



Weather Warning Systems in Oregon

Region 5 Interstate Access Gates

Doug Spencer, PE
Standards Engineer
Intelligent Transportation Systems

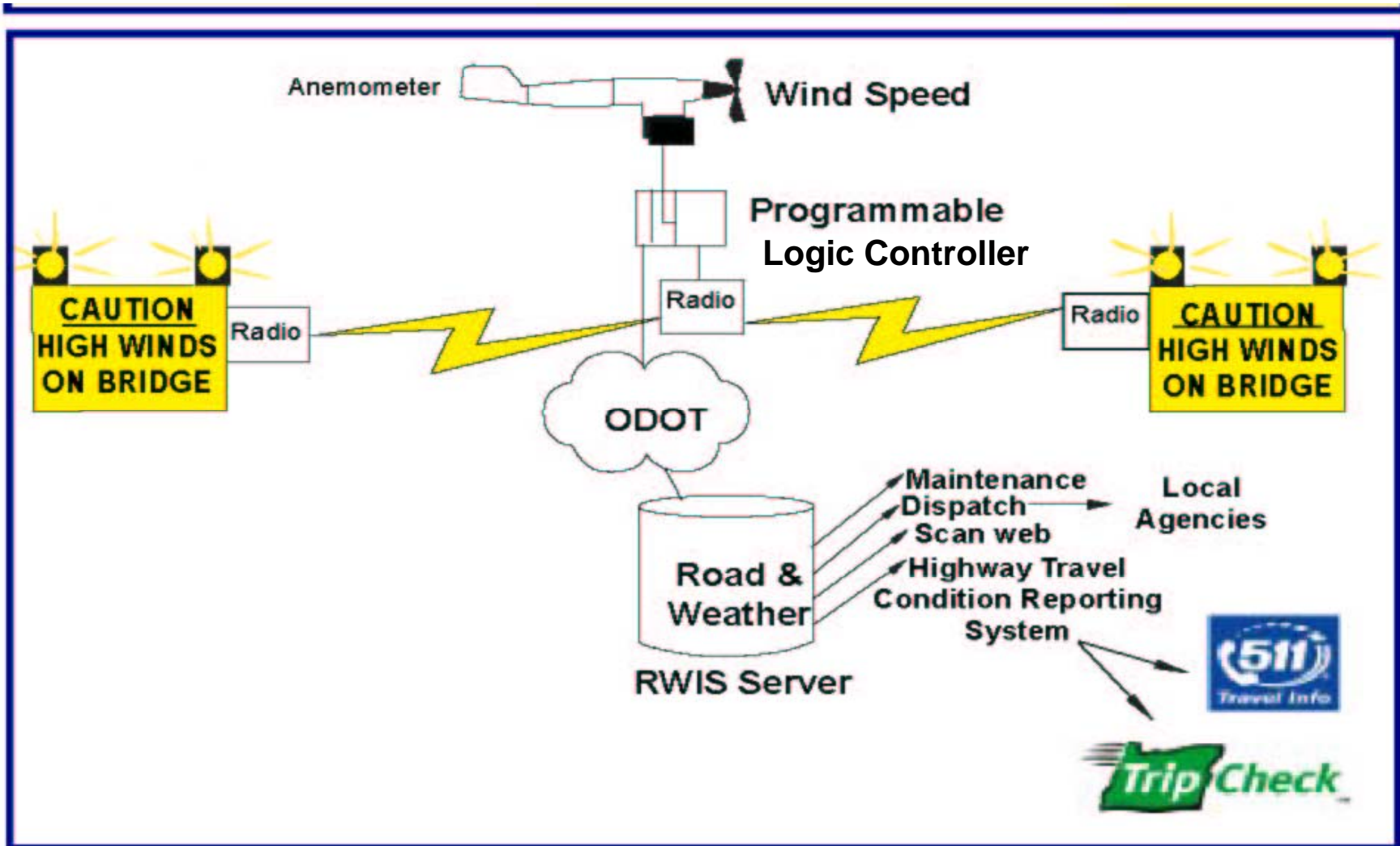


Weather Warning Systems in Oregon

- Flood Warning Systems
 - Seaside
 - Cushman - Florence
- High Wind Warning Systems
 - Port Orford / Gold Beach
 - Newport - Yaquina Bay Bridge
- Ice Warning System
 - Butte Creek – Hwy 140 Corridor
- Debris Warning
 - Located Western parts of the State



Yaquina Bay System Overview



Equipment at Yaquina Bay/Newport

■ Main Panel

- RM Young Anemometer with (4-20mA) transmitter
- Opto22 Ultimate I/O PLC
- RTD 3 wire temperature sensor
- Existing leased T1 circuit
- Existing camera
- 12V DC power supply
- UL 508A panel assembly
- Surge protection
- Heater
- 316 SST UL 50 Type 4X panel



Control Panel and Sign During Construction Photos



Radio and Flasher Cabinets

■ Equipment

- Radio – Dataradio Integra TR
FCC licensed 132-174 MHz
- 2 I/O Devices by Wireless Group
- NEMA Flasher
- UL 508A panels

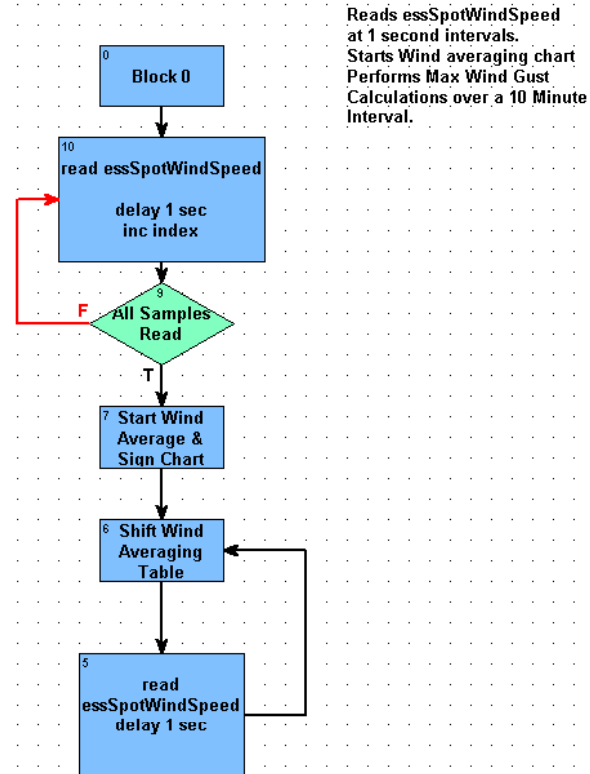
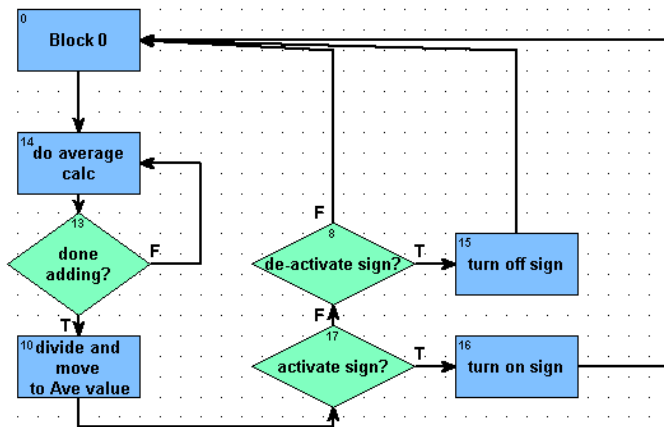
■ Installation

- UL Panel Shop
- Wireless Group
- ODOT Electricians



Yaquina Bay Opto22 PLC program

Wind Averaging Calculations
&
Sign Activation Control
Chart activated after 120
1 second readings are
obtained in the
Windspeed_Gust Chart



Reads essSpotWindSpeed
at 1 second intervals.
Starts Wind averaging chart
Performs Max Wind Gust
Calculations over a 10 Minute
Interval.



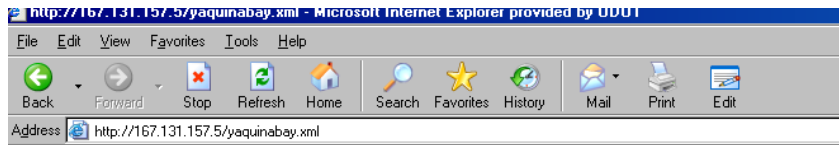


Project Parameters

- Maximum Gust, Avg. Speed, Avg. Direction defined from NTCIP 1204 Environmental Sensor Station Interface Standard
- Signs ON at 35 mph average speed or greater
- Signs OFF at 25 mph average speed or less
- Contact closures between PLC and radio systems due to organizational issues



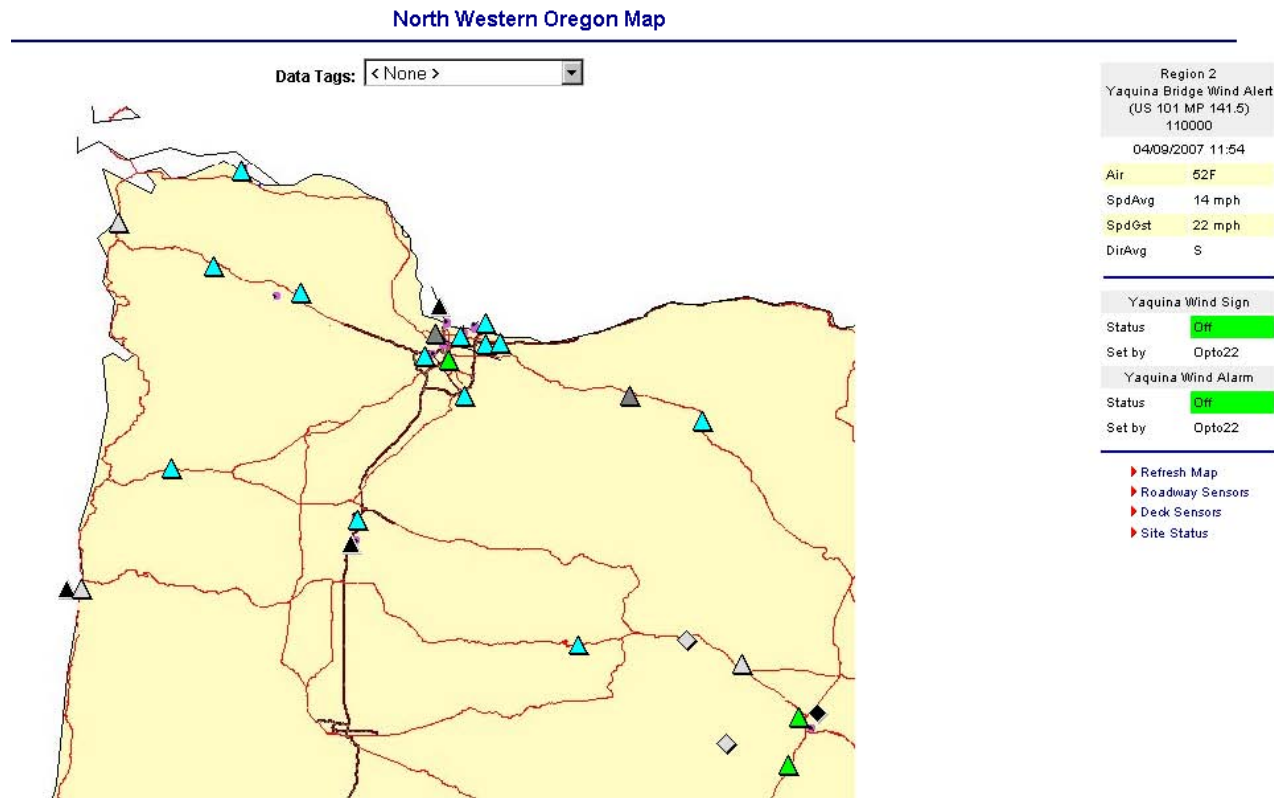
XML Data to SQL database



```
<?xml version="1.0" ?>
- <System name="Yaquina Bay High Wind Warning System">
  <IP>167.131.157.5</IP>
  - <Analog Name="Analog Unit">
    - <Point position="0">
      <Type>Input</Type>
      <essSpotWindSpeed>11.2</essSpotWindSpeed>
    </Point>
    - <Point position="1">
      <Type>Input</Type>
      <essSpotWindDirection>262.2</essSpotWindDirection>
    </Point>
    - <Point position="12">
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      <essAirTemperature>11.2</essAirTemperature>
    </Point>
    - <Point position="3">
      <Type>Input</Type>
      <essSpotWindSpeed_2>7.4</essSpotWindSpeed_2>
    </Point>
  </Analog>
  - <Digital Name="Digital Unit">
    - <Point position="4">
      <Type>Input</Type>
      <SignStatus>Off</SignStatus>
    </Point>
  </Digital>
  - <Digital Name="Digital Unit">
    - <Point position="8">
      <Type>Output</Type>
      <WindAlarm>Off</WindAlarm>
    </Point>
  </Digital>
  - <Calculated Values="Calculated Values">
    <essAvgWindSpeed>6.3</essAvgWindSpeed>
    <essMaxWindGustSpeed>10.0</essMaxWindGustSpeed>
    <essAvgWindDirection>201.0</essAvgWindDirection>
    <Compass_Direction>S</Compass_Direction>
    <essAvgWindSpeed_2>3.7</essAvgWindSpeed_2>
  </Calculated>
</System>
```



ScanWeb data for maintenance – ODOT intranet





Notification Via Other Media

- Automatic pages / email maintenance staff
- HTCERS
 - Requires dispatcher verification
 - Fax local agencies (e.g., law enforcement, police, schools, etc.)
- TripCheck.com
- 511





Yaquina Bay Bridge Operations

- Maintenance staff paged at different condition levels originally
 - Level 0 – Average wind speed reaches 45 mph
 - Level 1 – Average wind speed reaches 60 mph
 - Level 2 – Average wind speed reaches 80 mph
 - Average wind speed drops to 35 mph
- RWIS notification web application where maintenance can setup their own criteria. No longer closing bridge unless DM says so.



RWIS Notification – Flood Warning System

http://rwisnotifications.odot.state.or.us/subscription.asp?racf=hwye09&siteID=110003 - Microsoft Internet Explorer provided by

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit

Address http://rwisnotifications.odot.state.or.us/subscription.asp?racf=hwye09&siteID=110003

Home **ODOT** Search

RWIS Notification System

Add / Edit Subscriptions

Instructions: Check the boxes next to the alerts you wish to receive. If the alert has customizable conditions, edit those. To unsubscribe from an alert, uncheck the box. When you are done, click the "Update Subscriptions" button.

Seaside Flood Warning (US 101 MP 22)

- PreFlood Warning Alert**
Condition to trigger alert: PreFlood sensor switches to 'ON' position.
Condition to reset alert: PreFlood sensor switches to 'OFF' position.
Ignore Schedule: (If you check this box, this alert will be sent regardless of your alert schedule.)
- Flood Warning Alert**
Condition to trigger alert: Flood sensor switches to 'ON' position.
Condition to reset alert: Flood sensor switches to 'OFF' position.
Ignore Schedule: (If you check this box, this alert will be sent regardless of your alert schedule.)
- RWIS Failure Alert**
Condition to trigger alert: The station has not reported in the number of hours specified.
Condition to reset alert: The station starts reporting again.



RWIS Notification – RWIS Example

http://rwisnotifications.odot.state.or.us/subscription.asp?racf=hwye09l&siteID=285005 - Microsoft Internet Explorer provided by

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit

Address http://rwisnotifications.odot.state.or.us/subscription.asp?racf=hwye09l&siteID=285005

Murphy Hill (OR 18 MP 15.4) Update Subscriptions

Change Alert Schedule

Change Subscriber Information

System Administration

Questions / Feedback

Logout

ITS Home

Frost / Ice Alert

Conditions to trigger alert: Pavement temperature is at 33° or below and pavement is not dry, OR pavement temperature is at 32° or below and the dew point is at or above pavement temperature.

Condition to reset alert: Pavement temperature rises above 38°.

Resend Alert After: 8 in Hours

Ignore Schedule: (If you check this box, this alert will be sent regardless of your alert schedule.)

Wind Speed Alert

Condition to trigger alert: Average wind speed is at or above specified value.

Condition to reset alert: Average wind speed is 20 mph below specified value.

Wind Speed > 30 In MPH (minimum: 20)

Resend Alert After: 1 in Hours

Ignore Schedule: (If you check this box, this alert will be sent regardless of your alert schedule.)

Freezing Precipitation Alert

Condition to trigger alert: Air temperature is at or below 33° and the relative humidity is at or above 90%.

Resend Alert After: 2 in Hours

Ignore Schedule: (If you check this box, this alert will be sent regardless of your alert schedule.)

RWIS Failure Alert

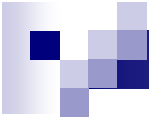
Condition to trigger alert: The station has not reported in the number of hours



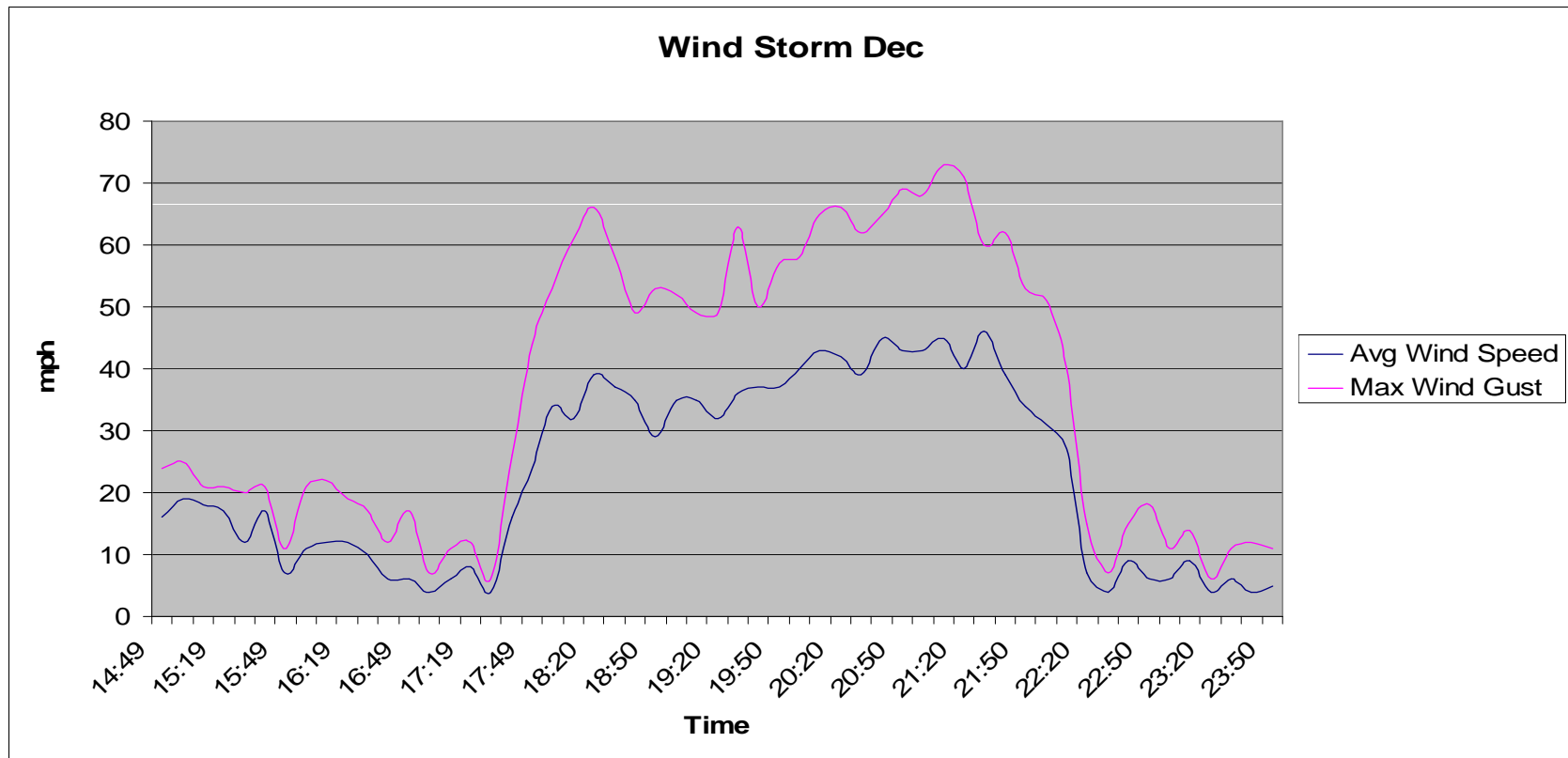
Port Orford High Wind Warning System - Upgrade

- Similar to Yaquina Bay except over dial-up.
- Crews used to have to drive hours to turn on/off signs manually. Then ITS added auto-dialer, again due to organizational issues. Finally using PLC.
- Beacons activated at 40 mph gusts or 35 mph average wind speed.
- Beacons deactivated at less than 30 mph gust and 25 mph average wind speed.
- Crews will not be paged when the signs turn on and off.
- Conditions monitored by TOC.
- Modified activation and deactivation conditions based on data from two major storms and due to longer corridor (approx. 20 miles).

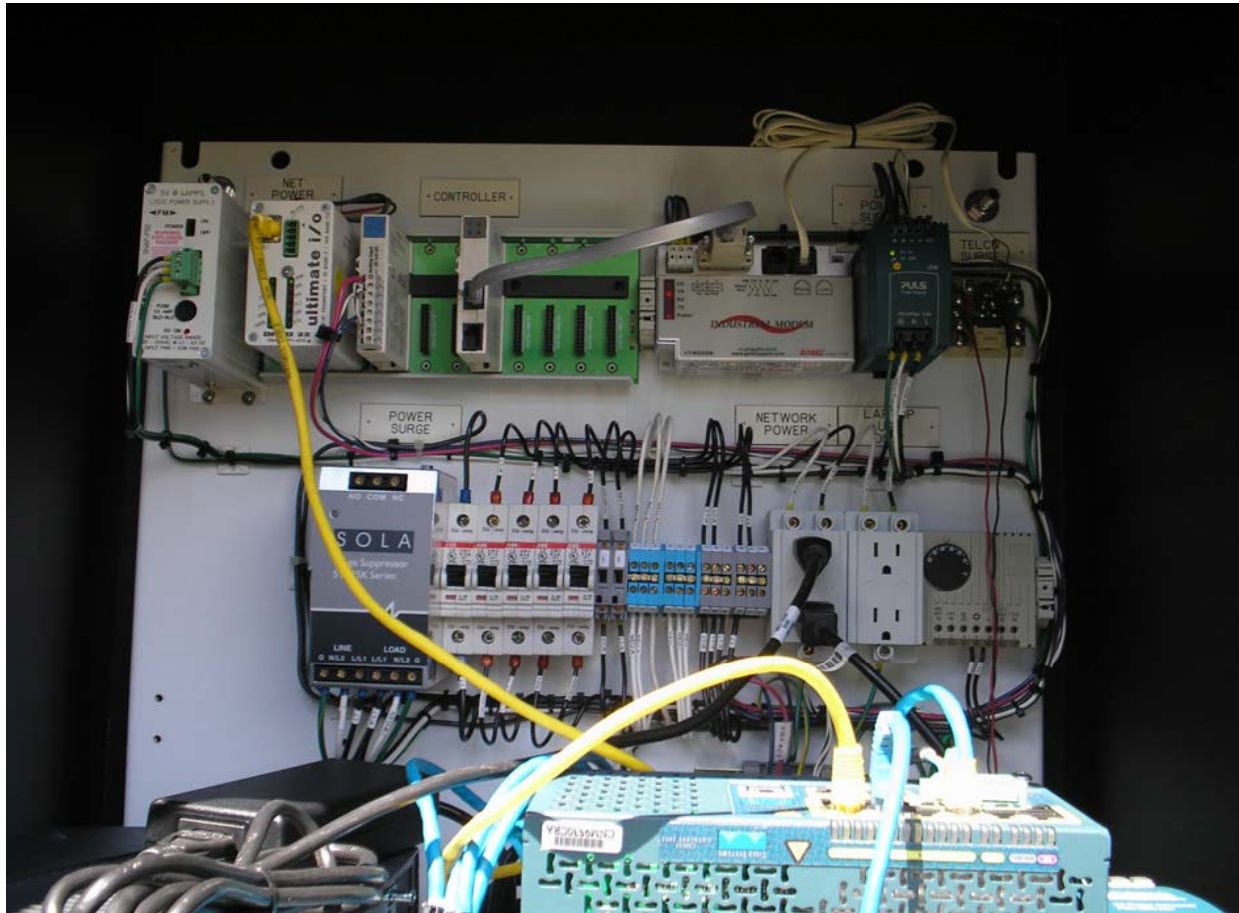




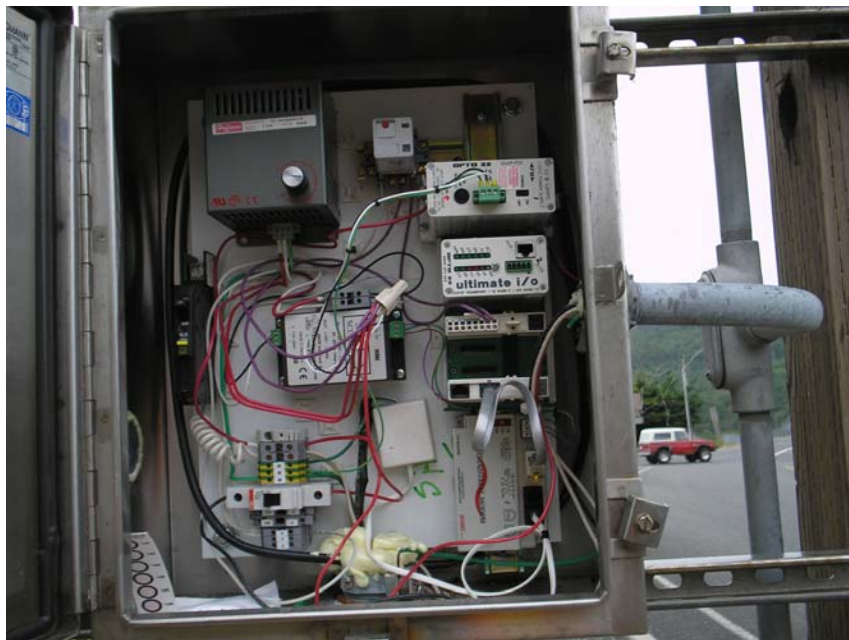
Winter Storm Data – Max Gust and Avg Speed



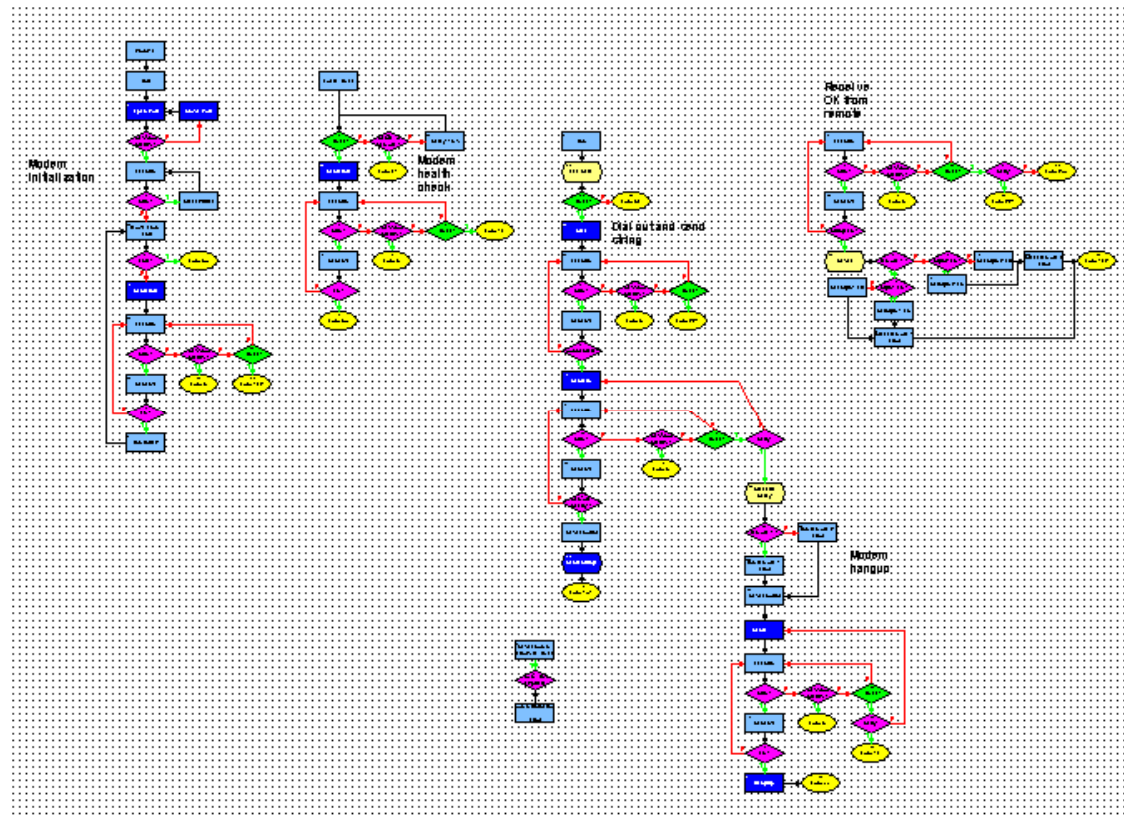
Humbug Mt. wind monitoring station



Sign location – PLC added to existing cabinet



Port Orford Opto22 Communication Program for Modem Connectivity





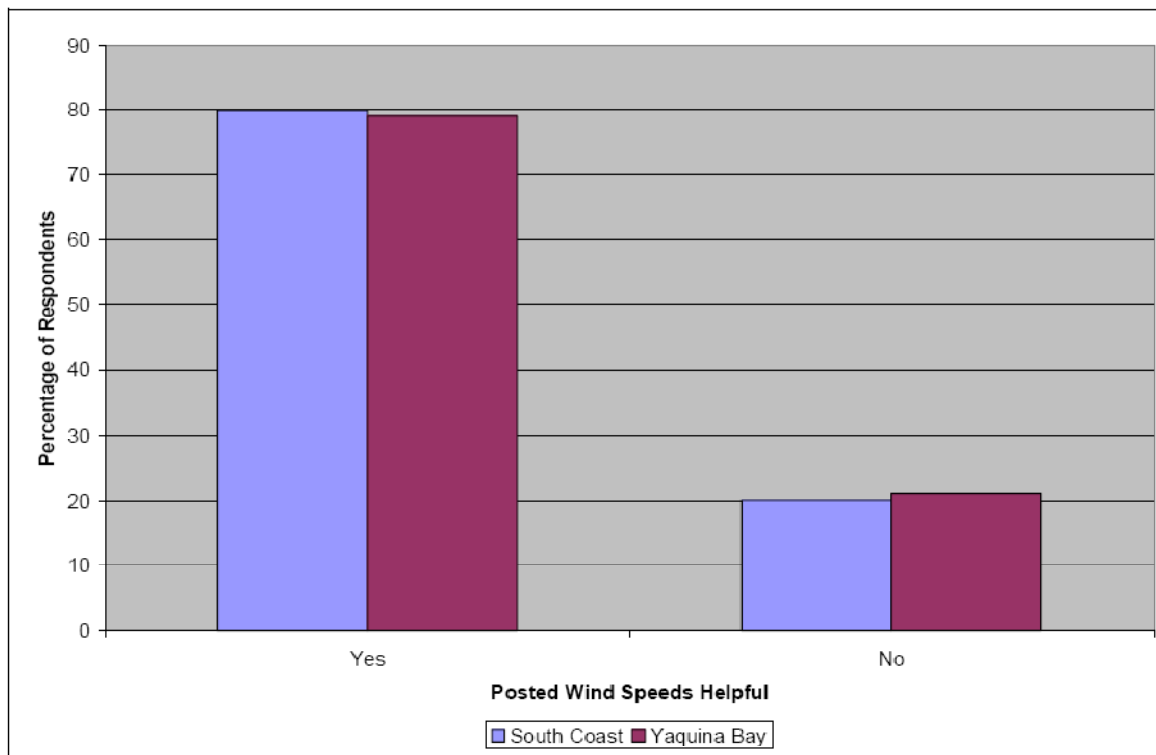
Wind Warning Systems Evaluation

- Performed by Western Transportation Institute
- Wind warning systems only
- Evaluate direct and indirect benefits
 - Cost savings related to road closures due to severe weather conditions
 - Increasing safety
 - Reduced crash risk
 - Improving staff safety
- Benefit/cost estimates
- Includes motorist survey



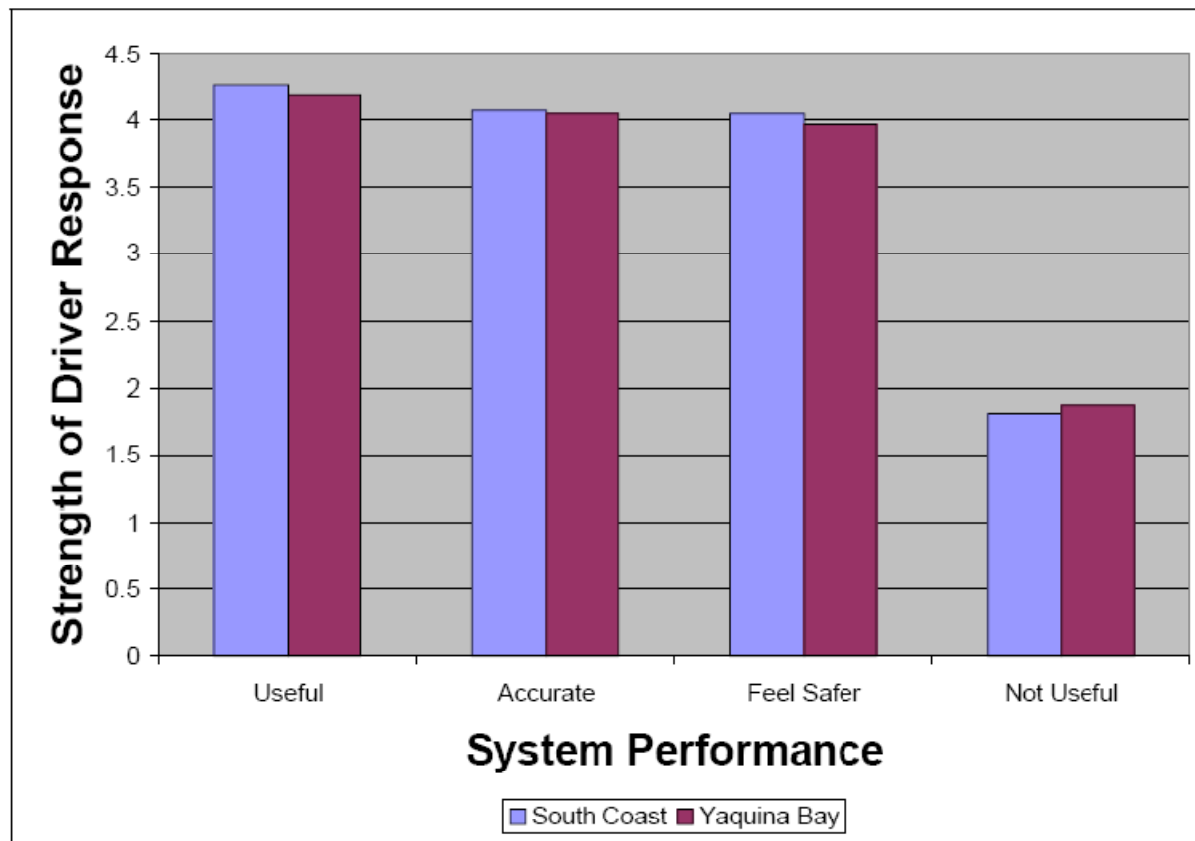
Helpfulness to motorists

Figure 7-4. Helpfulness of Posting Wind Speeds



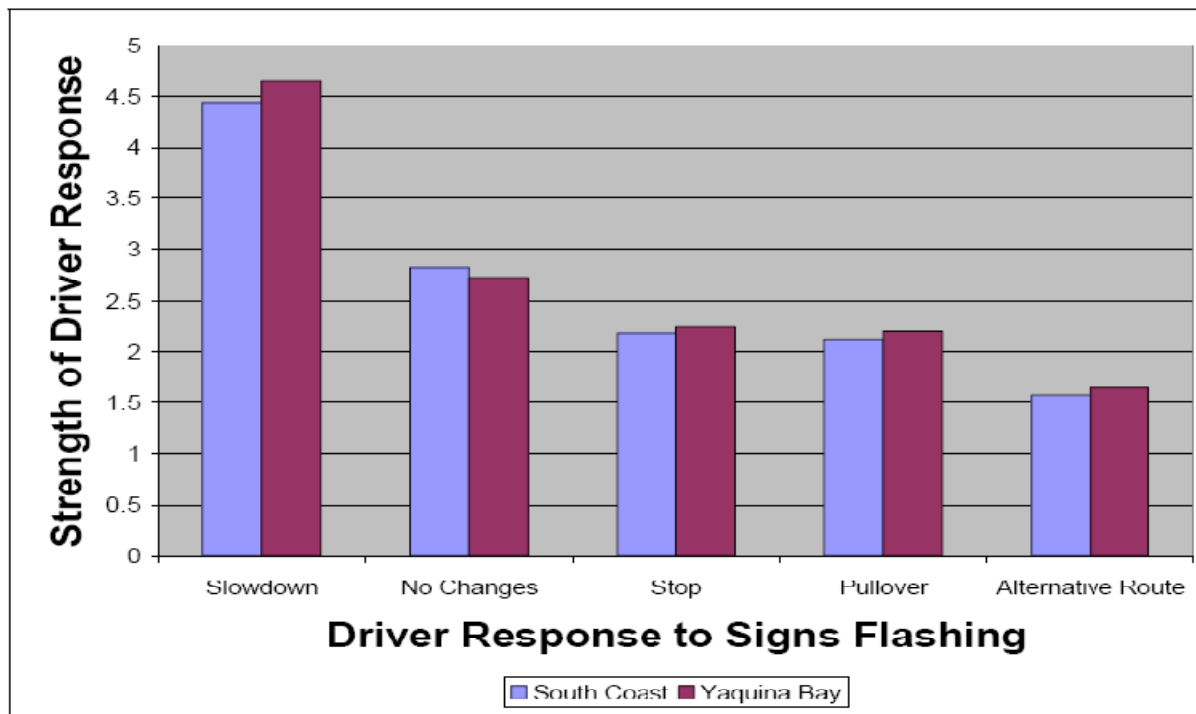
Perception of performance

Figure 8-2. Perception of AWSS Performance by Respondents



Driver response to warning

Figure 8-1. Stated Response to AWWWS Warnings by Respondents



Study summary

Table 9-1. Summary of Measures of Effectiveness (MOE) results from Motorist Survey

MOE	Measures	
	South Coast	Yaquina Bay
System Awareness among Motorists	More than 60 percent have seen the sign	More than 75 percent have seen the sign
System usage by Motorists	Mean agreement rating for slowing down when flashing is 4.4	Mean agreement rating for slowing down when flashing is 4.5
Sign Clarity	More than 60 percent have seen the sign	More than 75 percent have seen the sign
Message Credibility and Reliability	Mean agreement rating for system accuracy is 4.0 (1- Strongly Disagree and 5- Strongly Agree)	Mean agreement rating for system accuracy is 4.0 (1- Strongly Disagree and 5- Strongly Agree)



Seaside Flood Warning System

- Monitors water at low points in road (EoP and crown)
- Signs at each end of 5 mile corridor





Equipment

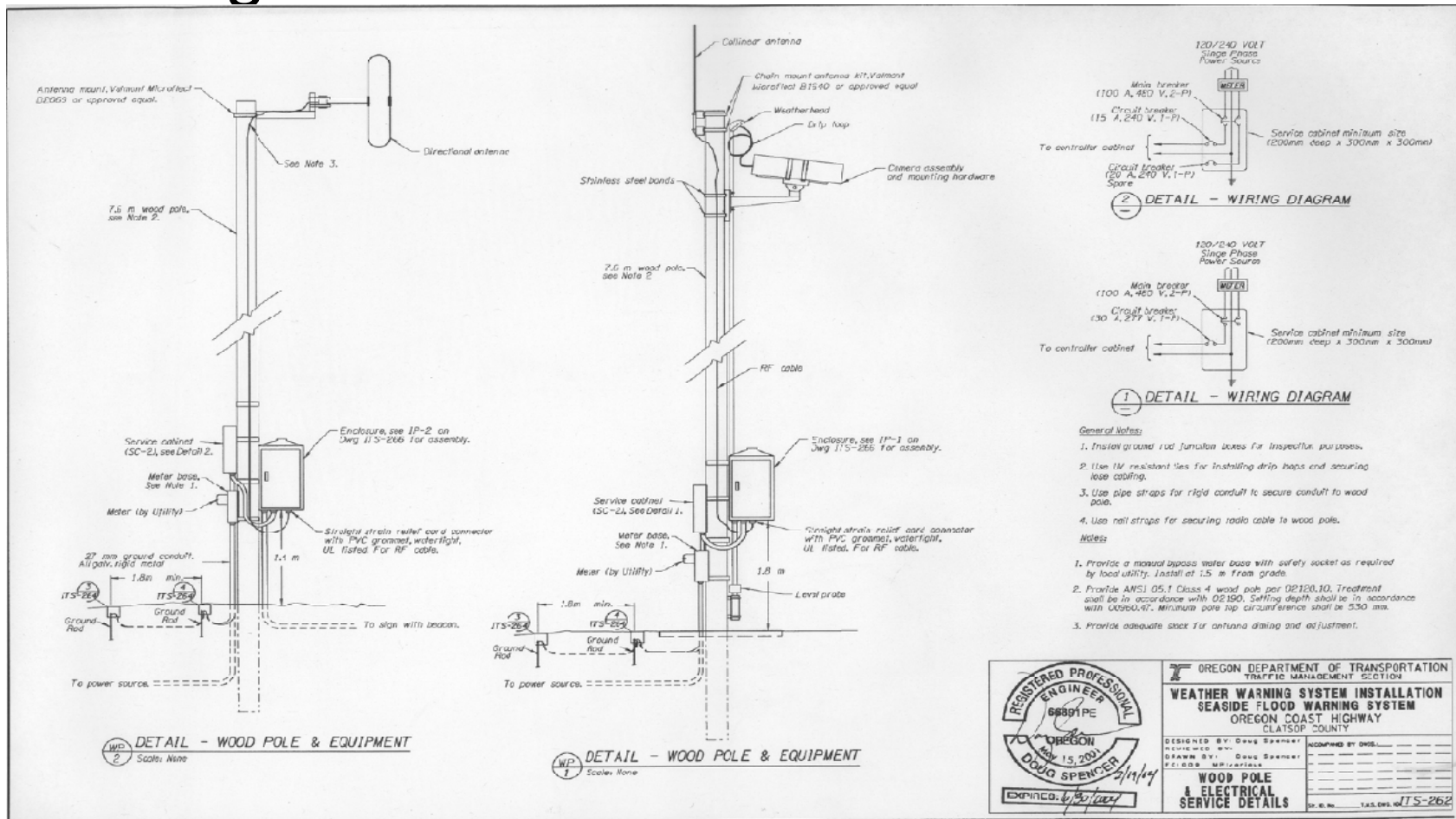
- Drexelbrook dual gap ultrasonic level switch
- Opto22 Ultimate I/O PLC's
- Dataremote Integra radio's, serial communications
FCC licensed within 132-174 MHz
- NEMA Flashers
- Customized 336S UL 50 Type 4x cabinets
- UPS and surge suppressors
- 56k frame relay leased circuit
- Pelco camera and Axis JPEG capture box



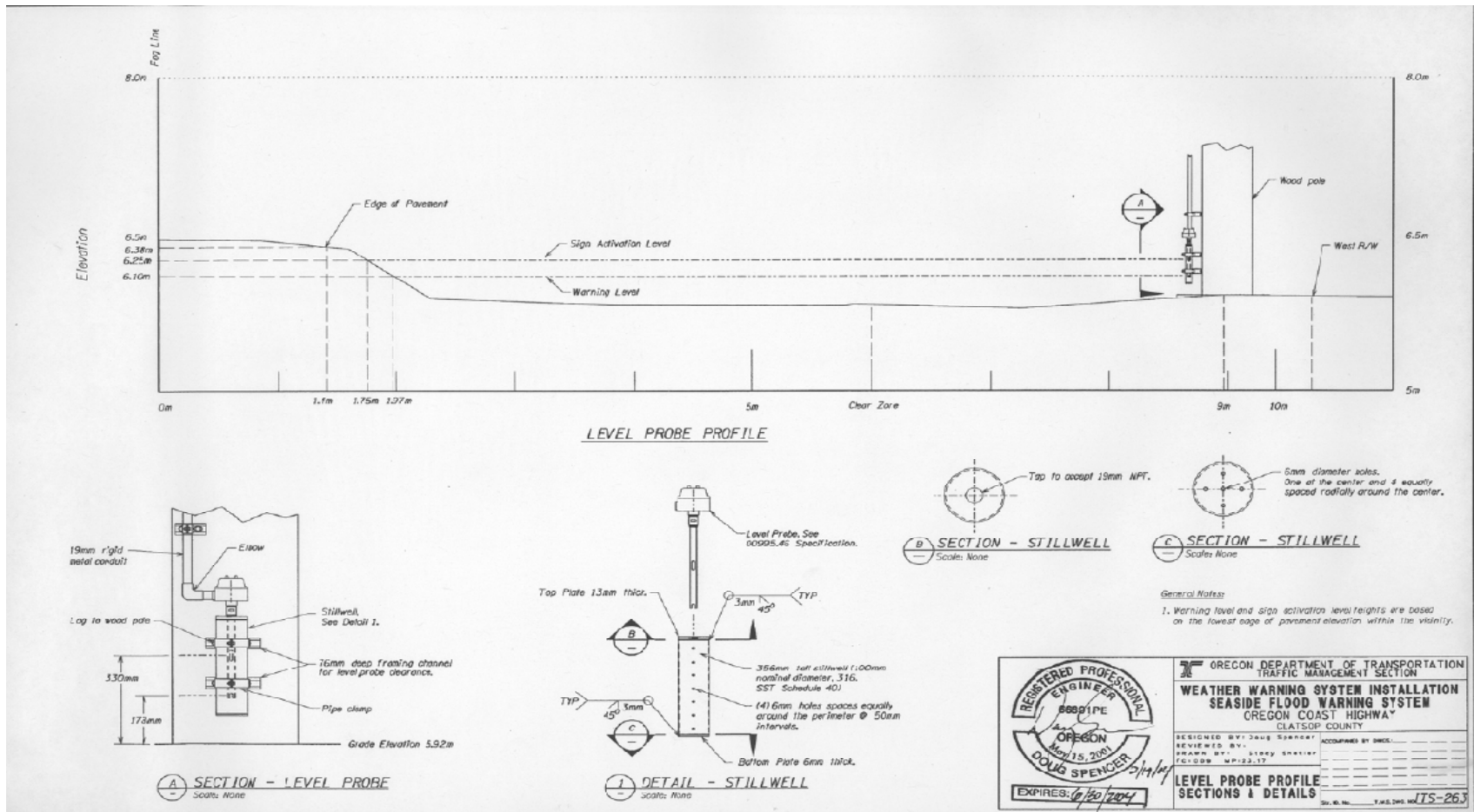
Main panel assembly and sign location



Drawing - Details

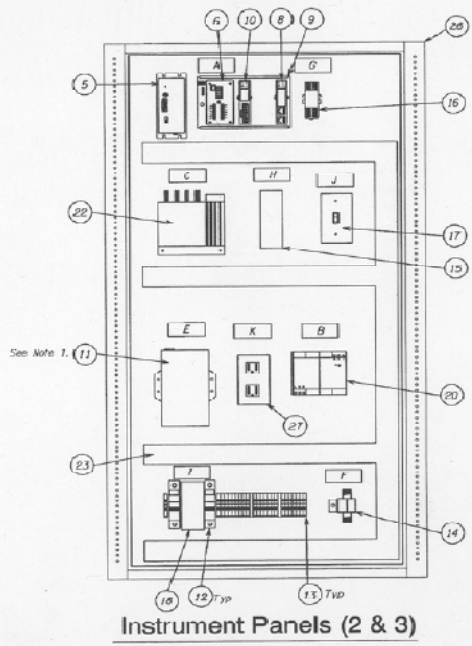
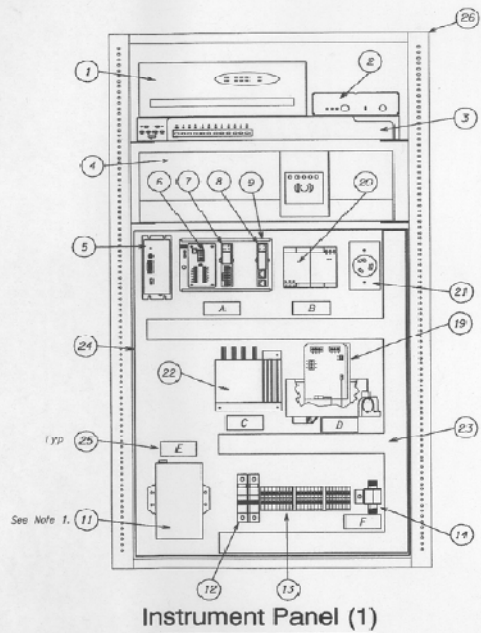


Drawing - Profile



Drawing – Panel Layout

NAMEPLATE SCHEDULE	
LETTER	ENGRAVING
A	CONTROLLER
B	DC PWR SUPPLY
C	RF MODEM
D	LEVEL SWITCH
E	HEATER
F	RF SURGE
G	RELAY
H	FLASHER RELAY
J	PWR SURGE
J	SIGM (ON/OFF (AUTO))
K	FOR LAPTOP USE ONLY



MATERIAL/PARTS LIST		
ITEM	NOMENCLATURE	MATERIAL/REFERENCE
1	Network Router	State Furnished
2	Video Server	Spec 00995.53
3	Network Switch	State Furnished
4	Uninterruptible Power Supply	Spec 00995.44
5	Controller Power Supply	State Furnished
6	Controller Brain Module	State Furnished
7	Digital Input Module	State Furnished
8	RS-232 Serial Module	State Furnished
9	I/O Mounting Rack	State Furnished
10	Digital Output Module	State Furnished
11	Heater	Spec 00995.47
12	Circuit Breakers	Spec 00995.25
13	Terminal Blocks	Spec 00995.26
14	Impulse Suppressor	Spec 00995.43
15	Flasher Relay	Spec 00995.45
16	Interposing Relay	Spec 00995.38
17	Toggle Switch	Spec 00995.50
18	Power Surge Suppressor	Spec 00995.48
19	Level Switch	Spec 00995.46
20	DC Power Supply	Spec 00995.37
21	Receptacle	Spec 00995.31
22	RF Wireless Modem	Spec 00995.31
23	Receptacle	Commercially Available
24	Backplane	Spec 00995.24(g)
25	Nameplate	See Nameplate Schedule/Specification
26	Rack Cage	Spec 00995.24(g)
27	Receptacle	120V, 25A, duplex, specification grade, commercially available

General Notes
 1. Panel layout shown for material purposes. Actual layout may vary. Submit panel layout for approval prior to fabrication as specified.
 2. Cabinet not shown for clarity. Install in 336 traffic style cabinet as specified.

Notes
 1. Maintain manufacturer recommended clearances around heater.

REGISTERED PROFESSIONAL ENGINEER
 66801PE
 OREGON
 DOUG SPENCER
 EXPIRES: 6/30/2004

OREGON DEPARTMENT OF TRANSPORTATION
 TRAFFIC MANAGEMENT SECTION

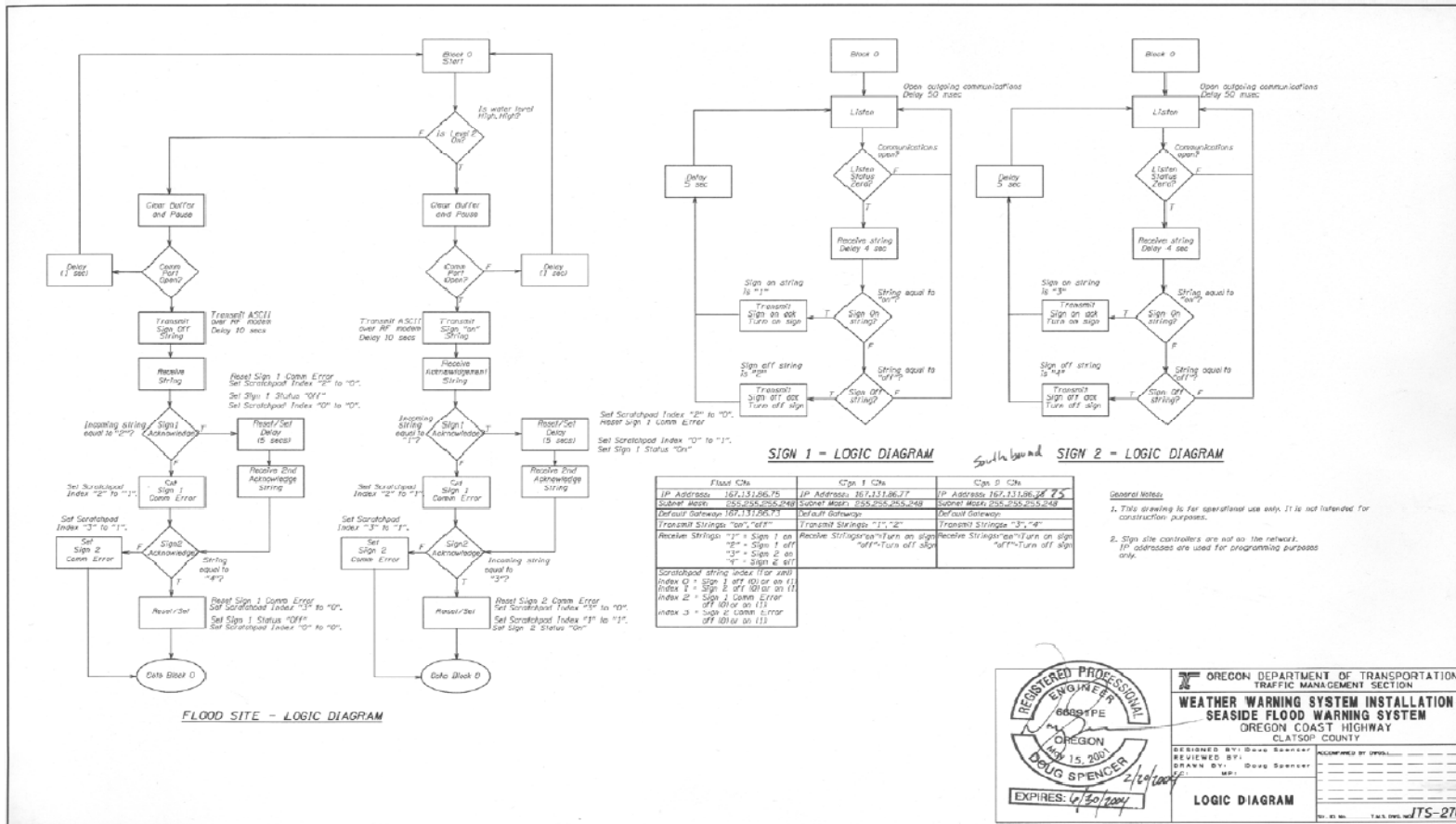
**WEATHER WARNING SYSTEM INSTALLATION
 SEASIDE FLOOD WARNING SYSTEM**
 OREGON COAST HIGHWAY
 CLATSOP COUNTY

DESIGNED BY: Doug Spencer
 REVIEWED BY: Steve Spitzer
 DRAWN BY: [blank]
 DATE: [blank]

INSTRUMENT PANEL LAYOUT



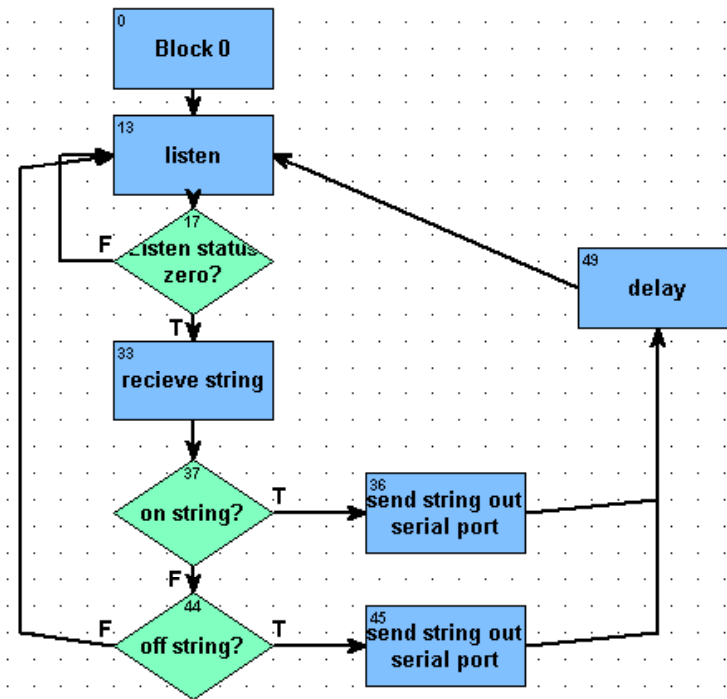
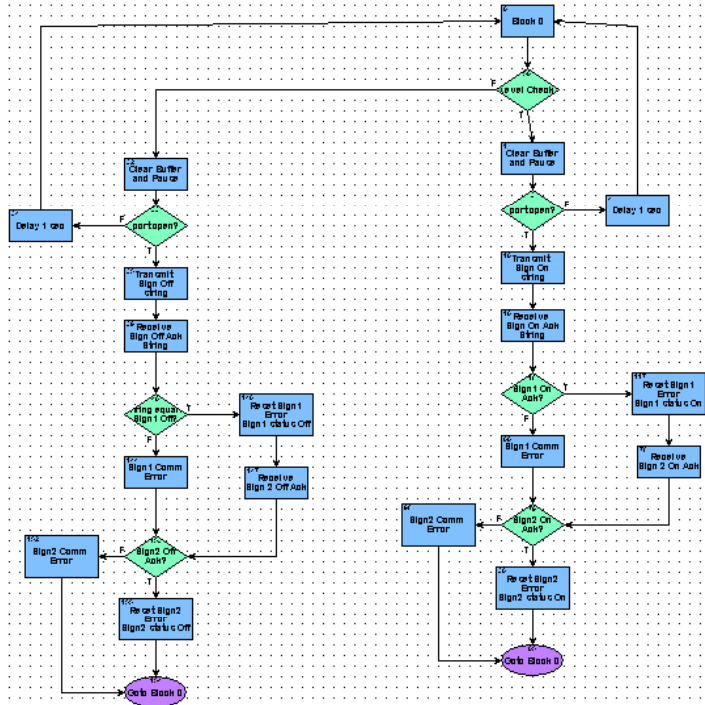
Drawing – Logic Diagram



Pictures – Stillwell and ultrasonic level switches being installed



Opto22 PLC Program





Installation and Operation Issues

- 336 cabinet came as 3R (ventilated) as opposed to specified 4X. Cabinets would leak air in. Condensation would form puddles of water in the bottom of the cabinets and salt cake equipment. Problem due to bolt penetrations and three point door system. Sealed vents and bolts with marine grade silicon. Used extra gasket on door.
- Equipment is not conformal coated – router, radio, switch, PLC, etc.
- Drilling a weep hole or using a drain/breather may help but the problem is the salt water content in the air.
- Multipoint door latches on Hoffmann style 4X are better for sealing out the air in coastal environment.
- UPS changed to power distribution assembly rack.
- Added electrical transfer switch to sign locations so a backup generator can power the signs.





Cushman Flood Warning System

- Existing float sensor and advisory signs installed by maintenance
- Added Surface Systems Inc. Linux RPU to get the condition into SQL database – 511, Tripcheck, HTCERS, etc.
- NEMA Flasher
- Dial-up connection
- Added SSI's Cochu camera for visual confirmation
- Relocated and upgraded advisory signs



Cushman Site Photos





Debris Warning System

- Requirement came from legislature due to highway closures from landslides
- DTMF tone activated advisory signs (6 total) using ODOT's microwave radio
- Geologist with Forestry notifies ODOT TOC's for activation/deactivation
- Motron Electronics TC-1 Talking Controller



Debris Cabinet and Sign Photos



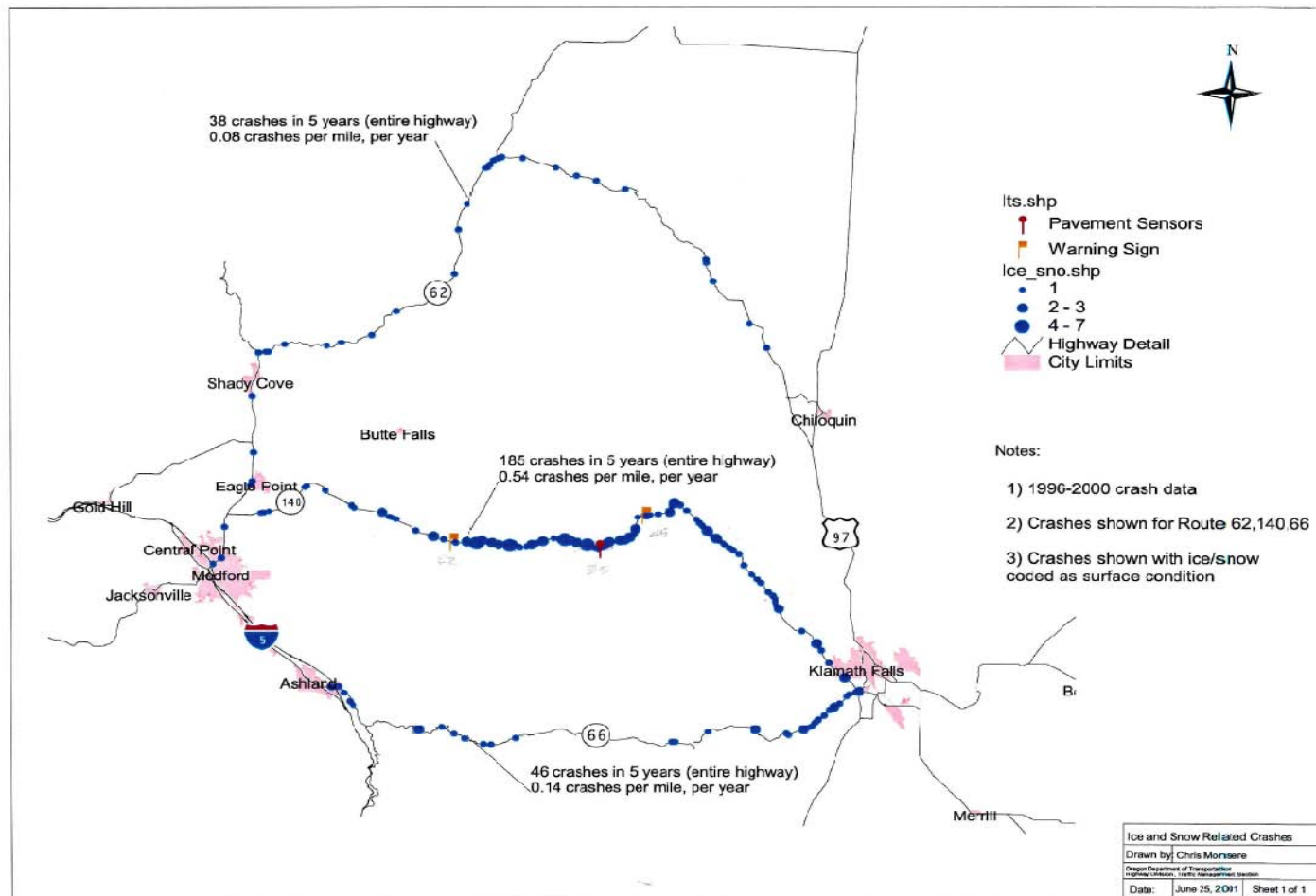


Hwy 140 Butte Creek Ice Warning System

- Used results from WTI's RWIS pavement sensor accuracy report and ice formation reports from several national laboratories.
- Initial algorithm (conservative): if relative humidity is greater than 80% AND air temp is less than 35 F AND the pavement is NOT Dry (wet, slush, snow, ice)
- Scripting done at the database not the RPU
- All sites cellular
- RWIS in the middle and advisory signs at the ends of the corridor. Locations based on crash data and maintenance.



Crash Data



Operations

- Two winters of operation.
- STE allowed as a limited liability (pilot) project with research to determine effectiveness.
- If effective, STE wants statewide index established for determining other locations.
- Research of the systems effectiveness has not started. ODOT needs to install traffic count and speed equipment.
- TOC operators can override system, manually control signs through ScanWeb's device control. Will integrate into TOC software in the future.
- FP2000 sensors had to be re-installed due to paving project.





Region 5 Traffic Gates for Interstate Access/Closures

- Need to close Interstate-84 due to severe winter weather conditions.
- Gates allow maintenance to focus on snow removal and not on monitoring closure points.
- May not require law enforcement to be present.
- Budget only allowed for two gates at this time. More planned for in the future.
- Wetlands impacted utility delivered power. Long tap from existing lighting service.





Research of Other States Using Traffic Gates

- Wyoming DOT
- Washington DOT
- Minnesota DOT
- Wisconsin DOT

- All other states using local control of gates.
- No NCHRP 350 reports on gates at Crash Level 3.
- No NCHRP 350 requirement on railroads
- Crash testing is not a FHWA or AASHTO requirement for gate arms.



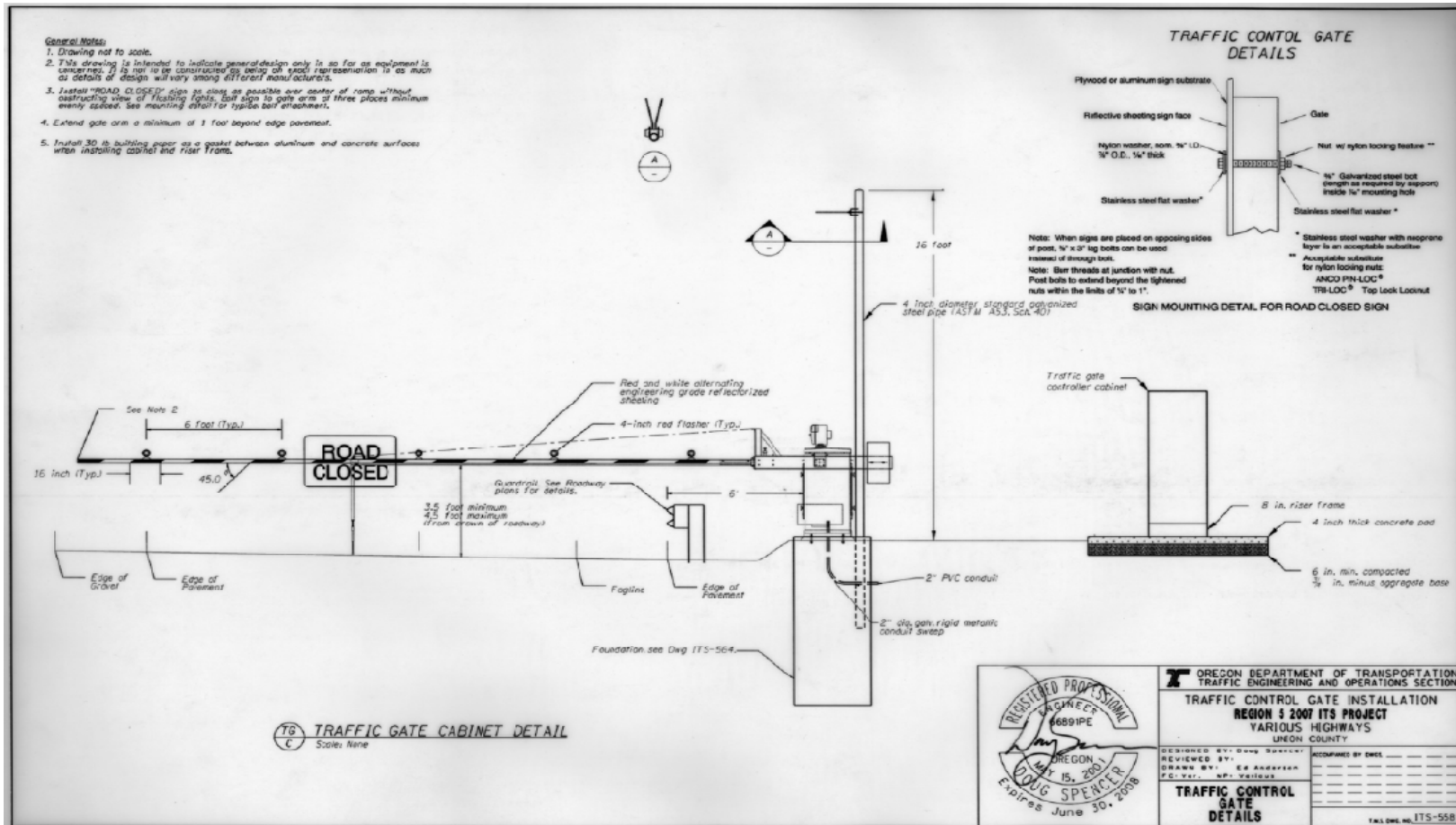


ODOT's Approach

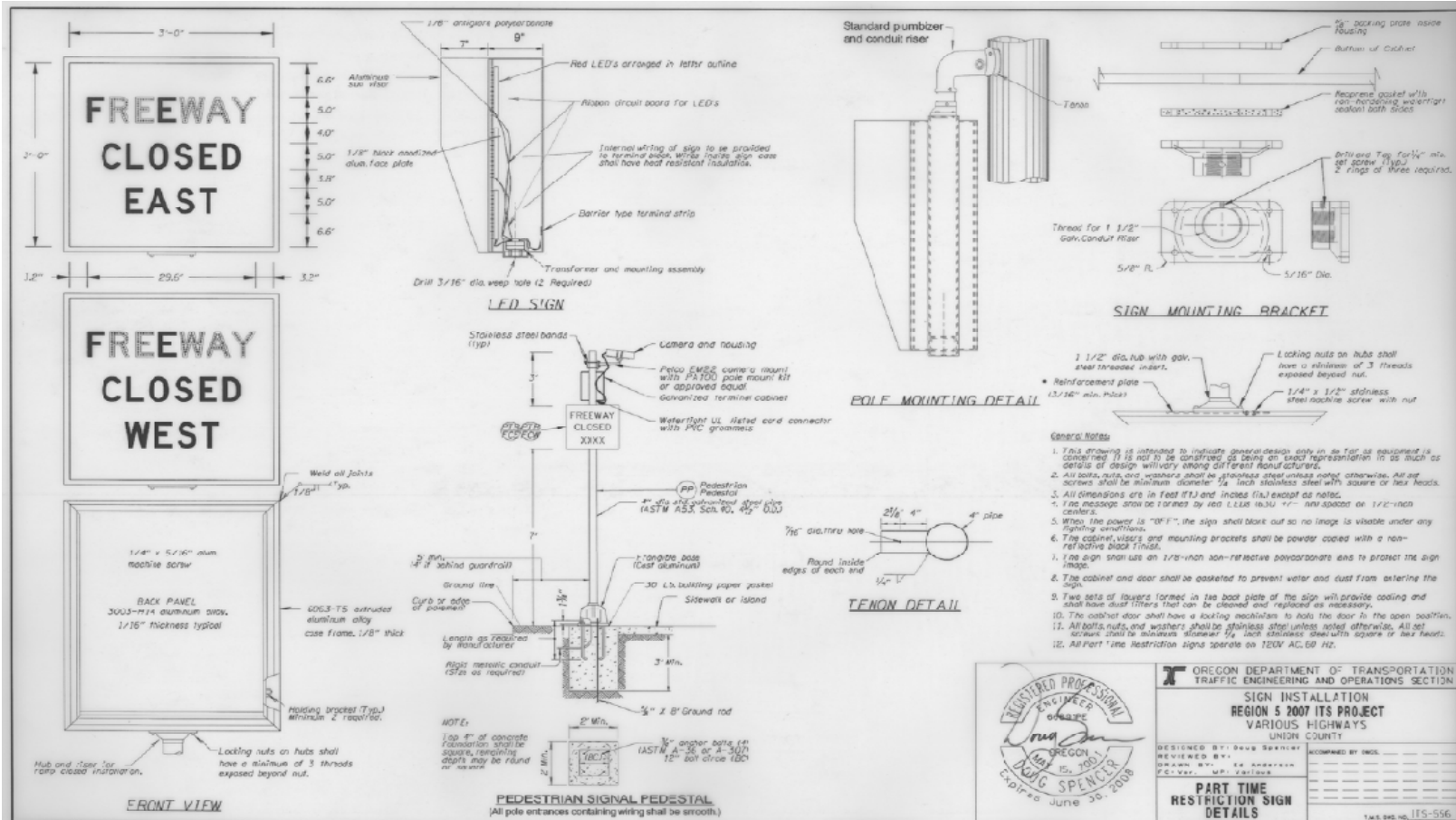
- Followed the ITS Architecture. Used Systems Engineering approach. Good for limiting scope creep and changes.
- Primary gate control through in-house developed web application.
- Used SSI's Linux RPU and SQL database for remote control. PLC custom driver or OPCServer too difficult to integrate due to Agency's organizational structuring.
- Failure of RPU or PLC will not cause system failure. Support by our technicians and electricians.
- Secondary control: radio control from maintenance vehicles, pushbuttons on local panels, hand crank.
- Needed to integrate into TOC software in the future. Needed to support 511, Tripcheck, etc.
- Confirmation by position switches into the RPU and visually by cameras.
- Designed using railroad gates used in Oregon and familiar by ODOT's Rail division.



Drawing – Traffic Gate Details

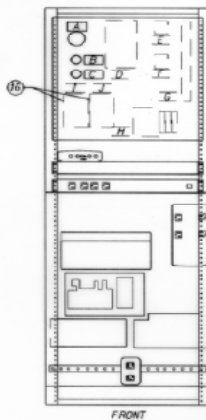


Drawing – Part Time Restriction Signs

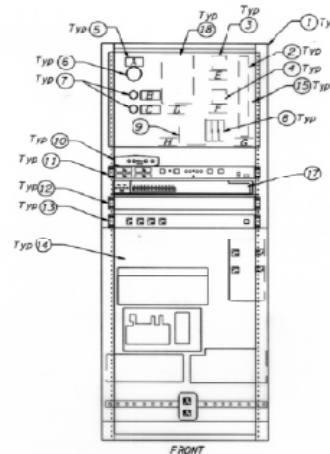


Drawing – Panel Layout

NAMEPLATE SCHEDULE	
LETTER	ENGRAVING
A	EMER STOP
B	OPEN
C	CLOSE
D	RADIO REVR
E	CONTROL FLT
F	TD FLT
G	TB-1
H	SURGE
I	CAM FIBER
J	GATE FIBER



TRAFFIC GATE ENCLOSURE ASSEMBLY
System No. 2, Union Junction Interchange

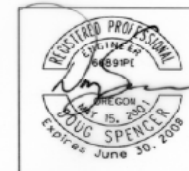


TRAFFIC GATE ENCLOSURE ASSEMBLY
System No. 1, Union Junction Interchange

MATERIAL/PARTS LIST		
ITEM	NOVENCILATURE	MATERIAL/REFERENCE
1	Rack Cage	Special Provisions 00995.15Q
2	Terminal Blocks	Special Provisions 00995.54
3	Control Relay	Special Provisions 00995.22
4	Timing Relay	Special Provisions 00995.21
5	Nameplate	Special Provisions 00995.72
6	Emergency Stop Switch	Special Provisions 00995.13
7	Pushbutton	Special Provisions 00995.12
8	Circuit Breakers	Special Provisions 00995.54
9	Surge Suppressor	Special Provisions 00995.24
10	Video Server	Special Provisions 00995.63
11	Network Switch	Special Provisions 00995.57
12	Fiber Distribution Panel	Special Provisions 00995.30H
13	Power Distribution Unit	Special Provisions 00996.55
14	Remote Processing Unit (RPU)	State Furnished
15	Backplane	Provided by Panel Shop
16	Ethernet Media Converter	Special Provisions 00995.56
17	Network Router	State Furnished (installed)
18	Audio Receiver	Special Provision 00993.53
19		
20		

General Notes:

1. Panel layout shows for material purposes. Actual layout may vary. Submit panel layout for approval prior to fabrication as specified.
2. Cabinet not shown for clarity. Install in 332 traffic style cabinet as specified.



OREGON DEPARTMENT OF TRANSPORTATION
TRAFFIC MANAGEMENT SECTION

**TRAFFIC CONTROL GATE INSTALLATION
REGION 5 2007 ITS PROJECT
VARIOUS HIGHWAYS
UNION COUNTY**

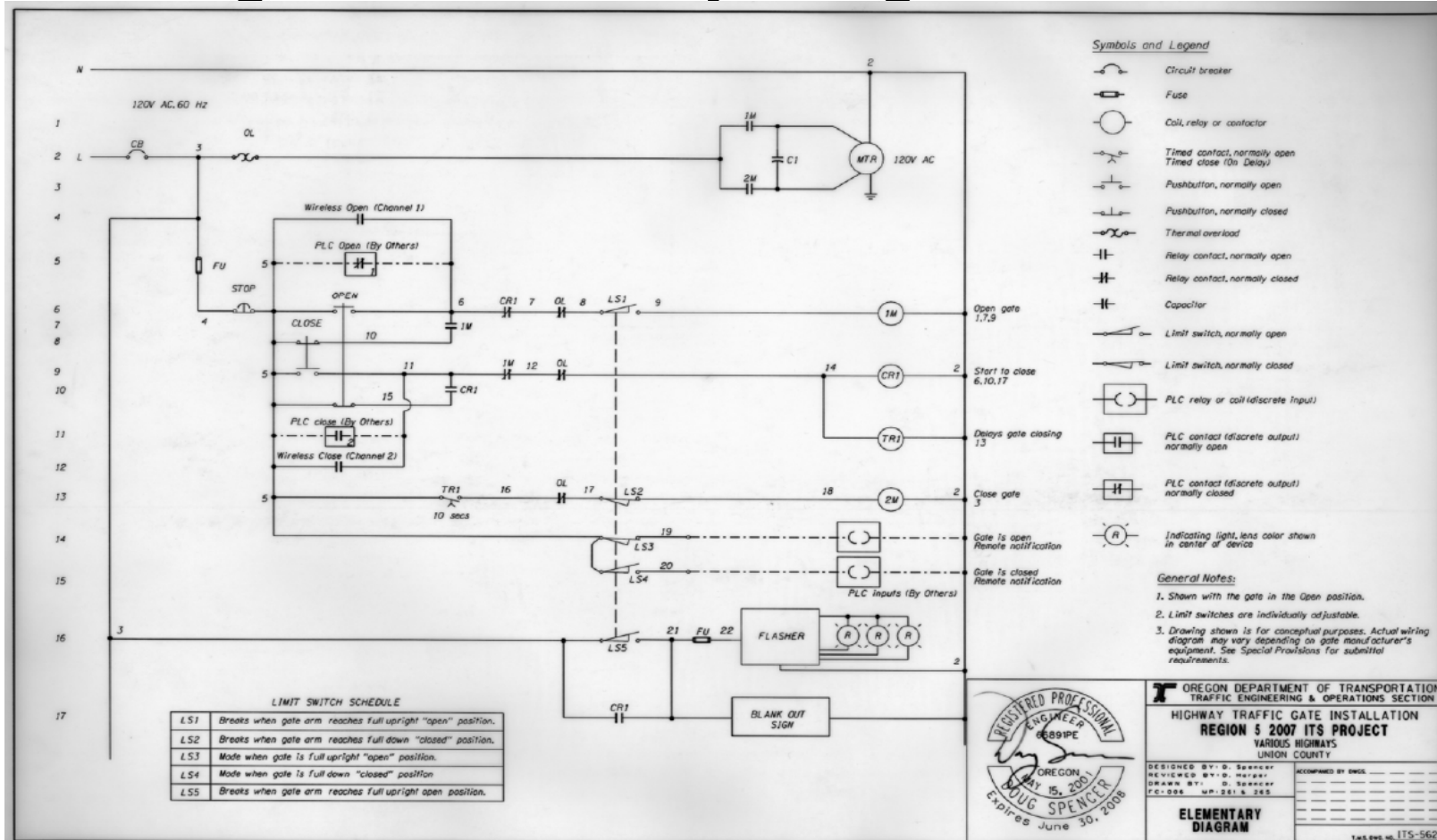
DESIGNED BY: DOUG SPENCER
REVIEWED BY: Adam Bracker
DATE: 10/15/2008
PROJECT NO.:
SHEET NO.:
DATE: 10/15/2008

TRAFFIC GATE ENCLOSURE PANEL LAYOUT

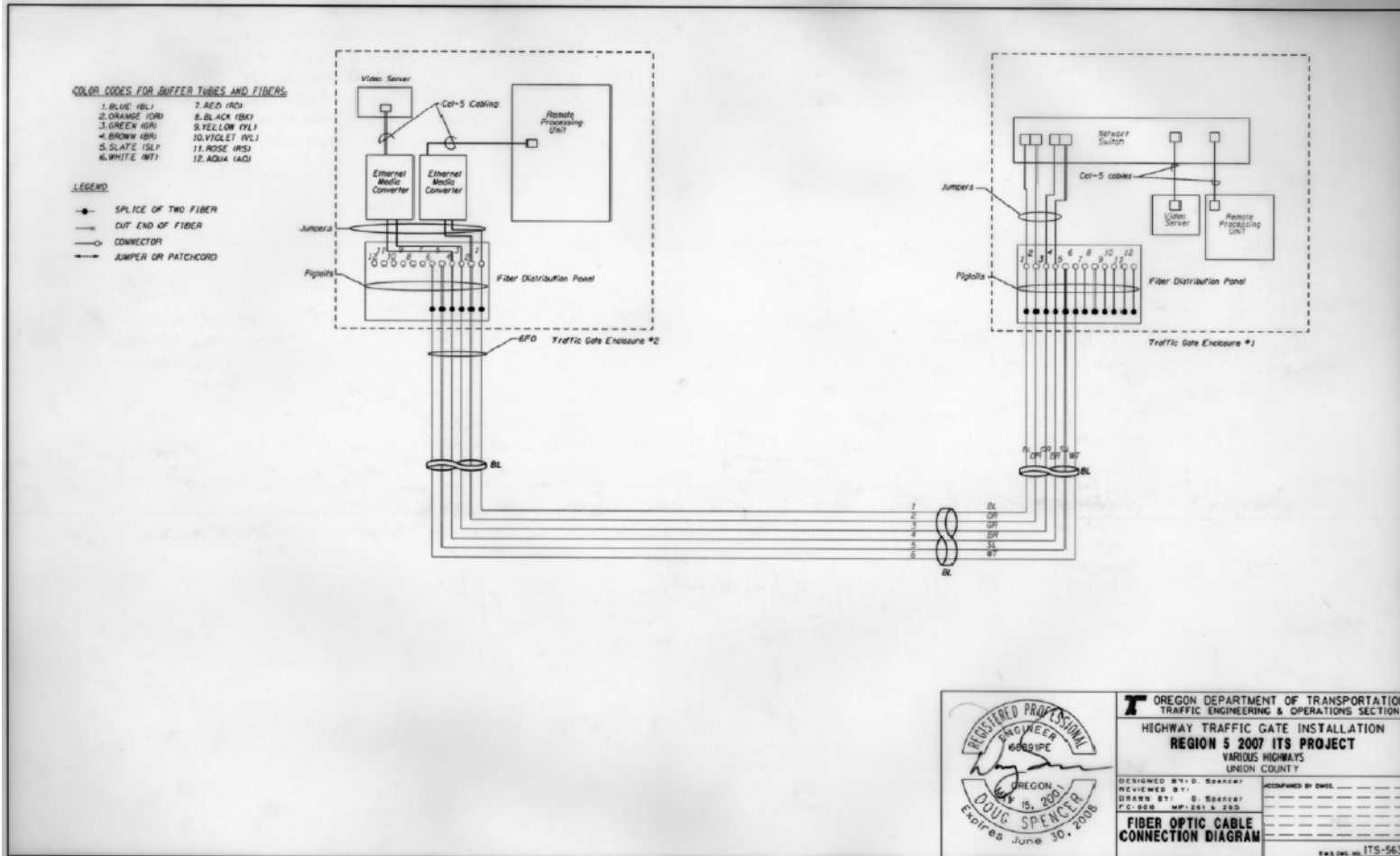
ITS-561



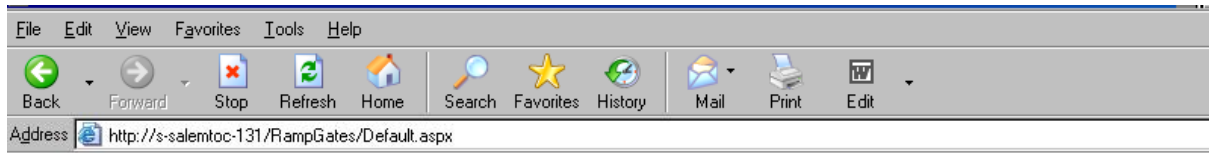
Drawing – Elementary Diagram



Network Connection Diagram



Web Interface



Gate Controls

[Home](#) | [View Log](#) | [Help](#)

Ramp Gate: Traffic Gate at Union Interchange On-Ramp I-84 MP 265.26 WB



Status: Open Gate
Last Updated: 4/12/2007 9:10:38 AM
Gate Status: OPEN
Gate Control: Software
Last Change: 4/12/2007 9:10:01 AM

Poll Site

Gate Controls:

Open Gate

Close Gate

Last image taken from site

4/12/2007 9:12:07 AM





Questions?

- Contact

doug.l.spencer@odot.state.or.us

or

(503) 986-3301

