How Land Use Change, Changed Culture

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Dr. Jillian Cadwell was an assistant professor in the Civil Engineering department at Gonzaga University in Spokane, WA. Dr. Cadwell's research incorporates an interdisciplinary study of ecology and fluid mechanics with a focus on the role of contaminant transport in the ecological health of aquatic environments. She recently resigned from her position at Gonzaga to start her family. Dr. Cadwell currently consults on a $1.2 million NSF grant that she procured in partnership with the University of Idaho faculty in Curriculum and Instruction, UI Extension, and two local Native American Indian Tribes: the Coeur d'Alene (CdAT) and Spokane (ST) tribes. The grant, ITEST, Strategies Project—Back to the Earth (BTTE), is addressing a national call to increase the STEM workforce pipeline by supporting and improving the STEM educational experiences for Native American students. Dr. Cadwell is a member of the grant leadership team with expertise in STEM content, curriculum development, and technology education. The team is using an interdisciplinary framework to reach under-served populations. The BTTE project delivers a culturally relevant and content rich STEM summer and after-school program for students in grades four through six on the Coeur d'Alene and Spokane reservations. Dr. Cadwell coordinates and oversees the development and implementation of the engineering activities for the program curriculum.

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Introduction

American Indian students are the most under represented ethnic group in STEM, accounting for 0.8% of students earning degrees with only 0.5% in engineering [1, 2, 3]. Locally, students from the Coeur d'Alene and Spokane Reservations suffer from a 60% to 68% cumulative dropout rate, lower than average achievement scores in mathematics, science, and literacy for 8th graders, and unusually low social economic status [4, 5]. Furthermore, despite the billions of dollars appropriated to support hundreds of organizations focused on improving STEM content in primary and secondary education, the portion of STEM degrees award to American Indian students remained unchanged between the years 2000-2009 [6, 3].

Native communities are in critical need of improving STEM education for their youth. This is particularly important in American Indian communities where connection with the landscape has been a focus of sovereignty as well as land preservation and restoration efforts. Non-natives, who do not always have the same tribal perspectives and values in these regards, typically fill tribal STEM positions. Desiring to increasing the number of American Indians in technical and leadership positions, local tribal communities are pursuing opportunities to connect their youth with STEM education in ways that are meaningful and relevant. In response to these needs, the three-year NSF-funded Back to the Earth (BTTE) project was developed as a partnership between the University of Idaho and the Coeur d'Alene and Spokane Tribes. The goal of this project is to develop a "place based" summer education program that aims to create STEM curriculum that integrates culture, historical, and local environmental topics for students on both Reservations.

While engaging tribal communities in engineering education can mutually benefit communities, students, and engineering educators, clear communication and setting expectations is challenging. Although the needs and intentions are clear, questions about content, process, implementation, and context remain unanswered. To facilitate communication between the tribal community, educators, and STEM experts, a Curriculum Framework Flow Chart was developed to visually display how STEM content could support an understanding of the Tribes' rich history and culture.

The focus of this paper is to describe and demonstrate how utilization of the Curricular Framework Flow Chart organized various topics that form the structure for the BTTE integrated curriculum. This is done by first providing background regarding the impact of historical land use changes on the tribal communities, and how improving STEM education can support preservation and restoration of their aboriginal land. Since the program began in the fall of 2012, this paper only presents the theoretical Curriculum Framework Flow Chart, its initial application, and then describes how the research team plans to utilize it for ongoing communication and curriculum development with the tribes. This paper also addresses lessons learned in designing and delivering a tribal community-based educational initiative. Finally, a discussion of how the Curriculum Framework Flow Chart could be extended for use amongst other tribal communities and cultures is considered.

Background

Significant land use changes in the Pacific Northwest began with European arrival in the 1800s when traditional landscape mosaics were converted for agricultural practices, mining, and logging [7, 8]. The abrupt push for western settlement occurred when the United States government gave federal land away for little to no cost in response to the Homestead Act in 1862, the Desert Lands Entry Act in 1877, and the Carey Act in 1894. The migration of settlers followed significant growth and generated a need for roads, flood control, irrigation, and power [7]. Construction of the new infrastructure required a monumental labor effort that accelerated the U.S. recovery from the Great Depression and provided the growing population with needed hydropower, improved mobility, and increased agricultural yield [9, 10]. Dams constructed during this period were considered engineering masterpieces by western settlers, including the Grand Coulee Dam, hailed as the "Eighth Wonder of the World" when it was completed [11]. However, these infrastructure and land use changes also began a pattern of channeling and diverting stream flows for surface irrigation, polluting water bodies with mining runoff, development of the flood plain, and stripping the land of native vegetation [12]. Impacts of these activities were severe and still adversely affect beneficial use of water bodies throughout the Pacific Northwest including: alteration of the river morphology, a decline in water quality, degradation of aquatic habitats, and reduced surface water connectivity [13, 14, 15].

As a result of these environmental impacts, the US Clean Water Act of 1965 and subsequent 1972 and 1977 amendments were passed into law providing the legal framework for managing land use practices impacting water quality from both point and nonpoint pollutant sources [16]. However, the consequences of land use changes on tribal communities were more severe. In many ways, it prevented tribes from continuing their traditional ways of life, losing not just cultural traditions, but access to lands and waters that were critical to their subsistence [17, 18]. As increasing numbers of Euro-Americans moved into the region, traditional American Indian activities such as fishing, hunting, and gathering became less tenable. Miners, surveyors, and immigrants traveling west competed for resources and access to aboriginal territories. The Coeur d'Alene Tribe was forced to give up their semi-nomadic life style that revolved around the changing seasons, and convert prime riparian habitat into agricultural lands for sustenance [18, 19, 8]. Construction of dams prohibited fish migration and resulted in the extirpation of anadromous fish, causing Tribes to rely on local fish stocks [19]. The Spokane Tribe, once known as "river people," moved inland, relying on hunting for sustenance [20]. The cumulative impact on tribal cultures and aboriginal lands has been so significant, the Council on Environmental Quality (CEQ) has "...recognized that tribes might bear disproportionate burdens..." [21, p. 193]. Perhaps most egregious imposition on these communities was that most of these changes to the landscape occurred with little to no communication or consultation with the tribes most affected [21].

Today, tribal communities are striving to survive and ultimately assert their sovereignty, maintaining their unique culture while also preserving and restoring their aboriginal land [22]. Many American Indians have a deep connection to the earth, and specifically their land or "place", perceiving it a living soul believing they are responsible to the land and all living things on the land. [23, p. 42]. For traditional American Indian people, mind, spirit, and matter are "one in the same" [23, p. 42]. Considering their spiritual connection to place, American Indian students in STEM careers have the potential to make the most significant and culturally relevant impact on their land preservation and restoration. However, many youth are disconnected from their tribal

culture and lack a connection to the "place". In a 2011 survey of fourth grade American Indian students, 44% reported knowing little to nothing about their Native history and traditions [24].

In this work, the "placed-based" approach to teaching is a means to connect youth with tribal cultural and historical significance of the geographical region in which their people lived, as well as an opportunity to personally experience the relevance and benefit of engineering applications in their own community [25, 26]. Semken and Freeman (2008) note that "in the natural sciences, place-based pedagogy is advocated as a way to improve engagement and retention of students, particularly members of indigenous or historically inhabited communities" [25 p. 1044]. Additionally, Gruenewald (2003) states that place-based pedagogies are important in the education of citizens that have a direct bearing on the well-being of the social and ecological places those people actually inhabit [27]. Thus, it is through this "place-based" curriculum that students in the BTTE project will be challenged to merge their learning about their history and culture with the STEM content and skills, to later provide leadership and direction to for continued sovereignty and development of their tribal communities.

The BTTE Program

Engaging the tribal community in the development of an integrated place-based curriculum, that includes STEM concepts along with teachings about tribal culture and indigenous knowledge, is a recommended approach to reconnecting tribal youth to their heritage, support sovereignty, as well as encourage land preservation and restoration [28, 29, 26]. The three-year BTTE project goals are to engage students in grades 4-6 from two neighboring American Indian reservations in the inter-Northwest, in an integrated STEM experience that merges indigenous knowledge, place, and cultural and historical significance with western approaches. This will provide a platform for helping to connect tribal youth with their aboriginal land as well as prepare a STEM workforce in the Coeur d'Alene and Spokane Tribal communities. It is through a regional watershed that connects the two reservations physically and culturally, that the context is provided to study the impact of watershed monitoring and water health through an engineering design. The BTTE curriculum incorporates interdisciplinary, place-based lessons on watershed, ecosystems and natural resource management.

Need for a Curricular Framework

The Curricular Framework Flow Chart shown in Figure 1 was created to provide a visual display of how environmental as well as historical-cultural topics can be integrated to create a STEM curriculum that emphasizes engineering design. Survey responses at the BTTE kick-off retreat first identified the need for a way to facilitate communication between the grant partners, which included the tribal communities, the University of Idaho Research team, and STEM experts. Thirty-seven participants attended the three-day retreat with the goal of reviewing the grant scope as well as brainstorm ideas for curricular design and focus. Of the participants, 25 responded to an end-of-retreat written survey including the following question, "How do you think we can best build our BTTE collaborations?"

Participants recommended that collaboration can best be built with communication, equal partnership, and community involvement. The single most common written response included

the word "communication," either directly or indirectly, while others provided a more detailed response, for example "communicating and keeping an open mind always" (MF, 051912). Most respondents implied the concept of partnership and community involvement for example "learn more about each other; learn more about the kids we are targeting; learn more about the communities we are targeting" (WS, 051912), however one participant was more specific, writing "by making sure the tribal communities have an equal partnership in the project" (SH, 051912).

The BTTE retreat participant responses echo a number of related studies, emphasizing the critical importance of tribal partnership and communication to the success of developing a culturally integrated education program [17, 30]. However, there is little research on how to collaborate with or otherwise engage tribal communities and stakeholders [31, 32, 33, 2]. The intent of the Curriculum Framework Flow Chart is to provide a visual representation of the integrated curriculum that will enable all project stakeholders to effectively plan and communicate curriculum that focuses on the project scope while also elucidating the values of the Tribe.

Process of Developing BTTE Integrated Curriculum

The integrated curriculum development for BTTE was a seven-part process that focuses on topics relating to a place of tribal significance as shown in Figure 2 and with specific details in Table 1. While shown sequentially, the first four parts should be approached in the order that supports community priorities and values. In addition, the first four parts will likely require iterative brainstorming sessions with the community and partners to determine potential places and topics that best align to support a holistic STEM-culture curriculum. During and after community brainstorming sessions, the fields in the Curriculum Framework Flow Chart, should be completed and used to organize various curriculum scenarios. Ultimately, the completed Curriculum Framework Flow Chart will become the curriculum structure used to guide the remaining curriculum development shown as parts 5-7 in Figure 2. While a brief description of parts, 5-7 are included in Table 1, an example of how to enact these parts is beyond the scope of this paper. Parts 5-7 are included only to show how the Curriculum Framework Flow Chart fits into the overall process of developing the integrated curriculum.

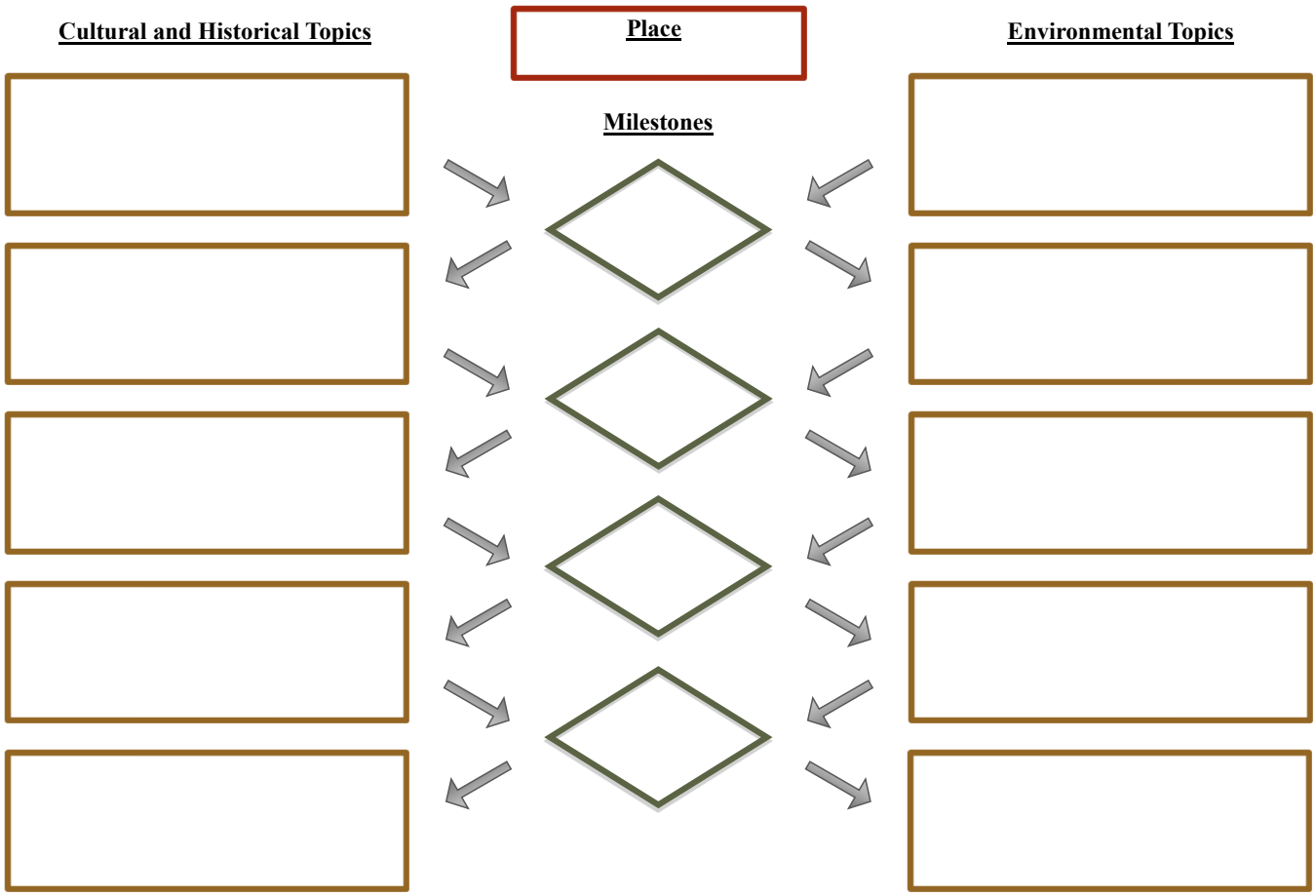

Figure 1. The Curriculum Framework Flow Chart

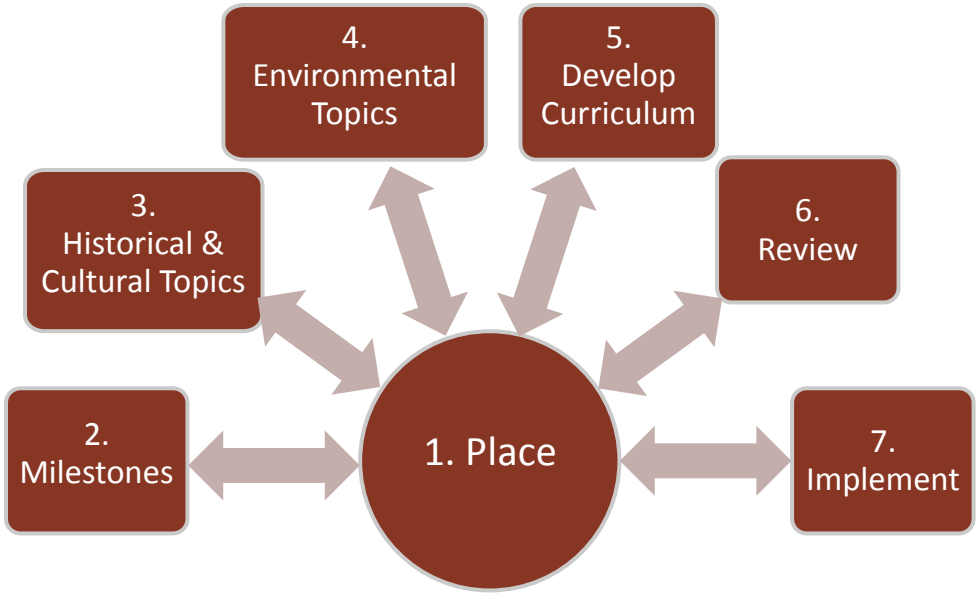

Figure 2. Process of Developing Integrated Curriculum

Table 1. Description of the Parts

#	**Part**	**Description**
1.	Place	The community selects a place (i.e. a geographical location) of cultural significance located within their aboriginal territory. Since this location is where teaching will occur, youth accessibility as well as appropriateness for an outdoor classroom should also be considered.
2.	Milestones	Determine critical cultural, historical, and environmental milestone that occurred at the place. The goal of selecting milestones is to align curriculum topics by considering significant events that may have affected both the tribal community and environment.
3.	Historical and Cultural Topics	The tribal community selects important Historical and Cultural topics related to the place that will ideally strengthen their youths' connection to their land and culture.
4.	Environmental Topics	Identify current environmental topics relevant to place.
5.	Develop Curriculum	Using the Curriculum Framework Flow Chart as a guide, develop grade level appropriate, STEM curriculum with a focus on engineering design. A dedicated team of educators, working with the specific grades, should lead this effort.
6.	Review	Request a review of the proposed curriculum by all partners including the Tribal Council, research team, and STEM educators. Based on review comments, work with partners to revise the curriculum as needed.
7.	Implementation	Implement final curriculum.

Flow Chart Demonstrated - Hangman Creek Example

This section demonstrates how the Curriculum Framework Flow Chart, shown in Figure 3, aligned cultural, historical, and environmental topics to create a visual structure for the Coeur d'Alene Tribe curriculum. Parts 1-4 of the curriculum development process, identified in Figure 2, were followed to develop the curriculum framework, with some iteration and brainstorming between the various topics to determine the best scenario to support a holistic curriculum. At the time of this paper, parts 5-7 were not yet completed.

Place

The particular study location, within their aboriginal land, selected was Hangman Creek near the confluence of Sheep Creek. Hangman Creek is significant to the Coeur d'Alene Tribe because it was once the only salmon migration route on the Reservation. However, the cumulative impact of land use change has degraded the water quality and creek morphology, blocking fish migration and reducing suitable wildlife and aquatic habitats. Today, major restoration efforts at this site are underway with the long-term goal of restoring sustainable habitats for native species and eventually the return of salmon [34].

Milestones - Four significant historical events appearing to have caused changes in culture and the environment are:

- Mission Period - In the 1830s, Jesuit Missionaries moved to the west and encouraged the tribe to give up their semi-nomadic life style and take up farming [18].
- Allotment Period - Through a series of executive orders from 1873 to 1889, the Tribe resettled onto the Reservation and in 1906, implementation of the Allotment Act reduced the size of the Reservation and tribally owned lands [35].
- Infrastructure Construction - Road and dam construction started in the late 1800's [8].
- Restoration - In recent years, restoration efforts have focused on reconnecting youth with the tribal culture as well as the land restoration [19, 36].

Historical and Cultural Topics - These topics describe how the land use changes affected the Tribe community. Below is a brief summary of the selected topics:

- Coeur d'Alene (CDA) Native Inhabitants - Based on oral history, the Tribe resided in the same present day area of northern Idaho for over 2000 years. They were hunting-gathering people relying on abundant fish, game, and roots for sustenance. Tribal activities revolved around a pattern based on five seasons; spring, summer, autumn, late fall, and winter. While the tribal community traveled throughout their Aboriginal Territory and the surrounding countryside, they resided in permanent structures along Lake Coeur d'Alene and its Tributaries [37, 8].
- Coeur d'Alene Tribe Native Inhabitants and Missionaries - After moving to the area, missionaries began the process of reduction, urging Tribal members to relocate and build dwelling around the Mission. Children attended Catholic boarding school while Jesuits instructed American Indian families on the agricultural way of life. This period marked the beginning of a loss of Native language and culture among the tribal community [18].
- Farming by Non-Tribal Members - Once successful farmers, the aftermath of allotment left tribal families with smaller infertile land, most unsuitable for agricultural practices. The reservation size was reduced and any "unused" areas were made available for non-

tribal ownership. While agricultural practices increased, by 1921, only four tribal families were still farming on their allotments [35].

- Impact on the Tribal yield - The impacts of infrastructure construction to tribal lands and waters reduced the beneficial uses of the water bodies and completely blocked anadromous migration of salmon. Inundation of wetland areas from dam construction resulted in a loss of some 30,000 acres of land used for encampment and food-gathering areas. The cumulative impacts on the tribal community have left many of their youth disconnected from their culture [24, 19, 34].
- Cultural Restoration - Today the tribe is seeking to restore not only the aboriginal land but also their culture. The tribe's hope is by connecting their youth to place and culture while also increasing the number of students entering STEM careers; they will be empowered to restore their own land and heritage and achieve ultimate sovereignty. A current activity aimed at teaching youth to their culture is Water Potato Day, a holiday celebrated by singing, dancing, and sharing the harvesting of a traditional food [38, 36].

Environmental Topics - These topics describe how the land use changes affected the environment and are the starting place for creating a STEM curriculum with an emphasis on engineering design. Below is a brief summary of topics chosen:

- Pre-Euro-American land conditions - Oral history recounts the pre-Euro-American land use as prairie and forested land cover. Anadromous fish migrated on the Coeur d'Alene aboriginal territory from the Spokane River to Hangman Creek and its tributaries [19].
- Modified Land Use - After the arrival of missionaries, land use changed to accommodate agricultural practices. The fertile soils of the flood plains were stripped of native vegetation to create farmlands. This increased sediment transport to streams and marked the beginning of water quality degradation [37].
- Post Allotment Condition - To accommodate the expanded agricultural practices, the topography was flatted and many wetlands were dewatered. Additional native vegetation was removed leaving bare land exposed, including vegetation in the riparian zone, and clearing forested areas. The increased irrigation demand required channelization of streams to divert flows. The impact of these changes began to alter the natural hydrology, increasing the travel time of surface runoff and sediment to water bodies [7, 19, 18].
- Impacts on Watershed - The construction of infrastructure, resulted in realignment of streambeds, blocked anadromous fish migration, and decreased suitable habitat of both aquatic and wildlife species. The increased sediment transport in surface runoff, reduced the capacity of streambeds, and in some cases, disconnected streams from the main stem, trapping fish species in oxbows of a once meandering stream. The cumulative impact of the land use changes has left the Hangman Creek water quality significantly impaired and listed as a class five water body on the Environmental Protection Agency (EPA) 303d list for sediment, temperature, and bacteria [39]. The major, human caused, non-point sources for these pollutants includes; roads, accelerated bank erosion, removal of riparian trees (reduction in shade over stream), and runoff from agricultural land as well as human activities [39, 15, 7, 19].
- Environmental Restoration - Today the Coeur d'Alene Tribe is restoring Hangman Creek. The long-term goals of the project include removing fish barriers, improving water quality, replanting native vegetation and creating sustainable habitats for wildlife and native fish. In addition, Sheep Creek, once realigned for road construction, will be realigned back to its original location [19].

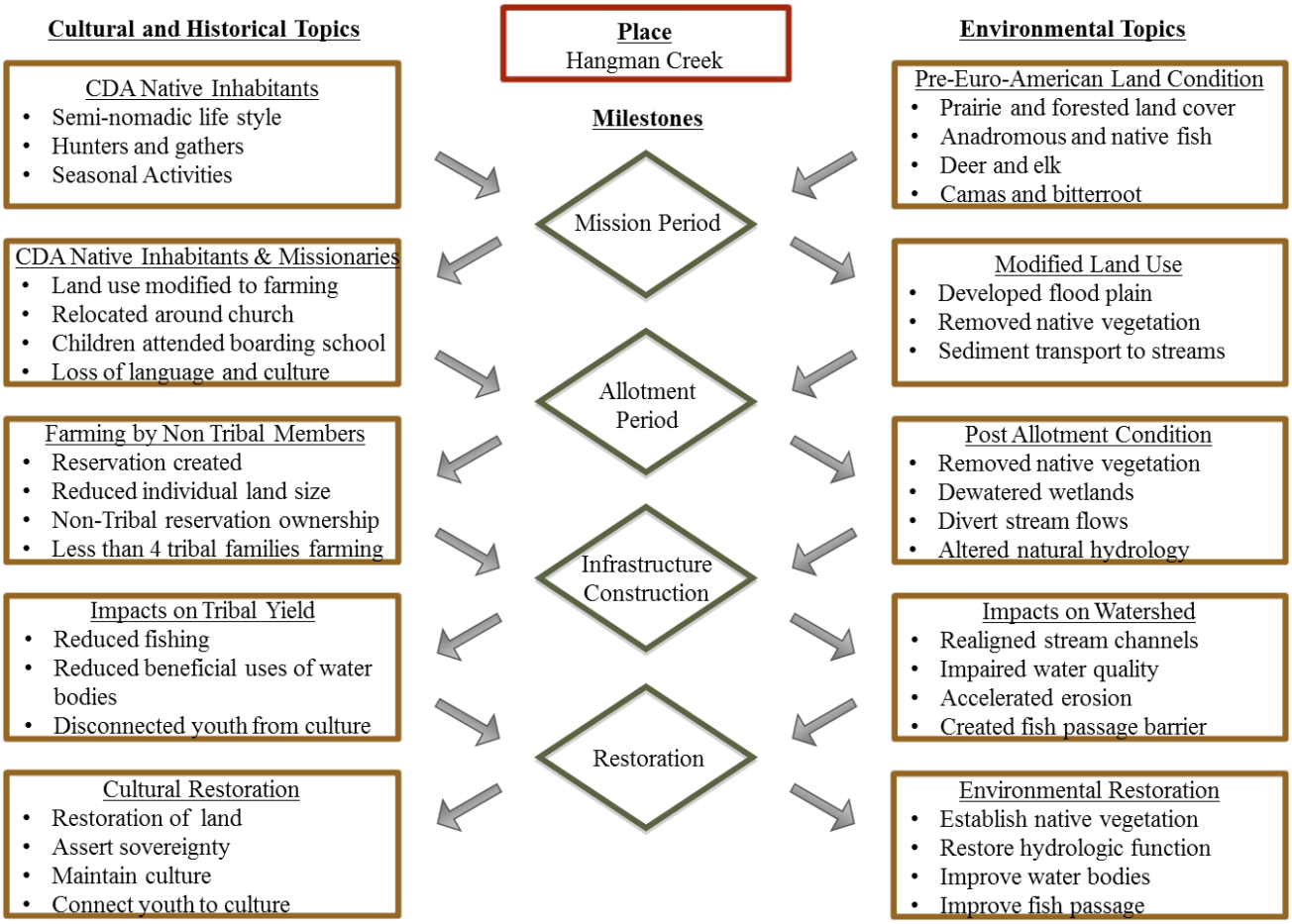

Figure 3. Curriculum Framework Flow Chart Demonstration - Hangman Creek Example

Conclusion, Lessons Learned, and Path Forward

At the time this paper was written, use of the Curriculum Framework Flow Chart to support BTTE curriculum was limited to creating the curricular structure for the Coeur d'Alene Tribe at Hangman Creek and to brainstorm a curriculum "place" with the Spokane Tribe. While the Curriculum Framework Flow Chart has facilitated the project team and Tribal partners to begin development of a holistic and specific curriculum, several lessons have already been learned. Prior to the creation of the Curriculum Framework Flow Chart, collaborative brainstorm sessions were broad, intentions were not always clear, and maintaining consistent communication between the partners had been challenging. With the addition of this tool, interdisciplinary partner brainstorming sessions appeared more focused, supporting effective communication and community engagement. Stronger partnership and engagement with the community was realized when the brainstorming focused on the first four parts of curriculum development independently without consideration for how they would align. Then after brainstorming was completed, the Curriculum Framework Flow Chart was utilized to determine which topics best aligned to support an integrated culture-STEM curriculum.

The Hangman Creek example is one of many curriculum modules that will be created during the three-year course of BTTE. Each summer three, three-week camps will be held at different geographical locations or "places" of cultural significances and each place will require the development of a Curriculum Framework Flow Chart. Each year the effectiveness of the Curriculum Framework Flow Chart to facilitate communication, partnership, and community engagement will be assessed based on written surveys and interviews with the partners. Using this input, the flow chart will be revised and improved, ultimately creating a general format that maybe adapted to engage any community in engineering education. In addition, other evaluation and assessments will include ability to engage Tribal students in STEM-related interests and projects in the community, achievement in STEM content and skills, and well as attitudinal changes toward STEM careers and study.

While the primary goal of the flow Chart was to reconnect Tribal youth to culture and improve STEM learning by engaging the community, there are additional community benefits that will be explored over the course of BTTE. Such benefits include documenting the oral history through the creation of a virtual watershed that could show the trajectory of landscape changes starting with pre-Euro-America conditions. Similar project have been completed for the Willamette Valley Watershed to help empower planners to understand the impact of growth and development in the Valley and ultimately focus growth in areas with the projected lowest impact [40].

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References

[1] D. Horwedel, "Operation STEM," *Issues in Higher Education,* pp. 36-39, 2006.

[2] J. Jarosz, "Enginering for Native Americans," *Winds of Change,* pp. 52-57, 2003.

[3] NSB, "Higher Education in Science and Engineering," in *Science and Engineering Indicators 2012*, Arlington, VA, National Science Foundation, 2012.

[4] Idaho State Department of Education, "AYP Preliminary Data 2011. 2010-11 Adequate Yearly Progress Report: Lakeside Elementary School (0752), Plummer-Worley Joint District #044," 2011. [Online]. Available: http://www.sde.idaho.gov/ayp/ayp08/detail.asp. [Accessed 5 January 2013].

[5] Office of Superintendent of Public Instruction, "Washington State Report Card," 2011. [Online]. Available: http://reportcard.ospi.k12.wa.us/summary.aspx?year=2011-12. [Accessed 5 January 2012].

[6] J. Kuenzi, "Science, Tehcnology, Engineering, and Mathmatics (STEM) Education: Background, Federal Policy, and Legislative Action," CRS Report for Congress, Lincoln, Nebraska, 2008.

[7] C. S. T. Z. J. Boyd, "Flood Irrigation Impacts on Summer In-Stream Temperature Extremes in the Interior Pacific Northwest," in *Ecological Water Quality – Water Treatment and Reuse*, InTech, Ed., Burns, OR, USDA-Agricultural Research Service, Eastern Oregon Agricultural Research Center, 2012, pp. 343-358.

[8] L. Woodworth-Ney, Mapping Identity: the creation of teh Coeur d'Alene Indian reservation, first ed., Boulder, Colorado: University Press of Colorado, 2004.

[9] Wikepedia, "Great Depression," 2013. [Online]. Available: http://en.wikipedia.org/wiki/Great_Depression#Turning_point_and_recovery. [Accessed 6 January 2013].

[10] P. C. Pitzer, Grand Coulee: Harnessing a dream, first ed., Pullman, Wash: Washington State University Press: Washington State University Press, 1994.

[11] Bureau of Reclamation, Grand Coulee Dam: The eighth wonder of the world, state of Washington, Coulee Dam, WA: Souvenirs Company, 1947.

[12] IDEQ, "Lemhi River Subbasin Total Maximum Daily Loads and Five Year Review," Technical Services, State Office, Idaho Department of Environmental Quality, Boise, 2012.

[13] IDHW, "Lemhi River Watershed TMDL," Idaho Department of Environmental Quality, Boise, Idaho, 1999.

[14] W. H. W. S. S. D. Weiming, "ANALYSIS OF AQUATIC HABITAT SUITABILITY USING A DEPTH-AVERAGED 2-D MODEL," USDA, Maryland, 2004.

[15] D. M. J. T. C. G. P. Tonina, "New Tools for Aquatic Habitat Modeling," Brisbane, Australia, 2011.

[16] EPA, "Clean Water Act (CWA)," 2012. [Online]. Available: http://www.epa.gov/agriculture/lcwa.html#Summary. [Accessed 8 12 2012].

[17] G. Lowan, "Exploring Place from an Aboriginal Perspective: Consideration for Outdoor and Environmental Education," *Canadian Journal of Environmental Education*, vol. 14, pp. 42-58, 2009.

[18] G. Palmer, "Indian Pioneers; The Settlement of Ni'lukhwalqw (Upper Hangman Creek, Idaho) by the Schitsu'umsh (Coeur d'Alene Indians)," *Oregon Historical Quarterly*, vol. 102, no. 1, pp. 22-47, 2001.

[19] G. Green, "Hangman Creek Restoration Project, Project No. 2001-03300," Bonneville Power Administration, Portland, Oregon, 2002.

[20] J. Ross, The Spokane Indians, first ed., Spokane, Washington: Michael J. Ross, 2011.

[21] B. H. S. Harper, "Tribal Environmental Justice: Vulnerability, Trusteeship, and Equity under NEPA," *ENVIRONMENTAL JUSTICE*, vol. 4, no. 4, pp. 193-198, 2011.

[22] S. Krakoff, "Radical Adaptation, Justice, and American Indian Nations," *ENVIRONMENTAL JUSTICE*, vol. 4, no. 4, pp. 207-212, 2011.

[23] G. Cajete, "Land and Education," *American Indian Science and Engineering Society*, pp. 42-47, 1994.

[24] NCES, "National Indian Education Study 2011 (NCES 2012–466)," Institute of Education Sciences, U.S. Department of Education, Washington D.C., 2012.

[25] S. F. C. B. Semken, "Sense of place in the practice and assessment of place-based," *Science Education*, vol. 92, pp. 1042-1057, 2008.

[26] J. Jabosz, "Engineering for Native Americans," *Winds of Change,* vol. Technology, no. Summer, pp. 52-57, 2003.

[27] D. A. Gruenwald, "The best of both worlds: A critical pedagogy of place," *Educational Researcher,* vol. 32 (4), pp. 3-12.

[28] M. Pember, "Providing a 'Full Circle of Support'," *Diverse Education,* no. 10781, pp. 1-4, 2005.

[29] S. Semken, "Sense of Place and Place-Based Introductory GeoScience Teaching for American Indian and Alaska Native Undergradates," *Place Baed Geoscience Teaching,* vol. 53, no. 2, pp. 149-157, 2005.

[30] P. K. P. Ngai, "Indigenous studies and inter cultural education; the impact of a place-based primary-school program," *Intercultural Education,* vol. 21, no. 6, pp. 597-606, 2010.

[31] G. A. Cajete, Igniting the sparkle, Skyand, NC: Kivaki Press., 1999.

[32] W. G. Demmert, "The influences of culture on learning and assessment among native American student," *Learning Disabilities Research & Practices,* vol. 20, no. 1.

[33] Y. R. G. K. A. R. B. Nam, "Perceptions and practices of culturally relevant science teaching in American Indian classroom," *International Journal of Science and Mathmatics Education,* 2012.

[34] G. Green, "hnt'k'wipn Management Plan," Coeur d'Alene Tribe Wildlife Program, Plummer, ID, 2008.

[35] Idaho Indian Tribes Project, "Idaho Indian Tribes Project; A Project of the Idaho GenWeb," 2012. [Online]. Available: http://www.idahogenealogy.com/indian/coeurdalene_indian_reservation.htm. [Accessed 6 January 2013].

[36] C. L. L. Meyer, "Developing a Community-Led Education Pipeline," *JOURNAL OF COMMUNITY ENGAGEMENT AND SCHOLARSHIP,* vol. 3, no. 2, pp. 80-81, 2009.

[37] T. Cox, changing patterns of land use among the coeur d'alene: an environmental ethnohistory, Manuscript.

[38] OPB, "Coeur d'Alene Indians Celebrate Water Potato Harvest," 2012. [Online]. Available: http://www.opb.org/news/article/coeur-dalene-indians-celebrate-water-potato-harvest/. [Accessed 6 January 2013].

[39] IDEQ, "Upper Hangman Creek Subbasin Assessment and Total Maximum Daily Load," The Idaho Department of Environmental Quality, Boise, Idaho, 2007.

[40] Pacific Northwest Ecosystem Research Consortium, "Willamette River Basin Atlas; Trajectories of Environmental and Ecological Change," Oregon State University Press, Corvallis OR, 2002.