QGIS for Water Utility Management:
Getting Started with QGIS for Free

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August 5, 2020

SACRAMENTO STATE
Office of Water Programs

ENVIRONMENTAL FINANCE CENTER
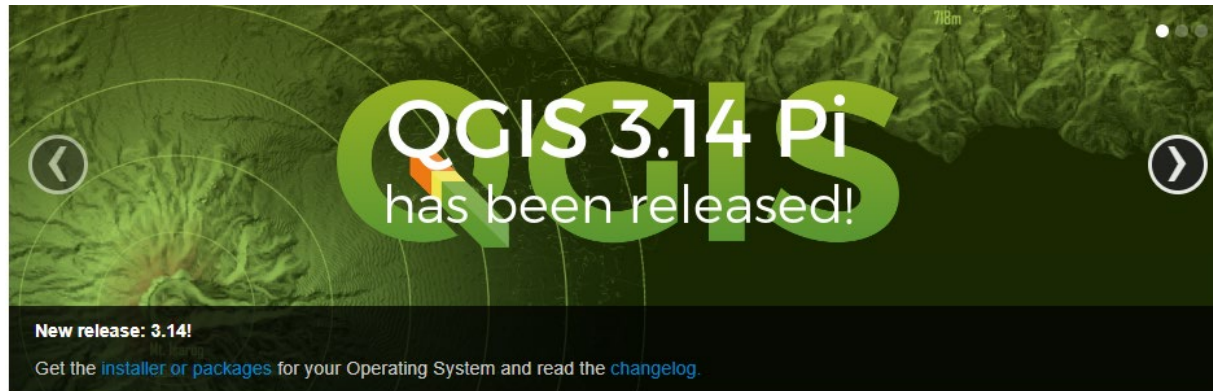AT SACRAMENTO STATE

Geographic Information Systems (GIS)

- Geographic Information Systems
  - Software systems for storing and analyzing data with spatial information

- Many types of GIS
  - Esri's ArcGIS is most popular

- Bringing maps to life
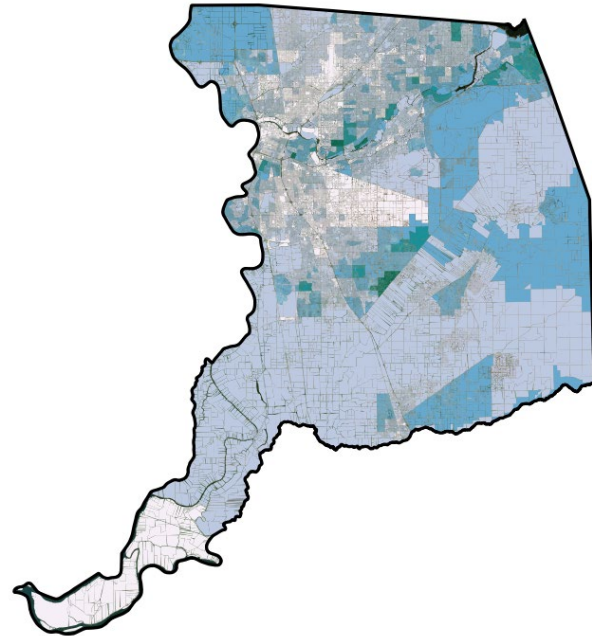
QGIS

- A free and open-source version of GIS software
  - Created over many years by a community of developers
  - Under continual improvements

http://qgis.org

How does QGIS Compare?

Capability	Software		
	Google Earth	*Esri ArcGIS*	*QGIS*
Mapping	Yes	Yes	Yes
Spatial Analysis	Limited	Yes, integrated	Yes, integrated or plug-ins
Cost	Free/Paid	Paid	Free
File and Database Support	Limited	Broad, easy to upload, can be hard to manipulate; ESRI Geodatabases	Broad (except for ESRI geodatabases), harder to upload, can be simpler to manipulate; PostgreSQL
Online mapping*	Support through Google Maps or 3rd party apps	Support through Esri Online	Support through QGIS Cloud
Integrated water utility analysis packages	No	Available packages (field operations, data management)	Not directly designed or integrated

QGIS supports analysis and mapping similar to ArcGIS, but does not currently have integrated solutions for utility enterprise management and advanced utility operations

* Google Maps, ArcGIS, and QGIS were all originally design as desktop applications

4

QGIS: Home Screen

How to Add Files: "Layer" Drop-Down Menu

File Browser

Layers
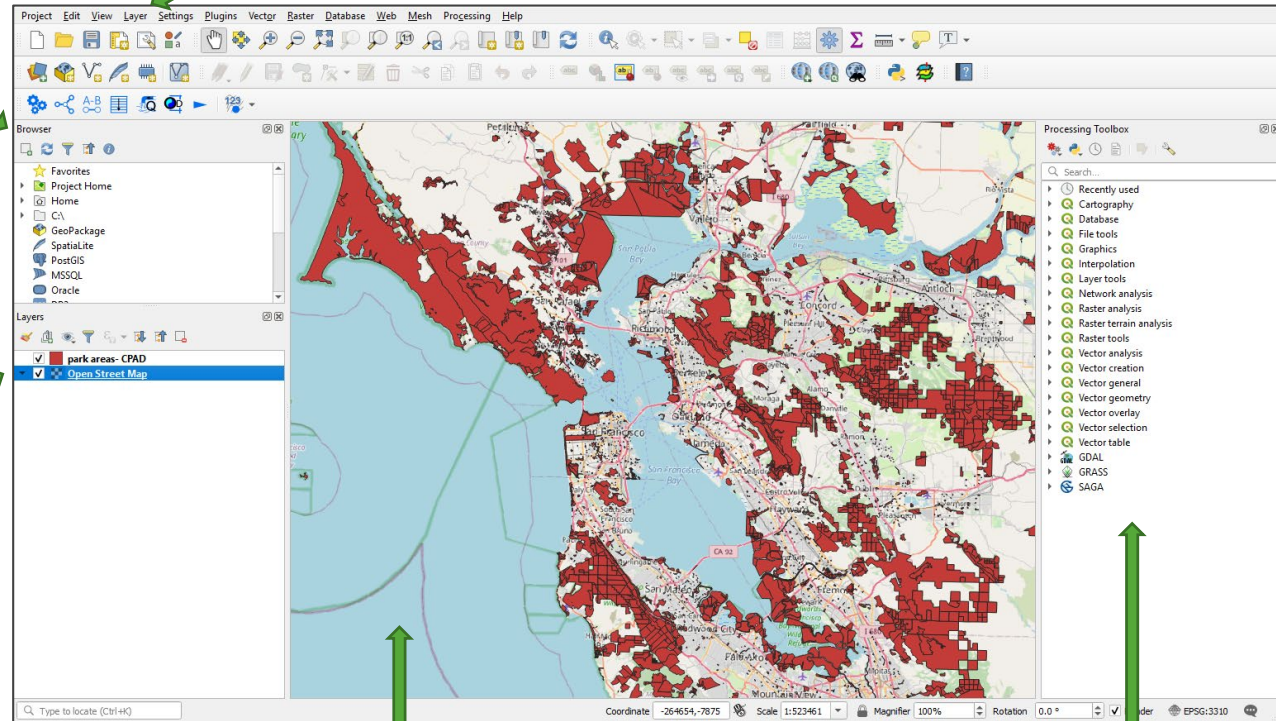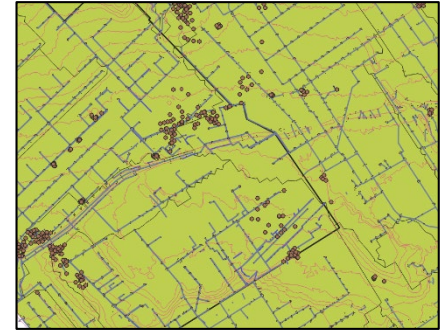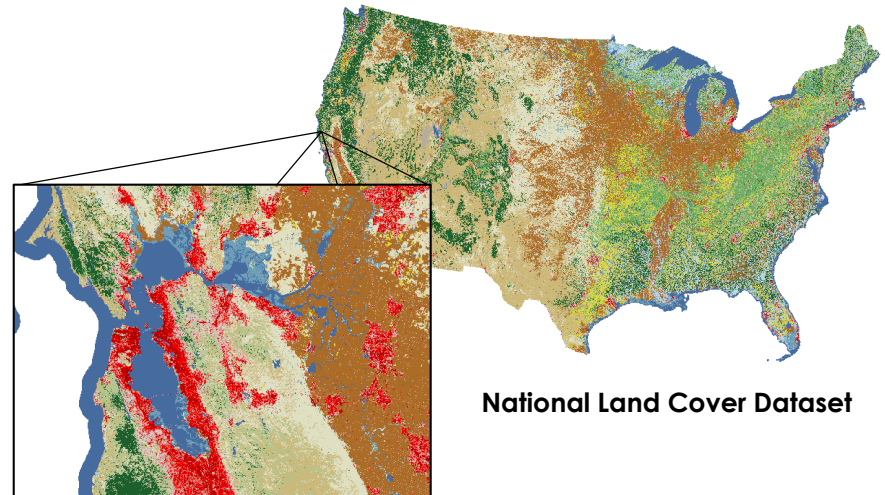
Map Window

Toolbox

Some Basic File Types

- Vector files: points, lines, polygons databases
  - Assets, agency boundaries, streams or watersheds

Urban stormwater infrastructure (compiled from multiple sources)

- Raster files: pictures
  - Digital elevation models, climate data, land cover

- Table files: data with spatial information

National Land Cover Dataset

Coordinate Reference Systems

- A Coordinate Reference System (CRS) defines how to project a flat map to the earth

- Represents a 3D "real" map on a 2D "flat" map
    - Hundreds of systems

- GIS software needs to interpret the input from a file to map it
    - Mis-identified CRSs are a common source of errors when mapping and processing data in QGIS

Nasa.gov

QGIS Views: Map and Data Table
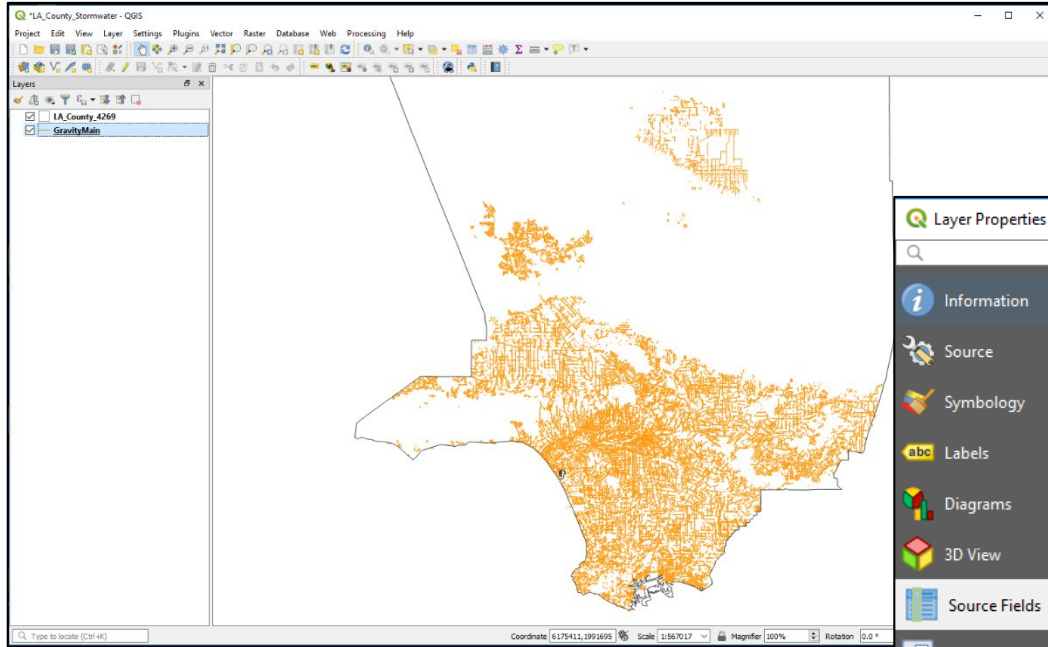
Database Fields

Mapping Storm Sewer Gravity Mains in LA County

GIS Files Store Data in an "Attribute Table"

Data Tables

Record: A row in a table of data

Field: A column in a table that stores the value of a single attribute

Water Utility Management Using QGIS

- QGIS can support:
    - Utility system mapping
    - Asset management
    - Watershed analysis
    - Rate studies

- Not "plug-and-play"
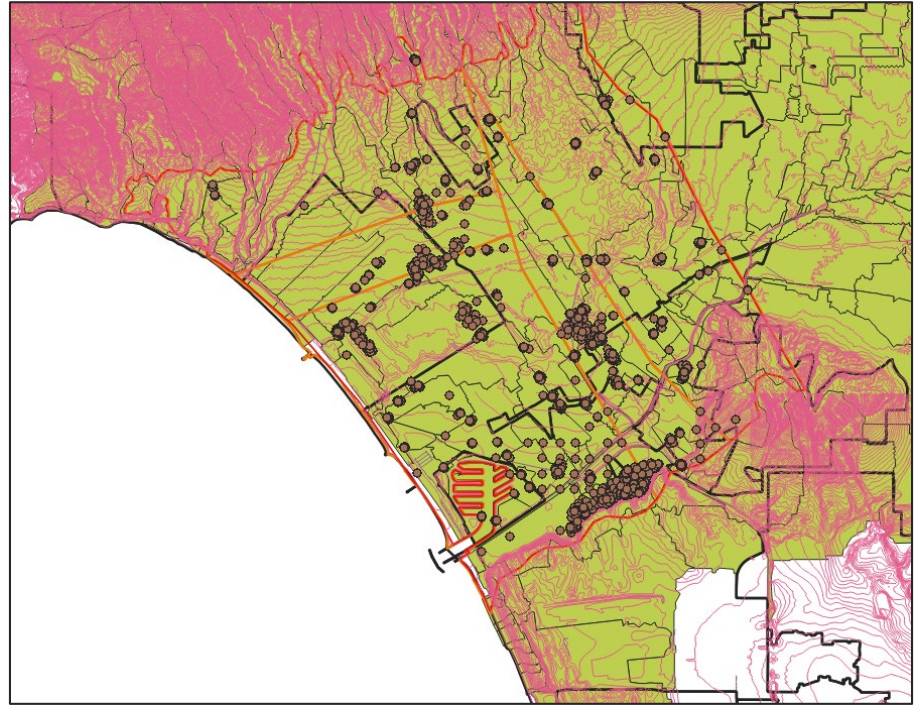
Add-Ons

- QGIS allows its community of developers to build add-on packages for specific needs
  - Can become part of the regular functions

- Some recent packages are designed to assist with utility management needs
  - *Qwater:* integration with EPANet, drainage planning
  - *SAGA Terrain Analysis – Hydrology:* watersheds
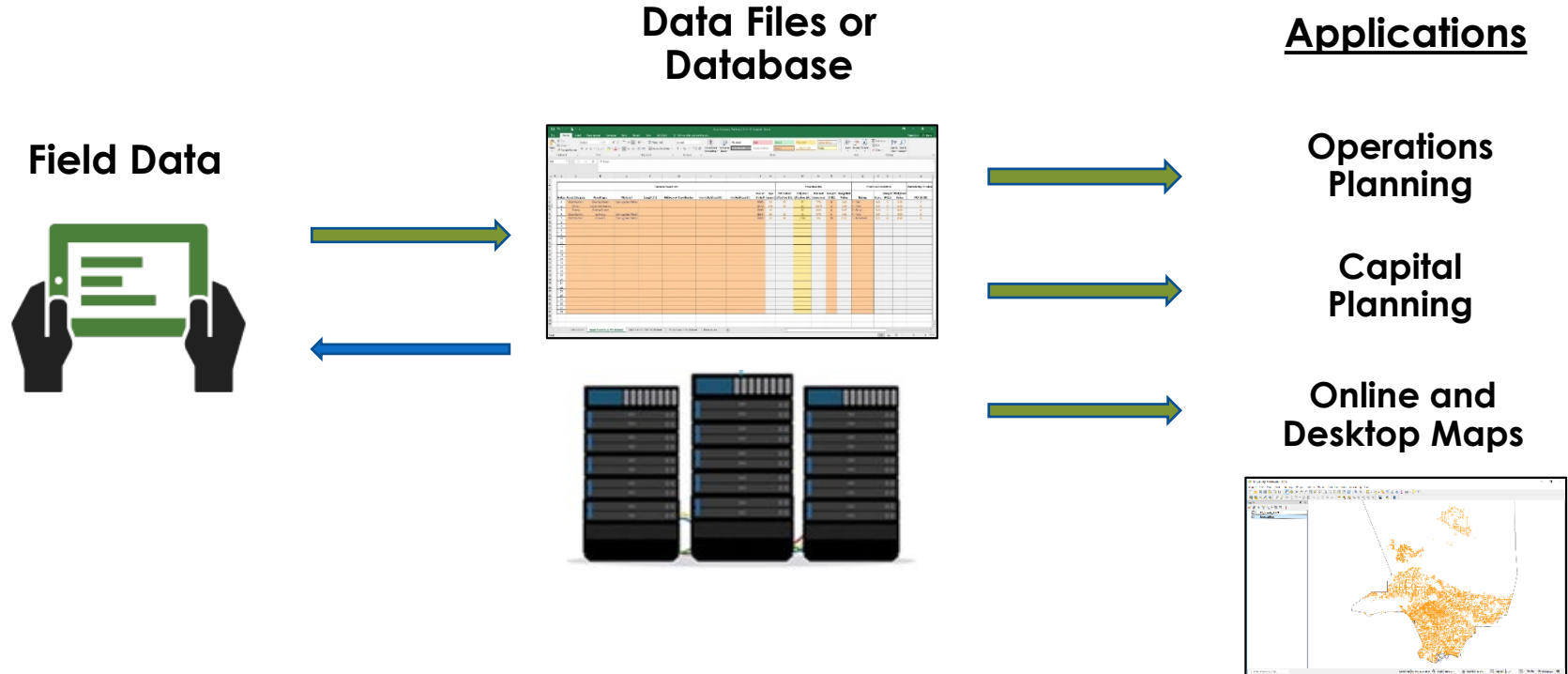 - *Qfield:* Field data collection

Web searches of "QGIS" and keywords for a task can find blogs and posts with solutions from the QGIS community

Example: Asset Management

- Storing utility assets in GIS databases
- Ways to classify assets
  - Location
  - Size, length, depth, material
  - Condition
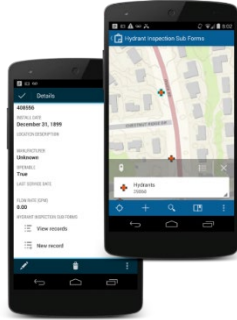
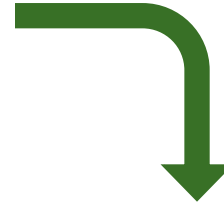| Features	Possible attributes (fields) for each asset
Asset # 1 2 3 …	Age Length, depth, size Location (GPS coordinates, latitude/longitude) Material Condition Cost or value Ownership Type

Example: Collecting Field Data for Asset Management

Field Data

Data Files or Database

Applications

Operations Planning

Capital Planning

Online and Desktop Maps

Example: Uploading Data for Asset Management

Field Data

Collected via field surveys or a mobile app

Database

Let's See an Example

Where Can I Find Data?

- ## Local and state GIS repositories

  - Administrative boundaries (e.g. cities, counties, field divisions, districts, sectors etc…)
  - Infrastructure information (e.g. dams, levees, water and wastewater treatment plants)

- ## US Census Tiger datasets

  - Census Blocks National Geodatabase

- ## U.S. federal agencies, such as U.S. Geological Survey

  - Public-Supply Well Water Quality Results
  - Flood inundation maps

- ## Esri Open Data Hub

GIS LOUNGE

Links

EPA Region 9 Environmental Finance Center:
http://www.efc.csus.edu

Contact:
erik.porse@owp.csus.edu

QGIS:
http://qgis.org
https://www.qgistutorials.com/