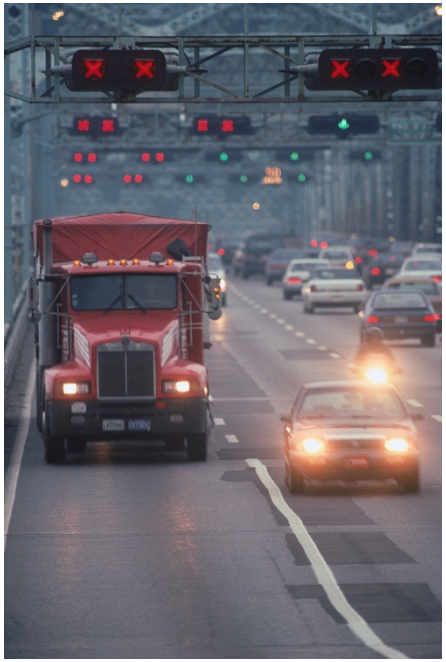
MULTIMODAL GNSS AT WSDOT

Definitions

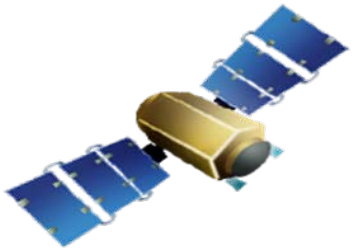
Multimodal:

- *"having or involving several modes of operation"*
- *"two or more different methods, processes, or forms of delivery"*



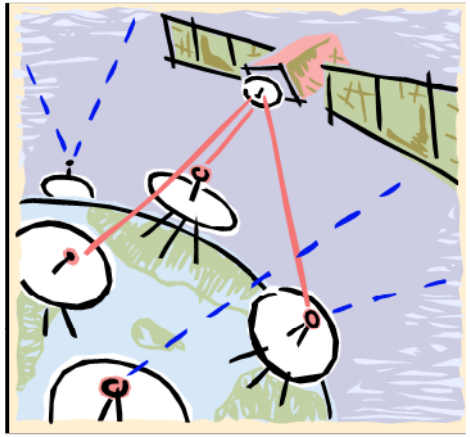
GNSS:

- *"Global Navigation satellite Systems"*
- *"using the GPS, GLONASS, Galileo, or Compass (Beidou) system"*

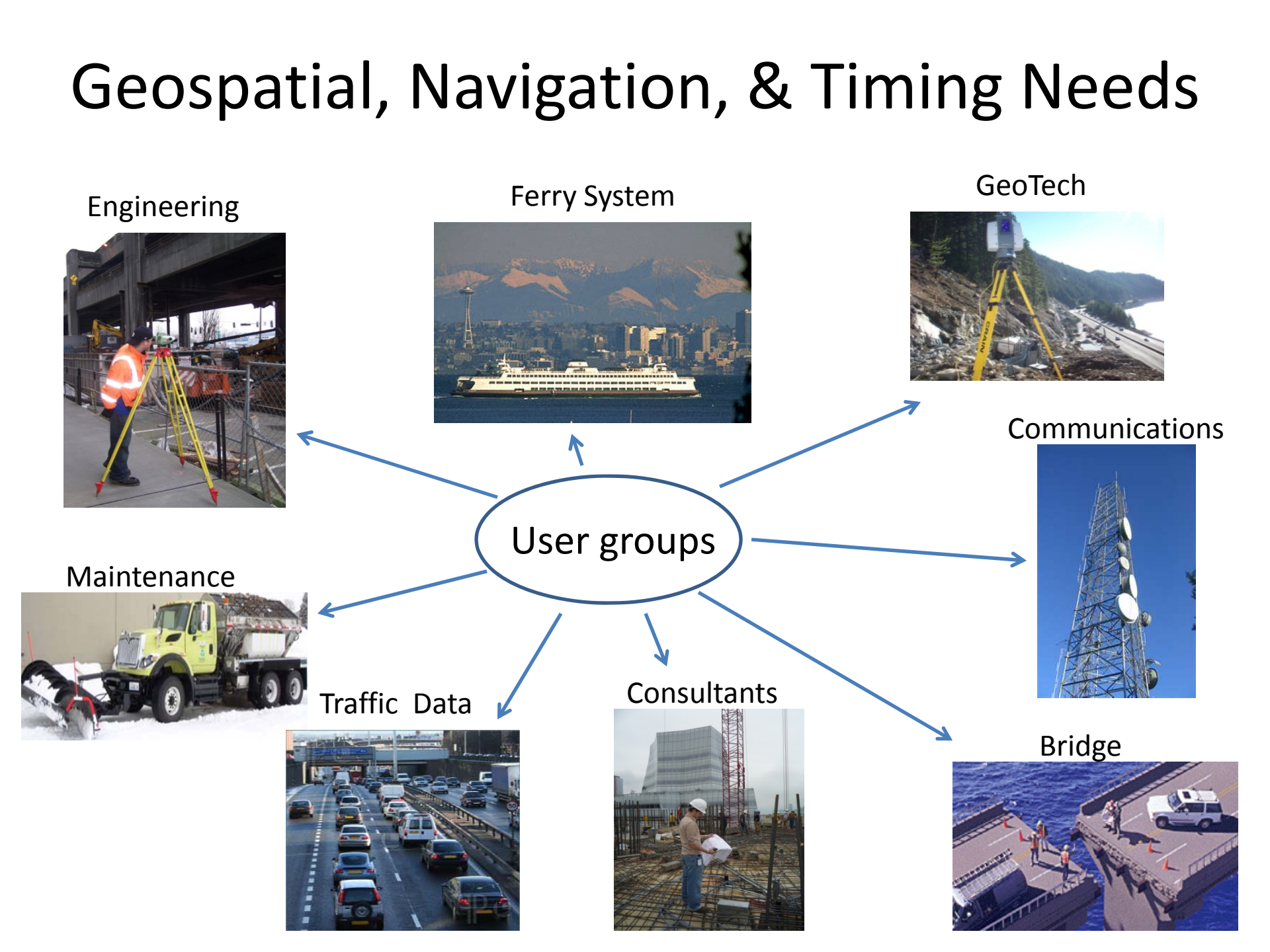


DGPS Services

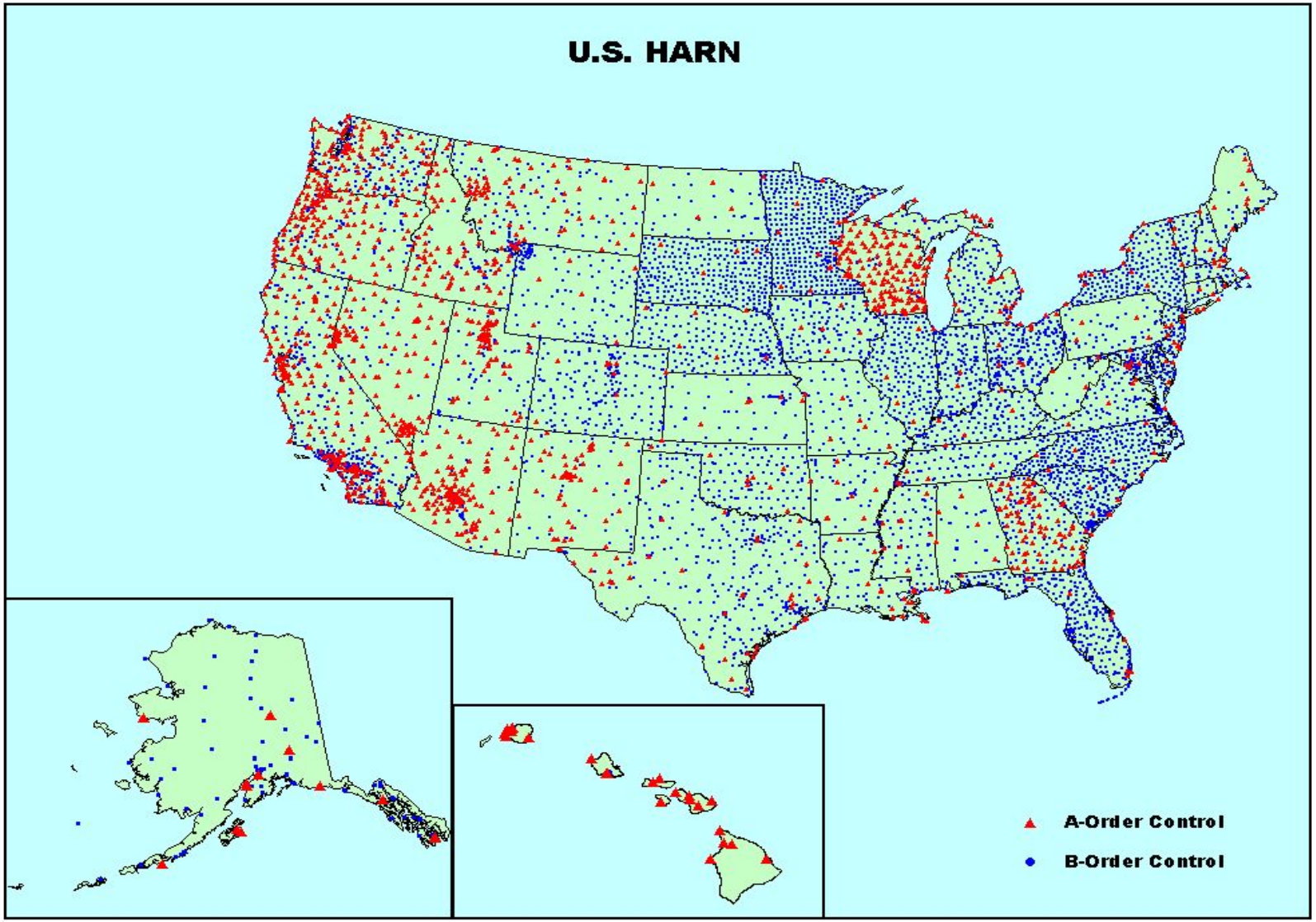
- US Coast Guard differential broadcast using longwave frequencies- 1996.
- FAA developed Wide Area Augmentation System (WAAS) broadcasting via geostationary communication satellites.
- USDept. Of Transportation, Federal Highway Administration, Federal Railroad Administration, and National Geodetic Survey expand the previous Marine Differential GPS to Nationwide- NDGPS. Completed in 1999
- Post Processing includes static, rapid static, and kinematic
- Real-Time kinematic (single base and network)
- Survey grade and inventory grade applications of all the above
- OmniSTAR and Starfire sources



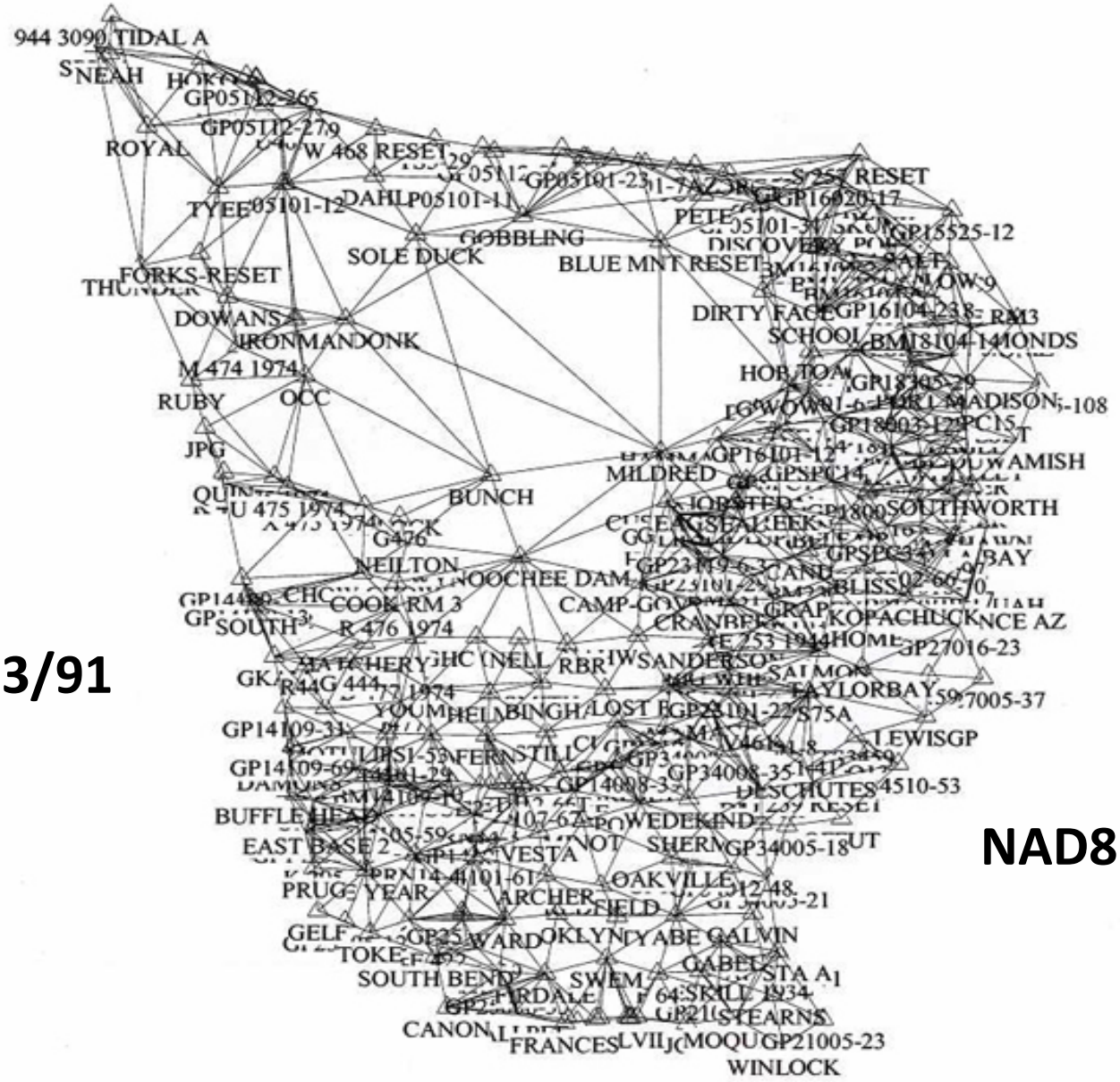
Geospatial, Navigation, & Timing Needs



High Accuracy Reference Network



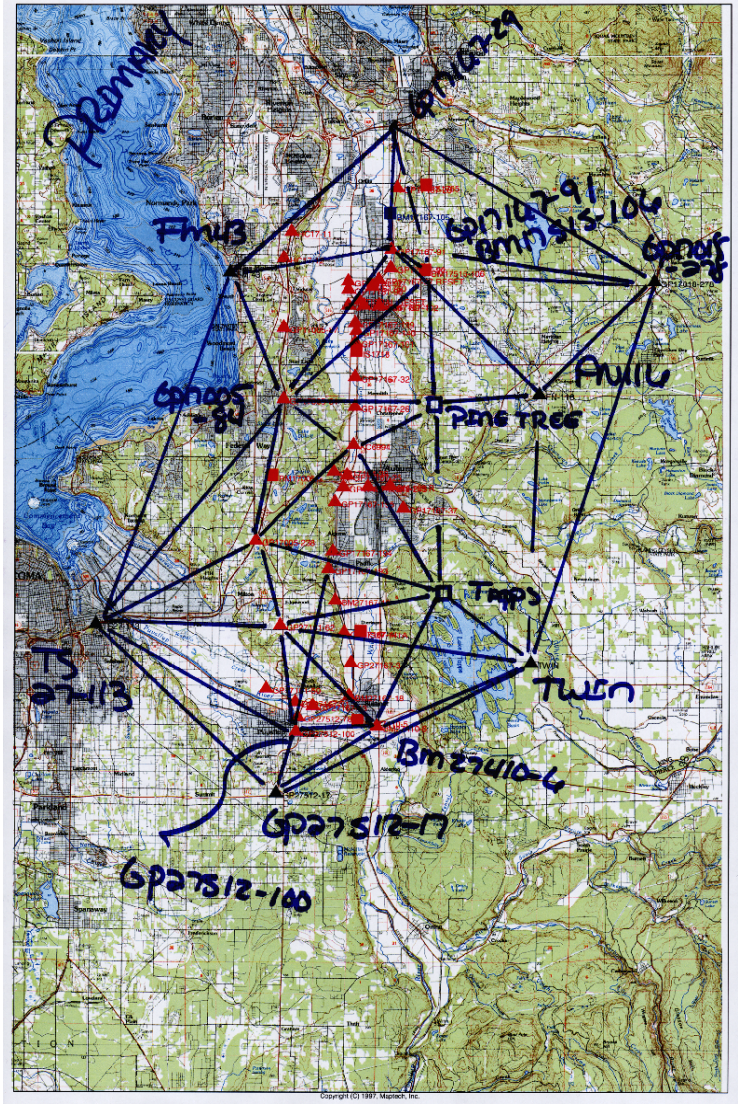
WSDOT Primary Reference Network



NAD83/91

NAD83/07

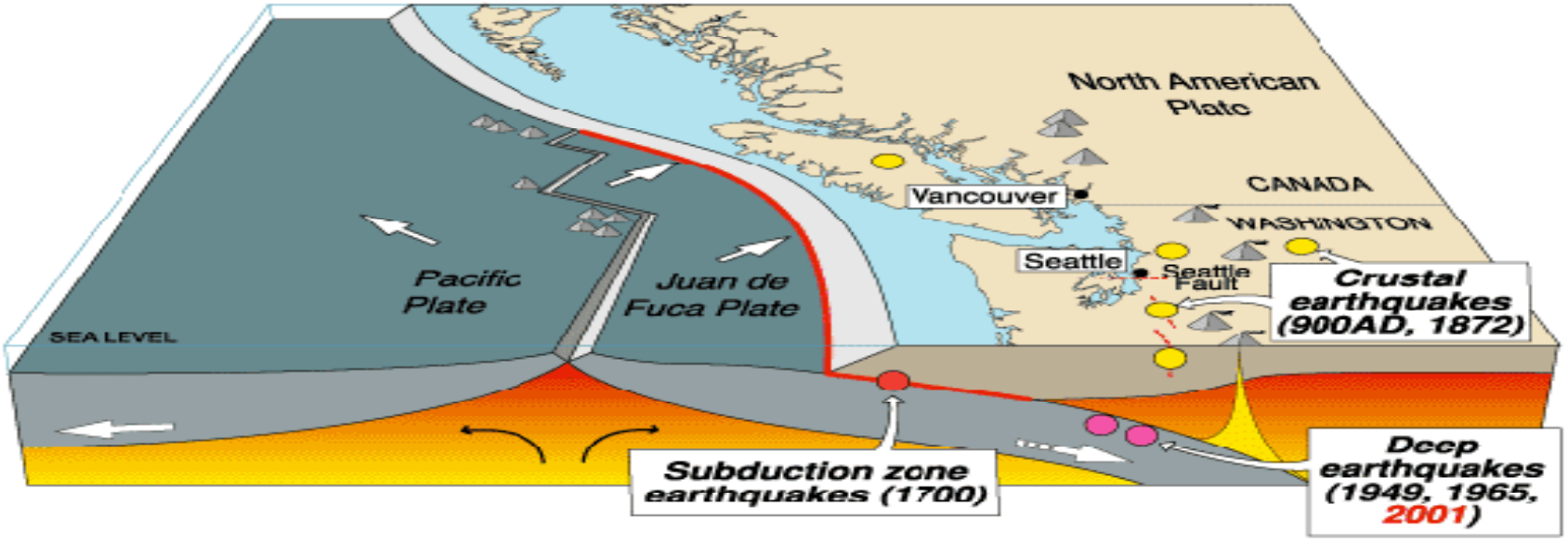
Project Geometric Framework
(Secondary and tertiary)



Geophysical Conditions Drive GPS Development

USGS

Cascadia earthquake sources



	Source	Affected area	Max. Size	Recurrence
●	Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
●	Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
●	Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Science Organizations Install CORS

Mt. Olympus CORS

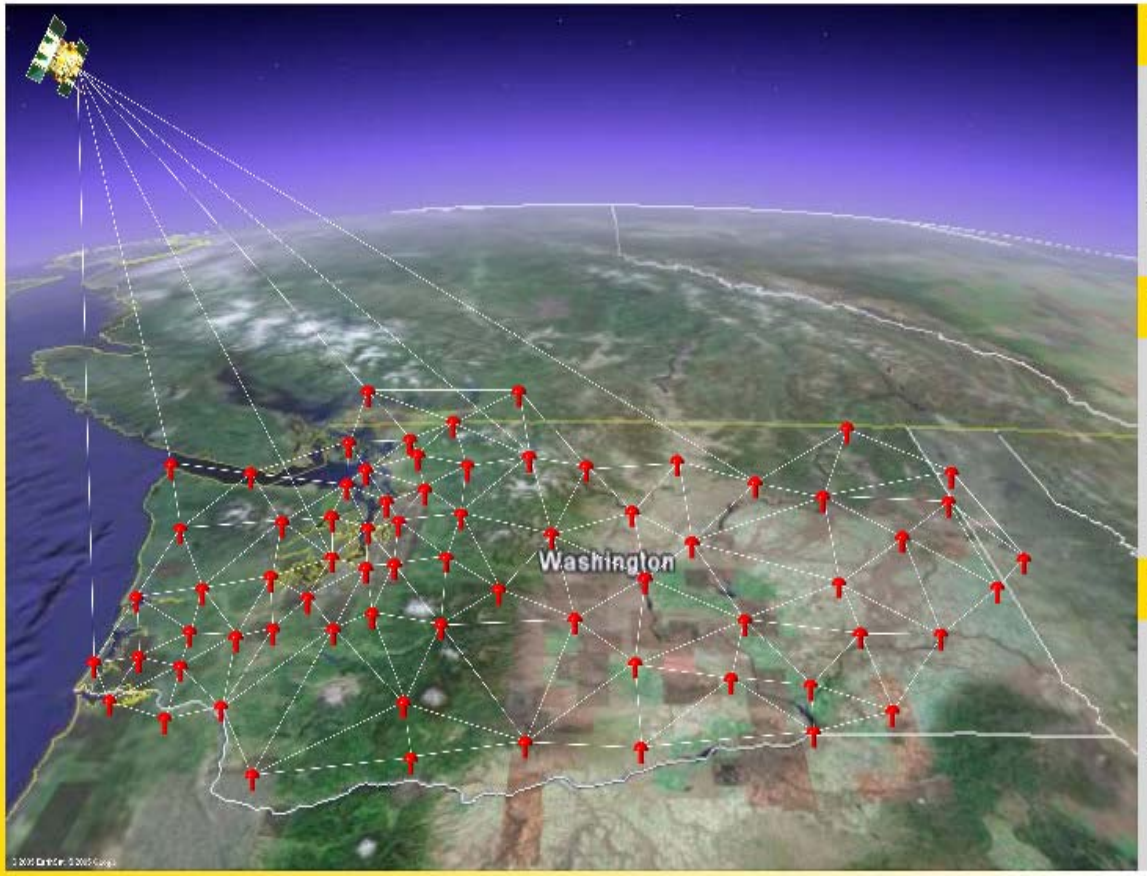
wsrn.org

Washington State Reference Network

A Regional Cooperative of Real-Time GPS Networks.

The *Washington State Reference Network* is a cooperative of real-time GPS networks offering survey data and real-time GPS correction services for Washington state. GPS data files from a network of *continuously operating reference stations (CORS)* are available for download to all with real-time services available through partnerships, memberships and subscriptions.

Visit www.wsrn.org for more information...



Technology.

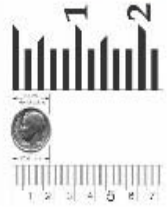
'Real-time GPS networks offering survey data and real-time GPS correction services."

Cooperation.

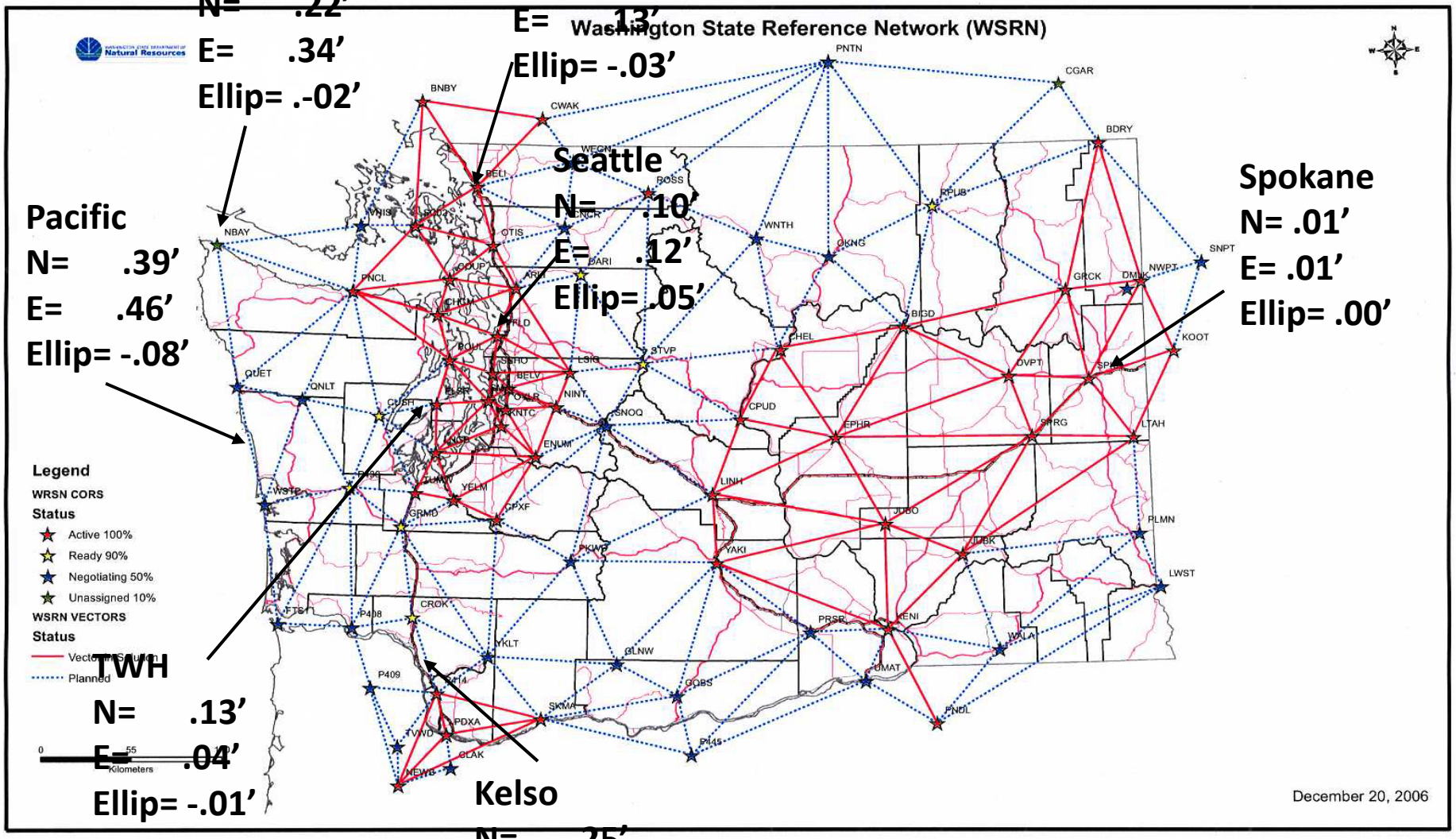
"Services available through partnerships, memberships and subscriptions."

Precision.

"Users achieve high accuracy location on the order of centimeters in seconds."



NAD83/CORS97 to NAD83/07 *Drift*



Neah
N= .22’
E= .34’
Ellip= .-02’

Sedro
N= .11’
E= .13’
Ellip= -.03’

Seattle
N= .10’
E= .12’
Ellip= .05’

Spokane
N= .01’
E= .01’
Ellip= .00’

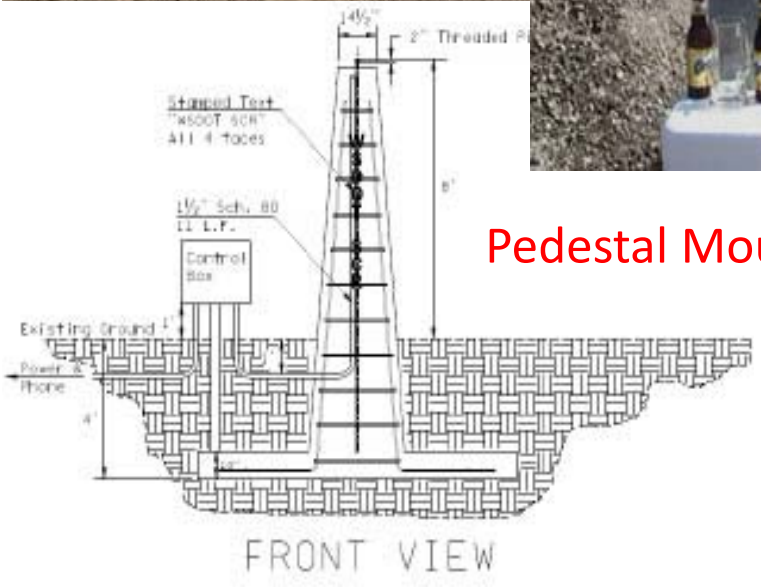
Pacific
N= .39’
E= .46’
Ellip= -.08’

TWH
N= .13’
E= .04’
Ellip= -.01’

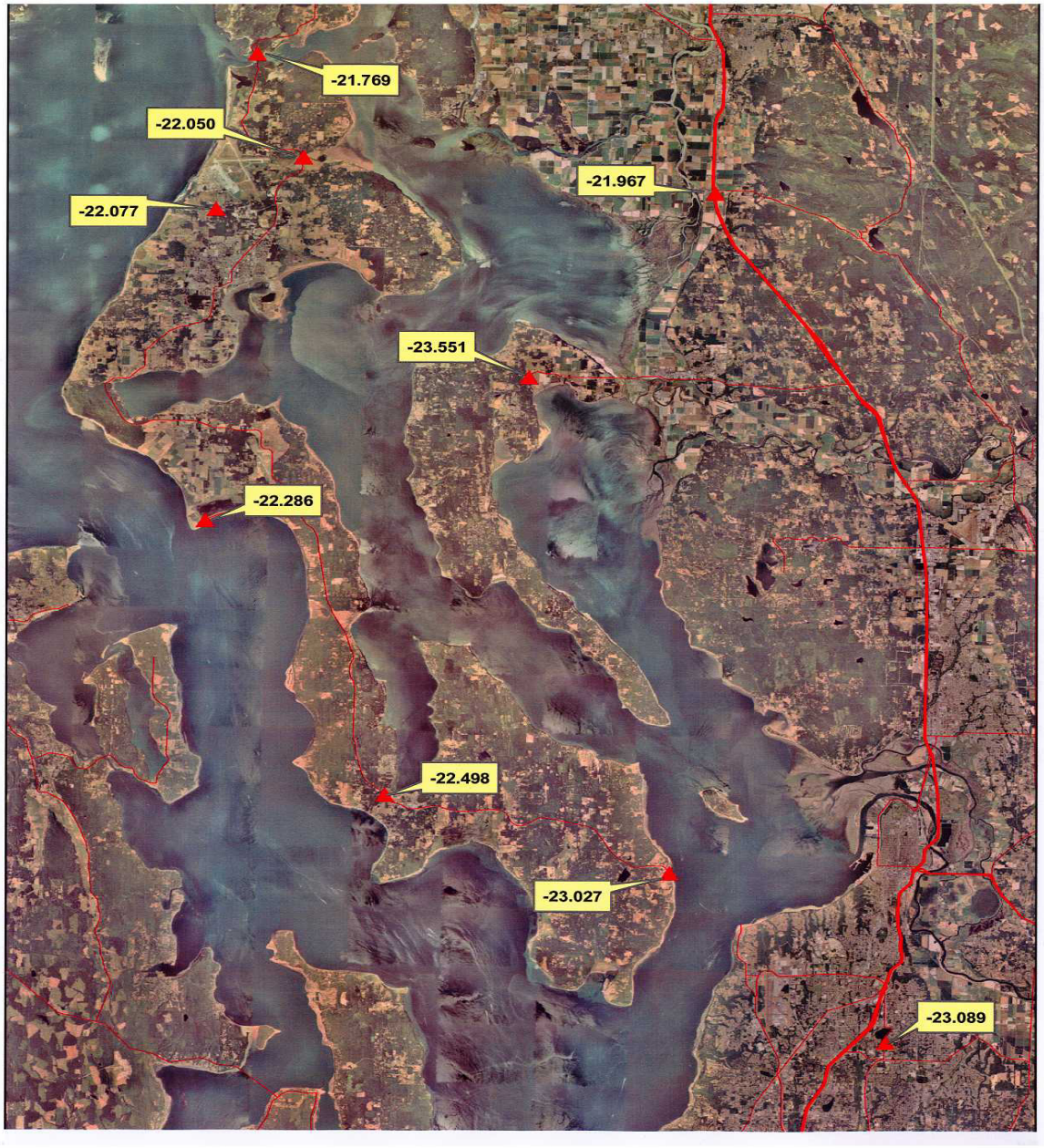
Kelso
N= .25’
E= .15’
Ellip= -.02’

Constant Operating Reference Station (CORS)

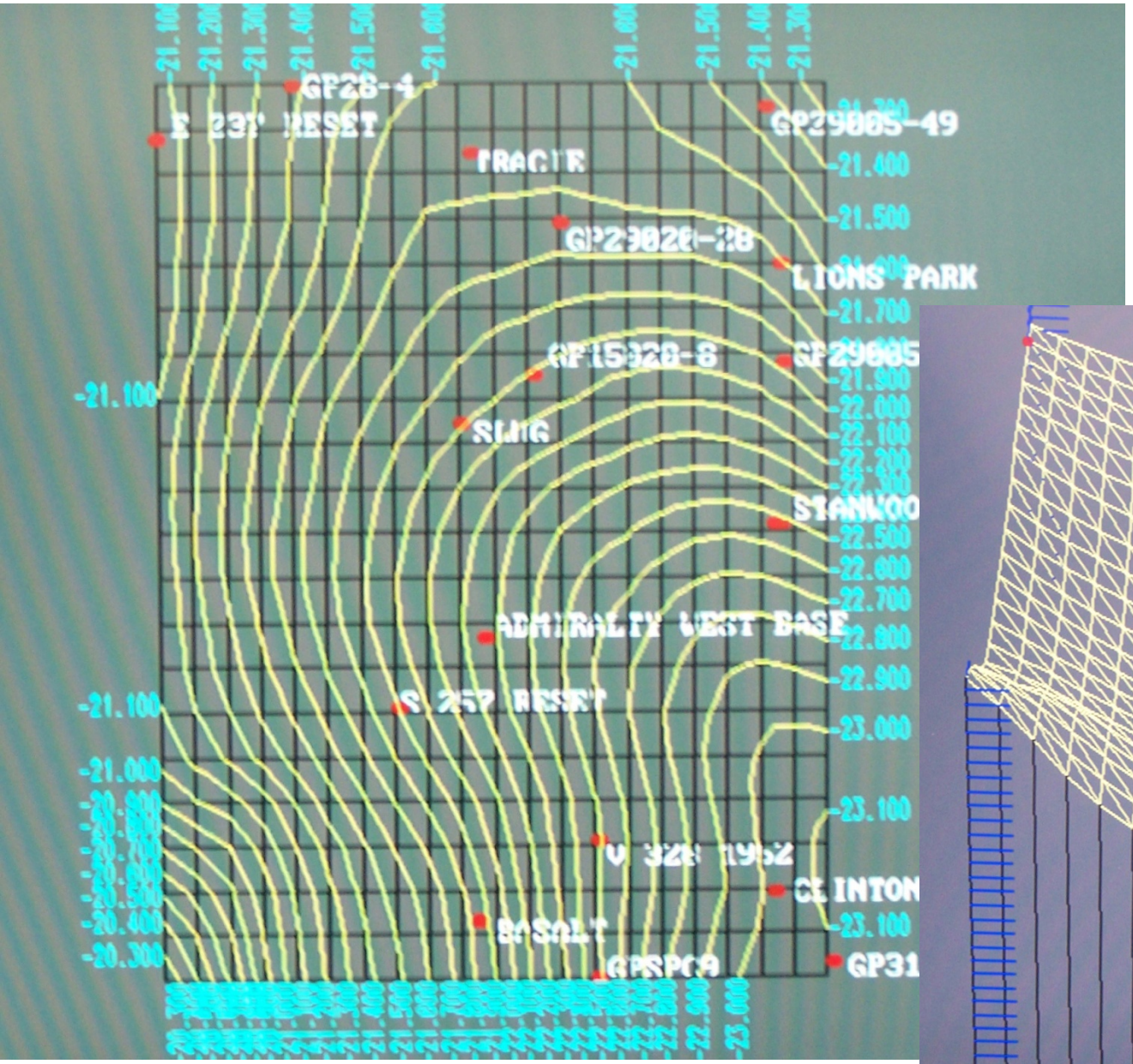
Pedestal Mounts

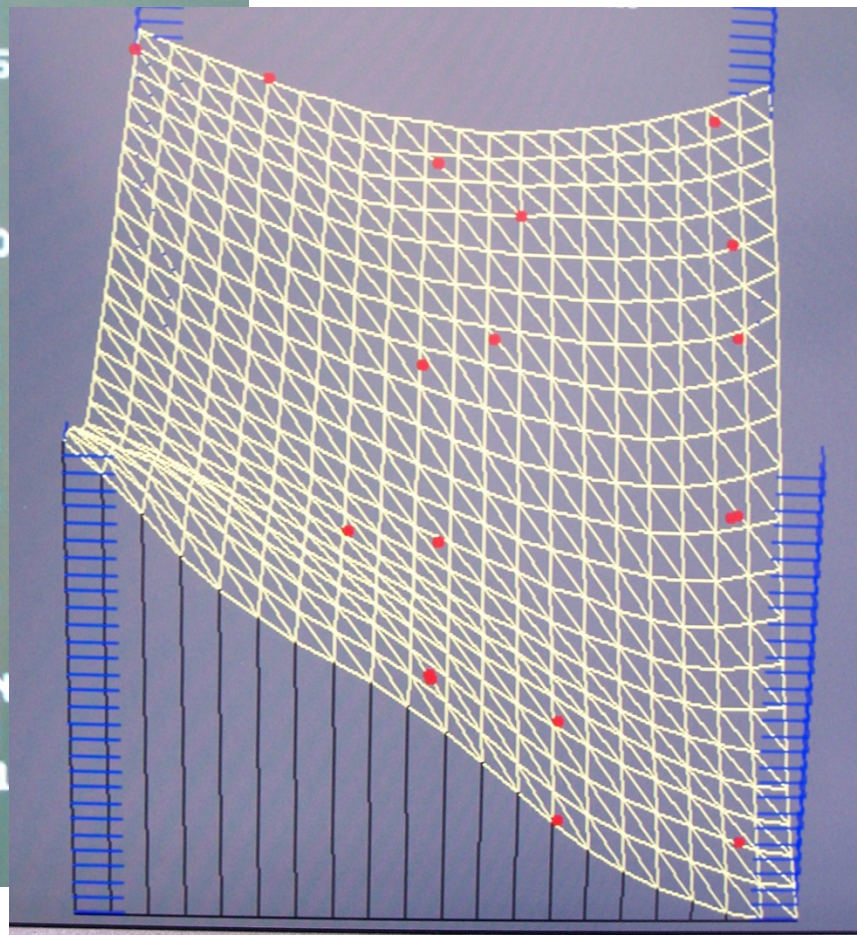


Extreme Geoid Change



Geoidal Trough





Height Modernization Needed

- Precision leveling to CORS essential

Mapping the SR410 Landslide at NILE

Using Long Range Ground based LiDAR

Photogrammetric Mapping

Using kinematic GPS in the air and on the ground

Aerial LiDAR Kinematic Survey

Bathymetric Mapping

Future > mLiDAR applications

Mobile LiDAR Watercraft

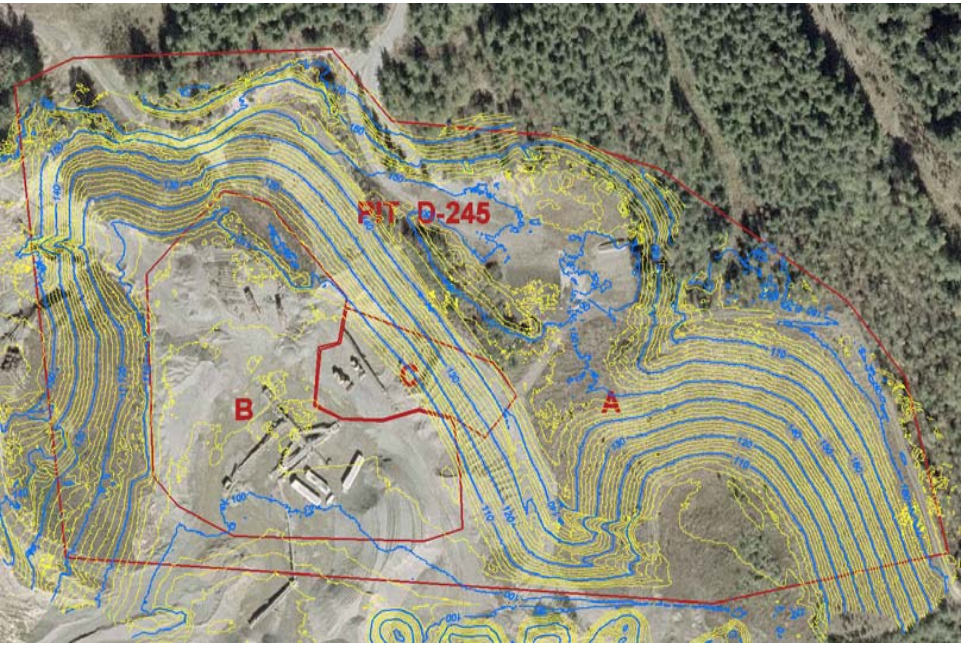
Marine Construction

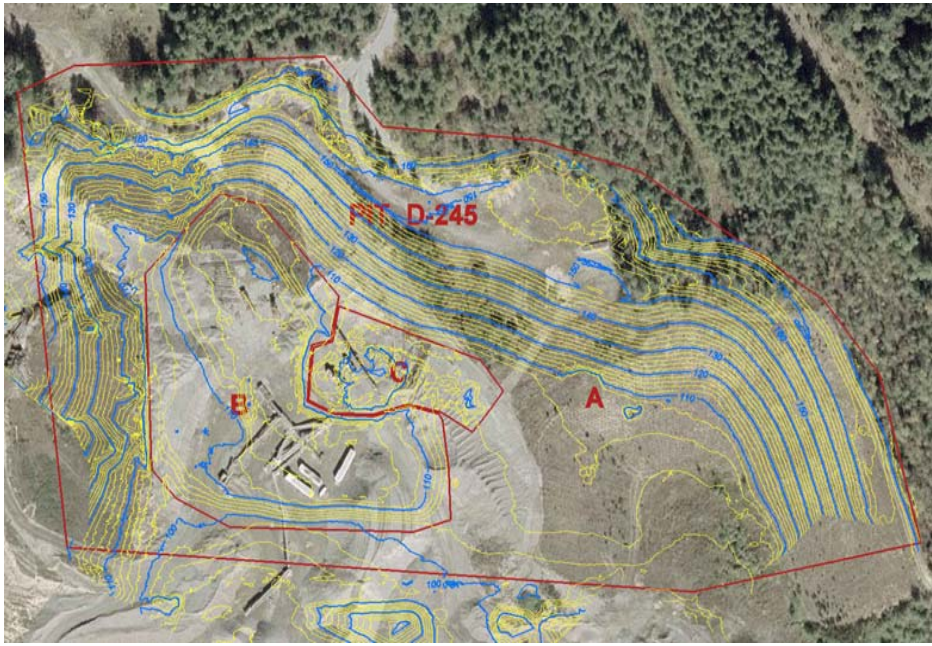
Robotic Grade Control

Real-Time Network

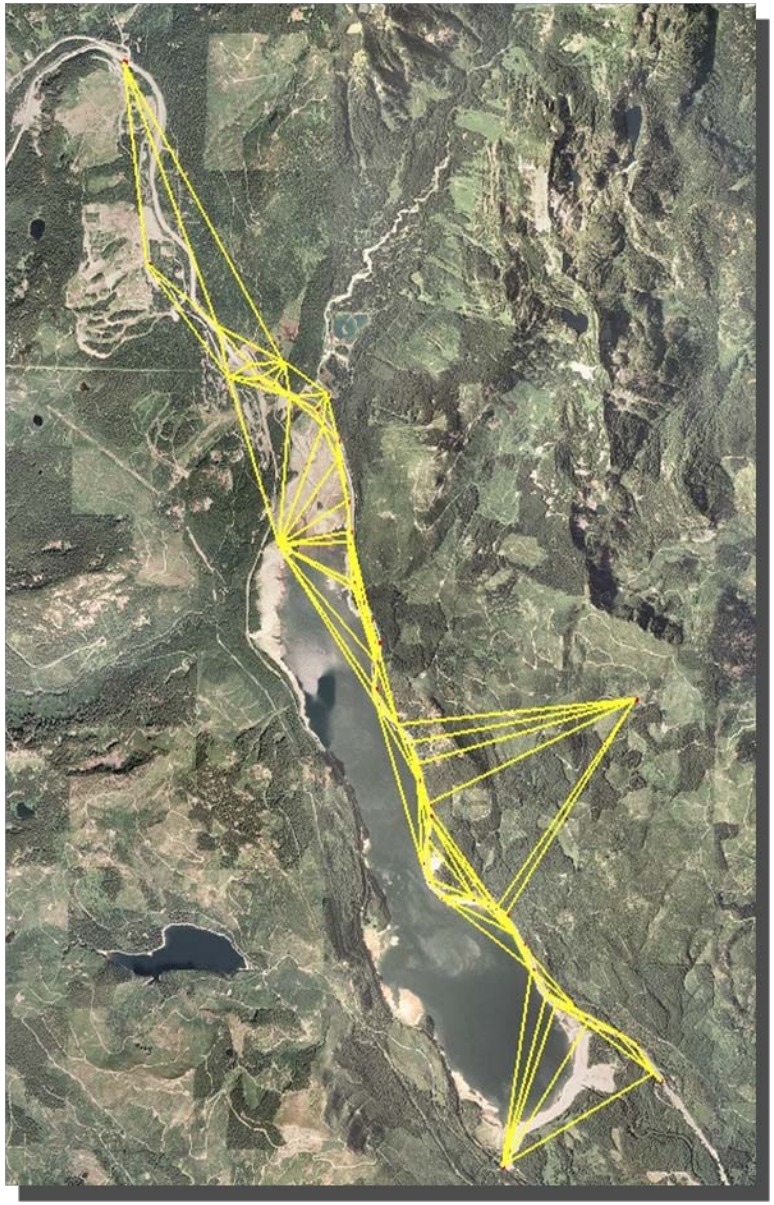
Single base

Pits and Quarry LiDAR Mapping





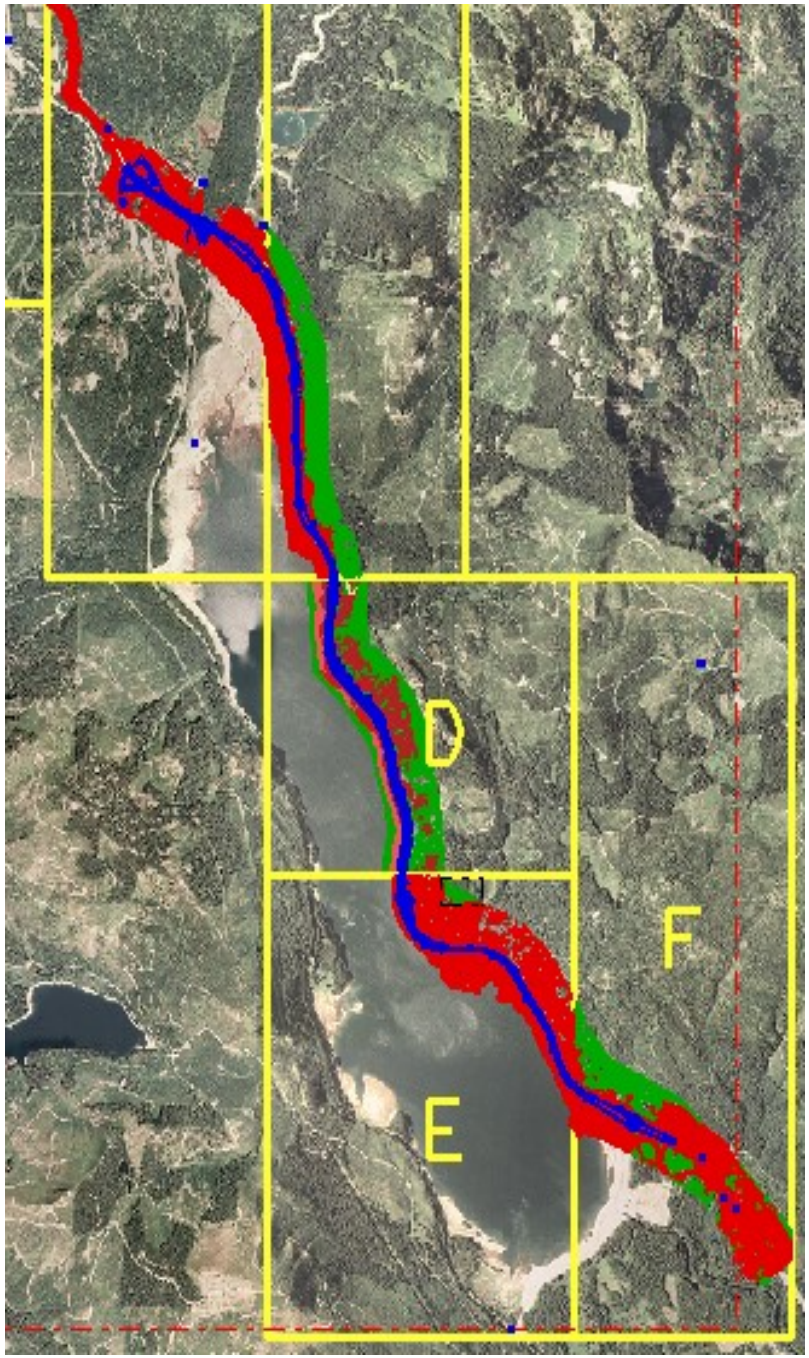
Secondary Control Network



Primary control was established for reconnaissance mapping several years earlier

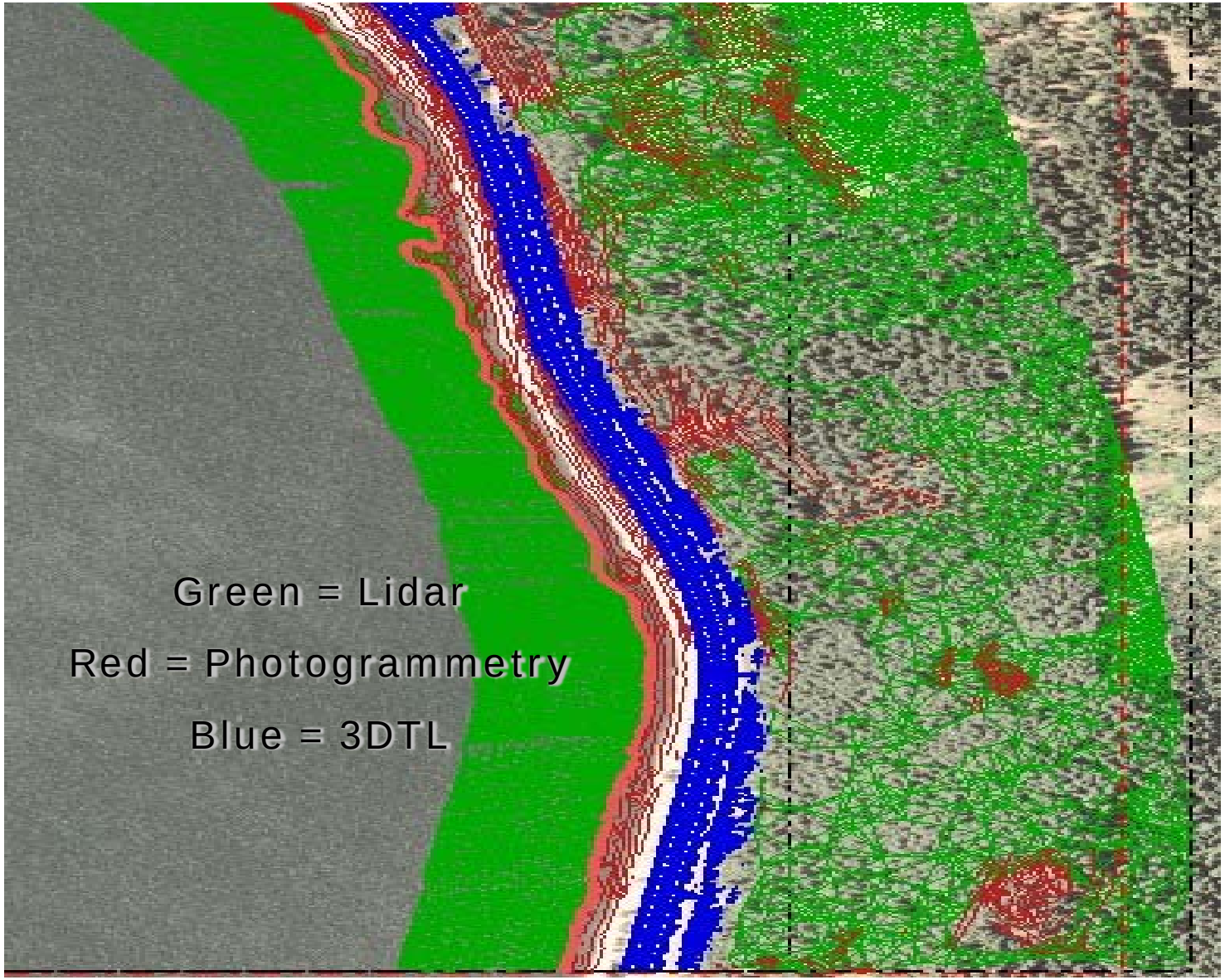
Secondary control was established by GPS (see yellow vectors)

2nd order bar code levels produced accurate elevations

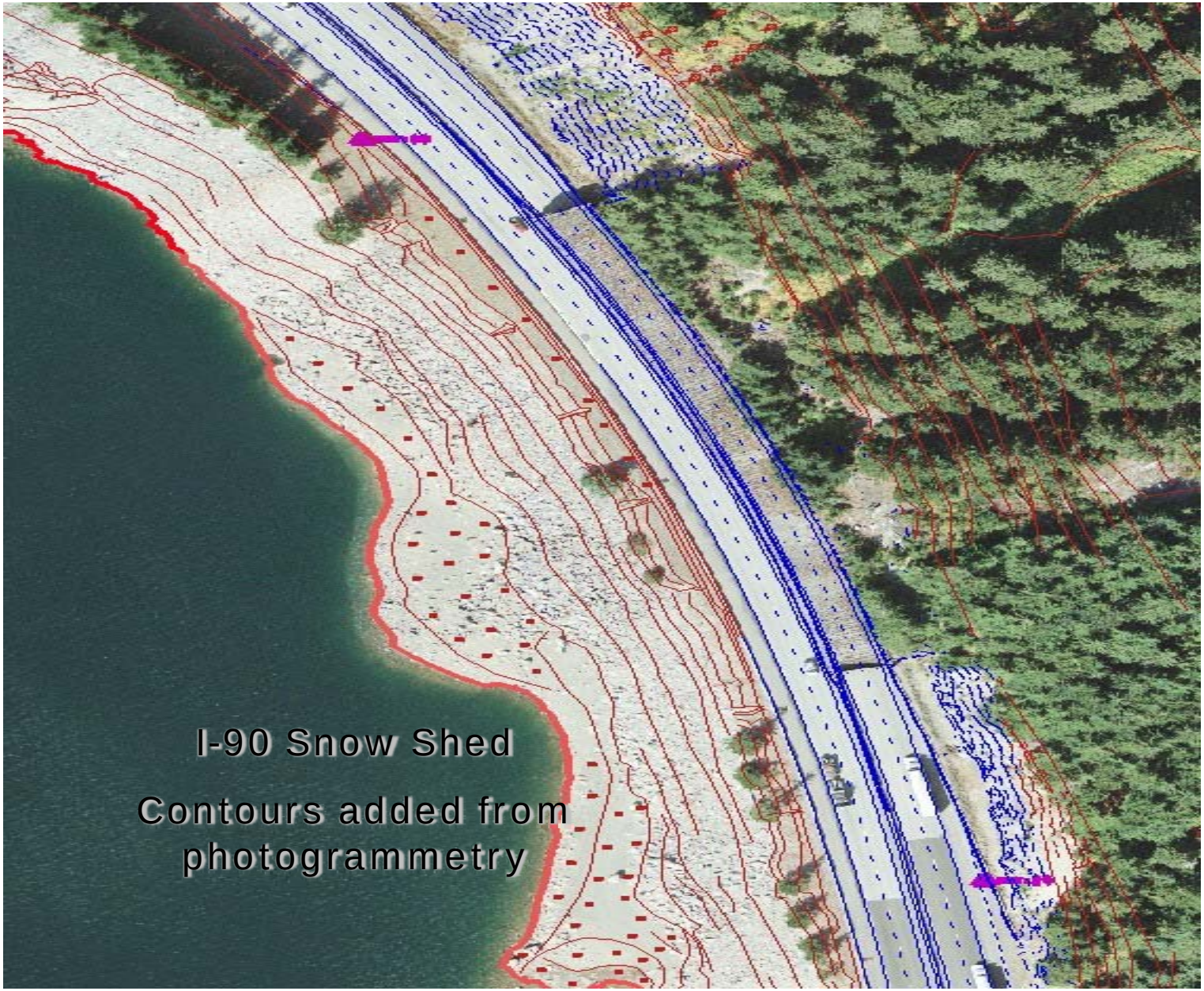


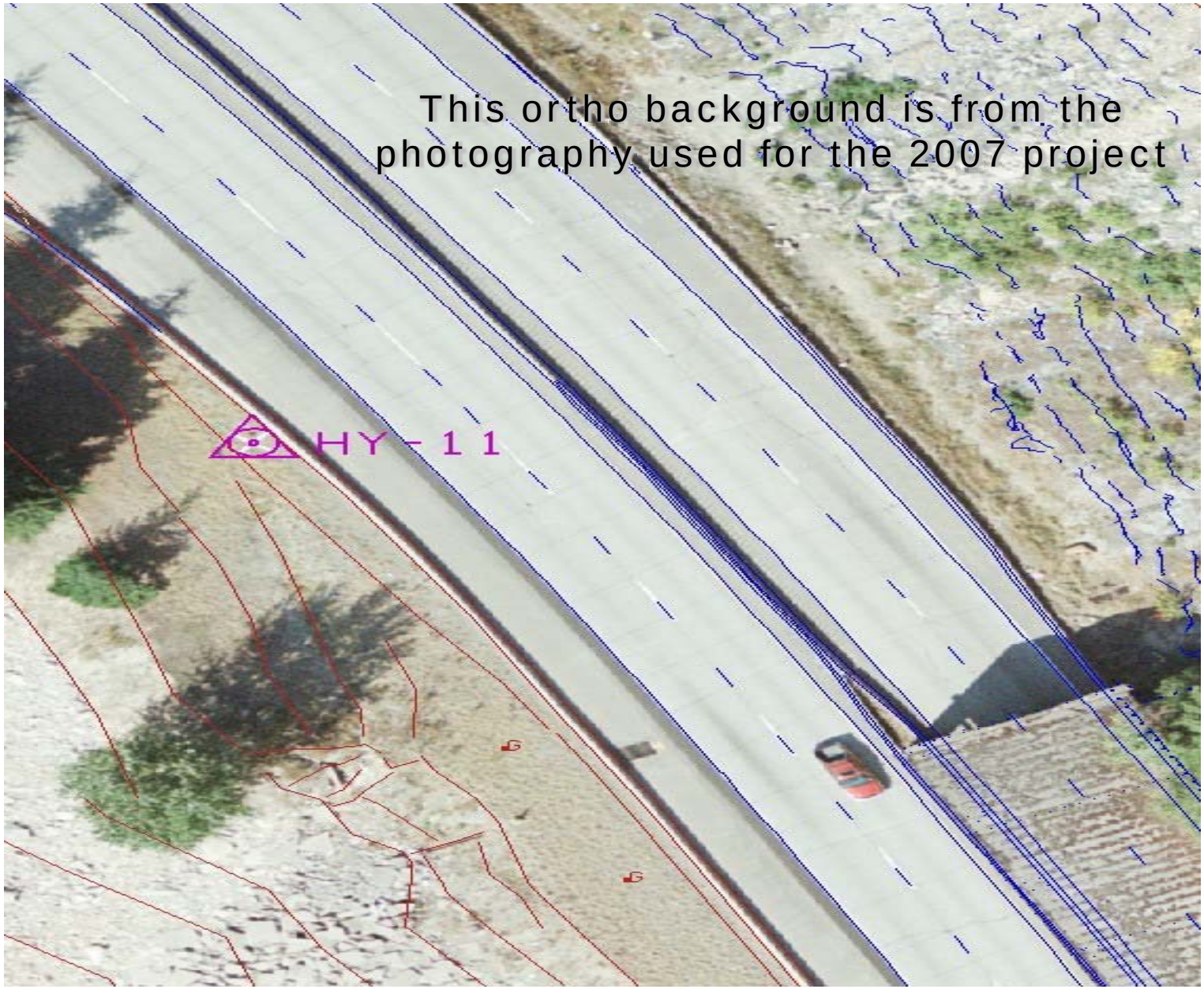
Hyak to Easton Basemap

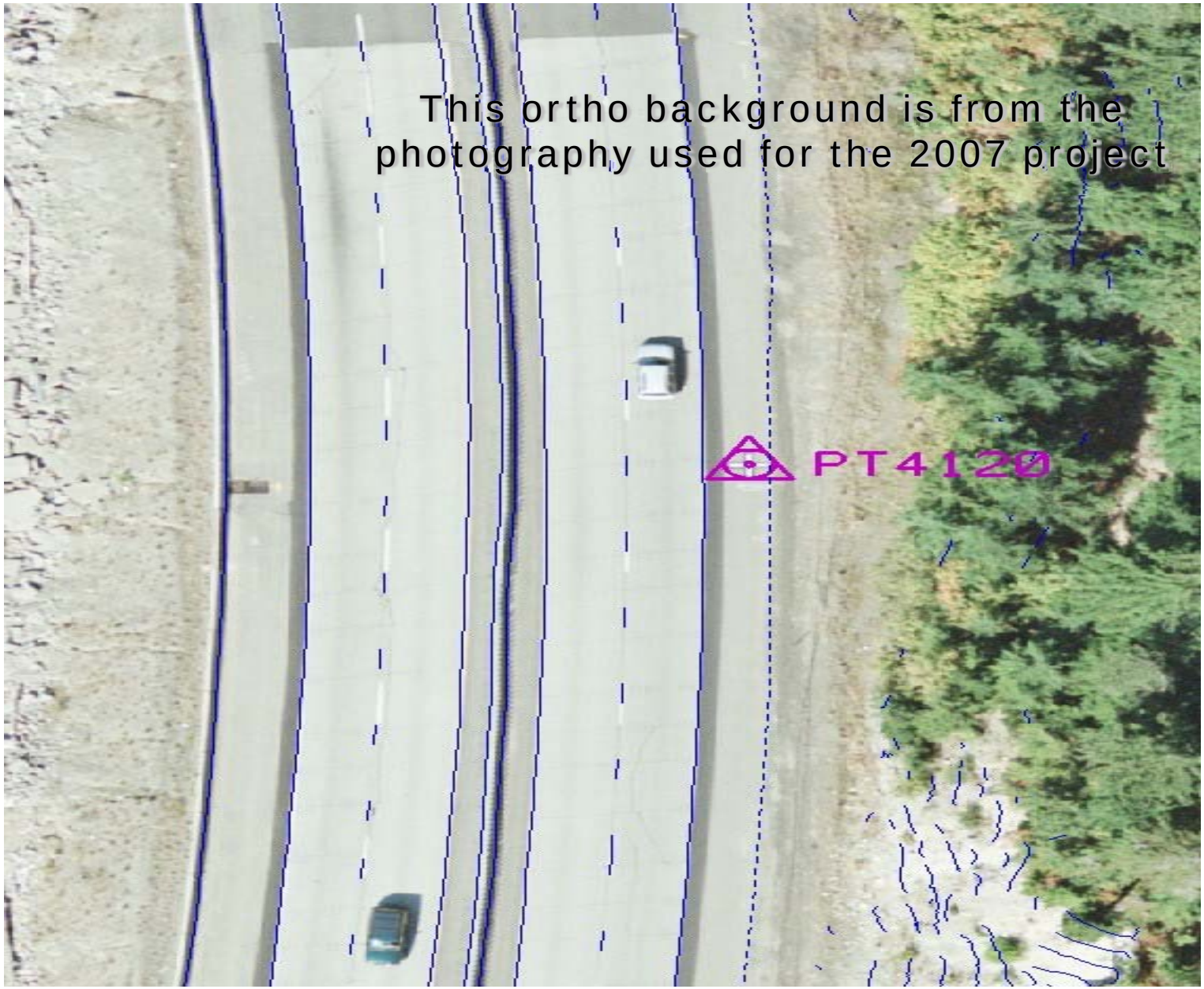
- Ortho (18” resolution)
- Green (LiDAR +/- 1.0’)
- Red (photogrammetry +/- 0.2’
- Blue (3D Terrestrial LiDAR +/- .02’)


Green = Lidar
Red = Photogrammetry
Blue = 3DTL


CAD from 3DTL overlay on ortho photo


I-90 Snow Shed
Contours added from photogrammetry


This ortho background is from the photography used for the 2007 project
HY-11


This ortho background is from the photography used for the 2007 project
PT4120

Displacement Detection on I-90 Mercer Slough Interchange, Bellevue

22 Leica GPS receivers installed by Bridge Preservation Office. Proprietary radio data streaming.

Motion Monitoring on the SR520 Floating Bridge, Lake Washington

4 Trimble GPS receivers providing motion data to VRS Real-Time Network, via radio link. Installed by Seattle Public Utilities.

Settlement Monitoring SR99 Alaskan Way Viaduct, Seattle

4 Trimble GPS receivers providing settlement data to VRS Real-Time Network via radio links. Installed by Seattle Public Utilities.

Automatic Vehicle Location

Mobile Data Collection installations grow from 450 units to more than 950

Washington State Ferry System

- Maintains an inventory of 274 GPS units
- Positional and heading data for navigation
- Onshore differential support

State Route Video Acquision

- Inventory grade GPS
- 360 degree camera
- 2 forward looking cameras
- Accuracy is stated 1/100 of a mile or 53’

Wireless and Communications

- Use GPS to position towers as required by FCC
- GPS enables Wireless Data Radio System by providing accurate timing source
- Supports 2-way voice, freight mobility, travel data, and maintenance initiatives such as the Smart Snowplow

Questions?