Multilayer Network Platforms: Designing Risk Management Solutions

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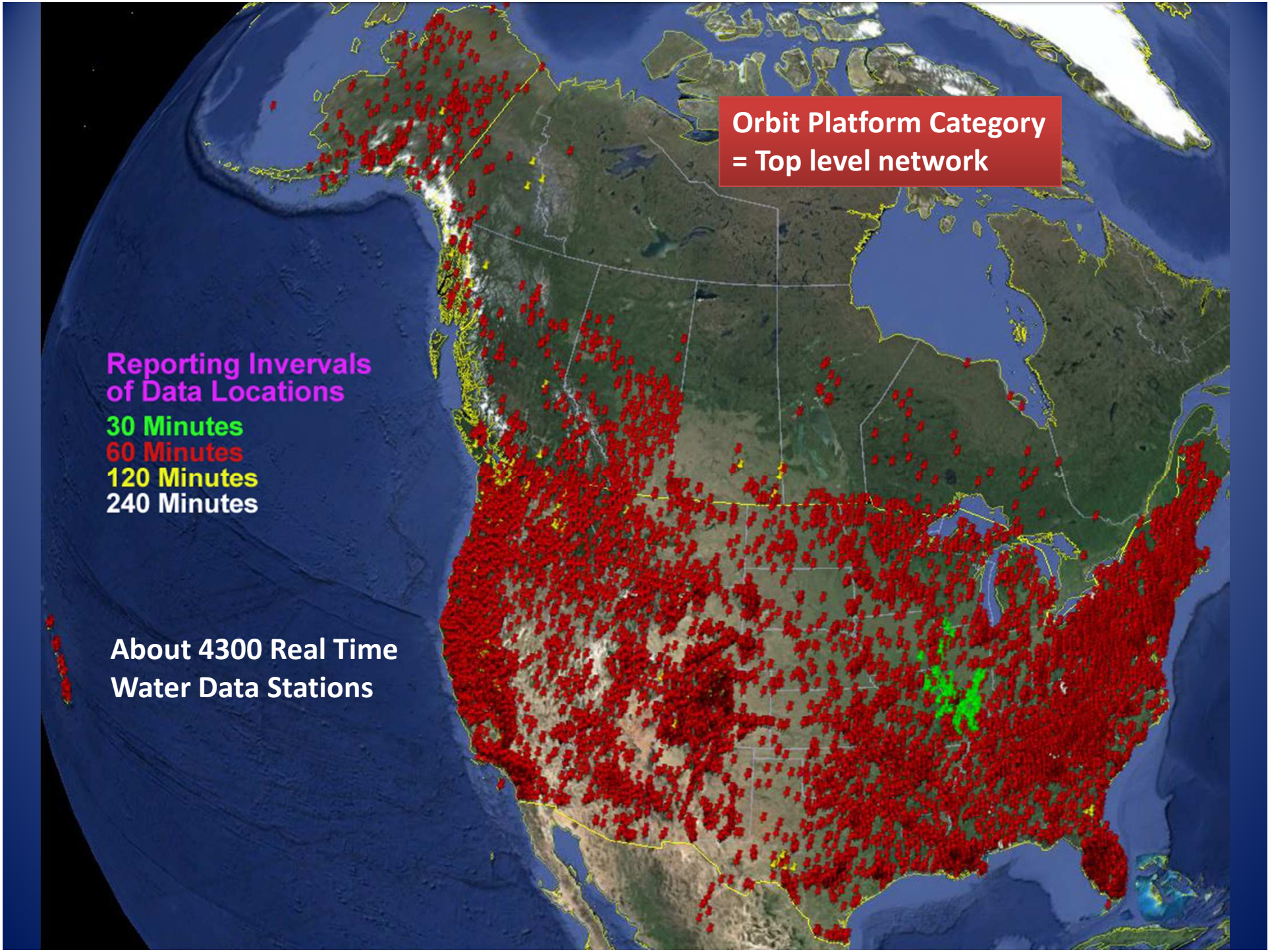
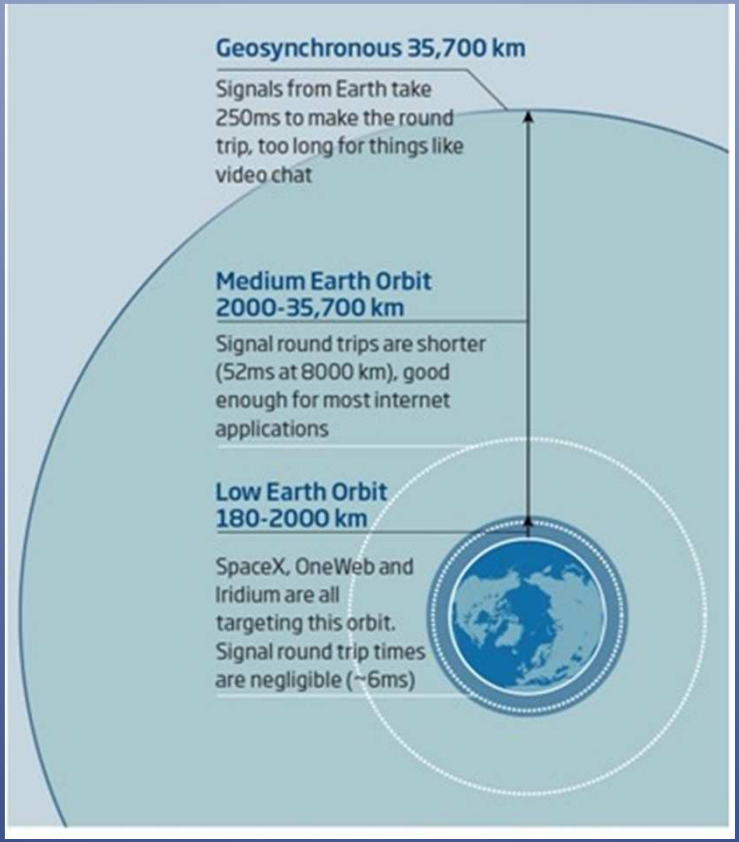
A general overview of hydrologic platform and delivery systems.

Data network design using current technology options.

What categories in interrelated network platforms are useful to define boundaries leading the right level of operating requirements?


Orbit Platform Category
= Top level network
Reporting Invervals
of Data Locations
30 Minutes
60 Minutes
120 Minutes
240 Minutes
About 4300 Real Time
Water Data Stations

Orbit Platform Limitations



GEO: Numeric Science/Eng data

> 525 Satellites

MEO: buffered internet network speeds

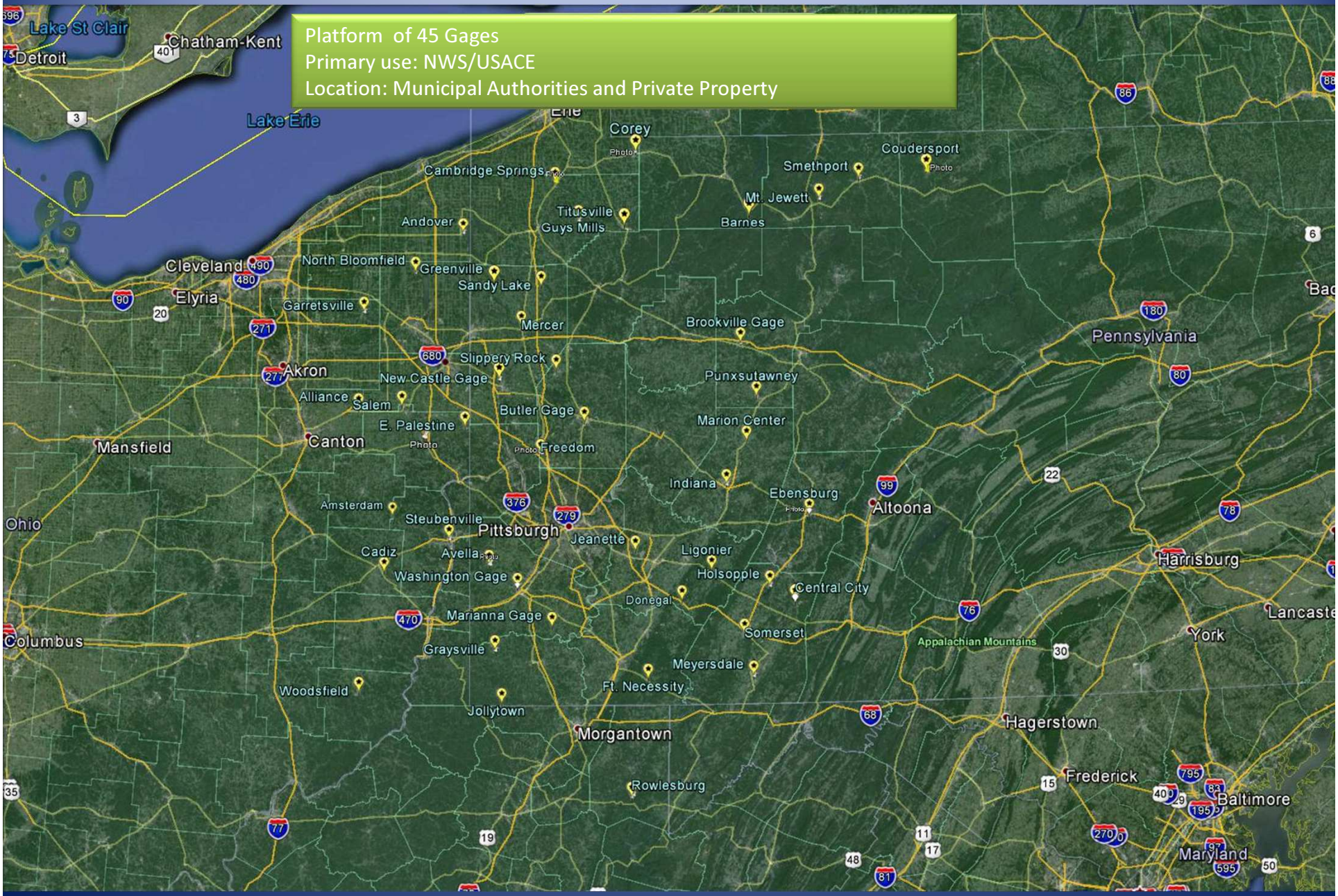
> 250 Satellites

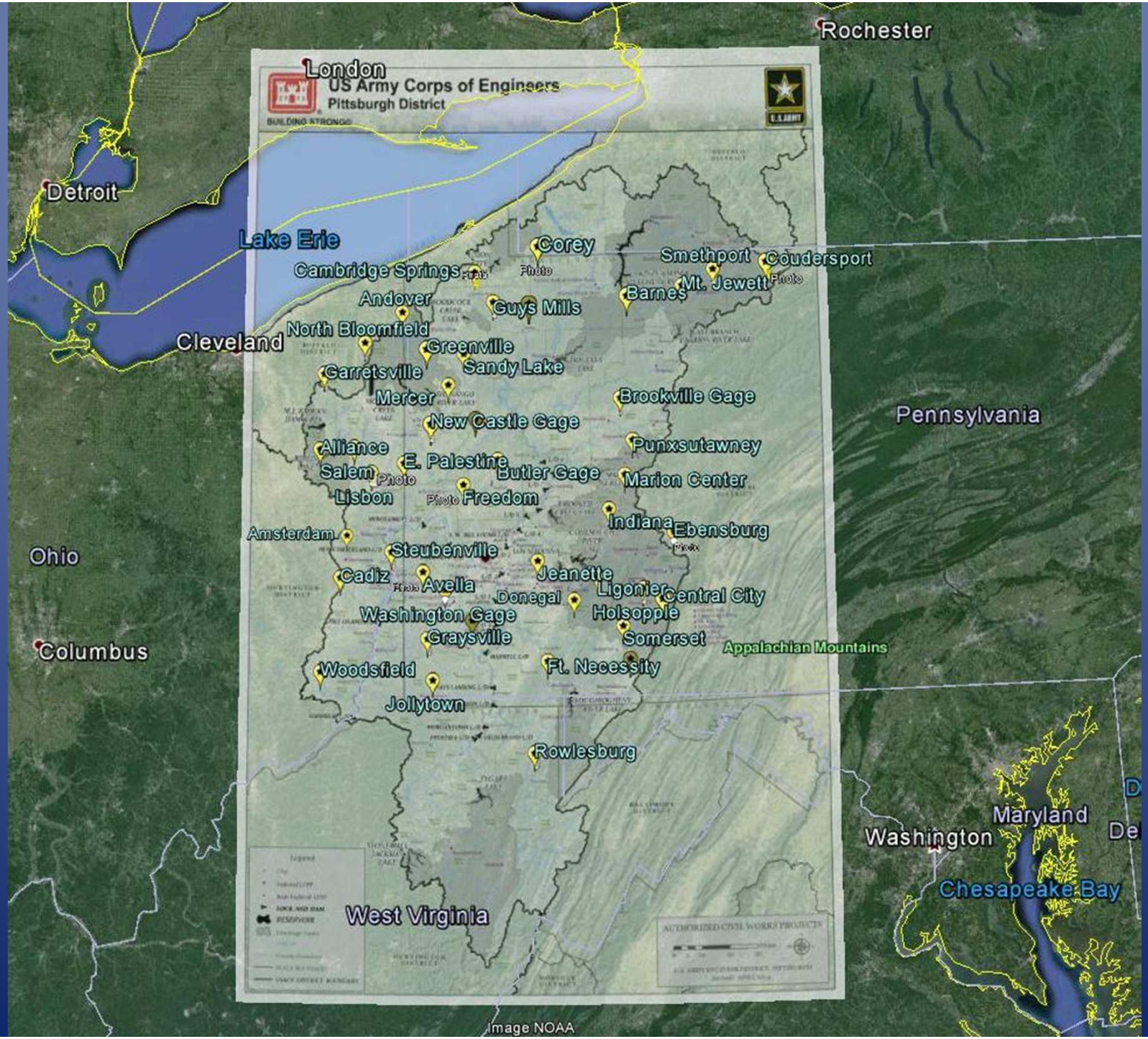
LEO: Near live I/O

> 1000 Satellites

Q: At what point do the different data network platforms overlap making for opportunities, or, confusion for risk management and research?

Platform of 45 Gages
Primary use: NWS/USACE
Location: Municipal Authorities and Private Property

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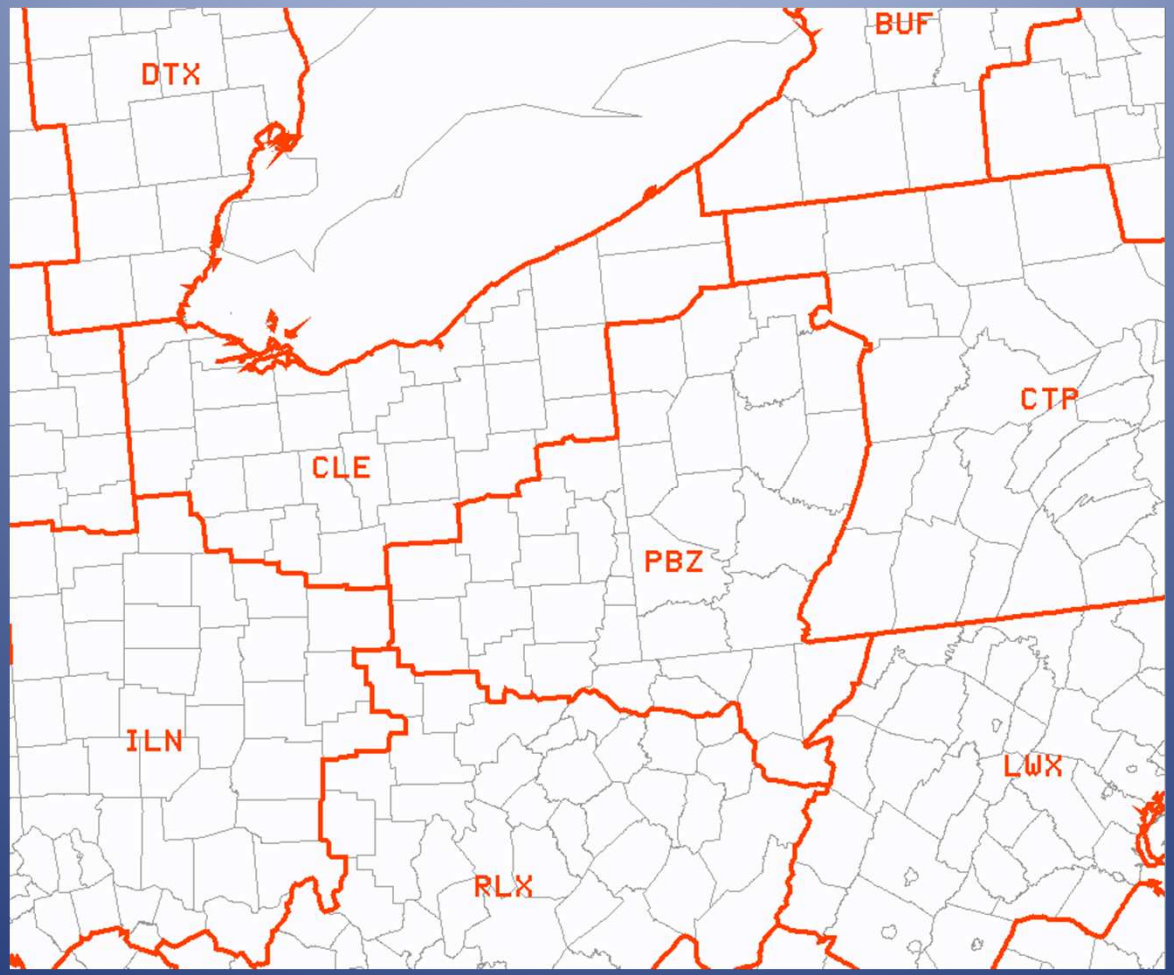
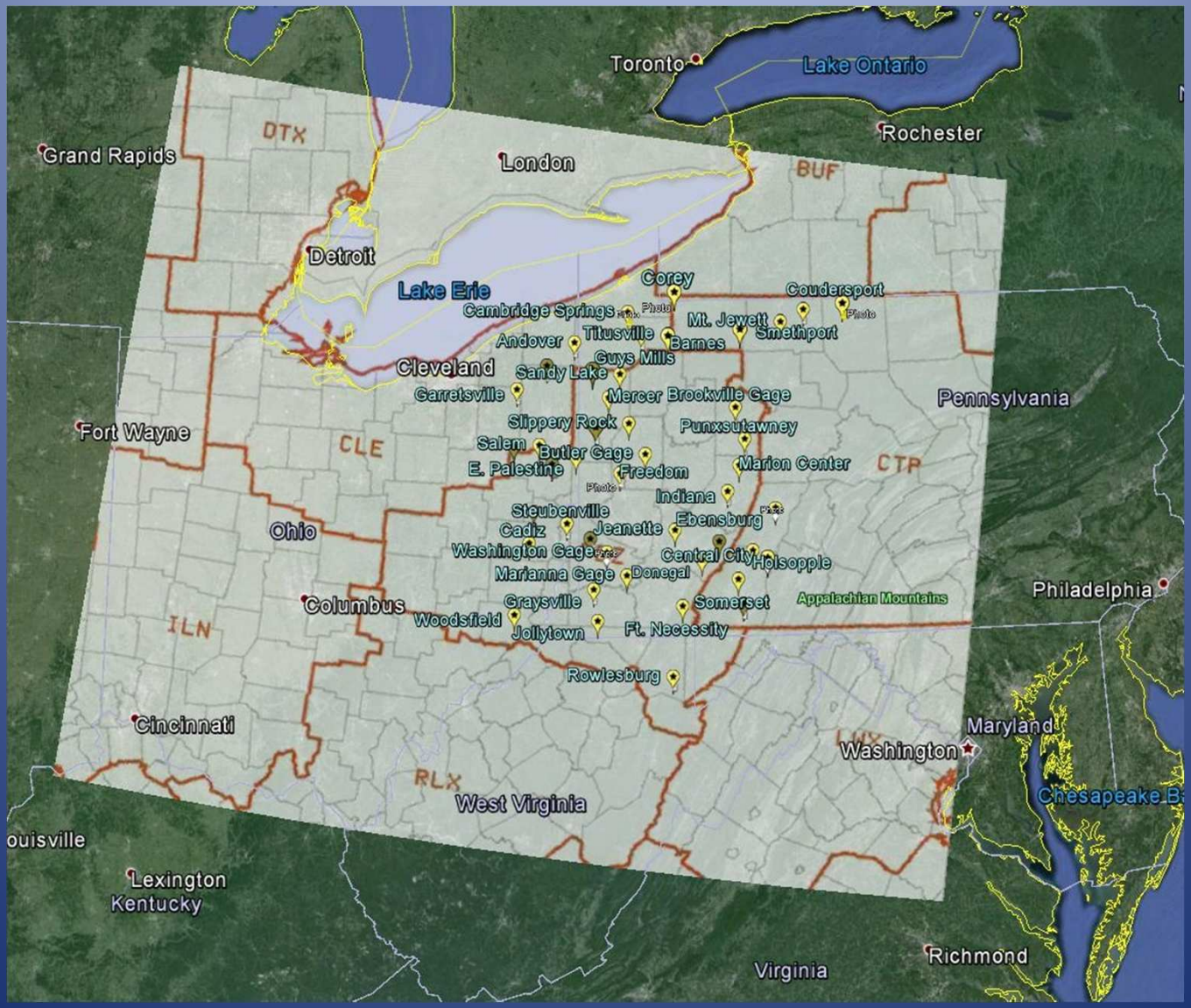
NWS County Warning Areas



NWS Reporting Offices



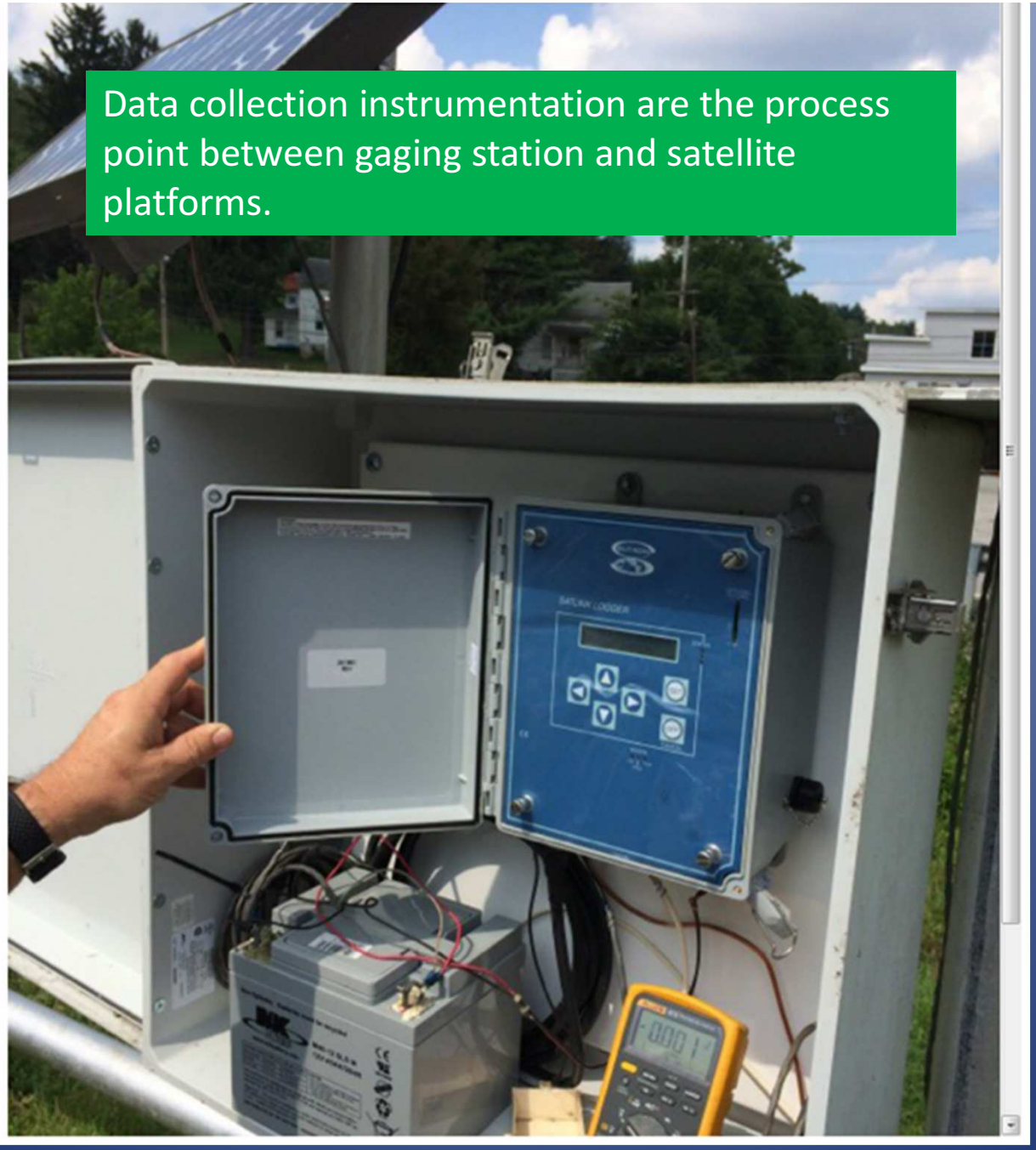
Established Network Characteristics

- River Drainage Basin -- Upper Ohio COE Boundary
- Climatological Reporting Offices – National Weather Service
- State Boundaries – PA DCNR, ODNR, WV DEP,
- County Boundaries with NWS -- Emergency Response
- Local Watersheds

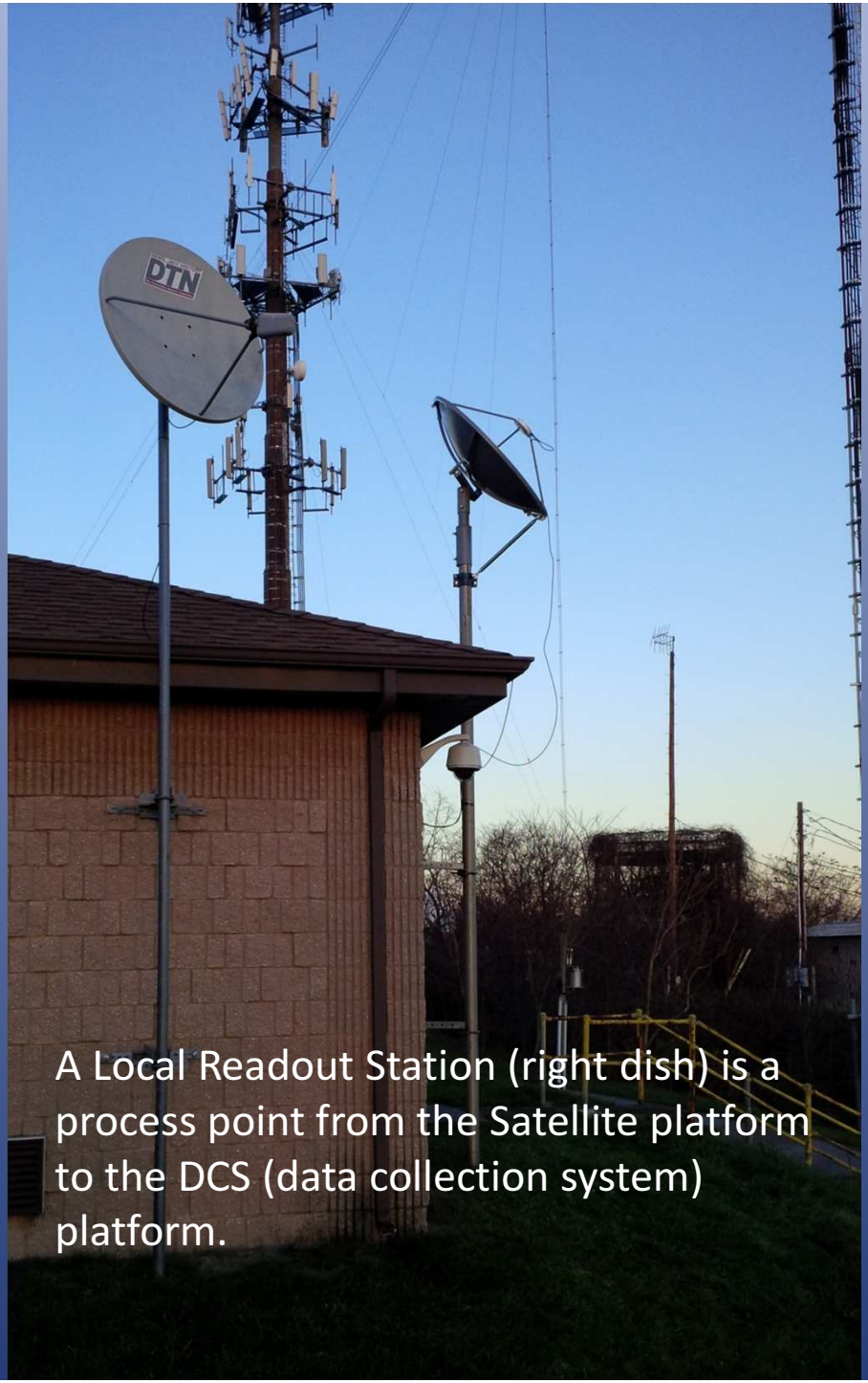
At local watershed level consider using cellular data modems as a process point for your data.

Photo

Collecting data at a local watershed platform.


Data collection instrumentation are the process point between gaging station and satellite platforms.

Air flow meter	Golay cell	Nichols radiometer	Sensor fusion
Alarm sensor	Gravimeter	Occupancy sensor	Sensor grid
Anemometer	Ground-penetrating radar	Odometer	Sensor node
Auxanometer	Gyroscopic sensor	Optical position sensor	Shack-Hartmann
Back-illuminated sensor	Hall effect sensor	Oscillating U-tube	Shock data logger
Barometer	Hall probe	Passive infrared sensor	Shock detector
Biochip	Heat flux sensor	Permanent Downhole Gauge	Silicon bandgap temperature sensor
Biosensor	Hot filament ionization gauge	Photodetector	Single-photon avalanche diode
Boost gauge	Image sensor	Photodiode	Soft sensor
Bourdon gauge	Image sensor format	Photoelasticity	Sonar
Calorimeter	Impact sensor	Photoelectric sensor	Special sensor microwave imager
Capacitance probe	Inclinometer	Photoelectric sensor	Staring array
Capacitance sensor	Inductive sensor	Photoionization detector	Stretch sensor
Capacitive displacement sensor	Infra-red sensor	Photomultiplier	Stretch sensor
Capacitive sensing	Infrared thermometer	Photomultiplier tubes	Stud finder
Carbon paste electrode	Integrated circuit piezoelectric sensor	Photoresistor	Superconducting photon detector
Catadioptric sensor	Intelligent sensor	Photoswitch	Synthetic aperture radar
Colorimeter	Ionization gauge	Phototransistor	Tachometer
Contact image sensor	Kinetic inductance detector	Phototube	Tactile sensor
Current sensor	Lab-on-a-chip	Piezoelectric accelerometer	Temperature gauge
Daly detector	Laser rangefinder	Piezometer	Thermistor
Digital sensors	Laser surface velocimeter	Pirani gauge	Thermocouple
Displacement receiver	Leaf sensor	Planar Hall sensor	Thermometer
Doppler radar	LED as light sensor	Position sensor	Tilt sensor
Electromechanical film	LIDAR	Pressure gauge	Time pressure gauge
Electron multiplier	Light-addressable potentiometric sensor	Pressure sensor	Touch switch
Electro-optical sensor	Linear encoder	Proximity sensor	Transducer
Electro-optical sensor	Linear variable (LVDT)	Pyrometer	Transition edge sensor
Electroscope	Liquid capacitive inclinometers	Quantum sensor	Triangulation sensor
Exhaust gas temperature gauge	Machine vision	Quartz thermometer	Ultrasonic sensor
Fabry–Pérot interferometer	Magnetic anomaly detector	Radar	Ultrasonic thickness gauge
Faraday cup	Magnetometer	Radar tracker	Variable reluctance sensor
Fiber optic sensors	Mass flow sensor	Radio direction finder	Velocity receiver
Fisheries acoustics	McLeod gauge	Rate sensor	Video sensor
Flame detection	MEMS magnetic field sensor	Reed switch	Visible light photon counter
Flame detector	Metal detector	Resistance temperature detector	Visual sensor network
Flow sensor	Microbolometer	Resistance thermometer	Voltage detector
Free fall sensor	Microelectromechanical systems	Rotary encoder	Water meter
Galvanometer	Microwave radiometer	Rotary variable differential transformer	Wavefront sensor
Gardon gauge	Motion detector	Scintillometer	Wheatstone bridge
Gas meter	Net radiometer	Sensor array	Wireless sensor network



A Local Readout Station (right dish) is a process point from the Satellite platform to the DCS (data collection system) platform.

Reservoir Operations.xlsx [Shared] - Microsoft Excel

Layout | Formulas | Data | Review | View | ApproveIt | Acrobat

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=K705

STONEWALL - WUE 321 - S - (304) 269-4588

Active platform data for reservoir regulation Corps of Engineers

SBURG'S SCHEDULE
- Hold pool 1066.3-1067.5
Hold slot opening about 10' below surface
/ change in opening - (724) 725-5289
H= 7.2' with 3 boards removed from Bendale
is >60 F & WT (Walkersville) is >50 F -
& 2 G's & start to raise Slot
AL EVENTS HERE

Full Pool = 1081.3'
Maximum Summer Conservation Pool = 1072.5'
Maximum Winter Conser
Minimum Pool = 1037.8'
Drainage Area = 101 sq.
Peak Flow for 3-hr Unit H
Recommended Drawdo

GATE OPERATING SCHEDULE

TOTAL	GATE	TOTAL	GATE

GATE CONFIGURATION

Max. Elev. for: Intake #1 = 1085.45'
Intake #2 = 1073.45'
Intake #3 = 1061.45'
Hoist Gate = 1050.45'

Using Gates 3-5 from late-May to late-Nov
the lake is thermally stratified
Elev. for: Dogg #1 = 1074.45'
Dogg #2 = 1062.45'
Dogg #3 = 1050.45'
If Air Temp is switch to
Release (800 cfs) Oct-Nov to clear leaf build up from Bendale
hecked 02Nov2011 no problem with 325 cfs)
w release <60 cfs may cause significant drop in WT due to 5-10 cfs cold water leakage
Slot opening(s) should be 4'
Maintain center of slot 10' below surface

Today's Outflow: 7am 470; 9am 830; 12pm 830; 3pm 830
Tomorrow's Weighted Outflow: 800

Stage	Flow	Baseflow
8.56	69	
9.78	450	15

8 2-4-2
Gates 1-2 - Use one gate up to 0.3
divide equally if >0.6'
Flood Setting = Gate 4 @ 0.5' OR Gates 1 and 2 @ 0.5' each
Channel Capacity = 2,300 cfs
Minimum Outflow = 5 cfs
Max Release = 1000cfs when below 1067.5'
to prevent fish from being swept downstream
Intake Worksheet: Stonewall Water Temps.xlsx
Estimate Clarksbu

Lake	24 Hr Pool Change	24 Hr Storage Flow	StonewallJackson-Lake 8am Pool Elevation	Storage	1Hr Pool Change	1Hr Storage Flow	StonewallJackson-Outflow 7am Outflow Forecast Stage	Flow	Current Forecast Inflow	Discharge Openings Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Operations	Reasons / Remarks	WQ Tower #1 Bottom Slot Opening	WQ Tower #1 Top Slot Opening	WQ Tower #2 Bottom Slot Opening	WQ Tower #2 Top Slot Opening	StonewallJackson Observed 24 Hour Precip	StonewallJa Outflow 7am Obser Water Ter
009	-0.06	-67	1067.92	36965	-0.02	-534	8.54	65	0	0	0.5	0	0	0			1045.45	1049.45	1049.45	1053.45	T	
053	0.02	22	1067.96	37053	0.00	0	8.54	65	200	0	0.5	0	0	0			1045.45	1049.45	1049.45	1053.45	0.85	
921	-0.06	-67	1067.89	36898	-0.01	-267	8.54	65	0	0	0.5	0	0	0			1045.45	1049.45	1049.45	1053.45	0.11	
788	-0.06	-67	1067.84	36788	0.00	0	8.54	65	0	0	0.5	0	0	0			1045.45	1049.45	1049.45	1053.45	0.00	
656	-0.06	-67	1067.78	36656	0.00	0	8.54	65	15	0	0.5	0	0	0	Set WQ tower #2 slot to 1045-1049	Continue lowering slots to winter position / Lower outflow water temperature	1045.45	1049.45	1049.45	1053.45	0.00	
523	-0.06	-67	1067.72	36523	0.00	0	8.54	65	0	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
413	-0.05	-56	1067.66	36391	-0.01	-267	8.54	65	0	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
258	-0.07	-78	1067.60	36258	0.00	0	8.56	69	0	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.03	
258	0.00	0	1067.60	36258	0.00	0	8.56	69	70	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.28	
148	-0.05	-56	1067.55	36148	0.00	0	8.56	69	15	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
037	-0.05	-56	1067.50	36037	0.00	0	8.56	69	15	0	0.5	0	0	0		no intake change - Scott working alone	1045.45	1049.45	1045.45	1049.45	0.00	
971	-0.03	-33	1067.47	35971	0.00	0	8.56	69	35	0	0.5	0	0	0			1045.45	1049.45	1045.45	1049.45	0.20	
794	-0.08	-89	1067.39	35794	0.00	0	8.56	69	0	0	0.5	0	0	0	9am: Close #2 Gate to 0.3'	Conserve storage	1045.45	1049.45	1045.45	1049.45	0.00	
706	-0.04	-45	1067.35	35706	0.00	0	8.45	45	0	0	0.3	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
599	-0.05	-54	1067.30	35599	0.00	0	8.45	45	0	0	0.3	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
515	-0.04	-42	1067.26	35515	0.00	0	8.45	45	5	0	0.3	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
410	-0.05	-53	1067.21	35410	0.00	0	8.45	45	0	0	0.3	0	0	0			1045.45	1049.45	1045.45	1049.45	0.00	
304	-0.05	-53	1067.16	35304	0.00	0	8.45	45	0	0	0.3	0	0	0	Set both WQ Tower Slots to 1041-1045	Continue lowering slots to winter position	1045.45	1049.45	1045.45	1049.45	0.00	
220	-0.04	-42	1067.12	35220	0.00	0	8.45	45	5	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.00	
115	-0.05	-53	1067.07	35115	0.00	0	8.45	45	0	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.00	
052	-0.03	-32	1067.04	35052	0.00	0	8.45	45	10	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.00	
926	-0.06	-64	1066.98	34926	0.00	0	8.45	45	0	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.00	
842	-0.04	-42	1066.94	34842	0.00	0	8.45	45	5	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.00	
800	-0.02	-21	1066.91	34779	-0.01	-254	8.45	45	10	0	0.3	0	0	0			1041.45	1045.45	1041.45	1045.45	0.26	
695	-0.05	-53	1066.87	34695	0.00	0	8.45	45	0	0	0.3	0	0	0	Set both WQ Tower Slots to 1037-1041	Complete lowering slots to winter position	1041.45	1045.45	1041.45	1045.45	0.00	
632	-0.03	-32	1066.84	34632	0.00	0	8.45	45	20	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.02	
653	0.01	11	1066.85	34653	0.00	0	8.48	50	150	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.61	
821	0.08	85	1066.90	34758	-0.03	-763	8.48	50	140	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	1.03	
737	-0.04	-42	1066.89	34737	0.00	0	8.48	50	20	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
674	-0.03	-32	1066.86	34674	0.00	0	8.48	50	15	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
653	-0.01	-11	1066.85	34653	0.00	0	8.48	50	100	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.12	
547	-0.05	-53	1066.80	34547	0.00	0	8.48	50	0	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
484	-0.03	-32	1066.77	34484	0.00	0	8.48	50	15	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
400	-0.04	-42	1066.73	34400	0.00	0	8.48	50	10	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
358	-0.02	-21	1066.70	34337	-0.01	-254	8.48	50	30	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
295	-0.03	-32	1066.65	34232	-0.03	-763	8.48	50	20	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
190	-0.05	-53	1066.63	34190	0.00	0	8.48	50	0	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.05	
106	-0.04	-42	1066.59	34106	0.00	0	8.48	50	5	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
022	-0.04	-42	1066.55	34022	0.00	0	8.48	50	10	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
043	0.01	11	1066.56	34043	0.00	0	8.48	50	180	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.54	
064	0.01	11	1066.57	34064	0.00	0	8.48	50	60	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.24	
022	-0.02	-21	1066.55	34022	0.00	0	8.48	50	40	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.22	
085	0.03	32	1066.58	34085	0.00	0	8.48	50	60	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.05	
001	-0.04	-42	1066.54	34001	0.00	0	8.48	50	20	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
959	-0.02	-21	1066.51	33938	-0.01	-254	8.48	50	20	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45	0.00	
874	-0.04	-42		#N/A	######	#N/A	8.48	50	8	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45		
793	-0.04	-41		#N/A	######	#N/A	8.48	50	9	0	0.3	0	0	0			1037.45	1041.45	1037.45	1041.45		

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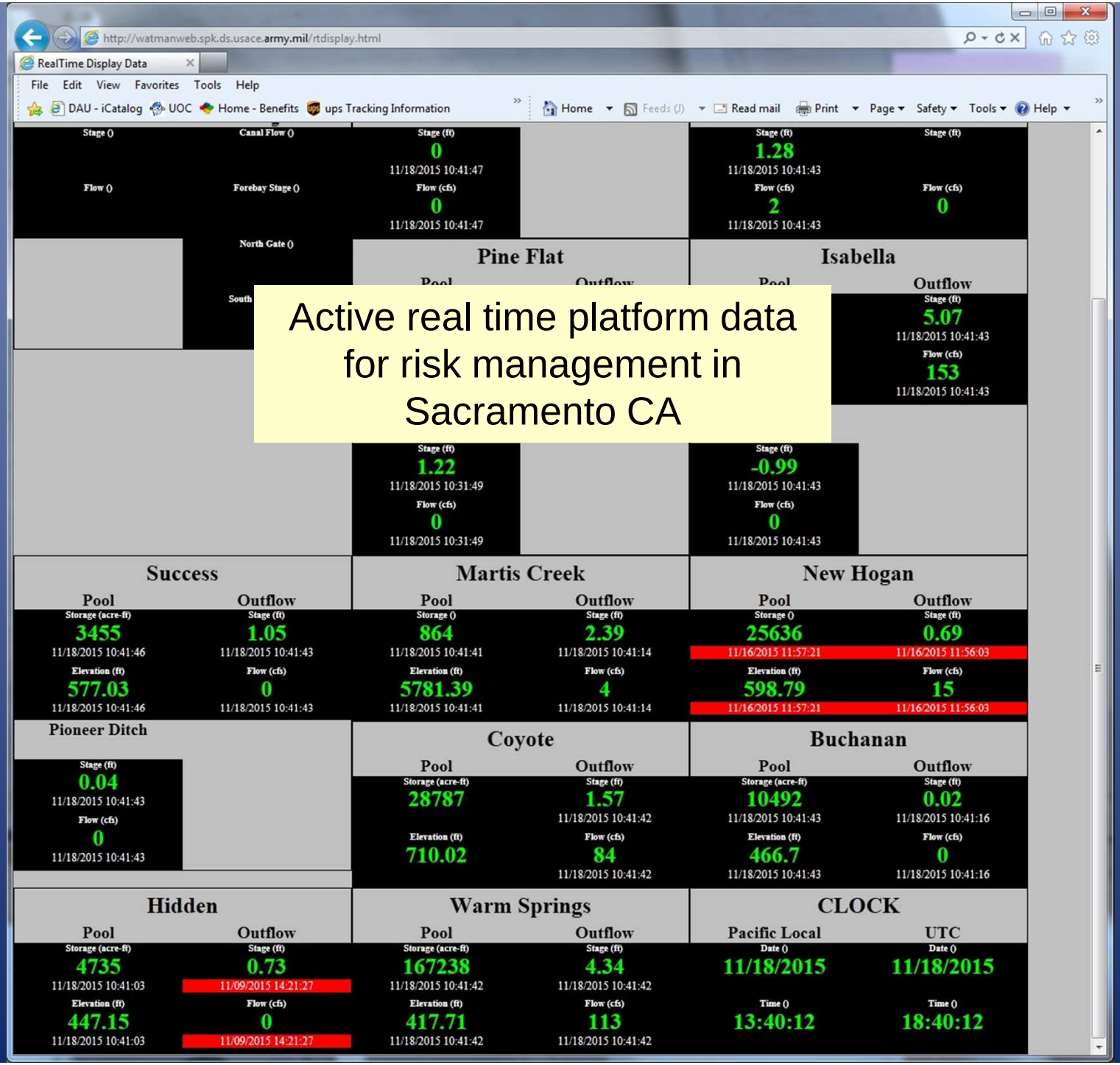
Charts Available in Pennsylvania

NESDIS ID	NWSLI	LOCATION	SHEF PHYSICAL ELEMENT CODES
CE6CAF56	ACMP1	ALLEGHENY RIVER AT LOCK AND DAM #3 NEAR ACMETONIA 1S	HP HT HP2 TW WC WP WO VB
CE515416	ALDP1	WEST BRANCH LACKAWAXEN RIVER AT ALDENVILLE	HG PC TW
DE40F60E	ALKP1	BRODHEAD CREEK NEAR ANALOMINK 2N	HG
DE46E5B6	ALLP1	LITTLE LEHIGH CREEK AT ALLENTOWN	HG
1736E6A6	ALNP1	JORDAN CREEK AT ALLENTOWN	HG
163ED8EA	ALWP1	WEST BRANCH SUSQUEHANNA RIVER AT ALLENWOOD	HG
17B856F8	ANAP1	GROUNDWATER WELL IN WASHINGTON TOWNSHIP, BUTLER COUNTY NEAR BOYERS 2SE	HB
328982EA	ANFP1	ALLEGHENY RAWS	PC US UD TA MT XR VB MM UR UP RW
1736C04A	APAP1	LITTLE LEHIGH CREEK AT TENTH STREET BRIDGE AT ALLENTOWN	HG
CE716062	ARHP1	LACKAWANNA RIVER AT ARCHBALD	HG VB
DE3C52C6	AUGP1	AUGHWICK CREEK NEAR THREE SPRINGS 3NE	HG
CE29C07E	AVLP1	AVELLA RAIN	PC
DE4DE61E	AXEP1	SPRING CREEK NEAR AXEMANN 1W	HG
CE59B342	AYLP1	AYLESWORTH LAKE NEAR JERMYN	HP PC TA
CE595E62	BCHP1	BALD EAGLE CREEK AT BLANCHARD	HG TW
CE29551C	BDDP1	MONONGAHELA RIVER AT LOCK AND DAM #2 NEAR BRADDOCK	HP HT TW WO VB
CE4A5020	BEAP1	BEAVER RIVER AT BEAVER FALLS	HG PC VB
CE5D306C	BECP1	BALD EAGLE CREEK NEAR BEECH CREEK STATION NEAR BEECH CREEK 2E	HG
DE3CD4D2	BEDP1	RAYSTOWN BRANCH JUNIATA RIVER AT WOLFSBURG NEAR BEDFORD	HG
DE3CE148	BELP1	DUNNING CREEK AT BELDEN	HG
CE7A5650	BETP1	LEHIGH RIVER AT BETHLEHEM	HG PC
D680012C	BGNP1	BIG KNOB RAWS NEAR BLAIN 3NW	PC US UD TA MT XR VB MM UR UP RW
D68027C0	BHDP1	BEARS HEAD RAWS NEAR MAHANOY CITY 4NE	PC US UD TA MT XR VB MM UR UP RW
CE6EB9D4	BKLP1	REDBANK CREEK AT BROOKVILLE	HG PC PC2
1787E594	BKTP1	INDIANA COUNTY WELL (IN919) IN BANKS NEAR HILLMAN 2SE	HB
DD53F478	BLDP1	BALD EAGLE CREEK AT TYRONE	HG
32A0962E	BLHP1	BLAIR HELIBASE RAWS	PC US UD TA MT XR VB MM UR UP RW
DD036558	BMBP1	SUSQUEHANNA RIVER AT BLOOMSBURG	HG
CE79D74A	BMRP1	TULPEHOCKEN CREEK BELOW BLUE MARSH DAM NEAR PLEASANT VALLEY	HG TW
DD8141F8	BNDP1	MARSH CREEK AT BLANCHARD	HG
CE6635B4	BRAP1	TUNUNGWANT CREEK AT BRADFORD	HG VB
CE79EC02	BREP1	SCHUYLKILL RIVER AT BERNE	HG PC
CE17816C	BRNP1	BARNES	PC
CE79CAEE	BRVP1	TULPEHOCKEN CREEK NEAR BERNVILLE 3.5W	HG TW
DE3E71DE	BSCP1	BIG SPRING CREEK NEAR NEWVILLE 3S	HG WT TW
DE1AB014	BSRP1	BIG SPRING RUN ABOVE TRIBUTARY NEAR WILLOW STREET NEAR LANCASTER 4SE	HG TW WC WT
17376248	BTHP1	MONOCACY CREEK AT BETHLEHEM	HG
CE69BBE0	BTRP1	CONNOQUENESSING CREEK NEAR BUTLER 1SW	HG PC
CE59788E	BUSP1	ALVIN R BUSH LAKE NEAR WESTPORT 6NW	HP PC TA



Active real time platform data for risk management in Sacramento CA

There are hundreds of potential data platforms in this picture.

Data platform method:

1 Start with the sensor end of your data and delivery system. Determine primary characteristics and requirements for project sensors in their environment. Weaknesses in primary data have derailed many research papers.

2 Immediately plan for minimizing lost measurement data. I.E. Reserve power supply options, scheduled data automated backups, and scheduled field QA checks.