

# WaveView™

Out-of-the-Box™ Software

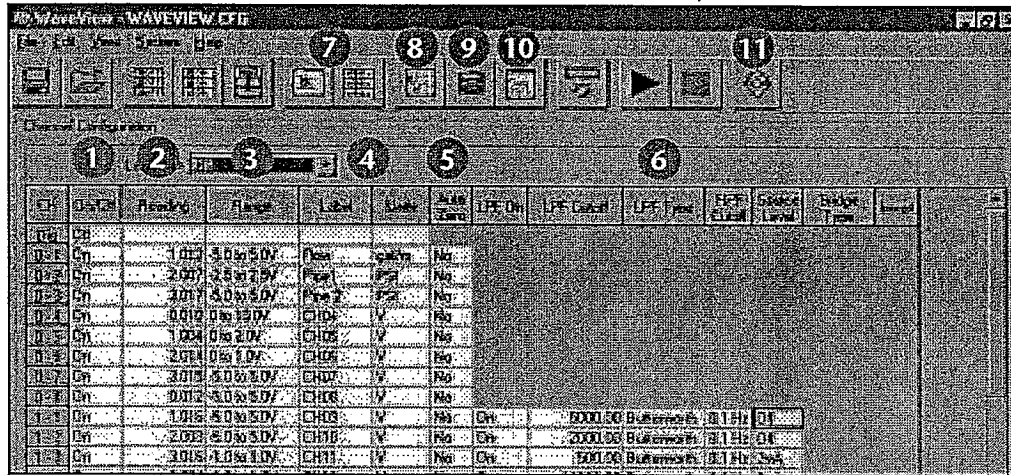


## WaveView™

WaveView is a Windows-based setup and acquisition application that allows you to configure, display, and save data to disk within minutes of taking the WaveBook™ Out-of-the-Box™. WaveView provides a point-and-click interface that simplifies operation of the WaveBook by allowing setup of all hardware, including the field-installable WBK options, without programming or connecting icons.

Unlike the mere example programs that many suppliers provide with data acquisition hardware, WaveView is a full-featured acquisition and display engine that provides all the functionality needed for many data-logging and display applications. For more frequency-domain analysis applications, use eZ-Analyst™ or DASyLab®.

WaveView's intuitive approach to hardware control simplifies system setup by automatically querying the WaveBook upon connection to your PC. As WBK options are added for signal conditioning or increased system channel count, WaveView's channel configuration spreadsheet automatically expands to accommodate the additional channels. Specific channel characteristics, such as gain, unipolar/bipolar, and channel labels, are automatically updated, and any additional functionality (such as low-pass filtering, filter cutoff, or excitation output), also automatically appear in the channel-configuration spreadsheet. WaveView is also designed for easy operation with display and analysis packages. WaveView provides data in formats compatible with a variety of sophisticated display and analysis packages, including MATLAB™.

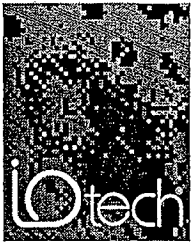


Note: The WBK40™ and WBK41™ are not currently supported in WaveView. We recommend using DASyLab® when using these modules, which includes full support for the WBK40/41. The WBK40/41 are also supported in LabVIEW™, DaqCOM™ and with our Windows® API DaqX DLL. If it is necessary to use these modules in conjunction with a WaveView application, then it is necessary to launch a second concurrent application to acquire data from the WBK40/41 into separate data files.

Included WaveView is an Out-of-the-Box™ setup, acquisition, and real-time display program

- 1 Designate an individual data channel as active or inactive by clicking on a select channel.
- 2 Reading column provides quick indication of sensor condition before acquisition begins.
- 3 Choose different ranges or gains for each channel, based on the particular WBK options installed. Bipolar and unipolar scales can also be selected for each channel.
- 4 Assign each channel a unique label, which will be automatically referenced throughout WaveView. Choose the desired engineering units in which to display acquired data, based on the installed WBK options. Parameters can also be entered to perform mX+b scaling on each reading before displaying it.
- 5 Use auto-zero to remove small offsets such as transducer drift or pre-load conditions prior to acquisition.
- 6 Enhanced features such as filter type, cutoff frequency, ICP® current source, and bridge configuration automatically appear when hardware is added to the WaveBook system. There are no switches to set and WaveView automatically updates itself for new configurations.
- 7 Click to review system configuration and acquisition parameters such as scan rate, pre- and post-trigger usage, and trigger criteria.
- 8 Scope Mode allows customizing and displaying of multiple traces; it supports cursors, re-scaling, and more.
- 9 Store data to disk in real-time; the auto re-arm function, with automatic file naming, supports back-to-back acquisition of over one million captures without user intervention.
- 10 Review acquired waveforms with a strip chart style display via eZ-PostView™.
- 11 Strain gage setup to calibrate WBK16™ strain gage channels.

Data Acquisition Hardware

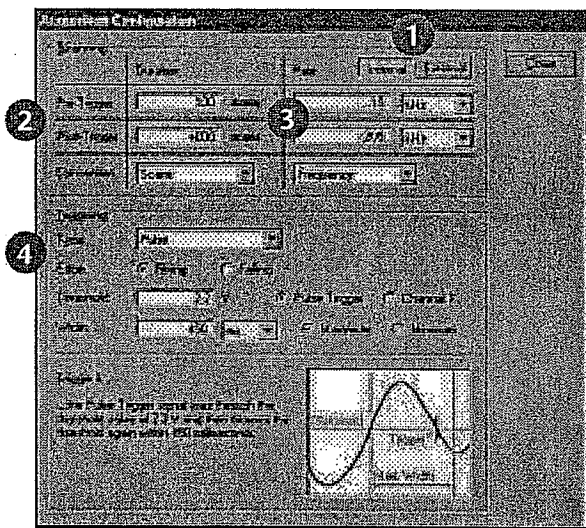


# WaveView™

## Out-of-the-Box™ Software

**Scan and Trigger Configuration.** The WaveBooks' powerful event-capture capability is made available through the simple, fill-in-the-blank style boxes in WaveView. In addition to single-channel, manual, and external TTL, advanced triggering for multichannel, digital pattern, and pulse trigger is also available. When using multichannel trigger all channels can be combined with boolean "AND" & "OR" operators to begin the acquisition at just the right time. In digital pattern mode, the WaveBook triggers on a user-defined bit pattern making it easy to associate analog data with digital sequences.

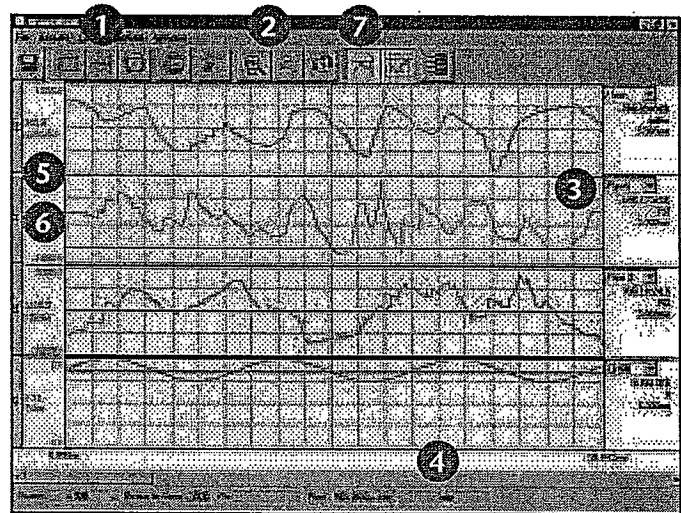
Unique to the WaveBook is the pulse trigger capability shown below. Typically available in systems many times its price, pulse trigger allows capturing that elusive event by defining the level of the signal and pulse width criteria. Now "runt" pulses or glitches buried in apparently good signals can be easily captured.



You can configure the WaveBook via WaveView's scan and trigger configuration screen

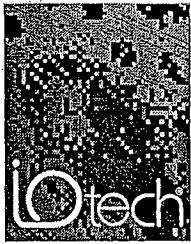
- 1 Allows selection of internal or external clock.
- 2 Lets you individually set acquisition duration for both pre- and post-trigger data.
- 3 Offers separate scan rates for both pre- and post-trigger data.
- 4 Select the trigger mode you need: immediate, manual, multichannel, digital pattern, or pulse.

**Scope Mode.** Unlike a traditional scope with only two to four channels, WaveView's Scope Mode allows any eight channels to be displayed. Furthermore, WaveView is not handicapped by the small memory limitations of DSOs. In fact, WaveView dynamically and transparently allocates a PC's RAM prior to beginning an acquisition. A simple point-and-click is all that's necessary to initiate multi-Msample acquisitions. In addition, because the data is already in the PC's RAM, a second point-and-click on the disk icon automatically saves this data to disk for import into eZ-PostView, a post-acquisition waveform review package, or into analysis packages, such as MATLAB™, DADiSP™, or Excel™.



Scope Mode allows you to display any eight of the WaveBooks' channels

- 1 Supports continuous or single-shot capture and display modes.
- 2 Provides zoom-in and zoom-out window control of the x-axis.
- 3 Displays user label and cursor data values.
- 4 Scroll through all data.
- 5 Provides auto-scale for quick maximization of the y-axis display.
- 6 Automatically scales axis in user-defined engineering units.
- 7 Enables cursor for on-screen measurements.

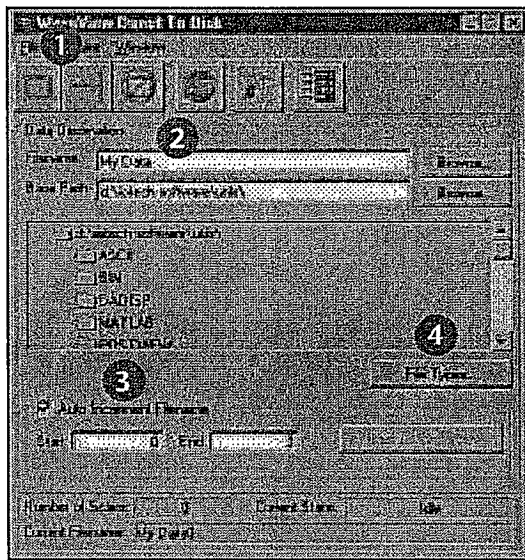


# WaveView™

Out-of-the-Box™ Software

**Logger Mode.** For applications where PC RAM is insufficient to record the entire test or where rapid back-to-back recordings need to be saved to disk, WaveView provides a Logger Mode. It complements WaveView's Scope Mode by allowing continuous\* recording data directly to disk.

Logger Mode can auto-increment file names to provide the unattended capture of millions of back-to-back events, without user intervention. Acquired data can be stored in several data formats for direct import to packages such as MATLAB™, Excel™, or eZ-PostView™.



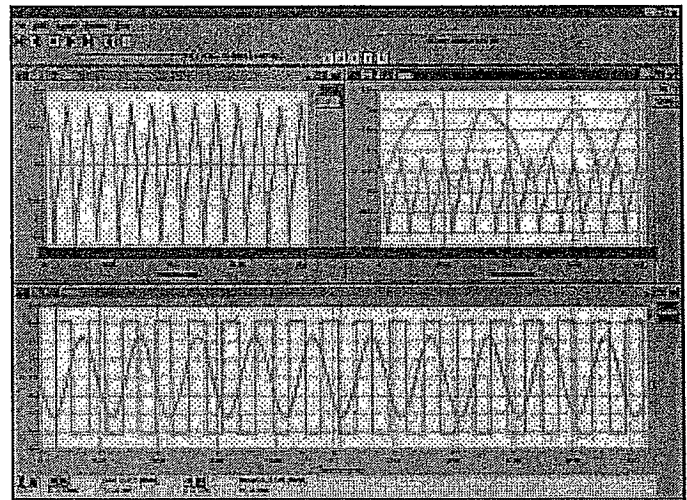
WaveView's Logger Mode can stream data direct to disk in a variety of formats

- 1 Allows the collection of single-shot or auto-increment file names for back-to-back acquisitions.
- 2 File name, path, and auto-increment index can be entered by simply filling in the blank.
- 3 Auto increment creates multiple data files, one per trigger.
- 4 Choose from an ever-growing list of data file formats for easy importing into other software packages such as DADiSP, DASyLab, MATLAB, Snap-Master, ASCII/Excel Universal File Format (UFF) 58A (ASCII), Universal File Format (UFF) 58B (Binary), and .WAV.

## eZ-PostView™

The basic eZ-PostView system that is included free with the Out-of-the-Box™ application software is powerful, yet easy-to-use. eZ-PostView's interactive graphics make it possible to quickly inspect enormous data files at fast speeds. Interactive zooming and cursors allow the user to view even the smallest details of collected data.

As needs evolve, the basic system can be enhanced by adding optional software modules. When needs exceed the capabilities of the free eZ-PostView, add-on eZ-PostView options are available that provide additional data viewing and management tools along with data analysis capabilities.

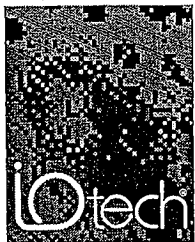


eZ-PostView, a Windows®-based, post-acquisition waveform viewing application

## WaveCal™

The WaveBook is shipped with WaveCal, an application that facilitates periodic calibration of the system. Although all WaveBook components are factory-calibrated to their rated accuracies prior to shipment, annual recalibration is recommended. WaveCal's simple on-screen instructions and direct access to the WaveBook's components make recalibration fast and easy.

\* For acquisitions in excess of 100 million scans, use DASyLab® or other available software



# WaveBook™ Series

## Specifications & Ordering Information

### General Specifications

Warm-up: 30 minutes to rated specifications  
Environment

Operating: 0° to 50°C, 0° to 95% RH,  
non-condensing

Storage: -20° to 70°C

Power Consumption

/516E: 1.8A max @ 15 VDC

/516A & /512A: 1.4A max @ 15 VDC

Input Power Range: 10 to 30 VDC

Vibration: MIL STD 810E

PC Communication

/516E: 10/100baseT Ethernet (300 ft. max)

/512A and /516A: Enhanced Parallel Port (EPP)

Channel Capacity

/516E: 8 built-in voltage channels, expandable to 72 channels with WBK options. Also can accommodate up to 3 additional WaveBook/516A, /512A, or WBK40 series options (any combination). Each /516A or /512A can be expanded up to 72 channels. Maximum WBK41 capacity is 854 TC input channels, 4 analog output channels, 272 digital I/O channels, and 6 counter/timer channels (see WBK40 on p. 63 for details).

/516A & /512A: 8 built-in voltage channels, expandable up to 72 channels using WBK options.

Dimensions

/516E: 285 mm W x 220 mm D x 70 mm H  
(11" x 8.5" x 2.70")

/516A & /512A: 285 mm W x 220 mm D x 45 mm H  
(11" x 8.5" x 1.75")

Weight

/516E: 1.9 kg (4.2 lbs)

/516A & /512A: 1.5 kg (3.3 lbs)

Handle: One carrying handle is included with each WaveBook

### Analog Inputs (18° to 28°C)

Channels: 8 differential, expandable up to 72 differential

Connector: BNC

Resolution

/516A & /516E: 16 bit

/512A: 12 bit

Ranges: Unipolar/bipolar operation is software selectable via sequencer

Unipolar\*: 0 to +10V, 0 to +4V, 0 to +2V

Bipolar: ±10, ±5V, ±2V, ±1V

Maximum Overvoltage: ±35 VDC

Input Bandwidth: DC to 500 kHz

Input Impedance

Single-Ended: 5M Ohm in parallel with 30 pF

Differential: 10M Ohm in parallel with 30 pF

Accuracy

/516A & /516E:

±2 to ±10V: ±0.012% of reading; 0.006% of range

±1V: ±0.018% of reading; 0.008% of range

/512A: ±0.03% of reading; 0.006% of range

Input Noise

/516A & /516E: <2 LSB (RMS)

/512A: <1 LSB (RMS)

Total Harmonic Distortion: -84 dB typ

Signal to Noise and Distortion: +74 dB typ

CMRR: 80 dB typ; 70 dB min; DC to 20 kHz

### Anti-Alias Filter\*

Type: 5-pole Butterworth; 20-kHz, low-pass software enabled

\* No unipolar mode or anti-alias filter with WBK11A, WBK12A, or WBK13A installed

### Triggering

Channel 1 Analog & Pulse Trigger

Input Signal Range: -10 to +10V

Bandwidth: 1 MHz

Latency: 300 ns

Multi-Channel Analog Trigger (up to 72 channels):

Range: Selectable per channel to input range

Latency: 2 µs/channel, plus 4 µs maximum

TTL Trigger

Input Signal Range: 0 to 5V

Input Characteristics: TTL-compatible with 10K

Ohm pull-up resistor

Latency: 300 ns

Software Trigger

Latency: 100 µs typical

Pulse Trigger Input

Input Signal Range: ±5V

Input Characteristics: 75 Ohm

Input Protection: ±10V maximum

Minimum Pulse Width: 100 ns

Maximum Pulse Width: 0.8 sec

Latency: 300 ns

### External Clock

Connector: Available on DB25 digital input

Input Signal Range: 5V TTL compatible

Input Characteristics: 50K Ohms pull up (to +5V) in parallel with 50 pF

Input Protection: Zener clamped -0.7 to +5V

Delay: 200 ns

Signal Slew Rate Requirement: 20V/µs minimum

Rate: Up to 1 MHz

Divisor Ratio: Divide by 1 through 255, selectable

Clock Counter Accuracy: <0.02% error

Clock Counter Range: 0.01 Hz to 100 kHz

### Sequencer

Operation: Programmable for channel, gain, and for unipolar/bipolar range in random order

Depth: 128 location

Channel-to-Channel Rate: 1 µs to 1.1 µs/channel, all channels equal

Maximum Repeat Rate: 1 MHz

Minimum Repeat Rate: 100 seconds per scan

Expansion Channel Sample Rate: Same as on-board channels, 1 to 1.1 µs, fixed

### High-Speed Digital

#### Inputs/General-Purpose Outputs

Connector: DB25 Female

Configuration: 16 TTL-compatible pins, selectable for input or output

Input Characteristics: TTL-compatible

Output Characteristics: ALS TTL output in series with 33 Ohms

Output Updates: Outputs may be changed via program control

Input/Output Protection: Diode clamped to ground and +5V

### Ordering Information

Description	Part No.
16-bit Ethernet, 1-MHz portable data acquisition system includes WaveView, and eZ-PostView; support for Visual Basic®, C/C++, ActiveX/COM, LabVIEW®, MATLAB®, and DASyLab®; and AC adapter	WaveBook/516E

Description	Part No.
16-bit parallel, 1-MHz portable data acquisition system includes WaveView, and eZ-PostView; support for Visual Basic, C/C++, ActiveX/COM, LabVIEW, MATLAB, and DASyLab; and AC adapter	WaveBook/516A
12-bit parallel, 1-MHz portable data acquisition system includes WaveView, and eZ-PostView; support for Visual Basic, C/C++, ActiveX/COM, LabVIEW, MATLAB, and DASyLab; and AC adapter	WaveBook/512A

### Accessories

Rack mount kit for /516A, /512A	RackDBK3
Rack mount kit for /516E	RackDBK4
Optional hardcopy manual set (2); includes programmer's manual, and WBK option cards & modules user's manual	489-0900

### Cables

Ethernet patch cable, 1.5 ft.	CA-242
Ethernet patch cable, 7 ft.	CA-242-7
DB25 male to DB25 female parallel cable, 2 ft.	CA-35-2
SYNC cable, 1 ft.	CA-74-1
5-pin male DIN to 5-pin male DIN	CA-115
5-pin DIN to automobile cigarette lighter power cable, 8 ft.	CA-116
DB25 to external clock BNC	CA-178
CE Compliant Cables	
1 male BNC to male BNC	CA-150-1
8 male BNC to male BNC	CA-150-8

### Software

Icon-based data acquisition, graphics, control, and analysis software with WaveBook driver	DASyLab
Real-time vibration analysis and recording software for the ZonicBook and WaveBook	eZ-Analyst
Post-acquisition time-domain analysis software for data acquired from the WaveBook	eZ-TimeView
Post-acquisition frequency-domain analysis software for data acquired from the WaveBook	eZ-FrequencyView
Reciprocating equipment post-acquisition analysis software for the ZonicBook	eZ-Rotate

For complete information on accessories and cables, visit [www.iotech.com/acc](http://www.iotech.com/acc)

### Related Products

Hardware	
ZonicBook	p. 59
WBK Options	p. 34
DBK Options	p. 112
Software	
WaveView	p. 30
eZ-Analyst	p. 63
eZ-Rotate	p. 66
DaqCOM	p. 232
DASyLab	p. 234
eZ-TimeView	p. 240
eZ-FrequencyView	p. 241

# Techniques and Accuracy for the SR90 Floating Bridge Heavy Load Test

## Project Geometric Framework Survey

### **Field Procedures**

Field observations utilize the static and fast static capabilities of Trimble's 5700 Global System Receivers, with Trimble's Zephyr Antennas. Antenna heights are measured uncorrected in meters, checked in feet and tribrachs are routinely calibrated. Network design accommodates a minimum of three vectors into each station with every baseline measured at least twice and a minimum of one and a half hour's occupation time for baseline in excess of ten kilometers. Baseline measurements of less than ten kilometers utilize ten minute occupations when six or more satellites are available and fifteen minute occupations when five satellites are available. Trimble GPSurvey Planning software is utilized to determine optimum constellation configuration for scheduling occupations.

### **Office Procedures**

Independent baseline are processed using the broadcast ephemeris and Trimble GPSurvey software. Upon checking loop closures, Trimnet Plus software is utilized to perform a minimally constrained least square adjustment to evaluate the internal consistency of the field measurements. A constrained adjustment is performed using the NAD 83/91 coordinates of the Washington State High Accuracy Reference Network or other previously tied stations shown on the survey diagram.

## Static Load Surveys

### **Field Procedures**

Field Procedures utilize kinematic capabilities of Trimble's 5700 Global System Receivers, with Trimble's Zephyr Antennas. Antenna heights are measured uncorrected in meters, checked in feet and tribrachs are routinely calibrated. Network design accommodates a minimum of four vectors from land-based Geometric Framework control stations into each of the eight bridge monitoring sites. First, a 10 minute kinematic session will follow a ten minute recess to allow bridge to "settle".

Then, for each the three pontoon segments, 10 minute kinematic sessions will be performed with the loaded truck trains parked in place. Data collection interval rate will be ½ seconds. Trimble GPSurvey Planning software is utilized to determine optimum constellation configuration for scheduling occupations.

### **Office Procedures**

Independent baselines are processed using the broadcast ephemeris and Trimble GPSurvey software. The results will be analyzed through a series of spreadsheets.

## Dynamic Load Surveys

### **Field Procedures**

Field Procedures utilize kinematic capabilities of Trimble's 5700 Global System Receivers, with Trimble's Zephyr Antennas. Antenna heights are measured uncorrected in meters, checked in feet and tribrachs are routinely calibrated. Network design accommodates a minimum of four vectors from land-based Geometric Framework control stations into each of the eight bridge monitoring sites. In addition, Trimble 5700 GPS receivers and survey-quality antennas will be mounted on the first truck of the two truck trains. Truck trains will be tracked in the kinematic mode at a rate of 35-45 mph, both west and east bound directions.

### **Office Procedures**

Independent baseline are processed using the broadcast ephemeris and Trimble GPSurvey software. The results will be analyzed through a series of spreadsheets.

## GPS Equipment Specifications

### **Trimble 5700 Gps Receivers**

#### Static and Fast Static GPS Surveying

Horizontal	+/- 5mm + 0.5 ppm Rms
Vertical	+/- 5mm + 1 ppm Rms

#### Real – time and post processed kinematic surveys

Horizontal	+/- (10mm + 1 ppm) (x baseline lengths) Rms
Vertical	+/- (20mm + 1 ppm) Rms

Note: Results gained during the course of conducting monitoring surveys, often far exceed the instrument specifications by implementing procedures that increase confidence in the results. Confidence in results is increased by redundant sampling and statistical comparisons of the residual differences. The amount of time observing satellites from a particular point, the number of satellites observed, the number of satellite observation sessions, the interval rate which the observation data is collected, and the satellite constellation configuration are very important elements leading to confidence.

## DATE'S OF SURVEY

**9/16 – 9/18 2005**

## ACCURACY:

(During a meeting with Scott Kuebler on 7/19/2005, wsdot geographic services represented by Kurt Iverson (360-709-5532) and Kurt Williamson (360-709-5533) Wsdot representatives explained that the possible accuracies would be defined @ less than 5cm (0.015ft), these accuracies could be improved by using optimal satellite constellation's and proper networking for the geometric framework, this improvement could give less than 2cm (0.006ft) accuracy for any given test)

Accuracy for the project is defined by multiple vectors measured to one of 8 stations located on the sr 090 floating br., at a specific period of time (test) and the vertical difference is compared to each other –

### Dynamic Test D1

		Leschi to Station 1		
Example: Station 1	03:39:00	9.864mt	32.362ft	Start of Test
	03:43:17	9.755mt	32.005ft	Lowest observed elev.
	Diff	0.109mt	0.357ft	

### Blue to Station 1

Station 1	03:39:00	9.866mt	32.369ft	Start of Test
	03:43:17	9.755mt	32.005ft	Lowest observed elev.
	Diff	0.111mt	0.364ft	

### Bridge Movement

Leschi	0.109mt	0.357ft
Blue	0.111mt	0.364ft
Difference	0.002mt	0.007ft

Comparing the two separate vertical differences 0.109mt (0.357ft) and 0.111mt (0.364ft) 0.002mm or 0.007ft shows a confidence level that the bridge dipped in this case approx. 0.110 meters or 0.361 feet for Dynamic Test D1.

Though this example is just one of many comparisons that took place, it does represent the true accuracies that were derived during this project.

As a result of the comparisons, the <2cm (0.006ft) was achieved, with most cases being <1cm (0.003ft).

If there are any questions regarding this matter please feel free to contact either wsdot Kurt Iverson (360-709-5532) or Kurt Williamson (360-709-5533).