



Preliminary contacts and tentative commitments to date:

- Doug Ficco PE, Columbia Crossing Project Director, strong support
- Gavin Schrock PLS, Seattle PUD, manager of PRSN
- Ron Singh PLS, ODOT Survey Manager, will provide stations
- Mike Gilroy PLS, Clark County Survey Dept., seriously interested in partnering
- Dan Renton PLS, Minister & Glaeser Surveying, will provide 1 station
- Nin Beseda PLS, Mackay & Sposito Surveying, seriously interested in partnering
- Dan Karsch PLS, US Forest Service, interested
- Jack Carlson PLS, OTAK Engineering, interested



## Southwest Region GPS Virtual Reference Station Network



Puget Reference Station Network (PRSN) base receiver



Ohio DOT network base receiver



Pacific Beach WA, US Navy site, Pacific Northwest Geodetic Array (PANGA) base receiver



Vancouver Area Engr. Office survey crew using RTK rover receivers for location survey

**WSDOT Mission Statement:**  
"Keep people and business moving by operating and improving the state's transportation systems vital to our taxpayers and communities."

For more information:

**Neil Francis**  
Chief of Parties / Survey Team Leader  
Vancouver Area Engineering Office



Region Map

**How do SWR crews work with GPS equipment currently?**

A crew sets up a mobile base receiver with FM radio equipment on control monuments. This allows the crew to survey with real time kinematic solutions (RTK) within radio communication distance of the base. A significant drawback to this method is that radio communications require "line of sight" between the base and the rover. In urban locations communication can be lost within 1/2 mile of the base. In the best case the range is 6 miles.

In order to place a new project control point a static survey is necessary. This requires multiple receivers operating at the same time on both known and new monuments.

**How can the SWR improve it's survey efficiency?**

Currently, the technology is available that would make mobile bases obsolete. For approximately \$75,000 the SWR could install 3 permanent stations that will tie into an existing network of bases (VRS) already established in the Puget Sound. We will partner with other agencies to develop a complete Regional network. This will allow all SWR crews to collect data within the limits of the entire region utilizing an RTK Rover and cell phone. The efficiency gains will be significant. In short, setting up and breaking down will be a thing of the past.

**What is a Continuously Operating Reference Station (CORS)?**

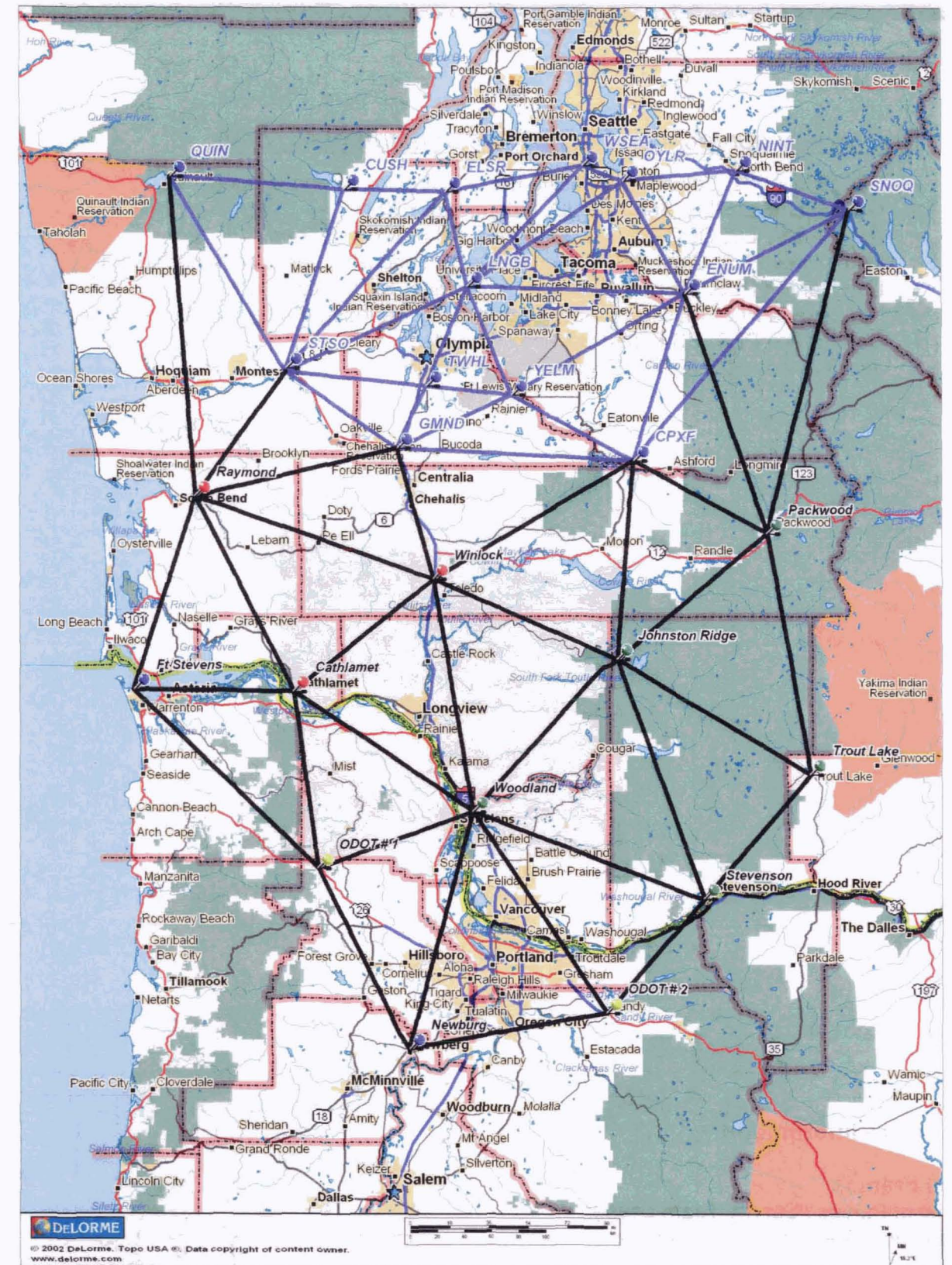
A GPS base receiver station that operates continuously and logs data on site or to the web. If the receiver is used by field crews for RTK solutions a radio or cell phone modem is required.

**What is a Virtual Reference Station (VRS) Network?**

A group of permanently installed GPS base receivers that communicate via the internet to a central processor/server array. In simple terms, the central processor analyzes the data from the bases and performs continual least squares adjustments. This virtually eliminates all errors introduced by the atmosphere. This data is then accessed by network subscribers utilizing data capable cell phones to perform RTK survey.

**PLANNING TIMELINE**

|                             |  |
|-----------------------------|--|
| <b>Current status</b>       | Overview presentation 3/25/05 to SWR management. Forming distribution list                     |
| <b>Month one</b>            | Identify and contact all possible partners. Identify existing CORS sites and owners.           |
| <b>Month two</b>            | Document commitments from partners. Field visit potential sites. Purchase necessary equipment. |
| <b>Month three and four</b> | Finalize site locations. Finalize agreements. Begin installation of stations.                  |
| <b>Month five and six</b>   | Finalize installations and test equipment. System operational.                                 |



- Blue push pins are existing Continuously Operating Reference Stations (CORS)
- Red push pins are 3 proposed WSDOT SWR CORS
- Yellow push pins are 2 proposed ODOT CORS
- Green push pins are 5 proposed CORS supplied by other commitments
- Blue lines represent the southern end of the PRSN network
- Black lines represent SWR network, which would become the southern extension of PRSN

## **Southwest Region GPS Virtual Reference Network**

We request the expenditure of \$ 75,000 for the implementation of three permanent GPS Virtual Reference Stations (VRS), which will be added to the Puget Reference Station Network (PRSN). Northwest Region is a subscriber to the PRSN and is utilizing the technology with excellent results. This equipment will improve efficiency and production, as shown below. Survey and Mapping grade GPS equipment used within a Virtual Reference Network has become an international standard as one of the tools in a modern surveyors toolbox. At least six DOTs in the US have developed VRS networks and more are in the planning phase to implement VRS networks. We have contacts and some commitments from Oregon DOT, Clark County, USFS, and several private engineering / surveying firms to partner with us to develop a Southwest Region network that extends across the Columbia River to include the I-5 corridor that is part of the Columbia Crossing analysis.

### **BENEFIT / COST ANALYSIS** **Four crews working within VRS network for 1 year**

| <i><b>Benefit</b></i>  |                   | <i><b>Cost</b></i>  |                  |
|--|-------------------|---|------------------|
| Less instrumentation setup and teardown, no backsight to set. 2.5hrs/day @ \$68/hr. average 2/3 of time (14 days per month per year per crew)  | \$ 114,000        | 3 Trimble Net RS CORS base stations   | \$ 75,000        |
| Reduced TEF rental rate due fewer GPS base receivers needed Region wide.   | \$8,900           | PRSN IT annual support (\$600 per station)  | \$ 1,800         |
| Confidence during construction staking - data collector with project DTM, alignments at point of staking. Real time data on screen. Less staking error, less redo. 1.5 hour / week of crew time @ \$68/hour for 6 mo. avg., 4 crews (Assuming 50% of time on construction tasks) | \$ 10,600         | Data only cell phones (\$80 per month per phone) (one phone per rover unit). Currently 2 offices with 4 rovers. | \$ 3,900         |
| Network adjusted real time data available to contractor using GPS controlled equipment (Tapani Underground on SR-502, City of Battleground and SR-500, 112 <sup>th</sup> contracts). Reduced need for WSDOT surveying.   | \$125,000         | Internet connection for dedicated IP to each base station. (3 @ \$80+/- per month * 12 months)                  | \$ 2,900         |
| <b>Sub Total Benefit</b>   | <b>\$ 258,500</b> | <b>Total Cost</b>   | <b>\$ 83,600</b> |
| <b>Other benefits not quantified for this analysis (financial and otherwise)</b>   |                   |   |                  |
| Improved crew safety due to no instrument or GPS base setups and moves during shift.   | Priceless         |   |                  |
| Network is beneficial to all partnering agencies and companies, using same geodetic data.  |                   |   |                  |
|  |                   | <i>Benefit to Cost Ratio</i>  | 3.09             |

*This Benefit / Cost analysis is based on one year with a B/C greater than 3.09*