**Project Category**: Coastal/Marine

**Project Title: Tectonic land level changes and their contribution to sea level rise, Humboldt Bay region, Northern California**

**Project Leader or Principal Investigator responsible for completion of project (***Name, organization, email address, phone number***):**

*Todd B. Williams*, Cascadia GeoSciences, [todd@cascadiageo.org](mailto:todd@cascadiageo.org), 707-498-7755

Team Leader, Humboldt Bay Vertical Reference System Working Group (HBVRSWG)

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Hydrodynamics specialist, tide gage deployment, data analyst, technical advisory committee

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Project management and administration, data analyst, technical advisory committee

**Cooperators/Partners (***name, affiliation, email address, phone***) and anticipated project contributions:**

*Dr. Ray Weldon*, Univ. of Oregon, Dept. of Geological Sciences, [ray@uoregon.edu](mailto:ray@uoregon.edu), 541-346-4584

Data analyst, historic data compilation, tide gage and leveling equipment, technical advisory committee

*Dr. Mark Hemphill-Haley*, Humboldt State Univ., Geology Dept., [markhh@humboldt.edu](mailto:markhh@humboldt.edu), 707-826-3933

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Field technician, data analyst, technical advisory committee

*Jason R. Patton*, Oregon State University, [jpatton@coas.oregonstate.edu](mailto:jpatton@coas.oregonstate.edu), 707-498-4290

Data analyst, technical advisory committee

*Jay D. Stallman,* Cascadia GeoSciences, [jays@cascadiage](mailto:jays@cascadiageo.org)o.org, 707-407-6237

Project management and technical advisory committee

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Technical advisory committee and outreach

*Eric Nelson*, USFWS, Humboldt Bay National Wildlife Refuge[, Eric\_T\_Nelson@fws.gov](mailto:Eric_T_Nelson@fws.gov), 707-733-5406

Technical advisory committee

**Project Summary**: This project will evaluate and quantify the two primary factors driving observed sea level changes in Northern California: eustatic sea level rise (ESLR) and tectonic land level changes. Local sea level changes will be mapped by incorporating land and sea level observations through deployment of temporary tide gages (at historic locations previously observed) and analysis of existing historic (1931-1988) level line surveys. The new sea level observations (6-9 months) will facilitate development of a 34-year trend (1978–

2012) in sea level change in the vicinity of Humboldt Bay, as well as provide information about potential tectonic land level changes that will be verified through analysis of the land-based level surveys. Trends in land and sea level change in north coastal California determined from this study, when integrated with the

work of Dr. Ray Weldon and colleagues at University of Oregon, fills an important data gap regarding coastal uplift and subsidence in the southern Cascadia subduction zone. In addition to helping complete the coastal

uplift & subsidence distribution along the Cascadia margin, the results of this study will provide necessary baseline information that can be used by land managers and planners in northern California to anticipate and plan for changes in sea level over the next century. Because ongoing land-level changes exceed ESLR in some

locations, determining these spatial and temporal trends are crucial to determining the local sea-level trends in northern California.

**Background and Need:** Recent advancements in the understanding of global environmental change have motivated coastal communities and land managers to better understand and initiate planning for future sea- level rise. Sea-level rise poses threats to local infrastructure, as well as species and ecosystems dependent on occupying a specific elevation range relative to sea-level. Reasonable estimates of future sea level change, although increasingly necessary to inform land and resource management in the coastal zone, are lacking in the Humboldt Bay region.

Vertical land changes must be considered when estimating local sea level changes and the potential effects at any given location. Local sea level is the combined measured effects of eustatic sea level change and vertical land movement, which can either amplify or reduce the observed rate of sea level change. Active tectonic processes associated along the Pacific margin from northern California to Vancouver Island cause ongoing vertical land level change, which can be observed along the coast in both the geologic record as well as in ongoing modern day deformation (Mitchell et al., 1994; Nelson et al., 1996; Atwater and Hemphill-Hailey,

1997; Fluck et al., 1997; Burgette et al., 2009). Tectonically-driven vertical land level changes in the

Humboldt Bay region are within the same order of magnitude as ESLR. Therefore, both variables are critical in examining local sea level changes over typical planning horizons.

Humboldt Bay is at the southern end of the Cascadia subduction zone where the offshore oceanic plate is descending below the onshore continental plate. The land and seafloor within this interface is subject to continuous vertical land- level changes throughout the seismic cycle, which can be characterized by examining both the long term strain accumulation and short term energy release. The earth’s crust flexes vertically on a time scale of hundreds of years as strain accumulates during interseismic time intervals. The resulting energy release during an earthquake typically results in land movement in the opposite sense of motion to the

observed interseismic vertical land level changes. This seismogenic process repeats itself on a time scale of hundreds of years. Modern analogues of this tectonic phenomena have been well documented over the last

half century in Alaska in 1964 (Plafker, 1969), Chile in 1960 (Atwater, 1992), and Northern California (Carver, 1992). More recently this phenomena has been observed in Japan after the 2011 Tohoku earthquake. Observing the slow steady interseismic vertical motion will not only allow a refinement of local sea level change, but provide a basis for estimating future coseismic land level change.

Near Humboldt Bay, published uplift rates range from approximately –2.5 mm/yr to 3 mm/yr (Verdonck 2006; Leonard et al. 2004). Deformation of the offshore Gorda plate at the Mendocino triple junction may

complicate contemporary efforts to accurately model interseismic land level changes in this region (Leonard et al. 2004) in the absence of additional tidal gaging data. Repeated marsh burial provides strong evidence of coseismic subsidence and therefore, inferred interseismic uplift (Vick, 1988 and Patton, 2004) at Humboldt

Bay, which appears to be at odds with the limited tidal gaging records available from the North Spit. Preliminary inference from existing instrumentation (i.e., continuous GPS observations and tide gauges) suggest that the Humboldt Bay region experiences -3 to -1 mm/yr of vertical land level change, resulting in observed sea level change of 5.3 to 3.3 mm/yr from south to north (HBVRSWG, 2011). These estimates were derived by combining 30 years of sea level data with 5 years of continuous GPS measurements. Land

subsidence is in the opposite direction of sea level rise and contributes to accelerated rates of apparent sea level rise. The rate of vertical land level change transitions from subsidence to uplift along California’s north coast between Trinidad and Crescent City. These rates are greater than in other parts of the Pacific Northwest and California (HBVRSWG, 2011).

Coastal land managers have a need to understand how estuarine wetland ecosystems, adjacent freshwater wetlands, and the animal communities that depend upon these habitats will redistribute themselves in response to sea-level change. In the Humboldt Bay region, salt marsh and eelgrass habitats that support diverse assemblages of migratory waterfowl and shorebirds, as well as fish and invertebrates, occupy narrow elevation ranges (1.7 to 2.6 m and -1.7 to 0.5 m relative to mean lower low water, respectively (Eicher 1987; Gilkerson

2008) making them especially vulnerable to changes in sea-level. Historic modification of coastal wetlands as a result of railroad and levee construction has reduced the area currently capable of supporting salt marsh by

90 % in Humboldt Bay (Pickart 2001) which in turn, limits the extent to which these species can migrate landward in response to rising sea-level, absent significant changes in land management and conservation. Remaining salt marsh habitats in Humboldt Bay and the Eel River delta have also been degraded by the

introduction and spread of invasive species, most notably, *Spartina densiflora* (Pickart 2001). Freshwater emergent wetlands adjacent to salt marsh in the Humboldt Bay and Eel River Delta also support large numbers of migratory waterfowl and may be impacted by saltwater intrusion associated with rising sea-level.

Potential management responses with respect to protecting coastal wetland habitats threatened by rising sea level are limited by a number of factors, the most significant of which include availability of funding and

suitable upland area for purchase to effect restoration and conservation. All of these factors conspire to make managing coastal wetlands in the face of climate change and specifically sea level rise a challenging endeavor.

By deploying a network of tide gauges around Humboldt Bay, we will substantially refine our understanding of the local and regional variations in rate of sea level rise or fall. Land managers will have valuable information by which they can better estimate the trajectory of specific wetland areas with respect to conversion to other habitat types. In addition to understanding near-term vulnerability of existing wetlands to local sea-level change, managers will also gain a better understanding of the potential for specific adjacent upland areas to provide future habitat refuge for coastal wetland species of interest.

Observing and quantifying sea-level change is fundamental to making sound management decisions in the coastal areas of Northern California and has been identified by groups including: the Humboldt Bay Initiative workgroup, the California Department of Fish and Game, the California Department of Transportation, and local and regional planning departments. This project will address the first logical step in characterizing the tectonic land-level changes that influence sea-level inundation in the Humboldt Bay region.

**Objective:** This project will characterize the interseismic tectonic land-level change associated with the southern Cascadia subduction zone. Understanding this ongoing phenomenon will allow us to quantify and predict future sea-level trends in northern California. Results from this study will provide fundamental sea- level rise data for making sound management decisions as they apply to managing coastal landscapes and the species and ecosystems that inhabit them, particularly those within the tidal prism, which are the most vulnerable to future sea-level rise . Quantifying future local sea-level change is the first logical step in planning management strategies for coastal ecosystems.

**Methods:** A combination of near shore water-level and onshore land-level surveys will be utilized to determine the tectonic land level changes and sea level trends around Humboldt Bay.

Temporary Tide Gage Deployment

When the North Spit tide gage was constructed, there were 11 locations within Humboldt Bay and its estuaries where sea-level was observed from 1978-1980. We propose to deploy a minimum of 3, and up to 6, temporary tide gages at historic locations for a period of 6-9 months. Tide gages and bar-code levels will be provided by Dr. Ray Weldon of University of Oregon. Site infrastructure (stilling well, staff plate, power system) will be constructed and each site will be surveyed to their respective tidal bench mark. Contemporary (2011-2012) water-level observations will be compared to initial (1978-1980) observations to determine a 34 year sea-level trend at each location around Humboldt Bay. Of the 11 potential locations to reobserve sea-level, we have identified 3 locations as priority: 1) Hookton Slough in South Humboldt Bay, 2) Eureka, and, 3) Mad River Slough in North Arcata Bay. These locations provide broad geographic coverage within Humboldt Bay and have relatively robust initial historic records. In Addition, the US Army Corps of Engineers San Francisco District office (Anne Strum) has agreed to provide 2010 tide gaging data from 2 locations in Humboldt Bay (Fields landing and Samoa), providing 2 more data points to include in the analysis.

In Trinidad, approximately 10 miles North of Humboldt Bay, there is a robust 10 year historic record from

1977-1987. The Trinidad Pier is getting rebuilt in 2011-2012, and will be observed if site construction allows. We are contacting the Trinidad Rancheria regarding funding opportunities for a permanent tide gage on the

new pier to support this and other projects. Additionally, the BLM plans to support funding through the BLM King Range Conservation District to establish sea-level trends near recreational routes in the King Range for public access and trail planning purposes. A new observation point may be established near Shelter Cove or other location along the King Range.

Level Surveys

Numerous historic level surveys have been completed around Humboldt Bay. There are 7 projects involving

~70 control points that were leveled in the vicinity of Humboldt Bay from 1931-1992 (http://www.ngs.noaa.gov). Forty (40) survey marks have 2 observations between 1944-1967 or 1967-1988,

and 19 have 3 observations from 1944-1988. University of Oregon will provide bar code leveling equipment

to perform short level ties between historic surveys where possible to provide new measurements for

meaningful locations only observed once (eg. 1931, 1944). All historic surveys will be tied to the North Spit tide gage (where needed) for proper reference to mean sea level, which will be the surface all observation points will be referenced to. Analyzing the repeated surveys will determine secular trends as well as evaluate monument stability or instability through time. We are communicating with CalTrans Dist. 1 regarding potential for survey work to be performed by their own staff to re-level the NAVD88 level line, last observed

23 years ago. A new survey would extend the historic record 20+ years and provide new baseline information to evaluate future earthquake induced land-level changes along critical infrastructure.

Continuous GPS stations operated by EarthScope (http://earthscope.org) exist just beyond the North and South

shorelines of Humboldt Bay and provide excellent anchor reference points for future potential GPS survey work. Both the County of Humboldt Surveys Office and the National Geodetic Survey have indicated they have the capacity to provide GPS equipment for projects such as a Height Modernization Survey (2-4cm vertical accuracy), which would help provide a mechanism to efficiently and effectively monitor land changes into the future.

Education and Outreach: Planned outreach activities include direct interaction with Humboldt State University and University of Oregon Geology programs, regular project updates will be provided to the local ecosystem science & planning community through the Humboldt Bay Initiative working group meetings, briefings to the Humboldt County Public Works and Planning Departments, the HSU Geology colloquium seminars which are open to the public, the Harbor District’s Humboldt Bay Symposium, and presentations to the Humboldt

Friends of Geology (HFOG) semi-annual meetings. A student and/or a senior team member may present the results at a scientific conference such the Geological Society of America or American Geophysical Union annual meeting. Presenting emerging results from this study will hopefully spark interest from the many stake holders that have an interest in estimating future sea-level change in northern California and the regional

observation points can be densified or expanded in the future.

Technical Advisory: While all team members are considered technical advisory to the project, and the project team has many years experience in tide gaging and leveling work, technical consultation and project planning will also be presented for review to Don Campbell, CalTrans Dist. 1 Surveys and Right-of-Way Support, and Marti Ikehara, the National Geodetic Survey’s Advisor to the State of California. These individuals have no official presence in the working group but have been enthusiastic project proponents as well as valuable technical advisory.

**Geographic Extent:** All of the proposed project will take place in Humboldt County, California. The proposed tide gage installations may range from Shelter Cove in the south to Trinidad Harbor to the north, with the bulk of the observations occurring within Humboldt Bay. This distribution of observation points will allow us to evaluate regional sea-level trends to compare to the interior of Humboldt Bay. Completion of this project will fill in the last remaining portion of the Cascadia subduction zone that hasn’t been characterized in this fashion, allowing for refinement of earthquake hazard assessments for the region.

**Timeline of Schedules, Products and Outcomes:**

Award date: Sep.1, 2011

Initial Technical Advisory Committee meeting: Sep. 15, 2011

Begin install tide gages: October, 2011

Conduct survey to NAVD bench marks and existing level lines: Oct. 2011 – continue as needed Apr. 2012

Compile existing leveling data: Oct. 2011

Collect tide gage data and maintain equipment: Oct. 2011 – Apr. 2012

Analyze data: Jan. 2012 – May 2012

Report on results: Sep., 2012

**Budget:** See attached.

**References Cited**: See attached.

**Disclaimer regarding Data Sharing:** We anticipate that this data will be shared without restriction with all entities, unless otherwise constrained.

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| **Table 1. Estimated logistic requirements and costs for characterizing interseismic vertical land level changes in the greater Humboldt Bay area, Humboldt County, California.** | | | | |
| **Cost Category** | | **Cost Rate ($/site)** | **Sites** | **Total cost ($)** |
| Installation of  Tide gages | Install tide gage infrastructure1 | 2000-4000 | min. 3; max 6 | $12,000 |
| Install tide gages and initiate operation and routine maintenance2 | 4470-8950 | min. 3; max 6 | $26,840 |
|  |  |  |  |
| Data editing, data QAQC, and  preparation for release3 | 1667-3333 | min. 3; max 6 | $10,000 |
|  |  |  |  |
|  |  |  |  |
| Sub Total | | | | **$48,840** |
| Survey tide  gages to tidal bench mark and nearest NAVD88 control | Senior surveyor | $500/day | 14 days | $7,000 |
| Survey technician | $250/day | 28 days | $7,000 |
| Sub Total | | | | **$14,000** |
| Data mining and database development4 | Student / technician | $25/hr x 8 weeks | 60 | $8,000 |
| Sub Total | | | | **$8,000** |
| Data analysis and reporting | Senior Staff | $35/hr x 8 weeks | N/A | $10,000 |
| Sub Total | | | | **$10,000** |
| Logistical costs (UofO) | Travel | .50/mile | 2400 miles | $1,200 |
| Per diem | $51/day | 28 days | $1,428 |
| Lodging | $100/day | 28 days | $2,800 |
| Sub Total | | | | **$5,428** |
| **Sub total** (personnel + operations + maintenance) | | | | **$86,268** |
| Indirect expenses (15%) | |  |  | **$12,940** |
| **Total Estimated Costs** | |  |  | **$99,208** |
| 1Installation of tide gage infrastructure costs include materials to anchor tide gages and the associated site development or redevelopment | | | | |
| 2 Installation and operation of tide gages includes securing site access and deploying sensors in the infrastructure | | | | |
| 3QA/QC includes 2 meetings of the technical advisory group supporting the project. One meeting will be conducted prior to tide gage depolyment and the other prior to data analysis and reporting. Includes pre-processing of tide data also. | | | | |
| 4Data mining and database development includes compiling & analyzing existing benchmark and level line data and integrating it into the results of the tide gage deployment | | | | |

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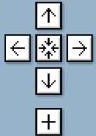
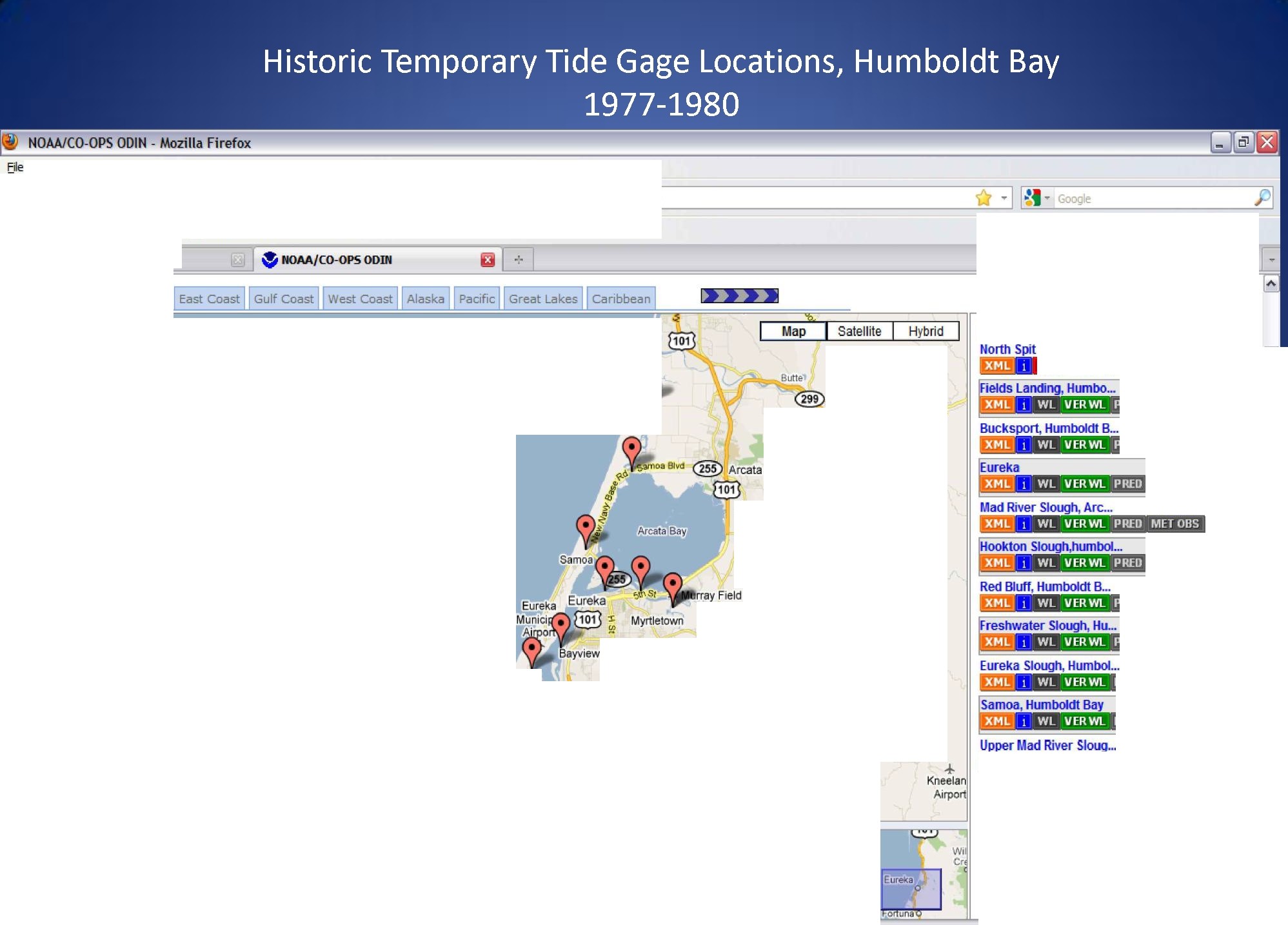
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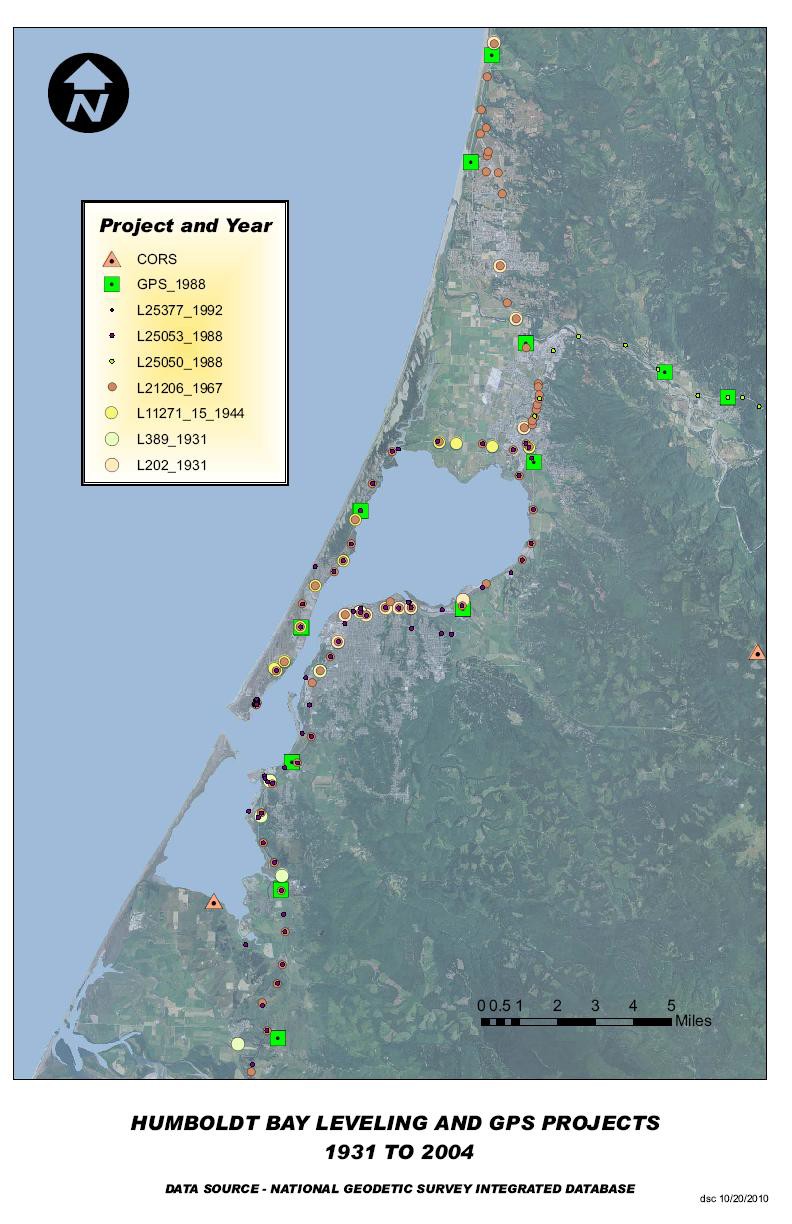
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Historic Leveling,



Humboldt Bay

1931: San Jose – Eureka

1931: Eureka – Grants Pass

1944: Arcata – North Spit

1967: Longvale – Crescent City

1988: Eureka – Redding

1988: Westport – Arcata – North Spit

1992: Garberville – Loleta

2004: State Hwy – Countywide GPS

Source: NGS Integrated Database; compiled

by Don Campbell, CalTrans Dist. 1, 2010.

**Todd B. Williams**

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**EDUCATION:** Masters of Science, Environmental Systems-Geology, Humboldt State University, December 2002.

Bachelor of Science, Geology, Central Washington University, June 1998.

**WORK EXPERIENCE:**

***\* Field Engineer II:*** UNAVCO, Inc. Plate Boundary Observatory (PBO), Northwest Region, 1/1/04-Present, 40-60 hr/week.

\*Assisted in opening (2004) and closing (2008) the N. California PBO office and warehouse space in Richmond, CA. Participated in building ~113 continuously operating GPS stations in CA, OR, and AK from 2004-2009. Present duties include maintenance and troubleshooting of solar power systems, radio & cellular data telemetry, QA/QC performance of GPS

receivers and antennas, and maintaining working relations with numerous private landowners, agencies, and institutions.

\*Ken Austin, supervisor, Regional Engineer-NW Region, UNAVCO, Inc, 303-775-2415.

\* ***Director:*** Cascadia GeoSciences, Humboldt County, CA, 5/30/07-Present, 2 hr/week

\* Helped establish CA non-profit corporation for purpose of conducting earth science research and environmental restoration in greater Humboldt Bay area. Focuses on supporting local community scientists and students at HSU and CR.

***\* Staff Geologist:*** Scotia-Pacific Company, LLC, Scotia, CA. 9/1/03-12/31/03, 50 hr/week.

\*Field data acquisition and geological analyses of landslide occurrence associated with large rainfall events that occurred on commercial timberlands in Humboldt County, California. Worked independently in remote forested regions and mapped and documented over 100 landslides in 2 watersheds over the course of 3 months. Created area-volume equations that estimate volumes of displaced material based on the aerial dimensions of the slope failures.

\*John Oswald, R.G., C.E.G., supervisor, *now at* Oswald Geologic, 707-407-5102.

***\* Staff Research Associate II:*** University of California-Berkeley, Seismological Lab, 1/14/03-5/13/03, 40 hr/week.

\*Reconnaissance of existing survey benchmarks, installation of new benchmarks, and collection of GPS survey data for

GPS survey profiles that span the northern San Andreas fault system in Mendocino, Lake, and Sonoma counties.

\*Dr. Mark H. Murray, supervisor, *now at* New Mexico Tech, 575-835-6930

**ADDITIONAL FIELD EXPERIENCE:**

***\* Field Camp Teaching Assistant:*** Humboldt State University, 5/18/00-6/4/00; 5/22/02-6/25/02.

\*Assisted in helping students learn the skills necessary to complete a geologic reconnaissance in the field. Field camp mapping areas included the Roberts Mountains, near Eureka, NV and northern Inyo Mountains outside of Independence, CA.

\*Dr. Raymond “Bud” Burke, supervisor, HSU, 707-826-4292.

***\* Geologic Expedition to Mongolia:*** Humboldt State University, 8/1/00-9/4/00.

\*Multi-institutional expedition through north-central Mongolia to investigate Pleistocene glacial and lacustrine deposits. Performed mapping of glacial deposits, lake deposits, and preliminary soil chronosequence analyses to delineate a potential paleoflood from Mongolia to Siberia.

\*Dr. Raymond “Bud” Burke, supervisor, HSU, 707-826-4292.

**TECHNICAL & FIELD RELATED SKILLS:**

\*Experienced in all aspects of reconnaisance, permitting, construction, and maintenance of continuous GPS stations.

\*Strong geology background and knowledge of how GPS aids in the understanding regional earthquake cycles.

**\***Collection and post-processing of raw GPS data using GIPSY-OASIS II and Trimble software.

**\***Computing skills include efficient use of LINUX, MS Office, Adobe Illustrator, and Adobe Photoshop.

**\***Proficient with Generic Mapping Tools (GMT) map creation and data presentation software under LINUX platform.

\*Experience installing and troubleshooting DC battery/solar power systems.

\*Extensive field experience building remote research equipment with use of truck/trailer, ATV, and helicopters.

\*Radio telemetry network design and implementation.

\*Five seasons of arc welding mild, galvanized, and stainless steel in the field.

\*Received wilderness first aid, CPR, firearm, flight safety, avalanche, and bear awareness training classes.

**PUBLICATIONS AND TECHNICAL REPORTS:**

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**NORTHERN HYDROLOGY & ENGINEERING**

**Jeffrey K. Anderson** Registered Professional Engineer, California, R.C.E 50713

**Principal Engineer** Registered Professional Engineer, Oregon, 64540PE Registered Professional Engineer, Nevada, 21067CE

**EDUCATION:**

**M.S. Environmental Resources Engineering** - Humboldt State University, Arcata, CA. 1998

**B.S. Civil Engineering** - Chico State University, Chico, CA. 1989

**EXPERIENCE:**

1995-present Principal Engineer – Northern Hydrology & Engineering: As general partner in a small consulting engineering firm, providing services in the following areas: hydrology, river and estuary hydraulics, stream and wetland restoration, wetland treatment systems, watershed hydrology and water quality, surface water quality studies, watershed management, urban stormwater technologies, water and wastewater systems, and environmental data collection and analysis.

2000-2003 Principal Engineer --Graham Matthews & Associates: Principal engineer, responsible for design and hydraulic modeling on a variety of stream channel and wetland restoration designs, hydrologic studies, and streamflow/sediment monitoring.

1993-1995 Research Assistant -- Environmental Resources Engineering, Humboldt State University: Development of conjunctive management plan of water and environmental resources in the Klamath Basin Area for USBR.

**QUALIFICATIONS:**

Mr. Anderson is a civil engineer with more than 18 years experience, and has been an independent consultant for over 15 years. His consulting experience includes hydrology, river and open channel hydraulics, stream and wetland restoration, watershed hydrology and water quality, surface water quality studies, watershed management, urban stormwater technologies, onsite and small community wastewater systems, and wetland treatment systems. Mr. Anderson has applied and/or developed computer models for hydrologic, hydraulic, and water quality studies of rivers, estuaries, lakes and watersheds. He has worked on hydrologic, hydraulic, sediment TMDL and sediment transport issues and stream restoration designs in California, Oregon and Nevada. Mr. Anderson also has considerable experience with water, wastewater, and natural wastewater systems. He also collects and statistically analyzes hydrologic, hydraulic and water quality data. Mr. Anderson’s experience in water resources includes serving as project or principal engineer on projects for such agencies as the City of Arcata, Oregon Trout, EPA, The Nature Conservancy and the Bureau of Reclamation. In addition, Mr. Anderson has served as part-time faculty for the Department of

Environmental Resource Engineering, Humboldt State University, Arcata, California.

**Areas of Specialization and Technical Skills**

Areas of specialization and training in the following: Hydrology, Hydraulics, River Engineering, River Restoration, Sediment Issues; Water Quality Modeling of Surface Water, Groundwater, Watersheds and Wetlands; Natural Systems for Wastewater and Storm Water Management; Wastewater Reclamation and Reuse; Watershed, Wetland, and Surface Water (rivers, estuaries, and lakes) Management and Restoration Plans; Computer Modeling and Optimization of Environmental Systems; Environmental Statistics.

**AFFILIATIONS AND CERTIFICATIONS**

Member American Society of Civil Engineers Member American Geophysical Union

Member American Water Works Association Society of Ecological Restoration

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**T HOMAS H. LEROY**

**P ROF E S S I ONA L G E O L OGI ST #7751**

**S PECI A LI Z A T I ON :** *Applied coastal geomorphology, geological field studies, Quaternary tectonics and stratigraphy, Paleoseismology, tsunami geomorphology, fluvial processes, erosion control, watershed restoration, project management*

**QUALIFIC ATIONS :**

Associate Geologist / Project Geologist, Pacific Watershed Associates Inc., 1999-present

Research /Teaching Assistant, Humboldt State University, 1994-1998

Geologist, U.S. Geological Survey Regional Field Mapping Team, 1994

M.S, Geology, Humboldt State University, 1998

B.S., Geology, Humboldt State University, 1994

California Registered Geologist #7751

USGS/NAGT award for outstanding performance in field geology, Humboldt State University, 1994

Member, Redwood Coast Tsunami Working Group, 2002-present

Member, Humboldt Bay Initiative group, 2009-present

Founding member, Humboldt Bay Vertical Reference workgroup, 2010-present

Co-editor, Humboldt Friends of Geology Field Guidebook, 2005; *Stratigraphic evidence of paleoearthquakes and paleotsunami in mid-to late Holocene sediments: Humboldt Bay and Lower Eel River valley, Southern Cascadia subduction zone.*

Co-editor, Friends of the Pleistocene Field Guidebook, 2006; *Signatures of Quaternary crustal deformation and landscape evolution in the Mendocino deformation zone, NW California*

**S UMMARY OF E X PER I E NCE :**

Tom Leroy has been an Associate Geologist and Project Leader for Pacific Watershed Associates since 2000

and a founding member of Cascadia GeoSciences, an earth science based 501c3 non-profit organization since

2006. He brings to his positions extensive training in geologic field methods, especially as they relate to coastal geomorphology and geologic hazard assessment. As a Project Leader, he is responsible for complete project management including proposal writing, budget preparation, field data collection and mapping, field crew supervision, data analysis, GIS map preparation, and reporting. His work experience has emphasized applied geologic and geomorphic hazard identification, characterization and mitigation related to engineering projects and erosion control and erosion prevention plans for federal, state and private landowners.

Mr. Leroy’s professional experience includes successfully completing over 2 million dollars in state and federally funded grant projects including several geologic hazard investigations related to estuary restoration projects in northern California. He participates with the Humboldt Bay Initiative (HBI) group and is a founding member of the Humboldt Bay Vertical Reference Workgroup. He has also served on several technical advisory committees for estuarine engineering projects as the role of geologic advisor. Mr. Leroy is also a specialist in subsurface stratigraphy and coastal sedimentation dynamics, particularly as it related to tectonic deformation in the Humboldt Bay and Eel River estuary regions. He is skilled in all aspects of sediment budget analyses from air photo analysis of land use and mass wasting to field surveys of fluvial erosion, stream channel surveys, and analyses of surface processes.

**P UBLI CATI ONS & P RES E NTAT I ONS :**

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