

Supporting an Accessible Geodetic Control Network for California

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CA GIS Council Geodetic Control Work Group

Mark S. Turner, PLS



Caltrans, 29 years

Chief, Office of Land Surveys Caltrans HQ-Sacramento

Monterey Peninsula College, AS degree in Land Surveying. Attended California State University- Fresno majoring in surveying/photogrammetry

Past/Present member of PECCG, CLSA, NSPS, and CSRC Coordinating Council

Various research projects, including, NCHRP Project 08-55 panel

Topics

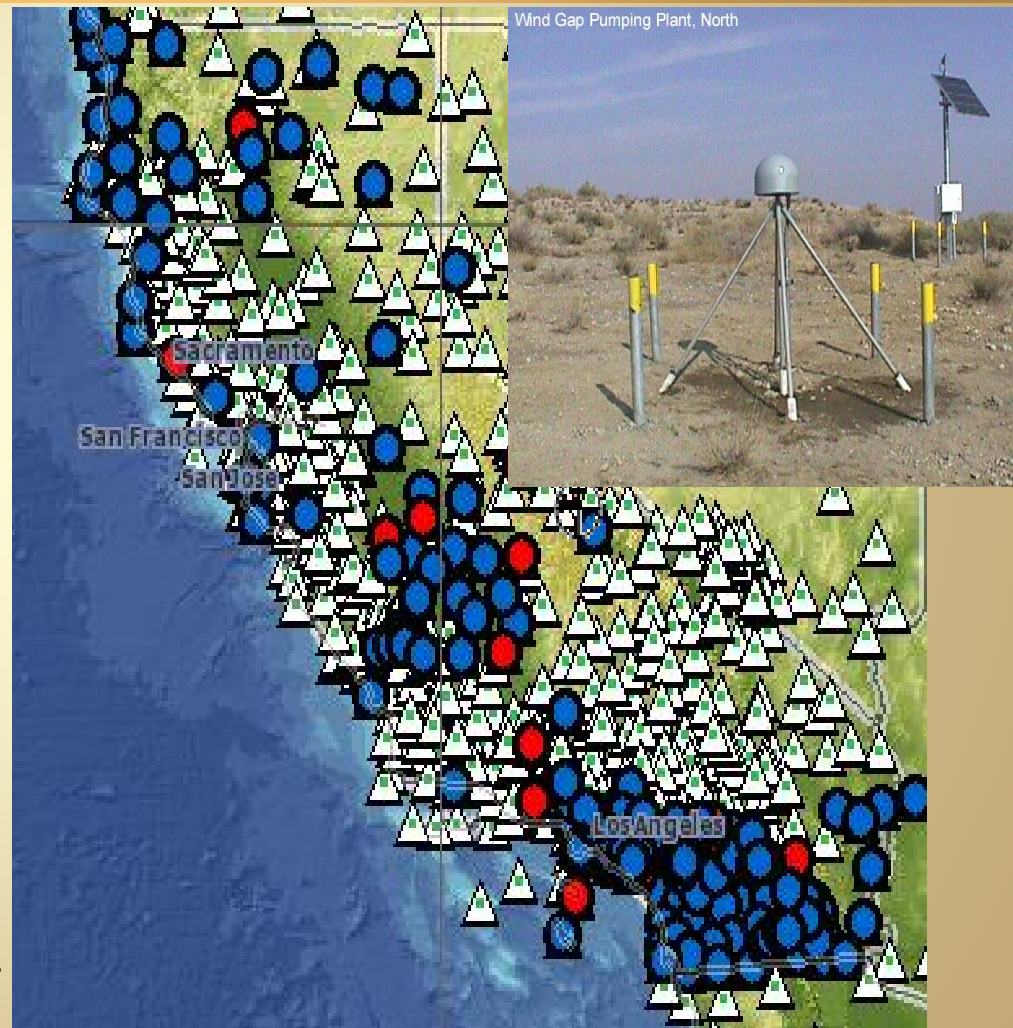
- What are we trying to accomplish?
- Why is this important?
- Who are we?
- Where have we been and where are we going?
- How are we going to get there?
- We need your help to answer these questions, offer comments and suggestions to Get it Done!!

What are we trying to accomplish in California?

A foundation set of geodetic control monuments and scientific models for horizontal and vertical geodetic positioning in California needs to be defined and subsequently maintained by a steward for utilization in field surveying and correct alignment by other GIS themes identified by the CA GIS Council.

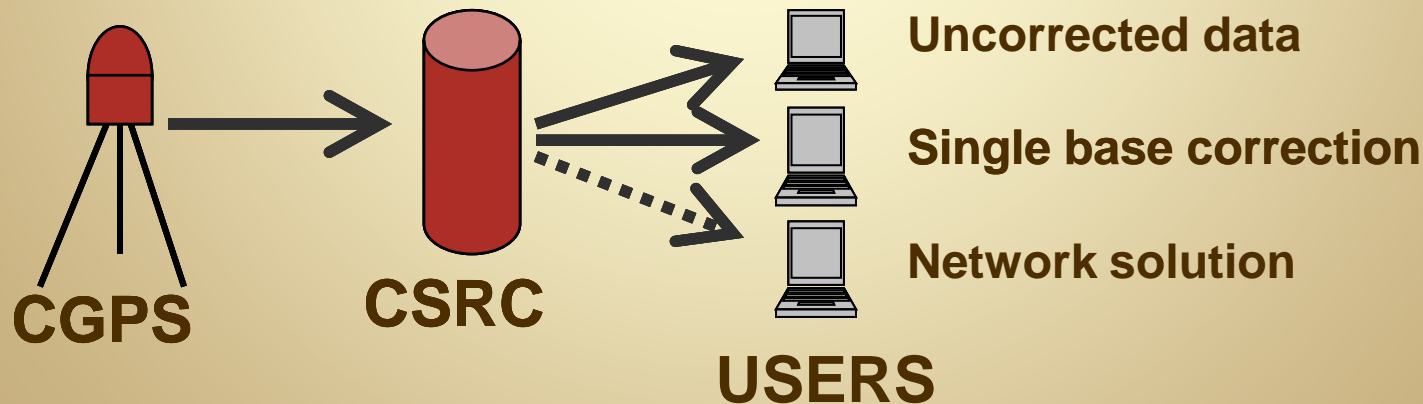
What is the CSRN?

- Network of GPS-observed active (CGPS) and passive geodetic control
- Passive (not shown): Several 1000's, including Height Mod stations, first-order or better
- Active: ~850 CGPS Stations, some RT (colored dots)
- CRTN: utilizes the existing geophysical GPS infrastructure and provides for the geodetic control framework that is outlined in the CSRC Master Plan.

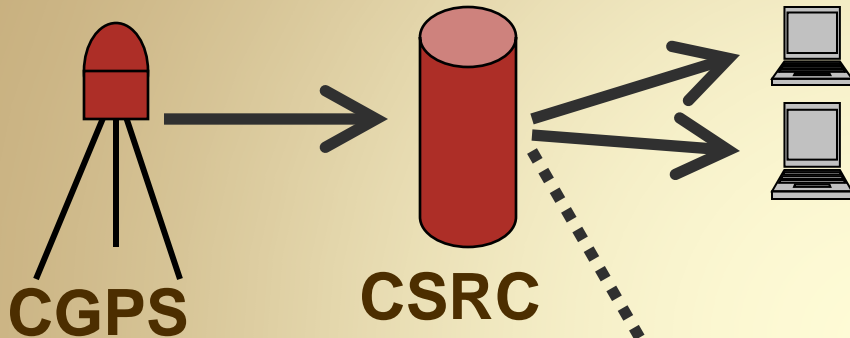


How is geodetic data used today?

- Earthquake and earth deformation monitoring
- Available to surveyors, geodesists, earth scientists
 - RINEX observations (uncorrected data)
 - Velocities
 - Single base correction RT (2011.00 epoch as of 6/18)
 - Network adjustment (software required)



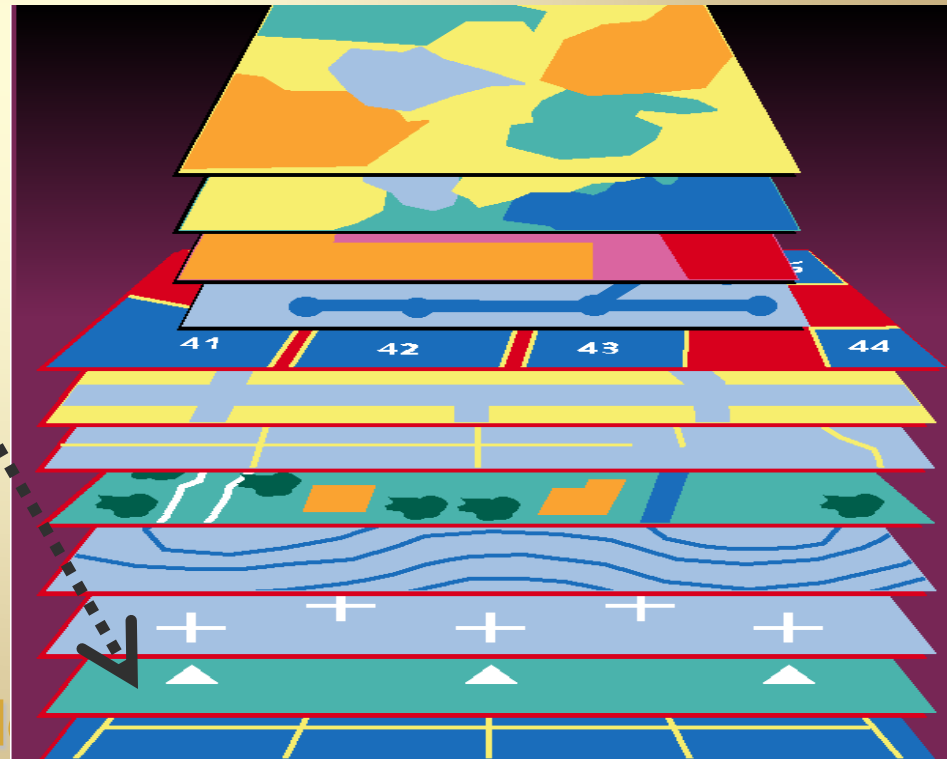
How Could CSRN be used?



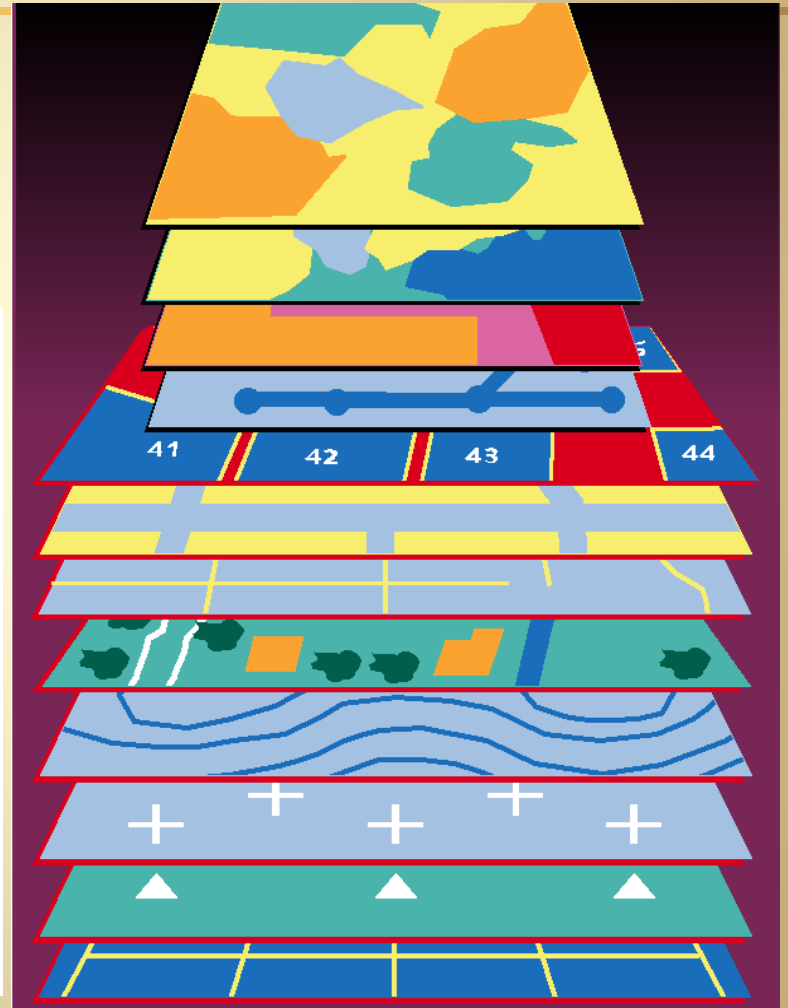
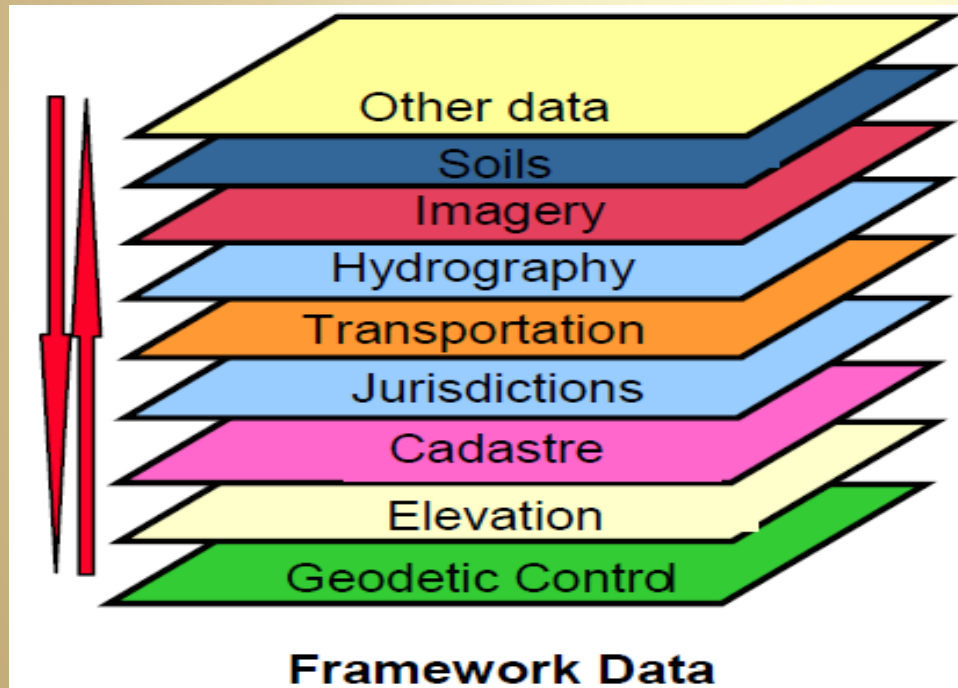
Post processing --Surveyors

Real time correction-- All

Geodetic Control Framework Themes



Geodetic Control supports Framework Data and many other Themes



How to control multiple data theme layers?



Geospatial data referenced to geodetic control for proper alignment and registration



Getting There

- California GIS Council chartered a Geodetic Control Work Group to create:
 - Statement of Purpose
 - Framework Data Standards
 - Strategic Plan
 - Outreach to the Geospatial Communities
 - **Geodetic**
 - **Surveyor**
 - **GIS**
 - **Users of geospatial data**, including real property, emergency response services, construction planning & regulation, transportation, natural resource conservation, municipal services and infrastructure, precision agriculture

Geodetic Control Work Group

Purpose and Goals

- Define Data and Infrastructure Standards
- Develop a Strategic Plan
- Develop a Business Plan- Programmatic Goals
- Recommend a Data Steward
- Communication Plan

CA Geodetic Control Work Group

GCWC – who are we?

- Chartered by CA GIS Council in 10/10
 - **Chair, Marti Ikehara** - NGS
 - John Canas - CSRC
 - Kevin M. Kelly - CSRC
 - Ric Moore – BPELSG
 - Mark Turner- Caltrans
 - James Harcharik - Caltrans
 - Tom Taylor - Caltrans
 - Bruce Joffe - GIS Consultants
 - Justin Height - Penfield and Smith
 - Michael McGee - McGee Surveying
 - Tim Case - RBF
 - Reg Parks - Santa Rosa Junior College
 - Steve Steinhoff - LA County DPW
- GCWG Sub-committees
 - Strategic Plan Subgroup- Mark Turner, Lead
 - Data Standards Subgroup- James Harcharik, Lead
 - Communication Plan- Tom Taylor, Lead

GCWG Mission

The **GCWG** seeks to:

- Define the Geodetic Control (GC) reference network, and define the framework theme for the CSDI geodatabase;
- Develop recommendations for their implementation, operation, maintenance, stewardship, and funding; and
- Provide guidance for standards and best practices for their delivery and utilization by the geospatial community

Federal (NGS) Geodetic Initiatives

- National Height Modernization Study/Program (1998)
 - Establish three-dimensional (lat/long/ellip ht) control monuments at 10 kilometer spacing that also has an NAVD88 elevation.
 - California designated as a “demonstration state” because it is subject to seismic activity, subsidence, floodplain management, coastal erosion, and heavy urbanization.
- Ten-Year Plan: Mission, Vision and Strategy (2008)
 - To define, maintain and provide access to the NSRS to meet our nation’s economic, social and environmental needs
 - To modernize the horizontal and vertical datums
- Guidelines for Real Time GNSS Networks (3/2011, v2.0)
 - General information, procedures and approaches for real time GNSS positioning in networks of active reference stations.

Past State Geodetic Initiatives

- 1994- California Geodetic Control Committee (CGCC)
 - CGCC prepared several papers and presentations to assist the community with GPS geodetic control surveying.
 - Recognized GPS technology and expanding use of spatial information for GIS and surveying.
 - Proposed a high-accuracy horizontal geodetic network of about 1,100 stations – California Spatial Reference Network (CSRN), which defines the Legal reference system for California Coordinate System (CCS) coordinate values.
 - Public Resource Code (PRC) modifications enacted into California law in 2005, Sections 8850 – 8861. Includes CA Orthometric Heights referenced to NAVD 88.
 - The work efforts of the CGCC were assumed by the California Spatial Reference Center in 1997

Present State Geodetic Environment

California Spatial Reference Center (CSRC)

- Goals include: (1) Establish and maintain the CSRN;
- (2) Provide the necessary services to ensure the availability of accurate, consistent, and timely spatial referencing data;
- (3) Monitor temporal changes in geodetic coordinates due to tectonic motion, earthquakes, volcanic deformation and land subsidence; and
- (4) Establish the legal spatial reference system for California.
- “A MASTER PLAN for a MODERN CALIFORNIA GEODETIC CONTROL NETWORK” published in 2003
 - Envisions a geodetic control network consisting entirely of CGPS.
 - Provides a seamless, accurate reference network.
 - Initial implementation recognized by the NGS to accomplish the goals and objectives of the National Height Modernization Plan.

CA GIS Council Geodetic Control Work Group

California Real Time Network (CRTN)

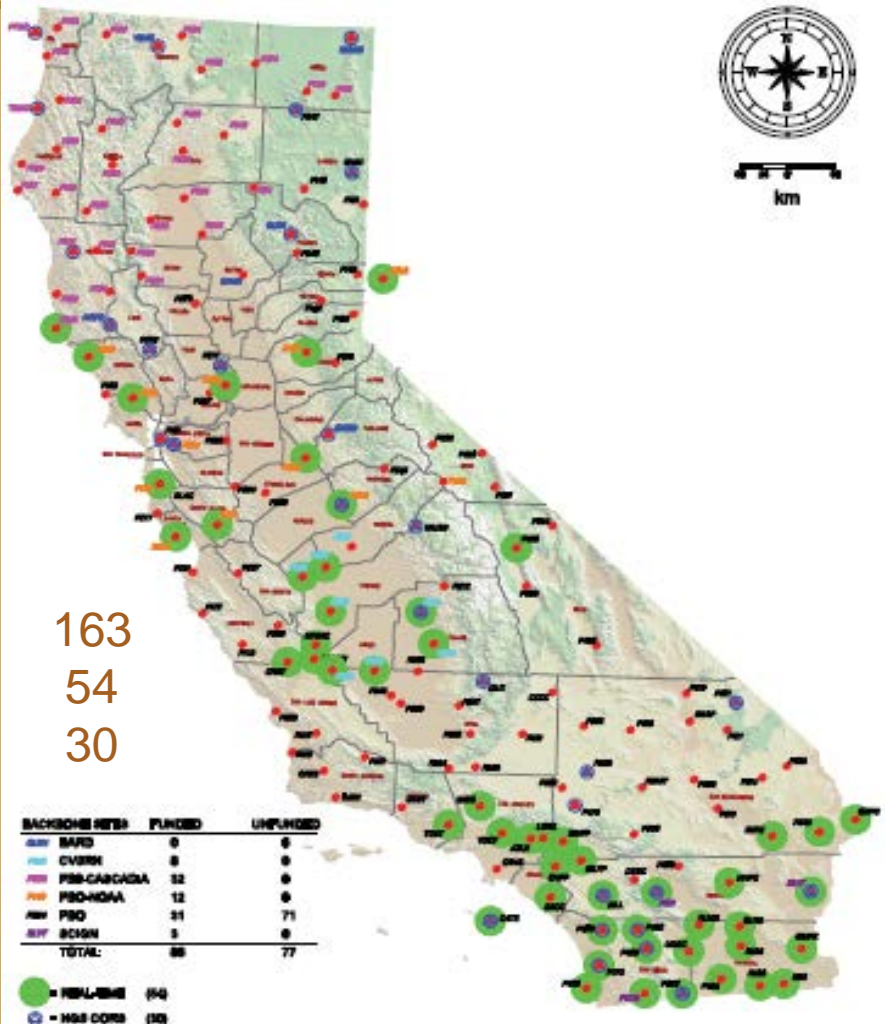
- CRTN is or will be a multipurpose statewide real-time network that utilizes the existing geophysical GPS infrastructure in California, and provides the backbone for the geodetic control network outlined in the Master Plan.
 - It provides accurate and reliable real-time positioning services that are consistent and on a common reference system (CSRN), and which fulfills the requirements of the California Public Resources Codes 8856(c)(e), 8857(c), and 8858(b) for GPS-derived geodetic coordinates and orthometric heights.
 - CRTN offers multiple real-time data streams to Consortium members as well as free open access RTCM data streams for single-base RTK positioning with respect to the CSRN.

Growth of (active) CGPS in CA

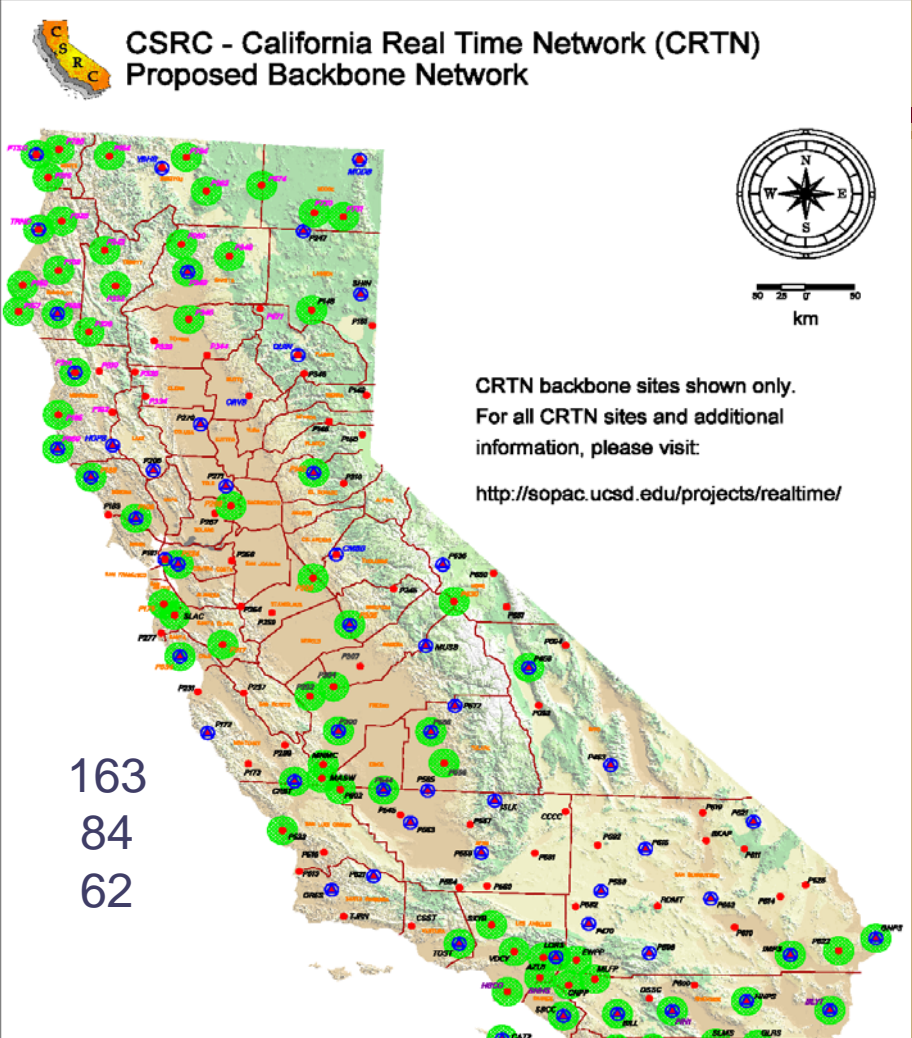
- 2000: NGS had ~25 CORS in California
- 1997-2005: SCIGN goal of 250 stations completed
125 integrated into PBO; 95 by USGS; others by SIO/JPL/+
- 2003-08: UNAVCO's PBO installs ~450 more in CA
- 2011:
 - NGS has >150 CORS, most of which are operated by others, but additionally includes USCG beacons
 - CSRC published coordinates for 830 in or nr CA
 - 84 (in May) of 163 CRTN Backbone sites are real-time; 62 are CORS
 - 185 CGPS in CA are RT

CRTN Progress 2010 - 2011

Backbone, RT, NGS CORS



163
54
30



163
84
62

Financial Support for CSRC

- 1999: Defined as a UCSD Support Group
- 2000-2009: Successful in applying for NGS Ht Mod grants, and some \$ from state/local agencies
- 2009-present: Only minimal \$ from state/local agencies
- Future—Quite uncertain (un-CRTN?):
 - nominal \$ from state/local likely
 - Funding from elsewhere?? Necessary!!!
 - No legal mandate to “exist”, eg, no requirement to produce or provide geodetic coordinates and velocities

GCWG Success Indicators

The GCWG is formalized by crafting a charter and workplan that have been accepted by the CGC.

The GC data sources, GCFT, and standards for metadata are defined.

Recommendations are developed that identify standards, stewardship, and funding for the establishment, implementation, and maintenance of a statewide GC network.

The recommendations, in the form of a Strategic Plan and Business Plan are officially adopted by the CGC.

Guidance is provided, in the form of policy and technical statements, for utilization and alignment of the GC theme by other themes.

What are some of the issues?

- Does the State of California need to continue to build and maintain geodetic control infrastructure?
- What are other states doing? (such as Minnesota, South Carolina)
- Do private RTN's play a role in this? With so many private RTN's, do we even need a state sponsored RTN?
- If so, should the infrastructure consist only of dynamic stations (CGPS), or should it include some level of passive monuments (“legacy networks” in counties and cities)?


Issues (continued)

- How would the California network interact/relate to the federal network?
- What is the demand level, and by whom?
- Is there an understanding by non-geospatial professionals of the importance of geodetic control? Especially in a dynamic environment like California?
- How does this all get funded, and what agency should take responsibility?
- Once formalized, what agency or group will provide summary information and guidelines for usage to the general user population and general public?

Getting Answers....

A Communication Plan

- Marketing, Awareness, and Promotion to:
- CA GIS Council
- Other CGC framework work groups
- State Geospatial Information Officer
- Geodetic communities
- We what to know what YOU think?

California GIS Council  Geodetic Control Working Group

Geodetic Control for the California Spatial Data Infrastructure

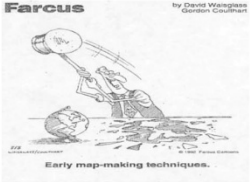
Introduction

The California GIS Council is implementing the California Spatial Data Infrastructure (CA-SDI) to address the following concerns and activities:

- Guarding against terrorism and criminal activities
- Emergency preparedness and response
- Planning strategic growth (e.g., San Joaquin Partnership)
- Mitigating the affects of global warming (e.g., Delta Vision)
- Sustainable management of our natural resources
- Restoring and ensuring environmental quality
- Pandemic detection and response

The Council through its strategic plan has identified seven main thematic layers of the CA-SDI, which is a Geographic Information System (GIS), to be implemented for a complete database to address the above concerns and activities. The thematic layers are:

1. Cadastral
2. Ortho Imagery
3. Transportation
4. Elevation
5. Hydrography
6. Geodetic Control
7. Governmental Units

 **Farcus** My Granddaddy's Geodetic Control

The thematic layer titled "Geodetic Control" is unique in that geodetic control is utilized by all other thematic layers to make a consistent map and GIS database. One might say that the geodetic control layer is the glue that binds all of the layers together. How does this happen? Well, the common language between all of the layers is the

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Connecting to the Geospatial Communities

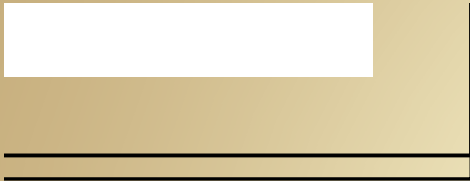
- California Land Surveyors Association
- American Council of Engineering Companies
- CEAC Survey Policy Committee
- Federal and State agencies and departments
- Local agencies: Cities and counties
- Geophysical and Earth Sciences
- Public utilities
- Business and Agriculture
- Academia
- Others? Who else should be consulted?

Federal GIS Initiatives

National Spatial Data Infrastructure (NSDI)

- Called for establishment in 1994 and reaffirmed in 2002 by the President.
- Building a framework of an information based society.
- Recognizes Seven Framework Themes
 - Geodetic Control, Cadastral, Orthoimagery, Elevation, Hydrography, Administrative Units, Transportation.
- Federal Geographic Data Committee (**FGDC**) develops geospatial data standards for implementing the NSDI. FGDC focuses on policy, standards, and advocacy.
- Federal Geodetic Control Subcommittee (**FGCS**) addresses lead agency responsibilities for the coordination of geodetic control and other surveying activities to support the geodetic control networks.
- The National Geodetic Survey (**NGS**) is lead agency for geodetic control.

National Spatial Data Infrastructure Core Framework Themes



State GIS Initiatives in CA (1)

- 1993- Governor's GIS Task Force
 - Recommended that CA-HPGN be used as the “foundation” for all future GIS data production.
 - Recommended the introduction of legislation requiring the adoption of NAVD88 as the official State vertical datum.
- California GIS Strategic Plan Phase 1 (2006)
 - Vision: Creating a California Spatial Data Infrastructure.
- California GIS Strategic Plan Phase 2 (2008)
 - Regional Participation- Workshops through GIS Collaboratives
 - Requirements: Existing Infrastructure, Data Sharing, Data Standards, Technology
 - Implementation Categories: Governance, Data, Marketing, Finance
 - Importance of Framework Data Sets

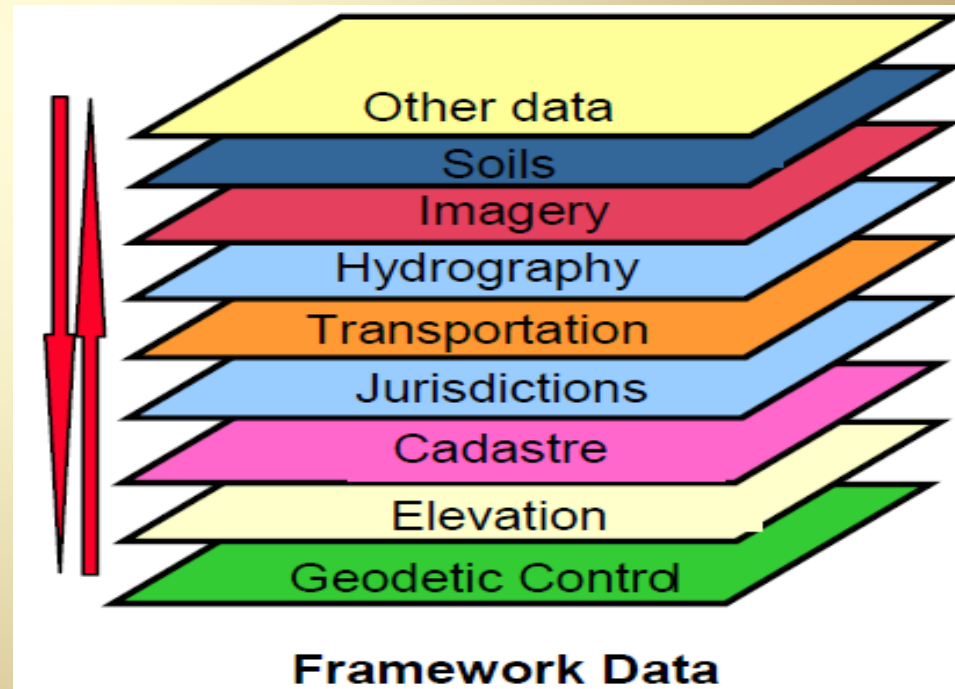
State GIS Initiatives in CA (2)

Geospatial Framework Draft Data Plan (2006)

- Provides a foundation for the California GIS Council (CGC) efforts.
- Used to develop the Strategic Plan Phase 2 implementation plan.
- California Geographic Information Association (CGIA) to obtain support for development of framework data.
- CGC to establish work groups to continue the framework data development strategy effort, including stewards and funding.
- Seven core framework themes : cadastral, orthoimagery, transportation, elevation, hydrography, geodetic control, governmental units.
- California-centric framework themes include: street addressing, utilities, public lands conveyance records, buildings and facilities, flood hazards, vegetation, biological resources, cultural and demographic stats, soils, wetlands, earth cover.

Linking Framework Data to Geodetic Control

- Imagery – direct to GC (base stations at airport and region)
- Hydrography - direct to GC or indirectly w/network correction
- Transportation - direct to GC or indirectly w/network correction
- Jurisdictions – tied to PLSS
- Cadastre – tied to PLSS; need to link PLSS to NSRS/CSRN
- Elevation - direct to GC or indirectly w/network correction



Web Resources

ORGANIZATIONS:

Geodetic Control Workgroup Wiki

<http://www.cio.ca.gov/wiki/GCWG-Geodetic-Control-Work-Group.ashx>

National Geodetic Survey

<http://www.ngs.noaa.gov/>

California Spatial Reference Center

<http://csrc.ucsd.edu/>

California Geographic Information Association

<http://cgia.org/geospatial-draftplan.htm>

STANDARDS and LEGISLATION:

National Spatial Data Infrastructure

<http://www.fgdc.gov/nsdi/nsdi.html>

Public Resources Code Sections 8850-8861

[http://www.leginfo.ca.gov/cgi-](http://www.leginfo.ca.gov/cgi-bin/waisgate?WAIISdocID=08601511662+1+0+0&WAIISaction=retrieve)

[bin/waisgate?WAIISdocID=08601511662+1+0+0&WAIISaction=retrieve](http://www.leginfo.ca.gov/cgi-bin/waisgate?WAIISdocID=08601511662+1+0+0&WAIISaction=retrieve)

Your Comments and Suggestions

- Questions?
- Comments, critiques
- Important ideas
- Willing to help

This presentation to be posted on GCWG wiki website:

<http://www.cio.ca.gov/wiki/GCWG-Geodetic-Control-Work-Group.ashx>