

List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:

Not Listed

REVIEWERS NOT TO INCLUDE:

Not Listed

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide (PAPPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of PAPPG Chapter IX.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Proposal & Award Policies & Procedures Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes

No

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Proposal & Award Policies & Procedures Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Proposal & Award Policies & Procedures Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

- (1) community in which that area is located participates in the national flood insurance program; and
- (2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

- (1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
- (2) for other NSF grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)

(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED**Certification Regarding Organizational Support**

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds \$5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:

- (1) has filed all Federal tax returns required during the three years preceding this certification;
- (2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
- (3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

Certification Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE		DATE
NAME Amye Osti		Electronic Signature		Jul 10 2018 7:57PM
TELEPHONE NUMBER 310-305-8289	EMAIL ADDRESS amy@34north.com		FAX NUMBER	

NATIONAL SCIENCE FOUNDATION

Program Solicitation/Instruction Guide Number

NSF 18-550

SBIR PHASE I - PROPOSAL COVER PAGE

TOPIC EA	SUBTOPIC LETTER (if any) EA1	TOPIC TITLE Educational Technologies and Applications	
PROPOSAL TITLE SBIR Phase I:Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM)			
COMPANY NAME 34 NORTH		EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) 954754924	
NAME OF ANY AFFILIATED COMPANIES (Parent, Subsidiary, Predecessor)			
ADDRESS (Including address of Company Headquarters and zip code plus four digit extension) 12277 SOARING WAY STE 107 TRUCKEE, CA 96161-3201			
REQUESTED AMOUNT \$223455	PROPOSED DURATION 6	PERIOD OF PERFORMANCE	
THE SMALL BUSINESS CERTIFIES THAT:			Y/N
1. It is a small business as defined in the solicitation.			Y
2. It qualifies as a socially and economically disadvantaged business as defined in the solicitation. (FOR STATISTICAL PURPOSES ONLY.)			N
3. It qualifies as a women-owned business as defined in the solicitation. (FOR STATISTICAL PURPOSES ONLY)			Y
4. NSF is the only Federal agency that has received this proposal (or overlapping or equivalent proposal) from the small business concern. If No, you must disclose overlapping or equivalent proposals and awards as required by this solicitation.			Y
5.SBIR: A minimum of two-thirds of the research will be performed by this firm in Phase I. STTR: It will perform at least 40 percent of the work and the collaborating research institution will perform at least 30 percent of the work as described in the proposal.			Y
6. The primary employment of the Principal Investigator will be with this firm at the time of the award and during the conduct of the research.			Y
7. It will permit the government to disclose the title and technical abstract page, plus the name, address and telephone number of a corporate official if the proposal does not result in an award to parties that may be interested in contacting the small business for further information or possible investment.			Y
8. It will comply with the provisions of the Civil Rights Act of 1964 (P.L. 88-352) and the regulations pursuant thereto.			Y
9. It has previously submitted proposals to NSF.			N
10. It previously submitted this proposal (which was declined) and significant modifications have been made as described in the solicitation.			N
11. It has received Phase II awards from the Federal Government. If "yes" provide a company commercialization history in the supplementary documents module.			N
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR			
NAME Amye Osti			
SOCIAL SECURITY NO. not displayed intentionally	HIGHEST DEGREE / YEAR UKNW/2018	E-MAIL ADDRESS amy@34north.com	
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COMPANY OFFICER (FOR BUSINESS AND FINANCIAL MATTERS)			
NAME Amye Osti	TITLE Chief Executive Officer	TELEPHONE NO. 310-305-8289	
OTHER INFORMATION			
PRESIDENTS NAME David Osti		YEAR FIRM FOUNDED 1999	
NUMBER OF EMPLOYEES (including Parent, Subsidiary, Predecessor) AVERAGE PREVIOUS 12 MO.: 8		CURRENTLY: 8	
RESEARCH INSTITUTION NAME 34 North			
RESEARCH INVESTIGATOR NAME Amye Osti			
RESEARCH INVESTIGATOR TELEPHONE NO. 310-305-8289			

PROPRIETARY NOTICE: See instructions concerning proprietary information.

Check Here if proposal contains proprietary information.

PROJECT SUMMARY

Overview:

Virtually every sector of the economy is currently accumulating data at a rate that exceeds their capacity to extract value from it. The ability to derive value from the data is limited by the lack of expertise and distinctive skills in our workforce. This research and development project addresses the K-12 data science learning challenges by developing a Watershed Data Lab (WDL) learning platform to support interdisciplinary, cross cutting and experiential curriculum in the classroom and in the field. Building on established watershed science principles, protocols, public data and curriculum, this project will start with the basics and use familiar environmental topics to integrate the fundamentals of data science as students explore their watersheds and learn to solve important problems facing our environment. The prototype platform will focus on the diverse communities of the Sacramento River Watershed (SRW) and Sierra Nevada Watersheds by providing tools for teaching landscape and watershed scale data collection, management, analysis and storytelling. Partners include the Sacramento and Lake Tahoe Watershed Programs, public and private school and independent stakeholders to evaluate commercialization strategy.

The WDL concept is based on project/field study learning and will use next generation science standards (NGSS). Building on partner curricula, the PI will extend the platform to STEM based inquiry to introduce data science subject matter. Using the practical application of watershed concepts, the research plan focuses on curricula integration, user interface development and learning techniques that will help students to gather, present and synthesize data, maps, images/video, wikis and documents. This data collection, synthesis and analysis will culminate in stories about field studies, watershed health, and local ecosystems. Broad research questions include: How do students learn data science concepts through watershed science investigations involving field studies, data analysis and watershed assessment? How much data is required for impactful comprehension of watershed health? How early can students synthesize data to make reasonable assessments? How do teachers learn to integrate data tools into their experiential learning instructional approaches? Does exposure to a comprehensive data picture improve multidisciplinary understanding of a watershed or impact stewardship?

Keywords and subtopic: Watershed, Data Management, Field Study, Cross-study analysis, Data analysis, Data science, Meta analysis, Stewardship, STEM, Learning platform. EA1. Pre K-12 Education

Intellectual Merit:

The intellectual merit of this Small Business Innovation Research Phase 1 effort resides in retooling, for academic use, an existing data platform originally designed for natural resource management. The pilot application will integrate key components (data, maps, documents, images, wiki and analysis tools) into one system for a comprehensive watershed view. Additional innovations will integrate data science learning modules, create watershed topic templates for curriculum support and develop a novel user interface that is easy and fun to use by teachers, students and the public. Methodologies include close collaboration with partner schools and watershed groups, prototyping real world field studies and design based research.

Broader Impacts:

The broader impact of the project provides an opportunity to transform the Watershed Data Lab innovation into a functional prototype deployed in classrooms. Throughout the project duration, the product will be iteratively refined to meet market requirements. This process will result in a market ready product that can be efficiently commercialized. Phase 1 product will targets both watershed programs and schools in order to maximize knowledge, access to data and watershed stewardship. Classrooms and schools within the pilot regions will include disadvantaged communities and use agile and responsive development methods for smartphone use. A WDL at a school or at the watershed level will create valuable educational resources for the entire community. The project will encourage inquiry into the natural world, enforce key principles of environmental sustainability, data literacy, and natural resource management, while fostering environmental stewards from a young age.

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Table of Contents	1	_____
Project Description (Including Results from Prior NSF Support) (not to exceed 15 pages) (Exceed only if allowed by a specific program announcement/solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)	14	_____
References Cited	3	_____
Biographical Sketches (Not to exceed 2 pages each)	12	_____
Budget (Plus up to 3 pages of budget justification)	4	_____
Current and Pending Support	6	_____
Facilities, Equipment and Other Resources	1	_____
Special Information/Supplementary Documents (Data Management Plan, Mentoring Plan and Other Supplementary Documents)	1	_____
Appendix (List below.) (Include only if allowed by a specific program announcement/ solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)	_____	_____
Appendix Items:		

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Elevator Pitch

The Customer: Today's data tools are designed for scientific or business analysis (SAS,R, Python, SQL, Scipy). The complicated and abstract nature of these tools make it difficult to integrate data science into K-12 curricula. K-12 classrooms can benefit from a generalized data learning platform that can supplement existing curriculum and enhance real world experiences (Derevenskaia 2014). We see an emerging opportunity to develop such a platform for schools focusing on the watershed science disciplines. Watershed science is a familiar, data rich and complex system that requires a multidisciplinary approach to analyze and problem solve (Shepardson 2007, Aylward 2005, Donahue 1998). These qualities combined with the proliferation of publically available environmental data services from local, state, federal government and NGOs create the ideal market opportunity to bring a **Watershed Data Lab (WDL)** to America's school's.

Fortunately, some of the heavy lifting for this product is currently underway by local watershed groups. Watershed groups develop significant scientifically vetted content and work regularly with local schools to educate teachers and students about watershed health and environmental stewardship (Donahue 1998, Kohler 2008). Watershed groups frequently conduct collaborative field studies and have recently become key data stewards for regional data (2018 Truckee River Watershed Council, 2018 Sacramento River Watershed). The implementation of a WDL instance at the watershed level provide data resources for the schools and the schools can provide data back to the watershed data programs. The NGO-school relationships will increase opportunities for collaboration, youth based environmental stewardship and communication. The use of modern technology in an active learning environment helps sustain student motivation and learning for problem solving and application to real world issues (Blumenfeld et al. 2011).

The proposed proprietary technology platform -Watershed Data Lab (WDL)- is a comprehensive data and information management system that will support the development of next generation data skills and reinforce science curriculum through problem-based inquiry of the natural world. The WDL will provide schools, which may lack the resources and expertise, with the ability to easily incorporate key data science and engineering practices into their curricula such as data management, geographic information systems, cataloguing, programming, experimental design, field data collection techniques and protocols, and data QA/QC procedures. The core components of the platform will include visual catalogs (for images, videos, documents, GIS), a mapping application (for viewing data and map features), wiki (for definitions and references), a data services engine (for aggregating and using public data) and data analysis tools. The work with our partners will guide us in the development of education modules and user templates for teaching data science fundamentals, collecting and analyzing data, making watershed assessments and telling stories. Lastly, the extensive and flexible content management system will allow schools to retain and archive valuable content and also allow students to easily search for information and data, while safeguarding their security and privacy from external online threats. Our goal is that the WDL will support inquiry into the natural world that will enforce key principles of data management and analysis environmental sustainability and natural resource management, while fostering environmental stewards from a young age.

The Commercial Opportunity

Broader Need

Creating a platform that can facilitate data science education is important, but what if we could do it in a way that prepared our youth to solve some of the most important environmental issues that the world is

facing today? To solve today's big environmental issues we must first understand the causes and underlying factors. This need to understand our natural systems has created numerous environmental and ecological datasets. Environmental and ecological data is increasingly being classified as big data where data analytics and advanced understanding of data processing is needed to interpret and apply the results (Burchette 2016, Hua-Dong 2015, Rominger and Ikeda 2015, Hampton et al. 2013, Michener and Jones 2012). Combinations of datasets and parameters unlock new patterns and possible problem solutions at the watershed scale and beyond. From an early age, these students will learn the power of data to solve problems in our natural world. Students will be given the tools to analyze real-world data sets to draw conclusions, propose cause and effect relationships, and communicate and collaborate with their peers. For a school or classroom unable to perform field campaigns or interact directly in the watershed, the Watershed Data Lab provides virtual access to real-world knowledge and data collected by their peers. Through the archive and catalog components of the Watershed Data Lab, students have access to data, field notes, images, and informational wikis; thus, creating an experiential learning experience in the classroom.

The Watershed Data Lab is grounded in experiential learning model of education. Experiential learning is an inquiry driven approach to education that develops critical thinking skills and engages students in hands-on learning activities that are practical and relevant (Association for Experiential Education 2018, Kolb and Kolb 2012). The Watershed Data Lab was imagined to prepare our youth for the challenges of data science and multi-disciplinary analysis. The WDL approach emphasizes experiential learning techniques (field work) and data science through real world activities starting in kindergarten and continuing through high school. By combining curriculum for understanding general watershed health (Project Wet 2018, Myers), field work and data science, the WDL will help foster the next generation of interdisciplinary students.

The Market

The Testbed Market: The impetus for this project began with existing customer relationships. 34 North's core business is application development for natural resource management and the industry is represented by diverse stakeholders, including research and educational institutions. The multi-stakeholder nature of our business has brought us together with many watershed groups, universities and schools. These relationships have been a natural driver of the idea and as a first major effort, 34 North and the Sacramento River Watershed (SRWP), Truckee River Watershed Groups, Tahoe Expedition Academy and Chico Public Charter have entered into agreements to collaboratively develop Water Data Lab pilots at the watershed scale and for the individual schools. The pilot idea is underway with more than 300 data sets, sample curriculum and the integration of field studies. We are currently working to develop learning modules and organize data based on existing curriculum, NGSS, and existing content from watershed groups. For example, forest health (Rizzo, David and Garbelotto 2003, Asner et al. 2016, Smith, Rizzo and North 2005) is of great concern in the SRW and pilot schools are interested in creating data workspaces for collecting and exploring fire data in their area. An additional topic of interest is local stream water quality and quantity assessments (Domagalski et al. 1998). Water quality data from the Truckee River watershed collected in compliance with EPA water quality standards is currently provided to 34 North for input and management. Data story development and assessments occur in a collaborative and well documented forum for R&D purposes.

Schools: Many schools participate in some form of watershed studies or environmental science activities related to the watershed. To enhance these studies, schools often conduct field studies, collect data and accrue knowledge that can be easily recorded, centralized, made accessible and archived. K-12 classrooms can benefit from a generalized data learning platform that can supplement and support these

activities. The customers are schools and educational organizations of all types that seek to better connect computer-based earth science, environmental data, data skills and earth stewardship into their science curricula.

California Watershed and National Watershed Programs: Watershed programs work regularly with local schools to educate teachers and students about watershed health and environmental stewardship. They frequently conduct field studies and have recently become primary data stewards for regional data. The implementation of a WDL instance at the watershed scale would provide data resources for the schools and the schools can provide data back to the watershed data programs. The NGO-school relationships will increase opportunities for collaboration, youth based environmental stewardship and communication. The programs will also give fundraising opportunities for NGO to continue with their valuable work. It is our intention to focus first on California because we have significant data collected and ready to use for this state. The second phase would develop strategy for a national program.

Learning Platforms: A third customer segment is to target 'common core' learning platforms (Summit Learning 2018, Blackboard 2018, Moodle 2018) who lack an active learning module. Our partner schools currently use some of these platforms and we have been able to audit the tools and begin to assess areas of opportunity.

Market Validation

Market Validation for Watershed Data Lab comes from existing customer relationships. 34 North currently supports clients that are using the commercial OpenNRM for education purposes (2018, Russian River and Petaluma Watersheds). Trade show feedback (AGU 2017) and Watershed events have also added to the market validation. But the biggest driver is the request by our clients for new features. We receive regular requests to simplify the application so that it can be more of an education tool and less of management tool for trained managers and scientists. Further validation has come from our education "road show". 34 North has demoed the concept to several schools and response has been positive, resulting in pilot schools to begin the commercialization process. All of these market forces above have consequently given us reason to take a step back and explore the education market and commercialization viability in earnest.

Preliminary Watershed Data Lab Business Model

(Based on experience selling to commercial and nonprofit entities)

The first phase business model will be tested as a cloud subscription services to the WDL application. Market tested pricing below is currently in the process of GSA commercial price classification. All revenue modeling use the low end of the ranges below.

Set up Fee: \$30,000-\$150,000 (Custom services to get application up and running for a single entity)

Monthly Subscription: \$1,500-\$5,000 mo (Hosting, Server Maintenance, Storage, Data Transfer, Support and Software Subscription. Due at the beginning of each month, paid by credit card. No subscription fee during preview period).

Data Services: \$200-\$500 month (Specialized Data)

Training: \$1,500 onsite, one day

Professional/Custom Development Services: (Billed Hourly on a contract basis)

The Competition

The WDL fills a relatively unsaturated market niche. In the initial stages of concept development, we sought to identify existing environmental education tools and technologies which have been developed for use in the classroom and have found few potential competitors. We continue to monitor the progress of

the identified applications, with the goal of advancing our product and ensuring that it brings innovation to the market. The majority of the products we identified as competition are either geospatial software companies or field based educational software applications. These major competitors' products are modified from professional use to fit into classroom learning environments. The GIS applications (ESRI, CartoDB) generally have a steep learning curve, and are often too complex for younger students. The main limitation of these products is the singular focus on geospatial data. We have found no products that fully manage and integrate the diversity of content at a thematic level. The combination of geospatial data, sensor data, photos, documents, wikis and data story templates is critical to complete curriculum support and cross disciplinary learning. The localized collection of data and information to retain valuable school intellectual property and the ability to archive and redistribute also ensures that the safety and security of students is safeguarded.

Market Challenges

34 North has been working in collaborative natural resource management for more than 15 years. The mission of our company has always been to create solutions that will help solve important issues facing our planet. The problem with this mission is that the market has yet to value these efforts like they value social media platforms, convenience applications or popular web enterprises. In that regard, what we are trying to accomplish will be difficult. In the environmental science market, return on investment does not meet traditional venture capital standards which make raising money and capitalization difficult. However, the emergence of venture philanthropy is changing this paradigm. We see opportunities in the venture philanthropy space but only after further development of the product is completed and successful market penetration is achieved. Even with these challenges, we believe that this effort is important for our youth, for employers and for the planet.

Like any technology platform, additional commercialization challenges will be related to user adoption. We are addressing this challenge head-on and from the beginning using the following strategies:

- a. The pilot platform will be compatible with mobile devices. Mobile access using responsive design and cross platform apps (IOS and Android) will reduce barriers to entry for schools with limited information technology resources.
- b. Pre-loaded content: Working with current 34 North content (IP), content partners and watershed program science content, the basic release of the platform will include environmental data, species, vegetation, land use and thematic content ready to use. This strategy can eventually become an optional pay data service for premium content.
- c. Field data wizards and exceptional user templates: A good portion of the phase 1 commercialization approach will be the implementation of baseline watershed science data collection and visualization interfaces. A minimum of 2-3 user experiences templates to encourage product adoption can significantly improve a products chances at success.

Commercialization Approach (Phase 1)

The Watershed Data Lab commercialization strategy approaches the market in 4 ways:

1. Targeting watershed groups and the schools they work with: Watershed groups (currently underway) have established relationships and existing programs working within the public school system. This strategy initially builds on the "Watershed Program" big picture platform and creates product familiarity within the schools. The platform will be mobile friendly so that all users can easily add or access data, no matter their resource access. The watershed group will create a bridge into the public school district without a direct sales team.
2. Targeting independent school and charter schools: The independent and charter school market has fewer barriers to entry than the public school sector. These schools have the resources for

rapid deployment and integration with existing curriculum. The expertise and know how derived from this market will create economic saving when preparing for the public school sector. We currently have pilot programs underway in both an independent school and a charter school in a disadvantaged community.

3. Targeting existing learning platforms for licensing/acquisition: (IBM, Summit). This strategy creates a direct path to the public school system by leveraging existing marketing and sales channels.
4. Target Public School Districts in areas with strong watershed groups: With the acquisition of new resources, 34 North will begin implementation of a Central California effort. We currently have required datasets to content to begin the effort. We envision this effort include Watershed programs and universities (UC Merced). The Central Valley is vast and contains the largest disadvantaged community and poverty level in the state. The benefits of this area however is that it is located at the base of the Southern Sierras which provides ample opportunity for experiential learning and participation in the stewardships of one of the State's natural treasures.

Revenue Potential and Resources Needed

Watershed Data Lab Commercialization Revenue Worksheet

	Year 1	Year 2	Year 3	Year 4	Year 5
		Break Even Year			
Grant Revenue	225,000	775,000			
New Watershed Data Lab Instance Sales	3	8	10	15	20
Set up/Licensing (School or watershed program, base instance \$30K)	\$90,000	\$240,000	\$300,000	\$450,000	\$600,000
Monthly Subscription Revenue (\$1,500 mo.)	\$54,000	\$198,000	\$378,000	\$648,000	\$1,008,000
Data Services (Subscription Sevics to Premium Content and Data \$300 mo.)	N/A		\$36,000	\$54,000	\$72,000
One Day Training Sessions	\$4,500	\$12,000	\$15,000	\$22,500	\$30,000
Professional Services	\$9,000	\$24,000	\$30,000	\$45,000	\$60,000
Total Product Revenue	382,500	1,249,000	723,000	1,165,500	1,698,000
Total Product Revenue and Grant Revenue	607,500	2,024,000	723,000	1,165,500	1,698,000

Watershed Data Lab Resources Needed

	Year 1	Year 2	Year 3	Year 4	Year 5
New Watershed Data Lab Instance Sales	4	8	10	20	25
Additional Technical Team Personnel	1	2	3	6	6
Salary \$65,000 plus 20%	\$78,000	\$156,000	\$234,000	\$468,000	\$468,000
Sales, Marketing, Training Personnel	1	3	3	4	4
Salary \$75,000 plus 20%	\$90,000	\$270,000	\$270,000	\$360,000	\$360,000
Hosting Facilities (\$500 per instance direct cost)	\$2,000	\$4,000	\$5,000	\$10,000	\$12,500
Additional Overhead (15%-20% of salaries, includes office and equip)	\$33,600	\$85,200	\$75,600	\$124,200	\$124,200
Personnel and Overhead Resources	\$203,600	\$515,200	\$584,600	\$962,200	\$964,700
Total Additional Resources	\$203,600	\$515,200	\$584,600	\$962,200	\$964,700
Estimated Profit	\$403,900	\$1,508,800	\$138,400	\$203,300	\$733,300
Total Schools/Watershed Groups in 5-Years	56				

The goal for the first year is the implementation of 3 WDL instances (pilots). These concepts are currently in incubation with participation from the SRWP and 2 schools. Initial conversations regarding commercialization of the product has been disclosed to collaborators and the budgeting is being discussed within those organizations. 34 North has an additional list of 50 target schools within the SRW and Tahoe regions that we will pitch by June 2019. We expect to have a working pilot as early as February 2019 that will facilitate sales. 34 North is currently staffed with resources to implement pilot projects and begin marketing and sales efforts. Adding 2 employees will help us to excel at the user interface development aspects of the project and develop marketing. Toward the end of year 1, 34 North plans to reveal WDL at 2 education conferences.

The Innovation

The Watershed Data Lab concept revealed itself organically through participation with academia in the natural resource management field. 34 North's proprietary platform, OpenNRM, is currently used for natural resource management throughout the State of California (Bay Delta Live 2018, Sacramento River Watershed Portal 2018, San Joaquin River Real Time Management 2018, California Estuaries Portal 2018) and is also deployed as a management tool for the environmental services industry. The core technology is sound and functional. The OpenNRM core runs enterprise resource management collaboratives for The United States Bureau of Reclamation, Metropolitan Water District of Southern California, California Department of Water Resources and others. Client's use the platforms for environmental data collection, processing, analysis and display. The products aggregate and display data to report on fisheries, water quality, real time conditions, water operations, restoration and project management. Regular outreach and marketing of OpenNRM within the industry has drawn the attention of the education community. As a result, we have dedicated personnel and resources to further the development of WDL. To date we have prototype components in development and a pilot project that includes teachers, school directors, parents and an advisory board. Throughout this pilot we have established critical next steps for development that are discussed in this proposal.

The vision of the WDL is an adaptable educational tool designed to complement environmental science and data science curricula by providing a platform to access, reference and manage field work as digital environmental data and information. Within the theme of Watershed Science, the WDL will guide students through all steps of the data management process: data collection, standard development (metadata), data management plan, data storage and organization, QA/QC, data queries and searches for related data (within the content management system). Students become data scientists, accelerating their growth and readiness for the workforce where data literacy is critical in nearly all STEM and non-STEM careers. The tool seamlessly manages both student collected and external datasets (publicly available), and provides a platform for data synthesis and big picture understanding through modern data story templates, visualization tools and analytics. Using existing curriculum and field study results, teachers will have access to tools to help teach students how to interpret and apply their data. The WDL addresses a widespread educational need to better incorporate data science, computational skills and analytical thinking into core curriculum. The product is hosted as a web-based portal, accessible by a single school, district or educators everywhere. In its current phase, the WDL has been developed in accordance with Next Generation Science Standards and close interaction with partner schools. Agile development will allow for modifications to meet the needs of specific schools.

The key challenges to implementing the first WDL pilot will be in the implementation of the user interfaces that will drive interaction between the field studies, data science and school curriculum. The core application currently supports field data collection, and the challenge will be adding wizard like interfaces that will support the student through all stages of the data management life cycle. By aligning science curriculum with basic watershed assessment topics and existing protocols (water quality, forest health, species, biodiversity, human activity) we can create interfaces that supplement topics and well as provide the tools to measure them. For example, many teachers use hand-outs to collect data and make assessment throughout their field study. The application can mimic this process and also extends that hand-outs life cycle. We will manage this challenge by working closely with educators and existing curriculum to develop strategies to complement and enhance what the teachers are already doing.

34 North founders have a personal mission to open source the core components to OpenNRM. Our experience in natural resource management and environmental science has demonstrated that people on the ground need the tools and but do not always have the resources to buy them. While what we are

proposing to develop here has significant commercialization potential, there is also opportunity to impact the future of our earth by offering some of what we do to the open source software community. 34 North currently has 5 processes/ideas in draft form for patents. At this stage, we are evaluating our mission to make a difference and securing patents. The next year will determine this trajectory. We understand the importance of both options available to us.

This project does not have roots in any NSF/SBIR funding.

The Company/Team

34 North, founded by Nathan Hemenway, Amye Osti, and David Osti, specializes in the intersection of technology, natural resource management and public policy. 34 North is responsible for bringing the OpenNRM collaborative natural resource management data platform to market and building a vibrant open data community. The company is now a leading provider of data management solutions for the State of California. The OpenNRM Enterprise Data Platform is used to manage large scale multi-agency efforts between USGS, USFWS, USBR, USACE, MWD, DWR, CASWRCB, EPA and many others in the California Delta, San Joaquin River and Sacramento River Watersheds.

Over the past year, the 34 North team has immersed itself into applications of watershed science for education. Key staff members have participated, organized, and led in multiple field events (Earth Day Expedition, Truckee River Watershed Snapshot Day, SnoWhat? Lake Tahoe to Pyramid Lake Expedition, Forest Restoration, and a Summer Bird Challenge). Involvement in these field campaigns has increased the team's knowledge of environmental education curriculum, student capacity, and teacher needs. Being a team of career scientists, the project team has also spent countless hours researching data science, environmental science, environmental education curriculum and teaching methods. Additionally 34 North has adopted local streams for monthly water quality sampling. These real world monitoring efforts, the data collected, and volunteers have become an integral part in developing the Watershed Data Lab concept. Each member of the project team has a passion for environmental stewardship and the education of tomorrow's leaders. With that goal in mind, we have developed and researched the ideas behind the Watershed Data Lab.

The members of the Watershed Data Lab Team have a variety of expertise in the sciences (Computer Science, Environmental Science, Sociology, Natural Resources Management, Geography, Ecology, Forest Management, Hydrology and Political Sciences) and each has spent their career synthesizing their primary field with computer and data science. Each member understands the need to develop scientifically sound and easy to use technologies for education.

The members of this team are not new to each other, having worked together for a number of years. Because of these working relationships in bringing other OpenNRM Products to market the team is not unfamiliar with the work and effort needed to bring the Watershed Data Lab to market. The team, led by Amye Osti works in a collaborative development environment for testing and production. Using project management software the team is able to track progress, log bugs and tasks, and maintain schedules. Members of the team are familiar with the project tracking software and have used it successfully in past efforts to bring Products to market. Stable and supported data platforms using the OpenNRM software stack include:

Sacramento River Watershed (SRW) Data Portal: Sacramento River Watershed Portal (Sacramento River Watershed Portal 2018) released in 2015 is a collaborative community of interests with the goal of expanding open and transparent sharing of information to better manage the Sacramento River

Watershed and Extensive Forest Restoration efforts. The multi-stakeholder effort was developed and is currently updated and managed by the SRW Monitoring Council. Authors include staff from the following organizations: 34 North (Nathan Hemenway), Sacramento River Watershed Program, California State Water Resources Control Board, California Department of Water Resources, CalFire, California Fire Safe Councils, United States Forest Service, Battle Creek Conservancy, U.S. Fish and Wildlife, Regional Conservation Districts, Integrated Regional Water Management Programs and University of California.

Bay Delta Live (BDL): Bay-Delta Live (Bay Delta Live 2018) released in 2016 is a collaborative community of interests with the goal of expanding open and transparent sharing of information essential in understanding the complex and dynamic ecosystem of the Sacramento-San Joaquin Bay Delta. The multi-stakeholder effort was developed and is currently updated and managed by a multi-agency workgroup. Authors include staff from the following organizations: 34 North (Nathan Hemenway), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, National Marine Fisheries Service, National Oceanic Atmospheric Agency, California Water Districts, California Agriculture, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.

The California Estuary Portal: The California Estuary Portal (California Estuary Portal 2018) was released in March of 2018 to the public is part of the State of California initiative to report water quality and watershed health, data and information to the public. Authors include staff from the following organizations: 34 North, California State Water Resources Control Board, California Department of Water Resources, United States geological Survey, The Bay Institute, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.

Within 5 years 34 North will continue to be a leader in natural resources management for the State of California. The Water Data Lab, will be developed, stable and profitable. Profits will begin in year 3 of the 5 year plan. After 5 years, 34 North has set an ambitious goal to sell 50 instances of the WDL. (For more detail on the commercialization plan see Table 1). We will capitalize on our efforts, relationships and reputation in California, expanding to regions of the state where we have good watershed knowledge and data streams (Sacramento San Joaquin Bay Delta, San Joaquin River Watershed, California Estuaries), scaling as needed.

The project team is currently working on the WDL concept and anticipates incorporating this project at an increased pace by Fall 2018. Over the following 6 months the average team member will devote 35% of their time to the Development of the Water Data Lab. The project will have one full time project coordinator and one full time IT staff member. Currently 34 North is contract by private entities and public agencies to continue watershed data work in the amount of \$700,000. We anticipate that 35% of this work can be applied toward the technical or data development of WDL. 34 North develops all projects to maximize economies of scale. One of our promises to our customers is that if one customer invests in a feature upgrade or a new dataset (34 North open data initiatives), we do everything we can to make it available to everyone.

Technical Discussion

Our proprietary technology is a comprehensive data and information management platform that will support the development of next generation STEM skills through problem based inquiry of the natural world. The WDL will provide schools, which may lack the resources and expertise, with the ability to easily incorporate key science and engineering practices into their curricula such as geographic information systems, cataloguing, experimental design, field data collection techniques and protocols, and data

QA/QC procedures. The platform includes integrated analysis tools and an interactive Geographic Information System (GIS) platform, which will allow teachers to develop cross-cutting lesson plans that require analytical thinking and problem solving. The extensive and flexible content management system will allow students to easily search for information and data, while safeguarding their security and privacy from external online threats. Our goal is that the WDL will support inquiry into the natural world that will enforce key principles of environmental sustainability and natural resource management, while fostering environmental stewards from a young age.

The Watershed Data Lab technical task is to retool a natural resource management application for education. The pilot application will integrate key components (data, maps, documents, images, wiki and analysis tools) into one system for a comprehensive watershed view. Additional innovations will develop and integrate data science learning modules, create watershed topic templates for curriculum support and develop a novel user interface that is easy and fun to use by teachers, students and the public. Methodologies include close collaboration with partner schools and watershed groups, prototyping real world field studies, design based research and implementation of existing experiential learning curriculum.

The Key WDL components can be summarized as:

- *Mobile Application*: standard mobile app available on IOS and Android for adding data from the field. Data management protocols are enforced.
- *Field Data Aggregator*: Web or mobile based field data collection tools.
- *Photos and Videos Catalogs*: Catalog supports geolocated photos, taken by students in the field and uploaded to the application. Metadata principles enforced here.
- *Document Libraries*: Student authored reports and catalogs for literature cited. Other relevant scientific research conducted in the field of study or geographic region of interest.
- *Wikis (archives)*: Informational articles created by students and participating experts. Student/Expert created wikis ensure that information is archived year to year, allowing the schools to build on and preserve well learned knowledge.
- *In Situ Data*: Student collected data (e.g. water quality samples) and publically available data (e.g. Federally managed sensor network, U.S. Geological Survey National Water Information System). Data collected in the field by students can be uploaded to the application using data submission forms. Once uploaded, that data can be visualized and analyzed using the site's integrated data and GIS tools.
- *Geospatial Data*: Student created and customized GIS in addition to hundreds of GIS layers already uploaded and relevant to the watershed/region. Key geospatial data from major GIS clearinghouses is aggregated on the site, removing the need for students to search external websites. Site specific GIS data can also be uploaded and styled by the users and incorporated into the application. The GIS platform includes basic geoprocessing capabilities, including spatial queries, distance and area measurements, and buffer analyses.
- *Interactive Maps*: Student and expert created maps with informative base maps and GIS layer overlays. GIS layers can be combined by students to create informative maps that can be saved or exported as images.
- *Graphs and Visualizations*: Student created graphs and visualizations using student collected data or external data.
- *Data Story and Map Story Templates*: Simple data and map story development. The applications use a novel "basket" concept to gather content from the platform catalogs, libraries, wikis and data repositories.

We have develop the following technical road map description for successful conversion and enhancement to the application for the education market:

Feature Enhancements for Easy Set up of WDL Instance

By using the components outlined above the customer can add information created by teachers, experts or students for students to discover. The application will provide the school/teachers/students with user interfaces to set up the platform and add data. The set up provides a 40 hours of technical assistance to get this process started, but the introduction tools with get anyone started. A complete content development process for a WDL instance will reduce time spent sifting through internet search results while keeping students safe from some of the unsavory content sprinkling many learning sites today. Students will have access to facts and spend their time proposing and testing hypothesis, not validating the information they've 'googled'. All information created by students, teachers or experts can be publicly available (choice is left up to the school or classroom). Public data can be viewed and used by students in other classrooms and for years to come. The project aims to take this concept a step further by allowing schools to "publish" completed content to a centralized learning repository for all schools to use and learn from.

Feature Enhancements for Data Collection and Field Study Support

Data Collection Protocols and Tools

The WDL platform will augment field-based STEM learning with data science. Before, during and after the field campaigns students will complete interactive data lifecycle exercises to understand the importance of data protocols and standards. The module will simplify data science concepts for student application to data collection. Prior to data collection students will learn about Data Management Plans (Environmental Protection Agency 2002, Environmental Protection Agency 2013, Hunt et al. 1996, U. S. Geological Survey 2018, River Network 2018, Alberta Biodiversity Monitoring Institute 2015, U.S. Fish and Wildlife Service 2013, U.S. Geological Survey 2018, MIT Libraries 2018, Australian National Data Service 2018, University of Oxford 2013) through a simple learning module. The development interactive web pages in a storytelling template will provide a referenced description of data, protocols and data management plans. We will develop this section with our collaborators, followed by peer review. Knowledge of and use of these data techniques will ensure that student collected data can be successfully archived and used later by other classrooms and students, creating a snapshot of watershed health. Through template data uploaders students will upload their own data and metadata. Templates will be built based on known field data collection programs (3C Institute 2018, ProjectWILD 2018, Nature Mapping 2018, Open Data Kit 2018, Every Kid in a Park 2018). Data uploaded via templates will be available in machine readable file formats for output and analysis.

Subject Matter Research, Curriculum Integration and Template Development

We are currently developing a set of WDL templates based on specific watershed science use cases and topics. The grant will support the implementation of these concepts, with the final deliverable being a set of templates that can quickly be deployed to other WDL instances. Currently, the four primary WDL templates are as follows:

1. **Water Quality:** This template will integrate water quality data collected and uploaded by students. It will contain a mapping application describing hydrologic features and water quality sample locations. The water quality data will be hosted on the platform, and students will be able to analyze, visualize and interpret the data using a set of graphical and statistical tools. The

template will allow students to assess and monitor water quality conditions within their local watershed.

2. **Forest Health:** This template will use GIS data to enable students to explore and analyze forest health conditions in their watershed. Geospatial layers will include tree point files, canopy cover datasets, fire hazard risk models, vegetation models, historic fire perimeters, insect and disease risk layers, and more. The template will enable students to synthesize data and information in order to communicate a story about forest conditions.
3. **Species Distribution and Abundance:** This template enables students to record species observations across their watersheds, and synthesize the data to understand species distribution. A mobile application is being developed so that students can efficiently record local observations on their mobile devices. This template will include geolocated observations, with curated information on wildlife species' natural history.
4. **Watershed Health:** This template will provide a synthesis of available watershed conditions data, allowing students to derive assessments on overall watershed health. The template will include a comprehensive geospatial data inventory and access to the region's in-situ sensor network data. The students will be encouraged to analyze how conditions have changed over time, build story maps and data visualizations, and synthesize their findings in interactive reports.

This technical task requires working closely with our teacher and schools to ensure the templates meet their needs. These templates will be refined to support the common core and NGSS standards. The objective is to ultimately produce a set of templates that can be easily enhanced or modified to meet local curricula, avoiding the need to design new templates from scratch.

User Interface Enhancements

OpenNRM Software, the foundational software and data management system for the WDL, has undergone years of development and is currently deployed as a natural resource management/watershed management application. The software was initially built for professional users, but as the application has gained more market exposure it has often filled a gap in the education field. We often find ourselves using the platform to educate a variety of watershed stakeholders about current conditions, fisheries, water quality, GIS and more. As such, we foresee technical challenges in curriculum implementation, student learning and retention tracking, development of the student and teacher interface, teacher user training, and scaling to include a significant number of schools. Pilot studies, currently ongoing, are helping to identify these challenges and techniques to customize and scale the software. Thus far, we have worked with classrooms to test the student interfaces with multiple data collection events, data input, and data analysis performed by students at several grade levels. The next step in our testing will involve teachers; aligning teaching topics with 'Course Blueprints' and teachers needs for successful student tracking.

We intend to make the WDL useful for students with a wide range of abilities and technical proficiencies. To accomplish this goal, the WDL must be a flexible program with variable levels of user permissions and associated tools. Determining how to tailor the WDL features to these different user and grade levels will be an iterative process that involves substantial user testing and feedback.

Data Management

The WDL relies on both student collected data and existing data networks. We will need to explore database schema that allow the student portals to share and partition data where needed. It is essential that we make data open and available to students for use and research without overwhelming the students with the amount of data. Teaching students about data access and data management will be a crucial element in the database structure. We will investigate the development of tools to teach students

how to manage and share their own data, search for related data, and access metadata for determination of data interoperability. These lessons and tools will be tailored to grade level.

Teacher and Student Administration Interface

Using an extensive association matrix interface, phase 1 of the project will document the requirements for developing a user administration interface for managing content and students. The objective is to create a visual schematic of each student's activity and its associations. The views can be parsed into student view or teach view. The teacher view allowing teachers to monitor and track student progress virtually and in real-time. This way teachers can quickly identify students who need extra time or support to complete the task. Working with our school partners, we will develop a teacher interface where the instructor can actively monitor students' progress and identify steps to take to keep all students on target of their learning goals. The development of 'Course Blueprints' (a priority deliverable of this project) in watershed subject areas will be based on the Next Generation Science Standards that help students acquire the critical thinking, research, reading, writing and presentation skills. Contextual help systems will allow students to seek out help on their own where needed.

Road Map

Months 1-4: Continuing research and documentation of subject matter and curriculum integration. Develop prototype templates for these key areas. Document workflow for adding new curriculum. Make recommendation for improving this process.

Key personnel : Amye Osti, Karly Wagner, Holly Jorgensen and Brendan Palmieri

Months 1-4: Technical Development

Data collection tools and database Schema and workspace builder tool enhancements for customizing how datasets can be distributed based on the following use cases: regions, subject matter topics, teacher or school preferences, watershed questions.

Key personnel: Nathan Hemenway, David Osti

Months 1-6: User Interface, Templates and Workspace Development

User interface design and implementation, wizard set-up tools, template development

Key personnel: Amye Osti, Brendan Palmieri

Month 6: Research Documentation and Report

Complete report for submission to NSF.

Key personnel: Amye Osti and Holly Jorgensen

Project Concept Screenshots

Chickadee Field Guide How To Protect Birds Expert Bird Information

Osprey



Common Name: Osprey

Range/Habitat: Near the ocean floor, along major rivers

Field Marks: Osprey are brown and white below. And overall they are whiter

Behavior: Ospreys find the fish they wan't to eat, then dive down to get it, sometimes

Songs & Calls: Common call is a keeeew or kleeew. Also gives a muffled wur-wur-wur

Quick Links

American Crow Anna's Hummingbird Bald Eagle Great Horned Owl Killdeer Mountain Chickadee Northern Flicker

Osprey Peregrine Falcon Red Tailed Hawk Stellers Jay Western Tanager White Pelican Wood Duck



Bird Range Basemap

Figure 1: Sample template for the Tahoe Expedition Academy Summer Birding Challenge. Students provided the life history information and drawings, which were then combined with bird range maps from the USGS GAP project. This interactive map story allows students to scroll through the different bird species, and the map automatically adjusts to show the bird's seasonal range cross the United States. This template also includes a user submission form for students to submit bird observations in the local Tahoe area.

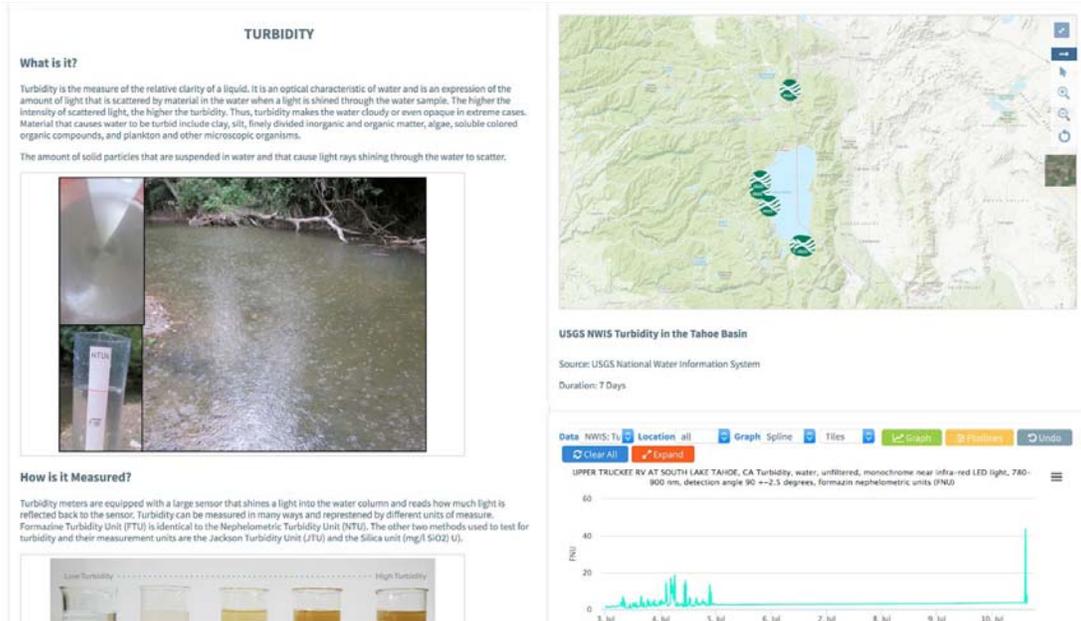


Figure 2: Turbidity overview from a 4th grade water quality monitoring template. This dashboard includes an overview of turbidity, explaining how it is monitored and why it matters. The information is accompanied by near real-time data from the USGS NWIS stations in the Tahoe Basin the measure turbidity every 15 minutes. The graphs are interactive and the data can be exported.

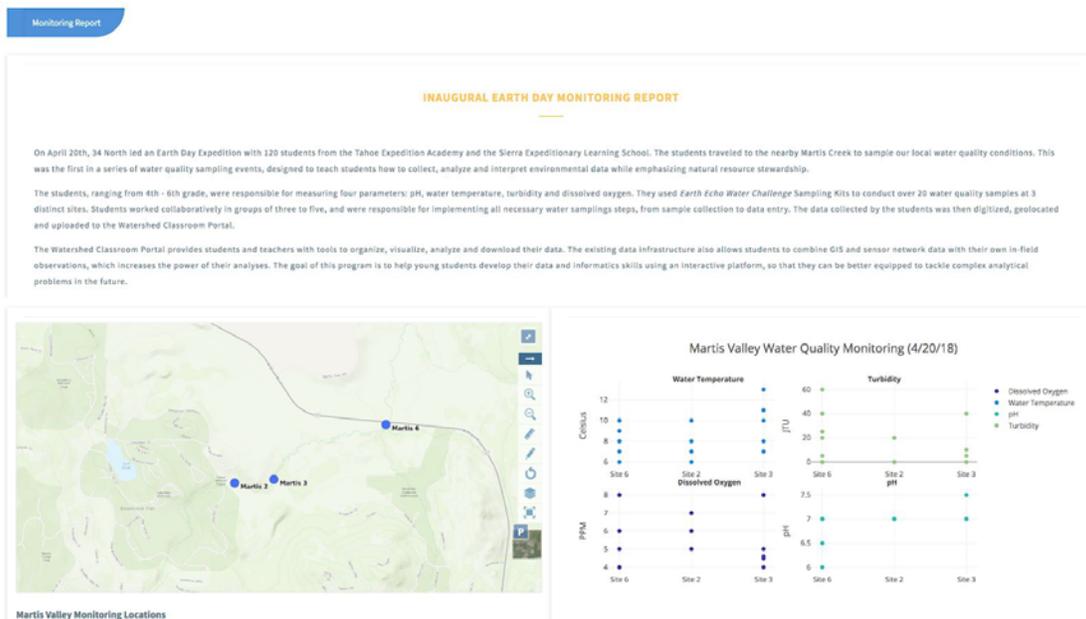


Figure 3: Earth Day Expedition water quality sampling dashboard.

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Graduate Institution: California Polytechnic State University, San Luis Obispo; San Luis Obispo, CA; MBA, and M.S. Computer Science, 2001

Appointments:

CEO and Founder, 34 North (14 years)

CEO, DEEPBLU Studios (8 years)

Director of Marketing-Entertainment, Stream Search (3 years)

Products:

1. Tahoe Expedition Academy (TEA) Watershed Classroom and Field Study Data Science Pilot Study: Working with Tahoe Expedition Academy and local stakeholders in the Lake Tahoe region, 34 North is using real world criteria and curriculum to determine feasibility of the watershed classroom data science platform. The project is located at watershedclassroom.opennrm.org and authors include: 34 North (Amye Osti), Mara Jenkins, Brendan Gants, Melanie Cooke, Jack Benter, Loren Trux, Mike Wyerman and the TEA students.
2. Sacramento River Watershed (SRW) Data Portal: Sacramento River Watershed Portal (srwp.opennrm.org) released in 2015 is a collaborative community of interests with the goal of expanding open and transparent sharing of information to better manage the Sacramento River Watershed and Extensive Forest Restoration efforts. The multi-stakeholder effort was developed and is currently updated and managed by the SRW Monitoring Council. Authors include staff from the following organizations: 34 North (Amye Osti), Sacramento River Watershed Program, California State Water Resources Control Board, California Department of Water Resources, CalFire, California Fire Safe Councils, United States Forest Service, Battle Creek Conservancy, U.S. Fish and Wildlife, Regional Conservation Districts, Integrated Regional Water Management Programs and University of California.
3. Bay Delta Live (BDL): Bay-Delta Live (www.baydeltalive.com) released in 2016 is a collaborative community of interests with the goal of expanding open and transparent sharing of information essential in understanding the complex and dynamic ecosystem of the Sacramento-San Joaquin Bay Delta. The multi-stakeholder effort was developed and is currently updated and managed by a multi-agency workgroup. Authors include staff from the following organizations: 34 North (Amye Osti), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, National Marine Fisheries Service, National Oceanic Atmospheric Agency, California Water Districts, California Agriculture, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.
4. The California Estuary Portal: The California Estuary Portal was released in March of 2018 to the public is part of the State of California initiative to report water quality and watershed health, data and information to the public. The project is located on the web at www.californiaestuaryportal.com and https://mywaterquality.ca.gov/eco_health/estuaries/index.html. The multi-stakeholder effort was developed and is currently updated and managed by The California Estuary Workgroup

https://mywaterquality.ca.gov/monitoring_council/estuary_workgroup/index.html. Authors include staff from the following organizations: 34 North (Amye Osti), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, The Bay Institute, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.

5. San Joaquin Real Time Management Program (SJRRTM): The SJRRTM water quality management (sjrrtm.opennrm.org) portal is a collaborative community and data portal developed to support real time salinity and water quality condition in the San Joaquin River basin. The project was developed by 34 North (Amye Osti) and is managed by the United States Bureau of Reclamation. The San Joaquin River Steering committee authors data and information for regulatory reporting.
6. Azimi-Gaylon, Shakoora, Fong, Stephanie, Goodwin, Peter, Hale, Tony, Isaac, George, Osti, Amye, Shilling, Fraser, Slaweki, Tad, Steinberg, Steve, Tompkins, Mark, and Videmsky, Laci. 2015. Enhancing the Vision for Managing California's Environmental Information-Final.
7. Quin, Nigel, Osti, Amye, Herr, Joel, Wang, Jun, Raley, Elwood. 2017. WARMF-Online - A Web-Based Portal Supporting Real-time Salinity Management in the San Joaquin River Basin. *Open Water Journal*. 4 (1) 33-49.
<https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?referer=https://duckduckgo.com/&httpsredir=1&article=1006&context=openwater>
8. Salinity Management Data Tool: Tool provides Delta scientists and water managers with in-depth analysis of salinity conditions in the Delta. By synthesizing hundreds of remote and localized data sets and web services users can develop a common operating picture to support water managers. Data products include operation dashboards and analytics, live conditions data visualizations and spatial contour maps of point time series data based on linear interpolation for the Sacramento-Bay Delta.
9. NMFS NOAA / USFWS Biological Opinions and Reasonable and Prudent Alternatives: Decision Support Data tools: Develop and maintain data dashboards is to provide the Delta Operations for Salmonids and Sturgeon and Smelt Working Group technical teams with a platform for visualizing, comparing and analyzing data from surveys and real-time monitoring. The dashboard would move beyond real-time data to real-time synthesis by providing an interactive and collaborative tool for developing and testing new hypotheses about fishery responses to water operations in the San Francisco Estuary.
10. Cache Collaborative Data Channel: The development of the Cache Collaborative data channel on allows for individual researchers to upload, share and comment on the data. The data channel creates a forum for dialogues between PIs about QA/QC, method changes, conditions at the time of data collection, express concern about current conditions, include field photos, and for feedback from their colleagues. In addition, stakeholders will have access to data analysis tools to perform preliminary analysis on their own and other's data, coupled with real time delta conditions. When dealing with such a complex and dynamic system it is necessary to utilize the data to its fullest potential, which is possible through data sharing and near real-time data analysis.

Synergistic Activities

1. Contributing Member of the California Data Management Workgroup. Participate in content development for informing California water Managers of Data Science practices.
2. Contributing member of the California Estuaries Monitoring Workgroup Member, responsible for creation of the Estuaries Portal on the State of California my Water Quality Website.
3. Contributing Member of the Sacramento River Watershed Monitoring Committee.

Nathan Hemenway

Professional Preparation:

Undergraduate: The School of the Art Institute of Chicago B.F.A., 1989

Graduate: Massachusetts Institute of Technology; Cambridge, Massachusetts; M.S. in Visual Studies, Art and Technology; 1991

Appointments:

CTO and Founder, 34 North (14 years)

Director of Operations and Production, NBCX (2 years)

Director of Technology, TheThreshold.com (2 years)

NBCUniversal, Inc. (2 years)

Products:

1. Tahoe Expedition Academy (TEA) Watershed Classroom and Field Study Data Science Pilot Study: Working with Tahoe Expedition Academy and local stakeholders in the Lake Tahoe region, 34 North is using real world criteria and curriculum to determine feasibility of the watershed classroom data science platform. The project is located at watershedclassroom.opennrm.org and authors include: 34 North (Nathan Hemenway), Mara Jenkins, Brendan Gants, Melanie Cooke, Jack Benter, Loren Trux, Mike Wyerman and the TEA students.
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https://mywaterquality.ca.gov/monitoring_council/estuary_workgroup/index.html. Authors include staff from the following organizations: 34 North (Nathan Hemenway), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, The Bay Institute, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.

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6. Al Wunderlich, Dana Boyd, Joe Davis, Michael Shia, Sarah Zehr, Rob Stupay, Curtis Lockshin, Elena Guipponi, Nathan Heminway, Jude Robinson, Shuguang Zhang. 1995. The Riddle of Life - Group Exhibition of Artworks concerning the DNA Molecule and a Brief Episode in its history - Tichnor Lounge/Boylston Hall Harvard.
<https://profiles.nlm.nih.gov/ps/access/BBADHL.pdf>
7. Nathan Hemenway. 2002. A Video Compression Scheme using Audio Frequency Analyses, or Voice Recognition.
<http://www.kksbolash.com/paintings/bio/compression.html>
8. Nathan Hemenway. The Bomb Project - A composition determined from data available from the OKLAHOMA GEOLOGICAL SURVEY OBSERVATORY CATALOG OF NUCLEAR EXPLOSIONS which is a CATALOG OF KNOWN AND PUTATIVE NUCLEAR EXPLOSIONS FROM UNCLASSIFIED SOURCES. 2003.
<http://kksbolash.com/teeter/bomb/>
9. Nathan Hemenway. 2003. Teeterings Algorithmic image creation using shape grammars to capture simple stacking procedures, San Diego SIGGRAPH
<https://www.siggraph.org/s2003/conference/art/2d.html>,
<http://kksbolash.com/teeter/shapes/>
10. Nathan Hemenway. 2008, F.A.R.M: Friendly Animal Recognition Machine.
<http://www.kksbolash.com/farm/imaging.html>

Synergistic Activities:

1. Contributing Member of the California Data Management Workgroup. Participate in content development for informing California water managers of data science practices.
2. Contributing member of the California Estuaries Monitoring Workgroup Member, responsible for creation of the Estuaries Portal on the State of California my Water Quality Website.
3. Contributing Member of the Sacramento River Watershed Monitoring Committee.

Holly Jorgensen

Professional Preparation:

Undergraduate Institution: California State University, Chico; Chico, CA; B.S. in Natural Resources Management and a B.A. in Sociology; 2004

Graduate Institution: California State University, Chico; Chico, CA; M.A. in Geography with an option in Environmental Policy and Planning, 2016

Appointments:

Executive Director, Sacramento River Watershed Program (7 years)

Watershed Coordinator, Deer Creek Watershed Conservancy (7 years)

Watershed Education Coordinator, Cottonwood Creek Watershed Group (0.5 years)

Products:

1. Sacramento River Watershed (SRW) Data Portal: Sacramento River Watershed Portal (srwp.opennrm.org) released in 2015 is a collaborative community of interests with the goal of expanding open and transparent sharing of information to better manage the Sacramento River Watershed and Extensive Forest Restoration efforts. The multi-stakeholder effort was developed and is currently updated and managed by the SRW Monitoring Council. Authors include staff from the following organizations: 34 North, Sacramento River Watershed Program, California State Water Resources Control Board, California Department of Water Resources, CalFire, California Fire Safe Councils, United States Forest Service, Battle Creek Conservancy, U.S. Fish and Wildlife, Regional Conservation Districts, Integrated Regional Water Management Programs and University of California.
2. Conference Organizer of the Sacramento River Watershed Program Annual Stakeholder Meeting and Watershed Forum, 2015, <http://sacriver.org/events/srwpevents/2015-srwp-annual-stakeholder-meeting-and-watershed-forum>
3. Holly Jorgensen, Project PI, Butte Forest Thin – Doe Mill Ridge Watershed Project uses forest thinning and low intensity prescribed fire to treat 227 acres of public land managed by the Bureau of Land Management (BLM) between Little Chico Creek and Butte Creek in the Sacramento River watershed. The project conducted pre- and post-monitoring to examine how pre-fire fuel reduction restoration treatments affect fire severity and improve forest health.
4. Holly Jorgensen oversaw and Organized *Wildfire Community Preparedness Day* with the Forest Ranch Fire Safe Council that included presentations, a field trip, and demonstrations on the use of fire safety tools. During this event, community members learned about fire behavior, regulations associated with burning, and tips and guidelines on the use of prescribed fire activities.
5. Holly Jorgensen worked to produce a 16-page newspaper insert titled *A Journey through the Sacramento River Watershed*. This informational insert was designed with students in mind and outlined key watershed issues ranging from “What is a watershed?” to “The Life of a Salmon”. Each component was paired with graphics, illustrations and interactive activities. It included word searches, trivia games, and guides for field based learning activities. In addition, it outlined tangible steps for students to take to reduce their impact on the local watershed. The insert was highly successful, with over 290,000 copies printed and distributed. The insert was also provided to 677 teachers at 406 schools, and the teacher’s guide was downloaded by 710 teachers

6. *Sacramento River Basin Report Card & Technical Report*. This comprehensive educational document was created by a diverse group of scientists and managers with the goal of providing watershed stakeholders with the information necessary for good watershed management. The Report Card is a science-based solution to a social and management need that measures aspects of the whole integrated system relative to stakeholder goals. It reports on the system using regionally-important and science-based indicators. This educational tool has served as a valuable resource for managers and stakeholders to understand the status and trends of key indicators within the watershed.
7. Holly Jorgensen, Organizer: *Restoring Balance in Our Forested Watersheds*. Workshop series on the history of fire in the Sacramento River Watershed. During these workshops, experts from CAL FIRE, CSU Chico, and local Fire Safe Councils speak about the current conditions, management challenges, and efforts to safeguard communities and the environment against catastrophic fires. These workshops have been hosted in the communities of Oroville, Forest Ranch and Paradise.
- 8.

Synergistic Activities

1. California Water Plan (CWP) Update 2013: Participated as a member of the *Sacramento River Forum* and the *Watershed Management Caucus* for this collaborative process to help develop content for the CWP through place-based dialog and subject matter discussions.
2. Lead Member of the Sacramento River Watershed Monitoring Committee: Responsible for the coordination and collaboration of monitoring activities (water and terrestrial) within the Sacramento River Watershed.
3. Community Action Volunteers in Education (C.A.V.E.): Elementary School Environmental Program - Designed environmental lesson plans for presentation to students.
4. Water Education Foundation (WEF) Water Leader.

David Osti

Professional Preparation:

Undergraduate Institution: California Polytechnic State University, San Luis Obispo; San Luis Obispo, CA; B.S. Landscape Architecture/GIS; 1994

Appointments:

President and Founder, 34 North (20 years)

Products:

1. Tahoe Expedition Academy (TEA) Watershed Classroom and Field Study Data Science Pilot Study: Working with Tahoe Expedition Academy and local stakeholders in the Lake Tahoe region, 34 North is using real world criteria and curriculum to determine feasibility of the watershed classroom data science platform. The project is located at watershedclassroom.opennrm.org and authors include: 34 North (David Osti), Mara Jenkins, Brendan Gants, Melanie Cooke, Jack Benter, Loren Trux, Mike Wyerman and the TEA students.
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3. Bay Delta Live (BDL): Bay-Delta Live (www.baydeltalive.com) released in 2016 is a collaborative community of interests with the goal of expanding open and transparent sharing of information essential in understanding the complex and dynamic ecosystem of the Sacramento-San Joaquin Bay Delta. The multi-stakeholder effort was developed and is currently updated and managed by a multi-agency workgroup. Authors include staff from the following organizations: 34 North (David Osti), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, National Marine Fisheries Service, National Oceanic Atmospheric Agency, California Water Districts, California Agriculture, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.
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6. Osti, David, Grossinger, Robin, Safran, Sam, Robinson, April, and Erica Spotswood. 2014. "Delta Historic Ecology Animation." <https://www.youtube.com/watch?v=JrLajuif3Ww&feature=youtu.be>, Develop electronic 3D model of the historical Sacramento-San Joaquin Delta (circa 1800). that can be used to render high-quality animated still images and flyover videos of the historical landscape at any Delta location.
7. "Sacramento-Delta Earthquake and Salinity Intrusion Model and Animation." <https://www.baydeltaalive.com/docs/2120>, Product Description: In 2014, Dave Osti of 34 North in collaboration with John DeGeorge of RMA, created a series of animated computer models to help managers, stakeholders, and the public understand the issues California faces when a catastrophic earthquake hits the Sacramento Bay Delta. Mr. Osti embedded the RMA salinity intrusion model into a 3D perspective animation to engage the viewer into an immersive visual experience.
8. Cache Collaborative Data Channel: The development of the Cache Collaborative data channel on allows for individual researchers to upload, share and comment on the data. The data channel creates a forum for dialogues between PIs about QAQC, method changes, conditions at the time of data collection, express concern about current conditions, include field photos, and for feedback from their colleagues. In addition, stakeholders will have access to data analysis tools to perform preliminary analysis on their own and other's data, coupled with real time delta conditions.
9. Burau, DeGeorge, Schmutte, D. Osti, and Hemenway. 2016. "Delta Turbidity and Salinity Real Time Management Data Tool." The data tool data provides a visual interpolation and provide correlating analytics of turbidity and salinity conditions for managers, scientists, and stakeholders who aim to better understand the general hydrodynamic and water quality conditions in the Sacramento Bay Delta.
10. Yolo Bypass Salmon Passage Model and Animation: In 2010, Dave Osti of 34 North collaborated with Curt Schmutte of Metropolitan Water District (MWD) to explore the idea of increasing floodplain habitat for out migration salmon. Using advanced visualization techniques, Dave Osti create a photo-realistic GIS model and animations to be used for the presentation of the Yolo Bypass as a perfect solution for flood management and salmon restoration. <http://www.baydeltaalive.com/docs/442>

Synergistic Activities

1. Contributing Member of the California Data Management Workgroup. Participate in content development for informing California water Managers of Data Science practices.
2. Contributing member of the California Estuaries Monitoring Workgroup Member, responsible for creation of the Estuaries Portal on the State of California my Water Quality Website.
3. Data interoperability and availability analysis, research and reports for Northern California watershed science studies and monitoring. Examination of field methods, data storage, parameters sampled, and other factors to determine data interoperability and availability.
4. Contributing Member of the Sacramento River Watershed Monitoring Committee.

Brendan Palmieri

Professional Preparation

Undergraduate Institution: Stanford University; Stanford, CA; B.S. in Ecology and Evolutionary Biology; 2016

Graduate Institution: Stanford University; Stanford, CA; M.S. in Earth Systems; 2017

Appointments:

Staff Scientist, 34 North (1 year)

Research Associate, The Natural Capital Project (1 year)

Graduate Teaching Assistant, Stanford University (1 year)

Research Assistant, Dirzo Lab, Stanford University (3 years)

Products:

1. Tahoe Expedition Academy (TEA) Watershed Classroom and Field Study Data Science Pilot Study: Working with Tahoe Expedition Academy and local stakeholders in the Lake Tahoe region, 34 North is using real world criteria and curriculum to determine feasibility of the watershed classroom data science platform. The project is located at watershedclassroom.opennrm.org and authors include: 34 North (Brendan Palmieri), Mara Jenkins, Brendan Gants, Melanie Cooke, Jack Benter, Loren Trux, Mike Wyerman and the TEA students.
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Synergistic Activities

1. Contributing Member of the California Data Management Workgroup. Participate in content development for informing California water managers of data science practices.
2. Contributing member of the California Estuaries Monitoring Workgroup Member, responsible for creation of the Estuaries Portal on the State of California my Water Quality Website.
3. Contributing Member of the Sacramento River Watershed Monitoring Committee.

Karly Rodriguez

Professional Preparation:

Undergraduate Institution: University of California, Los Angeles; Los Angeles, CA; B.S. in Environmental Science; 2011

Graduate Institution: University of Nevada, Reno; Reno, NV; M.S. in Hydrological Science, 2015

Appointments:

Staff Scientist, 34 North (3 years)

Student Services Contractor, U.S. Environmental Protection Agency (2 years)

Research Associate, University of Nevada, Reno (2.5 years)

Scientific Aid, California Department of Fish and Wildlife (0.5 years)

AmeriCorps Member, Watershed Stewardship Program (1 year)

Products:

1. Tahoe Expedition Academy (TEA) Watershed Classroom and Field Study Data Science Pilot Study: Working with Tahoe Expedition Academy and local stakeholders in the Lake Tahoe region, 34 North is using real world criteria and curriculum to determine feasibility of the watershed classroom data science platform. The project is located at watershedclassroom.opennrm.org and authors include: 34 North (Karly Rodriguez), Mara Jenkins, Brendan Gants, Melanie Cooke, Jack Benter, Loren Trux, Mike Wyerman and the TEA students.
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https://mywaterquality.ca.gov/monitoring_council/estuary_workgroup/index.html. Authors include staff from the following organizations: 34 North (Karly Rodriguez), California State Water Resources Control Board, California Department of Water Resources, United States Geological Survey, The Bay Institute, Delta Stewardship Council, U.S. Fish and Wildlife and The Environmental Protection Agency.

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6. Rodriguez, K., Swanson, S., McMahon, A. 2017. Conceptual models for surface water and groundwater interactions at pond and plug restored meadows. *Journal of Soil and Water Conservation*. 72 (4): 382-394.
http://naes.agnt.unr.edu/PMS/Pubs/61_2017_22.pdf
7. Society for Range Management Annual Meeting Sacramento, CA February 2015: Poster Presentation: Groundwater Movement in Restored Meadows of the Sierra Nevada Range
8. Little Truckee River Annual Working Meeting Sierraville, CA March 2014: Poster Presentation: Surface Water and Groundwater Interactions at Pond and Plug Restoration Sites in the Sierra Nevada Mountain Range
9. NWRA (Nevada Water Resources Association) Annual Conference Las Vegas, NV February 2014: Poster Presentation: Surface Water and Groundwater Interactions at Pond and Plug Restoration Sites in the Sierra Nevada Mountain Range
10. AWRA (American Water Resources Association) Summer Specialty Conference on Integrated Water Resources Management - From Theory to Application Reno, NV August 2014: Oral Presentation Groundwater and surface water interactions at pond and plug restoration sites in the Northern Sierra Nevada Mountain Range

Synergistic Activities:

1. Project WET (Watershed Education for Teachers) Certified: Framework for teaching watershed science to elementary aged students. Includes: community outreach, student engagement - taught watershed science to students in the classroom and through project-based lessons. Community outreach through events, meetings, and workshops to engage the community in watershed science and restoration ecology.
2. Contributing Member of the California Data Management Workgroup. Participate in content development for informing California water Managers of Data Science practices.
3. Contributing member of the California Estuaries Monitoring Workgroup Member, responsible for creation of the Estuaries Portal on the State of California my Water Quality Website.
4. Data interoperability and availability analysis, research and reports for Northern California watershed science studies and monitoring. Examination of field methods, data storage, parameters sampled, and other factors to determine data interoperability and availability.
5. Contributing Member of the Sacramento River Watershed Monitoring Committee.

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION 34 NORTH				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Amye Osti				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1.	Amye Osti - PI/CEO			4.00	0.00	0.00	33,300
2.	Nathan Hemenway - CTO			4.00	0.00	0.00	33,300
3.	Holly Jorgensen - Sacramento River Watershed Coo			2.00	0.00	0.00	15,000
4.	David Osti - President			2.00	0.00	0.00	16,500
5.	Brendan Palmieri - Staff Scientist			2.50	0.00	0.00	12,500
6.	(1) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)			6.00	0.00	0.00	37,500
7.	(6) TOTAL SENIOR PERSONNEL (1 - 6)			20.50	0.00	0.00	148,100
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	(0) POST DOCTORAL SCHOLARS			0.00	0.00	0.00	0
2.	(0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)			0.00	0.00	0.00	0
3.	(0) GRADUATE STUDENTS						0
4.	(0) UNDERGRADUATE STUDENTS						0
5.	(0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						0
6.	(0) OTHER						0
TOTAL SALARIES AND WAGES (A + B)							148,100
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							0
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							148,100
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)							24,000
2. INTERNATIONAL							0
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS	\$	<u> </u>				0
2.	TRAVEL		<u> </u>				0
3.	SUBSISTENCE		<u> </u>				0
4.	OTHER		<u> </u>				0
(0) TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1.	MATERIALS AND SUPPLIES						3,500
2.	PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						0
3.	CONSULTANT SERVICES						0
4.	COMPUTER SERVICES						0
5.	SUBAWARDS						0
6.	OTHER						15,000
TOTAL OTHER DIRECT COSTS							18,500
H. TOTAL DIRECT COSTS (A THROUGH G)							190,600
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Fringe Benefits (Rate: 15.0000, Base: 148100)							
TOTAL INDIRECT COSTS (F&A)							22,215
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							212,815
K. SMALL BUSINESS FEE (IF REQUESTED MAXIMUM = 7% OF J)							10,640
L. TOTAL COST AND FEE (J + K)							223,455
PI/PD NAME Amye Osti				FOR NSF USE ONLY			
ORG. REP. NAME* Amye Osti				INDIRECT COST RATE VERIFICATION			
				Date Checked	Date Of Rate Sheet	Initials - ORG	

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
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Rodriguez, Karly - Staff Scientist	6.00	0.00	0.00	37500

SUMMARY PROPOSAL BUDGET Cumulative

ORGANIZATION 34 NORTH				FOR NSF USE ONLY		
				PROPOSAL NO.	DURATION (months)	
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Amye Osti				AWARD NO.	Proposed	Granted
					NSF Funded Person-months	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				CAL	ACAD	SUMR
1. Amye Osti - PI/CEO				4.00	0.00	0.00
2. Nathan Hemenway - CTO				4.00	0.00	0.00
3. Holly Jorgensen - Sacramento River Watershed Coo				2.00	0.00	0.00
4. David Osti - President				2.00	0.00	0.00
5. Brendan Palmieri - Staff Scientist				2.50	0.00	0.00
6. (1) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				6.00	0.00	0.00
7. (6) TOTAL SENIOR PERSONNEL (1 - 6)				20.50	0.00	0.00
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)						
1. (0) POST DOCTORAL SCHOLARS				0.00	0.00	0.00
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00
3. (0) GRADUATE STUDENTS						0
4. (0) UNDERGRADUATE STUDENTS						0
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						0
6. (0) OTHER						0
TOTAL SALARIES AND WAGES (A + B)						148,100
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)						0
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)						148,100
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)						
TOTAL EQUIPMENT						0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)						24,000
2. INTERNATIONAL						0
F. PARTICIPANT SUPPORT COSTS						
1. STIPENDS \$ _____ 0						
2. TRAVEL _____ 0						
3. SUBSISTENCE _____ 0						
4. OTHER _____ 0						
(0) TOTAL PARTICIPANT COSTS						0
G. OTHER DIRECT COSTS						
1. MATERIALS AND SUPPLIES						3,500
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						0
3. CONSULTANT SERVICES						0
4. COMPUTER SERVICES						0
5. SUBAWARDS						0
6. OTHER						15,000
TOTAL OTHER DIRECT COSTS						18,500
H. TOTAL DIRECT COSTS (A THROUGH G)						190,600
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)						
TOTAL INDIRECT COSTS (F&A)						22,215
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)						212,815
K. SMALL BUSINESS FEE (IF REQUESTED MAXIMUM = 7% OF J)						10,640
L. TOTAL COST AND FEE (J + K)						223,455
PI/PD NAME Amye Osti				FOR NSF USE ONLY		
ORG. REP. NAME* Amye Osti				INDIRECT COST RATE VERIFICATION		
				Date Checked	Date Of Rate Sheet	Initials - ORG

C*ELECTRONIC SIGNATURES REQUIRED ONLY FOR REVISED BUDGET

Lines A and B - Personnel

Nathan Hemenway, Founder and CTO. Annual Salary: \$100,000. Nathan is the lead application developer, 4 month FTE budgeted time commitment.

Amye Osti, Founder and CEO and Project PI. Annual Salary: \$100,000. As the PI Amye will oversee all project operations, lead business development and maintain the product vision, 4 month FTE budgeted time commitment.

David Osti, Founder and President. Annual Salary: \$100,000. David will lead support application development and new data acquisition, 2 month FTE budgeted time commitment.

Holly Jorgensen, Sacramento River Watershed Coordinator. Annual Salary \$90,000 Holly will be in charge of partnership development (schools and watershed groups) in the Sacramento River Watershed and report development, 2 month budgeted time commitment.

Brendan Palmieri, Staff Scientist: Annual Salary: \$60,000. Brendan will support data acquisition, product testing, and database management, 2.5 month FTE budgeted time commitment

Karly Rodriguez, Staff Scientist: Annual Salary: \$75,000. Karly will support data acquisition, product testing, and database management, 6 month FTE budgeted time commitment

Line C - Fringe Benefits

For budget purposes we calculated 15% that offers a comprehensive fringe benefits package which includes health, life, disability workers' compensation, and unemployment insurance for fringe benefits based on current payroll and benefit expenses.

Line E.1 - Domestic Travel

\$4,000 for three-day Grantee Conference in the DC area for 2 project members (PI Included)

\$20,000 for domestic travel and attendance to two additional trade shows for marketing and customer engagement. Part of this research project will determine the best education trade shows for our product. We are using \$10K per show based on past show costs.

Line G.6 - Other

\$15,000 Boot Camp

\$3,500 Materials and Supplies: Marketing material for Tradeshows and business development (brochures, pamphlets, posters, and fact sheets)

Line I - Indirect Costs

\$22,215 Fringe Benefits at 15% of Total Salaries and Wages (\$148100)

Line K - Small Business Fee

We are requesting a 5% Small Business Fee consistent with our profit margins.

Current and Pending Support

(See PAPPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Amye Osti	Other agencies (including NSF) to which this proposal has been/will be submitted.
<p>Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title: SBIR Phase I: Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM)</p> <p>Source of Support: Grant</p> <p>Total Award Amount: \$ 0 Total Award Period Covered: 09/01/18 - 02/28/19</p> <p>Location of Project: Truckee, Ca</p> <p>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Summ:</p>	

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See PAPPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Nathan Hemenway	Other agencies (including NSF) to which this proposal has been/will be submitted.
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: SBIR Phase I:Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM) Source of Support: Grant Total Award Amount: \$ 0 Total Award Period Covered: 09/01/18 - 02/28/19 Location of Project: Truckee, Ca Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Summ:	

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See PAPPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Holly Jorgensen	Other agencies (including NSF) to which this proposal has been/will be submitted.
<p>Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title: SBIR Phase I:Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM)</p> <p>Source of Support: Grant</p> <p>Total Award Amount: \$ 225,000 Total Award Period Covered: 09/01/18 - 02/28/19</p> <p>Location of Project: Truckee, Ca</p> <p>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:</p>	
<p>Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support</p> <p>Project/Proposal Title:</p> <p>Source of Support:</p> <p>Total Award Amount: \$ Total Award Period Covered:</p> <p>Location of Project:</p> <p>Person-Months Per Year Committed to the Project. Cal: Acad: Summ:</p>	

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See PAPPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Brendan Palmieri	Other agencies (including NSF) to which this proposal has been/will be submitted.
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: SBIR Phase I:Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM) Source of Support: Grant Total Award Amount: \$ 0 Total Award Period Covered: 09/01/18 - 02/28/19 Location of Project: Truckee, Ca Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:	
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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See PAPPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.	
Investigator: Karly Rodriguez	Other agencies (including NSF) to which this proposal has been/will be submitted.
Support: <input type="checkbox"/> Current <input checked="" type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: SBIR Phase I:Data Science and Experiential Learning Platform: Connecting Science, Earth Systems and Math to Local Watersheds (STEM) Source of Support: Grant Total Award Amount: \$ 0 Total Award Period Covered: 09/01/18 - 02/28/19 Location of Project: Truckee, Ca Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00	
Support: <input type="checkbox"/> Current <input type="checkbox"/> Pending <input type="checkbox"/> Submission Planned in Near Future <input type="checkbox"/> *Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:	
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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.



April 11, 2018

SUBJECT: Letter of Support for Watershed Classroom Program

The Sacramento River Watershed Program is working with the 34 North Watershed Classroom to create experiential learning programs that will benefit both the Sacramento River Watershed and Sierra Nevada teachers and schools. The program offers:

1. STEM based workshops that will help teachers understand how to bring watershed science to our students in an experiential way.
2. Guided fields studies that include water quality sampling and forest health monitoring. SRWP will work with students to visit key locations for water quality sampling, provide sampling kits, bring topic experts and record our results into the Sacramento River Watershed Data Portal.
3. SRWP will host a culminating event in the Sierra Nevada region for all participating schools on Earth Day 2019. This will be an opportunity for students to interact with children from other schools and share their knowledge and experiences.

Chico Country Day Charter School values place-based learning and is very interested in participating in the program.

Sincerely,

Wendy Fairon

Wendy Fairon, Director of Education
Chico Country Day School

102 W. 11th Street, Chico, CA 95928

530-895-2650

www.chicocountryday.org

The mission of Chico Country Day Charter School is to provide a safe, joyful community where all learners are inspired to achieve their personal best.

We are not required to have a data management plan.



The Tahoe Expedition Academy (TEA) is very excited about collaborating with 34 North Watershed Data Lab project to develop and integrate existing common core curriculum user templates for understanding watershed science and helping our students become data science learners. The collaboration and project efforts include:

1. Implementing a Watershed Data Lab instance for our school.
2. Working with 34 North to integrate TEA content and field studies.
3. Working with 34 North to integrate common core curriculum and emphasize next generation science standards.
4. Coordinate with SRWP and 34 N to develop STEM based workshops that will help teachers understand how to bring watershed science to our students in an experiential way. Developing strategies to integrate these field studies into platform.
5. Developing a data science introductory course to initiate student interactions with the WDL platform.
6. Leading fields studies (water quality sampling and forest health monitoring). SRWP, local Tahoe watershed groups and 34N will work our students to visit key locations for water quality sampling, provide sampling kits, bring topic experts and record sampling results to our Watershed Data Lab located at watershedclassroom.opennrm.org.
7. TEA will work with 34N, SRWP, local stakeholders and partner schools to host a culmination event in the Sierra Nevadas for all participating schools, Earth Day 2019. This will be an opportunity for students to participate with children local schools and demonstrate the pilot platform.
8. TEA will work with 34N to create summer camps around the WDL platform. The camp will target 4-8 grade students.
9. Using the project as a fundraising platform to report watershed health, facilitate local watershed stewardship and build events.

The Tahoe Expedition Academy is very interested in participating in the program both as a customer and a content/curriculum collaborator. We see significant opportunity to create fundraising opportunities using the platform as the core connection to our community. Feel free to contact me with any questions.

Thank you,

Ken Martin

Ken Martin

Board Chair

Tahoe Expedition Academy

www.tahoexpeditionacademy.org



To:
National Science Foundation

From:
Randall Neudeck
National Science Foundation Funding Opportunity
Small Business Innovation Grant

Re: Metropolitan Water District Watershed Classroom Data Science Program Commitment Letter

To whom it may concern,

Metropolitan Water District of Southern California has worked with 34 North for more than 10 years. Throughout this time they have focused on the development of California based watershed data platforms that serve diverse stakeholders in the communication of water operations activity, ecosystem restoration and project management. Throughout this experience we have learned that we have a need for a workforce that can help to analyze and problem solve with the extraordinary amount of data before us. Efforts to better train our youth in both data science and environmental science should play a critical role in education of today and tomorrow.

The commercialization of the Watershed Data Lab concept, I predict will be a viable one. Our organization regularly invests in opportunities to educate the public and especially K-12 classrooms about watersheds and the critical role of water in California. I see this being a valuable tool for Los Angeles and Southern California schools and disadvantaged communities. We currently invest annually in Bay Delta Live and the Sacramento River Watershed data platforms and will continue to do so in the future. These investments have made hundreds of datasets available for public use and will ultimately spill over into the education platform for the Sacramento River Watershed and lake Tahoe regions.

The objective of this watershed classroom data science program is to prepare our youth for the challenges of data science and multi-disciplinary analysis. Most data tools today are complicated and designed for scientific and business analysis. Our collaboration and efforts aims to change this paradigm by developing a simple and easy to use curriculum and software platform that can aggregate, store and display data for practical applications that students and teachers find interesting and fun to use.

34 North is a solid company with great, hardworking employees. We will support this effort every way we can.

Sincerely,

A handwritten signature in black ink that reads "Randall Neudeck".

Randall Neudeck
Bay-Delta Initiatives



From:

Sacramento River Watershed Program

P.O. Box 9233

Chico, Ca 95927

(530) 781-2220

www.sacrriver.org

Re: Letter of Support for Development and Commercialization of a Watershed Classroom Application

One of the primary goals of the Sacramento River Watershed Program (SRWP) is to help educate the local community about watershed health. Covering 27,000 square miles from the Oregon border to the Delta, the Sacramento River Watershed covers most of northern California, linking every aspect of life in the region. As one of the largest watersheds in the United States, it serves as an important source of drinking water and recreation as well as a vital economic artery for commerce and agriculture. The SRWP provides education services to the local community and school system by providing outreach and educational materials, conducting field studies, workshops and events.

In 2015, 34 North and SRWP, working together with stakeholders, collected and digitized watershed data and developed a data portal for the Sacramento River region (srwp.opennrm.org). The launch of the portal was originally targeted at government agencies and stakeholders for watershed and forest management but the site has been well received as an educational tool as well. The feedback from the education front has encouraged our organization to pursue a student version of the portal that can be deployed throughout the region to teach the community about watershed health, field work and data science. Our ultimate objective is to help our kids to better understand how our watershed is connected through landscape and watershed level data collection and analysis.

SRWP is supporting 34 North efforts to modify and enhance the current OpenNRM software application for education. We can immediately use such an application for field study work, data synthesis with baseline data from the primary portal and implementation of our existing watershed curriculum. With such an application, SRWP would target local schools to participate in the data program as a subscriber. SRWP would be able to enhance the online experience through continued field studies, workshops, conferences and events.

Finally, I would like to note that as the SRWP data program has developed, we see first-hand the need for more data scientists and people who can work with multi-disciplinary situations, like watershed analysis and management. Our program has collected data for the entire watershed, but we have found few people who know how to make it all work together. Making a watershed based education platform that helps students understand the world in front of them and increase stewardship could make a world of difference.

Sincerely,

Chris Elliot

Chris Elliot

Sacramento River Watershed Program

Board Chair