

# Open Source Geospatial Software for the Desktop and Server

Richard W. Greenwood, PLS  
**Greenwood Mapping, Inc.**  
Wilson, Wyoming  
[www.GreenwoodMap.com](http://www.GreenwoodMap.com)

# Open Source Software

Inspect and modify the Source Code

**F/OSS, FOSS, or FLOSS**

*Free/Libre/Open Source Software*

Free of cost

Freedom to reuse

# **GDAL** *Geographic Data Abstraction Library*

[www.gdal.org](http://www.gdal.org)

## Raster Formats

GeoTIFF

NITF

Erdas Imagine (.img)

SDTS

HDF

ESRI Grids

ECW

MrSID

JPEG2000

DTED

... plus 35 more ...

# **GDAL** *Geographic Data Abstraction Library*

## Vector Formats

- Shapefile

- MapInfo (tab and mid/mif)

- Arc/Info Coverages

- ArcGIS Personal Geodatabase

- SDE

- DGN

- GML

- PostGIS

- Oracle Spatial

- MySQL Spatial

- ODBC

- ... plus a dozen more ...

# **GDAL** *Geographic Data Abstraction Library*

## **Using GDAL**

### **C++ Library:**

ESRI 9.2+

Google Earth

Safe Software FME

Leica

AutoDesk

... and many others ...

### **Scripting Environment:**

Python

Java

Perl

Ruby

# **GDAL** *Geographic Data Abstraction Library*

## **Command Line Utilities:**

- Format translation

- Spatial filtering

- Attribute filtering

- Reprojection/warping

- Mosaicing

# GDAL

## Converting MapInfo TAB files to ESRI ShapeFiles

```
C:\>ogr2ogr shapefiles Road_CL.TAB

C:\>ogr2ogr shapefiles Parcel.TAB -where "OGR_GEOMETRY='MULTIPOLYGON'"

C:\>dir shapefiles
Volume in drive C is C
Volume Serial Number is 843C-0DF1

Directory of C:\shapefiles

10/18/2008  08:12 AM    <DIR>          .
10/18/2008  08:12 AM    <DIR>          ..
10/18/2008  08:12 AM                2,345 Parcel.dbf
10/18/2008  08:12 AM                428 Parcel.prj
10/18/2008  08:12 AM           123,256 Parcel.shp
10/18/2008  08:12 AM                860 Parcel.shx
10/18/2008  08:12 AM           114,225 Road_CL.dbf
10/18/2008  08:12 AM                422 Road_CL.prj
10/18/2008  08:12 AM           517,684 Road_CL.shp
10/18/2008  08:12 AM                7,396 Road_CL.shx
                8 File(s)              766,616 bytes
                2 Dir(s)  7,078,711,296 bytes free

C:\>for %f in (*.TAB) do ogr2ogr shapefiles %f_
```

# GRASS GIS



*Geographic Resources Analysis Support System*

[grass.osgeo.org](http://grass.osgeo.org)

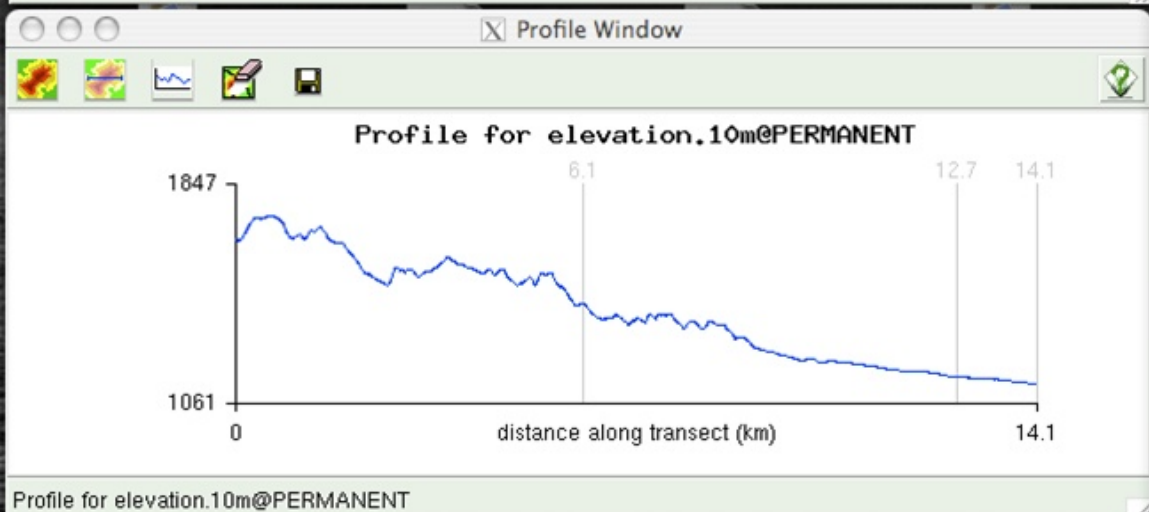
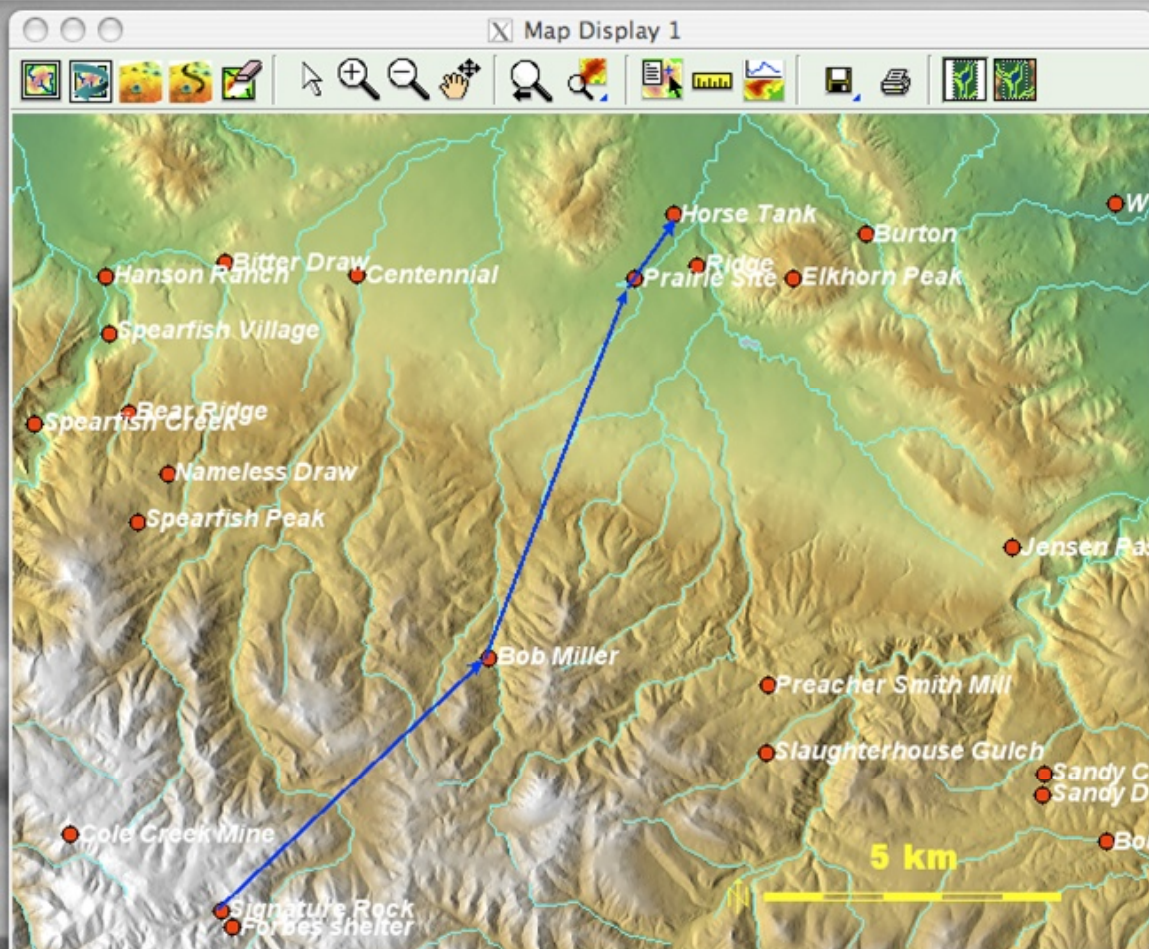
- Originally developed by the U.S. Army Construction Engineering Research Laboratories (1982-1995)
- Now Open Source



# GRASS GIS



- 2D/3D Raster Processing and Analysis
- 2D/3D Topological Vector Model including network analysis
- Attributes stored managed in various SQL-based DBMS
- Image Processing including ortho-rectification
- NVIZ 3D visualization tool displays raster, vector, and voxel volumes



GRASS6.3.cvs GIS Manager - spearfish60\_test PERMANENT

File Config Raster Vector Imagery Volumes Databases Help Xtns

Map Layers for Display 1

- scale 1
- archsites@PERMANENT
- streams@PERMANENT
- elevation10m\_shaded@PERMANENT

Display raster maps

Opaque 1.00 Transparent

Base map: elevation10m\_shaded@PERMANENT

values to display

Optional color draping. Use base map for shading, drape map for color in color relief map or data fusion

drape map: elevation.10m@PERMANENT

drape map brightness adjustment 30

Output - GIS.m

Of the non-null cells:

n: 2654802  
 minimum: 1061.06  
 maximum: 1846.74  
 range: 785.679  
 mean: 1348.37  
 mean of absolute values: 1348.37  
 standard deviation: 175.494  
 variance: 30798.3  
 variation coefficient: 13.0153 %  
 sum: 3579659211.6848597527

Save Clear

r.univar map=elevation.10m

Run Run (background) Run (GUI) Run (in Xterm)



GRASS6.3.cvs GIS Manager - spearfish60 neteler

File Config Raster Vettore Imagery Grid3D Database Aiuto

Map Layers for Display 2

roads@PERMANENT

Display vector maps

Opaco 1.00 Trasparente

Mappa Vettoriale: roads@PERMANENT

Visualizza: ☒ shapes ☐ categorie ☐ topologia ☐ direzioni linea  
☒ punti ☒ linee ☒ confini ☒ aree ☐ centroidi ☐ facce

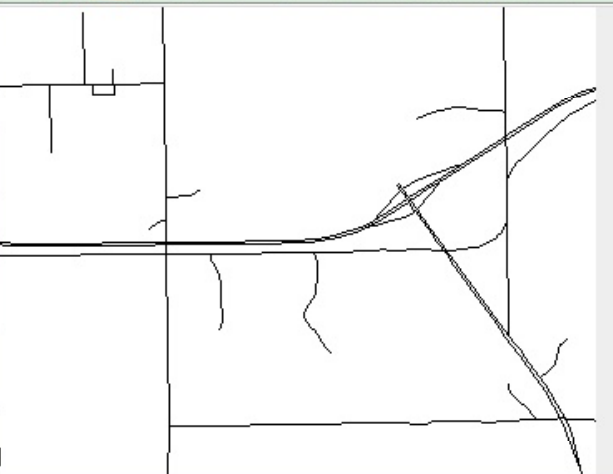
Point symbols: icona basic/circle size 5

Disegna linee: ☒ colore ☒ width 1 (pixels)

Riempi aree: ☒ colore ☐ colori casuali ☐ colori campo GRASSRGB

Label vettori: ☐ label colore testo ☒ grandezza testo 8

Map Display 2



Display: rows=149 cols=190 N- 603581.433566 4925362.55245

Displaying xy map to be georectified



Georectifying maps in gs group 1173.24070336 -1944.88393542

Gestione ground control points (GCPs)

Save Load RMS Esci

Select rectification method for rasters ☒ 1st order ☐ 2nd order ☐ 3rd order

Use	xy coordinates	geographic coordinates	forward error	backward error
<input checked="" type="checkbox"/>	1281.69567265 -1892.44417005	597861.473029 4926668.09129601083.6	0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0
<input checked="" type="checkbox"/>			0.0	0.0

Forward RMS error = 0.0, backward RMS error = 0.0

# Quantum GIS (QG/S)



[www.qgis.org](http://www.qgis.org)

- Modern user interface
- Cross-platform (Linux, Windows, Mac)
- Supports common Vector, Raster and Database formats
- Access to key GRASS modules through a plugin toolbox
- GPS interface plugin







# Java Desktops

## **OpenJump**     *Java Unified Mapping Platform*

[www.openjump.org](http://www.openjump.org)

- Originally a front end for the JTS Topology Suite

## **uDig**     *User-friendly Desktop Internet GIS*

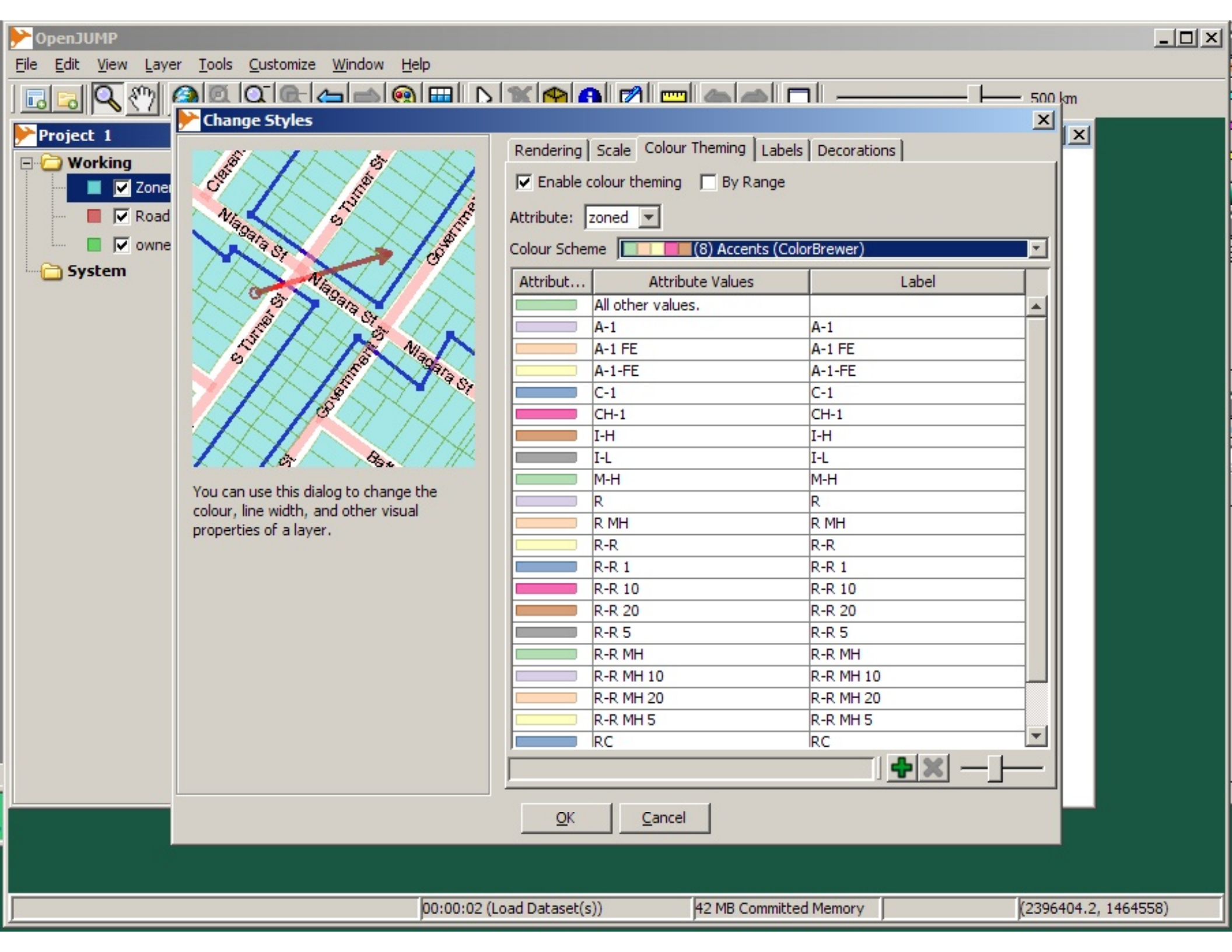
[udig.refractions.net](http://udig.refractions.net)

- A GIS Framework for Eclipse

## **gvSIG**

[www.gvsig.gva.es](http://www.gvsig.gva.es)



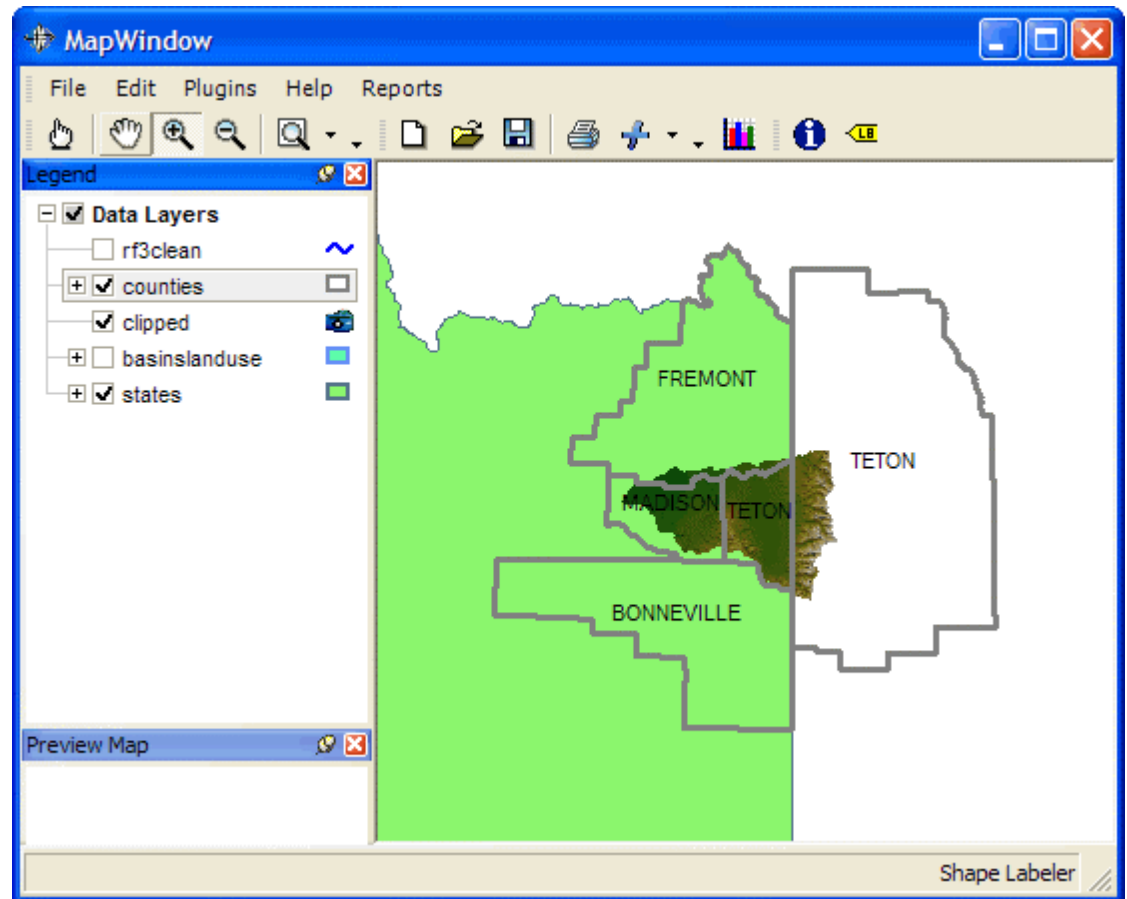


# MapWindow

[www.mapwindow.org](http://www.mapwindow.org)



- Idaho State University
- MapWinGIS ActiveX control





# PostgreSQL

[www.postgresql.org](http://www.postgresql.org)

+

# PostGIS

[postgis.refractory.net](http://postgis.refractory.net)



- PostgreSQL object-relational database
- PostGIS spatially enables PostgreSQL
- Officially supported in Arc 9.3 via ArcSDE
- zigGIS \$270 connector from [www.obtusesoft.com](http://www.obtusesoft.com)
- MySQL and SQLite have less mature spatial extensions

pgAdmin III

File Edit View Tools Help

Object browser

- Servers (3)
  - Localhost (localhost:5432)
  - Lucca (lucca:5432)
    - Databases (6)
      - fc\_lands
      - postgres
      - sc\_lands
      - swco
      - tc\_lands
        - Catalogs (2)
        - Schemas (5)
          - address
          - asr
          - clk
          - public
            - Domains (0)
            - Functions (686)
            - Sequences (7)
            - Tables (9)
              - assessor
              - example
              - geometry\_columns
              - ownership
              - parcel\_attrib
              - road\_cl
              - spatial\_ref\_sys
              - subdivisions
              - tscpt
            - Trigger Functions (3)
            - Views (0)
          - treas
        - Replication (0)
      - template\_postgis
    - Tablespaces (2)
    - Group Roles (0)
    - Login Roles (5)
  - sublettewyo (www.sublettewyo.com:5432)

Properties Statistics Dependencies Dependents

Function

- \_st\_asgml(integer, geometry, integer)
- \_st\_contains(geometry, geometry)
- \_st\_coveredby(geometry, geometry)
- \_st\_covers(geometry, geometry)
- \_st\_crosses(geometry, geometry)
- \_st\_intersects(geometry, geometry)**
- \_st\_overlaps(geometry, geometry)
- \_st\_touches(geometry, geometry)
- \_st\_within(geometry, geometry)
- addauth(text)
- addbbox(geometry)
- addgeometrycolumn(character varying, character varying, character varying, character varying, integer, character varying, integer)
- addgeometrycolumn(character varying, character varying, character varying, integer, character varying, integer)
- addgeometrycolumn(character varying, character varying, integer, character varying, integer)
- addpoint(geometry, geometry)
- addpoint(geometry, geometry, integer)
- affine(geometry, double precision, double precision, double precision, double precision, double precision, double precision, double precision)
- affine(geometry, double precision, double precision, double precision, double precision, double precision, double precision)
- area(geometry)
- area2d(geometry)
- asbinary(geometry)

SQL pane

```
-- Function: _st_intersects(geometry, geometry)
-- DROP FUNCTION _st_intersects(geometry, geometry);

CREATE OR REPLACE FUNCTION _st_intersects(geometry, geometry)
  RETURNS boolean AS
  '$libdir/liblwgeom', 'intersects'
  LANGUAGE 'c' IMMUTABLE STRICT
  COST 1;
ALTER FUNCTION _st_intersects(geometry, geometry) OWNER TO postgres;
```

Retrieving Function details... Done. 0.00 secs

# MapServer

[mapserver.gis.umn.edu](http://mapserver.gis.umn.edu)



- Originally developed by the University of Minnesota
- Now a project of OSGeo
- CGI or scripted in PHP, Python, Perl, Ruby, Java, or C#
- Cross-platform support

Linux, Windows, Mac OS X, Solaris, and more

- All raster and vector data formats supported by GDAL
- ESRI shapfiles, PostGIS, ESRI ArcSDE, Oracle Spatial

# MAPSERVER

- Open Geospatial Consortium (OGC) web specifications
  - WMS - Web Map Service
  - WFS - Web Feature Service (non-transactional)
  - WMC – Web Coverage Service
- On-the-fly map projection
- Thematic mapping, including expression-based classes
- Map element automation (scalebar, reference map, legend)

# OpenLayers

[www.openlayers.org](http://www.openlayers.org)

- Google style “Slippy” tiled maps
- Cross browser Vector support
- Multiple Layer Sources:

Google

Microsoft Virtual Earth

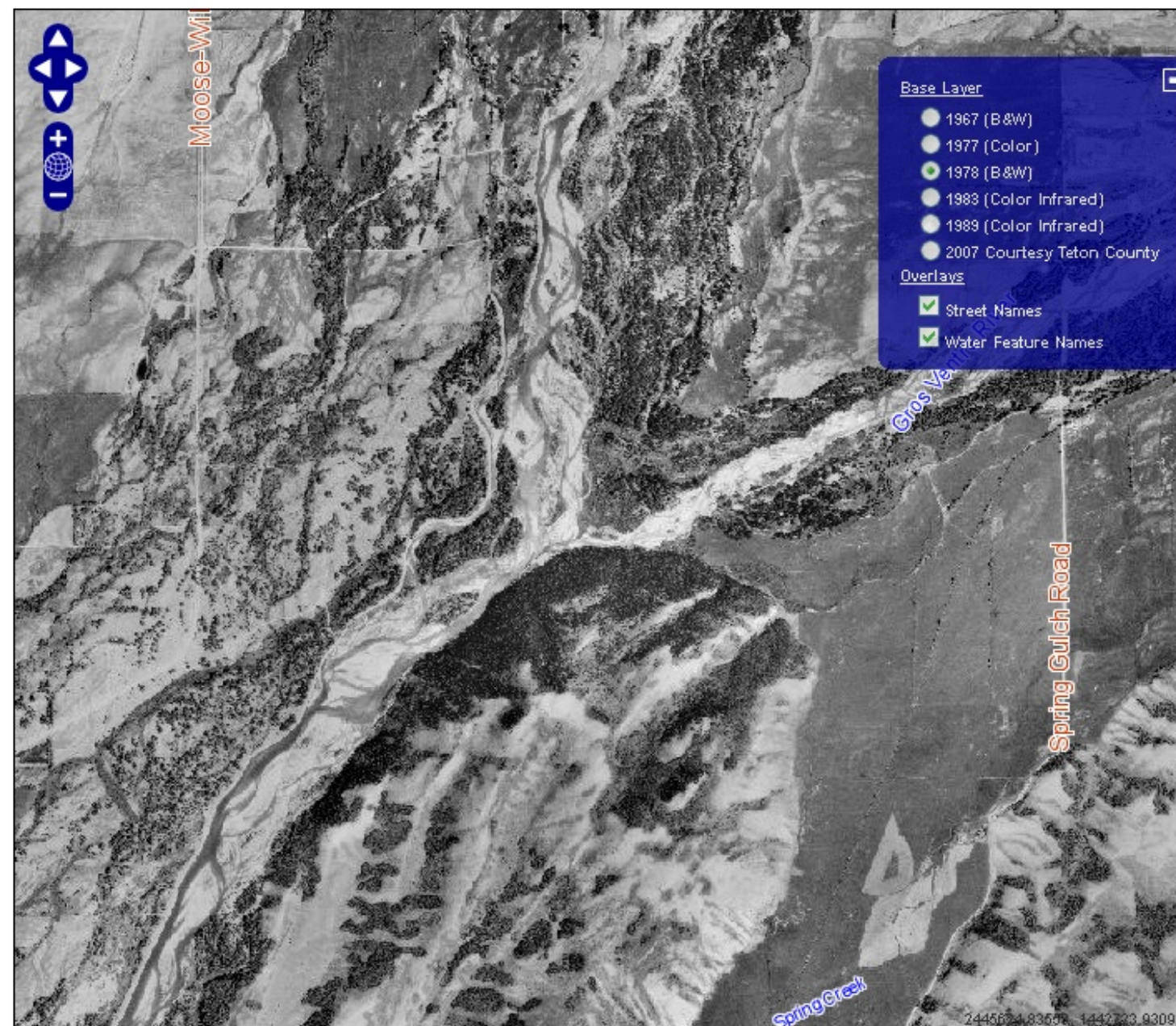
Yahoo

OGC WMS

MapServer

AutoDesk MapGuide





## Jackson Hole, Wyoming

### Historic Aerial Photography

#### [Teton Conservation District](#)

P.O. Box 1070 - 230 E. Broadway, Suite 2A  
Jackson, WY 83001 307-733-2110

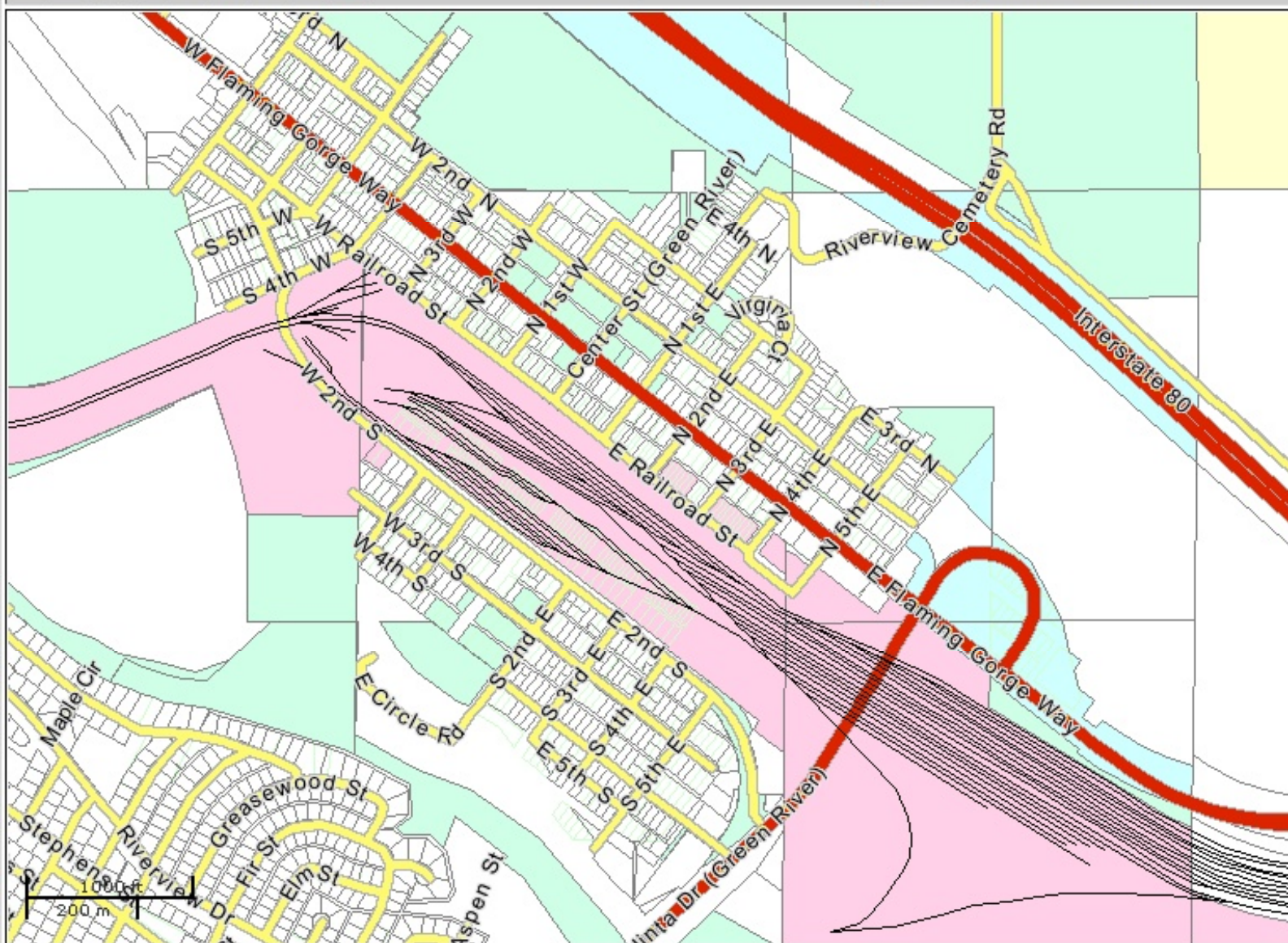
- Pick layers with the '+' at the upper right corner of the map
- Pan by dragging within the map window, or use the directional arrows
- Zoom in and out using the '+' and '-' in the upper left corner of the map
- Or zoom in and out using the mouse wheel
- Zoom rectangle by holding the shift key while dragging
- Zoom out to the full extent with the 'world' button

Not all years cover the same areas.

[Permalink](#) to copy current view into the browser address for bookmarks or email.

Designed by **Greenwood Mapping, Inc.**  
Built on Open Source software [MapServer](#) and [OpenLayers](#)





- ☐ Labels:
- ☐ Foreground Layers:
  - ☒ Roads, Streets, Highways
  - ☐ Cities
  - ☒ Ownership
  - ☐ Subdivisions
  - ☐ Public Land Survey
  - ☐ Growth Management Area
- ☐ Background Layer:
  - ☐ 2006 Aerial Photography
  - ☐ Voter Precincts
  - ☒ Tax Classes
    - ☐ BLM
    - ☐ BOR
    - ☐ G&F
    - ☐ Local Gov
    - ☐ OTHER
    - ☐ RSGA
    - ☐ STATE
    - ☐ UINTA
    - ☐ UP
    - ☐ USFS
    - ☐ USGS topos

Wyoming West Central NAD83 USft  
N: 376833 E: 1770693

Long: -109° 28' 21.0" Lat: 41° 31' 55.4"  
Long: -109.4725° Lat: 41.5321°  
Scale = 1 : 8894

UTM Zone 12 NAD83 meter  
X = 627429 Y = 4598949  
Designed by Greenwood Mapping, inc.