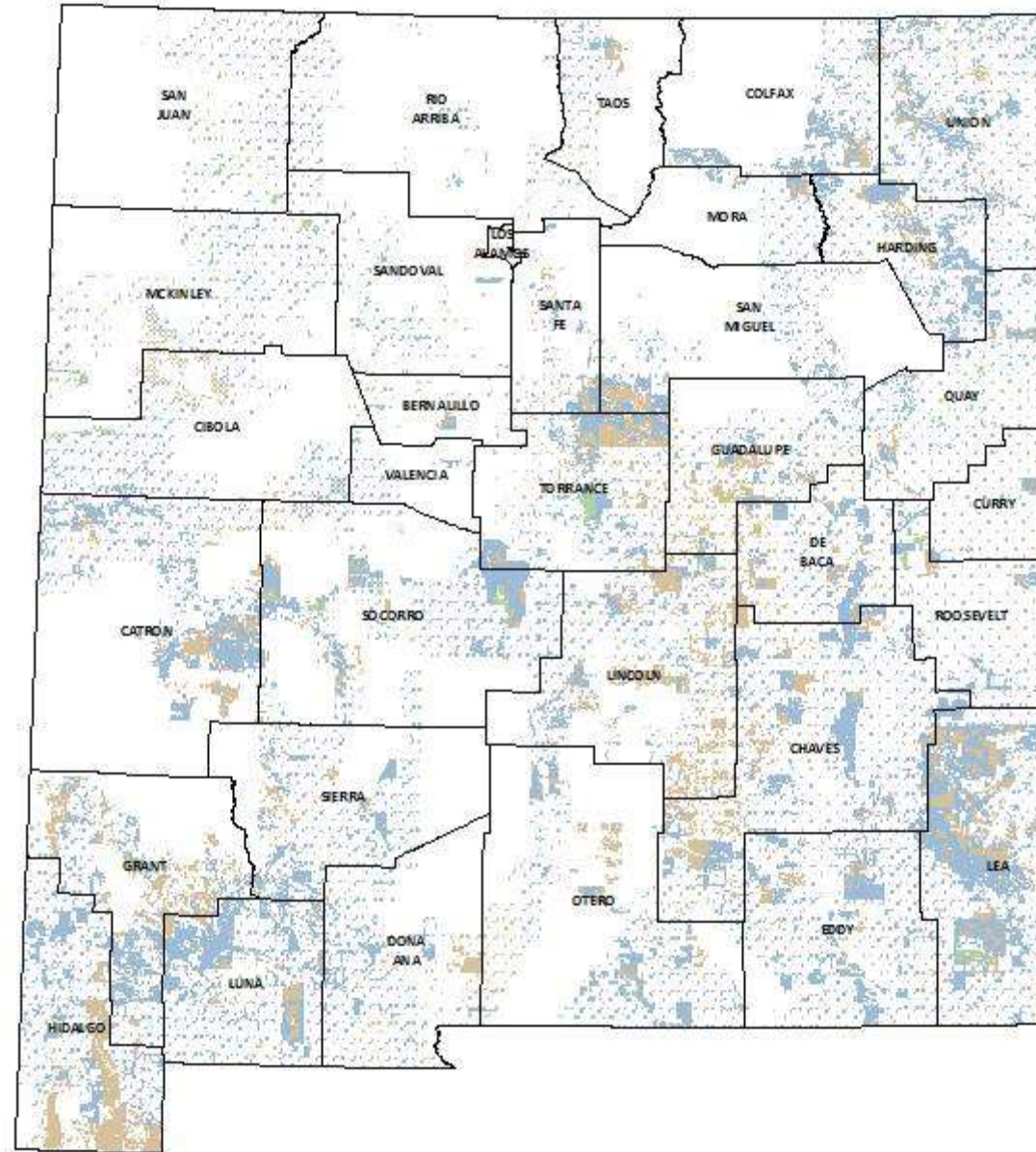
Goal is to teach about tuning the squirrely Geography/Geometry data type in SQL Server, not speaking on behalf of either Commission. All examples today are from data downloaded from public clearinghouses and manipulated with an inexpensive ArcGIS license for personal use.



# Background on the statewide data set.

## New Mexico State Trust Lands

- Approx. nine million acres of surface lands. (blue and green)
- Approx. thirteen million acres of separated rights. (all 3: blue, green and brown)
- Approx. 2 million discrete land parcels statewide. (350K state parcels)
- “Trust” Granted by the Feds to the States to be held in trust to fund the State’s public institutions.
- Fiscal year 2018: \$851 million.



# Federal Public Land Survey System (PLSS)

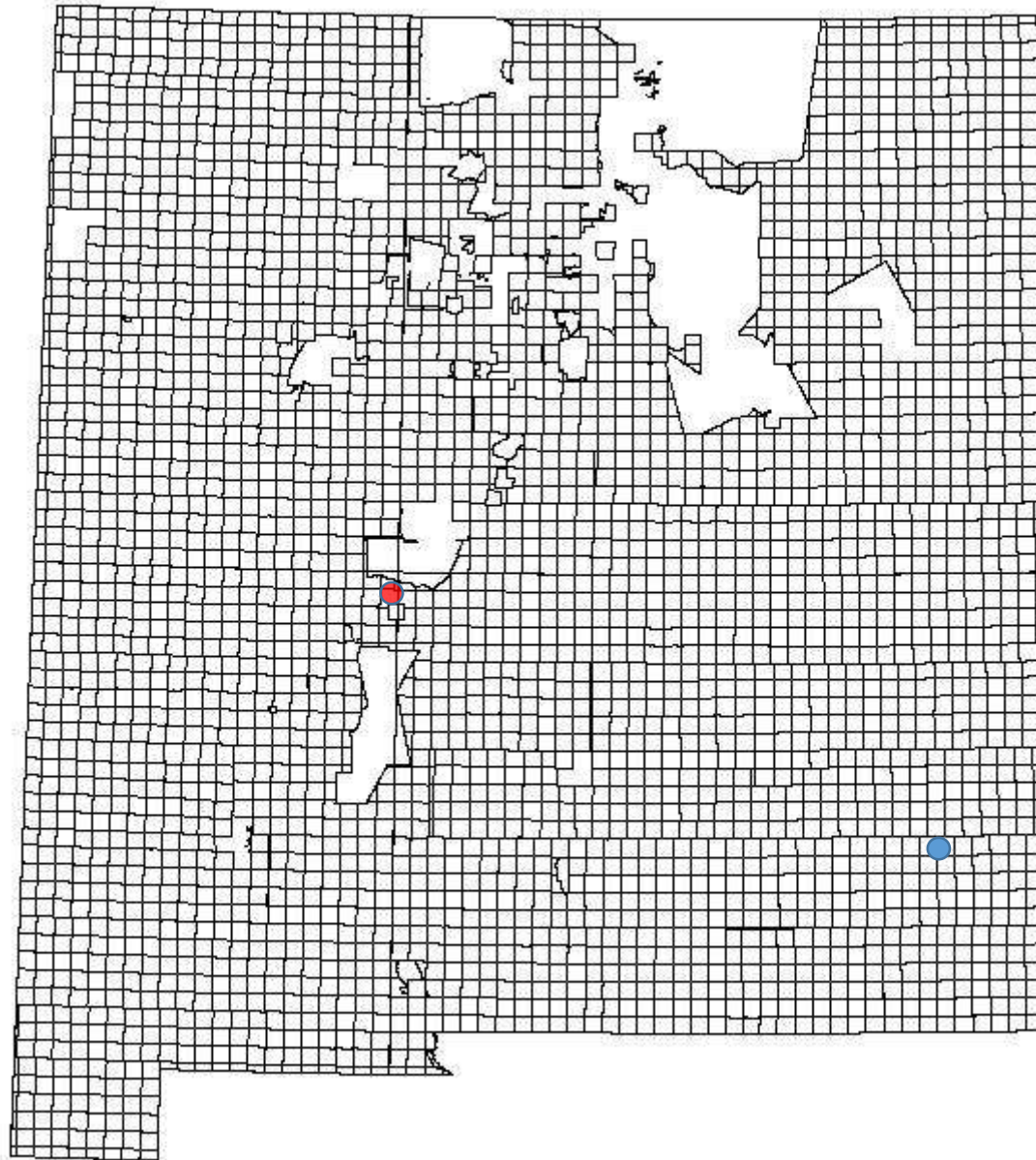
## Top level Meridian

- Most land systems of record use the PLSS to uniquely identify lands, instead of latitude longitude or UTM coordinates
- Meridian largest unit of measure in the database.
- One Grid in NM.



## Next Level PLSS Townships

- Over 3500 townships, approx. 6 miles wide.
- Except in grant lands.



● 01N 01E

● 21S 35E

# Next Level PLSS Sections ...

36 one-mile sections  
in a township.

## TL;DR History:

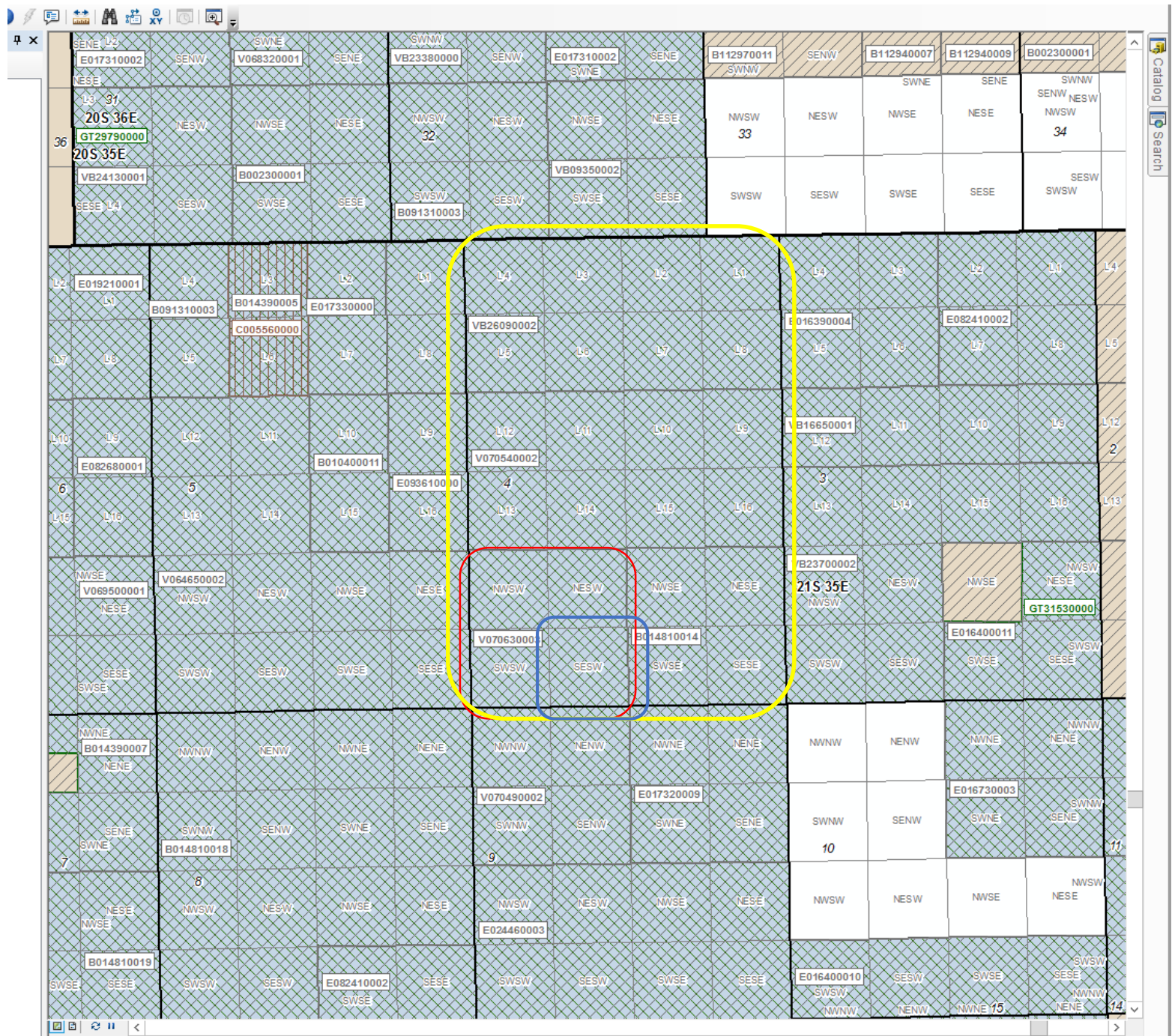
- General Land Ordinance (1785)  
– fund public education with land.
- Organic Act (1850). Sections 16 and 36. Beneficiary: Common schools.
- Ferguson Act (1898). Additional lands and additional beneficiaries.
- Enabling Act (1910). Sections 2 and 32.
- In lieu selections .





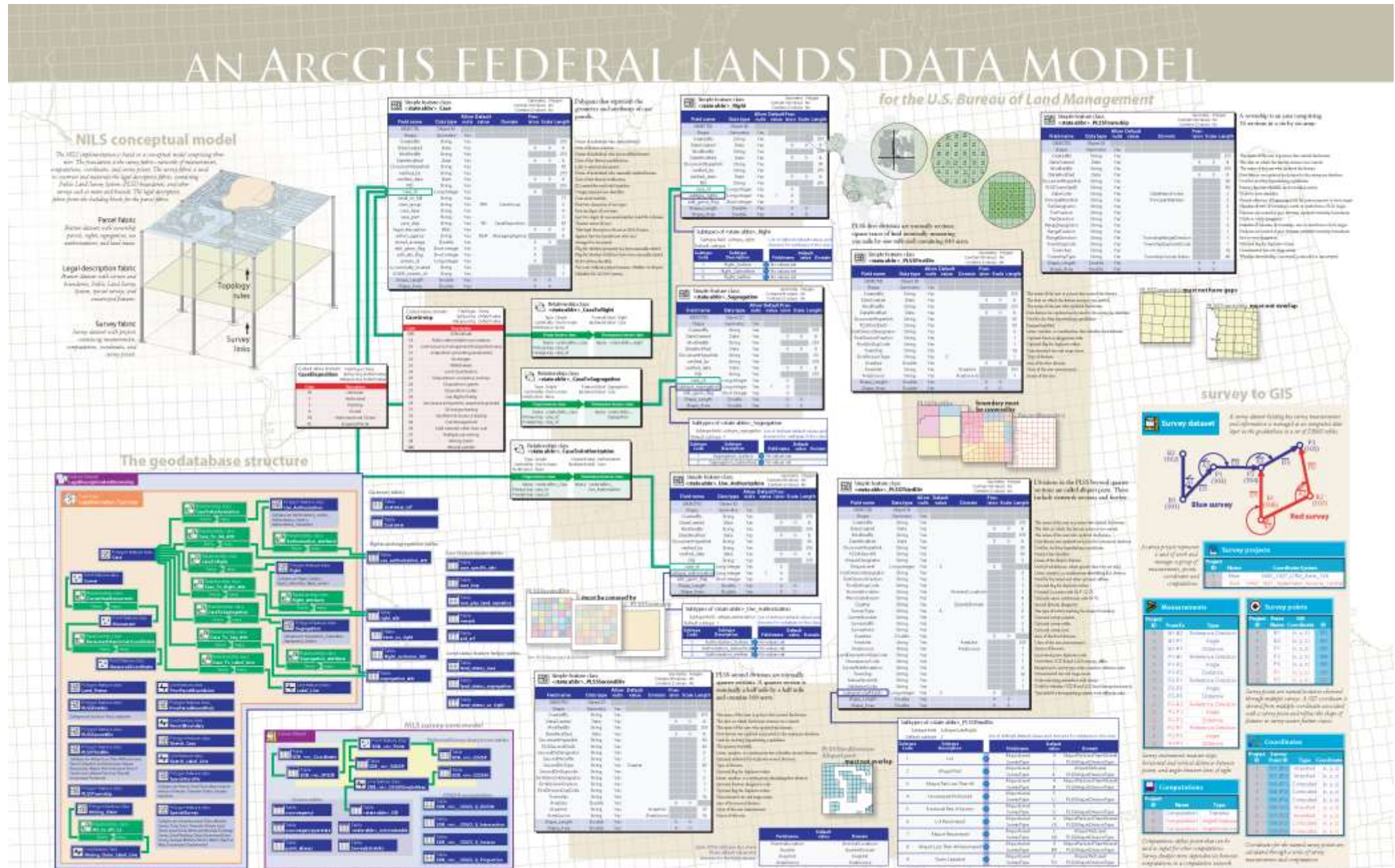
Usually sixteen 40 acre subsections in a section.

- Subsection SESW  
(in blue)
- 1/24<sup>th</sup> of Section 4  
(in yellow)
- 1.3 million of these in NM
- Later slide Spatial Query  
on prolific well in one of the four  
quarter quarters of a lease (in red).



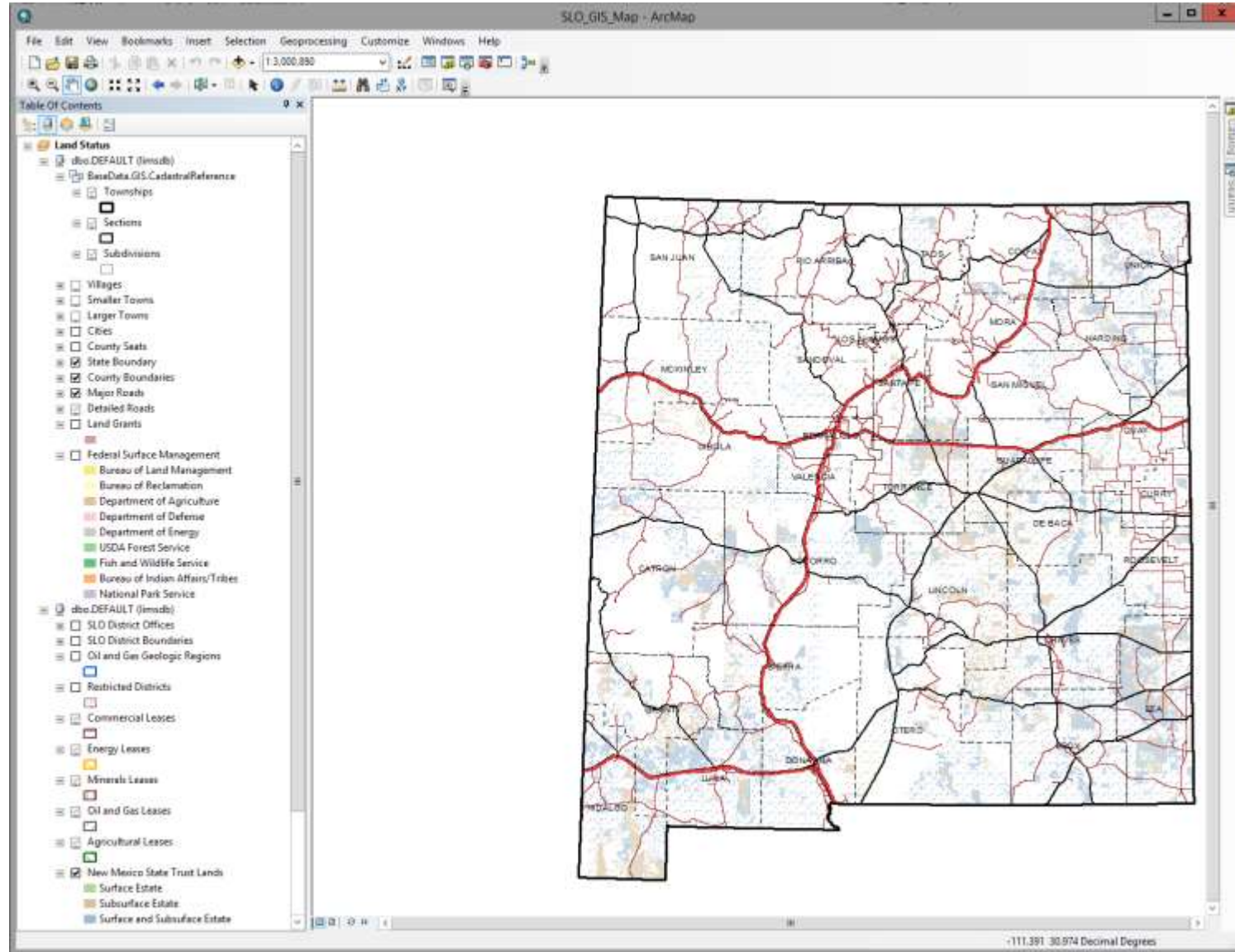


A BLM/ESRI Standard Land Data Model – (NILS) from late 90's... now called Geocommunicator or Navigator.



# Front End Applications on SQL Server Spatial data

## (#1) ESRI ArcGIS ArcMap v10.2.2 for Desktop



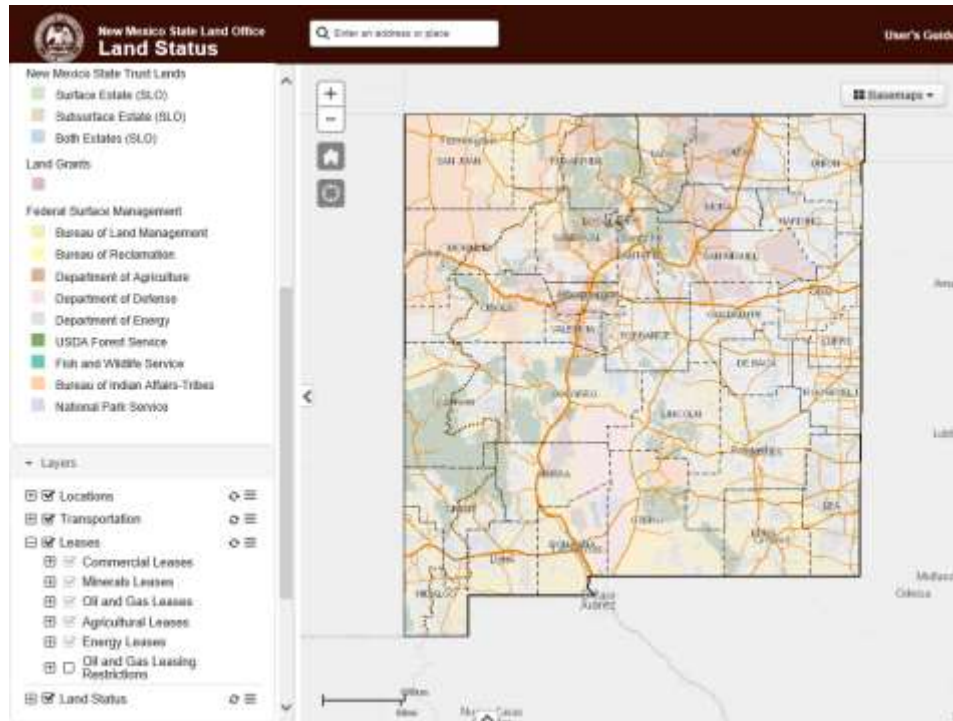
Demo



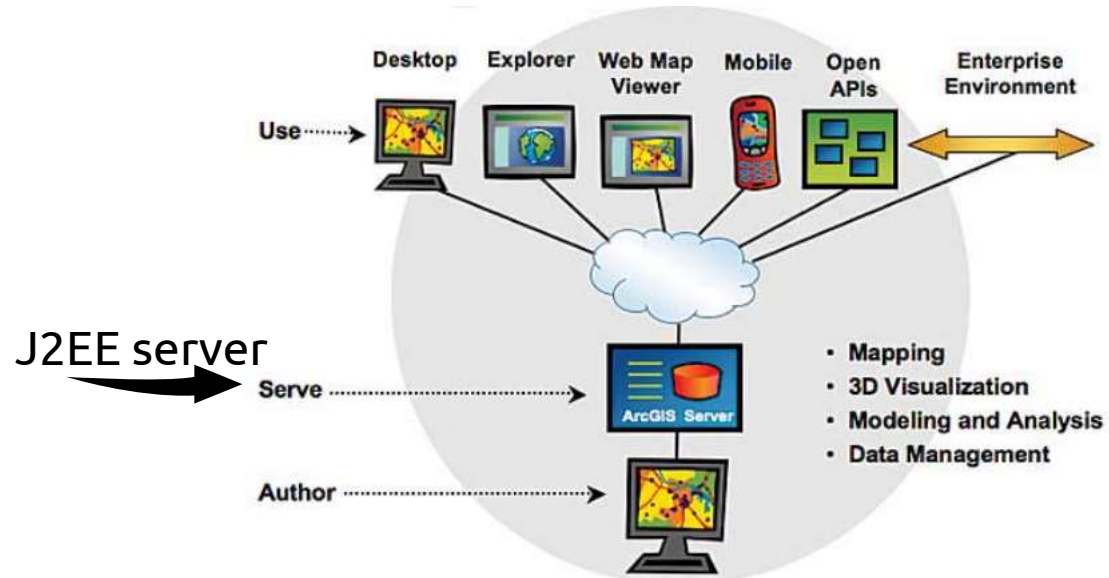
# Front End Applications on SQL Server Spatial data

## (#2) Interactive webmaps

<http://www.nmstatelands.org/interactive-maps.aspx>



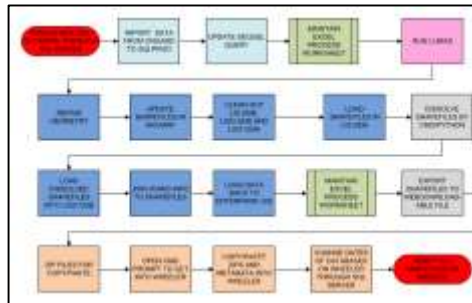
### (#3) Other apps: things that consume Web Services in ESRI ArcGIS Server v10.2.2



- Web services for internal .Net apps
- Google Earth .KML exports
- Mobile – Getac devices & custom application
- Rights of Ways – ESRI Workflow Manager
- ArcGIS Portal

## converting from PLSS (Township Range Section Subsection) to Geometry data type

# Survey point Numbering System



# Spatial data security models

Unfortunately most interactions between GIS and DBA staff members.

Starting to make some progress  
at the time of server migrations  
using 300 line cleanup template

```
1  -- cleanup template for geodatabase cleanup
2
3  -- cleanup database for user
4
5  -- cleanup database for user (if needed)
6
7  -- cleanup database
8
9  -- cleanup database
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11 -- cleanup database
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299 -- cleanup database
300
```

contractor #1  
security model #1



internal staff  
security model #2



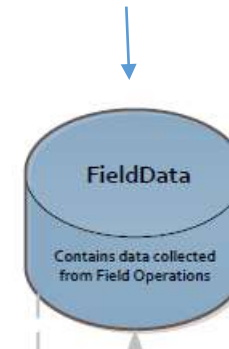
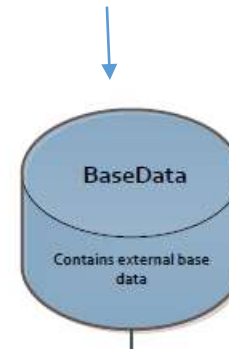
contractor #2  
security model #3



contractor #3  
security model #4



ESRI third party S/W  
security model #5





# Spatial table

gis.SLO_OGLEASE
Columns
OBJECTID (PK, int, not null)
MERIDIAN (numeric(38,8), null)
TOWNSHIP (nvarchar(5), null)
RANGE (nvarchar(5), null)
SECT (numeric(38,8), null)
SURVEYTYPE (nvarchar(1), null)
ALIQUOT (nvarchar(4), null)
UNIQUEKEY (nvarchar(20), null)
ONGARD_DTE (nvarchar(10), null)
PROCESS (nvarchar(12), null)
DISKEY (nvarchar(100), null)
OGTOWNSHIP (nvarchar(3), null)
OGRANGE (nvarchar(3), null)
QUARTERS (nvarchar(16), null)
QTRQTRS (nvarchar(112), null)
OGLOTTRACT (nvarchar(3), null)
LSE_PREFIX (nvarchar(2), null)
LSE_NUMBER (numeric(38,8), null)
LSE_SUFFIX (numeric(38,8), null)
STATUS (nvarchar(7), null)
LSDV_ACRG (numeric(38,8), null)
VEREFF_DTE (datetime2(7), null)
VERTRM_DTE (datetime2(7), null)
OGRID_CDE (numeric(38,8), null)
OGRID_NAM (nvarchar(45), null)
OGRID_ADR_NAM (nvarchar(30), null)
MAIL_STOP (nvarchar(20), null)
LINE1_ADR (nvarchar(30), null)
LINE2_ADR (nvarchar(30), null)
LINE3_ADR (nvarchar(30), null)
CITY_NAM (nvarchar(30), null)
ST_NAM (nvarchar(2), null)
ZIP_CDE (nvarchar(9), null)
CTRY_NAM (nvarchar(15), null)
PHONE_NUM (numeric(38,8), null)
FAX_NUM (numeric(38,8), null)
PROCDATE (datetime2(7), null)
SOURCEGRID (nvarchar(16), null)
GlobalID (uniqueidentifier, not null)
CreatedBy (nvarchar(255), null)
CreatedDate (datetime2(7), null)
ModifiedBy (nvarchar(255), null)
ModifiedDate (datetime2(7), null)
GRIDNAME (nvarchar(50), null)
SHAPE (geometry, null)
Keys
Constraints

```
-- MS SQL Server Spatial

SELECT
    SHAPE,
    SHAPE.ToString() AS WKT

SHAPE                                                    WKT
-----
0x21690000010C1E1DAF4714EB2341DC1E3046FF714B41      POINT (652682.1400078868 3597310.5483435225)

-- Oracle Spatial

CREATE TABLE OracleSpatialTable (
    OFFSET_FROM    NUMERIC(12,3),
    OFFSET_TO      NUMERIC(12,3),
    GEOM            PUBLIC.SDO_GEOMETRY
)

OFFSET_FROM OFFSET_TO  GEOM
-----
54.822      86.977    {4002,null,null,{1,2,1},{555828.9771,3610888.9205,0,54.822,555842.5771,3610916.543,0,

-- Oracle Spatial can transform projections on-the-fly in SQL

sdo_cs.transform(SDO_GEOMETRY(4001, 26913, SDO_POINT_TYPE(t.x, t.y, t.z),null,null),8307) AS GEOM_WGS84

-- old ESRI Spatial Binary (pre SQL Server 2008)

SELECT
    SDE.GIS.SLO_OGPUNSTUNITD.UNIQUEKEY,
    SDE.GIS.SLO_OGPUNSTUNITD.SHAPE,
    SHAPE.points F_points

FROM
    SDE.GIS.SLO_OGPUNSTUNITD

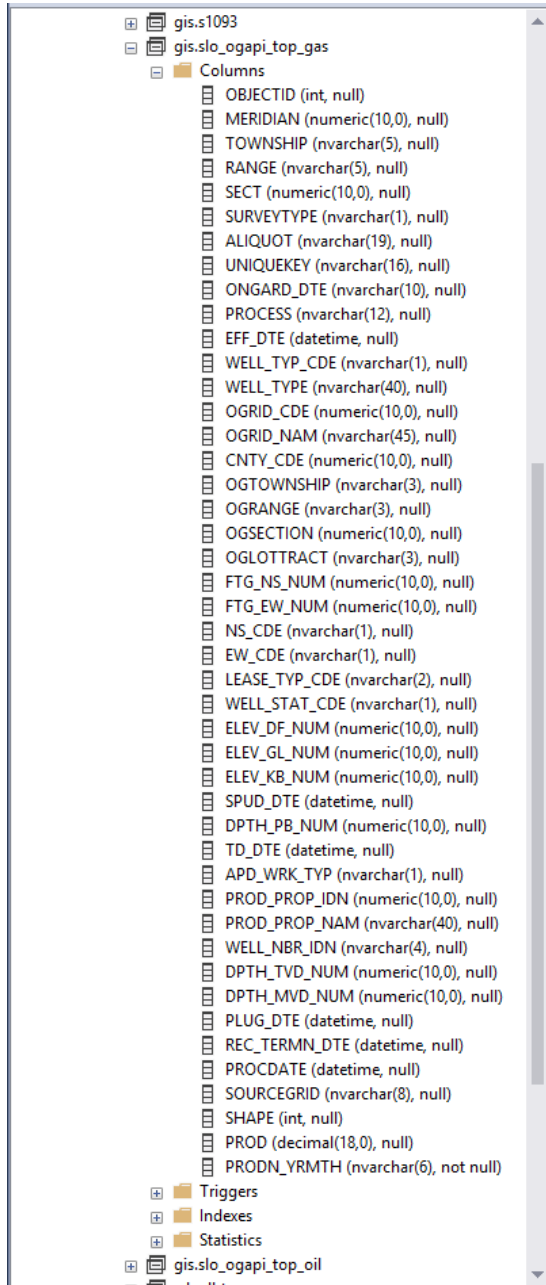
LEFT JOIN
    SDE.GIS.f557 SHAPE

ON
    SHAPE.fid = SDE.GIS.SLO_OGPUNSTUNITD.SHAPE

UNIQUEKEY      SHAPE      F_points
-----
1001156        2          0xA20C000000000000A9E1EDF209B6D3C8E106A562ED8B309B6
```

# Spatial View

“ESRI specific”



Spatial processing with ESRI toolbox often uses inefficient cursors ... but in SQL we can create view on a table with a geometry/geography column joined to additional data ... much faster.

Then “register” the view in ESRI with one of the two approaches:

- Using ESRI ArcSDE administration commands

```
sdetable -o create_view -s servername -D dbname -u username -p passwd -i esri_sde  
-T SLO_OGAPI_TOP_GAS -t "SDE.GIS.SLO_OGAPI" -c ""
```

- Using ESRI ArcPy Python commands

```
""" Create view containing SQL geometry type column """  
  
import arcpy  
import sys  
  
def CreateSpatialView(input_database, view_name, view_definition):  
    """ Create view containing SQL geometry type column """  
    try:  
        arcpy.CreateDatabaseView_management(input_database, view_name, view_definition)  
    except arcpy.ExecuteError:  
        print(arcpy.GetMessages(2))  
  
if __name__ == "__main__":  
    arguments = sys.argv[1:]  
    CreateSpatialView(*arguments)
```

# Spatial Index

gis.SLO\_OGLEASE

Columns

Keys

Constraints

Triggers

Indexes

I1479UNIQUEKEY (Non-Unique, Non-Clustered)

R166\_pk (Clustered)

**S125\_idx (Spatial)**

UUID\_166 (Non-Unique, Non-Clustered)

UUID\_OID\_166 (Unique, Non-Clustered)

Statistics

\_WA\_Sys\_00000007\_6522C3C0

I1479UNIQUEKEY

R166\_pk

UUID\_166

UUID\_OID\_166

Index Properties - S125\_idx

Ready

Select a page

General

Options

Storage

Spatial

Fragmentation

Extended Properties

Script

Help

Table name:

SLO\_OGLEASE

Index name:

S125\_idx

Index type:

Spatial

Spatial column

Name	Data Type	Identity	Allow NULLs	Add...	Remove
SHAPE	geometry	No	Yes		

Connection

limsdb\prod [NMSLO\sqladmin]

View connection properties

Progress

Ready

OK

Cancel

Help

Index Properties - S125\_idx

Ready

Select a page

General

Options

Storage

Spatial

Fragmentation

Extended Properties

Script

Help

Bounding Box

X-min

127119.099343

Y-min

3510943.72004

X-max

682752.399957

Y-max

4099048.36494

General

Tessellation Scheme

Geometry grid

Cells Per Object

16

Grids

Level 1

Medium

Level 2

Medium

Level 3

Medium

Level 4

Medium

Tessellation Scheme

Name of tessellation scheme.

OK

Cancel

Help

Histogram function later on

# SQL Server has Spatial Methods - follows ISO 19125 Guidelines

## OGC Methods on Geometry Instances

03/13/2017 • 2 minutes to read • Contributors

**APPLIES TO:** ✓ SQL Server (starting with 2012) ✓ Azure SQL Database ✓ Azure SQL Data Warehouse ✓ Parallel Data Warehouse

SQL Server supports the Open Geospatial Consortium (OGC) methods on geometry instances.

For more information on OGC specifications, see the following:

- [OGC Specifications, Simple Feature Access Part 1 - Common Architecture](#)
- [OGC Specifications, Simple Feature Access Part 2 - SQL Options](#)

### In This Section

- [STArea](#)
- [STAsBinary](#)
- [STAsText](#)
- [STBoundary](#)
- [STBuffer](#)
- [STCentroid](#)
- [STContains](#)
- [STConvexHull](#)
- [STCrosses](#)
- [STCurveN \(geometry Data Type\)](#)
- [STCurveToLine \(geometry Data Type\)](#)
- [STDifference](#)
- [STDimension](#)
- [STDisjoint](#)
- [STDistance](#)
- [STEndpoint](#)
- [STEnvelope](#)
- [STEquals](#)
- [STExteriorRing](#)
- [STGeometryN](#)
- [STGeometryType](#)
- [STInteriorRingN](#)
- [STIntersection](#)
- [STIntersects](#)
- [STIsClosed](#)
- [STIsEmpty](#)
- [STIsRing](#)
- [STIsSimple](#)
- [STIsValid](#)
- [STLength](#)
- [STNumCurves \(geometry Data Type\)](#)
- [STNumGeometries](#)
- [STNumInteriorRing](#)
- [STNumPoints](#)
- [STOverlaps](#)
- [STPointN](#)
- [STPointOnSurface](#)
- [STRelate](#)
- [STSrid](#)
- [STStartPoint](#)
- [STSymDifference](#)
- [STTouches](#)
- [STUnion](#)
- [STWithin](#)
- [STX](#)
- [STY](#)



# ArcGIS Help

[Home](#)[Get Started](#)[Map](#)[Analyze](#)[Manage Data](#)[Tools](#)[More...](#)[Manage Data](#) > [Geodatabases](#) > [Archiving data](#)[An overview of the geodatabase](#)[Designing a geodatabase](#)

## The archive process

ArcMap 10.3 | [Other versions](#) ▾

Queries on transactional versions are still on the base and delta tables:

Base table

ObjectID			

Adds table

ObjectID	Other Columns	

Deletes table

Deleted at	Deletes Row_ID	

Base, adds, and deletes tables

## How to get the registration\_id

```
SELECT
  registration_id,
  database_name,
  table_name
FROM [SLOData].[dbo].[SDE_table_registry]
WHERE
  table_name = 'SLO_OGLEASE'

  registration_id database_name table_name
  -----
  50              SLODATA      SLO_OGLEASE

(1 row affected)
```

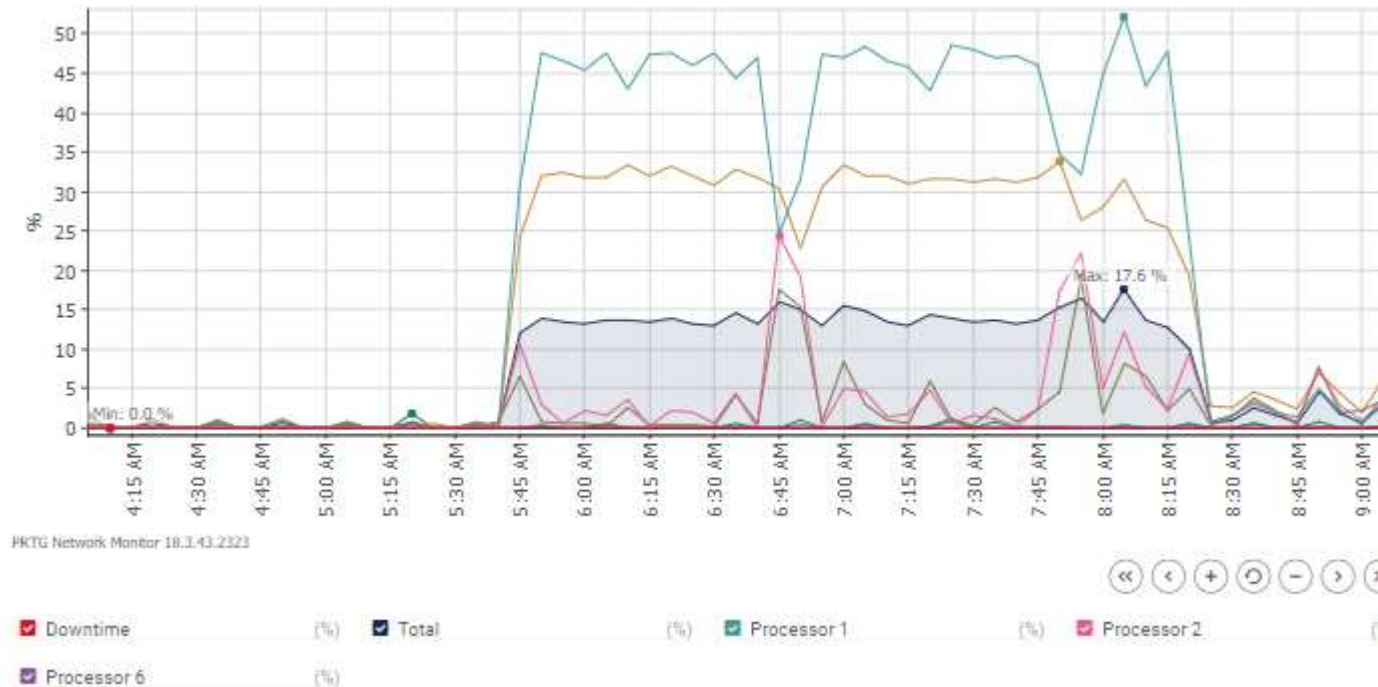
## Q&A from Part 1

.... any more questions on ETL from system of record into a feature class in a spatial database? ...

## Part 2

### Drilling into a DBA's production performance problem

OMG! What is all that CPU?



# Almost completed migration to Query Store ... Still using Old 2012 performance tools - Qure

Workload Trace				
Total Number of Events: 18287				
Location: C:\Performance\2018-01-05-06.apr				
Time Range: 1/5/2018 6:03 AM - 1/5/2018 6:03 AM 56287				

## Resource Consumption Statistics

### Overall Resource Consumption

Resource	Total	Average	Min	Max
Duration	3.12 min	0.03 ms	22 µs	48.81 ms
CPU	42.58 sec	1 ms	0 µs	34.22 sec
Reads	21.7M	381.4	0	20.2M
Writes	97.9K	1.74	0	30.37K
Row Count	98.1K	1.03	0	10.34K

### Top Consuming Batches

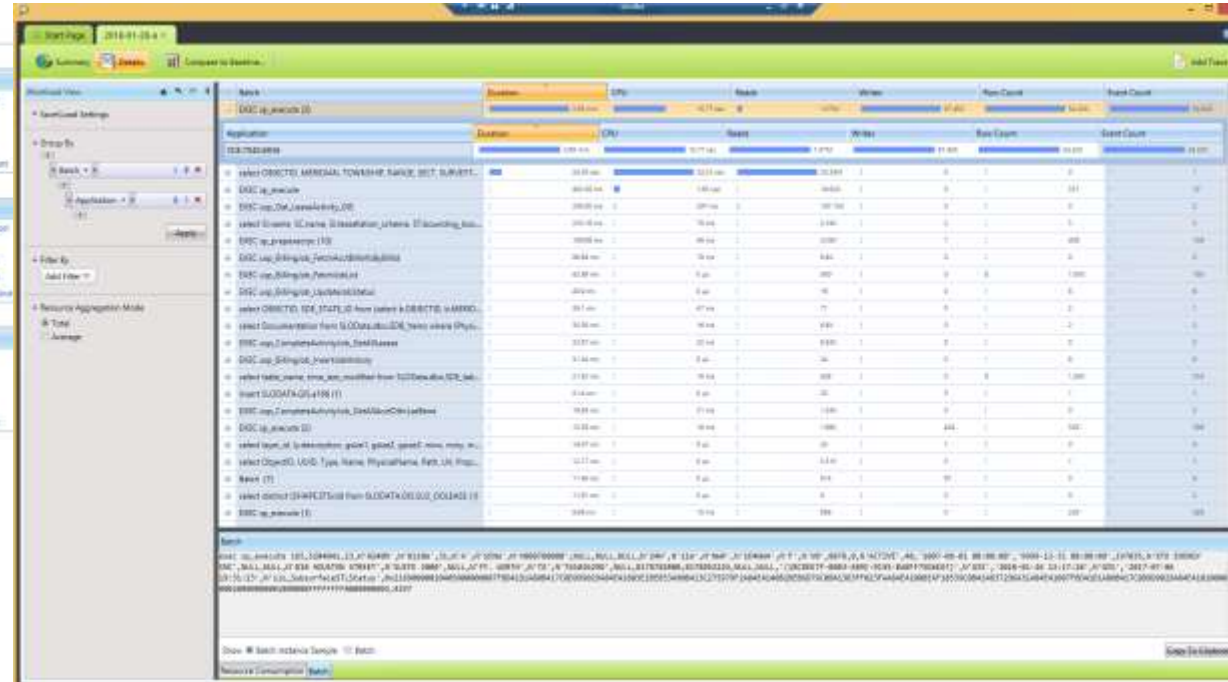
Resource	Top Consumer	Event Count	Total	Average	More Information
Duration	EXEC sp_executefree (1)	54322	0.69 min	0.07 ms	Show Batches by Duration
CPU	select OBJECTID, VERSION...	1	34.23 sec	34.23 sec	Show Batches by CPU
Reads	select OBJECTID, VERSION...	1	20.58M	20.58M	Show Batches by Reads
Writes	EXEC sp_executefree (1)	54322	37.45K	1.73	Show Batches by Writes
Row Count	EXEC sp_executefree (1)	54322	54.32K	1	Show Batches by Row Count

### Top Consuming Databases

Resource	Top Consumer	Event Count	Total	Average	More Information
Duration	SQLData	19999	3.12 min	0.14 ms	Show Databases by Duration
CPU	SQLData	19999	42.12 sec	1 ms	Show Databases by CPU
Reads	SQLData	19999	21.88M	384.22	Show Databases by Reads
Writes	SQLData	19999	97.98K	1.73	Show Databases by Writes
Row Count	SQLData	19999	58.1K	1.04	Show Databases by Row Count

### Top Consuming Hosts

Resource	Top Consumer	Event Count	Total	Average	More Information
Duration	SQLData	19999	3.12 min	0.14 ms	Show Hosts by Duration
CPU	SQLData	19999	42.12 sec	1 ms	Show Hosts by CPU
Reads	SQLData	19999	21.88M	384.22	Show Hosts by Reads
Writes	SQLData	19999	97.98K	1.73	Show Hosts by Writes
Row Count	SQLData	19999	58.1K	1.04	Show Hosts by Row Count



```
SELECT *
,SHAPE
,SHAPE.STArea()
,SHAPE.STLength()
FROM (
  SELECT /* ArcSDE NORMAL_FILTER */
    b.*
  FROM SLOData.GIS.slo_oglease b
  LEFT JOIN (
    SELECT SDE_DELETES_ROW_ID
    ,SDE_STATE_ID
  FROM SLOData.GIS.d166
  WHERE SDE_STATE_ID = 0
  AND DELETED_AT IN (
    SELECT l.lineage_id
    FROM SLOData.dbo.SDE_state_lineages l
    WHERE l.lineage_name = @P1
    AND l.lineage_id != @P2
  )
) d ON b.OBJECTID = d.SDE_DELETES_ROW_ID
WHERE d.SDE_STATE_ID IS NULL

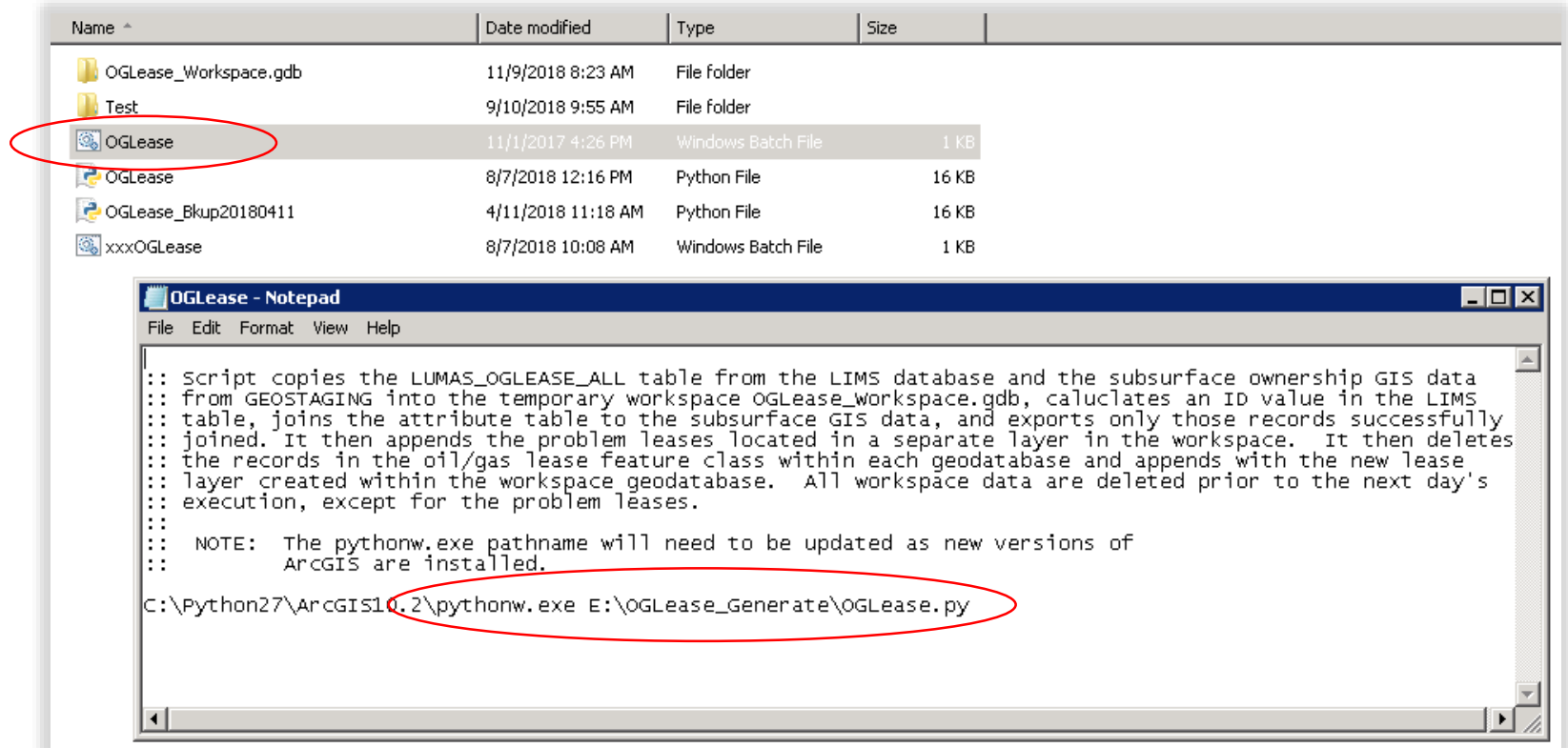
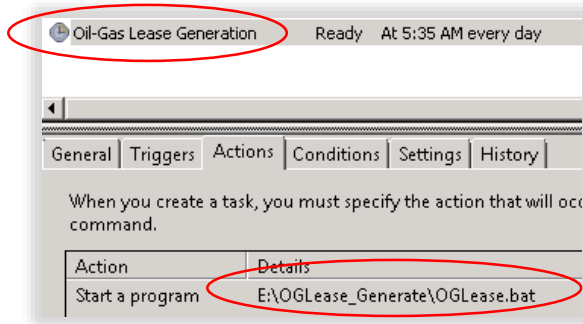
UNION ALL

SELECT a.*
FROM SLOData.GIS.s166 a
LEFT JOIN (
  SELECT SDE_DELETES_ROW_ID
  ,SDE_STATE_ID
  FROM SLOData.GIS.d166
  WHERE SDE_STATE_ID = 0
  AND DELETED_AT IN (
    SELECT l.lineage_id
    FROM SLOData.dbo.SDE_state_lineages l
    WHERE l.lineage_name = @P3
    AND l.lineage_id != @P4
  )
) d ON (a.OBJECTID = d.SDE_DELETES_ROW_ID
AND (a.SDE_STATE_ID = d.SDE_STATE_ID)
WHERE a.SDE_STATE_ID IN (
  SELECT l.lineage_id
  FROM SLOData.dbo.SDE_state_lineages l
  WHERE l.lineage_name = @P5
  AND l.lineage_id != @P6
)
AND d.SDE_STATE_ID IS NULL
) V_166
```

Some kind of cursor foo on a spatial table

Found thousands of these  
... entity framework cursor?  
No, joining into add&delete  
tables repeatedly.

Colleague found the task and the \*.bat file and the Python script call





# ESRI Model Builder

“it’s like Microsoft SSIS for GIS professionals”  
Result is a Python Script

```
#!/usr/bin/env python
# coding: utf-8 -*-
#
# OGLEase.py
# Created on: 2017-09-22 09:43:15.000000
# (generated by ArcGIS/ModelBuilder)
#
# Description: Creates an Oil/Gas Lease Layer from the LIMS table view. The program brings over the table view and the GIS Subsurf
# into a temporary work space (file geodatabase), creates a field called LLDID, joins the subsurface data with the tab
# keeping only the matching records, copies the new layer to a feature class in the work space, and dissolves the new
# the Lease ID. Once the subdivision-level and dissolved layers are created, the layers in GEOSTAGING, LIMSDB, and AT
# through Truncate/Append tools. The data in the work space is then deleted in preparation for the next day's run.
#
# This creates new layers each day after the Oil/Gas lease table view in LIMS is created from ONGARD.
#
# NOTE: Remove Code beginning at line 70 when land description for leases have been corrected.
# Leases are located in 31N 6W (Tract 40) and 26S 23E (TX Border).
#
# Import arcpy module
import arcpy

# Local variables:
# Connect to SDE Geodatabases and Public Web Server File Geodatabase
GEOSTAGING = "Database Connections\\
LIMSDB = "Database Connectio
ATLANTA = "

# Location of Subsurface Ownership Data and Oil/Gas Table in LIMS (from ONGARD)
slo_SubsurfaceSTLStatus = GEOSTAGING+"SLOData.GIS.slo_SubsurfaceSTLStatus"
LIMS_PROD_dbc_LUMAS_OGLEASE_ALL = "Database Connecti OGLEASE_ALL"

# Workspace and Temporary Data Sets (on GEOGRDD)
OGLEase_Workspace = '
SubSurface_Ownership = OGLEase_Workspace+"\\SubSurface_Ownership"
Subsurface_Ownership_Layer = "Subsurface_Ownership_Layer"

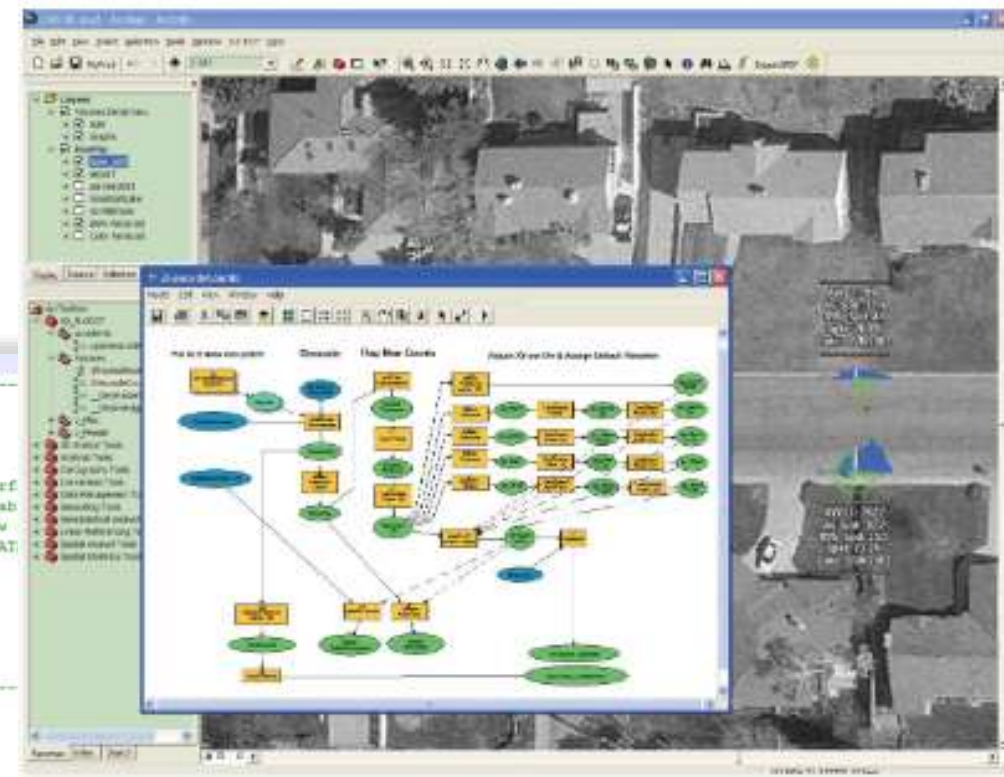
# Copy Subsurface Ownership GIS Data to File Geodatabase With Only the LLDID Attribute
arcpy.FeatureClassToFeatureClass_conversion(slo_SubsurfaceSTLStatus, OGLEase_Workspace, "SubSurface_Ownership", "", "LLDID \\\"LLDID\\\" true false false 64 Text 0 0 ,First,%,\"+slo_SubsurfaceSTLStatus+\",LLDID,-1,-1)

# Copy LIMS Table View into File Geodatabase (work space)
arcpy.TableToTable_conversion(LIMS_PROD_dbc_LUMAS_OGLEASE_ALL, OGLEase_Workspace, "LUMAS_OGLEASE_ALL", "", "MERIDIAN \\\"MERIDIAN\\\" true true false 2 Text 0 0 ,First,%,Database Connect IMS_P

# Add LLDID Field for Joining
arcpy.AddField_management(OGLEase_Workspace+"\\LUMAS_OGLEASE_ALL", "LLDID", "TEXT", "", "", "64", "", "NULLABLE", "REQUIRED", "")

# Calculate LLDID Field By Concatinating TRSQ. If Section Number is 9 or less, Add Another "0" Before the Section
arcpy.CalculateField_management(OGLEase_Workspace+"\\LUMAS_OGLEASE_ALL", "LLDID", "MERIDIAN+ TOWNSHIP+ RANGE+LLDIDzero( SECTION)+ SECTION+ SURVEYTYPE+ ALIQUOT", "PYTHON_9.3", "def LLDIDzero(section):

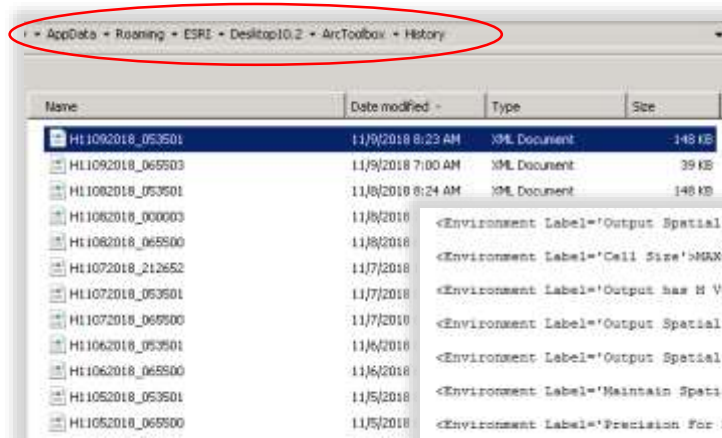
# Add GRIDNAME Field and Populate with "Subsurface" STL Status
```



Demo

Locating the slow lines of code in the script.

## ESRI Model Builder XML Log files - Timestamps



Name	Date modified	Type	Size
Ht1092018_053501	11/9/2018 8:23 AM	XML Document	148 KB
Ht1092018_065503	11/9/2018 7:00 AM	XML Document	39 KB
Ht1082018_053501	11/8/2018 8:24 AM	XML Document	148 KB
Ht1082018_000003	11/8/2018		
Ht1082018_065500	11/8/2018		
Ht1072018_212652	11/7/2018		
Ht1072018_053501	11/7/2018		
Ht1072018_065500	11/7/2018		
Ht1062018_053501	11/6/2018		
Ht1062018_065500	11/6/2018		
Ht1052018_053501	11/5/2018		
Ht1052018_065500	11/5/2018		

```
<Environment Label='Output Spatial Grid 1'>0</Environment>
<Environment Label='Cell Size'>MAXDEF</Environment>
<Environment Label='Output has M Values'>Same As Input</Environment>
<Environment Label='Output Spatial Grid 2'>0</Environment>
<Environment Label='Output Spatial Grid 3'>0</Environment>
<Environment Label='Maintain Spatial Index'>>false</Environment>
<Environment Label='Precision For Derived Coverages'>HIGHEST</Environment>
</Environments>
<EndTime>Fri Aug 17 06:40:20 2018</EndTime>
<EndTime>54 minutes 33 seconds</EndTime>
</ResultView>
<ResultView Tool='Append'>
  <CommandLine>Append_management !Workspace.gdb\OGLASE !spos;Database Connections\ GIS.slo_ogleasetapos; NO_TEST !spos;MERIDIAN &quot;MERIDIAN&quot; true 1
  <ToolSource>c:\program files (x86)\arcgis\desktop10.2\ArcToolbox\Toolboxes\Data Management Tools.tbx\General\Append</ToolSource>
  <StartTime>Fri Aug 17 06:34:54 2018</StartTime>
  <Parameters>
  <Inputs>
    <Parameter Label='Input Datasets' Type='Scalar'>!Workspace.gdb\OGLASE</Parameter>
    <Parameter Label='Target Dataset' Type='Dataset'>Database Connections\ GIS.slo_ogleasetapos</Parameter>
    <Parameter Label='Schema Type' Type='Scalar'>NO_TEST</Parameter>
    <Parameter Label='Field Map' Type='Scalar'>MERIDIAN &quot;MERIDIAN&quot; true true false 8 Double 8 38 ,First,# !Workspace.gdb\OGLASE,MERIDIAN,-1,-1,TOWNSHIP &quot;TOWNSHIP&quot;
  </Inputs>
```

## Lines 89 & 90 take over an hour each line

```
68 # Copy Features into Feature Class OGLEASE
69 arcpy.CopyFeatures_management("OGLEASE_Layer", OGLEase_Workspace+"\\OGLEASE", "", "0", "0", "0")
70
71
72 # **** REMOVE WHEN LEASES ARE CORRECTED - Bad Land Descriptions ****
73 # Append missing lease geometry to oil/gas leases. These are produced separately as a static data set.
74 arcpy.Append_management(OGLEase_Workspace+"\\MissingLeases", OGLEase_Workspace+"\\OGLEASE", "NO_TEST", "", "")
75
76
77 # Dissolve on LEASE ID and Other Lessee Information
78 arcpy.Dissolve_management(OGLEase_Workspace+"\\OGLEASE", OGLEase_Workspace+"\\OGLEASE_D", "UNIQUEKEY;LSE_PREFIX;LSE_NUMBER;LSE_SUFFIX;STATUS;VEREFF_DTE;VERTRM_DTE")
79
80 # Alter the Name of the Summed Acreage Field
81 arcpy.AlterField_management(OGLEase_Workspace+"\\OGLEASE_D", "SUM_LSDV_ACRG", "LSE_ACRG", "Lease Acreage")
82
83
84 #Import Dissolved Lease Layer SLOData.gdb (truncate/append) from the OGLEASE_Workspace
85 arcpy.DeleteFeatures_management(+ "slo_ogleased")
86 arcpy.Append_management(OGLEase_Workspace+"\\OGLEASE_I _ ogleased", "NO_TEST", "", "")
87
88 #Import Subdivision-level and Dissolved Lease Layers ncate/append) from the OGLEASE_Workspace
89 arcpy.DeleteFeatures_management("SLOData.GIS.slo_oglease")
90 arcpy.Append_management(OGLEase_Workspace+"\\C "SLOData.GIS.slo_oglease", "NO_TEST", "", "")
91 arcpy.DeleteFeatures_management("SLOData.GIS.slo_ogleased")
92 arcpy.Append_management(OGLEase_Workspace+"\\OGL _ "SLOData.GIS.slo_ogleased", "NO_TEST", "", "")
93
94 #Import Subdivision-level and Dissolved Lease Layers (truncate/append) from the OGLEASE_Workspace
95 arcpy.DeleteFeatures_management(:NG+"SLOData.GIS.slo_oglease")
96 arcpy.Append_management(OGLEase_Workspace+"\\OGLE + "SLOData.GIS.slo_oglease", "NO_TEST", "", "")
97 arcpy.DeleteFeatures_management(:NG+"SLOData.GIS.slo_ogleased")
98 arcpy.Append_management(OGLEase_Workspace+"\\OGLEASE_ _ "SLOData.GIS.slo_ogleased", "NO_TEST", "", "")
99
100
101 # Delete Temporary Data Out of OGLEase_Workspace.gdb in Preparation for the Next Day's Run
102 arcpy.Delete_management(OGLEase_Workspace+"\\LUMAS_OGLEASE_ALL", "Table")
103 arcpy.Delete_management(SubSurface_Ownership, "FeatureClass")
104 arcpy.Delete_management(OGLEase_Workspace+"\\OGLEASE", "FeatureClass")
105 arcpy.Delete_management(OGLEase_Workspace+"\\OGLEASE_D", "FeatureClass")
106
```



OMG! Gotta be the indexes. Double check index maintenance plans on the spatial table.

FROM (UNAPL33961.dbo).CommandSet  
where ObjectName IN ('sio\_splarea', 's166', 's166')  
order by StartTime DESC

ID	DatabaseName	SchemaName	ObjectName	ObjectID	IndexName	IndexType	PostgreSQLName	PartitionNumber	ExtendedInfo	Command	CommandType	StartTime	EndTime	Err
2694841	SIOData	gis	D166	0	NULL	NULL	_WA_Sys_00000002_7FDB89FC	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [_WA_Sys_00000002_7FDB89FC] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:34:59.253	2018-10-12 20:35:00.067	0
2694840	SIOData	gis	D166	0	s166_idx2	2	s166_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:34:57.667	2018-10-12 20:34:58.260	0
2694839	SIOData	gis	D166	0	s166_pk	1	s166_pk	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_pk] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:34:55.607	2018-10-12 20:34:56.057	0
2694791	SIOData	gis	s166	0	UID_OID_s166_a	2	UID_OID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_OID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:33:42.618	2018-10-12 20:34:05.905	0
2694790	SIOData	gis	s166	0	UID_s166_a	2	UID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:33:42.097	2018-10-12 20:33:52.600	0
2694789	SIOData	gis	s166	0	11479393QUERY_a	2	11479393QUERY_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [11479393QUERY_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:33:41.995	2018-10-12 20:33:41.998	0
2694788	SIOData	gis	s166	0	s166_state_idx2	2	s166_state_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_state_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:33:12.145	2018-10-12 20:33:30.080	0
2694787	SIOData	gis	s166	0	s166_rowid_idx1	1	s166_rowid_idx1	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_rowid_idx1] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-12 20:33:23.095	2018-10-12 20:33:24.410	0
2694204	SIOData	gis	D166	0	NULL	NULL	_WA_Sys_00000002_7FDB89FC	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [_WA_Sys_00000002_7FDB89FC] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:31:59.697	2018-10-10 20:31:59.473	0
2694203	SIOData	gis	D166	0	s166_idx2	2	s166_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:31:57.583	2018-10-10 20:31:59.692	0
2694202	SIOData	gis	D166	0	s166_pk	1	s166_pk	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_pk] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:31:18.993	2018-10-10 20:31:20.977	0
2694201	SIOData	gis	s166	0	UID_OID_s166_a	2	UID_OID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_OID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:31:17.122	2018-10-10 20:31:06.440	0
2694200	SIOData	gis	s166	0	UID_OID_s166_a	2	UID_OID_s166_a	1	<ExtendedInfo><PageCount>951364/<PageCount><Fragmentation>5.47286/<Fragmentation><ExtendedInfo>	ALTER INDEX [UID_OID_s166_a] ON [SIOData].[gis].[s166] REORGANIZE WITH (LOB_COMPACTION = ON)	ALTER_INDEX	2018-10-10 20:30:57.685	2018-10-10 20:30:57.133	0
2694199	SIOData	gis	s166	0	UID_s166_a	2	UID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:30:54.105	2018-10-10 20:30:56.967	0
2694243	SIOData	gis	s166	0	11479393QUERY_a	2	11479393QUERY_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [11479393QUERY_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:29:58.105	2018-10-10 20:29:56.977	0
2694242	SIOData	gis	s166	0	s166_state_idx2	2	s166_state_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_state_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:29:58.183	2018-10-10 20:29:54.140	0
2694241	SIOData	gis	s166	0	s166_rowid_idx1	1	s166_rowid_idx1	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_rowid_idx1] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-10 20:29:57.135	2018-10-10 20:29:58.500	0
2693603	SIOData	gis	D166	0	NULL	NULL	_WA_Sys_00000002_7FDB89FC	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [_WA_Sys_00000002_7FDB89FC] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:29:43.485	2018-10-09 20:29:43.540	0
2693602	SIOData	gis	D166	0	s166_idx2	2	s166_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:29:39.997	2018-10-09 20:29:43.480	0
2693601	SIOData	gis	D166	0	s166_pk	1	s166_pk	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_pk] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:29:12.750	2018-10-09 20:29:39.237	0
2693577	SIOData	gis	s166	0	UID_OID_s166_a	2	UID_OID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_OID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:29:09.987	2018-10-09 20:29:18.820	0
2693576	SIOData	gis	s166	0	UID_s166_a	2	UID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:28:54.923	2018-10-09 20:29:05.317	0
2693575	SIOData	gis	s166	0	11479393QUERY_a	2	11479393QUERY_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [11479393QUERY_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:28:56.985	2018-10-09 20:28:53.987	0
2693574	SIOData	gis	s166	0	11479393QUERY_a	2	11479393QUERY_a	1	<ExtendedInfo><PageCount>102470/<PageCount><Fragmentation>5.17791/<Fragmentation><ExtendedInfo>	ALTER INDEX [11479393QUERY_a] ON [SIOData].[gis].[s166] REORGANIZE WITH (LOB_COMPACTION = ON)	ALTER_INDEX	2018-10-09 20:28:59.513	2018-10-09 20:29:05.500	0
2693573	SIOData	gis	s166	0	s166_state_idx2	2	s166_state_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_state_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:28:52.245	2018-10-09 20:29:07.410	0
2693572	SIOData	gis	s166	0	s166_rowid_idx1	1	s166_rowid_idx1	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_rowid_idx1] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-09 20:28:48.643	2018-10-09 20:29:00.817	0
2677941	SIOData	gis	D166	0	NULL	NULL	_WA_Sys_00000002_7FDB89FC	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [_WA_Sys_00000002_7FDB89FC] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:26:43.483	2018-10-08 20:26:46.267	0
2677940	SIOData	gis	D166	0	s166_idx2	2	s166_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:26:33.787	2018-10-08 20:26:40.460	0
2677939	SIOData	gis	D166	0	s166_pk	1	s166_pk	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[D166] [s166_pk] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:26:28.475	2018-10-08 20:26:31.800	0
2677938	SIOData	gis	D166	0	s166_pk	1	NULL	1	<ExtendedInfo><PageCount>777354/<PageCount><Fragmentation>5.28849/<Fragmentation><ExtendedInfo>	ALTER INDEX [s166_pk] ON [SIOData].[gis].[D166] REORGANIZE WITH (LOB_COMPACTION = ON)	ALTER_INDEX	2018-10-08 20:26:03.091	2018-10-08 20:26:25.470	0
2677937	SIOData	gis	s166	0	UID_OID_s166_a	2	UID_OID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_OID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:25:47.127	2018-10-08 20:25:58.998	0
2677936	SIOData	gis	s166	0	UID_s166_a	2	UID_s166_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [UID_s166_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:25:34.505	2018-10-08 20:25:46.127	0
2677935	SIOData	gis	s166	0	11479393QUERY_a	2	11479393QUERY_a	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [11479393QUERY_a] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:25:28.975	2018-10-08 20:25:36.408	0
2677934	SIOData	gis	s166	0	s166_state_idx2	2	s166_state_idx2	NULL	NULL	UPDATE STATISTICS [SIOData].[gis].[s166] [s166_state_idx2] WITH FULLSCAN	UPDATE_STATISTICS	2018-10-08 20:25:18.637	2018-10-08 20:25:28.093	0

Base table never reorg or rebuild  
Spatial indexes never reorg or rebuild



Run Andy Yun's index analysis scripts (on Github).



## Uncovering Duplicate, Redundant, & Missing Indexes - A Sneak Peek

Andy Yun, Senior Solutions Engineer, SentryOne  
Moderated By: Mark Broadbent



Andy Yun  
Senior Solutions Engineer, SentryOne

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Block or report user

# Yun's UsageStatsQuery – his “go to” query ... result: it was index updates but only showed traditional indexes.

Database\ Schema\ TableName	IndexName	user seeks	user scans	user lookups	user updates	last_user_seek	last_user_scan	last_user_lookup	last_user_update	type_desc	is_primary	is_unique	is_unique_row_count	in_row_data_page_count	in_row_used_page_count	in_row_reserved_page_count	lob_used_page_count	lob_reserved_page_count	row_overflow_used_page_count
SQLData dbo	GDB_ITEMRELATIONSHIPS_R3_pk	14570	68133	1202	0	10/12/18 15:00				CLUSTERED	1	1	0	160	4	6	6	0	0
SQLData dbo	GDB_ITEMRELATIONSHIPS_GDB_ItemRel_DestID_idx	3976	0	0	0					NONCLUSTERED	0	0	0	160	1	2	2	0	0

```
-- Andy Yun's personal sys.dm_db_index_usage_stats query
SELECT
    databases.Name AS DatabaseName,
    schemas.Name AS SchemaName,
    objects.Name AS TableName,
    indexes.Name AS IndexName,
    dm_db_index_usage_stats.user_seeks,
    dm_db_index_usage_stats.user_scans,
    dm_db_index_usage_stats.user_lookups,
    dm_db_index_usage_stats.user_updates,
    dm_db_index_usage_stats.last_user_seek,
    dm_db_index_usage_stats.last_user_scan,
    dm_db_index_usage_stats.last_user_lookup,
    dm_db_index_usage_stats.last_user_update,
    indexes.type_desc,
    indexes.is_primary_key,
    indexes.is_unique,
    indexes.is_unique_constraint,
    dm_db_partition_stats.row_count,
    dm_db_partition_stats.in_row_data_page_count,
    dm_db_partition_stats.in_row_used_page_count,
    dm_db_partition_stats.in_row_reserved_page_count,
    dm_db_partition_stats.lob_used_page_count,
    dm_db_partition_stats.lob_reserved_page_count,
    dm_db_partition_stats.row_overflow_used_page_count,
    dm_db_partition_stats.row_overflow_reserved_page_count,
    dm_db_partition_stats.used_page_count,
    dm_db_partition_stats.reserved_page_count
FROM master.sys.dm_db_index_usage_stats
INNER JOIN master.sys.databases
    ON dm_db_index_usage_stats.database_id = databases.database_id
INNER JOIN sys.objects
    ON dm_db_index_usage_stats.object_id = objects.object_id
INNER JOIN sys.schemas
    ON schemas.schema_id = objects.schema_id
INNER JOIN sys.indexes
    ON dm_db_index_usage_stats.index_id = indexes.index_id
    AND dm_db_index_usage_stats.object_id = indexes.object_id
INNER JOIN sys.dm_db_partition_stats
    ON dm_db_index_usage_stats.index_id = dm_db_partition_stats.index_id
    AND dm_db_index_usage_stats.object_id = dm_db_partition_stats.object_id
WHERE objects.type = 'U'
    AND databases.name = db_name()
ORDER BY databases.name, schemas.name, objects.name, indexes.type_desc, indexes.is_primary_key DESC, indexes.name
```

Use Excel “conditional formatting” on results to find needle in haystack of hundreds of indexes

2.7 M user updates  
On 17.6 M row\_count







Source of problem – the stuff of ESRI convention on Versioned Feature Classes  
Performance Issues were a by-product of ESRI versioning.

### How Versioning Works

Adding Features  
Record added to the Adds Table  
Version will be referenced (GDE\_State\_ID Field)

### Versioned Editing – Reconcile and Post

How can versions be merged?

### Versioned Editing – Reconcile

Incorporate changes from the target version

### Versioned Editing – Post

Incorporate with target version

### Versioned Editing – Compress

How can extra in the A & D ("Adds") tables make it to the Base table for a versioned feature class?

After a post in the DEFAULT version, a compress will move the adds from the A & D ("Adds") tables to the Base table.

### Compress

Disconnect all user from the geodatabase before running a compress for best results.  
If users are logged on, the lineages that they are accessing will not be compressed.  
The result is fewer states will be moved to the base table.  
If using replication, synchronize before the compress.

Compress workflow

### Good Housekeeping Tip

For Geodatabases

Is it versioned?  
Different for PostgreSQL  
and Oracle:

```
SELECT NAME AS "Versioned feature class"
FROM dbo.GDB_ITEMS
WHERE Definition.exists('/Versioned') = 1
AND Definition.value('/Versioned')[1] = 'true'
```



But why? Digging deeper on the spatial index.

Three questions.

What tools did Microsoft give us for analyzing the index?

Is the index working, is it being used at all?

Does the index work quickly?

# What tools did Microsoft give us for analyzing the index?

Very little info in PASS, but two useful papers from Microsoft on Spatial Index Internals, both co-authored by Michael Rys – now on Spark for .Net.

## Spatial Indexing in Microsoft SQL Server 2008

Yi Fang, Marc Friedman, Giri Nair, Michael Rys, Ana-Elisa Schmidt

Microsoft Corp.

{yfang,marcfr,gair,mrys,anasc}@microsoft.com

SIGMOD'08, June 9–12, 2008, Vancouver, BC, Canada.  
Copyright 2008 ACM 978-1-60558-102-6/08/06...\$5.00.

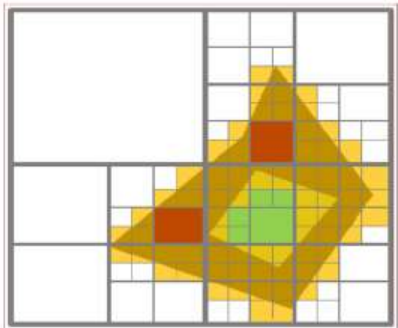


Figure-2: Grid decomposition of a polygon using 2x2 grids

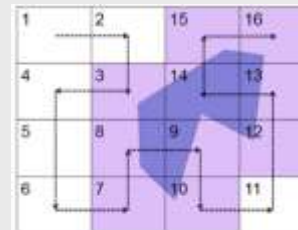
## Tuning Spatial Point Data Queries in SQL Server 2012



Microsoft®  
SQL Server®

### Tuning Spatial Point Data Queries in SQL Server 2012

Written by: Ed Katibah, Milan Stojic, Michael Rys, Nicholas Dritsas



Therefore, the mapping pattern for an index used over spatial data might look like:



However, as the point of the base object is needed to get actual spatial objects, the mapping pattern for the clustered index needs to be base table right-hand side:



# What tools did Microsoft give us for analyzing the index?

Diagnostic function #1: `sp_help_spatial_geometry_histogram()`

```
exec sp_help_spatial_geometry_histogram @tabname = "[ASLDDData].[dbo].[ASLD_SURFACE_PARCELS]", @colname =  
'shape', @resolution = 64, @xmin = 144206, @ymin = 3466600, @xmax = 685016, @ymax = 4099054, @sample = 100;
```

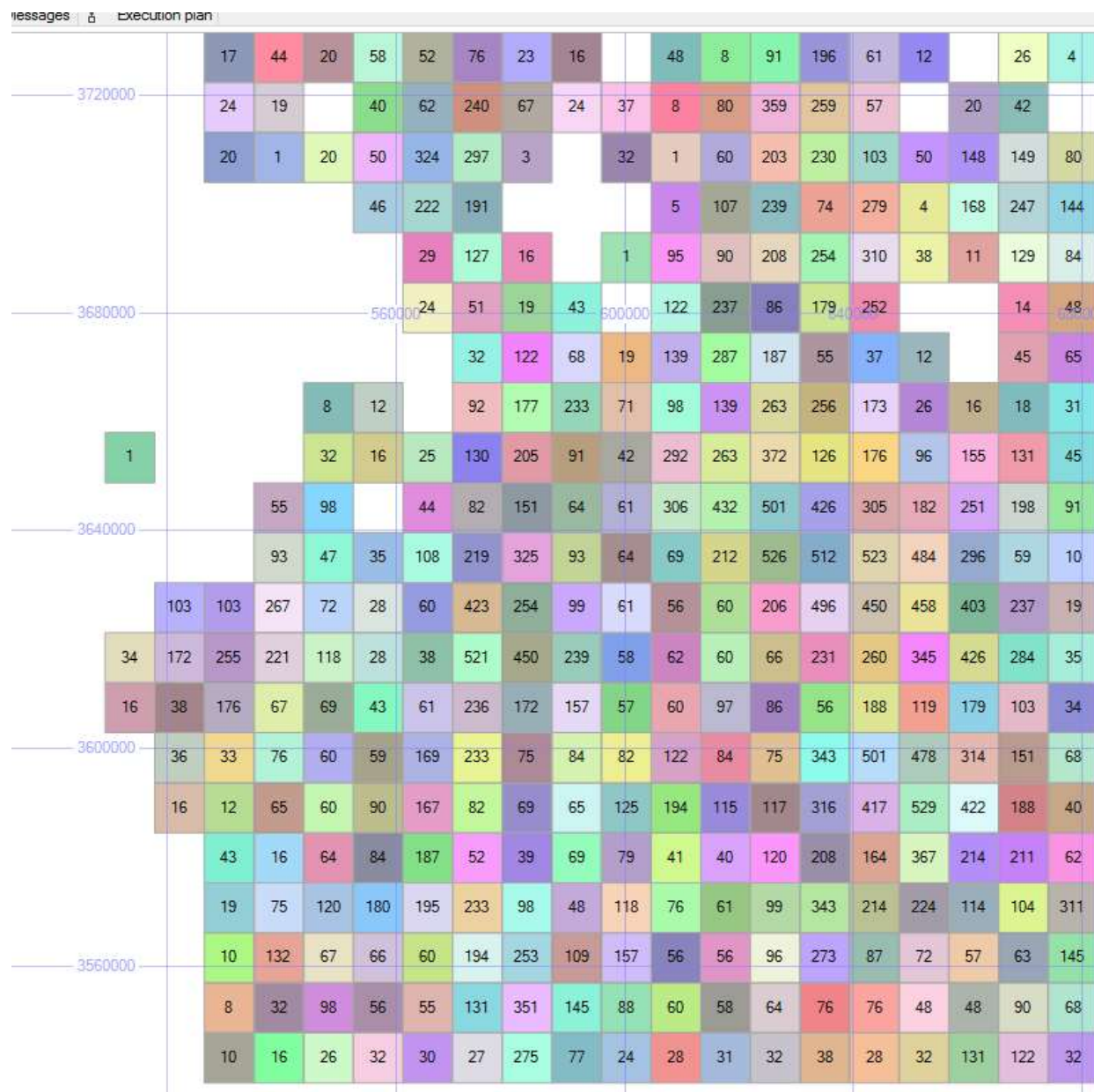


Zoom in:

Is the grid density for the spatial index evenly distributed?

`sp_help_spatial_geometry_histogram` tells us if the index is balanced or not

Values are the number of shapes in the smallest grid ... change index grid properties if unbalanced





# What tools did Microsoft give us for analyzing the index?

## Diagnostic function #2: sp\_help\_spatial\_geometry\_index

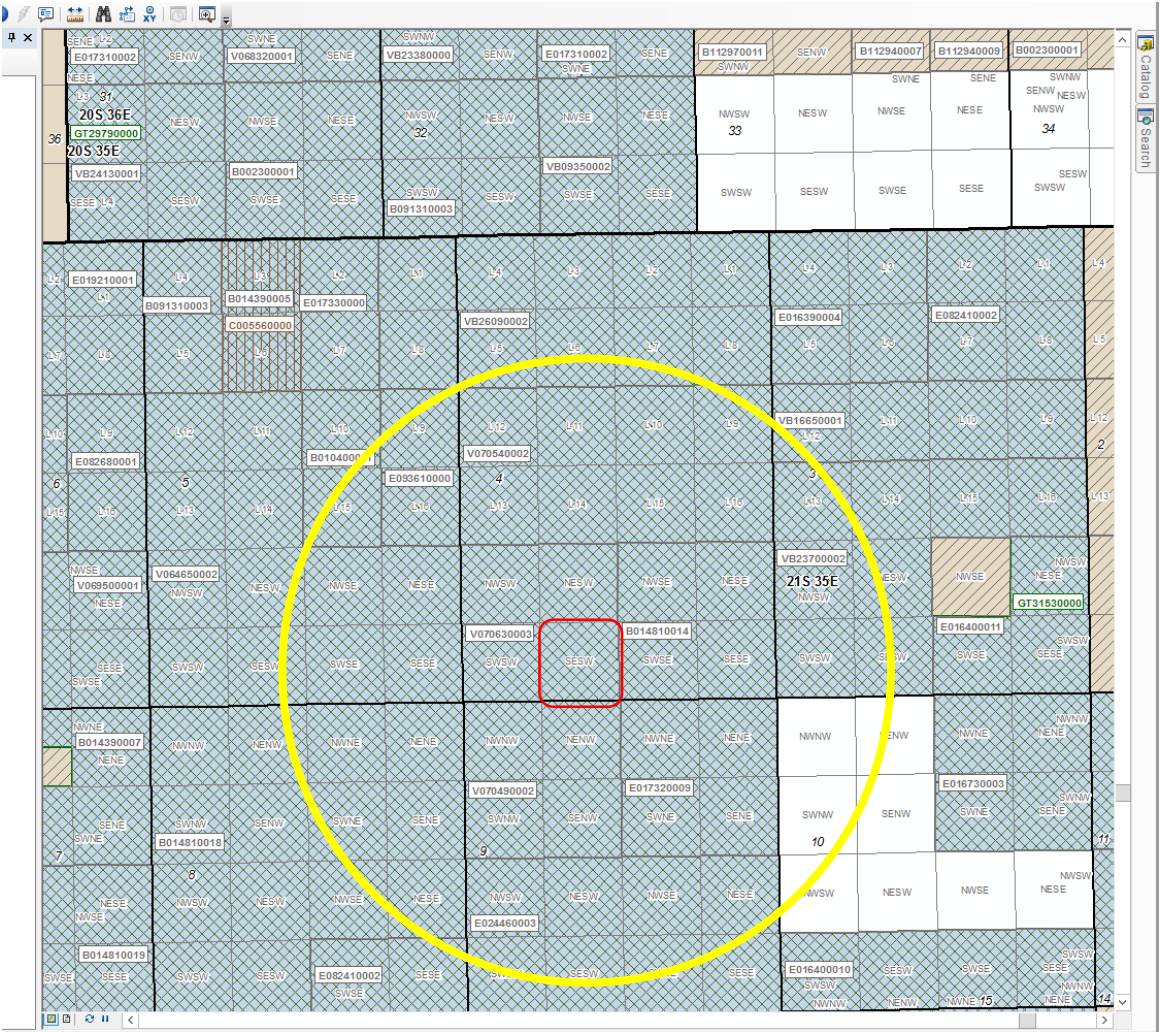
### Whatif scenarios on a spatial index

```
declare @qs geometry = 'POLYGON((-12162870 4086998, -12162871 4086998, -12162870 4086999, -12162870 4086998))';
exec sp_help_spatial_geometry_index @tablename = "[AZBaseData].[dbo].[PLSSSECONDDIVISION_AZ]", @indexname = 'FDO_Shape', @verboseoutput = 1,
@query_sample = @qs;
```

propname	propval bigpoly bigsidx	propval smpoly bigsidx	propval bigpoly smallsidx	propval smpoly smallsidx
Base_Table_Rows	17618929	17618929	56709	56709
Bounding_Box_xmin	127119.099343	127119.099343	127119.099343	127119.099343
Bounding_Box_ymin	3510943.72004	3510943.72004	3510943.72004	3510943.72004
Bounding_Box_xmax	682752.399957	682752.399957	682752.399957	682752.399957
Bounding_Box_ymax	4099048.36494	4099048.36494	4099048.36494	4099048.36494
Grid_Size_Level_1	64	64	64	64
Grid_Size_Level_2	64	64	64	64
Grid_Size_Level_3	64	64	64	64
Grid_Size_Level_4	64	64	64	64
Cells_Per_Object	16	16	16	16
Total_Primary_Index_Rows	265074776	265074776	853517	853517
Total_Primary_Index_Pages	1051507	1051507	2542	2542
Average_Number_Of_Index_Rows_Per_Base_Row	15	15	15	15
Total_Number_Of_ObjectCells_In_Level0_For_QuerySample	1	1	1	NULL
Total_Number_Of_ObjectCells_In_Level0_In_Index	327	327	2	2
Total_Number_Of_ObjectCells_In_Level1_For_QuerySample	64	64	64	NULL
Total_Number_Of_ObjectCells_In_Level1_In_Index	162574	162574	485	485
Total_Number_Of_ObjectCells_In_Level2_For_QuerySample	NULL	1	NULL	12
Total_Number_Of_ObjectCells_In_Level2_In_Index	264911875	264911875	853030	853030
Total_Number_Of_Interior_ObjectCells_In_Level1_For_QuerySample	36	36	NULL	NULL
Total_Number_Of_Interior_ObjectCells_In_Level1_In_Index	NULL	NULL	2	2
Total_Number_Of_Interior_ObjectCells_In_Level2_For_QuerySample	60759124	60759124	195701	195701
Total_Number_Of_Interior_ObjectCells_In_Level2_In_Index	28	28	485	485
Total_Number_Of_Intersecting_ObjectCells_In_Level3_For_QuerySample	162574	162574	485	NULL
Total_Number_Of_Intersecting_ObjectCells_In_Level3_In_Index	NULL	1	NULL	10
Total_Number_Of_Intersecting_ObjectCells_In_Level4_For_QuerySample	204152751	204152751	657329	657329
Total_Number_Of_Border_ObjectCells_In_Level0_For_QuerySample	1	1	1	2
Total_Number_Of_Border_ObjectCells_In_Level0_In_Index	327	327	0.0	0.0
Interior_To_Total_Cells_Normalized_To_Leaf_Grid_Percentage	0.0	0.0	0.0	0.0
Intersecting_To_Total_Cells_Normalized_To_Leaf_Grid_Percentage	0.0	0.0	0.0	0.0
Border_To_Total_Cells_Normalized_To_Leaf_Grid_Percentage	0.0	0.0	0.0	0.0
Average_Cells_Per_Object_Normalized_To_Leaf_Grid	0.0	0.0	0.0	0.0
Average_Objects_PerLeaf_GridCell	0.0	0.0	0.0	0.0
Number_Of_SRIDs_Found	2	2	2	2
Width_Of_Cell_In_Level1	69454.16257675	69454.16257675	69454.16257675	69454.16257675
Width_Of_Cell_In_Level2	8681.77032209375	8681.77032209375	8681.77032209375	8681.77032209375
Width_Of_Cell_In_Level3	1085.22129026172	1085.22129026172	1085.22129026172	1085.22129026172
Width_Of_Cell_In_Level4	135.652661282715	135.652661282715	135.652661282715	135.652661282715
Height_Of_Cell_In_Level1	73513.0806125	73513.0806125	73513.0806125	73513.0806125
Height_Of_Cell_In_Level2	9189.1350765625	9189.1350765625	9189.1350765625	9189.1350765625
Height_Of_Cell_In_Level3	1148.64188457031	1148.64188457031	1148.64188457031	1148.64188457031
Height_Of_Cell_In_Level4	143.580235571289	143.580235571289	143.580235571289	143.580235571289
Area_Of_Cell_In_Level1	5105789452.37831	5105789452.37831	5105789452.37831	5105789452.37831
Area_Of_Cell_In_Level2	79777960.193411	79777960.193411	79777960.193411	79777960.193411
Area_Of_Cell_In_Level3	1246530.62802205	1246530.62802205	1246530.62802205	1246530.62802205
Area_Of_Cell_In_Level4	19477.0410628445	19477.0410628445	19477.0410628445	19477.0410628445
CellArea_To_BoundingBoxArea_Percentage_In_Level1	1.5625	1.5625	1.5625	1.5625
CellArea_To_BoundingBoxArea_Percentage_In_Level2	0.0244140625	0.0244140625	0.0244140625	0.0244140625
CellArea_To_BoundingBoxArea_Percentage_In_Level3	0.0003814697265625	0.0003814697265625	0.0003814697265625	0.0003814697265625
CellArea_To_BoundingBoxArea_Percentage_In_Level4	5.96046447753906E-06	5.96046447753906E-06	5.96046447753906E-06	5.96046447753906E-06
Number_Of_Rows_Selected_By_Primary_Filter (may have false positives)	17618929	17618929	56709	56709
Number_Of_Rows_Selected_By_Internal_Filter (by the index optimizations)	517831	517831	17631	17631
Number_Of_Times_Secondary_Filter_Is_Called (the expensive operation)	12440298	0	39074	0
Number_Of_Rows_Output	0	0	0	0
Percentage_Of_Rows_NotSelected_By_Primary_Filter	0	99.9981440415589	0	99.9981440415589
Percentage_Of_Primary_Filter_Rows_Selected_By_Internal_Filter	29.3924278825347	100	31.0973566805974	31.1111111111111
Internal_Filter_Efficiency (by the index optimizations)	0.0	0.0	0.0	31.1111111111111
Primary_Filter_Efficiency	0	0	0	100

Demo

Is the spatial index working? Design a spatial query, in yellow, all SubSections within a mile of a prolific well.



1. Select a geometry to tessellate with.

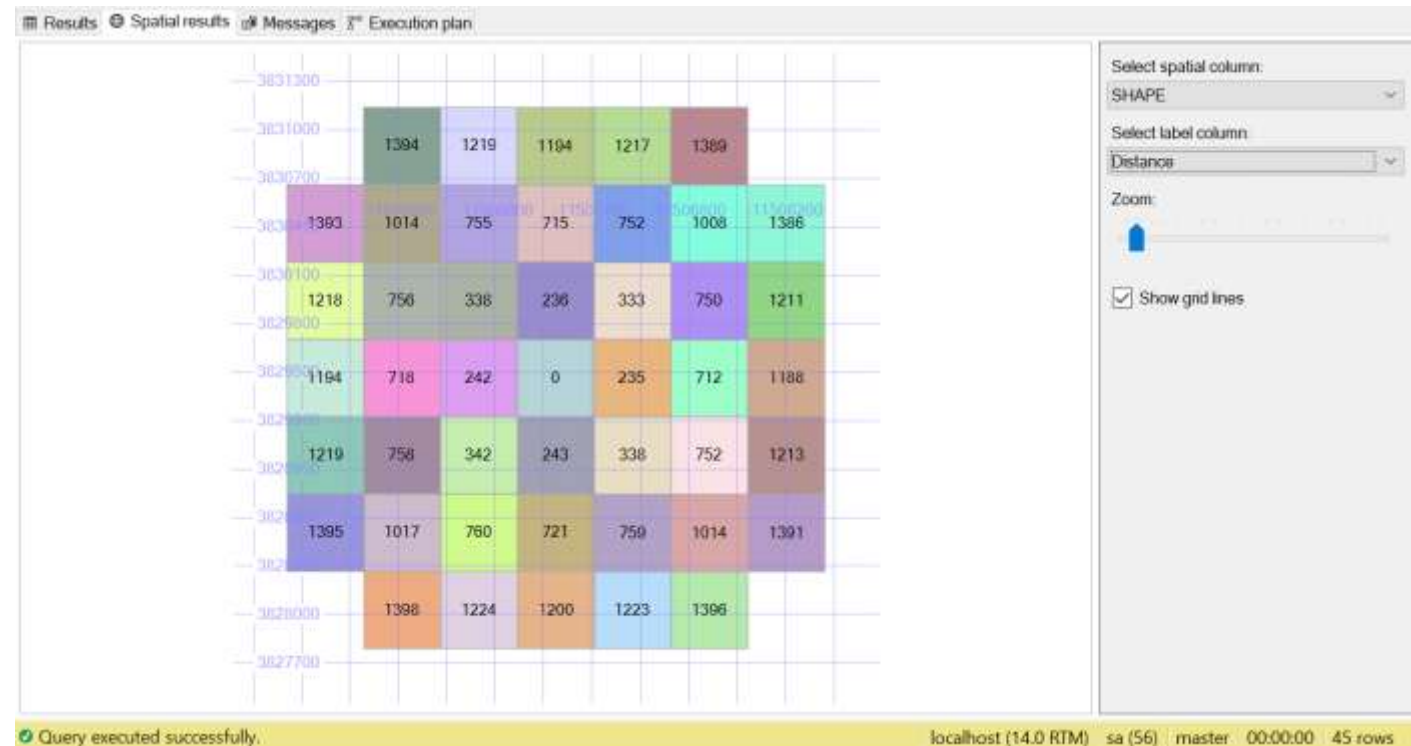
2. Use .STDistance() method in query.

3. Spatial Results

```
-- define a variable for the geometry to tessellate with, a spatial data value for a prolific well
DECLARE @point1 geometry;

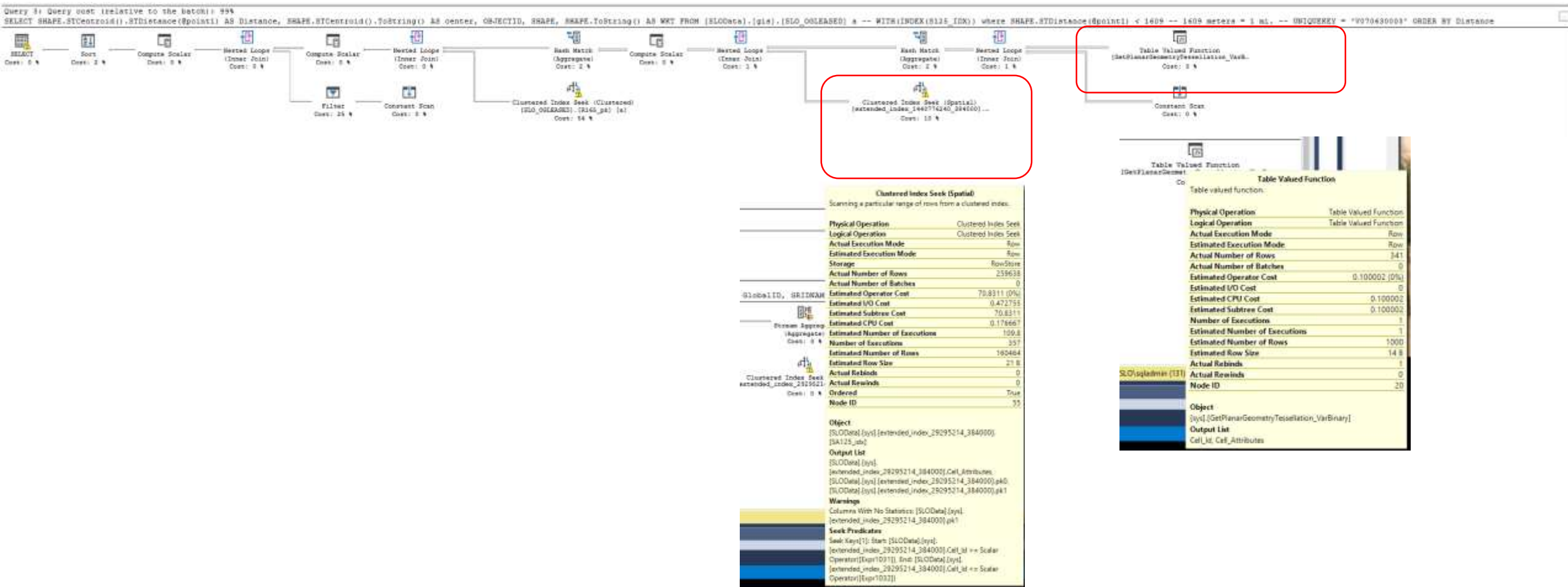
-- load the geometry point value for a prolific well into a variable
SELECT
    @point1 = SHAPE
FROM [NMBaseData].[dbo].[NM_WELLS_DISTRICT_ALL_WGS84_3857]
WHERE
    API = '30-025-38720' -- Well API = '30-025-38720' prolific well KF STATE COM #002 - CHEVRON U S A INC
```

```
-- find the PLSS subsections within a mile from the national blm dataset 24 million rows, 300M leaf nodes.
SELECT
    a.SHAPE,
    round(a.Shape.STDistance(@point1),0) Distance,
    a.SECDIVID
FROM [AZBaseData].[dbo].[PLSSSECONDDIVISION] a -- WITH(INDEX(FDO_Shape)) -- shouldn't need index hint
WHERE
    a.Shape.STDistance(@point1) < 1609 -- 1609 meters = 1 mi.
ORDER BY Distance
```





# 4. Execution plan verifies use of spatial index



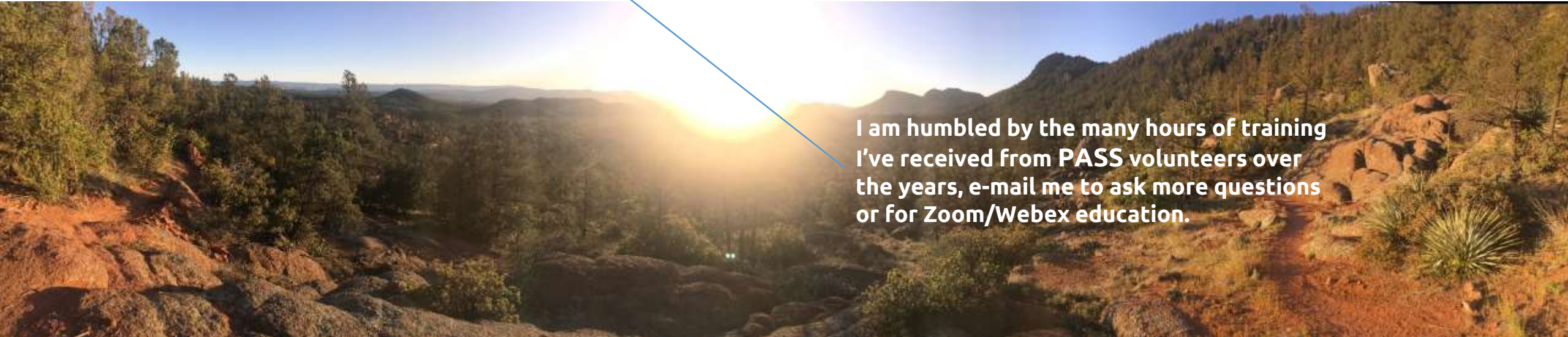
Demo

# Any Queries?

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twitter: @kevinkarns

🔒 GitHub, Inc. [US] | <https://github.com/kkarns/sqlsaturday-869> 🔍 ☆



I am humbled by the many hours of training I've received from PASS volunteers over the years, e-mail me to ask more questions or for Zoom/Webex education.