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NEGOTIATING THE SACRED:
UNDERSTANDING IMPACTS TO IKS AND ITEK
FROM USE OF REMOTE SENSING AND GIS TECHNOLOGIES
WITHIN TRIBAL LANDSCAPES

By

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Dissertation

presented in partial fulfillment of the requirements
for the degree of

Philosophy of Arts
in Cultural Heritage and Applied Anthropology

The University of Montana
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DEDICATION

I dedicate this doctoral journey and work and to those Indigenous students and scholars who have come before me, are on this journey now, and those considering it. This work and experience has been a Calling, as I could not have persisted along this winding and undulating path without the Creator's influence and protection. Braided through this journey has been tremendous moments of joy and of being embraced and supported by so many amazing people, most of who are now family.

WAY FINDING

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I give thanks to the lands of my ancestors and those who are present today who have supported and challenged me to do this work, and do it as an Eastern Shoshone woman. My son Ken and daughter Dani-Girl (may she rest in peace now) have been the anchors to my often anxious mind, heart, and spirit and are the sources of my inspiration and motivation. I include as family by Beagle Boy, Foley. He has been my emotional support pup through this journey and my sanctuary for well-being. Joining these family members are those who have come into my life and vice versa who are now kin and represent a global family that are invaluable to me as well. Among these is a special mentor, Dr. Shawn Wilson, who embraced my ideas and believed in my capabilities to be part of the movement and work with Indigenous Research Methodologies and Methods.

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Additionally, but far from finally, I am thankful to my Advisor and Committee Chair, Dr. Kelly Dixon. Her patient and understanding ways, along with her eclectic brilliance have been inspirations to me and helped me finish my program with a sense of sanity and well-being. I am further thankful to my Dissertation Committee Members who gave of their time, knowledge, and patience as part of my team on this journey.

I also acknowledge the patience and assistance of UMs Graduate School, particularly Ashby, Kelly, and Kendall who have each been amazing partners in this experience and I am so thankful to you and for you.

GLOSSARY of TERMS

Moving Camp is a term found within the language and conversations among many Indigenous Peoples in reference to moving from one place to another. Within my Shoshonean lifeways this is a term for referencing a time of setting up a camping space to gather for ceremony such as Sundance or for socializing at a powwow. In my dissertation I utilize this term in relation to the story path I navigate us along within the map presented by this work.

Indigenous People and Native American are two terms, within the United States, often utilized interchangeably. My use of these terms in this dissertation are distinguished for purposes of describing Indigeneity related to geographic positions. My use of the term *Indigenous* is applied in the plural and refers to a collective community of people identifying as being native or tribal to a landscape. In this way I try to utilize their own names for their people when publicly known, or in the plural for example, I use a statement such as “the Indigenous People of Australia.”

Native American, my use of the term *Native American* refers to a label federally created for Indigenous people within the United States. Again, here, if provided publicly, I will try to use the name the people refer to themselves with.

Urban Natives is a contemporary term I utilize to refer to those Indigenous people(s) residing in urban areas, such as cities that have been sites of relocation policies throughout history, and are yet spaces for large diasporic communities of individuals identifying as being Indigenous and or belonging to a tribal nation.

Seventh Generation is a Principle formulated within Haudenosaunee (Iroquois) worldviews about making decisions today that should consider the next seven generations well-being.

Indigenize(ing), as I understand and utilize the term within this dissertation, follows the logic of many Indigenous elders and scholars. To Indigenize is the work of Indigenous People. There is a need to reframe Indigenous social, political, and economic issues within Native historical and contemporary contexts that, as Māori scholar Linda Tuhiwai Smith refers to, becomes an Indigenous project with agendas of correcting stories and reframing them to build future narratives.

Indigenous Perspectives. I engage these in this dissertation as expressions of four understandings:

- a holistic worldview of socio-ecological relationality and interdependence;
- that includes recognition and implementation of shared belief systems that are enhanced by specific culture-based understandings and practices of values that represent ways of knowing, being, and doing, that also engage;
- dynamics of historical and persistent impacts on contemporary Indigenous realities that include social and environmental injustices,
- as evidencing a Peoples' resilience and adaptabilities.

Decolonizing has become a term of vast interpretation that is debated broadly and hotly. Today this term also engages questions of who can “decolonize” and what and why? I contend context is required to understand use of such a powerful tool for acknowledging a need for unpacking, removing, dismantling and other actions related to colonial strategies and elements used specifically as a hammer of Imperialism. This hammer, initially arriving in the vehicles of religion and education were, and persists, in being thrust upon the lives of Indigenous Peoples and the lands and environments that have constructed their ways of knowing, being, and doing. Use of this term within this dissertation is in reference to the work hoped for and accomplished by white and non-Indigenous persons as evidence of acknowledging such oppression existed and exists and a need for justice to be enacted.

Indigenous Knowledges. Recently there have been revisions to terms that reference what I refer to as Indigenous Knowledge, or preferably in the verb and plural tense being Indigenous Knowledges. Several scholars have opted to use the term “Indigenous and Local Knowledge,” as this follows the UNESCO LINKS education program definition. While I understand this change from the earlier term is for acknowledgement of place within an Indigenous peoples relationship with their knowledge sources, I have yet to adopt this new term. Presently, I contend, the simple addition of the word “local” limits perspectives of the applicability of Indigenous Knowledges, and as my intentions are to reveal broader implications of these knowledges, I will retain my use of the term Indigenous Knowledges throughout this document.

Further, to assist with understanding the term I offer the following statement derived from the November 2022 Whitehouse Guidance document that synthesized information from a variety of Indigenous scholarly work, and emphasizes:

Indigenous Knowledge is a body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Tribes and Indigenous Peoples through interaction and experience with the environment. It is applied to phenomena across biological, physical, social, cultural, and spiritual systems. Indigenous Knowledge can be developed over millennia, continues to develop, and includes understanding based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation. Indigenous Knowledge is developed by Indigenous Peoples including, but not limited to, Tribal Nations, Native Americans, Alaska Natives, and Native Hawaiians. Each Tribe or Indigenous community has its own place-based body of knowledge that may overlap with that of other Tribes.

Indigenous Knowledge is based in ethical foundations often grounded in social, spiritual, cultural, and natural systems that are frequently intertwined and inseparable, offering a holistic perspective. Indigenous Knowledge is inherently heterogeneous due to the cultural, geographic, and socioeconomic differences from which it is derived, and is shaped by the Indigenous Peoples’ understanding of their history and the surrounding environment. Indigenous Knowledge is unique to each group of Indigenous Peoples and each may elect to utilize different terminology or express it in different ways. Indigenous Knowledge is deeply connected to the Indigenous Peoples holding that knowledge.

ITEK and IKS, my use of these acronyms and terms reflect an agreement with the following definitions synthesized from a vast read of the topic. I refer to Indigenous Traditional Ecological Knowledges (ITEK) as those knowledges found among peoples' who identify as being "of" a particular locale that represents the source of knowledges they hold as constitutive to their cultural ways of knowing, being, and doing, which also reflect a relational and interdependent philosophy that decenters human beings, and holds them as part of the vast web of existence referred to as ecological.

In this way, I can then understand that **Indigenous Knowledge Systems (IKS)** represent these relationships as acts of reciprocity through practice of ITEK. Bryan Brayboy suggests "Indigenous Knowledge Systems are about the interconnectivity of what we might call the ologies: epistemologies, ontologies, axiologies, pedagogies, and cosmologies" (2021:8). Further, following my description for ITEK, the core understanding about systems is that they represent connections in relational and interdependent ways.

Transdisciplinary. I utilize this term to mean the collaborative engagement with research that strategically evolves the standard boundaries of academic disciplines in order to address problems that have common threads between them. This creates a community of co-producers of knowledges that enhance their relevance to solve problems and identify additional areas of concern that require creating a space where mutual benefit can be realized.

Tribal leadership. I use the term in a broad context, to mean those who may be council persons, or directors of departments and or programs. This does not exclude Elders, outside these two types, as being leaders among their people. I am defining tribal leadership in this way to address a specific act of leadership that requires decision making that has potential to create policy and engage governing processes.

Landscape Archaeology, I agree with the following for definition of this term derived from Chapman 2009:11,

“...means many things to many people...information from all areas of archaeological research may be used to examine archaeological landscapes...the methods that are most commonly used include cartographic study, documentary research, fieldwalking, and survey...[additionally utilized are]...earthwork survey, [and]...aerial photographic analysis.”

ABSTRACT

Freeman, Ren, PhD, Spring 2023, Department *Anthropology*
Negotiating the Sacred: Understanding Impacts to Indigenous Knowledge Systems and
Indigenous Traditional Ecological Knowledges from Use of Remote Sensing and GIS
Technologies within Tribal Landscapes.

Chairperson: Dr. Kelly Dixon, Anthropology. University of Montana.

How we see the world and ourselves in relation to it is largely achieved by the lens we are looking through and associated experiences within this relationship. This is additionally true when considering the acknowledged fact that Indigenous Knowledges are derived from natural and cultural sources and these assist in constituting the cultural identities of those Peoples associated with these sources. Presently there is a hunger for access and use of Indigenous Knowledges (IK) as never before seen in public ways, through a national Call for collaborative means to apply these knowledges to such as the issues we globally face as a result of Climate Change. What are Indigenous Knowledges? How are they created? Who holds these and can utilize them in public ways? These questions are an embedded aspect of this Call that requires attention. Further, what impacts exist that benefit, but also challenge, the endeavor to utilize Indigenous Knowledges outside local areas where they are derived? What of these sacred ways of knowing are being negotiated to attain their use? Five areas of concern were identified in response to these questions through application of An Indigenous Research Way (AIRW), a novel continuous improvement model for implementing Indigenous Research Methodologies and Methods, within research design and practice. Synthesizing these concerns into three themes, Education, Technology, and Tribal Leader Decision-Making, awareness was revealed of these as first level and gateway impacts. Indigenous ways of knowing, being, and doing operationalizes Indigenous worldviews about relationality and this as central to how Indigenous Knowledges Systems (IKS) are created and in turn create Indigenous Traditional Ecological Knowledges (ITEK). Understanding how we “see” ourselves in relation to this process is imperative. A burgeoning method for seeing landscapes, and they as sources of IK, is through use of remote sensing and Geographical Information Systems (GIS). This Phase I study, through a Kin-based Case Study and mixed-methods approach, sought to understand impacts to IKS and ITEK from use of these technologies within tribal landscapes through review and assessment of 73 ESRI tribal GIS public StoryMap projects, led by tribal practitioners, accomplished in 2017 - 2021. Assessment provides there exists an assumption that identifying as being Indigenous includes being a holder of cultural knowledges and that these are utilized at-will and regularly. The data troubles this assumption with respect to tribal individuals trained as practitioners of these technologies and their use of ITEK then provided through public digital media. Impacts to IKS and ITEK reveal enhancements and also replacement of the “seeing” accomplished by Indigenous People through technological means and the public perceptions of their cultural lifeways and persona of being Holders of Indigenous Knowledges. These impacts are broad in their implications as they attend to not only understandings of past and present access to ITEK but also future applications that brings the conversation into the realms of understanding being Indigenous off-earth.

SEME'
(Chapter) 1

Oo soo neek

...and so, this is the way of it...

As Native people we are People of space, image, and time...we constantly seek perspectives and knowledge of the world that explain it and the beings within it...the seeking of knowledge from a distance and placing it within a landscape, pervades our culture.

Lone Fight 2017

Indigenous and local cultures are being absorbed and transformed by the global culture of technology...and technologies are not value neutral...the data and resulting statistics that technology provides does not just describe reality—they create it.

Borgmann 2012

Sandler 2012

Walter and Anderson 2013

Technology is not just a tool for human use but...it is also a taken-for-granted access to freedoms that promote the illumination of human minds...and is a powerful influence and means of impact on human environments, mentalities, and identities.

Heidegger 1923

Pennock 2019

Shamir 2020

I remember the destruction that the sacred brings when it's not kept sacred.

Kelsey Dayle John 2019

Each of the statements above, provide a philosophical map for the journey and landscapes my research has afforded me to traverse, and continues to do so. The story of this journey will frequently meander, cross-through, take side trips, circle-back, and relate instances of trail blazing in its endeavor to share the basis, nuances, and hopes this work represents.

This “dissertation” is a tale of Moving Camp, and has been an adventure story that, like most stories, goes this way and that way but always has a purpose mapped along a route generally with a destination in mind. Or at least a place, or places, to stop and meditate on what has been learned and should be considered before moving on along the general path. Ultimately though it is the experiences of the knowing, being, and doing (Martin 2013) that have provided the greatest opportunity for making meaning of what is being learned and for sharing these as understandings to be considered by those interested in this work.

This dissertation speaks first to my own Shoshonean People and those Indigenous Peoples who are interested and involved with the technologies of remote sensing and GIS, and then also to our Allies, who are in liminal spaces personally and publicly with their desire to work with and among Indigenous People and their landscapes.

The purpose of this story is to relate an initial search for understanding impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) from the use of remote sensing and Geographic Information systems (GIS) technologies within tribal landscapes. Three themes derived from exploratory inquiry, that revealed five areas of concern, assisted in developing a specific site of inquiry. This dissertation shares my study of 73 cases that represent public tribal GIS projects, led by tribal practioners of these technologies, occurring between the years 2017 and 2021 within tribal landscapes.

The title of this dissertation reveals the dynamic of “to understand,” as a practice, utilized within an interpretivist framework—Case Study approach—and coupled with an Indigenous methodology, that created a Kin-based Case Study approach to partner with diversified mixed-methods to investigate a dual hypothesis. This hypothesis presents a theory that a) (null) there are benefits to Indigenous Peoples and their relationships with their landscapes from use of these technologies, but alternatively b) there may be shifts inside these relationships that creates loss of culture due to impacts to Indigenous Knowledge Systems—ways of seeing and knowing—that creates additional impacts to Indigenous Traditional Ecological Knowledges (ITEK). This focus also engages ethics within pedagogical and curriculum development platforms that investigates the scaffolding—origin constituting means—involving Indigenous Knowledge Systems as ways of knowing, being, and doing within the relationships between technology and Indigenous Peoples. This additionally creates concern around perceptions of tribal cultural identity development and persistence, and issues involving data sovereignty with the public sharing and use of these Knowledges for tribal leadership and also now federal agency decision-making.

How we know and identify ourselves reflects what we hold as necessary to their construction. Culture, being socially constructed, is emphasized within Indigenous communities and many, if not most, assigned this construction to their relationships with their land-based environments and ecologies, and these represent ways of knowing, being, and doing that create Indigenous worldviews. These then guide decisions about how we move within the worlds we occupy and visit.

How we see and engage relationships between the sources of our Indigenous Knowledges and ourselves is increasingly relevant today, as the world is calling for use of these knowledges outside the local areas where they are derived. Ultimately, this study asks you to consider that we who identify as being Indigenous, should assess ourselves in order to more fully understand if we have the capacities to access these knowledges and are the appropriate vehicles to provide them within public realms. What influences are revealed as occurring through this assessment of self? This study is an inquiry about the impacts that utilizing a technological lens has on our Ways to see and relate to the sources of our cultural knowledges and they as being constitutive of our cultural identities and Lifeways.

Historically Indigenous cultures and identities have been a focus of colonialism throughout the world. However, this focus has primarily engaged ways to remove, erase, and/or mask these. In the early 1900s a shift occurred and there began a campaign and policies that provided access to Indigenous Self-Determination. Culture became a commodity as well as a gateway for bringing to light the atrocities visited upon Indigenous people. Sociopolitical and economic agendas became drivers for elevating voices that had been severely erased, silenced, and also assumed and appropriated. Efforts related to increasing Indigenous presence in labor markets through populating academic institutions with Indigenous students has been a tremendous effort that is now seeing successes. There is a long road to bring parity though, particularly within STEM-based fields, these being Science, Technology, Engineering, and Mathematics. This endeavor is woven through another theme and concern this study happened upon through conversations with Indigenous graduate students and their recruitment from industries

hoping to hire not just them as skilled individuals, but also their assumed culture lens, with which to apply to broader issues for marketplace leverage. This poses existential and identity-engaging questions that impact individual financial well-being as well as issues of representation. Consider these concerns in relation to the November 30, 2022 joint release by the White House Council on Environmental Quality (CEQ) and the White House Office of Science and Technology Policy (OSTP) of the document Guidance for Federal Departments and Agencies on Indigenous Knowledge (November 30, 2022). The concluding statement provides,

Agencies should apply this guidance as a foundation for Agencies to consult and collaborate with Tribal Nations and Indigenous Peoples on the inclusion of Indigenous Knowledge in Federal decision making and research and consider whether agency-specific policies are appropriate.

Considering the departments that sponsored this work, a focus on environment, science and technology are foremost. Prominent among the industries seeking culture-based knowledge holders, in the form of academic students, are those within the STEM fields of Science and Technology.

Technology is perceived as the more “exciting” of the two. As well, this excitement is expressed in the White House Guide about the access to Indigenous knowledges useful to address global issues such as causes and effects of climate change. Understanding this excitement requires inquiry into access to knowledges and why and who benefits, and what has been negotiated along this dynamic process of coming to know self in relation to the sources of Indigenous Knowledges. How we see these sources—being land- and place-based—and our relationships with them, includes understanding of intentions for these relationships. Technology in the form of remote

sensing and GIS provides us tools and processes as a form of looking at these. Is why, how, and what we look at influenced by the these technologies and further influences assumptions about ones cultural self-identity, that also engages collective decisioning making about access and use of Indigenous Knowledges?

This dissertation, then, is ultimately a story about relationships and acknowledgement that Indigenous culture expresses methods of what is becoming increasingly recognized by western mainstream academia as science-based ways of knowing (Cajete 2000, 2005, 2020; Atalay 2006, 2008; Augare et al 2017; Bang and Medin 2010; Brayboy 2008). From a shared Indigenous worldview, not just the epistemological—the knowing—is to be understood and applied, but also the ontological—the Being, and the methods—the Doing. Within this construct there exists the axiological—the ethical considerations to be acknowledged and engaged. What mainstream academic research has relegated to the sideline is the deontological aspects of acquiring “new” knowledge. Deontology is necessary for balance to be achieved in research processes as it calls for attention to accountability measures.

The topic of attending to processes insists I must apologize at this point. I continue to face a challenge within the “writing up” process of academic research projects, as many Indigenous students and scholars face, with the style required by western mainstream universities. To persist with inclusion of a cultural perspective approach, there is a bridging of intentions, at the very least, that must be negotiated and built.

I have skipped ahead in my story and bypassed a necessary process and practice of being a StoryTeller, per perspectives found within my Shoshonean culture and those often found within a shared Indigenous worldview. My work with this study represents designing the journey according to An Indigenous Research Way (Freeman, 2017) (Appendix _1a & b) that attends to philosophies and practices of what are referred to as Indigenous Research Methodologies and Methods. Acknowledging this process requires that I provide an Introduction of this work in a particular way.

The process of Preparing to Do Research, as an exercise of Self-in-Relation is supported by Kovach 2010, Nakata 2003, L.T. Smith 2012. Additionally, Michelle Pidgeon and Tasha Riley (2021), cite, among others, Manulani Aluh-Meyer (2006) who shares that “relationship ‘in an epistemological sense, is the notion of self through other... relationships with an idea, or relationships with our environment’” (194-195). I contend within an Indigenous perspective this includes a pedagogical sense, as exploration and meaning-making of the relationships that include the topic, its contributing community, and these with self, as researcher. In this way, I am both the researcher and a study participant.

CLEARING AND PREPARING PLACES AND SPACES: UNDERSTANDING THE STORY TO BE TOLD

“Introduction.” Hmmm...I, as an Indigenous woman, understand this first to mean the sharing of self and the perceptions of our lived selves as the teller of the stories we have to share. I refer to this as a StoryWay place. Like most stories there needs to be spaces where you come to understand the Teller is both witness and part of the story

being told. This is also related to what Jo-ann Archibald, Sto:lo and St'at'imic First Nations scholar of educational studies refers to as Storywork (2008), a way of making meaning that builds and enhances the relationship between the Teller and the Listener. This place—the relationship—is a necessary starting point for the story of the journey of this dissertation work. In this way I am Indigenizing the process of academic research writing as you must understand my perspectives of designing and accomplishing this work is grounded in who I am as a result of who I belong to. Further, through introducing this dissertation in this way I am “speaking truth to power” as Sium and Ritskes (2013) states it, “by telling our stories we’re at the same time dismantling dominant notions of intellectual rigor and legitimacy, while also redefining scholarship as a process that begins with the self” (4). Further, stories as an Indigenous perspective and methodology represent “theory-in-action (Sium & Ritskes, 2013:2) and as such are designed to call people together, join in active listening, and promote conversations toward a common understanding” (Simpson 2013).

I am Newe: Researcher Positionality

Identifying as an Indigenous researcher, and especially when working within Indigenous contexts, requires acknowledgement of my social-cultural position and relationship to the topic and practice of my research project. This assists in answering the question of, “what makes this Indigenous” as a way of doing research. The following includes acknowledging the land and its people where I presently reside and have begun this work, and also the thanking of my own ancestors as well.

As a doctoral student at the University of Montana in Missoula, I acknowledge that this city and the University are located on the homelands of the Seliš and Qlispé People, but also is a place of diversity where historically and contemporarily additional Indigenous Peoples have visited, including my own Shoshonean People, who also claim relationships with this land. As well, I wish to express gratitude to the descendants of non-Native settlers who make this area their home and respect this land and its Indigenous First Peoples.

I also am immensely grateful to my ancestors and the many sacrifices they endured so that I might exist. They continuously inspire and sustain my life and work. The knowledges they continue to provide to and through me are invaluable and my responsibility, as a vessel of their wisdoms, is a great honor. It is such gifts as these that provide for my cultural grounding as an Eastern Shoshone woman. Each day and with every action I take, I attempt to hold myself accountable for the safe keeping, culturally sensitive use and appropriate sharing of these knowledges, according to the purposes the ancestors have set forth, and of which are occasionally deemed necessarily shifted as a result of life's many impacts on our ways of knowing, being, and doing.

Tsaan dahvay! Mah deh a'weko? Good day! How are you? I am Ren Freeman, and acknowledge my birth father who is Maskegowak Cree (Hudson's Bay area, Manitoba) and Scottish, of the Highland Clans of McKenzie and Fraser. I acknowledge my birth mother, who is Sosori-Eastern Shoshone-and who has provided me with my cultural identity that I embody each day.



Figure 1: Personal selfie, taken by Ren Freeman, 10/2021

I am a child of the Yellow Brow Clan and am Havi khe' Wai'peht—Mourning Dove Woman. Within our Sundance-Fasting Ceremonial family, I am also Bu'wew'asen Wai'peht—Whirlwind Woman. I am a “retired” Sundancer, and now mentor and “take care of” other female Sundancers.



Figure 2: Collage created from personal photos by Ren Freeman, 2020

I am a Sosori wai’peht—Eastern Shoshone woman—raised among my tribal community in Udadye—the Warm Valley—at Fort Washakie, the agency seat for the Wind River Indian Reservation in the state of Wyoming, which is situated amidst my Peoples’ ancestral homelands. It is “home” to my three children and me.

My two daughters, while members of the Mandan-Hidatsa Nations through their father, are also cultural knowledge keepers and members of our Shoshonean Sundance family.

As the mother of a son who is a child of the Apsa’alooka Nation (Crow, Yellowtail family) and Whistling Water Clan, I am also adopted into this clan and was given the name Woman Who Seeks To Learn, by my son’s paternal great-Uncle, Dr. Joe Medicine Crow. For the Apsa’alooka—a matrilineal culture—my adoption into the clan

was necessary to enable my son to be acknowledged as a Whistling Water Clan member, and to receive the name his great-grandfather, Crow Sundance Leader Thomas Yellowtail, bestowed on him.

A further connection between our two families exists through the “brother” bond between Thomas and my Shoshone-Comanche great-grandfather Sundance Leader John Trejillo, whose mother was Shoshone and Comanche, and his father from the Tewa People of Taos Pueblo. Parts of my ancestors’ story can be found in various public documents.

Grandpa John was the hereditary recipient of our Sundance Ways (Shimkin 1953, 1986; Hultkrantz 1987; Stamm 1999), as he is a descendent of Comanche spiritual leader Oh ha Meh’goya—Old Man Yellow Hand—who was the son of Ecuera Capa—Leather Cape—a Kotsoteka, Buffalo Eater, Shoshone-Comanche leader whose life and times are also shared through American and Spanish historical documents. Leather Cape was a prominent figure during the 1800s during Spanish explorations and settlements in the areas we now refer to as Texas, Oklahoma, New Mexico, Arizona, and Colorado. He was a recipient of one of the coveted Spanish silver-tipped canes, that acknowledged his leadership among various Comanche bands. Through this lineage, I am also a hereditary member of the Tedha-pukunuu—the Comanche Little Ponies Warrior Society—and also through my Yellow Brow Clan, who are the Keepers of our Big Horse Society ceremonies and songs.

These great nations, the Eastern Shoshone, Comanche, and Crow, have a long history with one another and share many cultural worldviews, such as the Sundance Way. Most of my Shoshonean cultural ways of knowing, being, and doing are the result of

knowledges gained through teachings and experiences as a Shoshonean person, woman and member of a Sundance family. As a Faster, within Sundance beliefs and practices, I see the world through the lens of its principles—its values—and these as shared through our language and living them each day.

These are also found among our larger Shoshonean, Newe, culture specifically as shared worldviews. In this way, one can say I have always applied a Newe reasoning to make meaning of my life and the world around me. I have shared this information to express some key personal attributes, that represent the core of my socio-cultural position, and which figure explicitly into the design and practice of this study.

Academically, I have a Bachelor's of Arts degree in Communication, from the University of Denver, with an emphasis in Inter-and Cross-Cultural Communication. There I once considered a career in Conflict Mediation, having followed the career of Noble Peace Laureate and former UN Secretary-General Kofi Annan. I have satisfied this goal, in part. In the Spring of 2021 I earned the University of Montana's Natural Resource Conflict Resolution Certificate, with a Practicum project that aligns with this dissertation topic. My Practicum work was accomplished with my own Eastern Shoshone tribe and centers on buffalo and wild horses as sources of Indigenous Knowledge. That work specifically engaged the review and revision of tribal wildlife management plans from an Eastern Shoshone perspective of "management," that reflects relationality and interdependence.

I hold a Master's Degree in Anthropology from the University of Oklahoma. Academically, I am referred to as a "four-field" anthropologist—more functionally, in contrast to philosophically, which identifies this term strictly within Boasian

methodologies. I have formal training in each of the four academically-recognized fields of anthropology, these being: Socio-Cultural, Linguistics, Bio-Anthropology, and Archaeology. I also have particular national and global experience in various applied anthropological emphasis, such as Cultural Resource Management (CRM), Museology, Material Culture Exhibition, Environmental Engineering and Project Management, as well as Cultural Heritage and Ecological Tourism.

Prior to my decision to obtain a PhD, I enjoyed a thirty-plus year career, within the fields of Cultural Heritage, Cultural Resource Management (CRM), and Tribal Cultural Heritage and Resource Management (TCHRM). My decision to seek a PhD is premised on aspirations to teach at the graduate level, from a philosophy of integrative knowledge pedagogy and with intentions to create Indigenous methodologically inspired curriculum through applications of Indigenous Research Methodologies and Methods. Of course, I also intend to continue working as a field anthropologist for as long as I am able.

In the Fall of 2019, I became a Sloan Indigenous Graduate Fellow (SIGP), having received their scholarship and financial resources to accomplish the research and work shared through this dissertation.

Additionally, in October 2019, I became the next President/Chair of the intercontinental American Indigenous Research Association (iAIRA), which primarily represents and services Indigenous research students, faculty, and professionals through its network and conference offerings. I am also a member of the University of Montana's first Heritage Collections Board.

Thank you for your patience and understanding as I shared an important aspect of research design from *An Indigenous Way of Doing Research* (Freeman 2017) (Appendix _1a & b_), this being the sharing of personal information in-relation to this dissertation. I realize that “self-identification and positioning within an academic work may trouble some readers. Yet, it is an honest way to approach the subjective nature of this work that also reveals my cultural preferences, biases, and politically-based experiences” (Freeman 2017:2). Within the worldview of most Indigenous Peoples we begin our sharing of information—our telling a story—by providing information about the storyteller (L.T. Smith 2012, 1999; Chilisa 2012; G. Smith via Kovach 2009; Wilson 2008). This contrasts with Euro-western research writing and presentation approaches which often place the researcher as an outside observer and interpreter (Lambert 2014; Mertens 2013; Smith 2012; Byrd 2011; Chilisa 2012; Kovach 2009; Wilson 2008; Trigger 2008; Colwell-Chanthaphonh and Ferguson 2008; Watkins 2000, 2006; Bernardini 2005; Sheehan and Lilly 2006; Bedford 1996; Tilley 1994; et al).

When we are Indigenous and are the primary storyteller we will enclose initial information within the frame of a personal story—referred to, as mentioned earlier, as a “StoryWay.” This contrasts with that which is otherwise and typically provided in lecture style (if spoken) or an academic style of writing, where response and contribution are limited or not acknowledged.

The StoryWay is perceived by most Indigenous scholars as a requirement of relational accountability found within the philosophy and practices of an Indigenous axiology and methodology (Absalon and Willett 2005; Wilson 2008). Additionally, there is an understanding, posed as a question, of how can we make inquiry and understand our

world if we do not acknowledge and situate ourselves as part of the story? (Absolon and Willett 2005; Hampton 1995; Wilson 2008).

Also please consider, while I am abiding by a general academic dissertation research proposal template, I am also following a particular writing style that engages my cultural ways of communicating, that reveals my identity and status as an Indigenous graduate student. I have prepared this dissertation from a Ways of Knowing (WoK) (Hockin, Miller, and Magee 1996; Myhill 2005) writing philosophy and style, which utilizes first person statements—use of the “I” and “my” pronouns—that enables critical literacy to be revealed as “self-in-relationship” (Styres 2019; Wilson 2008). This style derives from the humanities and social sciences, and is a form of self-reflection and -reflexive and as ethnographic expressions. I couple this with a Storying writing methodology that assists in describing experiences as personal narrative—as witness—and sharing them as a journeying process of coming to know (Flaherty 2020; L.T. Smith, Tuck and Yang 2019; Windchief and San Pedro 2019; Archibald et al 2019; Murdock 2018; Freeman 2017; Thiong’o 2017; Grande 2015; Bagele 2012; Kovach 2009; Wilson 2008; Archibald 2008; Myhill 2005; Kidwell 2001; Mason 2000; Ortiz 1998; Hockin Miller, and Magee 1996; Freire 1970/2012).

Additionally, within this written form of sharing, I adhere to a particular protocol regarding use of quotes and block quotes. I provide a statement here, that I had written and is contained within my Master’s thesis that took some effort to assemble, as I had sought advice from and meditated on the actions and words of other Indigenous scholars and elders about the matter. At present, I still stand on the following statement (Freeman 2017:29-30), about this practice

my worldview includes acknowledgement of who is sharing knowledge—in terms of what other stories exist and who are telling them—that relate to the ones I am telling. Paraphrasing of a person's thoughts and written works is heavily encouraged within Western scholarship. Most Indigenous scholars tend to quote the person's words, such as with use of in-sentence quotes and 'block quotes'. You see, words are representative of an individual's personhood and agency (Wilson 2008). Quoting directly, shows my respect for the relationship that is created by recognizing another individual's contribution of their new understandings of knowledge (Weiser 2017). This contrasts with engaging in acts of appropriation of a knowledge as something a researcher has 'discovered' and puts forth as if it is their own (Hermes 1998).

Further, a shared Indigenous perspective provides consideration of the fact that knowledge already exists, and when we as individuals come upon it, we experience the revelation of the event, as personal to ourselves. I believe the relationship we then create with the knowledge is what can truly be deemed of our own making—through our own observations and experiences with it. Again, I provide my own further thoughts on this (2017:29-30):

The Indigenous viewpoint extends rules about plagiarism and of comprehension. Cora Weber-Pillwax (2001), an Indigenous Australian educator, states it this way, 'A person's word belongs to that person and in some instances can be viewed as being that person' (156). This speaks to the relationship a person has with their knowledge source and of respectful ways we can acknowledge that relationship. My preference is to provide a mix of quotes and paraphrasing, when and where most appropriate and helpful in understanding my work in relation to others' scholarship.

Again, this research journey provides you with a story that engaged a continuous improvement model, An Indigenous Research Way (AIRW), with use of Newe Reasoning (a culture-based analytic method developed for this study), to investigate *Negotiating the Sacred: Understanding Impacts to IKS and ITEK from Use of Remote Sensing and Geographical Information Systems (GIS) within Tribal Landscapes*.

The Beginning of the Telling of a Story

As with most stories the Teller provides a snippet of what is to come. It has been my goal and endeavor to create a space where both Indigenous perspectives of designing and accomplishing research exists with that expected through mainstream western academia. I am resting on your patience and understanding as I proceed and move through this as a practice of a mixed-method research approach.

How we see the world and ourselves in-relation to it is largely achieved by the lens we are looking through and the associated experiences within this relationship. This is additionally true when considering that Indigenous Knowledges are derived from natural sources and these assist in constituting the cultural identities of those Peoples associated with these sources.

Presently there is a hunger for access and use of Indigenous Knowledges (IK), as never before seen in public ways, through a national Call for collaborative means to apply these knowledges to such as the issues we globally face as a result of Climate Change (2021 and 2022 Whitehouse initiatives). What are Indigenous Knowledges? How are they created? Who holds these and can utilize them in public ways? These questions are an imbedded aspect of this Call that requires attention.

Further, what impacts—challenges—exist that benefit, but also cause concern, about endeavors to utilize Indigenous Knowledges outside local areas where they are derived? What of these sacred ways of knowing are being negotiated to attain their use?

Five areas of concern were identified in response to these questions through application of An Indigenous Research Way (AIRW), a continuous improvement model for implementing Indigenous Research Methodologies and Methods, for research design

and practice. Synthesizing these concerns into three themes, Education, Technology, and Tribal Leader Decision-Making, awareness was revealed of these as first level impacts and gateways for additional impacts. In Chapter 2 I discuss these five concerns and how they derived the three themes of inquiry for this study.

Indigenous ways of knowing, being, and doing operationalizes Indigenous worldviews about relationality and this as central to how Indigenous Knowledges Systems (IKS) are created and in turn create Indigenous Traditional Ecological Knowledges (ITEK). Understanding how we, as Indigenous People, “see” ourselves in relation to this process is imperative.

A burgeoning method for seeing landscapes, and they as sources of IK, is through use of remote sensing and Geographaphical Information Systems (GIS). This study, through a Kin-based Case Study and mixed-methods approach, sought to understand impacts to IKS and ITEK from use of these technologies within tribal landscapes through review and assessment of 73 ESRI tribal GIS public StoryMap projects accomplished in 2017 - 2021. What has been found is there exists an assumption that identifying as being Indigenous includes being a holder of cultural knowledges, found within one’s own tribal cultural community, and that these are utilized at-will and regularly and this use is determined personally.

The data troubles this assumption with respect to tribal individuals trained as practitioners of these technologies and their use of ITEK as provided through public digital media. Impacts to IKS and ITEK are found to focus on enhancements and also replacement of the “seeing” accomplished by Indigenous People through technological means and public perceptions this creates of their cultural lifeways and persona of being

holders of Indigenous Knowledges. These impacts are broad in their implications as they attend to not only understandings of past and present access to ITEK but also future applications that bring the conversation into the realms of understanding being Indigenous off-earth. Ultimately, there is need to understand if these technologies are shifting the way Indigenous Peoples' relate to the sources of their traditional knowledges, and how this shifting benefits or negatively impacts this relationship in terms of cultural self-identities and public perceptions of Indigenous Peoples' and their Lifeways, particularly in terms of access and public use of their Traditional Ecological Knowledges.

Overall, the focus and value of this study, and as a mixed-methods inquiry, is its tri-fold implications for responding to what is a burgeoning hunger for access and use of Indigenous Traditional Ecological Knowledges. First, designing research and accomplishing it from a perspective of responsibility and accountability that represents a duty of care—such as An Indigenous Research Way model of practice provides—is a means to further understand and experience IRM&M, which implements IK processes. This then enables an engaging of a means to interpret and understand results that take into account the people and contexts of the study topic—such as the necessary creation of a congruent analytic method like Newe Reasoning. Additionally, the focus of the research becomes increasingly relevant beyond the needs of the community you are working with, because it will often also represent a micro version of what the world expresses it needs as a whole system and community.

Second, with application of the AIRW, there is a coming-to-know aspect of the research that delves into personal relationships, through Self-In-Relation activities, that creates a collaborative space of meaning-making between the researcher and the sites and

sources of the research. This creates a more intense focus on a topic and questions are zeroed in to reflect foundations of the inquiry. In this study it has been a journey to understand impacts from use of remote sensing and GIS. These technologies are an increasingly utilized tool within a multitude of approaches to gain insight to lands-based and place-based information—this information being the basis of IK. These technologies have become transdisciplinary and their use is becoming a norm for research overall.

Then, third, this study is first in response and attends to Indigenous People, particularly Indigenous researchers, and the positions they have been placed in with the Call for use of Indigenous Knowledges. For centuries now Indigenous People have suffered the effects of Imperialism and colonization. We have worked, though, diligently to gain space within those places that have been resistant to our voices, such as within academia. Now there is acknowledgement of our collective value and importance within the world, and this is primarily through the culture-based knowledge systems that are constituted by the lands and their ecologies that we are identify with.

The dilemma here is in addressing the impacts of colonization on these ways of knowing, being, and doing to understand if these ways are viable today. Are these knowledges, primarily known through philosophies of Being, operationalizable for addressing the issues that the Whitehouse Call requires of them for use within federal agencies, and particularly concerning Climate Change? Calls like this are drivers for the increase in attention to Indigenous Knowledges held by Indigenous Peoples. What is necessary to understand is, who are the knowledge holders that are willing to be our teachers? There is an assumption that we who identify as being Indigenous are also holders of our cultural knowledges and have access to them for the uses we personally

determine. Within this is a complex story about identity as a cultural citizen—a person who has a consistent relationship with the lands and people from which their cultural knowledges are derived.

Within the world of Native American education there have been great strides to include Indigenous people within STEM fields (Bang and Medin 2010; Bartlett, Marshall and Marshall 2012; Battiste 2002; Brayboy 2021; Brayboy and Castagno 2008; Deloria 1991; Florentine 2019; Grande 2015; Ma Rhea 2022; Medin and Bang 2014; Minero 2019; Smith, Tuck and Yang 2019; Tuck and Yang 2012; Walter and Anderson 2013; Walter 2016). Along with this is the well-known statistic that today 76% of Indigenous people report residing outside their tribal communities. The concern here is that there are more efforts for Indigenous students to be knowledgeable about STEM without equal attention given to the integration of traditional Indigenous knowledges that are appropriate and equally related to these sciences.

What is becoming more clear then, is what I have expressed above – these assumptions that identifying as an Indigenous person also means being holders of Indigenous Knowledges—and this has created a scramble for programs to also include inter-generational teaching between Elders, who are identified as holders of IK, and the youth of their tribes.

What I have found through this study is that there are impacts, beneficial and not, to the Indigenous Knowledge systems—Ways of Knowing—and Indigenous Traditional Ecological Knowledges. As Elders model and attest, these Ways require an element of in-person access by those seeking to understand their importance within STEM fields and the issues that can be addressed within these areas. This access has been universally

acknowledged as coming from and through relationships with land- and place-based sources of Indigenous Knowledges. Today, being in-relationship with lands and their ecologies is being enhanced, but also replaced by technological means of seeing and being with natural environments. Remote sensing and GIS provide less invasive means of access—of “seeing”—these environments, and are often mnemonic partners enabling revelation of knowledges long forgotten. However, we are asked by cultural knowledge holders to consider that this “seeing” is not to be accomplished merely with our eyes. There is a relationality aspect to learning what are Indigenous Knowledges through personal presence and time with these sources. In this way the understanding with what is meant by the knowing, being, and doing of Indigenous Knowledge Systems becomes a necessity of experiential education.

I will leave you here for a moment to consider what I have shared so far.

Within the next chapter I continue working with An Indigenous Research Way (AIRW), as the model utilized to design and accomplish the research study I am sharing with you now. I ask that you try not to venture too far ahead, but take the time to read each piece of this story in the sequence that I have provided it. There are elements within each chapter that guide you along the AIRW path and its relationality to how this work has been accomplished, why, and what has been learned.

WAHAREWE (Chapter) 2

Oo soo neek
... and so, this is the way of it ...

Wayfinding:

What follows, in part, represents my engagement of an initial required element of the An Indigenous Research Way (AIRW) model (Freeman 2017 with 2021 version applied, Appendix _1a & 1b_), as a research design and practice method of continuous improvement when utilizing an Indigenous Research Methodologies & Methods (IRM&M) approach. IRM&M integrates relevant aspects of shared Indigenous worldviews and as provided through this dissertation work, also those aspects from within my Shoshonean worldview. In this way the process provides an ethics-based space for diverse cultural contexts, protocols, and voices.

I have referred to this previously in Semi (chapter 1). An initial process of Preparing to Do Research, entails an exercise of Self-in-Relation and is supported by Kovach 2010, Nakata 2003, and L.T. Smith 2012. Additionally, Michelle Pidgeon and Tasha Riley (2021), cite among others, Manulani Aluh-Meyer (2006) who shares that “relationship ‘in an epistemological sense, is the notion of self through other... relationships with an idea, or relationships with our environment’” (194-195). I contend within an Indigenous perspective this includes a pedagogical sense, as exploration and meaning-making of the relationships that include the topic, its contributing community, and these with Self, as researcher. In this way, I am both the researcher and a study participant.

This chapter represents the Background portion of my dissertation, and since I am holding the Talking Stick right now, it is presented in a story-way style that continues the work of introducing myself to you. This, in Chapter 2, represents a revealing of Self-In-Relation to the topic and addresses why and how a person like me became interested in the topic of this dissertation and subsequently further developed my knowledge and research skill sets in community with others interested in this topic.

This initial step precedes and extends the process of a standard Literature Review task and is about finding relevance in the present world first and broadly from among those who may be interested in the topic and/or have experience with it. This approach assists with identifying where to look for previous or current academic work about the same or a similar subject matter. This further helps with understanding what could be the site(s) of study and who might be site(s) specific collaborators to potentially identify revisions to the topic and focused questions that will guide identifying additional participants and materials this research requires. Further, this model's process presents an approach of congruency to research design that attends to the development of the research framework and methodology that then guides the selection of appropriate methods to make inquiry, and importantly to interpret the data.

The AIRW process is akin to that found within contemporary versions of Action Research, Participatory Action Research, as well as those created through an Indigenous lens, such as Sonya Atalay's Community Based Participatory Research (CBPR) model of practice recommends (2012) and similar recommendations from a growing community of Indigenous researchers. Notably, the AIRW process of deepening and broadening the

work contributes to Preparing to Do Research that provides an in-community positionality statement within written academic research documents; this further enhances and creates added value toward addressing criticisms of stating deeper levels of researcher positionality found within western mainstream research processes within human-based participant studies and especially those related to Indigenous communities.

Thankfully, today, there is a continuing burgeoning discourse regarding these types of research approaches that are easily accessed. Ultimately this dissertation has been both a reflection-based and reflexive experience, and not just for me, but those who have visited with me along the way. I'll share more about this in the next chapters and also include what I have learned overall as a concluding summary, in Chapter 6, about my application of the AIRW, as a continuous improvement model for research design and practice.

Surveying Topic Landscapes and Points of Interest

Navigating Impacts of COVID-19

I belong to a large global group of student researchers whose work and academic programs have been, and in some cases remain, impacted by the effects of a viral epidemic referred to as COVID-19. The impacts included isolating at one's home, limited public excursions, and travel advisories. Initially, the sense was that this would only be experienced for a few months. However, even in this year of 2023 there continue to be cautions to heed. This is additionally true if you are considering being in Indigenous communities where medical services are already limited and the viral contact and contraction rates are yet disproportionately high. During the height of the epidemic many

Tribal Nations opted to close their communities to frequent coming and going of their residents and limited access to outside visitors. This was a measure to protect vulnerable members of their community, particularly their elders.

The pre-proposal exploratory work I had accomplished between 2018 – 2020 included observations and discussions with various Tribal and Indigenous Nations throughout the world, including those within my own Eastern Shoshone Nation and broader Uto-Aztecan linguistic family. Individuals working with their cultural knowledges through education within their communities was a focus, particularly within what is referred to as I-STEM, or Indigenous Science, Technology, Engineering, and Mathematics, or STEAM that adds Arts back into the acronym and discourse. This is also associated with Native Science (Cajete 2000). One Tribal Nation in the United States became the focus for the research I had intended to accomplish that would have engaged various experiential and site specific activities that included both tribal youth and elders. These individuals had assisted in developing the vision with me to inquire about use of remote sensing and GIS technologies by their tribal members for projects within their tribal landscapes and what might influence tribal leadership decision-making about cultural heritage and natural resource management.

The proposed start date for this project idea was put on hold pending updates of national and tribal reports regarding COVID impacts. I retained hope though, clear through my Research Proposal presentation and received an approval for that project. It was during the formal University of Montana Internal Review Board (IRB) application process, that included collaboration with tribal cultural community members and their review process to create the Consent Form, realization came that the project could not be

accomplished within my doctoral program timeframe with the COVID restrictions that needed to remain in place. In 2021 I accomplished additional exploratory work and revised the site and source accordingly and late that Fall received IRB approval.

Revisiting the Journey and Revising the Map

The dissertation you are reading is based on the shifts in research design that were necessary to continue with my original topic and primary question. The deeper and focused questions were developed based on experiences and literature reviews salvaged from the previous exploratory work and then combined with more recent information applicable to the revisions.

In retrospect, and a lesson learned, AIRW as a continuous improvement model, has proved helpful in understanding, as a result of the shifts to my study, there needed to be a more culturally appropriate starting point for my formal inquiry process for this study, that is less invasive and respects what is already offered as information from inside the sites of inquiry. This altered my approach strategy in significant ways.

The many side excursions this study has taken me on to investigate and seek Understanding of Impacts to IKS and ITEK from use of Remote Sensing and GIS technologies within Tribal Landscapes reflects my use of the term “Understanding” as a dynamic exploratory endeavor that situates well with a Case Study approach enhanced through development of a joint theoretical and conceptual framework inclusive of my own Shoshonean worldview, as a means to develop the methodology for this study that then guides the selection of congruent mixed-methods of inquiry and an analytic reasoning process.

To restate, the basis for this study is founded on a continuing and escalating interest in utilizing Indigenous Knowledges both inside tribal communities, where these knowledges are sourced and held within culture-based relationships, but also increasingly, from interest within global industries and federal governments. This increased interest, particularly since Haaland's April 2021 national Call, resulting in the November 2022 Guideline document created and distributed by the U.S. White House, to utilize Indigenous Knowledges broadly prompts questions this study attends to about IK and their Indigenous-Peoples' relationships as being influenced by learning about and utilizing technologies found within landscape archaeological surveys.

As shared in Chapter 1, a Kin-based Case Study approach in partnership with diversified mixed-methods has been utilized to investigate a dual hypothesis. The null theorizes this study can reveal an understanding of benefits to Indigenous Peoples and their relationships with their landscapes and its natural inhabitants from use of remote sensing and GIS technologies, but alternatively b) there may be shifts inside these relationships that creates loss of culture due to impacts to Indigenous Knowledge Systems—ways of seeing and knowing—that creates additional impacts to Indigenous Traditional Ecological Knowledges (ITEK). An approach such as this engages ethics within pedagogical and curriculum development platforms that investigates the scaffolding—origin constituting means—involving Indigenous Knowledge Systems as ways of knowing, being, and doing within the relationships between technology and Indigenous Peoples. This additionally creates concerns and perceptions around issues of tribal cultural identity development and persistence as well as data sovereignty issues

about public sharing and use of these Knowledges for tribal leadership and also now federal agency decision-making.

The broad topic of this study was explored through conversations within various communities of Indigenous people as interested parties to the access and use of Indigenous Knowledges. Derived from these conversations were five themes, and through associated reviews of literature three themes were identified as three threads to be understood further:

1. Education regarding relationships between Indigenous humans and their landscapes, associated with perceptions about access and public use of Indigenous Knowledges;
2. Technology, specifically the use of remote sensing survey and GIS technologies by Indigenous practitioners, as means to “see,” within tribal landscapes, and;
- 3) Tribal decision-making, as being influenced by these technologies, pertaining to cultural heritage and natural resource management.

These three focused themes assisted in developing the specific site of inquiry, these being publicly shared cases of tribal GIS projects within tribal landscapes. This dissertation shares my study of 73 such cases led by tribal practitioners of remote sensing and GIS technologies, occurring between the years 2017 and 2022. I will share details about these in the next chapters.

What this part of the story—being the Background chapter of this dissertation—in summary reveals overall, is that essentially there has always been and is an increasing interest among Indigenous peoples, but very little scholarship, focused on understanding impacts that include potential loss of culture-based relationships between sources of IK and their Indigenous human relatives, that further create impacts to Indigenous

Traditional Ecological Knowledge (ITEK), from use of technologies. Within this study I focus on remote sensing and Global Information Systems (GIS) technologies associated with landscape surveys. Further, there is even less scholarly information regarding influences produced by these technologies on Indigenous practitioners ability and desire to engage and retain their cultural lens—their ways of seeing the landscape and being in relationship with it—when training about and using these technologies for projects within tribal landscapes. In light of what I have to share with you in this dissertation, based on various evidence and assumptions this study brings to light, I conclude there should be more discourse and research about these concerns.

For now, and keeping to the course that the AIRW provides, let me tell you a bit about how I arrived at this topic, questions, and conclusion that led to my formal study, through sharing a few of my own stories, gathered from a variety of sources. These stories are teachings that express what influenced further topic and question(s) development, and how the focus became specifically about understanding, within the 73 public tribal GIS StoryMap cases:

- a) what benefits may have occurred through use of remote sensing and GIS technologies utilized within tribal landscapes by Indigenous practitioners,
- b) what technological influences may have created cultural knowledge loss, or negotiation of relationships between sources of Indigenous knowledges and their Indigenous human relatives,
- c) what roles and impacts has western-based training of Indigenous practitioners for use of remote sensing and GIS technologies played within a) and b) scenarios, and,

d) what these influences have meant to tribal leadership decision-making about their cultural heritage and natural resource management.

Among the “variety of sources,” beyond numerous personal conversations, is a lengthy reading list found within the Reference section of this dissertation—and these together make up my Topic and Literature Review. Within Indigenous perspectives, tribal colleges and universities, and increasingly among mainstream academia, conversations with Indigenous culture and experiential subject matter experts, such as Indigenous cultural community elders and citizens who are knowledge “holders” of Indigenous Knowledges, represents academic scholarship of the eminent order.

Now, finally, I invite you to

Stories of Self-in-Relation: Developing the Topic

Wayfinding: This part of the story, again being Waharewe, or number 2 in Sosori daigwap (my Shoshone language) as the chapter system goes, moves us further along the AIRW process of engaging Self-in-Relation that helps you to understand the journey of why a person like me became interested in the topic of technological influences on Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges and it becoming the research I embarked upon. This Chapter is presented in two Parts.

I need to take a brief thought excursion here before I share how I choose this study’s topic as related to personal memories and experiences. I need to speak to these memories as I would a beloved child who has come to visit. This is advice provided in a poem by a favorite Storyteller of mine, two time U.S. Poet Laureate Joy Harjo

(Mvskoke). The poem is titled, For Calling the Spirit Back from Wandering the Earth on Its Human Feet, found within her work, Conflict Resolution For Holy Beings (2015:4-6).

I share a few choice bits of that poem with you here:

...Turn off that cellphone, computer, and remote control.
Open the door, then close it behind you. Take a breath offered by friendly winds.
...Give back with gratitude...Acknowledge this earth, who has cared for you
since you were a dream planting itself precisely within your parents' desire.
Let your moccasin feet take you to the encampment of the guardians
who have known you before time, who will be there after time.
...Let the earth stabilize your postcolonial insecure jitters.
...The journey might take you a few hours, a day, a year,
a few years, a hundred, a thousand or even more.
Watch your mind.
Without training it might run away and leave your heart
for the immense human feast set by the thieves of time.
...You must clean yourself with cedar, sage, or other healing plants.
...Call yourself back. You will find yourself caught
in corners and creases of shame, judgement, and human abuse.
You must call in a way that your spirit will want to return.
Speak to it as you would a beloved child.
Welcome your spirit back from its wandering.
It may return in pieces, in tatters. Gather them together.
They will be happy to be found after being lost for so long.
Then, you must do this: help that next person find their way through the dark.

These words situate what I have to share with you next. However, now, if you wouldn't mind, please take a moment to sit back and meditate about what you have just read.

Oo soo neek—and so, this is the way of it...

My personal interest in exploring the world began as a child living within my Eastern Shoshone community in my homelands of Wyoming, commonly referred to as the Wind River Indian Reservation. Today, as back when I was growing up there, I can observe and participate in what are ecological experiences and messages about Ways of knowing and Being exemplified as relationships and interdependencies between humans and beyond-humans, and the earthly and beyond-earth places and spaces we mingle within. The development of my culture-based worldview began within the mountains, canyons, foothills, plains, and waterways of these landscapes and their ecological communities.

I contend it was no real surprise to those who knew me best that my educational interests would involve seeking to learn more about and to understand how to appropriately move within and between these relationships. In fact, many have heard me say, about my academic path as a four-field Indigenous anthropologist, that “I believe I was born to do this work.” Included with this remark is the acknowledgment that I exist today as I am because of impacts, both those positively and negatively, effecting the lives and worldviews that my parents, grandparents, and ancestors experienced as they traversed and negotiated their days. This created in me a need to see the world through their eyes—worlds influenced by ever shifting landscapes and with Imperial colonial contact. This contact resulted in major socio-economic and political impacts with agendas that did not and overall still do not have Indigenous Peoples’ best interests in mind.

An early memory from my childhood is an event that changed my life and I believe was a major inspiration for who I am today, as a four-field Indigenous anthropologist, with a concern for what impacts land, environments, and their ecologies, including humans and beyond-humans on earth and off.

I was eight years and with a favorite a'dah, uncle, of mine. He was not academically degreed but he knew our tribal landscapes well, and was a self-taught geologist. I was his shadow in those days and loved learning about rocks. I also enjoyed being on horseback and also hiking through the mountains. The time I am referencing, was a warm day on one such hiking occasion where we happened to be on a high point in the foothills of the Wind River Mountain range. I looked to the east out across the vast landscape where the foothills became the more level areas of what are called the "plains." There were dark dots here and there and I asked what those were. A'dah replied, "those are oilwell pads where pumps are drawing oil from our lands." The picture this presented in my mind was of the dark liquid being pulled—taken—from the earth. I asked him what the land thought about this. If the earth felt pain.

This event shifted, forever, the conversations between my a'dah and me. They became more focused on our cultural ways of being relatives with the earth. How this was the Way our Shoshone People learned how to be Shoshone. Soon thereafter I began joining others in my family and from our community for deeper excursions into our lands, to the high backcountry areas to camp, hike, gather berries, wild herbs and vegetables, fish, hunt, and generally be with each other and share our Ways of being a relative. There was always ceremony and stories, and laughter and pranks as part of how

we enjoyed each other's company. I also paid avid attention to the many stories that were told of the night sky and dreamt of stars and planets where other Beings might dwell.

On into my high school days I continued with this way of life and learning about myself, my family, my People, and those who shared the world with us. During this time I found many opportunities to travel to the lands of other Indigenous Peoples in the U.S., Canada, and Mexico. Various lands in Canada are also homelands to me through my father's People.

Within these travels among various Indigenous Peoples and their lands I began to notice similarities in our stories and relationships with our lands and environments. Indigenous people of my own age group were often afforded opportunities to work within "programs" available to us who enjoyed being out-of-doors, particularly in the 1970s with the Self-Determination policies being implemented within Tribal Nations. Youth-centered programs such as one of the oldest in this country, being the National Indian Youth Council (NIYC), afforded opportunities for youth to understand and connect their local tribal needs and issues with those from other tribes.

NIYC, founded in the 1960s as a civil rights activist organization, became in the 1970s focused on environmental issues. They created public education and job skills training as awareness building efforts among tribal-based youth, toward addressing negative environmental and health-related effects from exploitive industrial projects in Native American reservations such as coal mining, uranium mining, and drilling for oil. Upon one occasion a speaker from the Air Force talked about how visiting other parts of the world and learning about their cultures was part of their agencies "mission." I took an interest in this opportunity and was recruited to a new program that could lead to

becoming an astronaut. I'll share more about this in a bit, but suffice it to say I did not become an astronaut, sadly. But, over the years I have found my way back to projects and programs associated with this early dream.

Young adulthood saw me in college and also working within various fields that implemented my knowledge and experience with cross- and inter-cultural communication. In particular was, and remains to be, work within the arena referred to as CRM, Cultural Resource Management, and related to contexts involving Indigenous heritage, natural resource development, and also environmental education and policy. This laid an amazing foundation for me to enter the world of landscape archaeology and remote sensing technologies, primarily at the time, Ground Penetrating Radar (GPR).

Briefly, GPR is a locating method, primarily utilized in geophysical work—requiring being in physical contact with the land surface—that uses hardware and software to transmit radio waves—electromagnetic wave impulse technology—to create digital shapes of objects up to 100 feet below ground surfaces or within opaque structures. Further, it has been the success of GPR that has led to development of vehicular, airborne, and satellite surveying platforms (Daniels 2004). GPR is a method developed in 1904 by Hulsmeyer, and later patented by Leimbach and Lowy, with the first pulsed probing occurring in the 1930s. This technology quickly became broadly sought after as a lands-based surveying tool in the 1970s for a non-invasive—meaning alternative to excavation—means for archaeological and other physical research site studies, and most recently as a means to conduct forensic investigations (3-4).

CRM is a term as diverse as its applications. Broadly, CRM refers to management of cultural heritage within the realms of federal, state, and local laws, regulations, and

guidelines. This use of the term “cultural heritage” has been defined as places, structures, objects, buildings, as evidence of past material culture and lifeways that are means to understand, appreciate, and or preserve the past. This general description is a further development of the 1906 American Antiquities Act. The National Park Service, established in 1916, today exercises much of the authorizing and responsibility for practices of CRM. The 1960s enhanced both the definition and practice of natural resource management through movements around environmental concerns for preservation of natural heritage, such as plant and animal species and their ecologies. Within the National Park Service “resources,” in addition to ancient and more contemporarily historic structures, primarily refers to archaeological and ethnographic sources, cultural landscapes, and collections deemed of museum quality and contexts (National Park Service Policy Chapter 5 and ACRA 2023).

Further experiences stand out as directly contributing to the topic of this dissertation. My work in Alaska through planning and development of the Alaska Native Heritage Center (ANHC) and then as a Diversity Specialist working with project management teams for a global environmental engineering firm, which remains a prime contractor for the U.S. Departments of Energy (DOE) and Defense (DOD).

The ANHC brought me into a vast world of collaborative endeavors addressing historical and contemporary realities facing Indigenous Peoples of Alaska and their homelands. Primarily these were impacts to their lifeways due to policies and practices regarding their subsistence rights as a result of major resource industries and big government interests in the business model of Native Corporations. Within these structures there were huge effects as a result of technologies impacting the sources of

Indigenous Knowledges and influencing tribal leader decision-making that led to ancestral villages being abandoned by younger generations to relocate to urban areas. This is an example of a contribution to the high statistic of urban Indigenous residents.

However, this influx of Native populations to urban areas also led to the creation of a major cutting edge medical facility in Anchorage. If interested in this story, a good place to start might be with the December 22, 2021 Congressional Research Service report titled, Alaska Native Lands and the Alaska Native Claims Settlement Act (ANCSA): Overview and Selected Issues for Congress.

The ANHC is another result of the creation of Alaska Native Corporations. The ANHC publicly shares ancient and historical stories and exhibitions as foundational knowledge references for community programs engaging the contemporary continuance of Alaskan Native lifeways.

Thought Excursion: My sharing of this information provides consideration, recall, of my definition of “impacts” within this study. Impacts are observed as being either beneficial or non-beneficial to the Indigenous communities and individuals of this study’s focus. As these stories reveal, an impact can be both. This prompts a question such as, what has been negotiated though in terms of what has been lost, taken, or given up in this example, compared to what has been a replacement and achievement?

I applied this question to my ANHC experience within the understanding that the 26 acres the ANHC was built on, and had a soft open in 1999, had previously “belonged to” the Elmendorf United States Airforce base. The NEPA (National Environmental Protection Agency) impact study found that the land was “already quite disturbed” by military training maneuvers. At the time, some of the local Alaska Native People visited

with me about the healing that was needed prior to building the ANHC. The center represents eleven Native Alaskan groups, being Athabaskan, Eyak, Tlingit, Haida, Tsimshian, Unangax, Alutiiq, Yup'ik, Cup'ik, Siberian Yup'ik, and Inupiaq. There were ceremonies that occurred, but the larger community programs about land-human relationship healing were never developed, per original visions and recommendations. It seemed that the excitement about the twenty-plus year vision becoming a reality overrode these ideas, in terms of priorities. I recall that the architectural plans, aerial videos, and digital visioning presented to us of what was to be built were amazing.



Figure 3: Map of Alaska Native Heritage Center grounds and facilities. Open Access image courtesy of Alaskanative.net. Accessed March 2023.

After the Center opened and I moved back to the Lower 48, I have often wondered about how that visualization technology shifted the hearts and minds of the people who wanted to heal the land. Did they and how did they see their relationships with the land differently? Was there a forgetting about the land as a relative and instead focus was on it as a platform for what they would build on the land? I do not mean any disrespect for the Alaskan Native people involved and my colleagues on the development team. We were all caught up in the excitement. Further in my meditating on these questions I concluded that possibly the very construction, by Indigenous Peoples of that landscape, their daily presence and practice of their cultural lifeways, provided healing in ways that have become a permanent and specific expression of Indigenous relationality and interdependence in contemporary times. This may be something to learn from.

It was my work with the ANHC and involvement with the International Institute for Resource Management (IIRM), beginning in 1998, that intensified my work with landscape archaeological philosophies and methods, as applied to Indigenous lands and their Peoples', and became prominent in my personal professional experience.

A fortunate visit with a founder of the IIRM, brought me into a circle of Indigenous environmental art enthusiasts and science-based researchers that founded, myself included, the Indigenous Film Festival in Denver, Colorado. The focus was on public media and major films initially, created by and with Indigenous People about their cultural lifeways. Our first spotlight films were *Whale Rider* (2002) based on the book by Māori author Witi Ihimaera, who presented the film publicly and visited with middle school youth who attended courtesy of IIRM. A second film was also presented, *Antanarjuat: Fast Runner*, a 2001 film by and with Inuit People of the northern Arctic,

created by Zacharias Kunuk OC ONu who is an Inuit film producer and director. This film also won many awards as it was the first Canadian feature film to be produced entirely in the Inuktitut language. Both films provided explicit visual stories about human relationships with their environs and beyond-human relatives. Cultural knowledge creation and perpetuation as central to these relationships are key messages these films promote.

Thought excursion: The inclusion of Art within mainstream STEM focus is an activist endeavor to provide space for diverse ways of knowing the world and communicating it as shared belief systems and worldviews. STEAM is an acronym representing this shift, wherein Arts is included.

Within digital visual media depictions of cultural lifeways of Indigenous Peoples resides the need to draw upon both oral stories and material items, shared and informed by the Peoples' of these, as well as what the land provides that assists with knowledge sharing of relationships contained within them. Understanding the tools that the discipline of anthropology brings, particularly through archaeological means is key to understanding such relationships.

Landscape archaeology, in particular and especially since the late 1990's and early 2000's, incorporates qualitative (more narrative) methods of interpretation in its practices, that previously relied primarily upon quantitative (statistical data) science method approaches. Early ecologists such as Carole Crumley, author of the first text on historical ecology (1994), provided insight to ethnographic contexts importance in revealing relationality and interdependence between cultural knowledge systems and

those found within economic and political systems, particularly dealing with environmental and agricultural policies.

The bridging effect of narrative methods, prominent within social sciences, introduced the philosophy that “maps and plans of landscapes are an abstraction of the world and consequently cannot be relied upon alone when attempting to interpret what it is to be within a landscape...[and studying] the interrelationship between...[its various] features” (Chapman 2009:14). Landscape archaeology, today, is an appropriate forum for understanding impacts of technology on Indigenous ways of knowing, as well as the sources of traditional knowledges, and more so when coupled with Geographical Information Science (GIS) and its more popular GIS definition as being Geographical Information *Systems*. Use of digital spatial data gathering and mapping tools within tribal landscapes, is further supported by the early use of Tribal Nations (Taylor, Gadsden, Kerski, Guglielmo 2017).

Data gathered as requested by Tribal Nations about tribal landscapes, with use of remote sensing and GIS, has been utilized primarily for tribal leadership decision-making regarding local issues related to natural resource management, cultural and historic preservation, transportation, realty, education, economic development, health, public-safety, and agriculture (Taylor et al, 2017). These activities have now centered issues involving data sovereignty among Tribal Nations and has become a complex multi-faceted topic that highlights ethics around gathering, distribution, and storing of information.

Further, the topic of data sovereignty and public digital sharing of information related to sources of Indigenous Knowledges and the interpretation and uses of these by

their Indigenous human kin, engages a theoretical realm referred to as Affective Ecologies and Ecocriticism. These bring relevant broad questions to our attention, such as, how have these ecological sources of knowledge created the cultures we live in as human beings.

I provide more about this thinking in the next chapter as a part of the methodology I have developed for this study. For now, consider there is need for an understanding of a central tenet of Indigenous Knowledge creation found within the definitions of Affect, and in this dissertation is provided as being a collective agreement with such as Deleuze's 1978 lecture on Spinoza that provides us the concept of *affectus* defined as "a change in one's 'force of existing' (2011, 4 as cited by von Mossner 2017:11). Additionally, Heather Houser (2014) contends that evidence of Affect, as a definition, is found through "determining how objects and events rise to attention in our personal worlds and how attachments, detachments, and commitments form from that attention" (5). This is further expressed by Gregg and Seigworth (2010:1), as being Affect and

...is found in those intensities that pass body to body (human, nonhuman, part-body, and otherwise), in those resonances that circulate about, between, and sometimes stick to bodies and worlds, *and* in the very passages or variations between these intensities and resonances themselves.

This passing of intensities between humans and non- or beyond-humans is a powerful image of knowledge creation, transference, and meaning-making that may shift in its intended relevance as a result of technologies' influencing the way we "see" these relationships, within a definition of intensity as that being material for the creation of a cultural-self.

Thought Excursion: Additionally, where my dissertation attends to the partnership between landscape archaeology and GIS is centered in what is a “third theme” of archaeological practice, the other two being historical archaeology and landscape archaeology. The “third theme” is a practice that provides interpretation of data as an integration of ‘scientific’ methods and those more theoretical-based narrative methods, and together creates space for humanistic views and concerns to be a practice of research that engages beyond-human participants. In this way, we can see a mixed-methods approach applied, that is defined by and reflects Indigenous perspectives of research, versus research as integrating Indigenous perspectives (Wilson 2008). This thought attends to the idea of changes in one’s perceived or actual existence as a result of the influence of objects and events that we pay attention to, as presented above regarding the theories of Affect and Precarity.

Within the realm of affective aspects of landscape in an archaeological framework we find the collective works of Ruth Van Dyke and also the edited volume *Native American Landscapes* by Cheryl Claassen (2016) helpful.

Landscape archaeology—also referred to as archeogeography—is a sub-discipline of archaeology whereby one seeks to understand the ways human beings have been and are in relationship with their environments. These relationships have often resulted in human constructions and cultural meanings assigned to landscapes. Van Dyke’s work, largely within the Southwestern areas of the United States, brings consideration of performance theory, memory, phenomenology and visual representations related to place and space. As of her 2019 work Van Dyke encourages a critical review of people and their “things” with regard to understanding the sites of collaboration between them that

constructs intentional representations of these collaborations. While this stance engages a somewhat objective-based binary thinking, versus one based on subjective relationality, it does present consideration of interdependence and intentionality of co-creation.

Engendered perspectives, as a subjective form of binary reference, is addressed by Claassen (2016) through a review of essays sharing a multi-vocal view of landscapes. Multi-vocal is the concept of various individuals, or groups, of people looking at the same something but deriving different perspectives and meanings from what they are seeing. Claassen posits there is a difference between how Europeans and Native Americans perceived, and yet perceive, of their environments and is evidenced in their relationships with landscapes through such activities as naming customs. Europeans tended to prefer the male gaze and classification of land from their perspectives of the feminine and of a need for controlling and subduing it for human needs and uses. Alternatively, needs and uses of land through Native American perspectives, traditionally, reveal more complex and negotiated relationships with their environments have been engaged. This complexity created, and continues to create, place-based kinships that are not passive or to be subdued, but are active responsively, intentionally, and are reciprocal (xiv). Claassen assembles the various essays in her volume per taskscapes, storyscapes, and ritescapes as means to present the relationships between humans and landscapes from Native American perspectives.

The work of Van Dyke and Claassen, regarding Affect Theory as related to constitutive emotions, behaviors and actions, provides further insight to important elements of consideration regarding being off-earth as human explorers and colonists of other planets. Perceptions of what is and are landscapes will undoubtedly be evidenced in

literary and material creations and represent mindsets that can be assessed as to how, who and what benefits from this activity, and why.

This brings to mind my work of diversifying teams' composition and dynamics in project management within industry sectors relevant to global Environmental Engineering, and the attention to perceptions of landscapes and human intentions. This work took me into realms involving the United Nations and their Millennium Declaration.

From 2000 – 2015 The Millennium Declaration was as an essential agenda regarding international relations and reflected what is now understood to have been a socio-economic capitalistic purpose for increasing the supply of services and consumer goods to developing countries, but with a dependence-inducing agenda. The eight Millennium Development Goals (MDG) laid the groundwork for the rationale and operationalization of the current 17 Development Goals for Sustainability, that eventually replaced the MDG agenda, because of issues due to transportation strategies. All of the eight Millennium targets had relevance to the issues and challenges persistently impacting Indigenous populations, particularly since the arrival of colonial settlers, with Imperial mentalities, to their lands.

In the United States, this brought increased attention to sites of resource development such as coal, uranium, water, nuclear waste storage sites, and of course natural gas and oil as products to be developed for an increase in export markets. Geological and Archaeological survey technologies became increasingly in demand, and as a partner to pedestrian survey. Technologies such as ground penetrating radar (GPR) and aerial photography, that utilized Global Positioning Systems (GPS) that had been

developed in the late 1970s, and since has increased in popularity with new hardware and software programs. This has led to further development of remote sensing technologies utilizing satellite-based radionavigation systems. SpaceX satellite trains, known as Starlink, is a contemporary and increasingly prominent example of such a system that provides a global web for internet access that operates on the open-source Linux operating system (Tingley 2022). This is a massive operation of collection and storage of data. As well, ethics around what can and should not be “seen” by these technologies is an on-going request for discussion within the UN.

Two projects that stand-out during my five years with the Environmental Engineering firm, I referred to previously, were a telecommunications project in Hawaii and a transportation project in Beijing. Without going into much detail, both of these projects attempted to engage local labor and culture, but failed to initially and more fully account for their cultural perspectives of land and ecologies being disturbed by the projects, as local cultural citizens were not consulted. To be noted is that preliminary project visuals were stunning and utilized aerial photographs in presentations to the local project leads. To move the project forward, mediation was required as well as mitigation planning to center the concerns of the local cultural knowledge holders in these areas.

The Hawaiian project was re-scoped to include use of a survey method that meant walking the landscape, with an intentional utilization of a method of culture-lens centering land-human and beyond-human relationships, referred to as Cultural Sensory Pedestrian Survey (CSPS). Application of this experiential method evolved this work to be an example of a culturally inclusive designed and managed project. Local partners eventually created a Hawaiian telecommunications company. During the briefing of this

project I recall wondering what cultural knowledge sources, held sacred to the Hawaiian people, were identified and shared with the non-Indigenous engineers, and of these sources which ones existence was negotiated and “disturbed” in order for the project to proceed. What exactly shifted the views of local Hawaiian people regarding how they saw their landscapes and relationships with them? The answer involved seeing, from above through aerial photographs as well as through GPR and GIS data, the amount of land that would be impacted in comparison to that left undisturbed. The interpretation of quantified data bolstered rationales for the project to proceed. This is an example of economic realities Indigenous Peoples and their leadership contend with regarding their lands and attempts to increase the quality of life for their communities, and also as being good neighbors and global citizens. We see this narrative as a theme throughout CRM within projects that call for development of Indigenous lands.

The telecom project opened up access lines to a variety of resources and information that was perceived as being highly valuable to all involved. I recall thinking, “All involved” as a category impacted by this project should require more explicit details about what sources of Indigenous Knowledges and ITEK were impacted, in both beneficial and non-beneficial ways, as defined by the Hawaiian People in relationship with these sources.

I continued to meditate on this question and became more observant regarding future projects, such as planning for the 2006 Winter Olympics in Salt Lake City and also the 2008 Summer Olympics in Beijing. The 2008 transport infrastructure development project partnered with the Beijing City’s longer term strategies to improve all its major transportation connections. Contract partners are subject to the International Olympic

Committee's Sustainability goals and strategies involving such as natural sites, sourcing and resource management, mobility, workforce, and climate. Accomplishing Environmental Impact Studies and Reports are a routine requirement. The transportation strategy for the Summer Olympic Games involved areas along waterways with associated and distinct cultural sites. Aerial survey of these provided an avenue of seeing the landscape along the Grand Canal through a developer's lens. The entirety of the landscape once developed engulfs an area of approximately 2,864 acres that housed the Olympic Village and ten additional sites, including supporting facilities to manage operations.

Local comment emphasized a need for interpretation of cultural water, flora and fauna deities and their mythologies into planning schematics. Today there are primary venues, that also house landmark structures, as a legacy of the Olympic activities.

Olympic Forest Park, as an example, is located north along the Kahui Road, and today is a major central site for roads systems. While some natural landmarks and ecological characteristics were utilized, others were repositioned and or replaced with replicas produced through use of traditional garden construction technologies that provides an artificial landscape of gardens, mountains, and seascapes. Again, I wondered about the internal community conversations, if they indeed took place, that resulted in replacement of natural elements with symbols representing these cultural sources of knowledge. What was negotiated away and for this type of activity? Is the original traditional relationship with these sources of knowledge retained?

One of the threads wending through all these stories is the act of mapping as a way of seeing land and self-in-relation. I have come to realize all lands are in relationship with an Indigenous People. Spatial mapping technologies assists our understanding of this reality. What does this mean in terms of seeing oneself as part of the ecological web of life associated with being upon and in the land, with a responsibility for care and protection of this web?

Over the years, these experiences within my educational pursuits, international travel, and employment opportunities provided me further understanding that there does exist various and diverse ways of knowing self-in-relation to landscapes. Some of these ways are shared among Peoples whose cultural identities have been constructed as a result of these relationships.

An example of the revelation of “diverse” ways of knowing is seen through the work of Mi’kmaw Elder Albert Marshall (2004) that provides a concept from his culture referred to as “Two-Eyed Seeing.” He expresses this as Etuaptmumk and it is a concept shared by many Indigenous Peoples globally that represents ways of learning and making meaning between and amidst diverse worldviews. I understand this as a means to create and exist within a middle space between seemingly opposing value systems and or practices of one’s knowledges. As a concept this way of Being is now translating into integrative work within science and education fields. I am also observing acknowledgement that what is referred to as Native Science (Cajete 2000) embodies a holist understanding and practice of transdisciplinary science-based knowledge. These are examples of what is yet contested, in various obvious but also subsumed and even hidden spaces within academia. In the next chapter I share my perspectives of

methodology and methods that include an observation that has become a practice element with AIRW, this being the re-coupling of axiology (Etuaptmumk, if you will) and Deontology (Netukulimk, accountability) and these as needed to understand sustainability in terms of protecting knowledge sources and systems through protocols.

I learned about a similar work of comparisons, to that of Elder Marshall's, by Barnhardt and Kawagley, who in 2005, shared their visual conception of western science methods compared with Indigenous ways of knowing and presented this as a System of Indigenous Knowledges. Related to the topic of my dissertation is one story they provided, that haunts me still, about the observance by an Inupiaq elder regarding impacts of modern technology that shifted the relationship between father and son, and their ways of knowing and doing, through an experience of learning why and how to hunt caribou. The moral from this story, for me, is relatedly found among the work of various scholars, and is synthesized as being

Indigenous and local cultures are being absorbed and transformed by the global culture of technology...and technologies are not value neutral...the data and resulting statistics that technology provides does not just describe reality—they create it.

Borgmann 2012; Sandler 2012; Walter and Anderson 2013

Technologies create reality. Consider stepping back from the busyness of our daily lives and we may well find agreement with such an observation and statement. This created reality is felt and observed through a question like, how have our lives become attuned to and revolve around the capabilities of our technologies, such as our mobile phones? How might we Indigenize these technologies to reflect culture-based ways of knowing, being and doing found among Indigenous Peoples regarding communication? Has this already occurred someplace? Today we have a few examples with tribal

languages being adapted to keyboards and phone aps for language learning, that I consider as “Indigenizing” technology. Through my MA program I looked at various Talking Sticks found among Indigenous Peoples through the world. These helped me to understand how a Peoples’ sense of origin and identity as being human are socially constructed from the ways we move and behave in our environments. This includes how we communicate and what tools we use to assist us.

That exploratory research connected to an earlier personal story and interests that were part of my youthful dreams, that I referred to earlier. While a Junior in high school I received candidacy to attend the Colorado Airforce Academy in pursuit of my dream of becoming an astronaut—that is a story for another time. However, I revisited some of this interest in tools that help us communicate through my MA program, wherein during pre-proposal development of a research topic I explored the history of remote sensing technologies through a tribal-based environmental and social justice lens engaging the topic of communicating who we as human beings when off-earth.

As a now burgeoning industry, remote sensing technology was initially introduced as a military innovation and progressed further with its adaptation and associated uses within NASA off-earth landscape survey. My broad research question in late 2014 had been, “Are colonial methodologies migrating into outer space?” I sought to focus on Elon Musk’s SpaceX plans to terraform Mars and Richard Branson’s Virgin Galactic off-earth tourism endeavors. My project poster was accepted for presentation at the first UN High Forum UNISPACE+50 conference in Vienna in 2015. I further engaged the topic of remote sensing technology and its constitutive abilities, as a theory

derived through inquiry of social value mapping as understood through the lens of Native Science. My premise was, and remains, that mapping accomplished through remote sensing is highly influential in seeing and understanding ourselves, because it maps the source(s) of our knowledges—particularly landscapes—and what created, exists on and within them.

From Native Science perspectives, Indigenous peoples' have always sought knowledges, not just local to themselves, but also those from afar, and these have been held within stories that pass from generation to generation (Cajete 2020, 2005, 2004, 2000). These stories are the maps and “the aerial view of our lives and reality” (Lone Fight 2017:101).

I provide the following as an enhancement to the above stories and for consideration of the unfinished business we have here on this planet, we call Earth.

Regarding the above story about my colonial space-themed thesis proposal, I was not approved to formally conduct that particular study in pursuit of my MA degree, as it was deemed “too fringe for anthropological study at this time.” However, I have remained within a community of researchers and scholars related to the topic of landscape remote sensing survey, as related to my professional career as an anthropologist, and particularly within the field of archaeological survey methods. These years since that proposal have justified my early interest in the topic and questions I am presently sharing with you through my doctoral work.

This persistence has included keeping a close eye on the work of the United Nations Office of Outer Space Affairs (UNOOSA) and their “Space4SDGs” initiative

that positions their Committee on the Peaceful Uses of Outer Space (COPUOS) within the UNs 17 Sustainable Development Goals. Recall I have mentioned these previously.

The most recent, and quite intriguing, exciting, and also highly concerning of these endeavors involves the agricultural colonizing of the “far-side” of the moon, and it as being the “base” for launches to explore other planets such as Mars. Without data provided through landscape remote sensing, installed on China’s Chang’e 4 Rover, the experimental agricultural endeavor would not have been possible. Obviously, there are additional concerns with this type of activity, which my MA research question would have addressed, and to a degree has, within my dissertation research.

In 2009, Cultural Heritage debates revolving around who “owns” artifacts and the concepts of shared heritage, took a galactic turn, literally. Discourse about expanding legislation necessary for human material culture that had been left on the moon was deemed an emergency situation. One of the more public events these debates inspired was a global contest. In 2007, Tranquility Base, the landing site of the 1969 Apollo 11 mission to the moon, became inspiration for a \$20 million award, the Lunar X Prize, aka Moon 2.0, funded by Google and offered by the X Prize Foundation (Thomas and Walsh 2009). The competition invited private groups to develop, land, and maneuver a robotic rover on the moon before December 31, 2012. The deadline became expanded, many times, to eventually conclude on December 2018, as a “launch contract” became necessary to secure. Team SpaceIL was the first team to secure the contract, and did so with Elon Musk’s SpaceX aerospace manufacturing corporation.

There was an additional “Heritage Bonus Prize” of approximately \$1 million for the team that sends digital images back to earth revealing man-made objects that are still

visible at the Tranquility Base site. As there is no natural wind or rain on the moon, it was determined that even forty years later, Armstrong's footprint and the American flag he planted on the surface, would still be intact. Permanent preservation of surviving artifacts and their protection for historical purposes became the topic of a call within UNOOSA for strategies and criteria, through formalized agreements. Over the years since, there have been developed regulations to govern such activities. One such attempt was made by NASA's Beth O'Leary, an anthropologist, and then a professor at New Mexico State University in Las Cruces. O'Leary is noted as a pioneer in the emerging field of space archaeology. O'Leary developed the Recommendations to Space-Faring Entities: How to Protect and Preserve the Historic and Scientific Value of U.S. Government Lunar Artifacts (2011). These have remained in the status of *guidelines* as the development of an international treaty to enforce them has yet to be formalized. An example of the imperative need to have such regulations be in place and with the "teeth" necessary to prevent predicted episodes of artifactual and landscape destruction can be seen in what is referred to as the Beresheet Incident.

Consider, the concerns with technological assisted contact on the moon became a public reality in April 2019. "Beresheet"—a small robotic lander owned by the Israeli corporation SpaceIL—crashed into the moon's surface and was destroyed. For a minute, the world was engaged in a lunar "mystery" about the condition of its cargo. Soon after the crash, "it was discovered" that a container of tardigrades had been placed on the robotic lander, although this was not recorded on the cargo manifest. This became fact, as telemetry provided evidence that among the debris were tardigrades, or "water bears," that are microscopic creatures found on earth. Their DNA reveals an ancient lineage and

they have a reputation for being the ultimate survivors of extreme conditions—including “high and low pressures, high radiation levels, air deprivation, dehydration, and starvation” (Westreich 2019). How did this incident occur and what are its impacts?

The U.S.-based Arch Mission Foundation was permitted by SpaceIL to include a “lunar library”—a 30 million page digital file of human history and discoveries—in the form of a DVD-style disk, as cargo. At the last minute, and in secrecy, the Foundation’s co-founder, Nova Spivack, replaced the disk with a container of dehydrated tardigrades. Why? Because he could. As shared earlier, there are currently few laws that govern this type of activity, and as such only the current and limited scope of the 1967 UNOOSA Outer Space Treaty is seen as having been violated—which requests nation states oversee activities of non-government entities. This single incident, among others, creates a profound concern for creation of an ethics policy and laws for use of landscape remote sensing technologies and their associated uses, be they off-earth, and most definitely on-earth (Cohen et al 2020; Fernandez-Diaz 2020).

Will the tardigrades survive? Possibly, and especially if they meet up with any of the microbes China sent, or that have survived and grown over the last fifty-years since the Apollo 11 astronauts left their “defecation bags” behind; this was justified as necessary to address craft weight lift-off requirements. So, has there been a migration of colonial methodologies into outer space? Did technology impact Indigenous landscapes and the knowledges they contain? Will this impact yet undetected, but theorized lunar inhabitants, such as indigenous viable organisms?

There appears to be some hope in addressing questions such as these in the form of the Artemis Accords. These are essentially ten guidelines proposed by NASA in

October 2019 at the 70th International Astronautical Congress, to “ensure international cooperation and a safe, peaceful, and prosperous future” for collaboration in lunar-exploration efforts, which also includes Mars and other outerspace places. These principles are purported to be “grounded in the Outer Space Treaty of 1967, to create a safe and transparent environment which facilitates exploration, science, and commercial activities for all of humanity to enjoy” (NASA 2020). The ten principles are: Peaceful Purposes, Transparency, Interoperability, Emergency Assistance, Registration of Space Objects, Release of Scientific Data, Protecting Heritage, Space Resources, Deconfliction of Activities, and Orbital Debris and Spacecraft Disposal. The Earthlight Foundation, that O’Leary is associated with, has created from these principles, [A Declaration of the Rights and Responsibilities of Humanity in the Universe](#).

Within conversations around and the creation of these guidelines, we still largely only see rhetorical consideration of an ecological concern to the use of technology. Ultimately it will be the practice of these principles that reveals their importance and subsequent impacts from use of technologies such as remote sensing and GIS, that maps the areas being accessed and developed.

However, there is a recent related twist in these events that further increases concerns about what technology can provide that is beneficial, or not. This is seen through Elon Musk’s, largely philosophical and technology-laden proposals, presented at the October 2020 annual Mars Society Conference. His stance is that as a private entity, his SpaceX Corp. vision and proposal for creation of a self-sustaining “settlement” as a city on a planet such as Mars (it being classified as a “free” planet), would entitle his group the right to put forth “self-governing principles.” Musk has announced that

“SpaceX will not recognize international law on Mars” (Cuthbertson 2020). Agreement to this is already being promoted and enforced through the Terms of Service of the SpaceX Starlink internet project. Starlink already has hundreds of trains of satellites positioned in the earth’s atmosphere that is presently providing internet connection between earth-based people and to off-earth machines, among other endeavors involving the U.S. Departments of Energy and Defense.

Returning to 2019 I began an endeavor to become more involved with organizations and projects involving off-earth scenarios. The work of Alice Gorman (2019:11), *Dr. Space Junk vs The Universe: Archaeology and the Future*, hit a familiar note within me that has proven profound. She provided

Space is no less an ideological battleground today, but now, it’s about extreme late capitalism vs digital democracy. Or private good vs public good, or military vs civilian. We have a chance to make a new world beyond this world, but it will be the same old world all over again if we’re not paying attention to the narrative. It won’t be different if it’s supporting the same terrestrial power structures as before. It’s really about how we connect the past with the future in space. And for that, understanding heritage is essential.

When I read this I shouted, “fringe be damned!” The question I had originally posed for my MA in 2015 had been relevant and is today a central conversation among national and international policy makers and private entrepreneurs.

An additional work and book I had been familiar with, is Lisa Messeri’s *Placing Outer Space: An Earthly Ethnography of Other Worlds* (2016) wherein she provides a somewhat romantic notion that has us peering through telescopes, interpreting what we see as being “other worlds” through discourse about place-making practices through ethnographic methods. The stories she gathered and experienced provides consideration

of how to create spaces of familiarity with that which is even as yet a tremendous mystery to we earth bound humans. How do we accomplish this with the help of technology? Gorman's tool of choice was the telescope as a means to "see" these other worlds. Ongoing today is the evolving design and usefulness of telescopes. They provide images of what is off-earth and how we as viewers see these are created-for-us perceptions. This reflects the basis of what builds relationships as a result of technological influences. This is intentional as well.

A theme I traced within this work was that journeying off-earth should require preparation to be our best self to enable seeing these worlds through a humanitarian-based lens. What this means and looks like is the subject of many of my conversations and activities these days, as this relates to intentionality.

One such conversation actually began in 2016, as well. Donna Haraway gave us *Cyborg Manifesto: Addressing Science, Technology, and Socialist-Feminism in the Late Twentieth Century*. She describes a cyborg as being "a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" (5). She follows this with the statement, "Social reality is lived social relations." Relationality. She cites the voyeuristic-laden ideas of Frederick Taylor whose 1909 work in scientific management principles promoted employee surveillance as a means to increase productivity. This gave us a path to the past with the work of Bentham who in the early 18th century created an architectural design concept called Panopticon—Greek for "all seeing"—that when developed gave the penal system a circular building style for unobtrusively observing inmate activities. Joliette prison in Illinois is such a place. This idea of seeing without being noticed was taken into the philosophical realm by such as

materialist philosopher Thomas Hobbes and also social-political philosopher Michel Foucault. The link across centuries between their conversations about panopticon deals with the ethics of seeing citizens through ideas of pleasure-pain and discipline and punishment that represent censorship as a privilege of power.

This connects to use of technology as a means of seeing that relates to human intentions with an agenda of knowledge acquisition that requires understanding of these intentions. We see these ideas persisting through time with our Smart TVs and phones that “listen” and “watch” our private daily lives and “assist” us by sending ads to our emails and social media accounts. This is an actualization of arguments provided in the 1990s by Deleuze and Mathiesen, respectively, wherein the idea of a controlled observed physical space is replaced by digitally informed mass media as a space for cyber guards to monitor and manipulate society.

Reflecting on this history of thought, the panopticon is an ancestor of remote sensing as a geo-spatial tool and GIS is a space-age cousin with its “sophisticated database management system designed for the acquisition, manipulation, visualization, management and display of spatially referenced (or geographic) data” (Chapman 2006:14). This brings us back to Haraway’s ideas about what constitutes social reality. How does technology, as means to see one another, influence our social relationality with each other? This question is central to what has become my dissertation project.

Considering the past, the concept of remotely seeing—observing from afar—is of ancient origins when considered through Indigenous culture-based stories about being observers through technological means. Remote sensing is a highly flexible technology that now enables 360 degree access to what is desired to be seen. My study visits the act

of looking at land and its scapes through spatial technologies. This act by Indigenous Peoples is shared through the work of Duane Hamacher (2022) in *The First Astronomers*.

That work addresses yet mainstream views that science is not contained within Indigenous Ways of Knowing. The “star knowledge” shared in this volume provides consideration that these Ways are founded “on observations, deductions, experimentation and collective wisdom that provides insights and solutions to some of the problems we face today” (1). The “seeing” described herein is a verb for knowing. Among some of the living Peoples with the oldest evidence of human lineage yet present in their DNA, being the Indigenous of Australia, this knowing is a lens to understand “... not just the land and the sea...[but] also the sky” (Hamacher 2022:9 citing M. Nakata) as contributing to traditions about who they are and also their responsibilities to this way of knowing, being, and doing. This speaks to how culture is created through ways of seeing, and from the insight of Australia’s first peoples, “As a human endeavor, science is inseparable from culture ... Western science itself ... came from a specific culture, and that is Western European” (16). This brings to the conversation how we see ourselves, and what influences this seeing of self and what has constituted our cultural self. The study of patterns in star constellations supports the knowledge found in Songlines, or Dreaming tracks, that are stories, as walked traces (Savoy 2015), about Australian landscape formations and their relationships with human beings and beyond-humans.

Another such story is from Anishinaabe scholar Dawn Marsden (2020), through her intergenerational starship citizenship project, that addresses observing from afar through understanding a development process for Indigenous Knowledge Systems. These are shared Elder Stories shared about relatives “who travelled from other star systems”

and today make up Star Nations found throughout our earthly world (19). Marsden relates Anishinaabek teachings that her ancestors are from the Pleiades, and observing what this planet is capable of and who its residents are, provided the Seven Grandfather Teachings that are embedded in the eleven Indigenous Principles Marsden shares in her book. These Principles provide the foundations for socio-ecological systems she deems as being “necessary for intergenerational survival and fulfillment” (20). These systems reveal a model designed through the intersection of a mathematical formulation and a philosophical concept, being circular symbols and wholistic egalitarianism (Marsden 2020:24, figure 2). A reading of this work provides the perspective that the observational intentions of Anishinaabe ancestors were for mutual benefit, as public knowledge to be shared. We see this conversation in present-day American and European administration policy-making endeavors for emerging AI (artificial intelligence) that draws on intentions of use of technology in addressing its influences on ways humans learn, apply that learning, and for general benefit.

Again, the reason I have included this survey around space-based use of technology and its impacts, and these associated with Indigenous stories and experiences, is to remind us of the need to look at what has and is currently occurring on earth, and is yet largely unresolved. Technology is implicated and central, if not also complicit in both the beneficial and non-beneficial results of these activities. Inclusion of themes regarding technology and being off-earth also attends to Seventh Generation thinking, as time does not stand still and wait for resolution before moving forward. This behooves us to consider influences derived from use of technology, and from a variety of sources.

Part 2:

**Survey of the Landscape from other Perspectives:
Developing with Community, a focused research topic and questions.**

The contexts, foundations, and assemblage of this study reveal my agreement with the shared Indigenous perspectives and understandings of land as being one of two primary sources that constitute Indigenous knowledges (IK)—the other is spirituality-based.

Reflecting through this dual lens, I continued to consider what specific types of technology can and do impact land, particularly Indigenous lands, and perceptions of it within its relationships with humans. While I have had experience with many types of land and place-based survey technologies, I wanted to have this study be relevant to Indigenous practitioner use as well. The conclusion of my assessment pointed to a geo-spatial analytics platform: Geographic Information Systems (GIS), coupled with remote sensing technologies, such as GPR, drone-mounted hardware and software, as well as satellite platforms.

Situating tribal lands as representing sources of IK and ITEK, and their relationships with humans and beyond-humans representing IKS, I further explored what concerns may presently exist with use of remote sensing and GIS technologies. Again, utilizing the AIRW model of practice, I engaged elements of the Community-Based Participatory Research (CBPR) concept and model, provided by Ojibwe archaeologist, Sonya Atalay (2012). Within these methodologies are principles for ways to go about preparing for a formal study that initially centers, and then decenters the researcher. This is an act of both self-knowing and collaboration as partnership, to a degree that enables responsive and flexible shifts in dynamics and power when conducting research. This

methodology largely entails defining and developing the research focus and questions “with” communities of interested parties (Atalay 2012; La Salle 2010; Nicholas and Wylie 2009; Murphree 2008; Wulfhorst et al 2008; Wilmsen 2008; Strand et al 2003; et al). The AIRW continuous improvement model incorporates this methodology and additionally translates as a method of research design and practice.

Through my practice of this process, of designing research with communities, there has been revealed five primary concerns that have been further interpreted into three themes, as objectives, that guided my selection of sites and methods of inquiry, within a Case study approach toward Understanding Impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) from use of remote sensing and GIS technologies within tribal landscape survey, and subsequent influences on both tribal practioners of these technologies and tribal leadership decision-making regarding cultural heritage and resource use and management.

Within this process I found an associated topic that promoted my interest further and became a part of what I wanted to understand. As I have shared, since at least 2014 there has been an exponential increase in the excitement about use of remote sensing technologies within STEM-based subjects and associated industries. Use of landscape archaeological technologies is also one of the emphasis points within the drive for STEM-based learning within National Indian Education. High level funding has developed and increased educator training and student recruitment into technological fields associated with robotics and geospatial technologies (AISES 2020; NIEA 2020). Concerns surrounding STEM-learning associated with Indigenous peoples and their

traditional ecological knowledges, particularly with use of technology, have also increased and lent to my understanding of a need to explore deeper facets of my topic.

The “deeper facets” I refer to are revealed through my exploratory research stage of gathering numerous comments and concerns among Indigenous tribal-based leaders (to include directors of lands-based programs and projects), tribal Elders, GIS and LiDAR (Light detection and ranging technology) practitioners and trainers, STEM subject graduate students, community college and university faculty, and K-12 educators. These concerns are supported through further standard literature review. This process also became an avenue in which to review issues regarding cultural loss from “inappropriate” use of IK, IKS, and ITEK, that more broadly associates technology and its relationships to industry and STEM-based futurisms, that promote the concept of technological “influences.”

Through a “with community” approach, I came upon two key conversations which impressed upon me, what remains to feel like an imperative need, to accomplish preliminary investigation that delved deeper into identification of local concerns related to landscape-based technology and its impacts on IKS and ITEK. These concerns, as stories, were mnemonic for me and prompted memories and reflection on my own experiences, and knowledge from academic study, some of which I have previously shared with you.

The first, relates stories of experiences had by an elder Shoshone-Bannock man, who is a military veteran and has served in leadership positions for his tribe. His point in sharing these stories was that, from his observation and experiences, whenever a non-

Indigenous person or company, or the government, wants something that is related to Indigenous land, resources, knowledges they will always recruit/hire Indigenous peoples to lead the way in convincing other Indigenous peoples to go along with the plan. These Indigenous peoples, who “lead the way” for personal benefit, he referred to as “scouts.” This, he explained, is in reference to those historical Indigenous peoples who assisted—voluntarily or not—the military and missionaries to locate and reveal their own people and their vulnerabilities. This elder further shared contemporary stories that exemplified his observation. At one point, he seemed to seek my forgiveness for his involvement in the military. This amazes me still.

He framed this within stories that expressed a reality that advises, it is not always easy to make decisions about one’s cultural wellbeing. Largely, he said, because there is often high pressure to decide quickly, and this does not provide time to more fully understand what the outcomes might be. He gave a shy smile with this, and said it is a strategy. It is rather like buying a vehicle, with high pressure sales people stating the “deal” is only good that day. Before we ended that visit, he asked that I “watch” for these “scout” people and observe their behaviors and activities, especially with anything to do with Indigenous education, industrial development, and particularly technology. He said it was a good thing that I am taking on a “point position” and am willing to look into these “unchecked” areas within those that have many Indigenous people only looking at the fairytale or short-term benefits, that are actually distractions that feed an unwillingness or a denial about asking questions such as “should we” be doing this.

His comment about taking a “point position” reminded me of another conversation I had with an Indigenous graduate student, who is a water ecologist, and has

been a member of AISES for several years, including a term as Chapter President. I had asked him to share his thoughts about being an Indigenous scientist and the expectations of him from his community and from the AISES organization. He said it was an honor to represent his tribe within a field that is so important to their wellbeing, as well as to the world. He said he has received much needed and appreciated financial and moral support and opportunities for advancement as a result of his membership within AISES.

However, he added to this his observations around the excitement about his representation in the field, but that he also feels pressured to work on projects that are often not to the immediate benefit of Indigenous peoples overall, let alone his own tribe. As well, because of this he feels a hesitancy to approach his elders for permission to utilize tribal knowledges regarding water ecology. He fears though, his hesitancy will jeopardize his financial future and career opportunities. He said, while he has not engaged in what is an increasingly troubling development around this pressure, he has observed some Indigenous students are reacting to the pressures he spoke of by withdrawing from their programs, or more concerning, are “making up stories” about a cultural knowledge they pretend to hold or hope to gain and then utilize.

I shared that I was doing a review of the history and supporters of the AISES organization, with some of these concerns in mind. He nodded, leaned toward me, and urged me to be cautious, as the primary supporters were from the industries who benefit from science fields.

As I am an Indigenous individual and researcher, I too have observed concerning behaviors around levels of personal cultural knowledge and their uses. I stake out a defense that overall, the concerns around these are predicated on pressures of

contemporary realities. I speak of realities such as colonization that has largely robbed most Indigenous Peoples of our/their cultural knowledges and the ways of being keepers of these. Realities such as pressures from the precarities of life that seem to require concessions around uses of Indigenous knowledges that provide access to our ways of knowing, being, and doing. Realities, as pressures from affects that exist in society, such as the desire to seek higher education even with all the risks of potentially having to negotiate with that which we hold sacred. Ultimately though, advice from the communities I visited with provides that, personal values and an assessment of them in light of the context of issues is required. This is the philosophy of An Indigenous Research Way.

Reflection on Community Visits: Comments, Concerns, and Themes

I provide here a list—a typology if you will—of the comments and concerns shared with me through numerous conversations accomplished through preliminary exploration of the problem statement and broader topic of this study. I have interpreted these concerns into a one-sentence topic and prioritized them per rate of occurrence. This process produced five topic areas of concern. As well, I provide a summary of each, with associated discourse I found salient to the issue(s) I understand they pertain to, both directly and or broadly:

1) Security of data derived from use of GIS and remote sensing technologies and issues of Data Sovereignty.

Although attention, since the early 1990s, has been occurring to address issues related to geographical spatial data creation and use, it has only been recent that emphasis, from an Indigenous perspective, has been placed on the security and data sovereignty of tribal-based lands and natural resource data acquired through technological means (Cohen et al 2020; ESRI 2019; NPI 2019; Ballas et al 2018; Powell 2018; Steeves 2017; Simpson 2017; Johnson and Larsen 2013; Middleton 2011; King 2009; Battiste and Youngblood Henderson 2000; et al).

Concerns about data sovereignty—who owns and can utilize what information, when and how—figure largely within concerns of its security. This is a burgeoning discourse as tribal nations persist with their endeavors to restore, manage, and utilize their own lands and natural resources (Personal conversations 2015-2021; Cohen et al 2020; Simpson 2017; Walter and Anderson 2013; Atalay 2012; Fitz Gibbon 2005; Brown 2003; Battiste and Youngblood Henderson 2000; et al). Situate this need for security of data, that is already gathered, within the opposite extreme of the still persistent lack of information regarding Indigenous lifeways, particularly as shared from their perspectives, and we have another paradox occurring. The acquisition and security of tribal-based data also crosses through the advent of technology that is utilized within archaeological projects. The point of intersect is the conversation and call for development of ethics and protocols around data ownership, intellectual property rights, and use of Indigenous knowledges.

There is a particular story shared through a paper that discusses incommensurables between various knowledge systems, written by Barnhardt and Kawagley (2005). I had

referred to this story previously. Here, another poignant part of that paper relates perceived impacts that technology has introduced within the relationship between land and humans, as told by an Indigenous Knowledge Keeper. As the elder completed his story, of how he and his brother were taught the accrued knowledge associated with hunting caribou, he explained that in “those” days the relationship between the hunter and the hunted was much more *intimate* than it is now. His concern, he shared through other stories as well, is based on the “interventions” that modern forms of technology represent. He observes that the knowledge associated with Indigenous ecological symbiotic relationships, is slowly being eroded and unprotected (Barnhardt and Kawagley 2005:Abstract), and even substituted and woven with other forms of knowledge that “create ease of access,” as intervention for problems, yet also creates avenues for appropriation of Indigenous knowledges.

As I thought about the elder’s concern about knowledge being eroded, left unprotected, and being subjected to interventions associated with the presence of technology, I considered it also requires deeper thought about ethics of technological use (Cohen et al 2020, Fernandez-Diaz 2020, 2018). In contemporary society, this should include concerns about use of technology within Indigenous communities and how it potentially poses heightened security issues—as a form of erosion of cultural knowledge access—and as related to data sovereignty. Cohen et al (2020) situates the conversation about ethics in relation to landscape archaeological survey technology, as a yet unmet need. They provide examples of use of drones and LiDAR, noting this need is also broadly relevant within the realm of public use of various forms of geo-spatial imagery (76). This study highlights and calls for, in lieu of formal guidelines, three elements of a

checklist that archaeologists should refer to prior to use of drones and or LiDAR: “1) future access to and dissemination of data; 2) how to engage stakeholders; and 3) how to promote public education” (77).

Across the world, there is a movement toward understanding and asserting “Indigenous data sovereignty,” but what this means is in continuous development to be understood and evaluated; which results in a seemingly lack of interest by tribal leadership and their communities to determine standards (Tsosie 2019). Recent discourse about standards is moving the concerns forward in public places, such as to the White House Call for use of Indigenous Knowledges for federal decision making within their tribal consultation venues. I speak more about this in Chapter 6.

The data sovereignty issue addresses basic needs regarding decision making and management about tribal resources and cultural information. Since Europeans arrived among Indigenous peoples, their lifeways have been documented, collected, appropriated, and commodified for benefit of the colonizers, and often resulting in diminishment or demise of Indigenous people and their environments (Kukutai and Taylor 2016).

Consider, in 2018 a study was initiated by the National Congress of American Indians (NCAI) to survey American Indigenous peoples awareness levels, access, and use of data about their communities. Of the 567 federally recognized tribes receiving the survey, 25% responded. Of these, 83% agreed that access to data was a primary need for their people in order to develop tribal planning and management strategies. Concerning, was the revelation that “most of the external data that [tribal nations] use comes from the United States Census Bureau, the Bureau of Indian Affairs, the Department of Housing

and Urban Development and other federal agencies...state and county agency data as well as data from universities and colleges [in the form of research]” (NCAI 2018, 2). Data based on the lived lives of Indigenous peoples has been re-interpreted into data forms that reflect the agendas of these agencies, with little inclusion of the way this data is meant to represent the cultures and realities of the people, from their perspectives and for their benefits.

The caribou hunting story reveals, to me, two major concerns that my study has sought to address: impacts to ITEK that influence cultural relationships—between tribal peoples and their sources of knowledge, and the use and protection of these traditional knowledges from that which would create an imbalance of benefit. These issues are complex and require a deeper way of thinking about relationships between traditional knowledge sources and their peoples, in the face of contemporary needs and realities, that also calls for use of technology, but with understandings about its influences on ownership and access. This complicates the relationships within the present structure tribal nations are relegated to with federal government. As I shared a moment ago, this relegated space may be shifting in major ways at the federal level, and time will tell if agendas have also shifted toward a more mutually beneficial space created through honest collaborations.

The present COVID-related health pandemic has also revealed that a next level precarity is arising, in the United States and globally. Complicit are federal administrations’ increase in Trans-Imperial and totalitarian approaches to natural resource development, particularly that involving nationally conserved areas and tribal lands. This reflects

heavily the “staples theory”—first conceived by Harold Innis (1956)—and is a domestic economic theory describing a country’s tendency toward crisis as a result of its “over-reliance on raw commodity exports...and the structures of financial and commercial investment associated with primary resources” (Pasternak and Scott 2020:206; Watkins 2007). This promotes further concerns about “outsider” use of ITEK, as a result of Indigenous knowledges being gathered and “housed” by technology.

Additionally, there are Indigenous communities, the world over, that are extraordinarily impacted by the effects of climate change. There are needs, presently at emergency levels, for whole communities of people to be relocated. This poses existential and sovereignty risks for them. What land-based knowledges have already been or yet require documenting? What are the plans for mapping, what will become a nearly invisible landscape, for both present and future cultural futurism and academic concerns? Who will own this information and have decision making authority as to its uses?

In turn, and as stated previously, there is mounting excitement within the archaeological world that crosses-through industry, particularly as an enterprise of applied anthropology. Use of LiDAR, as a next-gen remote sensing technology, has evolved archaeological landscape survey, that is in effect a “turn” for the discipline and its practices. We see this through work and studies such as those taking place around the world, with increasing levels and applications. How are these uses of GIS and LiDAR technologies beneficial regarding the concerns and realities Indigenous peoples are encountering today?

Two events have heightened the level of these issues: the “leak” of sensitive tribal information through a call to tribal nations, from the federal government, in order to

receive CARES funding for their communities (Indian Times, April 21, 2020), and the release of information that the Iranian government has space-enabled weapons, via satellite, capable of hitting targets within the United States (Whitehouse Press, April 23, 2020).

The leak and misuse of tribal nation data is a sad and devastating story that transits (Byrd 2011) through time. One only needs to research the topic to find historical and persistent abuses from activities, such as medical and psychological testing and use of sensitive cultural landscape data that has created lasting harm for the tribal peoples involved. Couple this with the data leaks of geological information found within foreign intelligence and we have concerns that created a “bug-out” situation for NORAD at Cheyenne Mountain in Colorado to the state of Texas. Within housed geological information was the location of sources of Indigenous knowledges that are necessary to be accessed by Indigenous peoples.

Related and directly concerning for tribal nations, was the leak of sub-level Minuteman missile silo sites—300 silos and 15 launch control sites, in North Dakota, thought to have been decommissioned in the Reagan Administration. Reports were released in the 1990s that some of the missiles were moved to Montana, but in North Dakota, it was found that at least half are actually still operationalized and “launch ready” today. There are several tribal lands and communities of tribal peoples located in these areas.

These, and other such, events are all prompting concerns centered around an overarching question: How is land-based technological use for data creation, access, and security being adjusted and assured in light of a local, national, and global “common

hunger” (Fairweather 2006) for resources. Further, are there any assurances of security of data when seen through the lens of “American ambivalence” (Bruyneel 2007)—an in-favor/out-of-favor mentality and practice—related to Indigenous lands and exercise of sovereignty over their cultural heritage and natural resources? Is the present Call for use of IK part of this “ambivalence?” Such activities require Seventh Generation Principles be addressed and applied.

2) Concerns about levels of Understanding and Uses of IK, IKS, and ITEK and as associated with land-based technology use among Indigenous students, educators, and tribal leadership.

Beyond the concerns for issues around further “outsider” development, is a less examined concern for how and why “insider” tribal use of these technologies will impact their own IK and IKS. How does use of these technologies influence the way IK holders “see” the sources of these knowledges and how does this shift their relationships? This was a consistent theme expressed through conversations with tribal people, and it is associated with concern for “levels” of IK among Indigenous students, educators, and tribal leaders. The use of the term “levels” relates to what Jo-ann Archibald (2008) refers to as being “culturally worthy.” I take this idea and coin the term “cultural citizen” to mean one who not only publicly identifies as being of a particular Indigenous People, but one who also is in relationship with how their cultural ways of knowing, being, and doing are constituted. Within this study, this is relevant for understanding how interpretation of technologically produced data are interpreted through a culture-based lens.

This also engages what Bang and Medin (2010) refers to as “epistemological orientations” (1009). Their concern is with the relationships around epistemological origins—ways of knowing—and their associations with practices within science education. I refer to this concern as being relevant to the “health” of relationships between IK, IKS, and ITEK and their peoples’, and in this way view IK as having agency within this relationship. Through such a lens, cognitive processes are revealed through sense making, and evidenced through subsequent decision making, as a cultural process (Nasir and Hand 2006). The stories I listened to pointed to concerns about assumptions of the levels of—or relationships with—the sources of IK that Indigenous students, educators and tribal leaders hold, actively maintain, and pass along—as a form of knowledge perpetuation through informal and formal learning methods.

2a- Assumptions about level of IK among Indigenous students in K-12:

There is concern for the cross-cultural understanding of the levels of IK that Indigenous students bring with them into the classroom—be it tribal- or urban-based. There is perceived and documented pressure placed on Indigenous students and experienced in various ways. Here, I share a story told to me by an Indigenous educator of middle-school students within a small suburban school. Names and locations have been changed in order to share the story with you in this context:

The young boy, all of eleven years old, began tapping his pencil on the desk, the sound increasing steadily. “Colby!” The teacher stopped her lesson and addressed the tapping. “Are you paying attention? Do you understand the assignment?” She walked toward the boy. “Yes Ms. Carter, I understand, but I can’t do the assignment.” His eyes remained fixed on his desk top. She now stood beside him, “Why not? I only asked for everyone to report on some aspect of their tribal culture that makes them proud to be

Native American, and to use some of your language in the writing. Non-Native students will report on their own heritage as well.” She looked around at the other students, “I thought since it is Native American Heritage Month this would be a fun assignment to discuss heritage and culture.” The boy shyly looked around at the other students. He and his mother are Menominee and had recently moved to Minneapolis from Chicago, where she was raised. Many of the students at the small urban school were Natives, from a variety of tribes. He began tapping his pencil on the desk again. Ms. Carter leaned toward him, “Colby, what is the problem?” The boy broke the pencil and glared up at her, “I know I’m an Indian. That is my heritage! But I don’t know how to be Menominee or speak my language. Can you teach me? I need to be taught who *I* am, before I can do the assignment!”

This scenario continues to also play out within classrooms with Indigenous students present, but knowing one’s culture and ways of knowing, being, and doing are observed as often taken for granted and or assumed. This has created anxiety among students who are not knowledgeable of their cultural ways and language, for various reasons. This also creates opportunity for ridicule and perpetuation of lateral colonization to occur which further disrupts learning and student sense of self and identity as an Indigenous person (Shamir 2020; Cajete 2020; Windchief and San Pedro 2019; Dayle John 2019; McBreen 2019; Smith, Tuck and Yang 2019; Claxton and de France 2019; Newberry and Trujillo 2019; Paris and Alim 2017; Marker 2011; Bang 2010; S. E. Nicholas 2010; Steiner and Posch 2006; Durie 2005; Riggs 2005; Cajete 2005; Stephenson 2003; Moore 2003; Rhea 2002; Cajete 2000; Darrel Kipp 2013/2000; Freire 1970/2012; Zwick and Miller 1996; Ogawa 1995; Deloria, Jr. 1991; et al).

2b- Assumptions about level of IK among Indigenous students in higher education:

Visiting with many university Indigenous students, particularly those who have spent a large part of their lives living in reservation communities, there were two primary concerns related to assumptions about what they “bring with them in terms of Indigenous Knowledges.” Each student expressed feeling pressured “at times,” from other Indigenous students, to utilize these knowledges, particularly to exhibit use of their tribal languages. This goes beyond the persistence of non-Indigenous students assuming Indigenous students “naturally” have tribal traditional knowledge. Additionally, they added this pressure was felt primarily from faculty who are not Indigenous, but are “allies” of Indigenous lifeways and seek out this knowledge from Indigenous students. There is another aspect of the spectrum at play within this concern. This relates to being funded or a discontinuance of funding if they cannot contribute to their discipline through a cultural lens and or behavior that expresses and or utilizes their Indigenous knowledges. This is the reverse of pressures felt by Indigenous students when they desire to utilize and implement Indigenous knowledges, but are prevented from doing so. In all these scenarios there is observed furtherance of an academic colonial assimilation strategy.

Consider, Foucault continuously put forth his stance that power and knowledge are entangled and are constitutive of the Other, and the argument that “knowledge is not only a product of power—it is a form of power” (Moreton-Robinson 2016:107). With regard to education and Indigenous peoples, particularly those exercising their right to access their Indigenous knowledges and “live” their cultures, primary concerns have been with the prevention of Indigenous ways of knowing, being, and doing. We have seen this time and again as a colonial method, that has rarely deviated from its self-serving agenda.

However, there are those who observe, contemporarily, a more pronounced shapeshifting of these methods (Byrd 2011). These include co-opting of Indigenous knowledges through acknowledgement of their benefits. This now includes an increasing invitation of Indigenous peoples to bring their knowledge into the main, and once this is accomplished, there appears to be little emphasis in supporting the students' return to their own communities with what has been collectively learned through their university experiences. Unless, there is broader mainstream benefit to doing so.

Consider the use of Story. Not so long ago, stories—especially told from an Indigenous perspective by Indigenous people—were largely not considered relevant scientific information and were actually considered taboo within academic empirical studies. This is reported, observed, and experienced as highly confusing, as we have learned that stories—their content, telling and use—is a common practice among the cultures and societies of human beings. The importance of an oral story, as a verb and context, requires we be mindful of its history as the basis for what becomes written (Windchief and San Pedro 2019). If the storyteller is not permitted to tell a story from their own relationship with its context and content, where is the validity of the information? As well, removing the understood context and implemented value of the story from its people, diminishes the relationship and power of it for them (Archibald 2019).

Through Euro-western philosophy, a practice was inculcated that interpretation and publication of these stories was to be from a dominant perspective that assumed the right to tell them, especially those stories of the colonized and oppressed, which resulted in works that were re-interpreted, re-presented, and re-told from this dominant lens (L.T.

Smith 2019). Today, and fortunately, many researchers are moving away from this suppressive activity, and its practice is less tolerated within academia. However, what we are beginning to see is an apparent opposite end of this spectrum. Within most, if not every academic discipline, there is a turn toward regaling the beauty, bounty, and cathartic use of story.

Within the academy, there is now open invitation for the telling of Indigenous stories, and by Indigenous peoples, particularly if they are ecologically related and deemed useful in scientific matters. Referred to as a decolonizing research approach, Storywork is becoming both a methodology and method of choice across many disciplines (Archibald 2008; Kovach 2009; Kinloch and San Pedro 2014; Windchief and San Pedro 2019; Archibald, Xiiem, Lee-Morgan, and De Santolo 2019). “Stories in Indigenous epistemologies are disruptive, sustaining, knowledge producing, and theory-in-action” (Sium and Ritskes 2013:2), and within this practice of Indigenous knowledges, we have an imbedded call and request for their use beyond philosophies.

An ongoing literary conversation exists between Paul Sillitoe and Marzano (2009), Paul Sillitoe (2010), and John Briggs (2013) regarding the “Failure of Indigenous Knowledge Research in Development, Trust in Development: Some Implications of Knowing in Indigenous Knowledge, and Indigenous Knowledge: A False Dawn for Development Theory and Practice.” Their conversation revisits the last forty-five-plus years since the first Indigenous scholars brought into the barely prisms sunlit halls of academia their thoughts, experiences, and calls for Indigenous Methodologies within research design and practice. Their conversation is also fraught with impatience and frustration at a seeming halt to this progress, evidenced by pages of reference citations for

scholarship produced by Indigenous peoples, primarily relating shared Indigenous philosophies. Yet, there is also support and hope indicated for a transcendence of this scholarship beyond philosophical approaches to research, that moves toward the implementation of these as tools for development in applied and “action” ways. Again, there is concern with this request in terms of ethics and protocols, as well as for a deeper look into the intentions of it, and the ratio of benefits derived and by whom.

The issues shared within this category of concerns are woven together with the idea that these invitations to bring into academia Indigenous knowledges, are only a partial shifting-of-nature as now more cordial hosts expect university students and newly degreed Indigenous peoples to “figure out”—as part of their academic program and when they go “home”—how use of Indigenous knowledges, often now coupled with western science, translates as benefiting their own peoples (UNESCO LINKS, AISES and NIEA vision statements).

The intersect of these concerns can be investigated and possibly understood through a lens such as that Whyte’s (2018) question creates, “What do Indigenous Knowledges do for Indigenous Peoples?” We can continue to look at this question through the topic of Indigenous educators, that arose frequently within my community visits.

2c- Assumptions about levels of IK among Indigenous Educators:

The assumptions and associated concerns regarding Indigenous students’ level of IK and use of them, extend to concerns expressed with regard to and among Indigenous educators (Buss, Leonard and Moss-Redman 2020: Bartlett, Marshall, and Marshall

2012; Archibald 2008; Brayboy and McKinley 2005; Battiste 2002/2005; Bourdieu and Passeron 1977).

There have been recent inroads to acknowledging the voice and value of Indigenous peoples and their knowledges, through adoption of state education revisions to include perspectives of Indigenous educators and of their own cultural histories, present realities, and even futurisms. This has largely been achieved through the insistence and drive of Indigenous educators. We see this through such as various versions of Indian Education for All across the United States—presently observed more so in the West. However, recent reports highlight that endorsement and application are severely lacking.

Additionally, we have federal agencies increasing their reach toward tribal nations for insight about urgent environmental and climate related issues, which are primary sites being addressed by STEM-learning. Albeit, this has been a well-trod and stressful relationship for tribes as evidences of appropriation and inappropriate uses of ITEK have already occurred (Simpson 2017; Lowe 2015; Dunbar-Ortiz 2014; Echo-Hawk 2013; Battiste and Youngblood Henderson 2000; et al).

Looking at these developments through the work of Megan Bang and Douglas Medin (2010) situates the “places” of Indigenous educators, within the United States, as an undeficit focus within science learning and education. This means, moving the emphasis away from performance of mainstream STEM knowledge in a formal sense, toward the knowing of Indigenous knowledge related to STEM subjects through day-to-day practice and informal educational experiences. I refer to this as a “flip” that centers Indigenous epistemologies, which again, is a “departure from a deficit lens which views

community-derived knowledge as an impediment to learning academic STEM content” (Bang and Medin 2010:1009).

Bang and Medin approach the knowing of Indigenous knowledges as a cultural process that assumes science practices already exist within the epistemologies—Ways of knowing—among Indigenous peoples. I am of the same assumption. Their work looks at the improvement of teaching and learning through understanding what culture-based knowledge educators bring into their own training and subsequent professions. Bang and Medin’s theoretical approach “argues that the current state of knowledge about human learning and motivation has yet to adequately understand the ways in which culture is integral to learning” (1014, citing the work of Nasir and Hand 2006; Nasir, Rosebery, Warren, and Lee 2006). This connects to the concerns shared with me related to the level of IK Indigenous educators claim and utilize.

Further, within Bang and Medin’s work they look at evidences of these levels through observation of cultural knowledges being “lived” (Cajete 2000). They view the “day-to-day practices [as] sites at which epistemologies and epistemological stances are implicitly brought to life, learned and infused with meaning” (1017, citing Bang 2006). This goes half-way to what I interpret is an approach to understanding the concerns of this issue presented in this category, but what I saw as needed relates to a deeper level of understanding the relationship an Indigenous educator, and for that matter, a student has with Indigenous knowledges as deriving from land-based sources. Bang and Medin’s work explored their theory but only in-so-far as, for example, asking in a pre-survey “what constitutes a forest” and the response was a list of kinds of trees, plants, animals, etc. (1023). In the post-survey, after a 3-week STEM camp with Indigenous educators,

the student response was interpreted as successful application of educator instruction, if it revealed the answer as being more specific to species-type. Further success was granted if the post-survey response was that an Indigenous perspective of what constitutes a forest would include relationships between flora and fauna, such as deer eating grass.

My critique is that a deeper observation and interview is required to understand Indigenous educator levels of Indigenous knowledge. This may be revealed through additional assessment of their understanding of what constitutes IK, beyond the centering of human transmission—such as gained through Elder sharing. The same could be asked of students, and in both scenarios, personal revelation could be achieved through inquiries inside their cultural relationships with their IK.

Over the last decade we have seen an increase in Indigenous educator training that creates opportunities for educators to be students. Preliminary review provides a need to understand if this educator training includes that which empowers gaining IK—versus a seeming overriding assumption that the educator brings with them IK. As well, how then is their IK incorporated and ethically utilized within culturally sustainable pedagogies and curriculums, both at a tribal-local and urban level (Windchief and San Pedro 2019; Paris and Alim 2017; Archibald 2008; et al)? Again, Whyte’s question creates an intersect for concerns, and a platform that requires also addressing tribal leadership.

2d- Assumptions about levels of IK and ITEK among tribal leadership.

“We have to be the safe place” (Simpson 2017:144) should be the banner that hangs within every tribal nation’s council chambers. This is what I heard from many of the voices speaking about their concerns with tribal leadership and uses of cultural heritage

and natural resources. Of equal concern were statements that related the reality that we must face that some of our own people don't want our sacred sites protected and agree to development of them and negotiate away our relationships with what creates our cultural identities.

Corresponding to this observation were reflections that landscapes for human uses are not outside Indigenous philosophies or practices. What I interpreted from these conversations was a concern to remember and return to understanding cultural 'ways' that provide insight to the *purposes* of relationships between IK and ITEK and their peoples'. This is understood to then assist in structuring and maintaining the sacredness of both IK, ITEK and IKS – this being the sacredness of the relationship itself.

These insights alone provided a call for the topic of my research. This is further supported by actual requests that this study occur.

Throughout the conversations I received stories of childhood memories that related acknowledgement of the sacredness of the gift of ITEK. I had prompted these with a question I, myself, had been asked within a dream that occurred in January of 2017. It was quite a fantastical dream actually. I was an adult standing in a forest I knew well, and a black and white rabbit was asking me what I loved the most when I was a child. I responded that it was hearing the river, in the middle of the night, splash over boulders and multi-colored rocks; and that this helped me to feel safe and hopeful about life. The rabbit nodded and said those were gifts given by the nature spirits that inhabited each of those elements, and that their natures joining with human natures formed our relationships. I believe this to be true. My family can attest to the multitudes of river rocks that live and travel with me—several are from my childhood.

Tribal leaders, such as the late Claudeen Bates-Arthur (Attorney General for the Navajo Nation) have provided guidance to other leaders about their responsibilities to know their cultural knowledges and ways of being in relationship with them, and overall to provide protection of them and the derived relationships. Bates-Arthur was particularly concerned with the “need to distinguish internal self-images from those that come in from the outside to influence who we are now”—this in reference to the importance of the constitutive power of traditional knowledges (Tsosie 2019:40).

Consider the history and more contemporary events of several tribal situations where these questions of leadership’s’ need to remember and or learn about purposes and uses of IK were seemingly in periphery or an after-thought. Calls for accountability were, and are, often glossed or subsumed within other interests, typically those promoting distinct political or economic agendas. The repercussions of not respecting our relationships with IK haunt us still (Dayle John 2019).

One such example is the Navajo Nation and their historical complicity (admittedly) in using what they deemed as sacred—their knowledges of their lands and resources—for energy projects. These had been revealed time and again as providing little to no benefit for their people, and have created irreversible damage to the environment, and their culture—creating gulfs of disagreement among their people over these decisions ensue today. Dana Powell’s (2018) *Landscapes of Power*, an ethnography of the situation, is the first scholarly work to address this topic in over twenty years. She situates the issue of tribal natural resource use and the extraction of uranium and coal from Navajo lands, particularly that on and around Tse’ Bit’a’i—Shiprock, within the

moral dilemma, I refer to as negotiating the sacred, in an attempt to gain and maintain a modern state of economic well-being.

Another such story comes from the plight of the Lower Elwha Klallum people of Washington State, and the unearthing of their Tse-whit-zen Village, as told by Lynda V. Mapes, in her book *Breaking Ground* (2009). Again, tribal leaders claim complicity in their lack of remembrance that their people—their historical ancestors—once lived in a village that was to be bulldozed for development of a new Port Angeles dry dock. Tribal leaders did not consult their elders nor revisit their own archives, and instead approved the project. Even when the first human bones began to surface, tribal leaders did not heed elder protests to stop the work. The story is one that breaks your heart, as negotiation of what to do next created additional and enduring trauma for the Klallum people. Attempting to address these issues, their Council had decided their own people were to be contracted as laborers to remove, classify, and store their ancestors remains and artifacts. Those Klallum people who worked on the site could not and did not endure this for very long and the project was eventually stopped. Subsequent resulting trauma has persisted for those involved in the project.

These and so many other stories, particularly since European contact, harken back to the call for remembrance of cultural ‘ways’ of being and doing, within the relationships between IK and human beings—and this all has given me pause. I am reminded of the work of Lisa Lowe (2015) and her study and subsequent book *The Intimacies of Four Continents*. She relates the “often obscured connections between the emergence of European liberalism, settler colonialism in the Americas, the transatlantic African slave trade, and the East Indies and China trades in the late eighteenth and early

nineteenth centuries” (1). Her questions center on why the treatment of these events are held as being separate from the other—when they are “imbricated processes, not sequential events; they are ongoing and continuous in our contemporary moment, not temporally distinct nor as yet concluded” (7). This relates to the work of Jodi Byrd (2011) addressed through her book *Transit of Empire: Indigenous Critique of Colonialism*. Byrd situates colonial methods as the hammer of Empire’s thirst for power and control through a guise of human innovation and progress. This agenda, she posits, has never ceased and even has often translated into the mentalities of Indigenous leadership as means to address the precarity and affects of contemporary Indigenous lifeways. We see this through numerous works of Indigenous scholars writing on topics related to lateral colonization.

These works prompted my consideration—amidst the internal tribal dialectic conversations about leadership levels of IK—as to whether the “environmental guardian” and nature-based persona of Indigenous peoples’ has been a fabrication of white settler imaginations (Teeman 2016). There are scholarly works that approach this topic, yet seem hesitant to draw associations to the actions described above, as being within the ‘nature’ of Indigenous peoples, and halt on platforms of colonization and that of a colonized mind (Moore 2003). As I wrote those words, my arms became covered in goose bumps. As an Indigenous woman, I have a sense of blasphemy at the very thought of such being possible. Is this why there is hesitancy to go to “the place where spirits get eaten.”

These are the words spoken by Santee Sioux political activist and spoken-word artist John Trudell, during an interview in 2003 wherein he shared what he believes may

explain particular blatant acts against one's own culturally informed ways of knowing, being, and doing. That "place" he speaks of holds implications for the technological world we have come into.

Trudell observes that technology, while an exciting adventure of our human innovativeness and adaptability, has become a chosen form of distraction. It has created a loss of memory for the "original dream" that was given to our ancestors—these being teachings, as knowledges, to be kept safe and yet also passed from generation to generation. I relate this distraction within the teaching about monsters—like the Wendigo—that I have looked for within my own study, as a spirit represented by the theories of Precarity and Affect, that I referenced earlier. I will look particularly within tribal decision making, for evidences of futurisms, in the form of what Haraway (2016) refers to as "making kin-with." This exemplifies my use of a "flipped" lens, which I explain through my methodology and methods as a tool of observation that may reveal the decisions of tribal leadership that created an alternative journey of resistance and thriving that traverses those places that would otherwise eat one's spirit.

Through the stories that were brought to my attention, by those I visited with during the preliminary stage of my study, I was also reminded of the entanglement of the spiritual with the reality that is present within the responsibility for land and its resources. Returning to Powell (2018), she speaks to this through an account of the proposal of Desert Rock, as an energy development project within the Navajo Nation. She presents "four modalities of power": material-subterranean, cultural-political, knowledge-practice, and ethical-cosmological. These, she posits, represents the entangled reality of the sacred and profane encountered by tribal leaders in their attempts to navigate among the

landscapes of “modern logic of progress” and the honoring and practice of their relationships within it (250-251).

Stories and literary accounts such as these reveal the concern for tribal leadership to self-reflect on their level of cultural knowledge, its purposes, and uses as individuals elected by their peoples to hold the safety and future of Indigenous lifeways. This prompts and validates inquiry into, how does use of landscape survey technologies influence tribal leader decision making.

Further, two additional questions have been derived from this thinking: what happens to Indigenous peoples when their sources of traditional knowledge are endangered, or no longer accessible? What decisions are made in such situations?

These two questions are also implicated in the concerns expressed about current practitioner use of land-based technologies by both non-Indigenous and Indigenous peoples and their level of IK and protocols, particularly within tribal landscapes.

3) Concerns about level of IK and associated protocols of Practitioners utilizing land survey technologies.

Associated with concerns about protection and use of IK is an additional concern about non-Indigenous and Indigenous practitioners of land survey technologies and their levels of IK and associated protocols. This concern extends and is also bound within that of specific concerns about education.

Consider a frequent conversation around use of Indigenous knowledges for fire management, that has prompted an industry of workshops, government trainings, land specific and ecological policy reforms, and scholarship such as the works of Bill

Gammage's (2011) *The Biggest Estate on Earth* and Bruce Pascoe's (2014) *Dark Emu*, followed by many other studies and publications.

From Australia we first saw a growing public awareness of and interest in Aboriginal historical uses of fire management in their landscapes. These practices have been referred to as “traditional burning” or “cultural burning” and are being accessed to address risk levels of wildfires. We saw immense destruction in recent years with the fires that raged out of control for months throughout Australia and the increasing fire activity in California, often now lasting well over a month. In California, several tribes from the area were consulted, particularly the Karuk, from the Orleans area. In September of 2019, and several times since, I had opportunity to visit with community members working in their cultural heritage and resources departments and who are GIS practitioners.

It is exciting to finally have Indigenous voices and perspectives considered and implemented within public debates and policy. However, there is a deeper concern about who should be “traipsing” into ‘Aboriginal peoples’ lives, particularly if they are working for the tribe and engaged in looking for “traditional” or “ancient” knowledges (Neale 2020). These concerns are similar to those posed in the first set of concerns related earlier. Those and these shared within this category are similar and concern personal ethics that relate to all three themes of education, technology use within tribal lands, and decision making. I will not belabor the discussion further on these points of intersect, but offer an observation based around the stories about fire management and use of Indigenous knowledges.

In September of 2019, while I attended a refresher training provided by the National Preservation Institute in association with ESRI (Environmental Systems and Research Institute), who also provided instructors. At this training there were four times as many non-Indigenous attendees as there were Indigenous, yet the use of remote sensing/GIS/LiDAR examples were largely about Indigenous landscapes. There were datasets provided for our use from the USGS.

During break times, those Indigenous peoples present were typically in conversation about the sources and use of these data. As we delved into further training related to “emergent” technologies—such as StoryMaker and ArchGIS use with LiDAR—conversations included the inequities in number of trained Indigenous GIS Practitioners with those who are non-Indigenous. Several tribal individuals commented that one would think being Indigenous would have an advantage over those who were not, in terms of philosophies and ethics related to technology use within Indigenous landscapes. These individuals said their experience did not reveal that, and overall they felt there is a need to have GIS and associated technology training address this as an issue. Further, because there is need to respect the variabilities of cultural worldviews between tribes and other Indigenous peoples, a part of the training should be provided by the communities that are utilizing these skills, and not rely entirely on “outside” sources.

This led me to consider the Tribal GIS certificate and associates programs, first offered in 2010, through the Southwestern Indian Polytechnic Institute (SIPI) and their National Tribal Geographic Information Support Center (NTGISC) aka Tribal GIS, located in Albuquerque, NM. Established in 2009, Tribal GIS is a non-profit service organization who assists tribal governments and organizations with their geographic

information technology needs. Their statement includes a mission to address the “challenges of utilizing GIS as a tool within the tribal governments; which assists in making critical decisions for those responsible for the stewardship of their lands, resources, health and well-being of their people” (www.tribalgis.com 2020). Their stated primary objective is to “bring awareness to all aspects of implementing and maintaining a successful GIS program” through the establishment of best practices and standards within “Indian Country.” Tribal GIS, the nonprofit, has a sitting board with four executive committee members and five advisory committee members representing Indigenous nations within the United States.

Both the SIPI Tribal GIS certificate (33 hours) and Associates degree (65 hours) programs are accredited through the University of New Mexico system. They provide training to acquire technical skills related to geo-referenced data “for the purpose of economic, educational, and social development of Native American communities” and along with coursework, students participate in community-based demonstration projects accomplished at the SIPI Science and Technology building. This site has state-of-the art computer labs and classrooms. This has been possible through generous donations by land-based technology industry leaders.

During the NPI / ESRI training and symposium I asked if any of the tribal attendees had gone through the Tribal GIS programs or attended their annual conferences. Of the nine people I was speaking to, three were graduates of the programs. Their responses, though, further supported concerns about a need for culturally-centered curriculum and more Indigenous instructors who were “in relationship with” their Indigenous Traditional Knowledges and practiced them as a daily “way of being.”

Additional comments provided detailed examples of these observations. These concerns highlighted the continuing need for understanding the levels of IK among students, educators, and tribal leaders and what resources are available, need to be enhanced, or created to address impacts to IKS, IK, and ITEK.

A tangential concern expressed by a variety of Indigenous individuals related to the incentives being promoted and “promised” by both Indigenous and non-Indigenous entities for the implementation of STEM-based learning, and use of technology in particular.

4) Indigenous Student Practitioner Concerns: Promises of employment and consistent employment opportunities, through participation in learning and skills-building associated with STEM-based subjects. (Appropriation of knowledge is the concern.)

An often cited and barely changing statistic is found in most social studies regarding Indigenous students as being disproportionately and underrepresented in STEM fields, these being Science, Technology, Engineering, and Math. In a 2019 study, STEM bachelor’s degrees awarded to American Indian/Alaska Natives were only 0.4% of the group studied (Alexiades et.al., 2021). Jin et al, 2021 attributes low enrollment levels of Indigenous students within STEM fields to the prevalence of the Science Method found within Western academia that challenges and provides little acknowledgment of Indigenous ways of knowing as being science-based practices. This lack within Western academia also provides few resources and references to these ways of knowing as being

linked to Indigenous worldviews derived from their relationships with land-based and environmental ecologies (Miller and Roehrig, 2018).

Through the various conversations I engaged, it became evident that Indigenous communities have long memories, particularly for educational-related policies which promote themselves as benefiting their peoples, their culture, and the economies of their nations. This was observed through collective concerns related to three particular scenarios: a) learning skills associated with STEM-based learning, particularly those related to major industries, that require Indigenous peoples to learn knowledges that are not welcoming of integration of their cultural knowledges; b) education and training will require moving outside their tribal communities and is potential “brain drain” for their tribal nations, and; c) moving outside their tribal communities dislocates them from familial support systems, into urban areas where they are subject to inevitable fluctuations of industry. Of these three primary concerns, the third was an intersect with the other two.

Overall, stories about the effects of moving outside tribal communities revolved around situations that places individuals in perceived and risk-ridden environments of unemployment that statistically leads to debt, homelessness, and exasperates struggles for those challenged with addictions, that all creates potentials for loss of life. I found no lack of supportive scholarship for these three concerns, particularly that of the third addressed here (Shamir 2020; Benjamin 2019; Simpson 2017, 2011; Tsing 2015; Walter and Anderson 2013; Tshuma 2012; Berlant 2011; Byrd 2011; Bang 2010; Asma 2009; Writer 2008; Bruyneel 2007; Steinhauer and Posch 2006; Barnhardt and Kawagley 2005;

Wilson and Yellow Bird 2005; Brayboy and McKinley 2005; Stephenson 2003; Rhea 2002; Spivak 1999; L.T. Smith 1999; Ross 1995; Bender 1993; Bourdieu 1977; Bourdieu and Passeron 1977; et al).

More related to concerns a) and b), stated above, within the American National Education Association there have been initiatives over the last two decades that exemplify a national policy to focus on job training and career-based skills associated with STEM-based subjects. These have been seen, by non-Indigenous as well as Indigenous educators and various industry leaders, as crucially important to issues of unemployment within Native American populations. Beginning with the No Child Left Behind Act, enacted in 2002, states were asked to do basic skills assessments of students in particular grades (each state at discretion to choose the grades); this was a requirement if a state wanted federal funding. Under the first administration of the U.S. President Obama, a revision of the Elementary and secondary Education Act (ESEA) occurred, which adopted a global leadership strategy. In Obama's second term, he launched a revisioning of the nation's education policy and ushered in the 2015 Every Student Succeeds Act (ESSA). This Act made explicit a desire for the United States to achieve global parity through education, which has statistically lagged behind China and Europe.

ESSA empowered a specific objective, as a National educational mandate, for an increase in STEM-based learning. Within ESSA is another objective, this places an emphasis on STEM-based learning within Native American educational policies throughout the country, particularly targeting those states with Indian reservations and tribal school systems (AISES 2020; NIEA 2020).

The premise for such attention is largely related to industrial growth within technological fields and forecasts of needed increases in skilled workers (AISES 2020). This appears as a potentially successful approach and possible turning point in the flatline and or continuously growing rates of unemployment among Native Americans. Yet, there are concerns around these promises. Overall, post-training/degree/employment statistics are rather ambiguous on the success of the employment potentials, still reporting that Native Americans are yet underrepresented in STEM fields.

It is interesting that these statistics remain relatively constant. This is despite continued promotion by the National Indian Education Association, that has sustained their support over many decades for such employment-based initiatives (NIEA 2020). As well, there has been a distinct focus and continued advocacy along with major funding support, for the national organization American Indian Science and Engineering Society (AISES). Both organizations have operational origins in the early and mid-1970s. This brings to mind related stories from those I spoke to about federal, state, or corporate funded training.

With the Johnson administration in the early 1960s, economic development of training programs within Indian reservations were introduced through the Bureau of Indian Affairs. Prior to this Indian children and adults had largely been taken away from their communities to boarding schools and technical and industrial programs such as Carlisle.

I know this history well, as I am a fourth generation boarding school student, having attended Flandreau Indian School, in South Dakota, as did my mother and grandmother before me. As well, both my maternal great-grandparents attended and met

at Genoa Indian School, in Nebraska, during the late 1800s. They were both elementary school aged when taken there. My maternal great-grandfather was later sent to Carlisle and because he was “bright and could speak the English language pretty well”, he went on to be one of the first official delegates to the White House, just before the turning of the century, on behalf of the newly formed Eastern Shoshone of the Wind River—I have a copy of his “permit” card, that “allowed” him to travel outside reservation boundaries. His career as a delegate was relatively short-lived, as he and a tribal leader at that time exposed the BIA for creating “dummy” enrollment records and moving land plots out of individual tribal members ownership. Both men were subsequently murdered. My great-grandfather’s body was left in a shallow roadside canal. Their deaths remain “cold cases” to this day. Similar stories thread throughout most Indigenous families, and render complicit, education and industrial/technological development in Indian Country. Education for Indigenous peoples’, as I heard from so many of those I visited with, can thus be construed as a risk, not only for personal lives, but for their nations.

The work of Dunbar-Ortiz (2014) provides some excellent background on such events. The largest Johnson/BIA jobs training experiment was created at Shiprock, New Mexico among the Navajo/Dine’ Nation. The burgeoning electronics company, Fairchild’s, built their assembly plant there in 1969, subsidized by federal dollars. When it opened, over 1,200 Navajo people were employed. Five years later there were less than a thousand and at the close of 1975 there were fewer than six hundred Navajo people working there. Once the company had become a “giant” it was employing non-Native people for the full-time skilled positions, although the Navajo people had been trained and certified for those jobs. Noted are various similar concerns expressed today, with

emphasis of STEM-based training. The Fairchild's company had reported Navajo workers were quitting, but actually they were being laid off. This was a scam operation to take advantage of the federal subsidizing of six-months of wages for Navajo trainees. There are tribal supported reports of complicity within the Navajo tribal government. Eventually tribal workers gained enough numbers to protest these practices, albeit lives were lost. The plant was eventually closed and the business was moved outside the United States. Incidents such as these created means for the authorization of the 1975 Indian Self-Determination Act. Learning about this and other related stories reminded me of the cautions I heard from the tribal elder and veteran, as well as the AISES graduate student.

Historical-based concerns are real-world relevant today, particularly with the type and high level of funding for such initiatives as STEM-based learning. These concerns are also associated with themes that point to next level precarity related to inconsistencies of industry and its economic promise, that I referred to earlier. In this present theme, concerns touched on a deeper human level through making associations with the fluctuation potentials of the labor market, associated with education and technology and their historical and potential impacts on Indigenous well-being. Promoting the historical rise, increasing the popularity of, and need for technological skills, does not appear to carry equal weight with the realities Indigenous peoples face related to issues of culture and community.

Initiatives like those addressing training for jobs in big industry off-reservation make sense in the United States where over 70% of presently identifying Native Americans live outside tribal communities (AISES 2020; NIEA 2020). However, this

does not appear to diminish another primary concern, this being relevancy of STEM-based skills, as acquired job skills, particularly when there are few current markets for such skills, within their own tribal community.

5) Indigenous Practitioner Concerns: Job skills and training that are not currently or particularly relevant within tribal communities, other than as generalizations for industry needs.

It has become, sadly, a common concern to wonder about relevancy of “opportunities” presented to tribal-based Indigenous peoples and their leadership. Concerns about assimilation of Indigenous peoples into globalized economies are entangled with the concern for returning home with job skills, acquired through training that already created a need to be away from their community. This further addresses Whyte’s (2018) “supplemental value” argument within his question “What do Indigenous Knowledges Do for Indigenous Peoples” through an employment opportunity lens, that focuses on who benefits?

During my conversations with those who pointed to these particular concerns, I asked about the benefit of technological skill sets for developing an entrepreneurial pool of individuals within the tribal community. I prompted conversation around several current programs such as the Flathead Tech4Good program launched by Salish Kootenai College in 2017, Intel’s Native Coders program (2015), and NASA’s partnership with Southwestern Indian Polytechnic Institute (SIPI) in 2015.

In July of 2017, Salish Kootenai College offered a four-day technology camp for Native American high school students, who were instructed by specialists in the fields of computer science and media design. Elizabeth LaPensee, Anishinaabe and Metis, and Assistant Professor at Michigan State University, was among them. LaPensee is known for her work as a writer, artist, and designer of games that utilizes animation. Her work includes *When Rivers Were Trails* (2019, a 2D adventure game), *Thunderbird Strike* (2017, a side-scroller game), *Honour Water* (2016, a singing game), and an analog board game, *The Gift of Food* (2014). It would be an important consideration as further study to assess student experiences with technology that engages an Indigenous perspective and “where are they now,” as insights.

Intel’s Native Coders program is promoted as an initiative that “provides pathways to computer science for hundreds of Native American high school students through a culturally sensitive curriculum (2019). Began in 2015, to increase the representation of women and underrepresented minorities in the United States, it reported in October 2019 that it had achieved its goal a full two years ahead of schedule. How this was measured is a debatable topic of conversations with those associate with the program.

Native Coders has a focus to bridge “cutting-edge technology and endangered traditions.” It was first launched within three high schools in the Navajo Nation located in Arizona, with full funding that included providing computer science educators and a fully equipped lab at each site. The Native Coders program provides opportunities “to both stay at home and preserve culture while making an impact on the larger world” all while expanding access to technology and other opportunities within their community. This is

reported by Jolene Begay, a Dine engineering technician for Intel, who created a partnership with AISES—utilizing their curriculum along with \$1.32 million in scholarship support (AISES 2020; Florentine 2019). The curriculum is designed to be customizable per tribal culture, interests, and needs.

For Navajo students, utilizing coding as a technological skill, engaged design weaving patterns and learning how technology can impact design and color process for these forms of traditional culture. Spring 2019 saw the first class of graduates from the Native Coders' program, with an estimated 439 students completing the program. Feedback from tribal leadership and traditional crafts persons among the tribe had not yet been assessed, in terms of impacts they see as being beneficial, or otherwise. As well, understanding from the perspective of the students of this program what has been beneficial or more challenging, including future skills use and or employment opportunities, would be important information to such studies as mine.

Through my inquiry about the work being accomplished through SIPI, I learned the Southwestern Indian Polytechnic Institute (SIPI) had teamed up with the NASA Minority University Research and Education Project (MUREP) and created a STEM-based program administered at the community college level. This program was designed with not only a focus on students, but also on teachers who faced challenges of learning STEM-approaches, time, and resource availability.

To assist with building a foundation to support the work to be accomplished at the college level, the program “reached into” the high schools and middle schools to create a pre-requisite path for STEM-subject learning. Those students who then went on to attend

SIPI, were provided opportunities to practice their learning, through goals established by the Next Generation Science Standards (NGSS, 2015), through promoting “meaningful learning” experiences. Combining all these needs and goals was a challenge in and of itself, but through SIPI and their partners, they developed the Intelligent Cooperative Multi-Agent Robotic System (IC-MARS) program. This entailed creating a NASA-inspired robotics facility to conduct interactive/experiential educational activities. This includes design, build, and use of Rovers, modeled after the Roadrunner—an Arduino-based robotic operating system. This impressive program is exciting in its delivery of STEM-learning with applications that are beneficial for landscape survey and other utility tasks. What is not attended to, is utilization of this learning, skills, and products within tribal nations—particularly those students are culturally affiliated with. Through the SIPI GIS training and associate degree programs (the collegiate arm of the IC-MARS program) students gain additional knowledge and training with this technology. How students accessed and utilized IK with this type of technology would also be important to understand in terms of the relationship between IK and technology.

Additional Scholarly Academic Perspectives

Through reviews of additional discourse and scholarship it was revealed there are few studies engaging my study topic, particularly from an investigative methodology and methods premised on Indigenous perspectives. In fact, there is obvious neglect of the deeper facets of this topic, of impacts with contemporary archaeological-based technology, overall. Information I did find was primarily situated outside the United States and provided recommendations for improvement of GIS use—as it is currently

“narrowly” viewed and utilized—and or, the researcher has situated “impacts” related to technology and Indigenous Traditional Knowledge forms, within themes of cultural impacts on technology or as loss of industrial economic and political benefits.

In the main, my use of the term “impacts” invokes thinking of the hardware and their use-methods implemented in landscape-based survey associated with remote sensing technology—typically in the form of drones or that mounted on helicopters—and their physical effects on fauna and flora. An example would be the trauma to wildlife through aerial migration studies, or strategies for trees to be cut to enable “corridors” as a view shed and access to dense foliage areas. While these are most definitely activities with subsequent impacts, my interest in “impacts” of landscape archaeological survey technology on IKS and ITEK is through a specific Indigenous lens. This lens employs an understanding that situates technology as being *part of* the relationship with and between humans and their sources of Indigenous knowledges and as such, “impacts” are studied through a balanced approach that includes both positive and less-positive impacts.

Outside Indigenous philosophical communities we have support for this relationship through the contemporary works and early ecological thinking of Thomas Kuhn (1970) and Ian McHarg (1969) and others, followed by that of such thinkers as Berkes (2017). My use of the term “influences” in reference to technology is founded in philosophy that entails understanding how Native American education and land-based knowledges are implicated in the conceptualizing of technology as having agency. This situates technology—in an inferable sense—as capable of constituting and invoking influences and these being impacts to human cognition, in the form of decision making, that in turn, impacts Indigenous lifeways.

Taking in the landscape of what I had accomplished within the various conversations with interested parties, we can see that the context of this study's focus addresses that which is locally, academically, and broadly informed and complex. My use of the term "understanding" within the title for this study reveals a search, not only for identification of impacts, but a desire to reveal the dynamics of their creation, and both cognitive and applied responses to them. My intentional eighteen-month preliminary research journey, through conversations and standard literature review, revealed three overriding themes that created the focus for this study. These are restated here:

1. Native American education with particularity regarding the relationship between humans identifying as Indigenous and their cultural landscapes;
2. Indigenous Practitioner use of GIS and LiDAR technologies within tribal landscapes, and;
3. Tribal Leadership Decision-Making, related to the influence of these technologies upon tribal practitioners providing data and results and then tribal leaders use of this information for decisions pertaining to cultural heritage and natural resource management within their tribal landscapes.

The following is information in the form of a side trip, to provide an *associated depth* to the conversation about education, land, and technology and may repeat a scholarly reference here and there, but we will find our way back and continue on with what I found within standard literature review as related to these three themes. For now, consider these words

...Indigenous education is not Indigenous or education from within our intellectual practices unless it comes through the land, unless it occurs in an Indigenous context using Indigenous processes.

These words, by Leanne Betasamosake Simpson, a Michi Saagiig Nishnaabeg woman, and member of Alderville First Nation, and scholar of Indigenous pedagogy, are from her 2017 book, *As We Have Always Done: Indigenous Freedom through Radical Resistance*. Within it she repeats the call that Vine Deloria, Jr. put forth in his 2001 paper, *Traditional Technology*, which appears in the text, *Power and Place: Indian Education in America*, that he co-edited with Daniel R. Wildcat. The quote above, invokes the call to remembrance and a re-embracing of our human relationships with our landscapes, and more so, of the purpose for those relationships and how they might ethically evolve.

Most Indigenous peoples and Indigenous scholars attest to the imperative situating of land, as both place and space, and of it as the foundations of Indigenous knowledge sources and the formation of cultural epistemologies and practices. This follows a shared Indigenous philosophy that “education comes from the roots up...an individual’s intimate relationship with the spiritual and physical elements of creation is at the center of a learning journey that is lifelong...it is a gift to be practiced and reproduced” (Simpson 2017:154). With such a philosophy, we can see the motivations and persistent draw of Imperial-based methodologies, within which are colonial methods, for the theft of and destructive attacks on sources of Indigenous knowledge through outright aggression and or policies impacting Indigenous lands (Robinson 2018; Keeler 2017; Kohn 2013; Echo Hawk 2013; Kidwell 2001; et al). The use of Eurowestern-based educational pedagogies and curriculum, especially as mandates, and as the vehicle for systematic methods of assimilation are understandably suspect as a result. Additionally,

aside from the distinct discipline of education, these mentalities within academia persist within anthropology and archaeology specifically. These mentalities continue even though there have been advents of practices such as Action Research and Participatory Action Research (PAR). As well, it would appear we have moved a bit further from some troubling archaeological practices—such as excavation as a primary approach—evolving toward more advanced and less invasive techniques, such as the use of remote sensing technologies. Within landscape archaeological survey, geospatial and remote sensing technology has revealed evidence of whole communities, previously found only in the memories and lore of its Indigenous peoples. This form of knowledge gathering has been accomplished without a substantial removal of precious soil or land-based resources.

I contend then, that consideration of this excitement about technology within the historical relationship between education and Indigenous peoples presents an intriguing ideological paradox, particularly within a theoretical context premised on my previously referenced Theories of Precarity and Affect. A review of the historical “ambivalence” (Bruyneel 2007) America has with this country's First Peoples reveals validity for a continued regimen of wariness of educational mandates, to exist within Indigenous individuals and their communities. This is evident when understanding that national political and educational endeavors were initially hammers of colonial assimilation and termination of Indigenous peoples and their sacred sites, which are sources of subsistence and knowledges (Hoffmann and Mills 2020; et al). Today, there is additional intra-tribal wariness when Indigenous peoples support and drive National educational policies promoted as beneficial for Indigenous peoples, particularly when they also include access to Indigenous Traditional Ecological Knowledges (ITEK).

Almost daily, throughout the world, there are reports of important insights being provided about and through use of philosophies held within Indigenous Knowledge Systems (IKS). Recently there have been calls, and in fact insistence, for development of these philosophies—and a scaling up—for them to become more “useful” as practiced ways to address broader world issues, with emphasis on health and various other social and environmental crises (Lam et al 2020; Briggs 2013; Sillitoe 2010). This reveals a perception that Indigenous knowledges should be associated with “applied” disciplines through job skills learning and specific industry training for Indigenous peoples. We see this promoted through the 2015 national mandate to prioritize STEM-based learning. This is enthusiastically advocated and financially supported by such as: the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and their Local and Indigenous Knowledge Systems (LINKS) program; the American Indian Science and Engineering Society (AISES), and; endorsed by the National Indian Education Association (NIEA), which recommends policy and curriculum development, particularly related to tribal-based school systems. Within STEM subjects—these being science, technology, engineering, and mathematics—technology figures largely as the subject with the highest popularity and implementation among Indigenous educators and students (Lone Fight 2019; Ballas 2018; Taylor 2017; McBride et al 2016).

As well, “it is commonly known that Native people are tied to geography” (Lone Fight 2019:101) and much of the seemingly intractable conflict between tribal nations and the US Federal government revolves around issues of land and its use as a resource to be “developed” (Hoffmann and Mills 2020; et al), as evidence of social, political, and

economic progress. The emphasis on technology associated with Indigenous peoples promotes a timely need to investigate understandings of what impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) occur as a result of STEM-based learning mandates within Native American education—particularly related to land-based technology, and their subsequent influences on tribal decision making regarding cultural heritage and resource use and management. Though there are numerous examples to draw from as a basis for such a study as I have now accomplished, I present two here as reference.

As a first example, I draw from my reading of essays within Robinson's (2018) *Voices From Bears Ears: Seeking Common Ground on Sacred Land*. The overall theme of this text centers on "two cultures" views of understanding human relationships with land and responsibilities of stewardship of it. The continuing interruption of Indigenous peoples relationships with their lands is the overarching message of the persistence of legal confrontation within this case, from an Indigenous perspective. Largely, from the perspective of federal and state agencies, and various corporate entities involved, this issue represents a hinderance to economic development and furtherance of industrial and societal progress. Use of geospatial technologies have provided landscape images that locate features relevant to Indigenous culture and interests, particularly those residing within the areas now held in "trust" and "protected" through designation as a national monument and heritage site. Archaeological artifacts and historical non-native travel journals and reports have supported tribal claims thus far. Now, through technological means there is additional support for tribal oral histories. However, in the same frame,

this technology has also revealed the location of forgotten and or additional elements sacred and culturally important to Indigenous peoples. On the surface, this is a benefit for Indigenous peoples associated with the area. Yet, to date, geospatial technology has largely been owned and utilized by federal agencies, such as the United States Geological Survey (USGS). USGS is the “sole science agency for the Department of the Interior” (USGS 2020) and has a mission and global reputation for releasing data into the public commons for access at-will, even with the more recent “selection option” to not release data publicly; moreover, such technology/ies is/are supported by global auspices of Cultural Heritage as the property of all humanity, which reminds us of the importance of considering ethical implications from Indigenous perspectives.

Second, and further, in my reading of the 2012 article by Arlen Chase et al, *Geospatial revolution and remote sensing LiDAR in Mesoamerican archaeology*, regarding work being accomplished at the Angamuco site in west-central Mexico and also at the Maya city of Caracol in Belize, we see great excitement over what land survey technology has provided. At both sites, settlement structures and landscapes were greatly contextualized through use of LiDAR, to the degree that whole compounds have been revealed amidst dense forest canopies and sub-surface terrain.

Yet, my critique of this article and the work reveals a glaring lack of acceptance of invitations from or collaboration with local descendants of the Mayan people who built and lived in those structures. I observed this lack of consideration as missed opportunity for learning to be had by all, this includes the Mayan people themselves. Most of the excitement has focused on the technology and its perceived benefits to the archaeologists and their research. As I read through the article several questions persisted in my mind:

Were and are Mayan people actually being consulted about what is being found with LiDAR, thus engaging an ethnoarchaeological and historical archaeological approach? Are Mayan cultural-based knowledges utilized in any form in relation to the data provided by the LiDAR scans? If they are, has there been appropriate acknowledgement of their participation and contributions? How do the Mayan people perceive benefit from such technology that provides opportunity for interpretation and inferences about their history, culture, and present lifeways? Have discussions of cultural patrimony and “ownership” taken place? What, if any, ethical protocols have been created and implemented to address security of data?

I do acknowledge that an enduring dilemma within ethno-anthropology/-archaeology pertains to the question of “who speaks for the culture?” (Brown 2003). Maya are largely spread out over the nation states of Mexico, Guatemala, Belize, and Honduras and finding the descendants of a particular ancient site is challenging, as well as the fact that subgroups often do not recognize the authority of other subgroups to speak on their behalf. We can see this as a dilemma posed in the Sapiens article and conference paper by Chris Urwin (August 2020) entitled, “Indigenous Cultures Have Archaeology Too.” Urwin discusses the “unique” and “historical meaning-making by non-academic Indigenous peoples and conducted as part of daily life” (2). Which peoples’ daily lives are being centered is a challenge, as landscapes through time have been occupied by various peoples, and the Eurowestern dogma to generalize data masks and often seeks to avoid multi-vocality. However, the issue of the absence of an invitation and persistent encouragement for local Indigenous collaboration, by the archaeologists, can be perceived as a furtherance of promoting the disassociation of

Indigenous people from their cultural patrimony—and now this includes the engagement of technology. Ethics figures largely in this scenario.

Since the writing of their 2010 paper reporting on use of “Lasers in the Jungle” (focused on Belize-based Mayan culture), authors Arlen Chase, Dian Chase, and Adrian Chase have written extensively, as a collective scholar group, about LiDAR use within archaeological projects. In addition to the above critiqued 2012 paper, reflecting on the “paradigm shift” that use of LiDAR has created within the discipline and practice of anthropology and archaeology specifically, they have also addressed a major tangential issue through a 2020 edition. Their paper, “Ethics, New Colonialism, and LiDAR Data: A Decade of LiDAR in Maya Archaeology” (2020) points to the burgeoning cross-national debates around ethics of geospatial technology. This paper coincides with the work and presentation of various papers authored, collectively, by Anna Cohen, Juan C. Fernandez-Diaz, Sarah Klassen, and Damian Evans, among others. The debates these scholars focus on extend those developed over the last decade regarding data-set processing, long-term storage, and management. Recent additions to this discourse include data sovereignty—ownership—and public access, with a focus on ethics and protocols related to remote sensing and the emerging LiDAR technology within landscape survey and the data it provides.

I observe, much of this conversation reflects back on the initial rationale for the protection of cultural heritage from looting and military use, through a salvage operation represented in the forms of the authorization of the National Antiquities Act (1906) National Historic Preservation Act (NHPA 1966, with amendments in 1980 and 1992)

and the evolved form of the Antiquities Act, the Archaeological Resources Protection Act (ARPA 1979), administratively situated within the National Park Service.

Reflecting further on these matters, I looked through the work of Paulette Steeves, First Nation Cree-Metis Paleo archaeologist. Her 2017 paper, “Unpacking Neoliberal Archaeological Control of Ancient Indigenous Heritage,” reminds us of the still prevalent need to consult/partner with, acknowledge/credit, and utilize appropriately, the Indigenous knowledges of the people whose lands and cultures are part of a research study. To do otherwise, she posits, is akin to neoliberal “statecraft,” and this relates to concerns that technology is both a strategy and mechanism of social control. I pondered, “where is it we have come across similar discourse?” I have found that Steeves’ work is a continuation of the conversation found amidst those promoted by Martin Heidegger and before him, Edmund Husserl.

In 1927, Martin Heidegger provided us with his perspective about the potential for technology to *influence* society, through his book *Being and Time*. It was first translated into English in 1962. He argued that Western thought, since Plato, created a binary and outright conflict between philosophy and science, which set off a debate about the value of holism within an objective perspective. His later works address technology specifically within the conversation of subjectivity aligned with objectivity. Heidegger felt that a deeper understanding and vigilance is imperative, for observing why and how technology is created, and most importantly how it influences our meanings and making-meaning of being human, and relationships between us, and our environments.

This concern was extended to the ecological realm as a whole. His thinking along these lines were undoubtedly influenced by his teaching assistantship, at the University of

Freiburg, Germany, in 1919. There he met and worked with Edmund Husserl, the founder of Phenomenology. Heidegger assumed the teaching post in 1923 when Husserl retired.

Not long thereafter, Heidegger's work and career became entangled with world politics through his brief association with the Nazi party. He is quoted as stating that it was "the greatest stupidity of his life" (Blitz 2014, 65). Perhaps a reference to Heidegger is indeed timely, as he cautioned that countries with major global political and economic power would continue to pursue an agenda, as neo-imperialism, through globalization and technology, enhancing their homogenizing and extractive tendencies (Blitz 2014). This points to my earlier conversation regarding off-earth remote sensing activities.

Heidegger's work engaged existentialism, but not from the same line of thinking of that taught by Jean-Paul Sartre, whose philosophy centers the human being. Heidegger, instead, worked within the concept of existentialism from elements of what he referred to as "openness of being"; and as means to understand Husserl's phenomenology as "a method that tries to let things show themselves in their own way, and not see them in advance through a technical or theoretical lens" (Blitz 2014:67). With this thinking, we see potential for understanding, what I refer to as, the "return" of science, with its crafted focus on objectivity, to the realm of experience, as sense making, where science can once again engage other ways of knowing and being, and represent ecological holism. This situates technology, as a science, within a relationship with human beings, in contrast to it being a tool of human intentions.

We understand this more fully through Andrew Mitchell's (2012) translation of Heidegger's 1954 four-part Bremen lectures, assembled in book form. These were Heidegger's first lectures after World War II, when he was banned from teaching.

Therein he resumes his thinking on language, logic, and reality—a reality that figured largely on what he refers to as the “influences” of technology. In Part Two of the lectures is his most influential discussion about technology, “The Question Concerning Technology.” Overall, Heidegger’s argument was not about rejection of technology, but of perceiving its dangers, through understanding its “essence”, through “experiencing the technological within its own bounds.” Here Heidegger presents the agency of technology and a human fallacy in believing that just because we claim creation to a technology, we remain in control of it for our own means. He posits that a technology’s essence exists within its boundaries, which are not held in limit by human imagination. This gives rise to the thought that “technological things have their own novel kind of presence, endurance, and connections among parts and wholes” (Blitz 2014). Heidegger draws from this the argument that the human creator becomes bound by the technologies that now become fundamental to life and even displaces life in its evolving wake. This, he concludes, is the constitutive power of technology that influences human perceptions, and even understandings, of self and self-in relation. Here is the point at which we can understand that, within the relationship between nature—land knowing—and human beings, technology has also been present since “time immemorial.”

Fast forwarding through time, we see this thinking is resurrected and extended in such works as that found in *Debating Science: Deliberation, Values, and the Common Good* (2012), edited by University of Montana’s own Dr. Dane Scott. Within this volume is a chapter by Albert Borgmann, also a professor at the University of Montana, wherein he posits a need for a “theory of technology.” He bases his argument on a challenge to answer three questions: What do we know about it [the ‘culture’ of technology]; What

should be done about it [which invokes protocols], and; Why are we doing so little about it [to understand technologies effects] (171). He situates these questions within a lens of science, ethics, and the crafting of a theory of technology. Borgmann states, “Science warns and threatens us; ethics admonishes and scolds us” (174), and what is yet required is “an incisive look at the cultural structure of contemporary reality” (175); which he points to Heidegger as having already provided. Borgmann provides example of and extends Heidegger’s address of technology as a focal point of this ‘reality’ through the concept of “living within technology” (175), whereby we are subject to its constraints. He further situates this concept as a call for the need to understand the quality of these constraints—its ‘philosophy’—as this “paradigmatic pattern of technology has escaped sustained public scrutiny" (177). Here, again, we have shadows of a conversation around the ethics of technology.

**We should remind ourselves that computers
do not just shape our economy but also our culture and society.**

This observation is provided by Dr. Lior Shamir (2020), an associate professor of computer science at Kansas State University and an advocate for the increase in curriculum that showcases STEM fields in academic coursework. Dr. Shamir continues to situate technology—not just as an assumed tool for human use but—as a powerful influence and means of impact on human environments, mentalities, and identities. This is supported by the theories of Maggie Walter and Chris Anderson (2013), both Indigenous scholars, who contend the data and resulting statistics that technology provides does not “just describe reality—they create it” (9). Couple this with not just

historical, but still present—and at times seemingly intractable—conflict-ridden relationships between government, education, industry, and Indigenous peoples and their land-based resources, and we have absolute reason for curiosity, but also concern. With the investment of “substantial resources in efforts to attract more students to the [STEM fields] and STEM careers” (Shamir 2020:1), particularly Native American students residing in rural/tribal areas, there exists “unchecked” aspects of this endeavor.

Here, we can circle back to the Bear’s Ears dilemma and Mayan peoples of today, as important commentators about the use of modern technology, and as utilized by archaeologists and other practitioners of such as remote sensing and GIS as supporting the emergent use of LiDAR. Again, to people with a worldview that is centered on an ecological holism, technology is also part of the web of life, and our stories reveal this (Lambert 2014). Stories are our theories about life and it is the land that keeps our histories as memorials to our human relationships with it (Teeman 2016; Rowe 2014; Archibald 2008; et al). This exemplifies a moral relationship that exists between land and humans (Feld and Basso 1996). Further, through this philosophy we can also understand that places become embodiments within human psyche and “we are marked by the landscapes we inhabit, and they inevitably follow us into our interactions with others: (Johnson and Larsen 2013:11).

Consider, contemporarily, remote sensing technology has been situated as a powerful conduit of Indigenous knowledges and their relationships with humans, that reminds and further informs human beliefs about place and space. In this way, technology seemingly has assumed a role of witness and narrator, and this troubles our conceptions of what technology is and its meaning within human lives.

Through understanding more fully what is meant by “influences” of technology, I am able to think through these and associated concerns, and consider questions such as, would our ancestors recognize the way we are in relationship with our land and knowledges, as being the same that they initially agreed to? Are we being thoughtful and critical thinkers about how we perpetuate these relationships? Are we teaching our young people, “who would be the caretakers of the land” (Lone Fight 2017:104), these Ways? Are these relationships and knowledges reflective of the present-day basis for tribal leadership decision making, regarding use of their cultural heritage and natural resources? How are technologies, as both part of and as also re-purposed by human intentions, influencing these decisions? What ethics and protocols are required for the decolonizing and/or Indigenizing of administrative approaches to data security and use?

These questions relate to what I referred to as “unchecked” areas, which warrant investigation, and that should include a look at the use, sustainability, regeneration, and innovation of ITEK, and resulting impacts to IKS, if not the world. I contend, in a practical sense, we should be able to observe the evidence of these impacts through the actions of Indigenous students, educators, technology practitioners, and leadership, that reveals how they understand the relationships between their knowledge sources and their people, and define mutual benefit from their use. This would reveal the health of these relationships and indicate spaces requiring attention. These can become actionable items for the crafting and implementation of such as ethics and protocols around the use of GIS and LiDAR. This is hope that my dissertation brings with it and inspires.

To recap, from the five themes derived from the various conversations I have previously shared with you, I reflected on all these stories and the concerns expressed within them, and their assemblage as particular themes, provided support for two theories: a) there are beneficial impacts with the presence of land-based survey technology, and b) current and or potential impacts, in the form of cultural loss, exist through the presence of this type of technology. More specifically, I suspect, technology such as remote sensing and GIS and LiDAR are gateways for influencing decision making related to tribal cultural heritage and resource use and management. This responds to the overarching concerns evidenced through my interpretation and assessment of conversations, as mnemonic for sharing associated scholarship with you. The three themes the research of this dissertation engaged, as I previously shared are: Education: Native student and educator; Remote sensing and GIS technology within tribal lands, and; Tribal leadership decision making.

Literature Review within Three Themes

I provide here, as background, a summary of the select few and most relevant of academic-based scholarship that relates to the focus of my study as designed, its topic, questions, and what has been accomplished by scholars within the same or similar areas of interest.

Education

Addressing the need to acknowledge and implement various epistemologies for use with GIS and remote sensing technologies, I found the work of Megan Bang (Ojibwe) and

Douglas Medin (2010) helpful. I have spent some time already sharing my review and thoughts regarding this work. I add to that the following:

Within their paper *Cultural Processes in Science Education: Supporting the Navigation of Multiple Epistemologies* (2010), Bang and Medin argue for the need of increased Indigenous presence within STEM-subject learning through engaging a dialogue that shifts the issue from performance to “knowledge-of” science. They posit, “to improve teaching and learning for children and adults throughout the life course...we must delve more deeply into understanding learning and development as fundamentally cultural processes” (1009, also citing Cole 1996, Lee, Spencer, and Harpalani 2003; Nasir and Hand 2006; Rogoff 2003). There is a vast amount of scholarship that creates the statistic-based library that addresses the reality that underrepresentation of Indigenous peoples within science fields is persisting.

Within Bang and Medin’s paper, they center the “current state of knowledge about human learning and motivation” (1014) and call for an understanding of the ways culture is “integral to learning” (1014, citing Nasir and Hand 2006; Nasir, Rosebery, Warren, and Lee 2006). Their work provides emphasis on the framework of “sense-making,” introduced by Lee (2001, 1995, 1993). This approach leverages everyday experiences as knowledges that reflect living culturally and supports the argument that “there are no cultureless or ‘neutral’ perspectives—hence, everything is otherwise cultural (1014, also citing Rogoff 2003). This situates their argument for science education within Indigenous communities—tribal- and urban-based—to not follow the paths of assimilation, even in their more subtle forms of systematic and intentionally manipulative ways; these being the organization of learning environments and

curriculum that value the practices of the dominant culture (1015). A primary example is the practice of teaching a science-related subject in ways that initially “require students to learn or replace the personal epistemologies they bring with them” (1016) in order to recognize what science is, and then follow this with the teaching of “cultural ways” to students, such as occurs primarily in urban Indigenous communities. They posit that reframing of science-based learning is necessary to understand students’ prior epistemologies as resources and as being “knowledge in pieces that can be built upon” rather than replaced or overcome (1016, citing diSessa 2006).

Further, the work of Bang and Medin crossed through that of my overall research intentions. I too center the assumption that Indigenous students and educators have cultural-based epistemologies, but I argue there are no studies that measure their levels, prior to receiving informal or formal STEM-learning, that exemplifies “native ways of knowing” as being-in relationship to science-based subjects and ways of knowing. This assumption is part of the issue of understanding “the ways in which epistemologies are learned, used, and instantiated as well as the ways in which epistemological issues are connected to identity, knowledge form and content, sense making” (1016), with context being critical. We can find a similar argument and call on the work of Catherine Johnson et al (2017) and the fostering of Indigenous perspectives in STEM through understanding Indigenous experiences with ITEK. My argument engages this call, from a collective concern regarding assumptions about levels of IK among tribal-based students, educators, and tribal leaders, that will be useful in recognizing impacts to the sources of IK and ITEK. I posit further, this can also be seen through such as the actions of practitioners of GIS and remote sensing technologies that produce information, that in-turn may influence

the decision-making of tribal leadership. Review and observation of the interpretation of this information into data is key.

Additionally, my research sought deeper inquiries along these lines from participants, that go beyond acceptance of responses that the source of an Indigenous Knowledge begins with their elder. This assists in understanding *what* is being impacted—in this study, what equates to IK, IKS, and ITEK—through “understanding what Native peoples believe about their knowledge origins, priorities, context, and...teaches us more about its continuity” (1016). This also assisted in understanding participants level of engagement of Indigenous worldviews as being ecologically relational and interdependent and derived from sources such as land and that which exists on and within it. This inquiry did not prescribe a worldview, but only seeks to understand participants relationship with what they deem are sources of Indigenous Knowledges from a human de-centered perspective. The work of Bang and Medin is important to my research as it assists my own thinking, in ways that seek understanding of how STEM-learning, that incorporates Native Science elements, situates the human being in relationship with Indigenous Knowledge sources that derive from land-based epistemologies. Additionally, these authors call for a methodological congruency throughout research design and practice, as well as use of a model of continual improvement, which is what my study design engages, as well as taking up the standpoint that Native Science is STEM.

Further, addressing concerns regarding levels of IK prior to informal STEM-learning, with the additional concerns of large scale Indigenous organizational support—found also

within both the work of Supernant and Bang/Medin—I have reviewed papers written by various authors reporting their perspective on participating within the Hopa Mountain Native Science Field Center project (NSFC), funded by the National Science Foundation (NSF), and various corporate sponsors (Augare et al 2015). Here, I first relate a summary of the program and its outcomes, shared through a multi-authored paper, that included the work of Lisa Lone Fight (Mandan, Hidatsa, and Arikara). I then address Lone Fight’s (2017) personal work with regard to Tribal GIS and use of remote sensing within Indigenous landscapes, within my review on works related to Technology.

The Native Science Field Center project (NSFC) was a five year (2011-2015) endeavor, funded by NSF, to establish Native Science Field Centers at sites that engaged three separate tribal communities: the Blackfeet Community College on the Blackfeet Reservation in Montana; Fremont County School District #21 on the Wind River Reservation in Wyoming, and; the Oglala Lakota College on the Pine Ridge Reservation in South Dakota. Their implementation was staggered over the years of 2006 (Blackfeet), 2007 (Oglala), and 2008 (Wind River) with each program providing reports for model structure and implementation. The NSFC program’s primary mission was to “engage youth and adults in environmental science activities through the integration of traditional Native ways of knowing, Native languages, and Western science concepts.” While Hopa Mountain, as the program host, is no longer offering the project due to reduction in funding, their primary vision was to create models for the expansion of the NSFC concept within other Native communities. The Blackfeet camp has continued its program through a partnership with their local high school and Salish Kootenai College, with a focus on geoscience-related careers in the areas of Forestry, Wildlife Biology,

Hydrology, Geology, Environmental Science, and related subjects. The Wind River Camp is no longer operational but components of its program have been articulated into various courses offered through Central Wyoming College and are offered to residents of the Wind River Reservation. The Pine Ridge-based camp has translated its camp into the Generations Indigenous Ways curriculum offered to K-12 students.

The facilitator's assessment of these programs was accomplished through a cross-case analysis from a non-compete perspective (referred to as an Indigenous perspective) that focused on "variations in approaches to program implementation, curricular components, and the degree to which informal science education has been manifested at the community level" (228). Employing the recommendation of Bang and Medin (2010) for a better understanding of the context of specific environments a student learns science within, the NSFC approach created their version of a "culturally responsive education" model. This provided scaffolding to investigate their question: "What are the motivations, interests, and benefits for Native American youth who regularly attend an informal science education program that incorporates traditional knowledge, values and language?" (228).

Their preliminary findings were, "there is need to create learning opportunities that transition students from the classroom to the community" (231). This corresponds to the recommendation by Kimmerer (2012) that informal science education is an appropriate and more effective context for the integration of traditional forms of knowledge that are yet to be seen and implemented as appropriate for the formal setting of academia.

My review of the current literature regarding the NSFC project observed a gap exists within structure and analysis of the various approaches each program took for implementation of the vision and goals to provide access to science learning through informal settings to Indigenous tribal-based students. Each program began at the point of introducing STEM-based learning, with components of ITEK—as provided by various formal and informal local educators, that then was measured for development over time with continued input of informal-based information through classroom, field trips, and time spent with Indigenous Elders.

What I contend is, there is need to step deeper into the process by first assessing initial levels of understanding of IK within each participant. This will create a scaffolding that decenters the human as the origin of IK and focus on IK as being potentially sourced through various land-based forms. This represents an approach that first rests on shared Indigenous beliefs and knowledges. From this point there can proceed teaching and measuring in understanding each participants understanding of their relationship, and overall a human relationship, to IK and their sources. I consider that this approach would provide a deeper level insight of baseline understanding of the relationality and interdependency that exists between IK and their human beings, respecting particular contexts of course. My rationale is that this recognition and acknowledgement would encourage a more intimate understanding and response within participants. With such information there is the possibility of addressing personal and community solutions for land-based issues, as well as those broad and now climate change related issues. Here is where we can cross through the concerns and theme of technology—specifically that

which is utilized within landscape archaeological survey, in the form of remote sensing and GIS.

Technology: Landscape-based.

I say it again, Technology is exciting. As well, this excitement is expressed in the White House Guide about the use of Indigenous knowledges useful to address global issues such as causes and effects of climate change. Understanding this excitement required inquiry into access to knowledges and why and who benefits, and what has been negotiated along this dynamic process of coming to know self in relation to the sources of Indigenous Knowledges. How we see these sources—in this context being land-based—and our relationships with them, includes understanding of intentions for these relationships. Technology in the form of remote sensing and GIS is a form of looking at these. Is why, how, and what we look at influenced by the these technologies and further influences assumptions about self, that also engage decisioning making about access and use of Indigenous Knowledges? This persisted throughout my study and persists still.

The work of Kisha Supernant (Metis), 2017, was and remains notably important to my study, as it draws upon use of GIS and its social mapping applications to track the historic mobility of Metis communities across western Canada. This study seems to employ—while not specifically stated—my own intention for utilizing a continuous improvement approach. Supernant reviews studies that research through the standard LCP—“least cost”—analysis model, regularly utilized within archaeology. She further addresses critiques of the use of GIS, associated with LCP, within archaeology as “being

deterministic, mathematically driven, objective, and too far separated from the lives of people” (63)—this also echoed from such as Haciguzeller 2012; Bruck 2005; Thomas 2004; Schuurman and Pratt 2002, and; Thomas 2001.

Through her own case study, Supernant utilized the standard LCP model, and concludes with a defense for the use of GIS within Indigenous studies associated with their landscapes. However, she contends improvement of research and analytic models need to be modified through grounding them “in local knowledge systems rather than generalized models that can be applied to any similar cultural context (66), and which take into account “complex decisions made by people in landscapes where they have intimate knowledge” (71). This, she then refers to as becoming an “Indigenous GIS approach” with, in her case, a more specific reference to a “Metis GIS Approach,” which respects the centering of particular sources of Indigenous knowledges and their people. She contends this modification will refine GIS analyses capabilities and raise its benefit level and use among Indigenous-based studies, involving landscape surveys.

While this study is interesting on many important levels, it did not look specifically at impacts to IKS, IK, ITEK, or that occurs with use of GIS, nor at “influences” it may directly have in terms of decision making based on data derived from use of GIS and remote sensing. I found value though, in Supernant’s approach to situating the need for guidelines and ethics, that are Indigenous inspired, for the work of GIS and the data it provides.

An additional co-authored work by Wadsworth, includes Kisha Supernant’s insight of these technologies within the issue of Integrating Remote Sensing and

Indigenous Archaeology to Locate Unmarked Graves (2021:2). The contribution that

Supernant provides in this paper cites the conclusion that

only a few archaeologists practicing Indigenous archaeology have incorporated geophysics into their programs, and conversely, only a small number of archaeologists who specialize in remote sensing apply their techniques within community-based or public archaeology models ... [additionally] Indigenous archaeologies require changes to the design, process, and interpretation of archaeological results ... Reorienting remote sensing under an Indigenous archaeology paradigm serves to not only bridge the gap between Indigenous communities and archaeologists but also contribute to the decolonization of archaeological practice.

As more ethical forms of archaeological field practice (in this study GPR is utilized with GIS) are engaged, the intentions of utilizing remote sensing still reflect colonial extractive elements of the discipline for their purposes found within the shortening of time-frames at a site. “Multi-instrument” survey utilizes geophysics to “maximize data collection, solidify interpretations, and limit time/resource constraints ... to enable the ‘fly-in/fly-out’ nature of remote sensing” (2) that creates a less strenuous licensing, permitting, and consultation period. This process though, does not address relationship-building with the Indigenous communities where the field sites are situated. Addressing revision of research frameworks, involving remote sensing use within tribal landscapes, would provide opportunities to engage Indigenous perspectives within archaeological practice. This work would still disrupt and trouble current Action Research methodologies though, as collaborating with Indigenous perspectives within research design and practice opens up space for “asking questions about research relevance, audience, and benefits ... [and addressing] Indigenous ways of knowing by recognizing settler colonialism, privilege, and power dynamics” (3). This would represent

an integration process that more fully represents collaborative activities and reflects not only community-based, but community-guided practices.

That paper, though, yet misses the address of Indigenous individuals as practitioners of remote sensing and GIS technologies, through use of GPR Viewer and GPR Process. The reference to “extractive” qualities, explained within the paper, does not include use of IK provided by Indigenous community members to non-Indigenous researchers. Application of IK from their knowledge holders, who are also practitioners, would further the work of decolonization of extractive practices through application of first source Indigenous perspective techniques. This expansion would enhance philosophically and practically the goal to “incorporate all voices” within a project engaging Indigenous contexts, beyond design, process, interpretation, and review to include researcher as practitioner.

To be noted is another paper produced in 2021 with similar co-authors, Using GIS and Remote Sensing to Monitor Industrial Impacts to Archaeological Sites in the Athabasca Oil Sands of Alberta. This paper looks at oil industry development of tribal landscapes through the lens of remote sensing and GIS to quantify impacts through their analysis for benefit of Indigenous communities “who wish to begin exercising their inherent right to active roles in the co-management and protection of archaeological sites” (3). This is an engagement of the United Nations Declaration on the Rights of Indigenous Peoples, Article 11 (2007). This study takes note of variables recommended for improvement of data acquisition, storage, and access derived from GIS applications. Included is attention to challenges posed by disturbances to archaeological sites from use of remote sensing and GIS strategies. Recommendations for ground-truthing (to check

the accuracy of remotely sensed data within in-situ observations) include incorporating the culture of a site, to include its ecologies and “voices” of its residents. In this case, the inclusion of Indigenous perspectives is a recommended practice, as is training for Indigenous peoples to become practitioners of these technologies, as “such work will result in improved management of archaeological sites and landscapes from both cultural and scientific perspectives” (15).

Related to the work of Supernant, Lone Fight (2017) contributes to the discourse around Tribal GIS, through her further comment on work within the NSFC project and that accomplished thereafter. I found her call for continued work on development of “understandings” of how to work with GIS among Indigenous communities and their lands an enhancement to that provided by other Indigenous scholars. Here, I will focus on Lone Fight’s incorporation of her Indigenous philosophies and practice around planning and use of GIS and the “natural” way a “view from the sky” is pervasive within Indigenous cultures (101).

Entangled with the need to understand impacts to IK, IKS, and ITEK that occur through use of remote sensing and GIS are issues around the data that are derived from use of this technology. I have, within this document, spent some time discussing the work of such scholars as Albert Borgmann, Dane Scott, Anna Cohen, Sarah Klassen, Damian Evans, Adrian Chase, Diane Chase, Arlen Chase, and Juan Fernandez-Diaz, and others related to and around their call for a theory of technology, that presents an ethic and protocols around planning for the use of GIS and LiDAR, its actual use, and information and data derived from its use. I will not belabor that conversation here.

I do provide here, my understandings of the work and recommendations of Lisa Lone Fight (Mandan, Hidatsa, and Arikara), an Indigenous Scientist and Educator, in relation to the discourse other scholars have contributed, but which situates the use of GIS within a tribal setting and according to shared Indigenous understandings of this event.

The context Lone Fight creates between Indigenous perspectives, Indigenous landscapes, and GIS is through an understanding that it is within our stories that we can understand how technology is implicated in how we are guided through the journey we call life and that these stories represent our home (100). These stories are also presented, from a sky view, as points that are part of the “lattice” that represents ecological reality. She further contends that stories have origins that provide a temporal understanding and description of

existence before the universe was completely formed and before we were fully settled in ‘this’ world...and are a means for making sense of and exploring the world, and they aid us in understanding not only how the world worked/works but ‘how it was meant to work,’ and perhaps most importantly, who we are and ‘who we are meant to be’ (101).

Lone Fight is an obvious advocate for GIS within Indigenous landscapes. Her experience with this technology and perspectives, informed from her Indigenous worldview, are exemplified in her further statement, “...when indigenous mapping and new GIS and remote sensing technologies are combined, extraordinary things begin to happen” (101). She relates some of these “things” to the images that are provided through remote sensing technologies, and today there is “power” through GIS to express meanings of these images in relation to the landscapes they reveal. She worked with images through a mapping model known as “Stories and Spaces” that provided means to add narratives,

with “rich cultural content” to the images. She refers to this activity as a “method of claiming...spaces” (103).

Lone Fight introduces what she refers to as “true indigenous mapping” through her Respecting Indigenous Participatory Spatial Sovereignty (RIPSS) model, which is a process of knowledge generation founded on four particular tenets—as understandings—for the planning, use, and distribution of data created, and enhanced through GIS.

The model that Lone Fight presents is her version of decolonizing remote sensing technological use. I found her philosophy and approach refreshing. She presents a clear understanding of her location in reference to her Indigenous Traditional Ecological Knowledges through her story of a woman who climbed into the sky.

Within this story she relates the view this woman contemplates from her seat among the clouds. This view provides a consistency of worldview from Lone Fight’s culture that insists they are “a People of place...[but] are also, however, People of space, image, and time...[and] seek perspectives and knowledge of the world that explain it and the beings within it” (101). This also creates a resonance among most Indigenous ways of knowing, which is prominent within the stories of Indigenous peoples’ from Australia and Africa.

Anthropological fields are increasingly becoming multi-vocal and there now exists Visual Anthropology and Virtual Archaeology that assist with fostering multiple modes of communication with the public. These fields are core sites of practice and benefit from the products of remote sensing and GIS. However, as Stephen Wessels (2022) and his team reveal there are yet “problematic practices” due to the western paradigm origins of

archaeology and the slow turning of ontological healing of practices created by Cartesian separatory perspectives. Wessels cites Ingold's "dwelling perspective," as a counter to the Cartesian binary distinctions. Wessels project engages a case study at Ga-Mohana Hill in South Africa. This study critically analyzes 3D visualizations of archaeological sites to explore practices of concern and to develop an "approach to ensure that the significance, meaning, and *potency* of archaeological and living heritage places are transferred to their digital replicas" (2). There is relevance of this work that of the topic and questions of my study, as there is need to address ethics and social justice, from Indigenous perspectives, within the realm of visualization of the sources of Indigenous knowledges and these images as influences on Indigenous Ways of Knowing.

Wessels and team applied the dwelling perspective to the work at Ga-Mohana and deduced that "these sites are in fact places that people were inescapably immersed and were, therefore, interlocked in the forming of their lifeworld relationships that constituted their identity" (5). Furthermore, citing Casey 1996 and Thomas & Ross 2013, Wessels brings forward an intriguing observation

... places are where events, narratives, history, memories, and landscape intersect and intertwine ... places are continually being given meaning by people with diverse cultural backgrounds in the present, despite them having been created in the past ... Places are not fixed, they are continually happening and being reconstituted ... Places gather tangible cultural materials, as found in the archaeological record, but they also gather intangible experiences, histories, thought, and even memory ... a place is much more than space; they are spiritual, cultural, physical, and social living entities.

Thinking through these statements, in regard to my topic and questions to understand impacts to IKS and ITEK from use of remote sensing and GIS technologies, I further realize the importance of a worldview that recognizes and acknowledges the

agency of land, its environments, and ecologies and that they are capable of being influenced by these technologies. The fact that acknowledging land already was created and had meaning prior to human observation or relationships with it, is an important understanding about balance within relationships and particularly those with interdependencies. This brings me back to the quote I shared initially

Indigenous and local cultures are being absorbed and transformed by the global culture of technology...and technologies are not value neutral...the data and resulting statistics that technology provides does not just describe reality—they create it.

Wessels work brings to mind that of Terence Turner in the early 1990s, whereby working among Kayapo he observed, the flip side to my topic, of cultural influences on technology, in this case, use of videography. Hence the title of his paper Defiant Images: The Kayapo Appropriation of Video. It is worth understanding the flipside of my topic, to learn how culture has influenced and impacted technology (Laue 2018; Medin & Bang 2014). This would then represent a more inclusive collaborative endeavor between humans and their environments, that evolves their cultural worldviews and needs for technologies, as means to understand how we see ourselves as being influencers of and as being influenced by technology.

Seeing self-in-relation is an enduring practice of relationality and interdependence that draws one into a mutual space where past, present, and future exist as a concern for sustainability of life not just on this planet, but also when living off-earth. Bringing us back to this conversation is the work of Erika Nesvold (2023) and consideration of how humans see themselves in relation to earth-based lands and landscapes as fulcrum for her

larger interest of being Off-Earth. She provides exploration of her interest and questions, akin to those I had also considered, based on her experiences as an astrophysicist, particularly those related to places of ethics within the worlds of “NewSpace” as an evolution of space industry interests. Her recanting of a defining experience in 2016 while a member of a NASA research program wherein astrophysicists and machine learning and industry experts discussed “big data problems in planetary defense” (vii). Her questions to this group focused on ethics such as what are the strategies for protecting space environments from human activities, how to address various human and environmental exploitation issues, who will settle conflicts between humans who live in space, and other such value-laden concerns. She assessed the responses she received as largely being “we’ll worry about that later.”

Further, she observed that this group of space industry representatives were more interested in technical and technologically challenging issues such as “reusable rocket designs, economic strategies for making space activities financially feasible, and legal structures that would invigorate rather than inhibit their industry” (vii), that she perceived as having too narrow of a vision. Their priorities were not particularly inclusive of human rights where ethics issues are persistent past and transit realities that are yet needing address today.

She concedes there are numerous space ethicists at work on these issues today, however, there is a gap between her own STEM world and those of other disciplines largely within humanities fields that should be within these conversations and practices of being Off-Earth. Erika’s podcast, *Making New Worlds*, shares her journey to explore this gap and prompt others to pose questions that also attend to looking beyond the technical

and limited worldviews. She concludes with a “what now?” discussion that I am happy to report I have been and continue to be a part of.

In addition to my life-long interest in being off-earth I have developed a circle of like-interested scholars and have been invited to other circles with an interest in exploring what being Indigenous Off-Earth means. This has been a topic for Talks and activities I have provided, encouraged, and promoted and remain active in doing so. Most recently the 2021 year has been most prolific. I became a member of a Dine’ astroengineer’s dissertation team at MIT and he included me within an online presentation and conversation series through his term as MIT Native Student President. Additionally I am a board member of the Space for Humanity global organization and Co-research lead for two current NASA and NSF affiliated projects. I am acknowledged as bringing my interest in being Indigenous Off-Earth to these conversations and activities, and through sharing perspectives and experiences of the philosophy and practices found within Indigenous ways of knowing, being, and doing. Among the education I provide there is a consistent message that scientific traditions have always been part of how Indigenous People come-to-know their environments. I frequently cite the work of Dr. Gregory Cajete, a Tewa scholar from Santa Clara Pueblo, and his conceptions of Native Science as being derived from, indeed “born” from, daily experiential participation with the environments and landscapes that become our lifeways. This requires a broad and holistic understanding of where the roles of sensation, imagination, perception, emotion, spirit, and symbols exist within conceiving of concepts, logic, and rational empiricism. This

gives consideration to a larger discussion, for another time, about science as being culturally created.

It is a wonderful honor and gift to receive the stories of Indigenous peoples that assist our understandings of their worldviews. Providing these as means to educate and situate learning within holistic ways is extra ordinarily beneficial. Understanding if and how Indigenous practitioners of remote sensing and GIS technologies engage such stories within their training and practice is additionally beneficial to understanding impacts.

I remain convinced that there is need to delve deeper into investigating the levels of personal understanding about sources of Indigenous knowledges, as they apply within individual worldviews, prior to activities involving teaching, practicing, and making decisions regarding Indigenous knowledges.

Tribal Leadership Decision-making

The theme of decision-making runs through the entirety of the rational and warrant for a study as that I proposed and have accomplished. To pull it out from among the rest somehow isolates its value, yet, I will attempt to provide a narrative that relates the importance of investigating tribal leadership decision-making as a logical next process in understanding how remote sensing, GIS and LiDAR occurs within Tribal Landscape Survey as an influence on tribal decision-making, and particularly regarding cultural heritage and resource use and management.

Through my work and study of decision-making within the realms of cultural heritage and natural resources, I have recently turned repeatedly to the insights found

within the work of Amanda Cravens that situates use of technology within natural resource conflict resolution. Her paper *Negotiation and Decision-making with Collaborative Software* (2016) provides insight to influencing factors that exist within geospatial technologies. She suggests that this aspect of use is rarely recognized within decision-making models because there are few empirical studies that look at technology in this respect through an environmental lens (1). Seen through the disciplines of education, business, and communication, geospatial technologies provide an added tool and value for collaborative processes. This is increasingly important for implementation of consultative mandates within lands-based and environmental agencies that work with tribal nations.

However, researchers within the fields of computer and learning science stress the importance of not perceiving technology as a neutral tool. Studies have revealed that software—such as GIS—can “influence cognition and group dynamics” (3). These scholars recommend a need to “look holistically at the historical and institutional context in which software is designed and implemented in order to understand its impact” (Cravens 2016:3, citing Hasan and Gould 2001; Collins et al 2002; Masterman 2009). Studies employing this recommendation have found geospatial software “shaped individual and group problem-solving processes and highlights how the representation of information...influenced user negotiation over contested collective knowledge...[which further] influenced learning, group negotiation, and decision-making” (Cravens 2016:3). Recommendations include attention to the development of guidelines for the intentions and use of geospatial technology and for evaluative tools that gather pre- and post-user information to measure influencing factors and resulting impacts. This engages

understanding of how technology interacts with causal relationships, such as those constituted through social practices and experiences.

Over the last decade there has become more support within landscape archaeology for use of geospatial social mapping techniques. Cheetham (2016) extolls the virtues of this technology and calls for raising awareness of integrative approaches for its use. As well, Cheetham provides a concise history of the use of geophysical survey that reveals its expeditious rise within the field of archaeology. However, he cautions that the need for practitioner technical skill and knowledge remains a high priority (563) as is the avoidance of “simplistic guidelines for the application of these techniques” (564) that could otherwise create opportunities for inappropriate use of these technologies. He further recommends review of particular variables, developed by Schmidt (2002:9), that assist in determining appropriate geophysical survey techniques. Within these variables is the insistence that for relevant interpretation of GIS derived data, there is need to create a use plan that is integrative in scope and practice. This includes means to provide access to and inclusion of information in a narrative context. There are two popular techniques referred to as thematic mapping and social value mapping.

Regaled as the tool that incorporates an applied nature within uses of GIS, geospatial software such as that created and provided by ESRI, namely their ArcGIS product, has become increasingly popular for landscape survey needs. ArcGIS is created with a focus on social science applications that deliver means to enhance visibility of data through incorporation of themes. Themes are a mapping approach—referred to as ‘choropleth’—that evolves the cartographer visuals known as ‘legends.’ These are classification symbols that create meaning assigned to specific areas on a map. A popular

use of visual symbols is to “depict the geographical distribution of socio-economic data (Ballas et al 2018:36). The concept of choropleth is to provide the ability to represent both qualitative and quantitative difference within data affixed to a geographic area. The idea is by providing means to overlay “variables pertaining to human societies rather than [only those related to] environmental, geological or meteorological” (Ballas et al 2018:67) emphasis, GIS becomes a tool for increasing accessibility of information that can inform relationship scenarios between humans and their environments. This, then, related directly to the discipline and practice of historical archaeology as being tangential to landscape archaeology.

We can see through the use of GIS there is potential impacts that may be interpreted as both beneficial and yet, not. This is an important distinction when considering use of geospatial technology to survey Indigenous landscapes. Harkening back to Cravens et al’s (2016) cautions regarding the influencing factors of technology—as well as my earlier discussion of this issue—we can understand the need for conversations around the development for an ethic and protocols for planning to use and use of such technologies as remote sensing, GIS and LiDAR. Additionally, discourse around use of these technologies calls for development of new variables (referring back to Ballas 2018), or indicators, that enable understanding of how they impact human decision-making to the extent that a proactive response is possible to become the primary need of these technologies versus intentionally reactive, or after-the-fact scenario plotting.

These recommendations signal an opportunity for Indigenous perspectives to become a primary factor within the interpretation of technologically derived data.

However, based on the concerns revealed thus far, through my exploratory work on this topic, there is need to first understand self-in relation to that which constitutes Indigenous perspectives—namely Indigenous knowledge sources. I theorized, otherwise, there is danger of the reification of deficit-based interpretation and evaluation of data as a result. This will obviously hinder the potentialities of use of technology to inform tribal decision-making that reveals explicit benefits for tribal communities. Consider, through regeneration and or more fully acknowledging the relationships that exist between Indigenous knowledge sources—primarily land-based—and their human beings, technology can be reincorporated into this relationship and provide positive influences.

Finally, I saw need to consider Indigenous futurisms within understanding impacts of geospatial technologies. GIS applications are increasingly being utilized within social media (Ballas et al 2018). Applications such as GPS, MapQuest, Google Maps and others, broaden the concerns for data security and sovereignty. To be included in the conversation of influences as impacts of technology, is the public use of tribal landscape information. Platforms such as Facebook, Twitter, and TikTok have user communities that depend upon information provided through these means. The persistent statistic of a lack of tribal-based access to internet is greatly reduced through the number and use of Smartphones. We see the present health pandemic as a perfect example of the benefits of technology and particularly that which provides geographic information.

Web-based sites such as Indian Country Times and Native Health Network, among others, have continued to provide tribal area-specific insight and statistics related to updates regarding the COVID-19 conditions. This information would typically be subsumed and remain non-distinct within county and state information, otherwise. Yet, as

beneficial as this information is, there remains concerns about the type of information and map-based distinctions also provided in these reports. Decisions on what information is to be released requires further consideration that relates to the implications of public contributions to this information.

In a seemingly dramatic example, consider a technological innovation utilized by Twitter. “Geospatial fingerprints” has been developed by Tsou et al (2013) as a mapping software that analyzes Twitter data by locking onto key words (Batty et al 2010). This application uses words and images with geographical references to map the information as a site or physical location. For example, you and your family are Indigenous and on an outing in the backcountry of your reservation. You take photos with your iPhone, or Android phone, of the areas you are moving through. These images reside on your phone. You also decide to upload them through Twitter to share with your followers. This now becomes data that can be publicly accessed. So far this is your intention. Yet, with applications such as Geospatial fingerprints, the area you were in, depicted in your photos, can become points within a GIS mapping tool. The public, or others who are not authorized to be in those areas, can have knowledge that otherwise is not deemed available to them. I considered, this again, points to a need for a depth of decision-making that regards technology as a tool with immense capabilities for creating situations otherwise unimagined.

Looking further afield there is an intersection that cannot be subsumed within the concerns at the local level of tribal decision-making. I have retained the thread, that is industrial agendas, within the conversation about the drive for STEM-based learning

within Native education. To more fully understand the breadth of the concerns already shared thus far, requires a brief inclusion of the work of UNESCO and their LINKS program, which directly relates to the UNs 17 Sustainable Development Goals.

UNESCO's Local and Indigenous Knowledge Systems program (LINKS)

promotes local and indigenous knowledge and its inclusion in global climate science and policy processes...ensuring that local and indigenous knowledge holders and their knowledge are included in contemporary science-policy-society fora on issues such as biodiversity assessment and management (CBD, IPBES), climate change assessment and adaptation (IPCC, UNFCCC), natural disaster preparedness (ISDR) and sustainable development (Rio+20, Future Earth).

unesco.org/links 2020

Through the Knowledge Transmission project within LINKS, the goal is to support intergenerational sharing of Indigenous knowledges through bringing elements of informal education practices into formal education structures. We see this taking place with initiatives such as Indian Education for All. The vision and objective of these programs seemingly provides much awaited advancement in the request for Indigenous presence and inclusion within mainstream education. However, reading through the objectives of these programs there seems a glaring lack of equity in benefits back to tribal communities, beyond the inclusion of Indigenous voices within curricula and broader access to it by Indigenous students and educators. I suppose, I was, and continue, looking for “benefits” defined a bit more inclusively and evidenced in applied ways.

This observation returns us to the typology or categories of concerns, in particular, these being: concerns over levels of IK initially present within students, educators, and leaders, as well as acknowledgement of the source of IK, which would engage an ecological perspective that connects to the concern of application, or use, of

these knowledges that are beneficial to their communities. I remain interested in understanding more about the post-developments of bringing Indigenous knowledges into mainstream education. I understand it is generally yet early within these initiatives to measure such outcomes, but such data would be insightful in further understanding another concern, this being expectations of graduate students to utilize Indigenous knowledges. We have some sources of examples that are useful for such a study, found among such works as that provided by Linda T. Smith (1992, 2012, 2019) with many examples of Indigenous community project that implement Indigenous Knowledge Systems as practices.

This speaks again to the thread running through my research that considers Whyte's (2018) question, "What do Indigenous Knowledges Do for Indigenous Peoples?"

With obviously good intentions, through posing such a question, one has to wonder though about the relationship between programs such as LINKS, that is within the UN, and another of their endeavors—the 17 Sustainable Development Goals. Looking into these goals, we are able to understand that each is premised on weaving social and community projects and products into larger scale industrial and socio-economic and -political realms. Where the voices of Indigenous peoples reside within these, requires also looking into various sectors of the United Nations membership and their involvement, through committees.

While the advent of such a program as LINKS provides attention to local needs, there is concern that this represents an extreme polar shift from previous realities that tribal peoples and their leadership have endured. Concerns about the level of IK among

tribal leaders requires consideration of the context which these leaders move within. This includes not only state and American federal areas, but the global as well. It is at this scale that industry exerts most of its influence. Discourse provides a long history of the reality of this activity. Yet, there is less scholarship relating how industry has begun to pay closer attention to the gathering populous of support for potentialities of Indigenous Knowledges to impact their agendas and bottom-line. As I stated previously, this may be shifting with the White House Call for inclusion of Indigenous Knowledge(s) for federal decisions.

Through archival review, I came across a short article whose title intrigued me. Its content intrigues me further, as it represents a contemporary story of transit Imperial interests, as promoted by an individual Indigenous researcher among her own people.

I Leonora Tshuma is Xhosa, from Zimbabwe, and is a Master's of Science in Development Studies student. Her paper (2012), "Is Technology a Friend or Foe to Traditional Practices?" looks first at the issue of Indigenous Knowledges impacted by technology through the lens of industrialization advocacy. She then situates Indigenous traditional "practices" as impacts preventing expansion and or progress enabled through technology, noting, "Indeed, technologies significantly affect humans' ability to control and adapt to their natural environments" (2).

That statement introduced her article, with various examples to follow which related stories from her homelands in the Matabeleland region. A transition point came with her story of their King Sigcawu and his visits to the region, and his persistent urging of the people to revive their cultural practices. His message acknowledged technologies' dual impacts of "enhancing, reinforcing and complimenting traditional practices," but

then of also its “ability to disempower people by misrepresentation, provide a process for further colonization, and propel the loss of individualism and self, and group identity”

(4). This, Tshuma posits, is most evident among adolescents. Here, Tshuma flipped her lens and looked at how technological advances can be hindered by cultural practices. The author provides a story of male initiation into adulthood through their practice of circumcision. Tshuma claims the practice has been enhanced with the introduction of links to public health and higher education, but is hindered at the same time by resistance from “low educated” members of their community. The author points to a need for “cultural evolution...as it is inevitable” and technology is the greatest source for this through adoption and adaptation. However, Whitehouse (2020) provides an interesting commentary and contrast to how adherence to traditional cultural knowledges is actually assisting Xhosa communities resist infection from such as the current COVID-19 virus.

The more rural and generally closed cultural means of daily life has prevented the transmission of infections—this is among mostly rural populations. Whitehouse further states the obvious, “the virus can’t move without people to transport it.” Yet, he also contends technology insists on providing ‘substitutes’ to the point that the “old practice is completely abandoned.” This Tshuma also concludes, “societies should accept that the old practices and the new ones will always co-exist in this world...even within technologically advanced societies, tradition still exists.” However, Tshuma points to her observation that there is a fundamental problem with this conclusion and adds, there is a need to solve the problem of resistance to technology being a part of this equation. She perceives the answer through the efforts of “educationists, government and ordinary citizens.” She stresses, there is need to recruit among community leaders and citizens to

promote awareness and the positives of “absorbing technology...as it enhances development and contributes to the empowerment of traditional communities.” What she does not stress, is the means to retain these traditional ways, through the absorbing of technology.

The duality of how the information was presented in both articles reminds me of the cautions the elder shared about “scouts.” His advice was to “watch for” how Indigenous people are using their acquired skills and knowledge of “outside” cultures with that of their own culture, to work toward diminishment of the “home” culture in favor of what has been, and may continue to be, the source of those destructive activities. This amounts to assimilation for technological progress, elevating associated concerns to greater levels and creating another layer of complexity to consider how to achieve a balance of impacts and benefits between traditional practices and technology.

Additionally, the information contained in these articles has tremendous association with the stories I shared earlier as examples of tribal leaderships’ complicity in this dilemma through decisions to allow technological use and development to occur amidst and or with what is held sacred—natural resources and the physical remains of ancestors. This brings to mind a couple of other stories about relationships with what we hold sacred.

I had opportunity to reflect on the following statement within the context of the endangerment and or absence of what we deem are the sources of traditional ways of being, found as land and or what exists in and upon it.

Reconnecting Indigenous peoples to their territorial lands and water will restore the well-being and sustainable existences as nations. This

reconnection will bring back a sense of identity through re-establishing traditional practices, ceremony, language, and beliefs that come with the connection to the territory.

This statement was made by Claxton and Rodriguez de France in 2019, citing the call to return to traditional ways of being, issued by Senator Sinclair, of the First Nations organization Truth and Reconciliation Commission. This relates to the work of another movement, being Land Back and related to work involving co-management of lands and resources by Tribal Nations. I share more about this in Chapter 6.

At the 2019 Fall gathering of the intercontinental American Indigenous Research Association, I had the honor of being present to hear Dr. Kelsey Dayle John (Navajo Nation) provide a talk on her work with decolonizing educational perspectives through use of an Indigenous methodology that centers horses as “knowers” and as sources of Indigenous knowledge (2018). Myself, I was raised with cayuse and puuku—wild and ‘kept’ horses—and retain a special cultural relationship with them, as I also believe they are sources of Indigenous knowledge. Additionally, I had spent the summer of 2019 doing preliminary stakeholder analysis for what has now become my completed Natural Resource and Environmental Policy Conflict Resolution Practicum project, that earned my award of the Certificate from the University of Montana. This project related to tribal restoration and management of Bison and this work as related to wild horses and their reclassification from being an invasive species to that of natural native wildlife. Relatedly, Dr. Dayle John’s perspective intrigued me further when I read her paper, “Rez Ponies and Confronting Sacred Junctions in Indigenous and Decolonizing Education” (2019). She includes a statement that has stayed with me since and supported my

dissertation intentions to further inquire about the relationship purposes between Indigenous knowledge sources and humans, and their uses. Kelsey wrote, “I remember the destruction that the sacred brings when it’s not kept sacred” (55).

Each time I read those words I immediately get a lump in my throat and my eyes threaten to fill with tears. Dr. Dayle John’s profound observation, that recognizes the agency of what is deemed sacred, follows her discussion citing Vine Deloria, Jr’s life-long work and persistent call for the reconciliation of the sacred and the secular—the healing of the Cartesian split. I have often turned to the work of Philippe Descola (2013) and Donna Haraway (2016) as a reminder that this “split” is a relatively new thought and is yet evolving in braided and unbraided transcendences.

Descola provides, the divide originates with the work of Aristotle, as a political response to religious interpretations of phenomena. He accomplishes this through creating a taxonomy of the nature of humans as an ontological regime differentiated from “other” beings, through decontextualizing a being from their symbolic meanings, and assigning privilege to their functions, hence objectification. This is presented through Aristotle’s work, *Physics*, in 1837. Per Descola, the planting of human beings as nature beings was, though, crafted by Christianity as a means of exemplifying the Genesis claim of human superiority and “administrator” of all others of God’s creation (Descola 2013). Fast forward from Aristotle to the work of Kantian philosopher Heinrich Rickert (1899), and his contemporaries Weber, Heidegger, and Habermass, wherein western perspectives re-turn to relationality, albeit through formulations of contingent value as an aspect. With this, the torn and tattered veil between human and nonhuman transcendence begins to show signs of repair. However, the perspective of reality being the sole privilege of the

human gaze has held sway. The concept of interrelatedness and interdependence has primarily been posed as a challenge to human dominance and determinism, and is now largely being acknowledged and understood through the teachings of Indigenous peoples.

I also see in Vine Deloria, Jr.'s work a bridge between similar historical requests such as seen through the work of German poet-scientist Johann Wolfgang von Goethe (1749-1832), which was reflected on by British biologist T. H. Huxley in his forward provided in the first edition of the scientific journal *Nature*, in 1869, and further, with that of sustainability climatologist Daniel Christian Wahl (2012). Through time and space, we see this same urgent request, to see nature—as representative of the sacred and as sources of knowledges—everywhere, and to consider the dynamic interconnectedness and interdependency that this represents.

Harkening back to Dr. Dayle John's quote, I will now share a few more brief examples from recent stories of leadership decisions that have created lasting reminders of the dilemmas posed by lack of remembrance, maintenance, and honoring of our relationships with the sources of our knowledges. Also, of their influences on young minds and of their behaviors.

Whyte (2012) briefly relates the reality of Inupiat leadership deciding to partner with Arctic offshore drilling as a resource development venture, against the advice and warnings of traditional knowledge keepers among their people. These leaders stated they were concerned with the economic well-being of their people, which had up to that point depended largely on oil and gas extraction. These leaders saw this as their largest responsibility (Birger 2012). This is mnemonic for me as I am additionally haunted by a

photograph that is in the public domain that reveals the anguish such decisions inflict on some tribal leaders, and also subsequently on their people.



Figure _4_: Chairman George Gillette, of the Hidatsa, Mandan, and Arikara tribes at signing of Garrison Dam project authorization. Open Access.

This 1948 photograph (fig. _4_) depicts Hidatsa, Mandan, and Arikara—the Three Affiliated Tribes—tribal Chairman George Gillette at the signing away of a large area of his people’s lands along the Missouri River, so that the Garrison Dam could be built. Gillette was forced to sign over to the Federal government, 155,000 acres of land that more than 900 members of his people resided on. I have heard a first-hand account of these events, from my two daughter’s great grandmother, who is Mandan-Hidatsa and was witness to these events. She was a young woman living near Elbowoods, the then “center” of the reservation, that was in the path of the proposed flood waters that would enable the dam to exist. Hers is a story of traumatic displacement that also lends narrative to the complicity of several individuals in this photo. Aside from Mr. Gillette’s weeping figure there is clearly a tribal man standing in the back and to the right. His eyes are down cast but he bears a slight smile. Francis shared story after story of such tribal members as he, who were promoting the development of the dam as being beneficial to

the future of their people. In the years that followed, these individuals and many of their family members were referred to as “traitors” to their people. Yet, the stem of power that the Bureau of Indian Affairs brought through the tribal council structure, versus a “traditional” form of government, has permitted such individuals to attain enduring political status as leaders. In this year of 2023, those predictions in 1948 of benefit for the Mandan, Hidatsa, and Arikara people have yet to be fulfilled.

Recall my sharing the story by Dana Powell (2018) and her *Landscapes of Power: Politics of Energy in the Navajo Nation*, wherein she relates the century long disastrous relationship between the Navajo Nation and their dependence on natural resource extractions. In 2019, they turned away from these particular activities. Traditional voices among their communities were relentless in reminding Navajo leadership that they were violating their sacred lands and dishonoring the origins of their cultural knowledges. They went so far as to blame their continuously impoverished lifeways on these decisions. Current leadership has opted for wind and solar power industries to replace those of coal and uranium. Looking into solar energy provides occasion for additional questions: Does this shift reflect a return to consideration of and understanding the purpose of their peoples’ relationship with their sacred lands—as sources of their cosmologies and Indigenous knowledges? Or is the continued use of these particular lands for new industries merely a knee jerk repeat in modern form of the basis for decisions made a hundred years ago, that did not take into account the lasting results of negotiating the sacred?

There are arguments to this use of what is deemed sacred, through the stance that it is a *right* bestowed on tribal leaders, to act in accordance to their own thinking, to make decisions over the use of their cultural heritage and natural resources. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) centers the rights of Indigenous peoples to “freely determine their political status and freely pursue their economic, social and cultural development” (2007 UN General Assembly, UNDRIP Article 3). Further, in the preamble, language affirms and recognizes Indigenous peoples’ right to self-determination through acknowledgement of their knowledges, cultures, and traditional practices as means to assist them in exercising control and management of the development of their lands and resources according to their aspirations and needs.

Whyte (2018) connects his question to these UNDRIP statements through a reminder of a shared Indigenous philosophy about the responsibility that is inherent in decision-making; this of being accountable to the next generations through means of considering broader impacts of our actions, and in this way reflects an interrelated and interdependent way of being and doing (Benton-Benai 1988). Whyte concludes that while understanding what Indigenous knowledges do for Indigenous peoples is bound within discussions of value—such as supplemental- and governance-value—particular to those peoples’ within the context of the discussion, there is necessity for consideration of knowledge sovereignty. Indigenous knowledges are fragile and require attention and practice of them in order to be remembered and this occurs through and within relationship with them. Acknowledgment of the need for Indigenous peoples to protect “their own internal capacity to cultivate, transmit, remember, and exercise Indigenous

knowledges” (22) reflects the reality that these knowledges are “irreplaceable capacities that can guide Indigenous governance” (22).

Listening to and reviewing these and other stories kept reminding me of one of many summer “culture camps” among the youth in my Wind River community of which I had helped design and facilitate. We had over seventy youth attending the first annual offering of our three-day camps. These youth represented several different tribal nations besides that of our Shoshone people, but they all had a connection with our area. I had assembled the youth into seven different groups, each with two adults as ‘listeners’. Each group were to share their thoughts around two questions: what they understand cultural knowledge means and why it is important to Indigenous peoples. Once they returned to the larger group, the listeners reported on what they heard, as lesson learned, from their small group and invited individual students to expound on their comments. Even after these many years since that camp, I will always remember one comment and discussion in particular.

The listener happened to be one of the then council persons for the Eastern Shoshone tribe, reporting that there was concern about Native culture as not being ‘applicable’ in today’s world. The youth who had raised the topic related his story of being raised to hunt and fish, but that he would also live sometimes with his father in an urban area in another state. He said as he gets older he feels hunting and fishing are not needed because food is easily bought in stores. The listener-council person agreed with the youth and added that Native people today need to learn and understand modern ways

of living, over that from the past. My heart fell on the ground that day. I had expected a response that represented an integration approach.

In the moment, I was nearly rendered speechless. All I could muster, at the time, was appreciation for the topic and that we would spend more time exploring and discussing it during the camp. I was conflicted as how to respond because my own tribal leader had not defended the importance of perpetuating our cultural knowledges and ways of being and doing as contemporary Indigenous people. During the next days of the camp we did continue to discuss the topic—in fact we are still discussing it. During that camp, freedom of speech to address alternative views about that topic was hindered though, with the continued presence of the tribal council person, primarily out of respect for the age and position of this individual. Over the years, and as an element of this doctoral study, I surmise two primary premises for the position that particular tribal leader took: generational conditioning as a result of colonial impacts and or a narrow or diminishing hope for the contemporary survival of our Shoshonean and other Indigenous people, as cultural beings. This assessment is founded on deep respect as that leader was from my own family, and I had a lengthy part of my lifetime to visit with and observe this person. Tribal leadership has never been, historically or today, an overly coveted position. Only the stout of heart can successfully exist in the environments that contemporary tribal politics was born of and continuously evolves within. This was the advice from several tribal leaders I have visited with. I, though, persist in my curiosity as to how and why tribal leadership can best represent the story of traditional cultural knowledges thriving amidst contemporary realities.

Looking into the relationship between tribal leaders and Indigenous knowledges continues to cross through the realities of contemporary society. There is a much-needed focus on a concern I have heard repeated over and over: “How do we live a good life today and still honor our traditional cultural ways?” This is a concern that echoes through each of the three themes of this study. Particular to this theme of Tribal decision-making and associated with technology, is the question, “What impacts occur to a people’s culture and wellbeing, as a result of leadership decision-making, with the presence and use of land-based survey technology?”

Stories and questions such as these I have shared support my stance and the case that the topic and context of my study have been appropriately engaged through the three primary areas I have observed, these being: Native education, Practitioner use of landscape archaeological survey technology (remote sensing and GIS), and tribal leadership decision-making.

Overall, a personal history of growing up among my own Shoshonean community, employment, academic studies, and various experiences created my interest in the topic of impacts to IKS and ITEK occurring through use of technology. Exploration of this topic within the communities of Indigenous Elders, leaders, students, educators, landscape archaeological survey and geospatial practitioners, and various providers of academic and professional training revealed a variety of concerns. As well, most of the people I visited with requested that I engage the study I now have accomplished. One story from a tribal elder and veteran, and another from an Indigenous graduate student

and member of AISES, planted the seed to look *inside* that which is touted as beneficial and valuable to Indigenous peoples, and is also supported and collaboratively driven by them. This approach and these concerns provided the outline for my enhanced literature review. The synthesis these concerns and subsequent reviews of discourse provide was the basis for understanding the need and implications of such a study as you are now learning about.

In this chapter I have provided you with an annotated outline—a map—that provides understanding of

- a) What has led to this topic and focus—as well as the revelation of a lack of scholarship, if not outright neglect of it,
- b) The basis of my topic and questions, and theories—that use of remote sensing and GIS archaeological landscape technologies, within Tribal lands, created/creates positive impacts to IKS, and ITEK through Indigenous practioners training and the data derived from these technologies positively influenced/influences tribal leadership decision-making regarding tribal cultural heritage and resource use and management (null hypothesis), and/or contributed/contributes to current and potential loss or diminishment of IKS to ITEK that influenced/influences non-mutually beneficial training for Indigenous practioners and tribal decision-making regarding tribal cultural heritage and resource use and management (alt-hypothesis), and collectively, and;
- c) Why this study was imperative to accomplish and in the way I have gone about it.

My decision to investigate this focus as a Study, was additionally influenced in two intimate ways. First, and foremost, I am a person of the land. My cultural identity as an

Indigenous woman is largely constituted through my Eastern Shoshone cultural ancestry and present day lived experiences as an Eastern Shoshone cultural citizen, through a personal continuous relationship with land, and practices of land-associated Indigenous knowledges.

Second, I have experience with and an understanding of the history and contemporary use of landscape survey technologies through a variety of experiences, employment, academic coursework, and research projects. These include years of professional experience working with remote sensing landscape survey technologies within tribal and nonprofit cultural, natural resource, educational, and environmental programs. Also through employment and projects within Cultural Resource Management (CRM) and corporate industries such as environmental engineering, all which engage federal and state environmental and cultural heritage laws, policies and practices. It is within these latter experiences that I draw from for my working title, *Negotiating the Sacred*. This title holds a personal childhood memory of first seeing my homelands dotted with oil wells and learning that my own tribal people have often decided to use what we have deemed as being sacred cultural heritage and resources, in ways that have often not been mutually beneficial.

As a result of working in and with a community of interested parties, at local, national, and international levels, I have found there is yet a burgeoning call for such a study as that I have engaged, and this comes from not only Indigenous individuals and scholars but also those who are Allies around topics such as mine, and as cited in the body of this chapter as being Cohen 2020; Fernandez-Diaz 2018; Lam 2018; Hinz 2018; Lang 2018; Tengo 2018; Wehrden 2018; Whyte 2018; Martin-Lopez 2018; McCoy 2017;

Supernant 2017; Lone Fight 2017; Augare 2015; Abrams 2013; Anaya 2013; Aikenhead and Agawa 2007; Chambers 2004, among others.

When I first conceived of the topic of this study, I had theorized, there is such excitement about what technology affords us, and over time we have seen some of the benefits of this. However, there also is a persistent lack of attention and oversight to what may be present non-beneficial results and influences on Indigenous practitioner's education-related experiences with these technologies that also connect to tribal leadership decision-making about cultural heritage and natural resource management, and potential impacts. This study has sought to understand these.

Again I say, technology is exciting. The world has always been and continues to be greatly interested and intrigued by technology, especially that involving revelations about the worlds these tools help us to explore for making meaning of our relationships *with them*. Additionally, how these technologies have already influenced our worldviews and assumptions about self-in-relation required attention. How have we, and are we continuing to be, changed by these influences that also creates impacts, either beneficial or not, or both, to what constitutes our worldviews, is the thread woven through this study.

Additionally, it is my hope that the way I have gone about developing the topic of this dissertation and the way I have provided the information in this chapter, you can better understand the degree and commitment I have to the design and accomplishment of working within the tenets of Indigenous Methodologies and Methods, specifically with multi-methods described in this study as that representing the integration of quantitative

and qualitative approaches with a variety of Indigenous perspectives, particularly that of an Indigenous form of reasoning—an analytic model—created for this study. Recall, the entirety of this approach for the design and accomplishment of my dissertation project reflects a parallel endeavor to practice work I accomplished within my Master thesis (2017) and that has been revised in 2021, referred to herein as An Indigenous Research Way (AIRW), that is a continuous improvement model of research design and practice. Let us now visit more about this and the methodology and methods developed and chosen for this study.

BAHAITEE

(Chapter) 3

Aiya'ai dame bede anda n'angkwa
There you are, we've arrived at another place.

Wayfinding:

The process of AIRW in practice within this chapter is a form of application of what I learned, and shared, within chapter 2. The communities and individuals I visited with and literature I reviewed provided three themes, being Education, Technology, and Tribal Leadership Decision-Making. These provided the focus for hypothesis development and also to develop the platform of the theoretical framework and a methodology to seek Understanding of Impacts to IKS and ITEK from use of Remote Sensing and GIS Technologies within Tribal Landscapes. This methodology then guided choosing congruent methods to make my inquiries and gather data. This methodology also inspired the creation of a heuristic analytic method, Newe Reasoning—Newe is the name we Shoshone refer to ourselves meaning Us, a People. Newe Reasoning also represents shared worldviews and various Indigenous perspectives, interwoven with those of my Shoshonean culture.

What follows are my stories of these developments and related processes. The results of practices of the methods are shared in more detail in Chapters 4 and 5, with a discussion in Chapter 6.

Oo soo neek

... AND SO, THIS IS THE WAY OF IT ...

Developing A Way of Knowing, Being, and Doing

Indigenous scholars Windchief and San Pedro (2019:151) quote Comanche-Kiowa scholar Dr. Cornel Pewewardy

The concept of applying Indigenous research methods aspires to be a reconstructive and locative educational and social justice idea. This means that Indigenous research methodologies must be able to provide the outlines for distinguishing themselves from other research projects and methodologies of educational and social advancement.

What are IRM&M?

Trail blazing Indigenous scholars, such as Linda Tuhiwai Smith, Karen Martin, Shawn Wilson, Maggie Kovach, Jo-ann Archibald, Leanne Simpson, Marie Battiste, Sonya Atalay, Maggie Walter, Chris Anderson, Joe Watkins, and many others, acknowledge that Indigenous research methodologies are the research framework where place-based methods of gathering and disseminating data with attention to the paradigm (philosophy, world view), and cultural values of the researcher, and the community and individuals where the research is taking place. Indigenous Research Methodologies (IRM) differ from the Western approach because they are derived from and center tribal voices and their knowledges. Information is gained through relationships with and between people in a specific place, with the culture of Place as understood through our own worldviews, with the source of the research data, and with the person who knows or tells the story that provides the information.

In this way, the researcher acknowledges a personal relationship with the story and how it is interpreted by both the teller and the researcher-self. Generally in western academic models, the research project and data are separated from the researcher-self, who is merely an onlooker and interpretive representative. This practice translates what is observed as information gathering versus actively learning from those the story belongs to, as an embodied experience of relationality.

As well, we are at a place within the understanding and application of Indigenous Research Methodologies & Methods (IRM&M) where evolving the Action Research, Participatory Action Research, and Community Based Research models need to and are recently becoming *community-guided* and *community-led*. This provides space for a defined research partnership to be established and engaged, that also creates space for co-authorship that assists in researcher practice and understanding of the concepts of what we refer to as IRM&M.

Additionally, data collected through application of IRM&M can and is analyzed quantitatively as well as qualitatively, just like data collected through Western research approaches. What troubles Western academia is the acknowledged relationship between researcher and data that reveals a naturally occurring paradigm that seeks mutual benefit, but can be agendized for researcher purposes primarily (Smith 2012). A correction to this imbalance of benefit is largely seen through stated researcher positionality and the application of multi-methods that explicitly represent relationality and interdependence. I provided an example of this process for you in Chapter 2 with my work through engaging Self-in-Relation as an element of AIRW research design and practice.

Indigenous Research Methodologies and Methods are powerful and worthwhile despite various challenges, because they provide vital opportunities to contribute to the body of knowledge about this planet earth and other worlds and Indigenous Peoples' relationships with those environments—interactions between biological, physical, and chemical components—and their ecologies—organisms within environments.

A Way of Knowing and Being: Paradigm and Methodology

There is a difference between methodology and methods. Consider, the origins of the word methodology is comprised of two nouns that represent a branch of knowledge associated with principles about the generation of new knowledge (McGregor and Murnane (2010). Methodology, then, guides our selection of methods—which are the techniques and tools that we use to “make inquiry”—to gather information about our topic and questions. Together, methodology and methods represent the operationalizing of philosophies as its basis—its principles and means, its tools to engage investigation, and make analysis of the information gathered. Here, I share the methodology created, for the formal study such as I have accomplished, that has framed and guided the work of my research journey.

What follows, from my perspective, is one of many imperatives within my vision, design, and practice of the study I have accomplished. I submit that “why”—the thinking behind—I have gone about my planning in the ways I have, is just as important as “how” I have investigated to reveal answers to my research questions (Kovach 2009).

A basic tenet of an Indigenous Methodology (IM) follows the understanding that

when indigenous peoples become the researchers and not merely the researched, the activity of research is transformed. Questions are framed differently, priorities are ranked differently, problems are defined differently, and people participate on different terms” (Smith 2012:196).

This occurs as the result of philosophies expressed in culturally-lived ways (Freeman 2017). Synthesizing and utilization of Indigenous knowledge-based methodologies has been and remains a point of debate among many social scientists (Chilisa 2012; Preucel and Mrozowski 2010; Johnson 2010). There is also an assumption that Indigenous ways of knowing, being and doing are not applicable outside Indigenous communities and their related issues. Yet, there is the persistent thought and practice that Euro-western based research perspectives are applicable outside their communities, thus promoting the thought that they should be the choice utilized even among Indigenous focused studies. This represents the premise, held within academic communities, that non-Indigenous positivist-based scholarship should remain the prevalent form of empirical and systematic research paradigms (Hart et al 2017; T. Ingold 2017; Cajete 2015; L. Lambert 2014; M. Walter 2013; D. Rasmussen 2013; B. Chilisa 2012; M. Kovach 2011, 2010; Carjuzza and Fenimore-Smith 2010, L. Grande 2008, S. Wilson 2008; T. McGhee 2008; Guba and Lincoln 2005; L. T. Smith 1999; Rigney 1999; V. Deloria, Jr. 1997).

This also reflects the discussion Geertz (1973) provides regarding academy’s need for finding “the old key-to-the-universe view” (311). His reaction is that, this need to generalize is a short sighted view of knowledge application and sets the dialectic in

motion, and is painfully evident when this is realized. The tendency to perpetuate a hierarchal typology for knowledge use becomes inevitable with this mentality.

A decade later, in 1983, Geertz provides a follow-up to his work on “thick description” with his book “Local Knowledge” wherein he turns his attention to what he terms the “deprovincialization” of knowledge. He cites philosophers such as Heidegger, Wittgenstein, Ricoeur, Foucault, Habermass, Weber, and Kuhn as informing his focus on the practice of anthropology that engages concepts of knowledge produced from mundane experiences, but from the perspective of those actually living them. This, Geertz believes, will enable us to “attempt somehow to understand how it is we understand understandings not our own” (5). He speaks of course to what we refer to as hermeneutics—the theory and methodology of interpretation through experiential means.

Albeit, he contends this is not his intention, his is though, a conversation engaging the social conceptions of self through affixing various definitions of culture, that provide an existential argument that, in the present year of 2023 we are still contending with as relativism. Geertz cites Wittgenstein as referring to another challenge of interpretation of “ways” that are not our own, stated as: “but of course...we cannot use it, because it is permanently closed” (6). This is in response to after coming to understand how another understands, one finds an impasse yet remains, in terms of interpretation and representation of that knowledge. This is the place I refer to as the “space in-between methodology and methods” (Freeman 2022, presentation to NSF Interest Group for Indigenous Communities) and is an iterative process of coming-to-know and for meaning-making. I share more about this thinking in the next section, A Way of Doing: Methods.

This “representation” of knowledge is a primary argument with the creation and use of Indigenous Methodologies as a framework for research to be accomplished, by an Indigenous researcher and particularly when working with Indigenous peoples. Public sharing of Indigenous knowledge by Indigenous people is not a new endeavor however, as we know Seneca archaeologist Arthur C. Parker (1881-1955), followed by his daughter Bertha, applied his cultural perspectives to the way he conducted research. As a young man, Arthur had become acquainted with ethnographer Lewis Henry Morgan and was also introduced to Franz Boas, who was at the time with Columbia University designing what would become American Cultural Anthropology. Parker’s approach to research provides precedence for the presence of Indigenous methodologies and methods as being within the academy previous to forty years ago, when the bulk of most discourse and scholarship pertaining to Indigenous knowledges as methodologies arrived publicly through academia.

The profound statement by Audre Lorde (1979), that the master’s tools will never dismantle the master’s house, finds resonance with an African proverb quoted by Ngugi wa Thiong’o (2017, and cited by Archibald et al 2019:5) that further reveals Lorde’s meaning from an Indigenous worldview: “Until the lions have their storytellers, the story of the hunt will always glorify the hunter.”

Today, we have readily available “storytellers”—Indigenous scholars—who guide and provide examples for understanding what is meant by and presented as Indigenous Methodologies. Those scholars who utilize these provide insight that assists academia on

how to incorporate them, in culturally sensitive ways, into research design and practice so as to retain the voices and perspectives of those whose knowledges are being shared.

Overall, there are specific elements about Indigenous Methodologies that stand out from those of western and eastern methodologies (Freeman 2017). Prominent among these is the understanding that relationality is acknowledged within the basis of the totality of research design, even within a positivist paradigm. However, within Indigenous Methodologies the concept of relationality becomes a holism through the revelation of a philosophy of interdependency that actually and initially exists within relationality. This is a primary difference. Another, as expressed earlier, are the standpoints that an Indigenous researcher embraces and represents in their work, distinguishable from “western-based models as they center on Indigenous knowledges and reflect relationality at their core (Freeman 2017:66). We can additionally understand this through various visual constructs presented by Indigenous scholars, such as Barnhardt and Kawagley (2005), Lori Lambert (2013), Shawn Wilson (2008), and others. Throughout each of these constructs is the thread of “story” as a means—a Way—to gather, partner with through use, and share information.

As I shared earlier, “within Indigenous research methodologies it is common to begin with a personal story to frame the context and question and to also locate the researcher within the study and heuristically—at a personal level” (Freeman 2017:1; Absolon 2010/2005; S. Wilson 2010; Hampton 1995; Moustakas 1990). This derives from a cultural way of being and of being in relationship. A favorite pastime of my family while traveling through the night—which I am told is a common Newe’een thing to do—is to create stories that one person starts, then another adds to, then another, and

another until we collectively decide the story ends, or it is tucked away in our memories until “next time.” The story created and told/re-told, in this way, is not mine or any single persons, but becomes “our” story. As a result, I am particularly conscientious of how I listen, understand, interpret, and share information so as to retain the “way of” others’ perspective, while also providing my reflections and interpretations. As an Applied Anthropologist, I contend these ways reflect a community-way of advocacy for social justice through practice, in a form that enables us to share our own memories, experiences, and thoughts from our own perspectives as an Indigenous individual (L.T. Smith 1999, 2012; Wilson 2008; Archibald 2008, 2019; et al). In this way, story represents principles of relationship-making, maintenance, retention, and perpetuation. This is the basis of my methodological approach to research.

Situating the Topic and Questions as Hypotheses

Looking through the three identified themes, created from a synthesis of conversations and concerns—these being: 1. Education, regarding relationships between Indigenous humans and their landscapes, associated with perceptions about access and public use of Indigenous Knowledges, particularly within STEM-based fields; 2. Technology, specifically the use of remote sensing and GIS technologies by Indigenous practitioners within tribal landscapes, and; 3) Tribal decision-making, as being influenced by these technologies, pertaining to cultural heritage and natural resource management, I have conducted research to investigate questions associated with broader concerns, to reveal evidences of their present day validity and for impact variables occurring from use of remote sensing and GIS within tribal-based landscapes.

Understanding the three themes as a collective with the questions posed, it is appropriate to consider a *Null Hypothesis*—herein utilized within the mixed-methods approach—as being: the perceived positive impacts occurring to IKS and ITEK with tribal use of remote sensing and GIS technologies provide more positive influences, than negative, to Indigenous practitioners and tribal leadership decision-making regarding cultural heritage and resource use and management that provides means for mutually beneficial results. Evidences may be seen through statements made by participants as well as their use of data results that create or further specific projects within the tribes utilizing remote sensing and GIS technologies.

Along with this, I have developed an *Alternative Hypothesis*, that is complex theoretically: Use of remote sensing and GIS technologies within tribal landscapes are contributing factors of culture loss and persistently occurs initially at the source—this being the relationship between IK/ITEK and their Peoples, as Knowledge Holders—and represents a next level precarity that extends the affective elements of colonization directed at and now employed among Indigenous communities, through implementation of STEM-learning within Native education mandates. This premise may be evidenced through the increasing insistence, practice, and narrowly conceived use of remote sensing and GIS technologies within tribal landscape archaeological survey that results in impacts that influence tribal decision-making regarding cultural heritage and resource use and management that further jeopardizes Indigenous lifeways.

My overall approach to inquiry centered on a perspective that views impacts as capable of being both non-beneficial and beneficial, and are largely defined by the

heuristics developed for analysis along with the recommendations of topic related scholars. A further study approach would include inquiry among participants of the projects reviewed within this study. This represents an element of the partnership approach I engaged to identify and develop the research focus, inquiry sites and methods of this proposed study. Of particular note, is that this study honors and adheres to protocols and tenets reflecting the philosophies and use of Indigenous Methodologies—particularly that of the initial centering of the researchers socio-cultural position as an Indigenous researcher that is engaging their cultural ways of knowing, being and doing. As such, this study represents a primarily Shoshonean cultural way of doing research, in partnership with various shared worldviews.

Birth of a Way of Seeing, as Means to Know: Methodology

After having developed a research topic and focus, along with determination of hypotheses, there is need to next understand the process of the design of the formal investigation that has been accomplished, through the further practice of AIRW (as the template of practice that represents a continuous improvement model) and the construction of a methodology referred to as a *Newe Critical Theory of Land-Human Ecological and Technological Relationships*. This theoretical, as well as conceptual, framework was necessarily developed for this study and incorporates a recognition of the persistent presence of science-based ways of Indigenous knowing that shares space with and compliments western-science perspectives. What has been created, is an integrative methodology—a relational lens—reflecting a transdisciplinary approach and guide for selection of multi-methods and an analytic interpretive process.

The name of this methodology, a *Newe Critical Theory of Land-Human Ecological and Technological Relationships*, respects the shared Indigenous research philosophy and practice of crafting a framework that centers an Indigenous researchers socio-cultural positionality and culturally sensitive and collaborative use of specific Indigenous Knowledges, as well as pays attention to environmental and social justice issues within a study's design and implementation (Archibald et al 2019; Paris and Alim 2017; Rowe 2014; Walter and Anderson 2013; L.T. Smith 2012; Atalay 2012; Kovach 2009; Wilson 2008; Nicholas and Hollowell 2007; Brayboy 2005/2008; Barnhardt and Kawagley 2005; et al).

Further, this methodology integrates relevant elements of Tribal Critical Theory (Writer 2008; Brayboy 2005), Tribal Standpoint Theory (Foley 2006); Landscape Archaeology Theory (Brower 2020; Fowler 2016; Ingold 2010; Nicolas and Hollowell 2007; Atalay 2006; Bender 1993; et al); Culturally Sustaining Pedagogical Theory (Windchief and San Pedro 2019; Paris and Alim 2017; Grande 2015), and Social-Cultural Reproduction (Bourdieu 1977; Bourdieu and Passeron 1977). Additional elements of Marxist Socio-Economic Theory of Surplus (Marx 1951), are interwoven as they influenced the social change philosophies of Paulo Friere, Myles Horton, and Bud Hall.

Among these theoretical constructs, most are evidentiary of their purpose within my research frame. As education is one of the major concerns of my topic focus, that is identified in relation to the concerns with use of technology related to Indigenous lands, I share here a summary of my rationale for including Bourdieu's Social-Cultural Reproduction theory, with elements of a Marxist perspective.

Situating Bourdieu's Social-Cultural Reproduction theory, as a perspective of cultural loss, adjoins the Marxist theory of social reproduction, and it being the larger process that holds within it the concept of cultural reproduction, we can understand the centering on influences of institutions—particularly educational systems. This exemplifies how Marx's theory also crops up in various guises that require unpacking to determine their beneficial and or oppressive forms (Ferguson 2020). I engage these theories through the vehicle of education—as a reproductive transport entity—internationally, nationally and locally, and the various organizations that drive and support STEM-based learning within Indigenous education.

From a Marxist perspective—introduced through the idea of social reproduction in Marx's work, *Volume I of Capital*—socio-economics is the primary discussion (Marx 1951) within Bourdieu's reproduction model. Together, these can provide understanding of how the production of knowledge is a contractual agreement for “goods and services” and represents an integrated process that reveals the socio-cultural as a driver of economic decision making.

With use of these two theories, synthesized into one and then they with the others I have collected for this study, we can move beyond just describing what impacts look like. This is accomplished through use of this collective within an analysis of their relationship with each other, and then as a collective gaze at the issue of knowledge production as a process of producing value, and for whom. This, then, draws into consideration reproduction, as a strategy, of the request for STEM-based learning among Indigenous peoples, as a process of colonial methods—a contemporary transit-form derived from Imperialistic forces—utilizing education as a vehicle. This brings to mind a

closer connection with the work of Althusser (1971, 1995, 2014), who also followed Marx's social reproduction concepts, but in the form of state agencies and institutions as perpetuating social forms.

The entirety of this assemblage, albeit theoretically complex, appropriately provides a critical paradigm for Indigenous knowledge (IK)-based understandings within an archaeological praxis to reveal technological impacts to Indigenous peoples systems of knowing (IKS), and their educational approaches and decision making regarding their relationships with and sensitive use of their cultural heritage and natural resources (ITEK) (Pasternak and Scott 2020; L.T. Smith, Tuck, and Yang 2019; Moreton-Robinson 2016; Fowler 2016; Anaya 2013; Echohawk 2013; Atalay 2012; Nicholas 2012; Byrd 2011; Hall 2005; et al). Through this study, these theories have become congruent through the creation of the methodology titled a Newe Critical Theory of Land-Human Ecological and Technological Relationships.

Further, this theoretical frame engages an "un-deficit" position (Walter and Anderson 2013), where de-construction is not the over-riding goal, but instead acts of imagining and constituting reality with assembly of strategies that "re-center formations of knowledge, not contingent on the management or control of imperial interest, but rather enhance well-being" (Grande 2015:xvii). In this way, this study fully represents the spirit and "principles for postcolonial self-determination and human rights" (Battiste and Youngblood Henderson 2000) found within the 2007 UN Declaration on the Rights of Indigenous Peoples and its various instruments relevant to self-determination and cultural heritage.

A Way of Doing: Methods of Inquiry

Again, there is a difference between methodologies and methods. Ultimately development and use of Indigenous perspectives as a research methodology should logically guide the selection, and or development of methods. This includes the analytic tool to be utilized. Upon closer review of this process questions arise about congruency within research design and practice as an applied approach. What follows are various stories about methods and how I determined those that are utilized and how within this mixed methods and trans- and multi-disciplinary study.

I will do my best to express both an explicit detail of the doing—the methods—while also maintaining their relationship to the methodology of this project, and that of the analytic approach I developed to utilize in this study, which is yet being more fully developed.

The following details various methods I utilized predicated on the objectives of this study, the context site and sources, and the type of information and measurements sought. Additionally, and as I shared earlier, my research process engages a particular methodology—a hybrid approach—that requires certain methods be employed from the point of topic inception and first considerations of doing a study. As well, this approach subscribes to an iterative philosophy of gathering information, and as such, there may develop need for additional methods to be utilized within a particular site of inquiry. These will of course maintain congruency with the methodology of this study.

Here, I present the “doing” having been accomplished, which includes additions to a standard academic research “formula,” that assists in explaining the design guidance

for my study, as An Indigenous Research Way (AIRW), that includes preparing to do research as a method (Freeman 2017).

Please note: I have utilized aspects of the recommended process refinement models—akin to continuous improvement philosophies—that I shared in Chapter 2 for projects working with remote sensing and GIS technologies as related to land-based learning, from references I provided from Ryan (2016), Supernant (2017, 2021), Lone Fight (2019), Sanger & Barnett (2021), Wessels (2022), and Nesvold (2023) work. They also engage survey design considerations and relate to decision-making. I speak to this further as specific methods for assessing digital cases and their visual narrative measurement.

An Indigenous Research Way, as Method

An Indigenous Research Way (AIRW), as a method provides opportunity to share a bit more depth to the previous information regarding use of An Indigenous Research Way (AIRW) for research project design and practice. The following information relates AIRW as a multi-method process.

Being mindful of our own research process, is key to development and application of a methodological approach to engage a creative, innovative and impactful academic investigative study. This “mindfulness” is supported through a “design” approach for accomplishing doctoral level research (Ulibarri, N., Cravens, Cornelius, Royalty, Nabergoj 2014; Jones 2013; Halse & Mowbray 2011; Lovitts 2008; Bargar and Duncan 1982). Working within an applied research discipline, and associated objectives that reveals its usefulness, adds to the complexity of the process (Gibbons et al 1994).

Consider, “conducting original scholarship is a messy, inconclusive process that requires not only more sophisticated analytic thinking, but creativity, tolerance for ambiguity, and not knowing the right answer, and conscious management of one’s own research process” (Ulibarri et al 2014:251 citing Lovitts 2008). The necessity for preparing oneself for this journey [thus] is imperative (Graveline 2000; Kovach 2009).

Within a design-based research approach to the process of creating an investigative study, iterative learning is at its core and depends on context—not just of the issue, but also of the particular intentions of the researcher. These “intentions,” within an Indigenous Research Way (AIRW), are referred to as one’s Socio-Cultural Position (Appendix _B_). Within AIRW, these intentions are not only a reflection of an individual’s will, but also reveals their relationship with and respect for their ancestors, and is included in the meaning of the expression, “all my relations” (Absolon & Willett 2004; Geniusz 2009; Hart 2002; Kovach 2009/2018; Lavall’ee 2009; Linklater 2014; Weber-Pillwax 2004; Wilson 2013), and positions this process to engage work of understanding one’s Self-In-Relation.

Anthropologically, this is a practice of ethics, as it helps a researcher to think critically about one’s own perceptions of the world, and relationships and intentions with it. This practice becomes part of the entirety of the research process and lends validity and consistency of approach, particularly from a self-in-relation or “researcher-in-relation” concept perspective (Kovach 2009). These activities can then also be assessed at the conclusion of the study, as being a part of knowledge revealed and the outcomes of implementation of a continuous improvement model and method.

Communication comes in many diverse forms and is value laden; and as such is a duty of care that requires understanding of our personal accountability, this can be accomplished through a journey to discover our own socio-cultural position.

Within regard to the design for my Master research (2017), I made that statement. I utilized a shared Indigenous knowledge that highlighted the importance of communication—with self and others. I had been following the work of several Indigenous scholars, particularly that accomplished by Dr. Shawn Wilson, (Opaskwayak Cree). His seminal doctoral work with Indigenous Methodologies appears in his 2008 book *Research is Ceremony*, wherein he presents his “Elements of an Indigenous Research Paradigm” (71) that centers on relationality and accountability.

I had the great opportunity to meet Dr. Wilson in October of 2016 while attending the annual conference of the Intercontinental American Indigenous Research Association (iAIRA). There, I attended his presentation wherein he had extended his earlier work through adaptation of Maggie Walter’s “Conceptualization of a Research Methodology” (2013:45), which centers on research Standpoint theory, and is comprised of a researcher’s epistemology, social position, axiology, and ontology. She emphasizes that the concepts of standpoint, theoretical frame, and methods “are central to all methodology...inextricably entwined in practice...and [as such] underpins all methodologies, not just Indigenous” (44). Her work forwards an Indigenous reality that we are subject to modernity, and as such, we should not conflate difference with opposition; such as has been promoted through discourse on decolonization (73). Her standpoint clarifies the value, though, of what Indigenous methodologies provide, this being the increase in “the likelihood that we will ask questions that others have not and

fashion categories that heretofore have not been used” (73). Shawn Wilson’s methodology and concept extended that of Walter’s.

Wilson hosted my visit to Australia in 2017 and went on to recommend my acceptance into Southern Cross University’s Gnibi doctoral program that has a focus on Indigenous Philosophies. I was accepted into that program, but the vision for my currently accomplished study brought me to the University of Montana. I saw this as an opportunity to join other Indigenous scholars to enhance a much needed American presence within academic research that utilizes Indigenous Methodologies and Methods. Today Shawn continues to be a mentor for me, and more importantly, is my friend.

A product of my MA research and thesis was the enhancement of Dr. Wilson’s process of accomplishing research from an Indigenous perspective. It represents reflection on one’s personal journey as a researcher within the process of *knowing* the source of knowledge (epistemology) that informs the *being* (axiology and ontology) in relationship with the *doing* (methodology) of scholarly work that also reveals personal intentions behind research question(s), and enables a foregrounding of accountability for whom ultimately benefits from studies such as this. Additionally, within AIRW, it is paramount to address questions such as that of Potawatomie scholar, Dr. Kyle Whyte, which I have repeatedly stressed in this document in a variety of ways, what do Indigenous Knowledges do for Indigenous Peoples. Relatedly, an original contribution to Wilson’s model, was my focus on the pre-research stage of Researcher Preparation, that contributes to a major component in the research journey—that of understanding one’s own socio-cultural position. Doing research in an Indigenous way, is a method within my

present study and as it is an entirely iterative process, it is a method that is continuously used throughout this study.

Revision of the Research Landscape through Evidence Mapping

As the formal duration of my study occurred within times of a health pandemic, my research methods reflected this reality. I was settled on my topic and primary questions already and as I have shared, I spent quite some time working through the process of developing my research methodology, that provides both a logical path for my research but also respects my philosophy of working with Indigenous contexts, as needing to address social and environmental injustices.

As I have also previously shared within this dissertation, there became a need to revise my methodological approach to this study, in terms of selecting an alternative site and source(s) to pose my questions and seek understanding of them. This all felt chaotic to me. However, I decided to lean into this reality as means of thinking through my dilemma. Looking to Chaos Theory, the study of the way changes in the present have major consequences in the future (Leonard Smith 2007), held some advice and also comfort for me, through a mathematical perspective and process of randomization. I needed to redefine the research landscape quantitatively and qualitatively within the realities that COVID created.

Indeed, the reality of the pandemic has become evidence of the cliché “a new normal.” This led me to consider a pedagogical approach to solving the issue of site and source selection that would accommodate topic and questions as the place(s) and spaces for my inquiries. As the realm of my design process engaged a cartographic framework, I

looked to mapping as a systematic means of assisting my search. In this process I came across a health-based process called Evidence Mapping.

Evidence Mapping, has been a systematic method within academic studies since about 2000, with open publication of a map in 2003 by Yale Prevention research Centre addressing data use for policy making and best practice strategies. The mapping process assisted me with regaining focus on my topic and the three themes identified within my pre-liminary work. Mapping is commonly utilized to assist in identifying what evidence currently exists. This then led me to sit again within AIRW, in the pre-liminary elements of Self-in-Relation, about the situation of working with the effects of a health pandemic and an ethic of respect for building trust in times of self-care situations.

This led me to consider what approach would assist with understanding what information is already being provided that is in the realm of my topic and could be explored for answers to my questions.

In Chapter 2 I made a statement that the effects of the pandemic and the subsequent need to re-think sites and sources for my study had actually provided an opportunity to engage my research topic and questions in a more culturally sensitive and appropriate way. This brought to my thinking relationship building. Within AIRW the time required and processes of developing a relationship with humans and the environment is imperative. One does not simply happen upon the scene with questions, survey, and interview scripts. Upon inquiry with Committee Members it was suggested I look at Case Study versus an experiential field approach. After personal research about Case Study, and given timeframes and topic of this study I concluded that utilizing a Case Study approach was the most logical method to engage.

Case Study: An Approach Method

Recall I shared my definition of the word “understanding” found within the title of my study? I explained that it represents a term for the dynamics of coming-to-know what impacts occur to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) from use of remote sensing and GIS technologies within tribal landscapes. This investigation also emphasizes a focus on Indigenous practitioners use and training with these technologies. As a result of the processes of re-think I have shared this far, Case Study is an appropriate approach.

“Doing case study research remains one of the most challenging of all social science endeavors” (Yin 2018:3). The process required for use of Case Study as a method of approach follows need for a well-researched and developed methodology. With the survey of theoretical and conceptual works I accomplished and have presented previously to develop the New Critical Theory of Land-Human Ecological and Technological Relationships for this study I felt this approach was appropriate. Additionally, a choice to study a single case or multiple-cases with use of multi-methods of inquiry was attractive with regard to my interest in understanding quantity of use of remote sensing and GIS technologies within tribal landscapes, that crosses-through complex social phenomena found within studies associated with social and environmental justice issues and further associated questions.

Within such an approach is the usefulness of both an inclusive and pluralistic strategy for methods to be utilized in non-hierarchical relation-based ways that broaden these strategies for purposes of exploratory, descriptive, and explanatory means.

Attention to conditions for use of Case Study, as an empirical and systematic method of research, include form of research question(s) to be asked, the control the research has over behavioral events, and the degree of focus on contemporary versus overly historical events (Yin 2018:9). Within the study I wanted to conduct, my questions have been primarily related to how and why forms, and there is no objective to control behavioral events, and the cases should engage contemporary stories of practice. Here, the use of public cases of digital media (defined as documentation as a source) fits within “teaching case” definitions of humanities scholarship and within the fields of business, law, medicine, and public administration (Ellet 2007; Garvin 2003; Windsor & Greanias 1983; Towl 1969; Stein 1952; Llewellyn 1948). Add to this the realm where these fit within STEM-based learning and industries, and we have a basis for a transdisciplinary and multi-methods research project.

With regard to mode(s) of inquiry a Case Study approach accommodates different epistemological perspectives, such as application of both western and Indigenous methodologies and methods, through a congruent process of design and practice. This congruency is also evident when considering validity tests for research approaches when utilizing multi-cases within a single study. All four tests, these being Construct (data collection), Internal (data analysis), External (research design), and Reliability (data collection) were found achievable not just in the design of the study, but also throughout its practice.

With the above considerations, Case Study has been the approach utilized for the research now accomplished that I am sharing with you in this dissertation.

Site and Sources of Inquiry:

Through application of Case Study as a partner now within this study's conceptual framework and as method of approach, I was able to locate and identify a site with multiple projects that fit within the methodological strategy for the inquiry of my topic questions and hypothesis. The sources of information available to me within these projects then led to the further development, for this study, of a logic model as a guide, and development of a heuristic method of analysis and reasoning, that operationalized Indigenous shared core beliefs, that became the Newe Reasoning method. These were then coupled with scholar-based recommendations for use of remote sensing and GIS within tribal landscapes.

As I had shared within Chapter 2, it was through participation within a refresher course for ArchGIS, provided through the National Preservation Institute and ESRI (Environmental Systems and Research Institute) in 2019 that I first learned about a collection of tribal-based GIS projects, accomplished as StoryMaps, that were available for public review via the ESRI (Environmental Systems and Research Institute) website. To be noted, starting in April 2023, the National Tribal GIS organization located in Albuquerque, New Mexico, is hosting a tribal GIS StoryMaps submission opportunity as well. This looks to be similar, and potentially a replacement of this activity by ESRI.

As I reviewed digitally provided GIS projects that had taken place within tribal landscapes I was reminded of a statement I had come across within my literature review that spoke to me again of the agency of land and it as being in relationship with human

Indigenous peoples and how this relationship constructs and constitutes Indigenous cultures.

The land is more than a backdrop, space, or a location; it is a sustainer, speaker, and archive for Indigenous stories.

This observation by Sium & Ritskes (2013:7) stood out to me as rationale for investigating and gaining understanding of the topic focus of my study through *understanding* impacts to land, when it is understood land represents a source of Indigenous Knowledges that creates Systems of Knowing and specific types of knowledge, such as ecological-based knowledges. The use of technologies of remote sensing and GIS, as means to “see” and “know” land, then creates an interesting space for considerations of impacts to Indigenous Knowledges Systems, these being Ways of Knowing, and also for their associated Indigenous Traditional Ecological Knowledges (ITEK).

In further consideration for my analyzing StoryMaps—as digital media—Wessels (2022) provides, the replication of physical places, as sites, within digital spaces result in a lack of meaning-making and significance due to limited translation of the existing relationships between humans and landscapes that provide the sources of their cultural identity and knowledge. Wessels and his team sought to understand how to preserve this relational place through particular attention to three critical aspects, being Agency, Multi-Vocality, and Proximity that can be assessed for their presence as evidence of preservation of relationality. This encouraged my interest in building a study with the source being digital media.

Through my initial review, for source appropriateness, of what amounted to 73 digital projects, occurring between the years of 2017 and 2021, I saw the entirety of the projects were candidates as a case study of cases within the protocol of Case Study selection. One such protocol I practiced was the Pilot Case study, wherein I posed my topic and questions to a single project that then resulted in a basis of relevancy for digital media as a type of site and source to apply my inquiries to.

Relevancy of my original questions and the three themes was derived from this process. This created a deeper understanding and awareness for me that these three themes were also first level impacts and access points—or gateways—through which further impacts may occur. From this perspective, I was able to further refine and expand my questions to *understand*, that then enhanced my hypotheses, and created the basis for a process of data measurements. These questions became:

- a) Has the excitement about and use of remote sensing and GIS technologies within tribal landscapes been initiated by STEM-based industry drivers or first by the intentions of Tribal Nations and their needs?
- b) What impacts have occurred to IKS and ITEK from western-based training of Indigenous practitioners for use of remote sensing and GIS technologies, within tribal landscapes?
- c) With use of remote sensing and GIS technologies, as a means of “seeing” sources of Indigenous Knowledges, what impacts may have created cultural knowledge loss, or negotiation of relationships between IK sources and their Indigenous human relatives, because of their use within public venues?

- d) What impacts, related to questions a – c, occurred to tribal leadership decision-making about their cultural heritage and natural resource management?

Reflecting on these four specific questions I observed the dynamic of “understanding” was defined for me as a means of “seeing” self-in-relation through these projects, as cases, and this was relevant and congruent with the methodology I had developed for this study. I applied this lens to additional projects and determined that the site of inquiry needed to be the entirety of the public projects I had access to at the time.

Recall the focus of my research is to Understand Impacts to IKS and ITEK from use of Remote Sensing and GIS within Tribal Landscapes.

I have focused on three primary themes through which to investigate my question(s), these themes are: 1) Native American Education with regard to STEM-based subjects and relationships between Indigenous humans and their landscapes, associated with perceptions about access and public use of Indigenous Knowledges: 2) Use of remote sensing and GIS technologies within Indigenous landscapes, and their influences on Indigenous practitioner relationships with their sources of Indigenous knowledges (IK, IKS, and ITEK), and; 3) Influences of remote sensing and GIS use on tribal-based decision making, with emphasis on data sovereignty. Looking within these themes, I investigated the above four questions within the site of ESRI public tribal GIS projects between the years of 2017 and 2021. These specific projects are listed in Chapter 4

Specific Inquiry Methods

The following shares the various methods of inquiry I have employed within this study, and most logically required parallel and synchronous use reflecting a practice of imbedded and concentric circular paths, often found within an Indigenous worldview, as all actions are interrelated and move fluidly between and amidst each other. Included for less “typical” methods, or if my use required an enhancement of some sort, is a general description of their philosophical, historical underpinnings, and technical attributes, as justification for its use with the various cases of public tribal GIS projects within this study.

The following methods provided data for use within this multi-method study, with site and source(s) being ESRI social media website providing access to 73 public digital media-based tribal GIS projects between the years of 2017 and 2021:

- Observation and Observation-of Participation

Observation related to the viewing of public digital media from an anthropological lens provided a steep learning curve and challenge for inquiry as a method within a study designed per Indigenous Research Methodologies and Methods. In fact, I found no such specific guidance. This meant pulling relevant information from a variety of sources that would enable a logical and systematic observation method to be developed per the context of the inquiry for viewing digital media for answers to my questions. Once this was accomplished, I identified ways of knowing found within Indigenous worldviews and literature, pertaining to ways of observing digital media content, that then created a more critically complete method for observation and observation-of participation. This process provided understanding that enhancing a standard method of inquiry, to engage

Indigenous contexts, requires a custom approach and defies creation of a template for replicability, to a degree.

Guidance for observing and observing-of participation related to the four questions associated with my hypotheses and as being relevant with digital media sources, were derived from the following cited scholarship and interpreted through the lens of this study's topic and methodology, as they being appropriate context for inquiry:

- ESRI five principles for storytelling (details in Chapters 4 and 5).
- ESRI Insights, data analysis guidance (details in Chapters 4 and 5).
- Denzin, N.K, Y.S. Lincoln, and L.T. Smith, editors. 2008. Handbook of Critical and Indigenous Methodologies. Los Angeles: Sage.
- Denzin, Norman K. and Yvonna S. Lincoln. 2008. Collecting and Interpreting Qualitative Materials. Los Angeles: Sage.
- McCue, Duncan. 2022. Decolonizing Journalism: A Guide to Reporting in Indigenous Communities, pps 115 – 120. Oxford, UK: Oxford University Press.
- Ryan, Marie-Laure, Kenneth Foote, and Moaz Azaryahu. 2016. Narrating Space/Spatializing Narrative: Where Narrative Theory and Geography Meet. Columbus, OH: Ohio State University.
- Wessels, Stephen, et al. 2022. The Drone, the Snake, and the Crystal: Manifesting Potency in 3D Digital replicas of Living Heritage and Archaeological Places. Archaeologies: Journal of the World Archaeological Congress (details in Chapter 6)

Consider, a coupling of the above referenced observational guidance sources with tenets found within IRM&M (described in the beginning of this chapter), assist with defining and distinguishing elements between observation and participant observation (Ingold 2017), an issue that can be particularly poignant in a “turn” toward *observation-of participation* (Tedlock 1991). This is increasingly emphasized through a lens crafted from Indigenous perspectives that shifts who and what is being observed and by whom.

Again, as per my present knowledge, there are very few academic studies on the topic I have chosen—particularly, from an Indigenous perspective that also engages a continuous improvement model of researcher practice and calls for the creation of a particular type of analytic method that reflects a transdisciplinary methodology. In response, my research intentions were to fill the gap of accomplishing a research project that uses an Indigenous methodology in a congruent and consistent process, from preparation to-do research through its analysis, interpretation, and conclusions, that do not adhere to a strictly linear process, but in my observation and practice, are more iterative and spiral as a process—that provides space for reflection to build upon what is being learned. Additionally, I have yet to find a study that engages my same topic from an Indigenous perspective also associated with futurisms, that observes participation of Indigenous practioners of technologies typically occupied by non-Indigenous persons.

In the 1970s there was a shift from participant observation to the observation of participation. The difference is seen through a concept of being-in-relation-with, as seen through the process of research and participants as being co-participants in experiences, and this is written as a single narrative. This is often referred to as “action ethnography” (Cole 2005), first introduced by Sol Tax in 1960. This method is more of a strategy to assist people and to also learn something in the process, that centers advocacy for understanding, through self-experience, of that which is affecting others, and to participate in means that create a usefulness from this process. This method of inquiry is an important element in understanding how relationships are understood and perceived, and decisions made as a result. This engages concepts of Indigenous futurisms.

Adding to the philosophical complexity of this study addressing Indigenous futurisms is a place of necessary attention, and is reflected in what was presented in my funding proposal to the Sloan Foundation's Indigenous Graduate Program (2019), to this regard:

Indigenous futures are more fully visible through understanding how culture-based knowledges, generationally conceived, are applied in the present. This acknowledges Indigenous peoples as transcending beyond 'the researched,' to be the researchers as knowers and contributors of knowledge which is useful for contemporary well-being...[which] moves beyond exclusionary methodologies and sustainable-only objectives...toward transformational and regenerative thinking which is a distinctive aspect of Indigenous knowledge approaches to gain understandings of the world.

Being the Indigenous researcher of this study, that seeks to observe Indigenous researchers participation with technologies—as practitioners of technologies that gather information of landscapes—adds to the complexity of the method of Observation and Observation-of Participation. This additionally provides reference to an earlier sharing of my use of the theories of Precarity and Affect, as an observation lens, that presents an opportunity to reveal evidences of a transformational form of resistance, through practice of Indigenous Knowledges. Through this method, Indigenous futurisms (Dillon 2012) may be observed, as a practice of decision making that regenerates ways of being and doing that have empowered the survival of Indigenous peoples, thus transcending agendas of genocide, termination, assimilation, and even lateral colonization.

In my study I shapeshift Precarity and Affect through a Monster narrative, as I seek to understand cultural practices of embracing that which seeks to diminish or even destroy a people. This is an entirely appropriate and timely aspect of my research. Precarity is that state of being that is influx due to conditions primarily outside our

personal or even community control, which tend to manipulate lifeways toward social, political, and economic inequalities. Indigenous peoples are extraordinarily familiar with this state of being. In fact, there is a growing philosophy among Indigenous peoples that much of what we are encountering in life today is on apocalyptic scales; so, who better to inform ways of living within these conditions than those who have survived an apocalypse?

Affect is an acutely contemporary state of being for Indigenous peoples, in many respects. We see this most obviously within the relationship between education as a historical vehicle of colonization and Indigenous peoples. From the first instance of an Indigenous person purposely seeking a higher education, we see Affect at play. Consider, the policies and practices of the status quo academic community has been, and in many ways persists, in breaking down and or altering the personhood, identity, and cultural lifeways of the Indigenous student, to more conform to that which is not who they are culturally, nor how they live their worldviews daily. Yet, this student continues to pursue their academic degree in the midst of these risks. This presents a vision of a person striving for something that has been designed to create their demise.

How these seemingly risk-reflecting theories about life's processes can actually become forces representing advantageous methods for not only surviving life's extremities, but for thriving, is intriguing to consider. I find value in flipping the lens of observation toward actions and narratives that can be interpreted as forms of resistance, and that may already exist as Indigenous knowledges, within the tool kit of Indigenous peoples' ways of knowing, being, and doing.

Through use of both methods of observation, I have paid particular attention to behaviors, conversation, and activities that provide evidence of engaging the theories of Precarity (Freire 1970; Grande 2004, 2015; Voss 2018) and Affect (Berlant 2011), particularly from an undeficit (Walters and Anderson 2013) perspective, which I refer to as a “flipped” narrative of the typical application and definitions of the theories. As I shared, I have framed my approach to inquiry within a Monster Narrative (Forbes 1979; Asma 2009), that contemporarily we also find throughout the work of Donna Haraway, particularly that found within *Staying With the Trouble* (2016). Within my study I assign the role of monster to the presence of Precarity and Affect and situate Haraway’s making “oddkin”—her concept of relationship building with troublesome “Chthonic ones”—as a form of acceptance and reconciliation that life is extraordinarily challenging. This flipped use of these theories, also reveals a philosophy of hope, that further engages concepts of Indigenous futurisms (Dillon 2012).

Again, this way of utilizing the tools of observation and observation-of participation is versus these theories typically seen through a western colonial lens, that has prevailed as a deficit model of assessing Indigenous lifeways and meaning-making. As a theoretical consideration, the Monster narrative is engaged to understand this “flip” as an example of how these theories are typically manifestations of the fears and anxieties that exist within societies (Asma 2009). In 1979, Indigenous scholar Jack Forbes, described science and technology as examples of the Wetiko sickness—a virus or a psychosis—referred to as cannibalism. He posed the question, “can the Wetiko sickness be brought to a halt? (164). Wetiko monster lore is found among several Indigenous peoples.

In 2013, Paul Levy took up the concept from a position of Wetiko as representation of an “evil” that exists with the potential of either destroying or of “waking us up, depending on whether or not we recognize what it is revealing to us” (xvii).

Forty years later, in 2019, we can observe this monster has increased its appetite exponentially, with reference to evidences of the transit of Imperial and colonial methodologies and methods (Byrd 2011). Meditating on this, I thought it might be more advantageous to finally ask, how can we learn to live with these monsters—precarity and affect—, not as its subjects and victims, but as part of a holism that permeates life, and exemplifies a necessary balance? This is tangential to the concept I shared earlier in chapter 2, that technology has always been part of the human experience.

I contend monsters are revealed through recognizing their similar characteristics, and as temporal transit shapeshifters (Lowe 2015; Byrd 2011). Yet, also possibly as organic elements of nature, not to be destroyed, nor fled from, but understood as daily companions. This perspective engages “a pragmatic understanding of how people act to make their lives more viable, to bridge the gap between self and other, to grasp the elusive, and to transform abstract possibilities into embodied truths” (Jackson, 2013 book jacket review). This alludes to Sartre’s argument of the progressive-regressive, whereby possibility is inherent in our Being, especially as descendants of the past, and knowledges it provides in the present, and for the future.

My concept and use of “flipping” the theory and narratives of precarity and affect, is also represented by what Vinciane Despret (2015) refers to as thinking with attunement that incorporates joy and verve. Donna Haraway reflects on Despret’s concept and observes this represents a “becoming-with” (2016:128) opportunity and act of

collaborative story making, and not just between humans, but also between other- or beyond-humans. This, Haraway contends, requires an act of “going to visit,” whereby one must embrace the idea of

“training the mind and imagination to go visiting, to venture off the beaten path to meet unexpected, non-natal kin, and to strike up conversations, to pose and respond to interesting questions, to propose together something unanticipated, to take up the unasked-for-obligations of having met” (130).

Within this study, I observe for evidence of these “monsters” from a perspective that they are part of dynamic lifeworlds (Jackson 2013) that have been, are, and will continue to be present, most especially as experienced by Indigenous peoples and beyond-humans. Possibly, material with which to forge new constructs of decolonial freedom (Simpson 2017) can be obtained through such imaginings and praxis, which can be understood to resemble resistance and resurgence—a kind of persistence that is evident in contemporary Indigenous presence. I find this theme present in the work of Nick Estes, “Our History is the Future” (2019), which represents a treatise of the relationship and reciprocity between a land and its people, revealing a continuance of resistance and renewal, and not just as acts of survival, but as actions of thriving, that I have also investigated through the observation of tribal leadership decision making, based on the activities, data, and products (GIS projects) provided as cases within this study.

Additionally, having extended and “flipped” the lens to observe for impacts—described by this study’s hypotheses—as evidences of technological influences—provided information that suggests occurrences of retirement, replacement, regeneration, and/or innovation of Indigenous knowledges. Engaging the two types of observation, as a method, I have opened the space to understand remote sensing landscape technologies as

means to influence decision making to not only sustain cultural lifeways, but which enables and empowers them to thrive within present day realities and hopes. I have been particularly interested in those impacts and influences revealed as developing IK philosophies into models of practice useful at both local and broader scales, that create actually observed mutual benefits.

Within the work of McCue (2022), specifically within his chapter titled, Social Media: The New Moccasin Telegraph, there are insights to observing digitally created media as evidencing being both beneficial and non-beneficial to Indigenous viewers. Culture, Control, and Connection are provided as beneficial elements of social media. These three are “uniquely Indigenous activities” engaged through social media forms. Expressions of cultural identity, language, and lifeways such as distinct recipes for meals, clothing and jewelry styles assist in passing on cultural knowledge. Control is represented by an ability to design and broadcast their own, Indigenous-derived and provided, stories. This also represents the creation of social media groups that are “members” only for Indigenous individuals per particular criteria for access. An example provided by McCue is the groups created to address Missing and Murdered Indigenous Women that invited responses to move policies and practices forward to address the lack of care and assistance from law enforcement, state and federal governments, and also data gathering. Connection is promoted as a benefit through providing means for kinship to be established and maintained with family and friends who are Indigenous but are not physically present in their Indigenous communities. This element is also seen as benefiting the perpetuation of language and culture-based knowledges, as well as

providing platforms for activities regarding a broad range of interests particular to Indigenous peoples and their lands.

Least beneficial elements observed for social media sites are fake news, lack of trustworthy processes to verify information. Included as an inter-group detriment of social media is the observation of “lateral violence” and other harmful activities such as over-sharing of personal information that can create spread of gossip, rumors, and falsehoods. A contemporary and burgeoning practice is the “outing of pretendians,” particularly public within First Nations Peoples with regard to academics. Additionally, through social media participation one opens themselves to acts of public racism and online bullying from non-Indigenous individuals and groups. This has created an ongoing fear of broader use of social media sites.

Information such as this just provided lends itself to understanding perspectives of utilizing methods of observation and observing-for participation that have increased understanding of the spatializing of narratives found within public media sites.

As the site and source of this study is a public social media digital form, the method of observation takes on a hub position for inquiry with tangential aspects as additional methods. As noted above, Observation-for Participation is enhanced with the additional method of inquiry through observation of Participant-Reflexivity, as a vicarious-based practice.

- Participant-Reflexivity

As an activity of gathering knowledge, participant-reflexivity reflects an important ‘turn’ within social science research, and as a topic of debate within methods discourse. Prior to

this turn, the focus of construction of new knowledge has been researcher-centered, which often subsumed or masked participant voices and their active role in interpreting their own thoughts, knowledges, and experiences (Riach 2009). Observation of stated and physical generation of knowledge as provided by the participants of a digital project is a hybrid activity for inquiry.

- Ground-Level Seeing

Unique to my style of making inquiry, is a method I refer to as “ground-level seeing”(GLS) that is akin to another method I utilize referred to as “Ground -Level Listening” (GLL). GLS entails seeing at a deeper level than even that practiced within forensic-style and or profile specific inquiries, of an analytic process. Within these there is an observation goal to enhance the level of seeing what may not be obvious. Akin to Ground-Level Listening, the focus and intention within GLL is that of listening to give space for “silence,” or “stillness,” as an intentional activity of the listener/researcher (Kaner 2007). This practice minimizes researcher centered response to enable a shift that centers on the participant-speaker, and acknowledges not all conversation needs to be in the form of dialogic exchange (Bakhtin 1975). GLS applies the same philosophy but in practice requires a neutral observation starting point, to just see what is to be seen versus looking for specific information first. This engages a Grounded Theory approach to gathering information. GLS, as method, is observed as a natural part of conversation within Indigenous communication, particularly when visiting with Elders and young children. Observing the speaker(s) and they within their contexts without imposing an agenda initially on what can be seen, is an act of care for what is being offered as

information, versus insisting information be shared in particular ways. This additionally engages the locative narrative (Ryan 2016) process whereby the researcher is not the expert in the room. In the work of Ryan et al they adapt the work of Fredric Jameson (1991) in what is referred to as the “spatial turn” and the “narrative turn” (207), with regard to geography, that has become Narrative Geography. To be noted, Narratology is not the interpretation of individual works but the exploration of regularities found in multiple narrative texts, and when coupled with geography, becomes Geographical Narratology.

- Self-Reflection and -Reflexive Journaling

“We know what we know from where we stand” (Kovach 2009:7). This statement provides a depth of meaning to the process of writing-about, as insight and as to the purpose for utilizing a method such as self-reflection and -reflexive journaling. It is a means to embody the act of self-knowing within the act of knowing-with. It is also a way of sustaining relationships within ourselves that utilize various senses as means to know. From an Indigenous worldview, this relationality “allows knowing to be an act of consciousness that reaches beyond the mundane into connections and alignment with an essence that finds its renewal through the generations” (Garcia et al 2019: 109). This method situates me, not only as researcher, but as also a participant in this study and positioned to contribute knowledge.

- Interpretation Check-Back: A Method of Reciprocity and Accountability

Per AIRW and those research designs that subscribe to the humanization of research practices, such as Margaret Kovach (2013) suggests, is not only a form of condensed

conversational method, but is also a crucial element of concluding stages of research, through a form of checking-back for further accuracy of information and to provide space for participant's voice and thinking regarding the larger message of what has been revealed through research processes.

Birth of a Way of Understanding: Newe Reasoning, a heuristic method

The creation, application, and continued development of the Newe Reasoning method of reasoning follows the guidance of An Indigenous Research Way (AIRW) (Freeman 2017, 2022), a continuous improvement model developed as a result of my Master's thesis work and further enhanced through its practice within my doctoral work. As stated earlier, AIRW model is akin to that of CBPR, promoted by Sonya Atalay (2012). Positioning it, as a continuous improvement model, invites practice of its philosophy and applied elements to provide additional benefit to a study, related to research design and practitioner use of an Indigenous Methodological framework.

Through a similar process, Newe Reasoning has its origins from information gathered through inquiries and Native Science experiences among various Shoshonean Peoples, along with those from various Indigenous Nations. That journey started in 2018 and continues today. The information, through my interpretation and use, has provided both theoretical and conceptual foundations for this analytic method. As this method attends to multi- and mixed-methods research approaches additional insights have been garnered from various heuristic standards in addition to ethnomathematics.

The foundation of New Reasoning is aligned with the understanding that Shoshonean ways of knowing and meaning making are ancient in origin and practice

(Parry 2019; Atencio 2019; Whitley 2013; Manning 2008; Patterson 2008; Adovasio 2002; Nabhan 1982; et al). Additionally, these Ways reflect a proactive attention to temporal realities that require enhancement of these knowledges to be beneficial within modern lifeways. In this way Newe Reasoning is a product of both traditional and adaptive responsive knowledges and systems of knowing.

We can understand this through the most recent public and grant funded work of five elders, facilitated by the Fort Washakie School Office of Indian Education, in Fort Washakie, Wyoming. The work of acknowledging a Shoshone Core Belief System and visually developing it within a Seasonal Round conceptual structure produced, in 2008, is a means to understand Shoshonean lifeways in terms of values and practices applied in contemporary daily life. These beliefs or values and associated practices are imbedded in my cultural knowledge base and way of Being. There are found shared beliefs that are similar in their philosophical and applied meaning that have also assisted with and are within the thought-space of Newe Reasoning.

Shared beliefs is a term that assists us in understanding the relational and interdependent structures found within various knowledges systems. Within my own MA thesis I assigned the term Duty of Care to the re-introduction of deontology to the standard research element of practice, axiology. As I shared previously, this was due to my interpretation of an imbalance within western academic processes of research design and practice, that paid little attention to being accountable as researchers.

This interpretation is found within several other modes of worldview applications, such as the 4Rs that Kirkness and Barnhardt (1991) introduced, these being Respect, Relevance, Reciprocity, and Responsibility. Cajete (2000) introduces his version of Rs

within Native American Education associated with STEM, referred to as Native Science that became part of a synthesis of Rs within a 2021 academic project to decolonize research methods. Within this work the rationale for development of Six Rs was stated as being to emphasize “the significance of decolonizing research methods in higher education and implementing the Six Rs’ guiding principles provides positive alternatives to systematic atrocities and injustices” citing the work and support of Baskin 2005; Cajete 1994, 1999; Deloria & Wildcat 2001; Harris & Wasilewski 2004; Kawagley & Barnhardt 1998; Kirkness & Barnhardt 1991; Kovach 2008; L. T. Smith 2012, and Wilson 2001, 2008. The Six Rs they noted are: respect, relationship, representation, relevance, responsibility, and reciprocity also citing Brayboy’s 2005 work with Tribal Critical Race Theory as contributing to the project’s conceptual framework. Within critical theories we also find a burgeoning work developed by a community of global Indigenous scholars in the form of F.A.I.R. and C.A.R.E. principles that also engage data sovereignty discourse.

F.A.I.R. stands for Findable, Accessible, Interoperable, Reusable and C.A.R.E (per the Global Indigenous Data Alliance) stands for Collective Benefit, Authority to Control, Responsibility, and Ethics. Both center the need for guiding principles for scientific data gathering and management as a stewardship of care. F.A.I.R. Guiding Principles were first published in Scientific Data in 2016. A synthesis of these were drafted in 2018, during the International Data Week and Research Data Alliance Plenary in Gaborone, Botswana, and co-lead by Stephanie Russo Carroll, from the University of Arizona and Maui Hudson, from the University of Waikato, Aotearoa New Zealand.

These guiding principles assist our understanding and applied ways of addressing uses of Indigenous knowledges as source of culture-based data. The access to these is hotly debated within the use of remote sensing and GIS technologies. Attention to these principles within a Reasoning method is crucial to implementing Indigenous perspectives of research design and practice, as they weave in social and environmental injustice issues and provide means to recommend pathways for corrections. The inclusion of social and environmental injustices with regard to Indigenous lifeways brings us full circle to the crafting of an appropriate research methodology that also requires development of a congruent analytic tool. This respects the processes of Indigenous knowing, being and doing. Recently, new work has been presented by scholar Bryan Brayboy in his paper *a New Day* (2021), that addresses these as practices within academic models of stewardship, meaning care of knowledges.

With regard to share worldviews and values appropriate for public use, there is need of care for the opinions and requests of the holders of these knowledges. “The institution values knowledge as a noun, something that is on a page or a thing created in a lab; too often one-dimensional ... [Indigenous perspectives view knowledge as being] ... what people and peoples embody” (Brayboy 2021:6). This helps us to understand the relationship between sources of knowledge and people of these knowledges as systems to be protected. For these reasons specific details about what *Newe Reasoning* embodies is not provided, as it is a personal context-based and responsive method. What can be shared is what I have provided that is in the public domain related to various worldviews that attend to the need for care to be taken with access and use of Indigenous knowledges and ways of knowing them. What is an important element of *Newe Reasoning* found

within global academic discourse and acknowledged as culturally derived is ethnomathematics.

Ethnomathematics, with respect to the 1987 coinage of the term, and work of founding scholar Ubiratan D'Ambrosio, a Brazilian mathematician, whose perspectives provided consideration of mathematics as a way of generating, organizing, and diffusing knowledge created by diverse cultural groups (Rosa, Shirley, Gavarrete, Alanguí 2017). Within a study such as I have accomplished, ethnomathematics figures largely as a reasoning fulcrum due to *The Role of Culture and Ecology in Visuospatial Reasoning*. This is the title of a paper by Kay Owens (2017) that expounds on the cultural impacts that ethnomathematics plays to critically understand the role that language and environmental philosophies play within visual reasoning processes, such as methods of observation to assess video and other digital media.

Donald L. Fixico (2012) shared his understanding of shared ways of being through describing characteristics of Indigenous thinking. He stated that these ways are deeply contextual and holistic and are considerate of all the aspects of a topic as an environment of interest and study. That seeing all of the ecologies, as a totality of an environment is the source of traditional knowledge, and the construction of the ways to see and know are essential to understanding ways of Being part of an environment.

The idea and belief that land and its landscapes as embodiments of relation-based knowledges is not solely an Indigenous stance. Leading non-Indigenous anthropologists and archaeologists like Keith Basso, who in the 1980s began academic conversations regarding landscape relativity and through such works as *Wisdom Sits in Places* (1996), brought broadened attention to Indigenous perspectives. Engaging this discourse,

Tim Ingold put forth reflections, with such as landscape is “the familiar domain of our dwelling, it is with us, not against us, but it is no less real for that. And through living in it, the landscape becomes a part of us, just as we are a part of it” (2009:191).

The sentiment was also found in the work of Diane L. Teeman (Northern Paiute), a seasoned professional in the field of CRM, provides additional consideration of such questions as I pose throughout this dissertation. Teeman states (2008:628)

landscape is the keeper of our history. The acts and events occurring on the landscape become part of it. A component of the people who were part of those acts and events is forever intermingled with those places; in effect, an action on a landscape is also an action on not only prior acts and events but also the people who were involved in those activities....Because of this fact, we are the landscape from which we came and will each someday return, Our success at protection of important places is vital to this cycle of individual life and death, and the health and wellbeing of our communities depends on our ability to actively participate in a healthy relationship with our lands.

Utilizing IK, IKS, and ITEK alongside western-based technology is emergent and seemingly beneficial, both locally and broadly, if this pairing moves beyond exclusionary methodologies and sustainable-only objectives (Dearden and Mitchell 1998; Ramphal 1994; Courrier 1994), toward transformational and regenerative thinking (Wahl 2017; McGregor 2004), which is a distinctive aspect of Indigenous knowledge approaches to gain understandings of the world.

The work of Barta and Shockey (2006), among the Ute Tribe of Utah, prompted my curiosity about Indigenous analytics. After visits with both these scholars, I perceived a usefulness of their findings within my own research design. It provided the inspiration

and need to develop an analytic method based on my own culturally-based philosophical beliefs about Native Science and its practices. This situates me, as an Indigenous researcher for this project, as respecting a primary tenant of Indigenous Methodological research, this being the centering of Indigenous knowledges, and my relationship with them.

Additionally, Uteonian reasoning and interpretation requires assignment of numerical values to otherwise qualitative information to enable a quantitative understanding as a result. Ute elders contend it is the naming of a value that is unique to this system of knowing and reflects a process of daily use (Barta and Shockey 2006). In this way, quantitative expectations of data go beyond STEM measurements, through assignment of culturally-inspired mathematical values. Assessment through this method has provided such as, number of times IKS and ITEK were/were not held intact or were altered, and also provides a level of rationale for why this occurred and may/may not have been necessary, as well as factors influencing behaviors. This method extends the use of Bayesian analytics within the assemblage of Newe Reasoning. Bayesian process is a heuristic interpretive model that bridges the objectivist concepts of such as archaeological research and that of interpretation of objects that evoke their meanings through searches for inferential patterns (Cowgill 2015; Beach and Pedersen 2013; Schulte-Mecklenbeck 2011). It is used increasingly within landscape archaeology to access and regenerate culture-based knowledges and assess their “usefulness” in the present. Collectively these tools reveal the complexity of human behavior in decision-making that reflects cultural variations in present societal structures.

As well working within STEAM (science, technology, engineering, arts, and mathematics, with arts reintroduced to STEM) places equal value on the learning process, especially that which engages heuristic—experiential—methods. Newe Reasoning in partnership with a Native Science methodology retains essential elements of investigative rigor, thus is consistent with current educational theories about culturally sustainable pedagogies. Indigenous concepts of knowledge relationality and interdependence are effective within Indigenous research contexts. This is crucial to remember when incorporating STEM-field subjects into Indigenous student learning, for optimal success. Additionally, Indigenous futures are more fully visible through understanding how culture-based knowledges, generationally conceived, are applied in the present.

More technically and broadly, Newe Reasoning as a method addresses the lack of a consistent and congruent methodology of research practice, this being the inclusion of an Indigenous analytic model, when utilizing an Indigenous Research Methodology (Kukutai and Taylor 2016; Lone Fight et al 2015; Walter and Anderson 2013; Johnson and Larson 2013; Christie 2006; Wickson, Carew, and Russell 2006; et al). In this way, creation and use of this analytic method is an act of further decolonization of impeding western-based research practices that represent persistence in refusing Indigenous ways of knowing, being, and doing (L.T. Smith, Tuck, Yang 2019). Additionally, it can be understood as part of the much needed work of decolonization as well as Indigenizing of particular present researcher praxis, (Styres 2019; Johnston 2019; Paris and Alim 2017; Grande 2004, 2015; Battiste and Henderson 2000).

The innovative development of the Newe Reasoning method has been complex, but I have not been without assistance. The creation of it had already begun and engages a cross-cultural collaboration of Shoshonean ways of knowing and making meaning integrated with broad quantitative elements represented in shared belief systems found within ethnomathematics, and with specific mixed-reasoning elements from two western-science based analytic processes, these being: Actor-Network Theory (ANT), and Process Trace that partners with Bayesian Method. The interweaving of these ways of knowing represents not only a culturally integrative, but also a transdisciplinary means of interpretation of data (Brandt et al 2013; Johnson and Larsen 2013; Wickson, Carew, and Russell 2006; Christie 2006; et al).

Both the results of employing AIRW and the development and use of the Newe Reasoning model—both as continuous improvement models of research design and practice—represent transformative possibilities for use of Indigenous Research Methodologies and Methods and are derivatives and added value of this research process and dissertation, that is also provided as a teaching tool.

Operationalizing the various values, as worldviews, coupled with Indigenized science practices and theories created the practice of Newe Reasoning, as a heuristic tool for analysis that, I utilized to interpretate the data gathered through the various inquiry methods noted previously. Aside from attending to the specific questions of this study I also sought, overall:

a. To understand educational *approaches* utilized among both Indigenous students and educators, that relate to STEM-based subjects, specifically Technology, and its use with

Indigenous Traditional Ecological Knowledges (ITEK) in the form of remote sensing and use of GIS;

b. To understand approaches utilized to gauge levels of Indigenous student and educator ITEK, prior to and following their receipt of formal/informal ITEK/STEM-based, technology related, training.

Overall the application of Newe Reasoning, within this multi-methods study and as an analytic method provided intentional hybrid conceptual Level Two (Yin 2018) inferences as an analytic generalization (qualitative argument) that has basis within both a) corroborating, modifying, rejecting, and/or advancing the recommendations found within the cited works of Supernant, Lone Fight, Wessels, Sanger and Barnett, and Nesvold, and b) new concepts arose, through engagement of aspects of Grounded Theory as a method of inquiry. Quantifying data gathered through this study is represented in the assembly of the various cases (in Chapter 4), but analyzed as a collective of information generalized as a “case study” and not as representing an individual case. I share the results of the practice of Newe Reasoning within this study in Chapter 5.

WATSUWI (Chapter) 4

Oo soo neek

... AND SO, THIS IS THE WAY OF IT ...

Wayfinding:

The research I have engaged is one that employs philosophies found within cartography—being broadly the practice of compiling information about a landscape, interpreting it, and presenting it in ways that guide and assist. Within this study, from an Indigenous perspective, I also looked for liminal spaces within sites of perceived progress and benefit, that upon closer review, reflect overshadowed and or subsumed concerns, but also opportunities. Such spaces have been revealed among Indigenous peoples where they are learning and teaching about, supportive of, and subsequently utilizing technologies associated with their lands—which are and contains sources of their cultural knowledges.

The overarching interest of my study has been to seek understanding of what impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) occur as a result of use of remote sensing and GIS technologies within tribal landscapes. After accomplishing preliminary research on this topic—whereby numerous thoughts and concerns were collected along with the academic literature review—I refined my study intentions to focus on the topic of: Understanding Impacts to Indigenous Traditional Ecological Knowledges (ITEK) and Indigenous Knowledge Systems (IKS) from use of remote sensing and GIS technologies within tribal

landscapes. This is further characterized by defining these impacts as being beneficial influences (null hypothesis, per the evidence of tribal participation and measured by Newe Reasoning heuristics and key scholar recommendations) and/or non-beneficial (per the same measurements) influences on Indigenous practitioners of these technologies, and also on tribal leadership decision making regarding cultural heritage and resource use and management.

What follows is information, as reference, for the Case Study method of approach engaged to review 73 public tribal GIS projects occurring in 2017 through 2021. I also provide discussion of Landscape Archaeology and GIS as frameworks for the projects, a summary of the site host ESRI, and the StoryMap program for the Tribal StoryMap Challenge as context-related information.

Landscape Archaeology and GIS

Landscape archaeology, today, as previously stated, is an appropriate forum for understanding impacts of technology on Indigenous ways of knowing and more so when coupled within Geographical Information Science (GIS) and its more popular GIS definition as being Geographical Information *Systems*, with use of digital spatial data gathering and mapping tools, and is further supported by the early use of Tribal Nations (Taylor, Gadsden, Kerski, Guglielmo 2017).

“Historically, concerns with space and landscape have appeared on the archaeological agenda at times when difference, variability, and plurality have been at issue“ (David & Thomas 2016:25). Landscape as an archaeological endeavor has evolved in the last twenty years to become defined by the specific context it is utilized with versus

solely associated with a physical place that is impacted by human interactions. Today landscape definitions typically include being within broad ecological relationships that require addressing not only temporal states, but also scale. Smaller and regional emphasis brought attention to the work of Ian Hodder, who in the 1970s inspired discourse around spatial distributions within culture. This led to a deeper interest of this topic in the mid-1980s that implemented his influence on a “new kind of social archaeology ... [with a distinct focus on] not so much *adaptive (biological) humans as interacting (social) people* who engaged with their surroundings in various ways” (David & Thomas 2016:32).

The industry of CRM (Cultural Resource Management), as venue for applied archaeologies, was primed already to engage a broad work within the public through what landscape archaeology offered. The extension and evolution of the archaeological endeavor of “salvage” or “rescue,” particularly the work of cultural heritage assessment, became more inclusive of social dimensions of this work. A particular “dimension” has been inclusion of the symbolic and phenomenological elements that has led to an ethnographic form of archaeology now known as ethnoarchaeology. Acknowledgement within academia of the absence of Indigenous voices regarding their own perspectives about lands and landscape further broadened the reach of landscape archaeology as not only a scientific but a social enterprise that required attention to both as a synthesis for making-meaning and interpretation of lands-based projects. This provided a necessary “retreat from the more extreme positions of processual archaeology, and its demand for universal laws of human behavior” (David & Thomas 2016:35) and with an increase in the number of Indigenous archaeologists entering the field ethnological and

ethnographical methods and critiques became a point of influence for the study and application of landscape archaeological practices (Langford 1983; Rose et al. 1996; Watkins 2000; Lane 2016, and McNiven 2016). Use of ethno-methods provides a place for understanding context as prevalent within the “language of land” and that interpretation of such requires multi-vocal spaces.

When looking towards interpretation we enter the contemporary realm of spatial technologies that interface with those that assist in coding and assembling information as data. Overlay this activity with the social influences of being human, we are asked to engage the realm of ethics of access, storage, and distribution of data that has been gathered per specific intentions for specific agendas.

The act of research includes attention to ontological and cosmological realms that contribute to research ethics. The elements are core to understanding and working with Indigenous Research Methodologies and Methods, as Indigenous knowledges are centered and with them the People of these knowledges. Landscape archaeology also situates people-in-relation as its core purpose. Overlay the technologies of remote sensing and GIS there is a case for understanding the intentions of people within their landscapes, and the impacts that result, as “it would be rash to assume that our mapping practices are value-free or ideologically neutral” (Byrne 2016:609). Maps not only assist us in understanding geographical realities, they are party to creating realities (Byrne 2016; Borgmann 2012; Sandler 2012; Walter and Anderson 2013). Mapping has been an influence, and as such complicit, in western expansion and the colonial enterprise (Shamir 2020; Pennock 2019; Lowe 2015; Byrd 2011; Hall 2005; Lilley & Williams 2005; McNiven and Russell 2005; Meskell 2005; Smith 2005; Ingold 1992; Pratt 1992;

Carter 1987; Heidegger 1923). Maps, as visual aids, are an important element of our understanding of landscapes and their histories, present-day presence, and for consideration of the future. What influences our perceptions of landscapes and they as being in-relation to self is often first experienced through visual faculties and also media forms.

Geographical Information Systems, or GIS, is an increasingly important technology within the field of Spatial Information Systems (SIS). Again, “GIS is a sophisticated database management system designed for the acquisition, manipulation, visualization, management and display of spatially referenced (or geographical) data” (Chapman 2009:14). SIS, per ESRI 1995, is

An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

Technically, GIS currently utilizes two types of imaging systems: vector and raster.

Vector systems store data per points, lines and closed polygons “dropped” as markers of a geographic site in terms topology that looks at space and relationships between points.

Raster, works with data in terms of it being made up of various cells of information, such as color/shade, with each block of cells viewed both as a group and as individual blocks of details based on the value or attribute assigned to it. This creates a multi-dimensional grid with numerical values representing a modelling scheme. Both vector and raster systems work together to create a map with a variety of viewing options and related data.

GIS, being a software-based data analysis tool, is also a procedure within the field of archaeology that relates to three primary areas: methods, interpretation, and management and are often combined into a single theme of research. Another area,

spatial statistics, is yet being incorporated in evolved ways, and is closely associated with management of data, and this is through predictive modelling, related to site locations (Harris and Lock 1995). Predictive modelling is a debated method, however it has some relevance within theoretically positioning data. Within landscape archaeology, GIS has most often been utilized in three core ways: data for the archaeological record in the form of physical artifact locations and features descriptions of landscapes in terms of ecologies residing on the landscape. The third is an integration of these two (creating both quantitative and qualitative approaches) that brings a humanistic balance to understanding data derived from GIS means. Tilley (1996 and 1994), Thomas (1993), and Devereux (1991) all agree that measurement of experiences with landscapes is through visibility patterns, to include areas of perception and cognition (van Leusen 1999) and how landscapes influence these perceptions (Van Dyke 2008; Zubrow 1994). GIS provides the technology for assisting with these measurements and providing data in forms that can be interpreted for causal and or inferential meaning-making. This aspect is often a criticism of the potentials for use of GIS within landscape archaeology, as its “abstract nature” is perceived as being environmentally deterministic (Gaffney and van Leusen 1995). GIS assesses the measurable aspects of landscapes and as such may determine interpretive processes (Chapman 2009). This criticism is argued by Llobera (1996), and supported through social cultural theories (Cuculelis 1999), as being an underestimation and or over-simplification of the activities of the GIS practitioner. How a practitioner of remote sensing and GIS technologies determines what data to gather and the interpretation of it are both intentional acts and agenda-laden. Where does

interpretation cross-through the relationship of the data gatherer with those utilizing it? A term and practice engaging questions such as this is, counter-mapping.

How a person sees themselves in relationship with data about a landscape introduces a cultural and subjective element to the production and use of mapping technology, and when incorporated creates a “counter” to current maps that objectify landscapes as objects and things to be observed. “The term *counter-mapping* has been adopted for what might be described as the tactical deployment of cultural mapping” (Byrne 2016:609). This intentional inclusion of a people and their presence on a landscape provides correction of data and physical maps. Situating mapping as a strictly colonial endeavor erases the ancient science of Indigenous Peoples in placing themselves within their landscapes. Further to be considered, are the intentions of the map maker that might produce activities that align with colonial methodologies and methods, described as being without consideration of mutual benefits to the land and its peoples. When Indigenous people are the practioners of spatial scanning technologies and GIS derived data interpretation is there a guarantee that mutual benefit will occur? What influences would negate such sensitivities? Contextualizing data with social values requires understanding the operation of the technologies employed to gather the data. Use of the machines and software is also bound by the level of technical knowledge of the practioners as well as their level of cultural knowledge about the landscapes as sources of the data. How has technology and the training to its use impacted the way landscapes are seen, particularly by the Indigenous Peoples whose cultures and cultural identities are constituted from these landscapes. Have shifts in this “seeing” created a shift in the

cultural attributes of the people? Has this then created a dynamic shift within the relationships between people and their lands?

Today there are several training partners for Indigenous Peoples to choose from to gain skills with remote scanning and GIS technologies. Among them the early forerunner ESRI, and it as being a contractor for the U.S. Federal government to deliver training to federally recognized tribes in the United States.

Who is ESRI?

As of January 2023, per their public [website](#) , the Environmental Systems and Research Institute (ESRI) states it is

The global market leader in geographic information system (GIS) software, location intelligence, and mapping. Since 1969, we have supported customers with geographic science and geospatial analytics, what we call The Science of Where. We take a geographic approach to problem-solving, brought to life by modern GIS technology. We are committed to using science and technology to build a sustainable world.

Founded in 1969 by Jack and Laura Dangermond, ESRI is a privately held corporation with its global headquarters located in Redmond, California and is best known for its ArcGIS software. Theirs was a vision for technology to assist with decision-making to address a needed balance between human development and a need for more mutually beneficial environmental stewardship. Both Dangermond are alum of Harvard and the Lab for Computer Graphics and Spatial Analysis, with an emphasis on mapmaking software. Their first contracts provided environmental studies for land-use and planning projects through digital mapping and spatial analysis.

ESRI has 49 offices located throughout world and eleven research and development center with over 5,000 employees, and is a \$1.1 billion business. Its clientele range from non-profit and or non-governmental organizations throughout the world, Fortune 100 companies, national and local governments—including all fifty states in the United States, and ArcGIS is utilized within 12,000 universities worldwide.

As a geoscience-focused company their popularity has grown with the global issues of climate change, sustainability, and social and economic inequality. Their vision is to empower all organizations to embrace a geographic approach to holistically understanding the interrelatedness of these issues through integration, through multidisciplinary avenues, of diverse information sources. Their vision is that “together, we have the power to transform society and design a better, more sustainable future” (ESRI 2023).

In 1999 ESRI introduced ESRI ArcMaps and in 2019 launched a revised and evolved platform for storytelling through maps called ArcGIS StoryMaps. The previous version is no referred to as a “classic storytelling template” with ESRI now requiring all platform users to convert to the ArcGIS version. ArcGIS StoryMap software utilizes GIS derived data, as various mapping tools and visuals, that supports applications of text and audio narratives. This creates original digital and interactive stories that can be published and shared.

ESRI ArcGIS StoryMap Challenge for Tribes

Tribal Nations have been early “customers” of ESRI remote scanning and GIS training and products (Taylor 2017). Tribal participation is related to a desire and need for

understanding their environments better through accessing various information to inform their management decision-making and solutions-inspiring strategies. Most of this activity involves conservation and protection of their landscapes, addressing needs for managing infrastructure and natural resources, history, language, and cultural knowledges re-generation, and health and wellness related issues.

Promotional and funding partners such as the National Preservation Institute have worked with the Department of the Interior in providing access to consultation with experts as both trainers and practitioners, and of the physical technology and training for federally recognized tribes. In 2017 ESRI launched a StoryMap Challenge for tribes to share their stories of use with GIS, mapping, and as a cultural knowledge perpetuating endeavor. The themes from year to year are slightly different and address national issues, but are promoted as being locally relevant (ESRI 2022).

In creating a StoryMap ESRI provides tutorials and templates for the development of a StoryMap and also includes “five principles of effective storytelling.” These principles are: Audience suitability, Appeal, User experience, Easy-to-read maps, and Simplicity of the story. The first asks for consideration of who your audience will be. The second addresses why, what, and where questions a viewer might have regarding the topic and landscape presented. The third principles is the more technical of the five and requires understanding the StoryMap tools availability and matching these with the intentions for creating a map. The fourth provides advice and tips for utilizing interactive tools for the viewer to access to gain a richer and more concise experience with the map. The fifth principle is another tips section about overall review of the draft map and how well it provides simplicity of use and readability and clarity of the message wanting to be

delivered through the map. These principles are primarily mainstream evaluation methods for the map maker. I share in chapters 5 and 6 the integration of these principles with the Newe Reasoning tool developed for this study.

ESRI promotes StoryMaps as additionally useful within STEM classrooms, to promote interest in and thinking through and with geoscience and spatial systems, as a means to visualize data and add context through narrative elements.

The Projects of this Case Study

The approach taken for this research is Case Study and engages defining the “case” being studied in terms of context and data to be gathered. Primarily utilized within qualitative studies, this approach is useful as it provides an enhanced intensive and context-bound quantitative analysis through an exploratory form of inquiry, per bounded measurements determined in the scope of the study that when assessed through data analysis has provided themes, patterns, and issues presented through interpretation of the data. Case Study as a research approach utilizes a multi-methods application of inquiry and analysis. Quantitative data is generated as well as Qualitative through assessed audio and visually narrative texts. This approach is often referred to as a “triangulation” methodology that provides structure for in-depth, rigor, and comparative data gathering and analysis of 73 public tribal GIS projects occurring from 2017 – 2021. I provide here a list of the projects within my Case Study, as well as a weblink for direct access to the ESRI site and public project information. Also please note: with the analysis of each project I am coding each so as to respect AIRW approach to use of specific identifiable information regarding tribal communities and their landscapes, even though the information is provided by

tribal project staff within publicly assessable formats. This decision is made per an ethic of acknowledging tribal data sovereignty and as this study did not engage inquiry methods of personal contact it is appropriate for me to make such a decision to code data that I assess and comment on further. Of note, is that per literature review and various conversations with Indigenous data sovereignty ethicists there currently is no scholarly guidance about whether to code information or not, that is provided within publicly accessible social media sites directly by Indigenous and or Tribal identifying individuals or Nations. I engage this conversation further in chapters six and seven.

Additionally, some information has been removed from the ESRI site since the time I first reviewed and accessed it, and is no longer available. The reasons for this are not known to me, at the time of writing this dissertation.

Main Esri Site:

<https://www.esri.com/en-us/industries/government/departments/tribal/tribal-challenge/overview>

Within the Menu of this site is a Gallery section, there you will find the various publicly available project details per year.

2017: 9 projects

Colville Confederated Tribes and the White Mountain Apache Tribe, Cedar Fire
“BAER Cedar Fire StoryMap”

Note: BAER is the Burned Area Emergency Response team that operates out of the U.S. Department of the Interior and Indian Affairs Office. Teams are assembled as needed and composed of specialists within the location and contexts of the area to be assessed. Team members do on-site assessments and provide written treatment recommendations that subscribe to tenets that emphasize protection of life, health and safety, critical cultural and natural resources, and infrastructure.

In this project members of the Colville Confederated Tribes were part of the BAER team and provided the creation of the StoryMap and submitted it to the ESRI Tribal Challenge.

Agua Caliente Band of Cahuilla Indians

“The Trails of Indian Canyons”

Samish Nation, Washington State

“Marine Debris Clean Up in Samish Traditional Territory”

Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

“Birch Creek Watershed Action Plan”

Ho-Chunk Nation

“Ho-Chunk National Hunting Lands”

Nisqually Indian Tribe

“Nisqually Salmon Recovery and Climate Change Adaptation”

Tulalip Tribes

“Sustaining Treaty Resources: Tulalip Natural Resources Projects”

Pyramid Lake Paiute Tribe

“Virginia Mountains Complex”

Spokane Indian Reservation

“Baer Cayuse Mountain Fire”

2018: 15 projects

Samish Indian Tribe

“Our Future Climate in Samish Traditional Territory”

Native Village of Georgetown

“Life along the Kuskokwim”

Coeur d’Alene Tribe of Indians

“Come Visit the Community Garden”

Seminole Tribe of Florida

“Seminole Tribe of Florida Attractions”

Seminole Tribe of Florida

“History Washing Away”

Prairie Island Indian Community

“Wild Rice – Psin”

Burns Paiute Tribe

“Mule Deer-Vehicle Collisions in Eastern Oregon”

Cherokee Nation

“Remember the Removal”

Confederated Tribes of the Colville Reservation

“Invasive Plant Species Impacts Natural Resources”

Pueblo of Sandia

“Wildfire Risk Potential Study”

Agua Caliente Band of Cahuilla Indians

“Indian Canyons Golf Resort”

Morongo Band of Mission Indians

“Morongo’s Journey & Economic Success”

Coeur d’Alene Tribe

“Coeur d’Alene Tribe UAS Program”

Santa Clara Pueblo

“A Journey Toward Establishing Forest Resiliency”

Hoopa Valley Tribe

“Cannabis Farms Could Leave Salmon Runs Smoked”

2019: 21 projects

Confederated Tribes of Grand Ronde

“Tribal Treaty Area”

Red Lake Band of Chippewa Indians

“Indian Land Cessions in Minnesota”

Seminole Tribe of Florida

“A H.E.R.O. for Tribal Heritage”

Samish Indian Nation

“A Decade of Disappearance”

Saint Regis Mohawk Tribe

“Removal of the Hogansburg Dam”

Confederated Tribes of The Colville Reservation

“Confederated Tribes of the Colville Reservation A Brief History”

Confederated Tribes of The Colville Reservation

“2018 Woolsey Fire”

Confederate Tribes of The Colville Reservation

“Mendocino Complex Burned Area Emergency Response”

Confederated Tribes of the Umatilla Indian Reservation

“Meacham Creek Watershed An Effort to Bring Life Back to a Floodplain”

Confederated Tribes of the Umatilla Indian Reservation

“Lidar Guiding Salmon Restoration in Washington’s Tucannon River Basin”

Seneca Nation of Indians

“Cattaraugus Territory – Invasive Plant Monitoring”

Seneca Nation of Indians

“Allegany River/Reservoir restoration and resiliency Project – Funded by the NFWF”

Pueblo of Sandia

“Community Enhancement Initiatives”

Hoopa Valley Tribal EPA

“Cannabis Farms Could Leave Salmon Runs Truly Smoked!”

Yakima Nation Fisheries

“Yakama Nation Harvest”

Coeur d’Alene Tribe

“It Gallops on Wood”

Twenty-Nine Palms Band of Mission Indians

“Using Satellite Imagery to Manage Tribal Lands”

Twenty-Nine Palms Band of Mission Indians

“Theresa A. Mike Scholarship Fund Story Map”

Stockbridge-Munsee Community Band of Mohican Indians

“Stockbridge-Munsee Community Band of Mohican Indians -Who We Are”

Stockbridge-Munsee Community Band of Mohican Indians

“Stockbridge-Munsee Community Band of Mohican Indians – Programs Overview”

Stockbridge-Munsee Community Band of Mohican Indians

“Stockbridge-Munsee Community Band of Mohican Indians – Restoration Projects”

2020: 15 projects

Samish Indian Nation

“Our Future Climate in Samish Traditional Territory”

Karuk Tribe Department of Natural Resources

“ku’kuum ya’v nukyaati peethivthaaneen (We make the World Good Again)

Snoqualmie Indian Tribe

“Lake Sammamish”

Samish Indian Nation

“Marine Debris Clean Up in Samish Traditional Territory”

Samish Indian Nation

“A Decade of Disappearance: Bull Kelp in the San Juan Islands”

Pueblo de San Ildefonso

“Po’woh’ Geh’ Owingeh and the Manhattan Project”

Confederated Tribes of the Colville Reservation

“Confederated Tribes of the Colville Reservation: A Brief History”

Choctaw Nation of Oklahoma

“Chiefs of the Choctaw Nation of Oklahoma”

Tulalip Tribe

“Snohomish Floodplain Acquisition Strategy, 2018”

Nez Perce Tribe

“Restoring the South Fork Salmon River”

Seminole Tribe of Florida

“As the Tribe Grows, We Grow!”

Shakopee Mdewakanton

“Minnesota Greater Metro Drinking Water”

Coeur d’Alene Tribe

“The Restoration Partnership”

Squaxin Island Tribe

“Sea Level Rise in the South Salish Sea”

Twentynine Palms Band of Mission Indians

“Tribal Air Monitoring Program”

2021: 13 projects

Keweenaw Bay Indian Community Natural Resources Department

“Brownfields Tribal Response Program: A Tour”

Navajo Nation

“Navajo Safe Water: Protecting You and Your Family’s Health”

Snoqualmie Tribe

“Finding reciprocity in Restoration”

Confederated Tribes of Grand Ronde

“Invasive Species Monitoring on Tribal Lands”

Tolowa Dee-ni’ Nation

“Selling Stolen Land – Unceded Territory of Tolowa Dee-ni’ Nation”

Samish Indian Nation

“Samish Indian Nation Timeline – Since Time Immemorial”

Samish Indian Nation

“Partnering to Save the Endangered Oregon Spotted Frog”

Samish Indian Nation

“Coast Salish Place-Names of the San Juan Islands”

Samish Indian Nation

“A Decade of Disappearance: Bull Kelp in the San Juan Islands”

Yankton Sioux Tribe

“Yankton Sioux Tribe COVID-10 Community Recovery Efforts”

Confederated Tribes of the Colville Reservation

“Confederated Tribes of the Colville Reservation – A Brief History”

Twenty-Nine Palms Band of Mission Indians

“Trails and Tribulations: Stories of Transition and Resilience in California’s High Desert”

Pokagon Band of Potawatomi Indians

“Bnewi ga bye zhewebzeyak”

In the next chapter I provide the story of my analysis and results. A discussion of these results is provided in Chapter 6.

MANAIGITE
(Chapter) 5

**REVEALING KNOWLEDGE
Through
NEWE REASONING**

Oo soo neek

... AND SO, THIS IS THE WAY OF IT ...

Wayfinding:

Still applying the AIRW research design and practice model, we find ourselves at the write-up stage of the results of my study, that is an expression of Indigenous perspectives and voice, and of “giving back” through the notice, attention to, and acknowledgement of the various tribal GIS projects. Here the focus is on communication in good ways that attend to considerations of interpretation and representation of the information gathered and assembled as data to be analyzed, or measured, and reasoned with and about, per the topic and questions of this study.

What follows first is a brief recap, per the recommendation and style of Medin and Bang (2014), whose work also follows a StoryWay that builds relationality through communication done in good ways that takes care of the listener and reader. In this way, I remind you of the results of this study and dissertation process so far. This process includes what my conceptual framework, methodology, and choice of inquiry methods are so as to provide understanding of the analytic techniques and processes I have applied. I then focus on the results through both quantitative and more qualitative and

narrative means, and conclude this chapter with a summary of Understandings, as prelude to the Discussion of this information in the next chapter. All told, this chapter represents a Results Story.

The Journey So Far ... A Results Story

As you have been reading each chapter of this dissertation, hopefully in sequence per my request as I use a StoryWay of sharing information, you have also been learning about and experiencing the An Indigenous Research Way (AIRW) continuous improvement model for the design and practice of this study. In Appendices _1a & b_ I share the process map for this dissertation and it as being in relationship with the 2021 AIRW map of research design and practice process elements. As I shared previously, in Chapter 6 I will also discuss use of the AIRW within my doctoral research and dissertation work for improvements to its design as a model for research design and practice per IRM&M.

It is now time that I place the Talking Stick on my lap and reflect on our journey so far. As I stated, this is a story about results. Here, I provide a narrative summary as an outline and map to how and why we arrived at where we are now:

Abstract (this was written last)

Chapter 1: Semie' - Introduction (this was written second to last)

- Includes part 1 of my positionality statement.
- Summary of the dissertation journey.

Chapter 2: Waharewe - Background

- Continuation with part 2 of my positionality statement, that provides insight to my Self-in-Relation:

- Origins of interest for my research Topic and initial question, were shared through personal experiences, insights, and thoughts.

This led to an exploratory process that identified “interested parties.”

- An 18 month exploration, through conversations and discussions, with interested parties related to learning about what impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) exist from use of remote sensing and GIS technologies within tribal landscapes. When information was assessed and coded, it revealed five areas of concern related to the topic and initial question about impacts. The five areas were:

1) Security of data derived from use of GIS and remote sensing technologies and issues of Data Sovereignty.

2) Concerns about levels of Understanding and Uses of IK, ITEK, and IKS and as associated with land-based technology use among Indigenous students, educators, and tribal leadership.

2a- Assumptions about level of IK among Indigenous students in K-12.

2b- Assumptions about level of IK among Indigenous students in higher education.

2c- Assumptions about levels of IK among Indigenous Educators.

3) Concerns about level of IK and associated protocols of Practitioners utilizing land survey technologies.

4) Potential Indigenous Practitioner Concerns: Promises of employment and consistent employment opportunities, through participation in learning and skills-building associated with STEM-based subjects.

5) Indigenous Practitioner Concerns: Job skills and training that are not currently or particularly relevant within tribal communities.

- Additional questions were developed from this information and when assessed with the previous information, re-coded, and synthesized three primary themes were revealed, these being:

- Education, with an emphasis on Native American Education, particularly regarding the relationship between humans identifying as Indigenous and their cultural landscapes, associated with perceptions about access and public use of Indigenous Knowledges, related to drivers of this education within STEM-based fields, and associated industry partners;
- Technology, related to the Education theme with regard to Indigenous Practitioner training and use of remote sensing and GIS technologies within tribal landscapes, and;
- Tribal Leadership Decision-Making, related to the influence of these technologies upon tribal practitioners through their provision of data results and recommendations, and this then influencing tribal leaders decision-making pertaining to cultural heritage and natural resource management within their tribal landscapes.

From this process and results, I realized three key things: 1) that the process of AIRW, engaged as the initial Self-in-Relation element, as applied to myself assisted with identifying who I considered “interested parties, and as a collective group we represent a “system of interest” (Medin and Bang 2014); 2) The results of this process, being identification of five themes of concern, revealed that “impacts” needed to be explored as being both beneficial and or non-beneficial per the statements and observations I, and other interested parties, had made thus far; 3) These five themes provided a guide for the standard Literature Review process per this study’s topic.

- The Literature Review revealed gaps in scholarship related to this study’s topic and questions, and produced the goal for this research and assisted in development of a null and an alternative hypothesis. These are:

Goal: To *Understand* impacts to IKS and ITEK from use of remote sensing and GIS technologies within tribal landscapes.

Related to this goal is the repeat of advice provided previously and by Leanne Betasamosake Simpson, a Michi Saagiig Nishnaabeg woman, a member of Alderville First Nation, and scholar of Indigenous pedagogy. These words are from her 2017 book, *As We Have Always Done: Indigenous Freedom through Radical Resistance*.

...Indigenous education is not Indigenous or education from within our intellectual practices unless it comes through the land, unless it occurs in an Indigenous context using Indigenous processes” (154).

This laid the foundation for this research as being land-human relationality and interdependence, and situated the topic and questions for development of hypotheses, being:

Null hypothesis: The observed positive impacts occurring to IKS and ITEK with the use of remote sensing and GIS technologies reflects the voluntary use and participation with these technologies. The understanding I have situates this observance as that this use provides more positive influences, than negative, to Indigenous practitioners and tribal leadership decision- making regarding cultural heritage and resource use and management that provides means for mutually beneficial results. Evidences may be observed through actions and statements made by participants, within the project media, as well as their use of data results that create or further specific projects within the tribes utilization of remote sensing and GIS technologies.

Alternative hypothesis: While theoretically complex, use of remote sensing and GIS technologies within tribal landscapes are contributing factors of culture loss and persistently occurs initially at the source—this being the relationship between IK, IKS, and ITEK and their Peoples, as Knowledge Holders—and represents a next level precarity that extends the affective elements of colonization directed at and now employed among

Indigenous communities, through implementation of STEM-learning within Native education mandates. This premise may be evidenced through the increasing insistence, practice, and narrowly conceived use of remote sensing and GIS technologies within tribal landscape archaeological survey that results in impacts that ignore, replace and also influence tribal decision-making regarding cultural heritage and resource use and management that further jeopardizes Indigenous lifeways.

Overall the synthesis of the entirety of the information in the process thus far had provided four core statements that next guided the development of the Methodology for this study. These statements are:

As Native people we are People of space, image, and time...we constantly seek perspectives and knowledge of the world that explain it and the beings within it...the seeking of knowledge from a distance and placing it within a landscape, pervades our culture.

Lone Fight 2017

Indigenous and local cultures are being absorbed and transformed by the global culture of technology...and technologies are not value neutral...the data and resulting statistics that technology provides does not just describe reality—they create it.

Borgmann 2012

Sandler 2012

Walter and Anderson 2013

Technology is not just a tool for human use but...it is also a taken-for-granted access to freedoms that promote the illumination of human minds...and is a powerful influence and means of impact on human environments, mentalities, and identities.

Heidegger 1923

Pennock 2019

Shamir 2020

I remember the destruction that the sacred brings when it's not kept sacred.

Kelsey Dayle John 2019

Chapter 3: Methodology and Methods: An Indigenous Way

- There is a difference between methodology and method and it is relationship-based.
- Development of New Critical Theory of Land-Human Ecological and Technological Relationships, as the guiding methodology for this study.
- Impacts to original study approach due to COVID-19 required a re-think that engaged Evidence Mapping to identify Case Study method as an approach.
- Protocols of Case Study method coupled with further application of Evidence Mapping identified a site and sources for inquiry, that were congruent with the methodology of this study. The site is ESRI (Environmental Systems and Research Institute) website and the source is the public provision, through this website, of 73 tribal GIS StoryMap projects (submitted by relevant tribal project staff), occurring in the years of 2017 – 2021.
- A Pilot Case Study was engaged to prove relevancy of this site and sources, as publicly shared digital media, per the perspective of the 3 themes of concern.
- This process confirmed relevancy as well as the revelation that these 3 themes of concern, are first level impacts and access points—gateways—through which further impacts may occur.

- This process also provided enhancement and extension to this study's goal, as being to *understand* ... what impacts occur, as a dynamic process, that then led to revision of the four questions in more specific ways, that in-turn enhanced the hypotheses from being an "either or" stance to that of including the possibility of an "and also" result potential. The four questions became:

- A. Has the excitement about and use of remote sensing and GIS technologies within tribal landscapes been initiated by STEM-based industry drivers or first by the intentions of Tribal Nations and their needs?
- B. What impacts have occurred to IKS and ITEK from western-based training of Indigenous practitioners for use of remote sensing and GIS technologies, within tribal landscapes?
- C. With use of remote sensing and GIS technologies, as a means of "seeing" sources of Indigenous Knowledges, what impacts may have created cultural knowledge enhancement, or loss, or negotiation of relationships between IK sources, and systems of knowing, and their Indigenous human relatives, because of their use within public venues?
- D. What impacts, related to questions a – c, occurred to tribal leadership decision-making about their cultural heritage and natural resource management?

Chapter 4: ESRI and 73 of its Projects as cases for this Study

- List of 73 tribal GIS projects. These are not sub-sets, but complete sets as gathered per their respective years, between 2017 and 2021. Tribal project staff submitted information for public display and access through the ESRI website, a social media digital resource that emphasizes education and training for GIS practitioners, and sharing of GIS projects with the world.

Aiya'ai dame bede anda n'angkwa
There you are, we've arrived at another place.

Knowledge Revealed

Conceptual Framework and Logic Model

The results of the various methods of inquiry and assessment, through Newe Reasoning heuristics—a synthesis of various principles and core beliefs—and the addition of relevant ESRI principles for digital media-based story map creation and sharing, are provided through the lens and structure of the four questions, and addressed through the three first level impacts of Education, Technology, and Tribal Leadership Decision-Making.

This information is provided in both narrative and quantitative forms. The logic model for this process is contingent on addressing the four primary questions of this study, repeated here for relevance within this section:

- A. Has the excitement about and use of remote sensing and GIS technologies within tribal landscapes been initiated by STEM-based industry drivers or first by the intentions of Tribal Nations and their needs?
- B. What impacts have occurred to IKS and ITEK from western-based training of Indigenous practitioners for use of remote sensing and GIS technologies, within tribal landscapes?
- C. With use of remote sensing and GIS technologies, as a means of “seeing” sources of Indigenous Knowledges, what impacts may have created cultural knowledge enhancement, or loss, or negotiation of relationships between IK sources, and systems of knowing, and their Indigenous human relatives, because of their use within public venues?
- D. What impacts, related to questions a – c, occurred to tribal leadership decision-making about their cultural heritage and natural resource management?

These questions have been addressed when looking through the various assessment and analytic methods utilized within this study, and was accomplished in a variety of ways. I share next the conceptual construction of each of four assessments. I begin with the Newe Reasoning analytic method, then the ESRI principles of Storytelling as a reflection-based assessment method for the ArcGIS StoryMap construction that also incorporates elements

of Shambu (2020) Indigenous Film Critique, and the third is the Reasoning Reflection on six scholar recommendations as a method of observational assessment of their inclusion or absence within each digital project. This process style is repeated with a summary of Reasoning reflections of Null versus and/or Alternative Hypotheses. Within Chapter 6 I revisit this summary with additional regard for a Monster Narrative reflecting the flip of theories of Precarity and Affect, from a deficit approach to one that is about thriving within a realm that embodies past, present, and future concerns.

Understanding through Newe Reasoning

Newe Reasoning as a method of analyzing data for this study is an appropriate response to issues of incongruency within research design and practice, related to use of Indigenous Research Methodologies and Methods.

Additionally, this process of development of a methodologically relevant and congruent analytic method is a common practice when working within multi- or mixed-method research whereby value sets are representative of the interpretation and assessment process. Compare the rationale, creation, and application of Newe Reasoning with that of the National Science Foundation (NSF) Review matrix and it as being conceptualized and operationalized per value sets identified and translated by its task force members from within the NSF (Medin and Bang 2014). Consider, "... how science gets done reflects who's doing it ... [and the NSF] has been considering revisions to their Merit Review Principles and Criteria" (236) toward a more transparent acknowledgement stance that reflects diversity in values and their aspects translated and applied within research proposals and projects from a context position.

Here I provide a comprehensive guide to the analytic measurements performed by each element within the Newe Reasoning tool, that when synthesized becomes a system of knowing and specific context-relevant inquiry. To understand if impacts are occurring to Indigenous ways of knowing and Indigenous Traditional Ecological Knowledges there is need to define these ways in terms of observable phenomenon that reflects shared Indigenous worldviews. We find these present in the following sections:

Section 1: Newe Reasoning heuristics: Within the in-text Data Table that follows, is a coding system utilized to represent a heuristic containing seven elements of assessment, represented as H1 - 7, and a guide is included with the associated data table. These heuristic elements are a synthesis of principles and core beliefs found within:

- A. Eastern Shoshone Seasonal Round Core Beliefs (2008)
- B. Six Rs of Indigenous Research (2022)
- C. C.A.R.E (2022, GIDA <https://www.gida-global.org/care>)
- D. F.A.I.R (2022, GIDA <https://www.gida-global.org/care>)

A. Eastern Shoshone Seasonal Round Core Beliefs (2008):

Situated for understanding a system of knowing, being, and doing among Shoshonean Peoples, the Seasonal Round is a structure where core beliefs can be understood as values that are applied within everyday life. These then, when operationalized, become concepts of living as a Shoshonean person and are observable as Lifeways reflecting our worldviews. These twelve Core Beliefs are selected as relevant to

myself, as researcher, the topic of this study, and part of the process of observational and review assessment.

Nanwhanduh (*Family*)

Nah soom boe ree ghund (*Humility*)

Doe-Gway-Newe (*Honesty*)

Duh-reh yah hy-chee (*Humor*)

Dumuh-newe-daigwap (*Language*)

Dumun newe nuh-hup (*Tradition*)

Dumuh-narayshoontye mumun guduhn nisoongund (*Spirituality*)

Duh-voe-poy (*Life Lessons*)

Soo-woo-gye (*Respect*)

Guhtand (*Courage*)

Bah nah soo muh-guhn (*Honor*)

Nah-doe-wahzow-we-gund (*Generosity*)

B. 6 Rs (Tsosie 2022). Founded on the work of Kirkness and Barnhardt (1991), 4rs

(respect, relevance, reciprocity, and responsibility) were adapted and expanded to become Tsosie et al's 6 Rs, that are described as:

Respect: This value acknowledges and honors the Earth and natural world as relatives and our human interconnectedness to all which exists therein.

Relationship: This value is founded on recognition and acknowledgment of the kinship that exists within the universe and the knowledges that are created and shared for the benefit of all, that collectively embody an honest approach to being in relationship.

Relevance: This value expresses connection in transparent and embedded ways that reflects understanding of differences and similarities that are negotiated in order to create a space of balance in approaches to understanding.

Reciprocity: This value engages a continuum of intentional exchange as a dynamic process of mutual respect for the needs of both self and others.

Responsibility: Akin to accountability (deontological value), responsibility is an axiological value that represents another side of an ethic of balanced knowing, being, and doing that has care for self and others within relationships.

Representation: As a practice based on ethical understandings, representation as a value is all encompassing of the other five r's, as it reflects learned behaviors from one's community and acknowledges these through actions of care.

The following principles reflect discourse and movements toward open data and open science that engages Indigenous Peoples' rights, interests, worldviews, values, and intentions for collective benefit in ways that are determined by their Indigenous authors. The following information was found at [GIDA](#) (2023 site information) and accessed for their relevancy to this study.

C. F.A.I.R. principles: Findable, Accessible, Interoperable, Reusable

D. C.A.R.E. principles: Collective Benefit, Authority to Control, Responsibility, Ethics

As you can see, there are many similar and shared core beliefs, as value statements, overlapping between these four concepts. Synthesizing these per my own understanding and interpretation of their applicability to the topic and analytic intentions of this study, creates the heuristic method I refer to as Newe Reasoning. The various tribal GIS projects of this case study are reviewed per these standards and quantified per observed occurrence. Next each project is further analyzed in relation to the themes of education, technology, and tribal leadership decision-making that are represented within the four primary questions of this study in order to understand evidence of and impacts to IKS and ITEK, as being either beneficial, non-beneficial, or both with distinctions identified and defined by these heuristics. Please note, these four primary questions are situated within the various heuristics 1 – 7.

H1: Acknowledgement of respect for land and its ecologies, and as honoring of these as relatives is evident through observation, written and/or verbal activities.

H2: Acknowledgement of responsibility of care between land/nature, humans and beyond-humans as representing traditional cultural spirituality is evident through observation, written and/or verbal activities,

H3: Relevance for use of remote sensing and GIS technologies and as being initiated by tribal persons/organizations that represents acts of honesty, respectful humility, and generosity are evident through observation, written and/or verbal activities.

H4: It is evident through observation, written and/or verbal activities that the data gathered during activities within the project is an explicit reciprocal act of intention that is beneficial to land and those in relationship to it, including its ecologies.

H5: It is evident through observation, written and/or verbal activities that the data gathered during the project activities are interpreted and shared in ways that provide means for additional tribal leadership decision-making that can be understood as lessons-learned about perpetuation of cultural knowledges.

H6: It is evident through observation, written and/or verbal activities, that training for Indigenous practitioners of remote sensing and/or GIS technologies has occurred.

H7: It is evident through observation, written and/or verbal activities, that the Indigenous practitioners of remote sensing and/or GIS technologies within the project have utilized their tribal IKS and/or ITEK.

Section 2. It is my intention and recommended practice with use of the Newe Reasoning method, that the following represents a relational responsive activity that furthers congruency of this method as being relevant and respectful to the site and sources where data have been experienced and gathered. This is especially true given the topic and questions of this study that seeks to understand the relationship impacts that remote sensing and GIS have on IKS and ITEK. These technologies for gathering and interpreting data are coupled with the sharing of this data in a public digital media form. How one “sees” their worlds, particularly elements within these that constitute one’s

ways of knowing, being, and doing is imperative to understanding what influences and how this is accomplished and what shifts as a result. The activities of then producing data in forms that are shared with others additionally impacts, not only the person doing the “seeing”, but how others perceive the data and material being presented to them. How are the practitioners and authors of the StoryMap projects furthering impacts in these ways, is a particular focus of the section 2 assessment.

While the projects are presented as ArcGIS StoryMaps, there is consideration for these digital media to also be assessed per elements found within evaluations of Indigenous film. Within the following ESRI Five Principles is an overlay of guidance, as an enhancement, provided by Shambu (2020) reflecting a call for revision of film evaluation criteria that responds to the complexity of aesthetic and context found within public media written, produced, and/or distributed by Indigenous artists. The ESRI principles have been enhanced by the following:

- Consideration of “representational context” within the StoryMap is evident and observed as a reflection of the inclusion of Indigenous realities.
- Consideration of the production team, through an auteurist critical approach—meaning the worldview of the filmmaker—is observed as being represented by all or a majority of Indigenous individuals associated with the visual media creation.
- Consideration of acquisition of viewer response as a continuous learning and improvement opportunity has become a necessity for public media projects, and is observed through the StoryMap media form.

Here I continue with section 2 assessment, now as being:

Reasoning per ESRI Five principles + Shambu (2020) Considerations guidance for Creating a StoryMap (2018). The following ESRI Five principles are accessible at this weblink: <https://www.esri.com/arcgis-blog/products/story-maps/mapping/5-principles-of-effective-storytelling/>

These principles are stated per ESRI text, and coded here as, asking Does the project ...:

1. Connect with your audience (who are a diverse audience of viewers/readers), E5p1+
2. Lure People In (the hook also reflects Indigenous perspectives of the topic), E5p2+
3. Choose the best user experience (StoryMap templates chosen per project intentions), E5p3+
4. Make easy-to-read maps (mapping story structure respects Indigenous perspectives), E5p4+
5. Strive for Simplicity (concise and clear information respects cultural sensitivities). E5p5+

As previously stated, the above Principles are enhanced by the three Shambu (2020) considerations and are coded with the inclusion of a + symbol, such as E5p1-5+.

Reflection on project assessment results is provided further in this chapter.

Section 3. Within previous chapters of this dissertation I have referenced the following scholars as providing relevant information, questions, and guidance related to the topic and questions of this study. In the next chapter I provide an opportunity to reflect on these works through Discussion, but I also want to mention them here as being relational

to the New Reasoning approach as means of congruency for understanding evidence of impacts, per the definition of potentially being beneficial or not with regard to the Call of each of these scholars.

Within Chapter 6 I will address Reasoning Reflections on five Scholarly

Recommendations, provided by:

- i. Supernant, 2 selections: 2017 and 2021:
2017: Modeling Metis Mobility: Evaluating Least Cost Paths and Indigenous Landscapes in the Canadian West. This paper addresses use of GIS by Indigenous practitioners and knowledge holders regarding their landscapes.

2021: Integrating Remote Sensing and Indigenous Archaeology to Locate Unmarked Graves: A Case Study from Northern Alberta. This paper addresses use of remote sensing, emphasizing ground penetrating radar (GPR), within tribal projects and landscapes.
- ii. Lone Fight 2017: With the statement that “GIS scientists are courted for validation” (101) this work puts forth consideration of need for “participatory mapping” per a guideline referred to as RIPSS (Respecting Indigenous Participatory Spatial Sovereignty), that is a GIS/remote sensing knowledge generation process. Four “understandings” are presented as recommendations.
- iii. Wessels et al 2022: The Drone, the Snake, and the Crystal: Manifesting Potency in 3D Digital Replicas of Living Heritage and Archaeological Places. This paper addresses a need to “critique the western paradigm of archaeological visualization and propose recommendations for inclusive, decolonized visualizations of living heritage and archaeological places.”
- iv. Sanger and Barnett 2021: Remote Sensing and Indigenous Communities: Advances in Archaeological Practice. This paper represents a Call for changes within archaeological practices for addressing ethics of utilizing remote sensing instruments among Native American communities.
- v. Nesvold 2023: Off-Earth Ethical Questions and Quandaries for Living in Outer Space. Despite the title pointing to non-earth-based landscapes and issues, this text addresses many of the preliminary concerns expressed by interested parties of this study’s topic. Of particular interest is the issue of “how to balance our other interests and desires with the need to protect the environment from ourselves.”

Further in Chapter 6 the entirety, as a collective of recommendations, is discussed within the frame of the four primary questions within relevance to the three primary themes of concerns, that have been provided by exploratory and literature review processes, and these are:

- Education
- Technology
- Tribal Leadership Decision-Making

Section 4. Reasoning reflections of Null versus and/or Alternative Hypotheses, with additional regard for the Monster Narrative reflecting the flipped theories of Precarity and Affect. A reflective result is provided in summary here in this chapter, but also woven within the discussion provided through Chapter 6. Within these two statements—hypotheses—we find that the foundation for this research is as being land-human relationality and interdependence, and situates the topic and questions for development of these hypotheses, they being:

Null hypothesis: The observed positive impacts occurring to IKS and ITEK with the use of remote sensing and GIS technologies reflects the voluntary use and participation with these technologies. The understanding I have situates this observance as that this use provides more positive influences, than negative, to Indigenous practitioners and tribal leadership decision- making regarding cultural heritage and resource use and management that provides means for mutually beneficial results. Evidences may be observed through actions and statements made by participants, within the project media,

as well as their use of data results that create or further specific projects within the tribes utilization of remote sensing and GIS technologies.

Alternative hypothesis: While theoretically complex, use of remote sensing and GIS technologies within tribal landscapes are contributing factors of culture loss and persistently occurs initially at the source—this being the relationship between IK, IKS, and ITEK and their Peoples, as Knowledge Holders—and represents a next level precarity that extends the affective elements of colonization directed at and now employed among Indigenous communities, through implementation of STEM-learning within Native education mandates. This premise may be evidenced through the increasing insistence, practice, and narrowly conceived use of remote sensing and GIS technologies within tribal landscape archaeological survey that results in impacts that ignore, replace and also influence tribal decision-making regarding cultural heritage and resource use and management that further jeopardizes Indigenous lifeways.

Reminder Note: Within this logic model for assessment and analysis of data, only section 1 is the analytic tool referred to as Newe Reasoning, whereby Indigenous shared worldviews, as value sets, are synthesized and operationalized as a quantitative method. Newe Reasoning further utilizes an iterative approach that applies additional topical and inquiry contexts in the form of a qualitative approach. Section 2, Reflections on ESRI principles, with an overlay of guidance provided by Shambu (2020) film evaluation criteria as considerations that responds to the complexity of aesthetic and context found within public media written, produced, and/or distributed by Indigenous artists.

represents a topic emphasis and relevant method for assessment; in this case the emphasis is ESRI StoryMaps created by tribal-based individuals and as public digital media applications. Section 3, Reflections on Scholarly Recommendations are discussed in Chapter 6 per their observed occurrence within project assessments. Section 4, Reflections of hypotheses, represents a review of my hypotheses in terms of these three reasoning methods, and I provide a statement as results at the close of this chapter. This section 4 is also further discussed in Chapter 6. Additional understanding is also provided in that chapter regarding the application of AIRW related to the development and practice of the research methodology, methods of approach and inquiry, and analysis tool utilized in this study.

Data Gathered and Assessed, as a process of Indigenous Knowing

We do not 'store' experience as data, like a computer: we 'story' it.

Bolton 2010, quoting Winter 1988:255

Interestingly, the quote I share here has significant relevance to my approach to data gathering, assessment and sharing of it in a form of results that is both quantitatively- and qualitative-based. The work of gathering “data” is an important experience to be shared, just as much as presenting the numbers associated with the information gathered. Story, presented as a statistical mathematic-based text, is found within Indigenous ways of knowing and applied as understandings for what is referred to as ITEK, within ways of daily living. These knowledges applied within an analytic methodology can be understood through a review of literature and practices within the disciplinary field of ethnomathematics.

As I had shared previously, inspiration for the development of Newe Reasoning as a method of analysis came first from realizing the need for a methodologically congruent analytic method, this led me to the work of Barta and Shockey (2006). Their time among Northern Ute People within the realms of “mathematical ways” opened my understanding of what has always been a way of knowing and making sense of the world from and through Indigenous perspectives, that is also reflective of “ethnomathematics.”

Further research about ethnomathematics provided insight to this work as a pedagogical turn referred to as “culturally relevant mathematics” (Matthews et al 2022). Pedagogy and learning applications situated from a cultural context and a “doing” perspective is responsive to students in academia today, these being a “generation of children ... known as the most racially, linguistically, and ethnically diverse, and more digitally exposed than any previous generation” (2). The western standard of practice for students has been “learning isolated procedures ... such as key vocabulary, watching the teacher do guided examples, and then engaging in a lot of independent practices ... [and] the singular goal of this script was getting correct answers to prescribed problems” (3). Within a classroom where culturally relevant math is taught, the goal is to engage in diverse problem-solving strategies and through experiential and group-learning. Such a process of cultural-based inquiry would include actively encouraging the centering of “I notice, I think, I wonder” to understanding how knowledge is gained and applied.

Returning to the work of Jim Barta, who in 2014 collaborated on an extension of his work with Ute People, through the text *Math as a Verb: Activities and Lessons from Cultures Around the World*, we find this quote in the Preface, by Fabian Jenks, a Northern Ute elder

Mathematics is a verb! In Ute, we do not have just one word to describe mathematics—rather we name it as we use it. When we count, build, design, cook, hunt, or fish, we are doing mathematics.

What this speaks to me of is that Newe Reasoning as an analytic tool is both a quantitative measuring and qualitative reflexive method, both being two-sides of a whole and provides a necessary balance. Similarly, my own development and use of this method—that is still being developed and will remain an iterative process of collaborative application—reflects what culturally relevant math and Math as Verb advises, that understanding our world in quantitative terms is a “process shaped and influenced by its use and by the culture of those using it” (Barta et al 2014:v). Further, how this is accomplished requires an approach of multicultural understanding that knowledge evolves; it is not fixed, but is and must remain responsive to change, within a culture and the world it exists within. This story of mathematics has often been portrayed as being separate from those who identify strongly with a particular Indigenous culture, by those who western academic history has promoted as “developers” of mathematics; when in fact, mathematics was a basic dialect throughout the world, only its applications were and remains contextual. As educators it then would behoove us to gain an understanding of this history and the movement toward implementing culturally relevant mathematical learning in classrooms and as an experience within diverse contexts and mediums.

Additional information by Marcia Ascher (2002) addresses technical applications of mathematical philosophies and their operationalization within statistical formulas and interpretations of these through diverse cultural lens’ and specific coding methods;

coding meaning “labels that assign symbolic meaning to the descriptive or inferential information compiled during a study” (Miles 2020:62).

Understanding the study you are reading, as being “mixed-methods,” and often debated as meaning the same thing as “multi-methods” in its approach as a Case Study, is an important aspect for understanding the assemblage of data and interpreting results of the analysis of this data. I have often interchanged the use of these two terms. Vast amounts of literature now also toggle these terms. In some instances within literature you will find that “multi-methods” refers to use of two or more qualitative methods within the same study and that “mixed-methods” refers to use of both qualitative and quantitative methods within the same study. In all the material I have read about this interchanging of terms, there is support that utilizing either the term of mixed- or multi-methods as approaches has the same advantage of “transforming key issues of descriptive and causal inference from matters of speculative assertion into points of empirical debate” (Seawright 2016:1).

Within this dissertation, as a Case Study, the analysis and results are interpreted per an intertwining of both correlation and causal inference, as an integration of intellectual disciplines regarding analytics. The hypotheses provided by this study, within a dynamic process of understanding, argues that there are impacts caused by remote sensing and GIS technologies, as inferred by the data results, but then also observance of correlative elements is required to understand causation, and this requires understanding temporal-based knowledge acquisition and use.

Returning to the topic of coding, you can see within this multi- or mixed-method study, the engagement of both quantitative and qualitative approaches, and an additional

consideration of Indigenous perspectives as part of this diverse approach. This entire perspective, as a balanced blend of both quantitative and qualitative ways of knowing, being, and doing, is evidenced through the AIRW research and practice model overall, and specifically within the activity of data assembly, analysis, and results sharing. This all presents coding as a challenging endeavor. As such, within this study *Affective Values Coding* (Miles et al 2020) methods have been utilized to identify patterns defined as “impacts.” Choosing this format, versus an AI generated analytic process respects and attends to the statements assembled from shared Indigenous worldviews—these being values and attitudes—about the topic and questions of this study, and as observed within public digital mediums, StoryMaps.

Overall, Indigenous perspectives of knowing that center on mathematical concepts are found to have been responsive to cultural contexts and the realities of these worlds, and as such, continuously evolve accordingly; this per the work of such scholars as Barta and Shockley. There are foundational epistemological frames for this knowing process, but use of these knowledges is a practice of relationality and interdependence. This is particularly important to understand when the sources of these knowledges shift for a variety of reasons. Today, there is a focus on impacts of climate change on our natural worlds. These worlds are the realms of the sources of our Indigenous knowledges. Impacts to these are of obvious and great concern when looking at Indigenous ways of knowing and the need to understand how we reason with this knowledge to make sense of our worlds.

Results and Impacts Revealed from Sections 1 & 2

I begin with the Newe Reasoning analytic method, providing tabulation of its seven heuristic elements, H1-7, and then the results of its application. I then provide tabulated and reflection-based narrative results from application of the ESRI principles of Storytelling as StoryMap construction enhanced by the Shambu (2020) considerations. These elements are represented by E5p+1-5. I also provide my interpretation of these results as related to the hypotheses of this study. As I shared previously I will also present a reflection-based narrative of results where six scholar recommendations have been observed, or not, within each digital project. This will be discussed within the next chapter.

Newe Reasoning Heuristics: Section 1

The following refers to section 1, the Newe Reasoning method of analysis, and data are represented in tables assembled per year and each specific project's identifying factors are coded per year and assigned a random sequence number. I provide here a basic legend for indicators residing within the tables.

- A symbol by the project code indicates that technical issues or intentional removal of partial (*) or entirety (^) of the StoryMap occurred.
- Color coding of specific cells:
 - lt. green = observed specific IKS and/or ITEK
 - lt. grey = No observed specific IKS and/or ITEK
 - pale yellow = Heuristic elements with specific IKS or ITEK designations
 - lt. blue = projects with specific tech use observed or referenced
 - lt. orange = totals per column
 - dk. orange = overall totals
- Additionally: Symbol > indicates the StoryMap was created as a project whereby a tribe had invited a regional response team as a collaborator, that consists of both Indigenous

and non-Indigenous members. Remote sensing and GIS technologies are typically utilized by Indigenous cultural specialists, as team members, and are from various tribes.

Heuristics Legend

H1: Acknowledgement of respect for land and its ecologies, and as honoring of these as relatives, is evident through observation, written and/or verbal activities.

H2: Acknowledgement of responsibility of care between land/nature, humans and beyond-humans as representing traditional cultural spirituality is evident through observation, written and/or verbal activities.

H3: Relevance for use of remote sensing and GIS technologies and as being initiated by tribal persons/organizations that represents acts of honesty, respectful humility, and generosity are evident through observation, written and/or verbal activities.

H4: It is evident through observation, written/or verbal activities that the data gathered during project activities is an explicit reciprocal act of intention that is beneficial to land and those in relationship to it, including its ecologies.

H5: It is evident through observation, written/and or verbal activities, that the data gathered during the project activities are interpreted and shared in ways that provide means for additional tribal leadership decision-making that can be understood as lessons-learned about perpetuation of cultural knowledges.

H6: It is evident through observation, written and/or verbal activities that training for Indigenous practitioners of remote sensing and/or GIS technologies has occurred.

H7: It is evident through observation, written and/or verbal activities that the Indigenous practitioners of remote sensing and/or GIS technologies within the project have utilized their tribal IKS and/or ITEK.

The following are my data results
 Newe Reasoning Data Table: _A_

Project Yr	Project Code	H1	H2	H3	H4	H5	H6	H7	When H=7 # of H Occurences Observed per project	# projects assessed	Overall Median when N=7 as H	Overall Mode of all projects reviewed	Projects displaying and/or referencing specific Tech use
2017	>17-9*			x	x		x		3				x
	17-8			x					1				x
	17-7^								n/a				
	17-6			x	x				2				x
	17-5^								n/a				
	17-4	x	x	x	x	x	x	x	7				x
	17-3	x	x	x	x	x	x	x	7				x
	>17-2*	x		x	x	x	x	x	6				x
	>17-1*			x	x		x		3				x
TT		3	2	7	6	3	5	3	29	7	3	3	7
2018	18-15^								n/a				
	18-14	x	x	x	x	x	x	x	7				x
	18-13*	x	x	x	x	x	x	x	7				x
	18-12	x		x			x		3				x
	18-11*	x			x	x	x		4				x
	18-10	x	x	x	x	x	x	x	7				x
	18-9				x				1				x
	18-8^								n/a				
	18-7	x		x	x	x	x		5				x
	18-6			x	x		x		3				x
	18-5			x					1				x
	18-4			x					1				x
	18-3^								n/a				
	18-2			x	x	x	x		4				x
	18-1			x	x	x	x		4				x
TT		6	3	10	9	7	9	3	47	12	4	4	12
2019	19-21			x	x	x	x		4				x
	19-20^								n/a				
	19-19	x	x	x	x	x	x	x	7				x
	19-18^								n/a				
	19-17	x	x	x	x	x	x	x	7				x
	19-16	x	x	x	x	x			5				x
	>19-15				x	x	x		3				x
	>19-14				x	x	x		3				x
	19-13			x	x		x	x	4				x
	19-12			x	x		x		3				x
	19-11			x	x		x		3				x
	19-10			x			x		2				x
	19-9^								n/a				
	19-8			x	x	x	x		4				x
	19-7	x	x	x	x	x	x	x	7				x
	19-6			x	x		x		3				x
	19-5^								n/a				
	19-4^								n/a				
	19-3	x	x	x	x	x		x	6				x
	19-2*	x	x	x	x	x			5				x
	19-1			x	x				2				x
TT		6	6	14	15	10	12	5	68	16	4	3	16

Continued, Newe Reasoning Data Table: _A_

Project Yr	Project Code	H1	H2	H3	H4	H5	H6	H7	When H=7 # of H Occurences Observed per project	# projects assessed	Overall Median when N=7 as H	Overall Mode of all projects reviewed	Projects displaying and/or referencing specific Tech use
2020	20-15	x	x	x	x	x	x	x	7				x
	20-14	x	x	x	x	x	x	x	7				x
	20-13^								n/a				
	20-12	x	x	x	x	x	x	x	7				x
	20-11	x	x	x	x	x	x	x	7				x
	20-10			x			x		2				x
	20-9	x	x	x	x	x			5				x
	20-8^								n/a				
	20-7				x				1				x
	20-6	x	x	x	x	x	x	x	7				x
	20-5			x	x	x	x		4				x
	20-4			x	x		x		3				x
	20-3^								n/a				
	20-2			x	x		x		3				x
	20-1^								n/a				
TT		6	6	10	10	7	9	5	53	11	5	7	11
2021	21-13	x	x	x	x	x	x		6				x
	21-12			x	x				2				x
	21-11	x	x	x	x	x		x	6				x
	21-10			x	x		x		3				x
	21-9				x				1				x
	21-8	x	x	x	x	x	x	x	7				x
	21-7			x	x		x		3				x
	21-6	x	x	x	x			x	5				x
	21-5	x	x	x	x	x	x	x	7				x
	21-4^								n/a				
	21-3	x	x	x	x	x			5				x
	21-2				x				1				x
	21-1^								n/a				
TT		6	6	9	11	5	5	4	46	11	5	5	11
N=73										57			
N=57		27	23	50	51	32	40	20	243		4	4	57

What has been learned from Section 1 data

The following is presented as a quantitative and qualitative summary of data related to each year assessed and their respective projects in relation to the 7 heuristic elements of assessment. Reflections in terms of impacts found per the four questions and three themes is provided after the Tables.

2017

N=9 total projects within this year and 7 had assessable data, with 2 n/a due to removal of link to project materials.

Of the 7 reviewed projects 3 represents the middle range # of occurrences of H1, 2, 5, 7.
Of the 7 reviewed projects 3 represents the average # of occurrences of H1, 2, 5, 7.

2 of the total 9 projects had all material removed, resulting in 7 projects being assessable.
3 of 7 total projects assessed were response team projects.
3 of 7 total projects had partial material removed.
3 of 7 total projects assessed held observed IKS and/or ITEK information. (lt. green)
4 of 7 total projects assessed had No IKS and/or ITEK information observed. (lt. grey)
7 of 7 projects referenced or exhibited specific use of remote sensing and/or GIS.

Note: Typically when the response team are part of the project there is tech involved.

H6: 5 of 7 assessed projects revealed tech training present among Indigenous participants.

H7: 3 of 7 assessed projects revealed Indigenous use of IKS and/or ITEK with tech.

2018

N=15 total projects within this year and 12 had assessable data, with 3 n/a due to removal of link to project materials.

Of the 12 reviewed projects 4 represents the middle range # of occurrences of H1, 2, 5, 7.
Of the 12 reviewed projects 3 represents the average # of occurrences of H1, 2, 5, 7.
However, 1, 3, 4, and 7 were all equal at 3.

3 of the total 15 projects had all material removed, resulting in 12 projects being assessable.
0 of 12 projects assessed were response team projects.

2 of 12 projects assessed had partial material removed.
8 of 12 projects assessed held observed IKS and/or ITEK information. (lt. green)
4 of 12 projects assessed had No IKS and/or ITEK information observed. (lt. grey)
12 of 12 projects referenced or exhibited specific use of remote sensing and/or GIS.

H6: 9 of 12 assessed projects revealed tech training present among Indigenous participants..

H7: 3 of 12 assessed projects revealed Indigenous use of IKS and/or ITEK with tech.

2019

N=21 total projects within this year and 16 had assessable data, with 5 n/a due to removal of link to project materials.

Of the 16 reviewed projects 4 represents the middle range # of occurrences of H1,2, 5, 7.
Of the 16 reviewed projects 3 represents the average # of occurrences of H1, 2, 5, 7.

5 of the total 21 projects had all material removed, resulting in 12 projects being assessable.

2 of 16 projects assessed were response team projects.
1 of 16 projects assessed had partial material removed.
11 of 16 projects assessed held observed IKS and/or ITEK information. (lt. green)
5 of 16 projects assessed had No IKS and/or ITEK information observed. (lt. grey)
16 of 16 projects referenced or exhibited specific use of remote sensing and/or GIS.

H6: 12 of 16 assessed projects revealed tech training present among Indigenous participants..

H7: 5 of 16 assessed projects revealed Indigenous use of IKS and/or ITEK with tech.

2020

15 total projects within this year and 11 had assessable data, with 4 n/a due to removal of link to project materials.

Of the 11 reviewed projects 5 represents the middle range # of occurrences of H1,2, 5, 7.
Of the 11 reviewed projects 7 represents the average # of occurrences of H1, 2, 5, 7.

4 of the total 15 projects had all material removed, resulting in 11 projects being assessable.

0 of 11 projects assessed were response team projects.
0 of 11 projects assessed had partial material removed.
7 of 11 projects assessed held observed IKS and/or ITEK information. (lt. green)

4 of 11 projects assessed had No IKS and/or ITEK information observed. (lt. grey)
11 of 11 projects referenced or exhibited specific use of remote sensing and/or GIS.

H6: 9 of 11 assessed projects revealed tech training present among Indigenous participants.

H7: 5 of 11 assessed projects revealed Indigenous use of IKS and/or ITEK with tech.

2021

N=13 total projects within this year and 11 had assessable data, with 2 n/a due to removal of link to project materials.

Median: of the 11 reviewed projects 5 represents the middle range # of occurrences of H1,2, 5, 7.

Mode: of the 11 reviewed projects 5 represents the average # of occurrences of H1, 2, 5, 7. However, 1, 3, 5, 6, and 7 were all equal at 2 occurrences.

2 of the total 13 projects had all material removed, resulting in 11 projects being assessable.

0 of 11 projects assessed were response team projects.

0 of 11 projects assessed had partial material removed.

6 of 11 projects assessed held observed IKS and/or ITEK information. (lt. green)

5 of 11 projects assessed had No IKS and/or ITEK information observed. (lt. grey)

11 of 11 projects referenced or exhibited specific use of remote sensing and/or GIS.

H6: 5 of 11 assessed projects revealed tech training present among Indigenous participants.

H7: 4 of 11 assessed projects revealed Indigenous use of IKS and/or ITEK with tech.

Narrative Summary of Section 1 Data Results

Note: Analyzing per year is reflective of keeping to the referential year the project was submitted to ESRI.

Overall, 73 projects were presented as submissions of tribal GIS projects in years 2017 – 2021, with 57 being accessed for assessment through this study. This resulted in 78% of all possible projects within these years as being able to be accessed. The differential is due to some projects having their access links removed, partially removed, or unavailable during the times I attempted to access them. Within the 57 projects there

were a total of 243 occurrences of heuristic elements observed out of a potential for 399 to occur. This represents an observation of 61% of all projects variously engaged H1-7, with an overall median # of 4 and mode # of 4 per projects with H1-7 occurrences. Respectively this is represented as: H1 had 27 total occurrences; H2 had 23 total occurrences; H3 had 50 total occurrences; H4 had 51 total occurrences; H5 had 32 total occurrences; H6 had 40 total occurrences, and; H7 had 20 total occurrences. Of the 57 projects assessed all 57 were observed to have referenced or exhibited use of remote sensing with use of the ArcGIS data platform.

Looking inside the data at each year as a collective of years and related to each heuristic we find:

H1, being evidence through observation of respect for the land and its ecologies in ways that honor these as relatives, reports a consistently low representation within each of the years, starting with 2017 at 3 out of 7 occurrences, 2018 has 6 out of 12, 2019 has 6 out of 16, 2020 has 6 out of 11, and 2021 has 6 out of 11. For all years we find that there are 27 occurrences of H1 observed out of 57 projects. This is just under 50% representation of what is an important ontological philosophy for most Indigenous peoples.

H2, observation of acknowledgement of responsibility of care between land/nature, humans and beyond-humans also reports only 23 occurrences are found among the 57 total projects assessed. Within the year of 2017 there are 3 out of 7, 2018 has 3 out of 12, 2019 has 6 out of 16, 2020 has 6 out of 11, and 2021 has 6 out of 11. This less than 50% result is related to H1 data in that they both engage relationship and interdependence

philosophies found foremost within Indigenous philosophies of knowing, being, and doing.

H3, found observations of use of remote sensing and GIS technologies being initiated by tribal persons/organization occurred within a total of 50 out of 57 projects. In year 2017 there are observed 7 occurrences out of 7 projects, in 2018 there are 10 out of 12, in 2019 there are 14 out of 16, in 2020, there are 10 out of 11, and in 2021 there are 9 out of 11. It is the purpose of each of the projects to be associated with GIS, as ESRI has invited tribal nations to participate. This particular heuristic, though, also observed for explicit evidence where the tribal project authors initiated the project and submission per their intentions to share information. There were five projects where this observation was absent. These were those projects that included primarily photo presentations with little narrative or accompanying audio, whereby I could not assess intention.

H4, observed for reciprocity evidenced through what type and ways data was gathered regarding land and ecologies that the project focused on. There are 51 occurrences observed out of 57 projects assessed. Within the year of 2017 there are 6 occurrences observed out of 7 projects, in 2018 there are 9 out of 12, 2019 has 15 out of 16, 2020 has 10 out of 11, and 2021 has 11 out of 11. As GIS is a landscape survey tool, focused on geographic data, this high level of occurrence is not surprising. Of the six projects not revealing explicit reciprocity there was a shared topic of historical and museum-collection focus that centered humans as individuals of interest within a particular landscape. The mapping elements emphasized human demography over landscapes.

H5, observed for a dual interaction of activities, these being tribal leadership decision-making that evidenced lessons-learned about perpetuating cultural knowledges. This attended to ethical protocols observed within the tribal project that reasoned why such information was being shared in a public format. Out of 57 projects, there are 32 occurrences observed. In the year 2017 there are 3 occurrences within 7 projects, in 2018 there are 7 out of 12, 2019 has 10 out of 16, 2020 has 7 out of 11, and 2021 has 5 out of 11. This overall result produces a cautionary flag as attending to the ethics of sharing ITEK is of paramount concern, historically and present-day.

H6, observed for evidence of training having been accomplished or being engaged by the Indigenous participants of each project. Overall 40 out of 57 projects evidenced training about and use of remote sensing and GIS technologies was among Indigenous participants of the projects. In 2017 there are found 5 occurrences out of 7, and in 2018 there are 9 out of 12, and in 2019 there are 12 out of 16, in 2020 there are 9 out of 11, and in 2021 there are 5 out of 11. It is interesting to note that in the years where invited response teams and higher levels of collaborators exist the number of trained Indigenous practitioners of remote sensing and GIS is also higher. This might indicate a reliance on outside sources, versus providing training for and utilization of local practitioners. This would create a cautionary flag within these projects in terms of presence of local tribal cultural ways of knowing and applications of ITEK being utilized in local projects versus shared IK information. As well, further insight would be advantageous to understand if challenges to local Indigenous practitioner training exists.

H7, is related to H6, in that observations were accomplished to see where and how Indigenous practitioners of remote sensing and GIS technologies utilized their tribal IKS and/or ITEK within their project. Overall there were 20 occurrences found out of 57 projects. Respectively we see in 2017 there are 3 projects with occurrences out of 7 projects, in 2018 there are 3 out of 12, 2019 has 5 out of 16, 2020 has 5 out of 11, and 2021 has 4 out 11. These are relatively low numbers considering these are projects from tribal nations.

ESRI Five Principles plus Shambu (2020) Considerations: Section 2

The following is presented as a quantitative and qualitative summary of data results relating to each year assessed and their respective projects in relation to the assessment performed. As shared earlier in this chapter, within the following ESRI Five Principles is an overlay of additional guidance, as an enhancement, provided by Shambu (2020) reflecting a call for revision of film evaluation criteria that responds to the complexity of aesthetic and context found within public media written, produced, and/or distributed by Indigenous artists. This guidance is:

- Consideration of “representational context” within the StoryMap is evident and observed as a reflection of the inclusion of Indigenous realities.
- Consideration of the production team, through an auteurist critical approach—meaning the worldview of the filmmaker—is observed as being represented by all or a majority of Indigenous individuals associated with the visual media creation.

- Consideration of acquisition of viewer response as a continuous learning and improvement opportunity has become a necessity for public media projects, and is observed through the StoryMap media form.

Section 2 assessment, now is represented as being:

Reasoning per ESRI Five principles + Shambu (2020): Considerations and Guidance for Creating a StoryMap (2018).

The following ESRI Five principles are accessible at this weblink:

<https://www.esri.com/arcgis-blog/products/story-maps/mapping/5-principles-of-effective-storytelling/>

The ESRI principles are enhanced and stated and coded here, and as asking Does the project:

1. Connect with your audience (who are a broad and diverse audience of viewers/readers), E5p1+
2. Lure People In (the hook also reflects Tribal perspectives of the topic), E5p2+
3. Choose the best user experience (StoryMap templates chosen per project intentions), E5p3+
4. Make easy-to-read maps (mapping story structure respects Indigenous perspectives), E5p4+
5. Strive for Simplicity (concise and clear information respects cultural sensitivities). E5p5+

The following tables refer to section 2 data and are assembled per year and each specific project's identifying factors are coded per year and assigned a random sequence number.

The ESRI plus Shambu elements are denoted by E5p+ 1-5. I provide here a basic legend for indicators residing within the tables.

- A symbol by the project code indicates that technical issues or intentional removal of partial (*) or entirety (^) of the StoryMap occurred.

- Color coding of specific cells:

- lt. green = observed specific IKS and/or ITEK
- lt. grey = No observed specific IKS and/or ITEK
- pale orange = ESRI elements with specific IKS or ITEK designations
- lt. blue = projects with specific tech use observed or referenced

- dk yellow = totals per column
 - dk. orange = overall totals
 - turquoise = # symbol relevance for mainstream industry focus.
 - dk. green = & symbol relevance for heavy inclusion of ITEK and concerns of oversharing.
- Additionally: Symbol > indicates the StoryMap was created as a project that a tribe had invited a regional response team as a collaborator on, that consists of both Indigenous and non-Indigenous members. Remote sensing and GIS technologies are typically utilized by Indigenous cultural specialists, as team members, and are from various tribes.

Section 2 Data Table: _B_

Project Yr	Project Code	E5p1+	E5p2+	E5p3+	E5p4+	E5p5+	# of E5p+ Occurrences Observed per project	# projects assessed out of total projects submitted	Overall # of E5p+ Occurrences per project yr	E5p+ occurring most frequently of projects assessed	Projects displaying and/or referencing specific Tech use	Projects with # symbol	Projects with & symbol
2017	>17-9*#	x					1				x	x	
	17-8#	x					1				x	x	
	17-7^						n/a				n/a		
	17-6#	x	x				2				x	x	
	17-5^						n/a				n/a		
	17-4&	x	x		x	x	4				x		x
	17-3&	x	x		x	x	4				x		x
	>17-2*#	x					1				x	x	
	>17-1*#	x					1				x	x	
TT		7	3	0	2	2	14	7 of 9	14	E5p1+	7	5	2
2018	18-15^						n/a				n/a		
	18-14&	x	x	x	x	x	5				x		x
	18-13*&	x	x	x	x	x	5				x		x
	18-12	x		x			2				x		
	18-11*	x	x	x			3				x		
	18-10&	x	x	x	x	x	5				x		x
	18-9#	x		x			2				x	x	
	18-8^						n/a				n/a		
	18-7&#	x	x	x	x	x	5				x	x	x
	18-6#	x		x			2				x	x	
	18-5#	x	x	x			3				x	x	
	18-4#	x	x	x			3				x	x	
	18-3^						n/a				n/a		
	18-2&#	x	x	x	x		4				x	x	x
	18-1&#	x	x	x	x		4				x	x	x
TT		12	9	12	6	4	43	12 of 15	43	E5p+1 & 3	12	7	6
2019	19-21&#	x	x	x	x		4				x	x	x
	19-20^						n/a				n/a		
	19-19&	x	x	x	x	x	5				x		x
	19-18^						n/a				n/a		
	19-17&	x	x	x	x	x	5				x		x
	19-16&	x	x	x	x	x	5				x		x
	>19-15			x	x		2				x		
	>19-14#	x	x	x			3				x	x	
	19-13#	x	x	x			3				x	x	
	19-12#	x	x	x	x		4				x	x	
	19-11#	x	x	x			3				x	x	
	19-10#			x	x		2				x	x	
	19-9^						n/a				n/a		
	19-8&#	x	x	x	x		4				x	x	x
	19-7&#	x	x	x	x		4				x	x	x
	19-6#	x		x	x		3				x	x	
	19-5^						n/a				n/a		
	19-4^						n/a				n/a		
	19-3#	x	x	x			3				x	x	
	19-2*&	x	x	x	x	x	5				x		x
	19-1#			x	x		2				x	x	
TT		13	12	16	12	4	57	16 of 21	57	E5p+3	16	11	7

Continued Section 2 Data Table: _B_

Project Yr	Project Code	E5p1+	E5p2+	E5p3+	E5p4+	E5p5+		# of E5p+ Occurrences Observed per project	# projects assessed out of total projects submitted	Overall # of E5p+ Occurrences per project yr	E5p+ occurring most frequently of projects assessed	Projects displaying and/or referencing specific Tech use	Projects with # symbol	Projects with & symbol
2020	20-15	x	x	x	x	x		5				x		
	20-14	x	x	x	x	x		5				x		
	20-13^							n/a				n/a		
	20-12&	x	x	x	x	x		5				x		x
	20-11&	x	x	x	x	x		5				x		x
	20-10#	x	x	x				3				x	x	
	20-9&	x	x	x	x	x		5				x		x
	20-8^							n/a				n/a		
	20-7#	x	x	x				3				x	x	
	20-6&	x	x	x	x	x		5				x		x
	20-5&#	x	x	x	x	x		5				x	x	x
	20-4#	x	x	x				3				x	x	
	20-3^							n/a				n/a		
	20-2#	x	x	x				3				x	x	
	20-1^							n/a				n/a		
TT		11	11	11	7	7		47	11 of 15	47	E5p+1,2,3	11	5	4
2021	21-13&#	x	x		x	x		4				x	x	x
	21-12#	x	x		x			3				x	x	
	21-11&	x	x		x	x		4				x		x
	21-10#	x	x		x			3				x	x	
	21-9#	x	x		x			3				x	x	
	21-8&	x	x		x	x		4				x		x
	21-7#	x	x		x			3				x	x	
	21-6&	x	x		x	x		5				x		x
	21-5&	x	x		x	x		4				x		x
	21-4^							n/a				n/a		
	21-3&	x	x		x	x		4				x		x
	21-2#	x	x					2				x	x	
	21-1^							n/a				n/a		
TT		11	11	0	10	6		38	11 of 13	38	E5p+1 & 2	11	6	6
N=73									57					
N=57		54	46	39	37	23		199		199	E5p+1 @ 4 with E5p+2 & 3 @ 3	57	34	25

What has been learned from Section 2 data

My interpretation of the results, as a reflection on project assessments per section 2, provides:

2017

N=9 total projects within this year and 7 had assessable data, with 2 n/a due to removal of link to project materials.

2 of the total 9 projects had all material removed, resulting in 7 projects being assessable.

3 of 7 projects assessed were response team projects.

1 of 7 projects assessed had partial material removed.

2 of 7 projects assessed held observed IKS and/or ITEK information. (lt. green)

5 of 7 projects assessed had No IKS and/or ITEK information observed. (lt. grey)

7 of 7 projects referenced or exhibited specific use of remote sensing and/or GIS.

E5p1+: 7 of 7 assessed projects revealed Connection to a broad and diverse audience.

E5p2+: 3 of 7 assessed projects revealed a hook that reflected Tribal perspectives of the topic.

E5p3+: 0 of 7 assessed projects revealed stated choice of StoryMap template utilized.

E5p4+: 2 of 7 assessed projects revealed mapping structure respected Indigenous perspectives.

E5p5+: 2 of 7 assessed projects revealed concise and clear respect for cultural sensitivities.

Of the 7 assessed projects for 2017 there were 14 E5p+ occurrences.

Of the 7 assessed projects for 2017 the E5p+ mode was E5p+1

5 of 7 assessed projects focused on mainstream industries with perceived negotiation of IKS/ITEK (# symbol).

2 of 7 assessed projects shared large amounts of IKS/ITEK information with a perceived oversharing perceived as negotiation with mainstream interests (& symbol).

2018

N=15 total projects within this year and 12 had assessable data, with 3 n/a due to removal of link to project materials.

3 of the total 21 projects had all material removed, resulting in 12 projects being assessable.

0 of 12 projects assessed were response team projects.

2 of 12 projects assessed had partial material removed.

8 of 12 projects assessed held observed IKS and/or ITEK information. (lt. green)

4 of 12 projects assessed had No IKS and/or ITEK information observed. (lt. grey)

12 of 12 projects referenced or exhibited specific use of remote sensing and/or GIS.

E5p1+: 12 of 12 assessed projects revealed Connection to a broad and diverse audience.

E5p2+: 9 of 12 assessed projects revealed a hook that reflected Tribal perspectives of the topic.

E5p3+: 12 of 12 assessed projects revealed stated choice of StoryMap template utilized.

E5p4+: 6 of 12 assessed projects revealed mapping structure respected Indigenous perspectives.

E5p5+: 4 of 12 assessed projects revealed concise and clear respect for cultural sensitivities.

Of the 12 assessed projects for 2018 there were 543 E5p+ occurrences.

Of the 12 assessed projects for 2018 the E5p+ mode was E5p+3

7 of 12 assessed projects focused on mainstream industries with perceived negotiation of IKS/ITEK (# symbol).

6 of 12 assessed projects shared large amounts of IKS/ITEK information with a perceived oversharing perceived as negotiation with mainstream interests (& symbol).

2019

N=21 total projects within this year and 16 had assessable data, with 5 n/a due to removal of link to project materials.

5 of the total 21 projects had all material removed, resulting in 16 projects being assessable.

2 of 16 projects assessed were response team projects.

1 of 16 projects assessed had partial material removed.

11 of 16 projects assessed held observed IKS and/or ITEK information. (lt. green)

5 of 16 projects assessed had No IKS and/or ITEK information observed. (lt. grey)

16 of 16 projects referenced or exhibited specific use of remote sensing and/or GIS.

E5p1+: 13 of 16 assessed projects revealed Connection to a broad and diverse audience.

E5p2+: 12 of 16 assessed projects revealed a hook that reflected Tribal perspectives of the topic.

E5p3+: 16 of 16 assessed projects revealed stated choice of StoryMap template utilized.

E5p4+: 12 of 16 assessed projects revealed mapping structure respected Indigenous perspectives.

E5p5+: 4 of 16 assessed projects revealed concise and clear respect for cultural sensitivities.

Of the 16 assessed projects for 2019 there were 57 E5p+ occurrences.

Of the 16 assessed projects for 2019 the E5p+ mode was E5p+3

11 of 16 assessed projects focused on mainstream industries with perceived negotiation of IKS/ITEK (# symbol).

7 of 16 assessed projects shared large amounts of IKS/ITEK information with a perceived oversharing perceived as negotiation with mainstream interests (& symbol).

2020

N=15 total projects within this year and 11 had assessable data, with 4 n/a due to removal of link to project materials.

4 of the total 15 projects had all material removed, resulting in 11 projects being assessable.

0 of 11 projects assessed were response team projects.
 0 of 11 projects assessed had partial material removed.
 7 of 11 projects assessed held observed IKS and/or ITEK information. (lt. green)
 4 of 11 projects assessed had No IKS and/or ITEK information observed. (lt. grey)
 11 of 11 projects referenced or exhibited specific use of remote sensing and/or GIS.
 E5p1+: 11 of 11 assessed projects revealed Connection to a broad and diverse audience.
 E5p2+: 11 of 11 assessed projects revealed a hook that reflected Tribal perspectives of the topic.
 E5p3+: 11 of 11 assessed projects revealed stated choice of StoryMap template utilized.
 E5p4+: 7 of 11 assessed projects revealed mapping structure respected Indigenous perspectives.
 E5p5+: 7 of 11 assessed projects revealed concise and clear respect for cultural sensitivities.
 Of the 11 assessed projects for 2020 there were 47 E5p+ occurrences.
 Of the 11 assessed project for 2020 the E5p+ modes were equally 1, 2, 3
 5 of 11 assessed projects focused on mainstream industries with perceived negotiation of IKS/ITEK (# symbol).
 4 of 11 assessed projects shared large amounts of IKS/ITEK information with a perceived oversharing perceived as negotiation with mainstream interests (& symbol).

2021

N=13 total projects within this year and 11 had assessable data, with 2 n/a due to removal of link to project materials.

2 of the total 13 projects had all material removed, resulting in 11 projects being assessable.
 0 of 11 projects assessed were response team projects.
 0 of 11 projects assessed had partial material removed.
 6 of 11 projects assessed held observed IKS and/or ITEK information. (lt. green)
 5 of 11 projects assessed had No IKS and/or ITEK information observed. (lt. grey)
 11 of 11 projects referenced or exhibited specific use of remote sensing and/or GIS.
 E5p1+: 11 of 11 assessed projects revealed Connection to a broad and diverse audience.
 E5p2+: 11 of 11 assessed projects revealed a hook that reflected Tribal perspectives of the topic.
 E5p3+: 0 of 11 assessed projects revealed stated choice of StoryMap template utilized.
 E5p4+: 10 of 11 assessed projects revealed mapping structure respected Indigenous perspectives.
 E5p5+: 6 of 11 assessed projects revealed concise and clear respect for cultural sensitivities.
 Of the 11 assessed projects for 2021 there were 38 E5p+ occurrences.
 Of the 11 assessed project for 2021 the E5p+ modes were 1 & 2.
 6 of 11 assessed projects focused on mainstream industries with perceived negotiation of IKS/ITEK (# symbol).
 6 of 11 assessed projects shared large amounts of IKS/ITEK information with a perceived oversharing perceived as negotiation with mainstream interests (& symbol).

Narrative Summary of Section 2 Data Results

Overall for section 2 data, 73 projects were presented as submissions of tribal GIS projects in years 2017 – 2021, with 57 being accessed for assessment through this study. This resulted in 78% of all possible projects within these years as being able to be accessed. The differential is due to some projects having their access links removed, partially removed, or unavailable during the times I attempted to access them.

Within the 57 projects there were a total of 199 occurrences of heuristic elements observed out of a potential for 285 to occur. This represents an observation of approximately 70% of all projects variously engaged E5p+ elements, with E5p+1 occurring most frequently. Respectively this is represented as: E5p+1 had 54 total occurrences; E5p+2 had 46 total occurrences; E5p+3 had 39 total occurrences; E5p+4 had 37 total occurrences and; E5p+5 had 23 total occurrences.

Of the 57 projects assessed all 57 were observed to have referenced or exhibited use of remote sensing with use of the ArcGIS data platform. Additionally noted with the section 2 assessment is 34 of 57 projects assessed were denoted with the # symbol indicating an observation of potential negotiation of IKS and/or ITEK with regard to a focus of the project on mainstream industries, particularly agricultural and/or natural resources, and their policies and practices of management standards and development projects in ways that override, erase, subsume, and/or appropriate Indigenous ways of knowing, being, and doing.

Further to be noted within the section 2 assessment is 25 of 57 projects assessed were denoted with the & symbol indicating an observation of potential negotiation of IKS and/or ITEK with regard to what I refer to as an over-sharing of these within project

materials. This is assessed as a concern with regard to tribal intellectual property rights, data sovereignty, and/or ethics of data sharing in public digital social media sites. This concern is related to perceived and/or stated potential pressures to appeal to a broader, and potentially non-Indigenous audience.

Each of the E5+ standards included attention to Indigenous viewers/readers, except for E5p+3. This element relates to the type of StoryMap that was utilized, in terms of a style template. To be noted is that in years 2017 and 2021 no information was provided as to which ESRI ArcGIS template was utilized. Upon additional review of the ESRI website regarding StoryMap design tutorials and templates it was noted that a shift had occurred where movement away from a single use of a Classic template became a campaign. Interpretation of this activity is a result from various statements that relate the updates are to provide ease of construction for StoryMaps by non-technical users. As well, this activity around template styles is noted as being attention paid to the StoryWay philosophy of storytelling by Indigenous Peoples' through additional offerings of templates such as Cascade, Journal, and Series style; with the former two being the most popular. These templates provided for additional narrative and audio/video capabilities that also allowed for cross-referencing of information between pages/slides in a bridging fashion. This respects the StoryWay of sharing information in spiral and/or concentric circle formats versus a strictly linear approach. Overall though, my interpretation of the emphasis of ESRI requiring projects to note in their introductory statements which template they used also assisted ESRI in understanding which templates drew more use from among tribal authors and provided a case to move away from the Classic template toward an array of templates.

Also the various projects that invited response teams to be involved, denoted by the > symbol, were not specifically attentive to style types nor whether or not the viewer/reader was Indigenous. These projects' information is provided in a more general audience approach and specifically relates to a distinct type of event assessment for particular agencies and stakeholders.

Another interesting element to note is within E5p+1, and denoted by the & symbol next to the project code, that addresses the style construction topic of connecting with your audience (who are a broad and diverse audience of viewers/readers), there were notable projects that read as being also specifically addressed to one's own tribal people. Text and audio video links were utilized that expressed a personal appeal—tribal citizen to tribal citizen—to pay attention to the information being shared as it related historical, language, and cultural information that reflected the tribes' traditional origin stories and significant historical and culture-based events. This is read as being potentially overt actions to perpetuate the passing on of cultural knowledges to present day tribal citizens via a public digital medium. The concern for me here, relates to intellectual property rights and tribal social media sharing ethics. With the intention to share a project topic important to a tribal community with a broad and diverse public audience viewing and reading about this information from the position of a social media site, is there occurring a conscious negotiation of what cultural knowledge is being shared, in order to satisfy the digital audience? Does this then equate to an impact of “oversharing” that creates a gateway for appropriation and or strategies that bind the tribe in ways that are destructive or diminishing of their IKS and/or ITEK? These projects are further denoted in the table through color coding as being dark green.

The opposite is true of the projects denoted in the table with light grey shading and the # symbol next to their coding number, and totals are color coded as turquoise. These projects were overall absent of observed elements of IKS and/or ITEK. This is reported as a result within section 1, sans the turquoise color coding. Within this section 2, this absence is also interpreted and reflects the presence of intentions of sharing the technologically derived data in ways that places little attention on (possibly purposely so), masks, erases, or replaces the values (per Newe Reasoning) of Indigenous knowledges related to the topic and project goals in lieu of western standard requirements and intentions. A frequent example is found within the projects that have specifically an agricultural and/or natural resources focus, and most often within the realm of management of these.

Interestingly project 18-7 is coded with both the & (oversharing) and # (erasure/replacement) symbols. Within this project ample IKS and ITEK were shared in terms of natural resources that are present and important to the tribe, but also this information was situated as an appeal to engage state agricultural and natural resource policies and practices that would require the removal of these “relatives” in lieu of “balanced progress” elements and situations that would “benefit all concerned” within the area. Additional information would need to be gathered in order to understand the particulars of this decision and to ascertain where exactly mutual benefit exists and from tribal perspectives, as well as what was negotiated in order to reach this understanding.

Consistent throughout most of the projects is a utilitarian perspective of Indigenous knowledge sources, these being of the natural world. Project 18-2 provides a wealth of cultural information. However, the descriptions of natural elements that are

acknowledged as being sources of traditional knowledges that have constituted the culture of the tribe are also referred to and situated as primarily existing for the benefit for and use of humans. Within the shared beliefs and philosophies of Indigenous worldviews reflecting definitions of relationality, the natural world and those who are beyond-human are referred to as relatives. These kin are acknowledged as having a Being that is also external to humans and is often respected as a peer in this respect. The aspects of use of these Beings by humans are within realms of sacrificial gifting of selves for human needs, that also attends to reciprocity.

Nearly an opposite of that approach has been the lack of explicit cultural information but clearly an Indigenous perspective is present. Projects 19-11 and 19-19 are such representations. Their approach to a common insect pest situation that moves away from use of mainstream chemicals in lieu of bioecological, or solutions through attention to biological naturally occurring solutions, presents a level of Indigenous knowledge use that attends to the observational quality of Indigenous knowing practices. No observed use of tribal language or stories is utilized but one can understand from what is presented that an Indigenous way of knowing, being, and doing is the logic basis for addressing a rather normalized and mundane situation.

Project 19-10 presented an interesting approach that is intriguing to consider following-up on. This project provided only a few tabs of information that categorized geographic areas and included only photos that revealed plot information on a common map shared between the areas. No narrative text is provided at all. Was this intentional, and if so for what purpose? Or was information removed or forgotten to be included? From what is provided, one could possibly assess this as being a project that was strictly

for the benefit of a particular audience, and in this case for a natural resource and development agency. The absence of narrative text and directional information counters the purpose of a social media platform approach that seeks to share information broadly and to a diverse audience.

Within each of the 57 projects there is reference and /or explicit visual evidence of remote sensing and GIS use. This is also to be assumed as these projects are all categorized as GIS projects through their submission as ESRI ArcGIS practitioner projects. Over half of the projects provided explicit technical information regarding what GIS is and how it is utilized.

Please note, as a Case Study approach to inquiry, overall analysis of the data within both sections 1 and 2, also engaged plausible assumption and within this study is defined as, each person representing the tribal project, who identifies or is phenotypically observed as being from that tribe or another Indigenous People, is participating in an Indigenous Knowledge system of knowing, being, and doing and has a relationship with ITEK. What is observed through these assessments is whether or not this is evident.

In academic research plausible assumption is utilized within hypothesis-based methodologies with the meaning “to have the appearance of a truth or reason ... worthy of being accepted as true or reasonable” (2023 Merriam-Webster Dictionary). In this study, I engage this as a major coding and analytic concern. Recall within the exploratory work that derived the five thematic concerns is the assumption that a person who identifies as an Indigenous person holds cultural ecological knowledges. Additionally, as this study did not engage in survey or interview methods, if a person within the video project is

observed as not self-identifying, there is a plausible assumption based on phenotype and tribal proximity that the above is also true.

Additionally, the attempted use of a quantitative analysis system for social science data, in this case R and RStudio, was not successful with the present descriptive and observed data, in the form of manual viewing of audio/visual digital forms, versus survey-based. Use of a plausible assumption associated with the value-based heuristics model of Newe Reasoning also was not conducive to use of R platforms. Traditional manual assembly and assessment of linear data in the form of average/ median, and mode calculated results was applied with N=73, and with use of Xcel Spreadsheet formulas within pivot tables. I am though convinced that with more time and knowledge of quantitative analytic AI-based systems, particularly with knowledge of algorithm coding, there could be use of these with Newe Reasoning processes.

Impacts Observed as a Collective from Sections 1 and 2, per Three Themes

Here, I share reflections on the data from both sections 1 and 2, and as results related to the three themes of Education, Technology, and Tribal-Leader Decision-Making per their additional respective descriptions described earlier in this chapter. Recall, I have perceived that these three themes are themselves first level impacts, as they represent broad areas identified as having influences on Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges when use of remote sensing and GIS occurs within tribal landscapes. I perceive these three themes to be gateway points for impacts to occur. Within this study 57 projects were assessed, with the understanding that 16 projects were unable to be assessed as their material links were entirely removed at the

time I attempted to access them in 2021. The gallery of 73 projects can be accessed at the primary Esri Site: <https://www.esri.com/en-us/industries/government/departments/tribal/tribal-challenge/overview>.

Education

Described as being about: An emphasis on Native American Education, particularly regarding the relationship between humans identifying as Indigenous and their cultural landscapes, associated with perceptions about access and public use of Indigenous Knowledges, related to drivers of this education within STEM-based fields.

Use of remote sensing and GIS technologies within tribal landscapes are obviously a highly tribal participatory undertaking as 73 projects were accomplished and submitted through the ESRI public portal within a four year period. These projects, while identifying data has been coded, do represent tribes from across the United States with a higher percentage being represented by tribes in the western region. Looking at who ESRI is as a GIS software development firm and their history, since 1969, of promotion among Indigenous leadership, academic associations, geographic and geospatial analytic industries, there is reason to believe they drive much of the excitement about technology use as related to earth systems, and through educational opportunities. Additionally ESRI is a prime contractor for the Department of Indian Affairs, and their Indian Education division.

Through understanding the results of both sections 1 and 2 data there is found a relatively low number of occurrences. In section 1 there being 27 (H1 data), where Indigenous participants of the 57 projects accessed openly acknowledge a holistic

relationship with the lands and their ecologies that are the topic of focus. However, in these 27 projects there is acknowledgement of the participants largely being Indigenous to those lands. Yet, understanding that philosophically these lands are deemed relatives, there is no acknowledgement of this relationship or the honoring of it within these projects. As well, within section 2 data we find this topic being the two lowest overall occurrences within the five E5p+ elements.

While the drive by academia and industry partners within STEM fields to increase the presence of Indigenous students and professionals is certainly a benefit for the labor market, there is concern as to the assumptions made about individuals declaring Indigenous identities. The assumption is that there exists a relationship between these Indigenous individuals and their Indigenous ways of knowing, being, and doing, that will benefit STEM-disciplines and their associated industries. This concern also crosses-through education initiatives with a call for cultural-based pedagogy and curriculum. Here is where we may find the intersection of the excitement about technology, as a key focus for drivers of academic enrollment and industry hiring endeavors.

Additionally, from the data in sections 1 and 2 we also see that in years 2019, 2020, and 2021 there was a slight increase in H1 and E5p+4 and 5 occurrences. Looking at regional, national, and global trends that draw focus to the relevancy and benefit of Indigenous knowledges, and this through their holders, may provide some explanations. Conversations about environmental issues, particularly associated with realities of global climate changes, has created an emphasis on IKS and ITEK. This in turn has encouraged an increase in partnerships within academic research being accomplished by Indigenous students. This then also connects with who is funding this research and why.

Organizations such as the American Indians in Science and Engineering (AISES) are important players within this scenario as they have access to Indigenous student and faculty communities and are bridges between them and interested industries. This is further enhanced by the recent 2021 call by Deb Haaland, US Secretary of the Interior, for use of Indigenous Knowledges within federal policy decision-making. This extends, through various agencies that connect with environmental and industry partners.

Variously, it can be seen that impacts of assumptions about the relationship between students and faculty identifying as Indigenous and sources of Indigenous Traditional Ecological Knowledges they may be drawing from for academic and industry benefits, require a deeper understanding. This topic is complex and emotionally engaging as it reflects colonizing histories and neo-colonial persistence among Indigenous Peoples. As well, there is the reality of economic benefits that can be achieved for those Indigenous individuals utilizing traditional cultural ways of knowing, being, and doing. Here, as well, there is concern that these endeavors incorporate tribal protocols that attend to cultural sensitivities and ethics for use of such knowledges. This, as the cliché goes, is easier said than done. Relationship building is a necessary element of access and use potentials for ITEK; even by those who are raised and remain among their tribal communities. From this study and the data derived from it I can understand that there is need to attend to this concern regarding lack of attention to the relationship aspects of ITEK and its sources, and those engaging IKS, by those educational drivers of Indigenous student and faculty seeking to increase their visibility. I can stand on this understanding through consideration of the emphasis of the 57 projects to focus on industry and funding audiences, as seen through data within both sections 1 and 2.

Within section 2 data E5p+1 and E5p+2 both attend to the audiences of the StoryMaps. Who are the central viewers/readers for these various projects? Looking at the data we find that over all there is a high level of intention to share information with broad and diverse audiences, and from review of the projects these are primarily state, federal, and NGO audiences. Of the 57 projects assessed section 1, E5p+1 has 54 occurrences observed and E5p+2 has 46 occurrences observed and both reflect a total possible of project occurrences of 57. These are high ratios wherein relationships between the Indigenous project creators/presenters and their audiences do not reflect a focus or acknowledgement of the sources of ITEK as being relatives to Indigenous peoples who are presenting about landscapes. Access and utilizing these knowledges from the land is an intention without respect for the ethics of such activities. This is hard to report as ultimately it is up to each tribal nation and their communities to determine if and what such relationships are and whether or not and how to move within them.

Additionally we find support for such an observation within section 1, through results of the H2 element, that observes for acknowledgment of responsibility of care between land/nature, humans and beyond-humans there is also a low occurrence of this activity. Of the 57 project projects assessed there were only 23 that were observed engaging this standard.

Within Indigenous philosophies of knowing, being, and doing there is a tenet to have care for that which sustains us as Indigenous Peoples. We are Indigenous Peoples because we identify and are cultural citizens of the our Indigenous communities through our ancestral blood ties. It is an accepted anthropological theory that culture is socially constructed, and as such relationality and interdependence among the sources of

knowledges that provide the material for cultural constructs and those who embrace said cultures is imperative to their collective health and continuing existences. This behooves everyone involved to attend to the honoring and care of the sources of our knowledges in ways that create mutual benefit in ethical and transparent ways. The data supports a finding that impacts both beneficial and non-beneficial have and continue to occur from use of remote sensing and GIS technologies within tribal landscapes.

Technology

Also related to the Education theme, but with regard to Indigenous Practitioner training and use of remote sensing and GIS technologies within tribal landscapes this theme draws attention to the training of Indigenous persons to be practitioners of remote sensing and GIS technologies and their use within tribal landscapes.

As previously referenced, “... how science gets done reflects who’s doing it” (Medin and Bang 2014: 236). This quote addresses concerns about who is providing and how training of remote sensing and GIS technologies is accomplished among Indigenous individuals interested in being practitioners. We see through section 1 data and within results of H6, who is training Indigenous persons interested in being practitioners of these technologies, and where, is something to take a closer look at. H6 data revealed that while 40 of 57 projects were observed having participation of Indigenous practitioners, most of these projects had invited outside sources to collaborate with internal tribal departments. This is relevant within H7 data where results found only 20 of 57 projects had observations of Indigenous practitioners utilizing their tribal IKS and/or ITEK.

Again, there is need to do further study, via forming relationships with project folks and surveying and interviewing them for specifics related to all the H1-7 elements.

For now, what is available in terms of who provided remote sensing and GIS technologies training, beyond ESRI, is The Tribal GIS group in New Mexico. This group has been active within training Indigenous individuals to be practitioners of these technologies for over thirteen years. Each April they hold an annual conference in Albuquerque as an event of the Southwestern Indian Polytechnic Institute (SIPI) and in partnership with the University of New Mexico. Through SIPI they provide various certificate and degree programs with a focus on remote sensing and GIS technologies. Without further study, it is not understood if, how, and by who any incorporation of IKS and/or ITEK is being provided through this source.

In terms of understanding impacts through this theme and the study data, there are findings to support that both beneficial and non-beneficial impacts have and are yet occurring.

Tribal Leadership Decision-Making

This theme relates to sections 1 and 2 and this study overall, through a focus on influences of these technologies upon tribal practitioners through their provision of data results and recommendations, and this then influencing tribal leaders decision-making pertaining to cultural heritage and natural resource management within their tribal landscapes.

What we find in both sections 1 and 2 is that understanding is about who is a local Indigenous practitioner within a presumptive assumption per what they reveal about

themselves, what others share, and the credit provided to them via the online sources. What the data collectively provides about tribal leaders utilizing the work of these projects, particularly those that provide access to understanding how they engage IKS and ITEK, is through the fact that these projects exist, and through public social media sites. Can we assume that authority has been given for use of this information in these broad and public ways? It may be appropriate to do so, however, it would be interesting to understand why 16 of the 73 total projects initially presented through the ESRI site withdrew their links for access to their project materials. Initially I had predicted that the development of a similar opportunity for tribes to submit their GIS-based projects via public social media was a consideration, however this would need to be verified with each of these projects.

In terms of understanding what the data reveals about impacts to IKS and ITEK from use of remote sensing and GIS technologies as related to tribal leaders utilizing results derived from these sources, it is evident further inquiry is needed. However, within the projects assessed tribal department leadership has been the authorizing participants for the work that has been accomplished with submission of the 73 tribal GIS projects to the public media site for ESRI. The impacts found are both beneficial as well as non-beneficial in that they relate to the other two themes with regard to the presence and availability of these technologies for tribal use. What is concerning is potential for leaders to not be as well informed as they should be about use of their ITEK within public project forums. This crosses through data sovereignty and research ethics components that have protocols relevant to the need for integration of Indigenous

perspectives within mainstream education as well as specific training of local Indigenous persons to be practioners of these technologies.

Section 3: Five Scholar Recommendations

As previously shared, I address results of five scholar recommendations in relation to the results of section 1, Newe Reasoning heuristics, and section 2, ESRI Five Principles plus Shambu(2020) considerations, as well as section 4, reflections on hypotheses, within Chapter 6 through reflection and reflexive discussion.

Section 4, Reflections of Overall Results per Hypotheses and Assessed Impacts

Doing research through a cultural lens based on value sets that create a distinct worldview, as well as reasoning the data for results through this lens is not unusual. Doing the work of self-in-relation and assembling a methodology and methods per this lens, as a congruent process, is. Developing a hypotheses along with qualitative reflection and reflexive considerations is also less utilized with academic research design and practice. These approaches are referred to as multi- or mixed-methods research. This study has engaged this through collaborative means through application of quantitative, qualitative, and a culture-based reasoning tool referred to as Newe Reasoning. This process has been referred to as Section 1. To further respect the site and sources of data within this study, I attended to the context of the projects as being publicly shared digital media via an online social site, and provided additional assessment through use of the ESRI 5 Principles, enhanced by three Shambu (2020) guidelines for media creation and critique. This has been referred to as Section 2.

Reflections of Results per 4 Questions

Review of the results in relation to the four specific questions assists us in addressing their relevance to the two hypotheses applied to this study. The Null hypothesis states that no change in assumptions occurred as a result of this study's intervention of inquiring about impacts to IKS and ITEK through use of remote sensing and GIS within tribal landscapes. The Alternative hypothesis states that there are impacts observed through the inquiries made by this study. In sum, both hypotheses have been attained, as was predicted at the start of this study. The reason for this is as a result of the situating of these hypotheses as a dynamic of understanding two halves of a whole, where impacts are defined as being both beneficial and non-beneficial as related to their influences on IKS and ITEK.

The four questions, that this study attends to are restated here, and are followed by my interpretation of the findings from data gathered and assessed through this study:

1. Has the excitement about and use of remote sensing and GIS technologies within tribal landscapes been initiated by STEM-based industry drivers or first by the intentions of Tribal Nations and their needs?

The results of this study reveal that the subjects and intentions of each of the 57 projects accessed were beneficial to each of the tribal participants, as there were evidences of use of the information gained by these technologies as being beneficial to the tribe represented by the participants. In this way, their respective goals were met with this use. Can we understand whether or not this was *initiated* by the tribe themselves or by a non-

tribal partner from a STEM-based sector, in terms of an impact? This has not been fully ascertained within this study. While 50 of the 57 projects assessed (H3 data) were obviously led by persons representing the tribe , along with project partners often being from state and federal agencies and NGO organizations and entities, further research in the form of personal contact and relationship development with the project leaders, then followed by permissions to survey and interview them would be necessary for additional understanding about who initiated the project and for whose primary benefit. As an “impact” the results reveal a beneficial impact that attends to the null hypothesis, as reflecting that the tribe engages these technologies based on their understanding there will be benefits to their communities. However, as previously stated, I can ascertain that the alternative is also found in that impacts from use of IKS and ITEK are occurring as both H1 (land acknowledged as sources within IKS and being ITEK and as relatives) and H2 (land represented as traditional cultural spiritual-based sources to be cared for) are presenting low results. H1 is assessed at 27 occurrences within 57 assessed projects and H2 is assessed at 23 occurrences within 57 assessed projects. This translates to less than a 50% occurrence and reflect impacts of lack of acknowledgement and explicit practice of these values within various projects.

To be noted is that within the 57 assessed projects are 5 response team participations. Recall these are a diverse team of specialists who work specifically with impacts to natural resources and projects referred are referred to as damaged or destructive force impacts. These teams are invited through the leadership of tribes, typically through their THPO (Tribal Historic Preservation Office/officer). These five projects would be the only definitive results found as to who initiated the specific use of

remote sensing and GIS technologies within tribal landscapes, as these teams always utilize these technologies through their involvement and teams are representative of at least 50% Indigenous “expert” practitioners and/or intern-practitioners.

Can we ultimately state that in seeking answers to this particular question that these technologies are causal of these impacts? I find that answer is yes. The use of these technologies within tribal landscapes is the focus of these projects and is reflected in the 100% occurrence of these technologies are found within the 57 assessed projects. Further, H3 specifically addresses the relevance of these technologies to the project and reveals an intention for sharing of the information derived from these technologies with their own tribal communities as well as outside them. H3 has a 50 out of 57 score and informs my opinion that these technologies are potentially causal of the lack of explicit acknowledgement of land as a spiritual and cultural source of IKS and ITEK due to the machine- and AI-based process for gathering of information and interpretation of information as data results. Visualization, let alone operationalization, of Indigenous knowledges and they as being value-based has and continues to be challenging.

Within the realm of Geographic Information Systems (GIS) there are becoming more facets of discourse that reflect visualization and also publicly sharing of tribal-based data that is founded within tribal worldviews—these being based on cultural value systems. Ballas et al (2018) provides some guidance about theories and applications found with GIS as associated with the social sciences and concerns about sharing tribal-based data.

Tribal-based data naturally associates with concerns and issues of data sovereignty due to the spatial distribution of variables demographically defined by the

operator of the technology. In other words, what is the intention of gathering particular data. Further troubling this standard is the overlay of valuation of human-scaled belief systems that produce physical results within a landscape. An example is the belief that building a dam on a river will provide access to larger quantities of water by those engaged in agricultural activities and industries. Within GIS, as related to assignment of values to objects, there is an approach referred to as “human cartograms.”

Geovisualization of data related to social human activities is reliant on the interpretation of said data, within the definitions provided by the intentions for gathering such information. Consider, within the medical field the human body is assessed visually as a field of various interrelated and interdependent variables. For this example, suggested by Ballas et al (2018), the intention is to understand degrees of sensitivity within a human body. We can assign landscapes with these same visual field variables to understand scale of impact to the source(s) of sensitivities—in the case of the human body these are nerve endings—present on and within the targeted landscape. When a variable is assigned the value, of say, respect, we can understand an impact to the landscape where respect is exhibited or not through visualization of what is defined as respect for the landscape.

Per the previous example, is building a dam on said river evidence of respect for the river and that which is in relationship and interdependent with it? One needs to look further at who is asking the questions and why (Medin and Bang 2014). The operative element of understanding if, how, when, and why remote sensing and GIS technologies are impacting IKS and/or ITEK is in the revealing of who is asking the questions and operating the technology. This leads us to question number 2.

Within the assessment provided as section 2 ESRI principles and enhanced through synthesis with Shambu (2020) considerations, we find similar results of influence. 34 of the 57 projects assessed were observed as having a focused intention to respond to STEM-based inquiries and/or industry inquiries. Provision of these can only be assumed, sans further inquiry through survey and personal conversations, as responses for project funding received or applied for. A sense of reporting-out is observed within over half of these projects and this is indicative of responding to governmental or NGO-based inquiries, as they tend to be managing and/or community partners.

2. What impacts have occurred to IKS and ITEK from western-based training of Indigenous practitioners for use of remote sensing and GIS technologies, within tribal landscapes?

Within the results of assessment of 57 tribal GIS projects elements H6 and H7 directly attend to this question. H6 sought observation that evidenced the technology was operated and utilized by Indigenous practitioners who had been trained to do so. Anyone who has dipped their toes into the worlds of GPR (ground penetrating radar), or drone-based landscape survey quickly realizes specific training is required. The same goes even more so for LiDAR and satellite-based sensing technologies. GIS, as a software program featuring spatial databases, and part of a broader array of technologies referred to as SIS, or Spatial Information Systems, appears to be requiring the least amount of training. However, this is not true. GIS carries the heavy responsibility of being a data management system utilized for the acquisition, visualization, manipulation and

management of the display of geographic information (Chapman 2006). In some regards, GIS is beginning to be thought of as much more than data acquisition and management but as a “place to think” (15). This ability within a technology gives further attest to the belief that

Technology is not just a tool for human use but...it is also a taken-for-granted access to freedoms that promote the illumination of human minds...and is a powerful influence and means of impact on human environments, mentalities, and identities.

Heidegger 1923

Pennock 2019

Shamir 2020

To be a practitioner of remote sensing and GIS technologies can be construed to be complicit in the impacts of its presence and use within the work of landscape survey. I use the term complicit, not solely in the pejorative sense, but more so as a knowledgeable collaborator with potential to influence what may be an act seen as non-beneficial. Situating human and technological relationality within the frame of collaboration also engages the opinions of various scholars who perceive the agency of technology as needing further consideration and understanding. In this sense technology is not so much an object that humans have created for their purposes, but technology expands with its use as a dependency that drives creation of realities, and these I define as impacts.

This is what I interpret to be the meaning of the following synthesized statements as a quote

Indigenous and local cultures are being absorbed and transformed by the global culture of technology...and technologies are not value neutral...the data and resulting statistics that technology provides does not just describe reality—they create it.

Borgmann 2012

Sandler 2012

Walter and Anderson 2013

Reflecting on the results related to training of Indigenous persons as practitioners of these technologies, we find that H6 reveals 40 occurrences within 57 accessed projects. This means that Indigenous persons are being trained to operate these technologies. H7 reveals that of the 57 projects assessed only 20 evidenced use of these technologies in association with their tribal/culture-based knowledge systems and/or traditional ecological knowledges. Can we then say that how and by who the training was received from is indicative of the low level of IKS and/or ITEK within the observed project? I would contend that there is a great possibility that this is the case, as again application of social human factors, such as values, within the GIS process of data analysis is limited in its ability to visualize these values as evident upon the landscape. This is possibly due to the lack of training as to how to code algorithms with these value sets and have them reflected in the data results. This does not mean that there is no training available to engage this.

Within Chapter 6 I share reflections on curriculum provided within a GIS training that took place in 2020 within a tribal college setting that partnered with NASA's Earth Science Applied Sciences division. The invite to this training promoted it as an introduction to remote sensing and GIS with use of the ESRI ArcGIS system and examples of tribal-based lands data. The "trainers" are non-Indigenous but "joined by tribal members" who advocate for the importance and beneficial use of these technologies for their communities.

Within the ESRI suite of training materials there are a series of frequently revised guides for GIS Analysis. One such guide, introduced as a second edition in 2020, alerts the reader to its association with social sciences with its title inclusion of Geographic

Patterns and Relationships (Mitchell 2020). As promotion of the second edition the preface provides that recent “technological developments have reduced the burden on the analyst’s skill” (viii). This seemingly counters my statement of needed training, noted above. However, I also consider that understanding the positionality and intentions of the analyst are important elements to factor inside the use of remote sensing and GIS technologies. I take up this stance further as a discussion in the next chapter.

Ultimately, I respond similar to what I provided for section 1. There is need for further research in the form of personal contact and relationship development with the project leaders, then followed by permissions to survey and interview them would be necessary for additional understanding about who received training for these technologies and from who. Important would be reviewing the specific curriculum and observation of post-application of the training. As an “impact” the results reveal a beneficial shift that attends to the null hypothesis, as reflecting that the tribe engages these technologies based on the knowledge and experience of their own tribal citizens, that equates to a benefit for their community overall. However, I again can ascertain that the alternative is also found in that impacts from a lack of observed use of IKS and ITEK by Indigenous practitioners within the assessed projects is evident.

With regard to findings through section 2 data, there is observation within the narratives and text of each of the projects that GIS tech is being utilized and provided by Indigenous persons. Several projects related having their StoryMap created by a specific department within their tribe that relates to natural resources and GIS specific tasks. Again, further information would need to be acquired to ascertain specifically who has been trained for use of remote sensing and GIS technologies, where this was

accomplished, and who were the instructors. Knowing this information could provide further insight as to the relationship status between the practitioners of these technologies and ITEK, as sources of knowledge received through engaging Indigenous Knowledge Systems within their tribal communities. Utilizing pre- and post-survey and conversational methods with practitioners could attend to this inquiry. Additionally, understanding where and who training has been provided can lead to further inquiry about curriculum use of IKS and ITEK.

3. With use of remote sensing and GIS technologies, as a means of “seeing” sources of Indigenous Knowledges, what impacts may have created cultural knowledge enhancement, or loss, or negotiation of relationships between IK sources, and systems of knowing, and their Indigenous human relatives, because of their use within public venues?

The operative term within this question is “seeing” from both philosophical and practical perspectives. Additional to this is the need to understand the state of the relationship between humans and their sources of IK, found within ecological realms, and as being impacted by this seeing in terms of IKS and/or ITEK being provided and shared within public venues. How Indigenous people/persons present their relationship with these sources may be perceived as endangering the safety and well-being of these sources. Access to ITEK has and continues to be a coveted process.

It is worth reflecting on this aspect as it arose during conversations, unrelated to my specific research, while attending an Indigenous research ethics curriculum review session at the University of Washington. There, Indigenous scholar peers were discussing

the ethics of accessing public information that had been provided by Indigenous sources. The primary question being whether or not this information is to be accessed without additional communication and authorization from the authors who provided the information on public media sites.

Additionally, from my analysis of the projects, this aspect is an unexpected impact and gap in our knowledge about ethical protocols around tribal individuals and/or nations voluntarily providing cultural information via public digital social media sites.

In terms of my question of how are ITEK, as sources of IKS, perceived or “seen” when provided in a social media form is valid per the concerns of assumptions about Indigenous Peoples and their level of IKS and ITEK knowledge and use of such in daily and importantly professional work-related activities. I perceive that the excitement about and around remote sensing and GIS technologies, with the assistance of academic and industry drivers, has created both beneficial and non-beneficial means.

For the moment, the results from application of Newe Reasoning regarding this question of seeing draws into the conversation all seven of the heuristics utilized to assess the 57 projects. Overall, what the data reveals is that there is a preference for tribal staff of these projects to let the “lens” of the technology provide how and what is seen in terms of the landscape. This also creates an impact as to the maintenance and furthering of the relationships between landscapes and their Peoples’, as interpersonal and more intimate actions are replaced by the technological devices and also the GIS-based interpretative applications of what is seen per the intentions of why the data was gathered in the first place.

4. What impacts, related to questions a – c, occurred to tribal leadership decision-making about their cultural heritage and natural resource management?

Clearly, there has been observed a corresponding authorization of the projects for their submission to the ESRI tribal GIS social media site. Whether or not there were revisions to these authorizations is considered within the fact that 16 data project links were removed or partial materials were removed from their respective online site locations.

Within both Newe Reasoning section 1 and ESRI section 2 data findings we can see some level of shift through denial of access. Within section 1 the H5 data, being the element specifically addressing tribal leadership decision-making, 40 of the 57 projects assessed represented some level of impacts, as 17 projects did not have leadership representation explicitly presented.

This result is mirrored within ESRI section 2 data findings per number of projects without data link access. The impacts found here are perceived to be more relevant to what is being shared via digital media and how, as it being provided publicly. If the technology realm is expanded to include public social media sites as vehicles for GIS-based data that includes IKS and ITEK to be revealed, the impacts could be understood as both beneficial and non-beneficial.

As an interesting development of understanding impacts that has been revealed through this study is the submission by tribal communities and individuals Indigenous ways of knowing and Indigenous Traditional Ecological Knowledges, as publicly shared information via social media and the relationship of this activity to IRM&M tenets, intellectual property standards, and data sovereignty discourses. Through projects that are

assumed to engage and provide access to IKS and ITEK, consideration of the post remote sensing and GIS technological impacts becomes imperative. To understand this activity further an additional study would be required.

Summary of Understandings

The narrative text provided previously in this chapter per each of the four questions with inquiry within each of the three themes, that are also first level impacts as gateways, are represented quantitatively in their entirety within this Chapter 5. Herein, I shared the processes of analysis and provided summary examples and conversation about the data and results, in detail, for methods sections 1 and 2 respectively.

What the results reveal, per my interpretation of the data, is that both beneficial and non-beneficial impacts have occurred within each of the assessed projects as a result of use of remote sensing and GIS technologies within tribal landscapes. Benefits such as engaging in STEM-based fields of study through Indigenous perspectives is evident, and yet, also seems to be driven by industry that tribal leaders deem important to respond to and partner with. Non-beneficial impacts are also part of this observation as there is evidence of technological use overriding personal relationship access to ITEK and the interpretation of information provided through this access. This can be seen in projects where the interpretation of data is not provided by or in-part by tribal cultural educators and/or knowledge holders. The question remains, if these technologies were not utilized, but instead more traditional forms of relationship building, access, and mutual utilization employed, would there be persistent concerns about perpetuation of cultural knowledges

for tribal citizens and learning and application of the values and ethics related to Indigenous Traditional ways of knowing, being, and doing?

In Chapter 6 I will discuss these results further within the context of relationality among and between the information presented from previous research, in the form of six recommendations from scholars within the fields represented by this study. Additionally I will discuss the entirety of the data results as generalizations with regard to trends and recent topics related to this research, and from a perspective of Indigenous thriving amidst colonial-based precarity and affective realities within landscape ecologies, and their associated geographical narratives.

Finally, overall understanding as an assessment of research design and practice processes and continuous improvement is also provided regarding the application of AIRW related to the development and practice of the research methodology, methods of approach and inquiry, and analysis tool utilized in this study.

NAAFAITE (Chapter) 6

Oo soo neek

... AND SO, THIS IS THE WAY OF IT ...

CIRCLE TIME ...

Wayfinding:

Continuing on with the process that An Indigenous Research Way (AIRW) provides for this study's design and practice, we are at the stage of reflection- and reflexive-based conversations, as part of the expression to "give back." At the conclusion of the last chapter I have taken up my Talking Stick and began to reflect on what the experience has provided for gathering information—data—and my read of it, in order to understand if, where, and why impacts are occurring to Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges with use of remote sensing and GIS technologies within tribal landscapes. Here I continue the "giving back" of my thoughts regarding what I now understand about the topic and questions posed by this study. This giving of information is perceived as part of my Peoples' gifting way. Thoughts expressed verbally are intimate activities that are an invitation to the Circle that we are sharing and often begin with a story that provides a thread for the conversation to continue on with. I offer the following statement from a story that comes to mind that expresses my thoughts at this point in this study's journey, provided by Kirin 2018 (through citing Wolf 1996:6)

The instruments and techniques of a particular technology are the product of a prolonged process of cultural accumulation in the past ... Once a technology has come to include these items ... they become part and parcel of everyday existence, and hence culturally necessary.

What follows is my reflection of what I have learned through the exploratory and literature review processes, information gathered and closely reviewed, and in terms of further associated information consulted during this study. Additionally, I share deeper consideration of this study's findings in relation to additional personal experiences and also present-day trends. I provide considerations of Indigenous perspectives in philosophical ways associated with the quote I shared above, being how persistence in use of a technology creates dependency on it and can though promote a culture of a return to ways of knowing, being, and doing as well as a means to provide space for adaptation and thriving. In this way we can understand the constitutive ways technology impacts human intentions and lifeways. Near the end of this chapter with my assessment of use of AIRW and what revisions to the model have occurred and why, as means to further develop its continuous improvement application. I close this chapter, and dissertation, with concluding thoughts, that also address limitations that have occurred, and further study considerations.

A Coming-to-Gather Way

It may be noted, that the focus, approach, and accomplishment of this study has been an endeavor of bricolage—meaning acts of construction. I understand this term was provided in 1962 by French anthropologist Claude Levi-Strauss as a theory of structuralism, that influenced other great thinkers such as Jacques Derrida, Gilles

Deleuze, Jacques Lacan, and Michel Foucault. A hallmark of this philosophy of doing is the bringing together of resources, in a making-do with what is at hand-fashion, that is act of responsiveness to present day concerns. Levi-Strauss saw this activity as a means to represent a bridge between concepts and the “scientific mind” to create a holistic system as a performance vehicle. Derrida argued that this means of a collective approach is a de-centering effect that draws upon too many diverse ideas and inhibits moving toward solutions. Levi-Strauss, however, takes a pragmatic approach to inquiry and problem-solving with an intent to get solutions found in the present versus in a theoretically imagined future.

We find a similar thought in the work of Donna Haraway’s (2016) *Staying with the Trouble* that I have referred to in Chapter 3. Additional thought on this was provided with respect to Despret’s (2015) optimistic collaborative philosophy that creates an opportunity for “becoming with” (Haraway 2016:128) that is inclusive of all who are involved with solution-finding endeavors. Within a study, such as this, the premise made is that there is need to first understand concerns associated with topic, and in pluralistic ways. This broadens the conversation and situates inquiries within a bricolage structure where problems are also perceived as opportunities.

These various ideas are meaningful, and connected through the topic of this study that engages the dynamic of understanding, to explore impacts—defined as potentially beneficial or non-beneficial, or both—within a given context and situation—where landscape survey technologies are now a common means to see geographic areas.

Additionally, having extended and “flipped” the lens to observe for impacts—as means of application of a strengths-based approach versus a strictly deficit focus—as

evidences of technological influences provided information that suggests retirement, replacement, regeneration, and/or innovation of Indigenous knowledges. Engaging observation of public digital media created and provided by Indigenous persons within tribal contexts, I have opened the space to understand remote sensing landscape technologies as means to influence decision making to not only sustain cultural lifeways, but which enables and empowers them to thrive within present day realities and hopes for their futures. I have been particularly interested in those impacts and influences revealed as a developing of IK philosophies into models of practice useful at both local and broader scales, that create actually observed mutual benefits. Along with this inquiry was the need to balance this interest with observation of where, what I refer to as negotiations, of IK and ITEK are occurring in order to achieve means to thrive. The various projects assessed within this study have provided information toward understanding the presence of both beneficial and non-beneficial influences as a result of knowledge about and use of remote sensing and GIS technologies.

This is what has been realized within the findings of this study. While there are impacts that create concern, such as a high ratio of observed absence of use of IKS and/or ITEK when use of remote sensing and GIS technologies within tribal landscapes and various associated projects, these are also opportunities to bring this to light for consideration of a return to understanding of the value, intentional learning, and perpetuation of cultural knowledges that may be applied in appropriate and sensitive ways that bring even greater benefit to the work being addressed. This then embraces my proposed conceptual address of realities of life that reflect the theories of precarity and affect operationalized through a monster narrative that requires embracing of them in

order to thrive amidst them. In the scenarios of this study, this monster is represented by the technologies being observed, and they as now common and a normalized method of being-with and seeing tribal landscapes.

Reflections on Recommendations from Five Scholars

As promised, here I will address Reasoning Reflections on five scholarly recommendations that this study has been associating with.

The first reflection is from the work of Dr. Kisha Supernant,

Supernant, 2 selections: 2017 and 2021:

2017: Modeling Metis Mobility: Evaluating Least Cost Paths and Indigenous Landscapes in the Canadian West. This paper addresses use of GIS by Indigenous practitioners and knowledge holders regarding their landscapes.

2021: Integrating Remote Sensing and Indigenous Archaeology to Locate Unmarked Graves: A Case Study from Northern Alberta. This paper addresses use of remote sensing, emphasizing ground penetrating radar (GPR), within tribal projects and landscapes.

Synthesizing the contributions of this work into points of relevance within this study provides a focus on the use of remote sensing and GIS technologies by or with Indigenous practitioners of these technologies within tribal landscapes. The emphasis of both papers is on the testing of current popular models versus modeling of integrated approaches for inclusion of Indigenous presence and knowledges, as practices, within landscape archaeological projects. Excerpts from these papers assist in understanding their position and recommendations that are synthesized and further considered within the reasoning methods for this study.

Within Supernant 2017 we understand a related concern, within this dissertation, about representation of Indigenous Peoples and their knowledges, through use of cartographic methods and tools such as GIS, through the introductory statement provided here:

Cartography, once a tool of empire, is now being subverted by indigenous communities to expose the assumptions that underlie representation. Indigenous uses of mapping and subsequently GIS to assert claim to territory, ongoing use, and rights to resources land have been ongoing since the 1960s and 1970s, although some have questioned whether GIS is a suitable tool for understanding Indigenous conceptions of landscape. Concurrently, GIS as a tool within archaeology has been subject to critique for being deterministic, mathematically driven, objective, and too far separated from the lives of people.

Further, this paper acknowledges that (63-64)

threads of indigenous GIS, social GIS, and indigenous archaeology have not yet been woven together in a way that informs how archaeologists analyze spatial data ... [and] conclude by proposing ways indigenous landscape knowledge can be integrated into and transform social GIS analysis of archaeological data.

Within Supernant 2021 we understand a similar concern and recommendation. I provide excerpts from the paper to this effect.

We argue that when these Indigenous voices are equitably included in research design, practice of remote sensing changes and more meaningful collaborations ensue. Drawing on Indigenous archaeology and heart-centered practices, we argue that remote-sensing survey methodologies, and the subsequent narratives produced, need to change. These approaches change both researcher's and Indigenous communities' relationships to the work and allow for the inclusion of Indigenous knowledge (IK) in interpretation (Abstract).

To be noted, through this study collaborative GPR work—"reorienting remote sensing under an Indigenous archaeology paradigm" (203)—was accomplished at the request of the Chipewyan Prairie First Nation, and important conversations ensued. Within these

conversations were perspectives, offered by the tribal community, of the benefits and challenges of Indigenous and non-Indigenous collaborations in working with remote sensing technologies, and these as contributing to the work of reconciliation and decolonization within the fields of anthropology, archaeology, and geography.

A reading of the findings from this study revealed that tribal members were engaged in the research project design through application of various IK utilized for area access and treatment of site artifacts. This information guided the linear grid and survey transects planning. The actual use of technology was by non-Indigenous persons. The primary tribal contributions revised project methodologies and methods. Interpretation of the data was a collaborative effort and provided insight to the need for more fully understanding the effects of integrating Indigenous principles (IK-based values) within archaeological geophysics research, the study provided evidence of the need to do so. Ultimately, the recommendations from this study are: a) establish relationships within the study/project group between Indigenous and non-Indigenous participants and partners; b) eliminate barriers by identifying challenges and solutions; c) Incorporate all voices, through provision of space for Indigenous perspectives within the design, practice, and interpretation of the work, and; d) Acknowledge the past experiences of working collaboratively and how to heal and move the work forward in ways that respect how Indigenous participants approach the topic, questions, and ways of understanding their cultural perspectives that value what is being individually and collectively learned.

The recommendations contributed by Supernant 2017 and 2021 collectively provide insight that through Indigenous perspectives landscapes are not sites to be performed

upon or merely observed. They represent a kin-space where life is lived as an individual within a community persisting in a holistic ecology. The community collectively constitutes knowledges that become mundane ways of knowing, being, and doing. These are not held in stasis, but are mnemonic of the emotions and lessons to be learned through experiences gained as a community of humans and beyond-humans within this relational and interdependent environment. Further, there is need to understand, as a practice, that generalized models attempting to integrate systems of Indigenous ways of knowing often disrespect and skew how learning of these is engaged and how access and interpretation of traditional knowledges are sensitively derived therein.

Looking at the overall recommendation provided through these two studies as being a means to assess the 73 public tribal GIS StoryMap for application of these recommendations, or not, I found the following:

While the first of the ESRI tribal GIS StoryMaps assessed were submitted within the year 2017, an assessment of them per Supernant recommendations is still valid, through acknowledgement within these papers, of the fact that such conversations and recommendations had been occurring previously. As such, there is found that the fact that all of the StoryMaps assessed within this study are tribal community created and submitted, the overall recommendations made by Supernant are present. However, my results also reveal specifics of these recommendations as being applied are varied. For example, who initiated the projects and with what intentions that are actually beneficial to the tribe is an area assessed as a concern. There are also projects that do not provide explicit applications of an IKS or ITEK to a degree that understanding of incorporation is being accomplished of what is described as inclusion of tribal “voices” within the

interpretation of data gained through remote sensing and GIS technologies. Furthermore, the overall call for attention to the respect of land as being more than a site to be traversed or for that matter a commodity exhibited for intentions that are not directly beneficial to the landscape is marginally represented by the projects. The final interpretation of the presence of these recommendations within the projects assessed through this study is that there is a concern about a next level assumption by the viewer/reader of public information provided by Indigenous sources that they have worked within their own IKS and applied, explicitly shared or not, ITEK within their project processes. As Supernant contended, the effects of the recommendations are yet to be more fully explored through closer personal observation and participation with the tribal community and individuals working with remote sensing and GIS technologies.

Lone Fight 2017: With the statement that “GIS scientists are courted for validation” (101) this work puts forth consideration of need for “participatory mapping” per a guideline referred to as RIPSS (Respecting Indigenous Participatory Spatial Sovereignty), that is a GIS/remote sensing knowledge generation process. Four “understandings” are presented as recommendations.

Through the contributions of Lone Fight, as a recommendation for inclusion of Indigenous perspectives within projects engaging remote sensing and GIS, we are afforded her creation of the RIPSS process that centers on four “understandings” (104):

- Indigenous People (explicitly including Elders, students, and tribal decision-makers) must be involved in the collection, analysis, and application of indigenous spatial knowledge.
- The knowledge of indigenous Elders and community members must be respected and validated throughout the process.

- Indigenous spatial knowledge must be contextualized within oral traditional and cultural history.
- Indigenous spatial knowledge must not be used to harm indigenous communities environmentally, historically, economically, spiritually, linguistically, or culturally and is generally considered the ‘property’ of the community.

What is most intriguing and sets Lone Fight’s recommendation apart from Supernant’s is the confidence in tribal applications of IKS and provision of ITEK for project use. She provides rationale for this confidence through knowledge and experiences, as stories, from her own People, the Mandan, Hidatsa, and Arikara Nations. She offers that these stories (101),

are our means of making sense of and exploring the world, and they aid us in understanding not only how the world worked/works but ‘how it was meant to work,’ and perhaps most importantly, who we are and ‘who we are meant to be’.

She goes on to share that it is the way of Indigenous Peoples’ to go to places that afford an aerial view of our landscapes—our worlds—in order to understand them and our places within them. She provides consideration that as Indigenous humans, we are “People of space, image, and time ... [and] the seeking of knowledge from a distance and placing it within a landscape, pervades our culture ... that the history of GIS, Indigenous People, mapping and sensing has no clear beginnings” (101). This can be understood to explain her comment “GIS scientists are courted for validation” (101), and even more so today when that scientist is an Indigenous person. Hers is a call for attention to the education needed for more fully engaging these opportunities. Her own experiences as a remote sensing and GIS practitioner provides insight to the processes of application of

IKS and ITEK with work involving these technologies. Possibly, this is the site of where her confidence is drawn. Her work with Indigenous students within a tribal community provided opportunity for the practice of her own recommendations. The results were reported as “the students who would be the caretakers of the land used spatial science technologies and elder wisdom to explore the very lands they will be asked to steward” (104). Her process represents “participatory mapping” activities wherein Indigenous People created the maps and also interpreted them for local and public education purposes. She refers to this process as “indigenizing remote sensing and GIS ... [and contends that in order to accomplish this] Indigenous people must have the best tools and training to achieve it” (105).

Looking at the overall recommendation provided through the work of Lone Fight as being a means to assess the 73 public tribal GIS StoryMap for application of this recommendation, or not, I found the following:

While the 57 projects that were accessed for review were promoted as being tribal participant and Nation submitted, there were no clear statements made as to the specific training received for utilizing remote sensing and GIS technologies. It is encouraging though that what is observed is the credits provided within most of the projects reveal there are Indigenous professionals, even titled as experts, involved. As has been learned from exploratory visits with individual interested parties and through literature reviews, training for use of these technologies is necessary. The creation of a StoryMap also requires an understanding of how these technologies work with one another for gathering information, assembling it as data, interpreting it through various analytic tools, and then creating a means to share the information. This is good news for the educational

endeavors of Indigenous individuals interested in utilizing these technologies. What is less encouraging, at least from the perspective of a Case Study and observation-based methods use, is that engagement of Indigenous Knowledge Systems and use of ITEK is not as obvious. Overall, there has been training accomplished. Has it been training that is inclusive and encourages use of IKS and ITEK, and this described as a “best tools” approach? It is not, overall, evident that this has occurred.

Wessels et al 2022: The Drone, the Snake, and the Crystal: Manifesting Potency in 3D Digital Replicas of Living Heritage and Archaeological Places. This paper addresses a need to “critique the western paradigm of archaeological visualization and propose recommendations for inclusive, decolonized visualizations of living heritage and archaeological places.”

The work of Wessel’s project is a reminder that additional emphasis on archaeological survey and applied representations of the work is still needed as a focus when working with Indigenous living heritage and archaeological sites. The issues focused on within this paper center on the challenges of translating and visually representing value-based relational aspects of physical sites with their past and present inhabiting communities.

An excerpt from this paper’s abstract provides the purpose of this work is to digitally replicate a site of living heritage as an archaeological place that “responds appropriately to its political, cultural, and social context along with communicating its archaeological significance.”

Further, Wessels contends that it is the western philosophical origins of archaeology that have created an ontological binary that is evidenced through visualizations of cultures within anthropological studies. With the use of remote sensing and GIS increasingly representing standard scaffolding tools for this imagery there are

concerns about bias of the operators and how they see that which is being replicated. A central finding and persistent question of this dissertation is how does technological means of seeing people, landscapes, etc. influence what is produced and which constitutes assumptions about what is being represented. There is agreement that a crucial network of elements of this work include the way data is produced and how the interpretation of it is accomplished, and shared. In this way technology is a co-producer of the information. This is additionally true through what Ingold (2000) posits about how we perceive the world by moving through it. Digital technology affords us this ability to traverse a landscape without actually being with it in person. This enables a pseudo relationship to occur and can be manipulated by the viewer to experience a place through the lens and tools of technology.

What is increasingly being erased and/or masked within these conversations and applications, Wessels posits, is that this technology is a voyeur for minute details of a landscape and records these for various stated reasons that are expressed as engaging preservation and conservation issues. He asked though, “what is exactly being recorded for preservation?” This harkens back to an increasingly frequent topic held within tribal GIS practitioner conversations about providing, as tribal people and nations, IK information in public forums. Two recent articles by journalist Melanie Lenart exemplify this topic.

The stage for these articles were provided during a 2022 First American Land-Grant Consortium annual conference held in Albuquerque, New Mexico tribal educators discussed “the use-and-abuse-of Indigenous Traditional Ecological Knowledge” citing the November 2021 Call by the U.S. Whitehouse for use of IK within federal decision-

making. Overall concerns were about “how to protect the Indigenous Traditional Ecological Knowledge identified as a priority in many federal grant opportunities, including the renewal grants supporting ag-related programs and research at tribal colleges and universities.” Related to these concerns is that these groups are exercising the Whitehouse Call and Guidance document (distributed November 2022) as support for their request that ITEK be included in proposals. During discussion periods a conference attendee was noted cautioning others “to be wary about signing away author rights when publishing information about Indigenous Knowledge in western journals, citing an experience involving the Salish and Kootenai tribes in Montana.” This attendee further cautioned, “Make sure that you’re not signing the rights to traditional knowledge over to another entity ... we wound up in a position where traditional knowledge was published ... and the publisher laid claim to traditional knowledge even though it’s referenced in the book ... They told the tribe they were no longer able to share that information.” Additionally, participants and guest speakers contended that “options for protecting ITEK are limited because of the US legal system ... There’s no policy set in the United States to protect sovereign data.”

Relatedly, Lenart provided a briefing of this event in a piece within the 2022 Native Science Report. Through this same source and author on March 29, 2023, in an article titled Safekeeping Native Knowledge, further information was provided about the Whitehouse move to produce and provide the public with the Guidance for Federal Departments and Agencies on Indigenous Knowledge, that was digitally distributed November 2022. This news opens the conversation for Tribal Nations to develop protection-based policies regarding their Indigenous knowledges and to avoid further

conflict with those entities and individuals accessing and utilizing this information publicly. At the present, it can be understood that access of information provided publicly via digital media, including social media sites, is open source information. This is further complicated by current policies that invoke the Freedom of Information Act (FOIA) for information co-produced by tribes and others who have utilized public and or federal funds are required to disclose and make available the information, that may contain IK and/or ITEK. This is particularly exercised by such federal agencies as the United States Geological Survey (USGS), which regularly works with Tribal Nations on a variety of geoscience projects. There are additional guidance provided through such as Appendix C of the U.S. Global Change Research Program that suggests researchers be attentive to informed consent processes. However, these do not attend to the situation where tribes have already provided information publicly, of their own volition and through their own websites and media sources.

To further stress the issue, within another of Lenart's articles dated February 22, 2023, titled Finding Common Ground, there are additional guidance and cautionary tales, particularly within an example and commentary by members of the Karuk Tribe in Northern California. They relate stories of their long-term experiences of working with state and federal governments on projects involving their traditional knowledges about "cultural burns" as fire suppression measures. They situate this information within the lukewarm reception by tribes of the Whitehouse memo and Guidance document. Theirs is a reminder to be cautiously optimistic.

One story involved an area Karuk call Pikya'vish, a sacred site also known as the Panamnik World Renewal Ceremonial District. Agreements had been made, all the

required steps accomplished to protect the area, and tribal mapping of the area had been submitted as requested. The result of this “collaboration” was relayed as “... you know, the first thing they did is they went right there and they started putting (bull) dozers on there ... So it was like, ‘what are you guys doing ... are we just identifying things so you can damage them?’”

The tribe went on to sue the National Forest Service and won their case to stop the logging. Ultimately, facilitation of discussions through centering value systems and beliefs of all parties provided paths forward. The previously highly quantitative processes of Agricultural and Geographic and Geological policies were not useful in assessing the needs and benefits for tribal partners. The integration of these various value sets though opened space for a multi-method approach that has proven to move projects forward. The greatest benefit of this integration process was the application of ethics, from Indigenous perspectives, of the recording and distribution of information regarding tribal landscapes.

While this was one tribe’s public sharing of their experiences with technology and its impacts of being the lens for gathering ITEK, it is a tale found among most Indigenous tribal communities. These tales have a thread through them that reveals technology encourages the sharing of ITEK and by tribal nations, as leaders are asked to participate in high level management policy forums that engage their cultural heritage and natural environments and they perceived as being resources. As well, there is a caution for those technology practitioners to be mindful of advising use of these technologies for the mere sake of keeping up and being engaged with the worlds these technologies are centered within. We see this tendency within AI and IT fields whose mission is to create better, bigger, and broader ways of mining for information and use of their applications. Present

examples are with ChatGPT platforms that are entangled with issues of data sovereignty and personal demographic privacy issues, and their access and uses.

Returning to the work of Wessels, we find he argues that the creator of digital media forms is influenced by the capabilities of the technology utilized to reproduce the images of relationships being observed. He provides an example of drone use to survey and create a grid of the landscape within an African village site. The broad aerial capabilities of this technology required conscious attention to parameters being surveyed, as there were points where ceremony and ritual had been, and are present-day frequently, accomplished. While previous surveys' documented these sites, it was a directive by Wessels team to try not to include these, and if imaged, they would be removed in editing processes under the guidance of the tribal representatives. What is an interesting dynamic of this process is the gaps between tribal opinions of what can and cannot be shared. The excitement of seeing, from an aerial view, the landscape and what may have gone unnoticed from a ground-level view, creates an emotional response. Having the additional technological ability to enhance these images with details that "bring to life" various elements is intriguing. The project results concluded that what can occur, when ethics in decision making are understood and abided by, is meaning-making of places that are important culturally requires decisive discussions about the public sharing of this information. For whose benefit and intentions is the information to be shared is key to these discussions. A level of internal ethical process though is required and an inclusive consensus realized is necessary, because once information is digitally reproduced and provided in public forums—and becomes part of the metaverse—it can be virtually

impossible to completely remove it and its influences on the viewers, and on future assumptions of what is viewed.

The primary recommendation offered, through a system of stepped approaches, is to be cognizant of these influences from use of remote sensing and GIS technologies, and their power to co-create and alter perceptions of what is being observed. This also draws in the debates within science fields about objectivity and subjectivity, and from Wessels' understanding perspective is the determining factor for what is provided for viewing in a particular way, with a particular message.

Looking at the overall recommendations provided through this study, as being a means to assess the 73 public tribal GIS StoryMap for application of these recommendations, or not, I found the following within the 57 projects that were accessed. The messaging that all the projects engage is that they were provided to the public intentionally, and the assumption is that these were created and provided with tribal approval. Viewing particular projects it is clear that information sharing-drivers were not necessarily tribal-based though. As well, only assumptions can be made about the internal mechanisms that determined what ITEK would be provided and if there was a conscience understanding that placing the StoryMap in a public forum would provide access to them. Possibly this is what occurred with the subsequent removal or registration-based elements that appeared within some project, post-submission.

Sanger and Barnett 2021: Remote Sensing and Indigenous Communities: Advances in Archaeological Practice. This paper represents a Call for changes within archaeological practices for addressing ethics of utilizing remote sensing instruments among Native American communities.

Sanger and Barnett provide guidance to the issue of archaeological emphasis and increasing use of remote sensing and GIS technologies within projects involving Indigenous communities and their landscapes. There is an appreciated balance of the topic with regard to their insistence that these technologies are viewed by archaeologists, and tribal partners, as actions that engage more responsible and ethical methods within their work. However, this does not override the need to continue to do better. There are consistent challenges with use of these technologies that create areas of conflict, or where such can occur and are addressed as four potentialities. These are: a) Cultural Sensitivity, b) Sovereignty and Relationship Building, c) Data Accessibility and Ownership, and d) Conflict with Traditional Knowledge and NDN Science.

By now you are becoming familiar with the threads that remain visible within the discourse of this topic. Of the four noted areas of focus within this paper the fourth is of primary interest as a less attended to concern within most of the literature I have come across related to the topic of this dissertation. Situated as various “tropes” within anthropology, and specifically archaeological projects involving Indigenous histories and also their contemporary lifeways, this fourth item addresses the findings of my study in a particular way.

Sanger and Barnett cite the tropes of “science versus religion” and “discovery” of ‘lost cities’ or ‘vanished peoples’ as recurrently attributed to projects involving remote sensing and GIS and that this reifies the damage created by imperial and colonial methodologies and methods. Their recommendations are to reframe remote sensing and GIS to enable mitigation of such issues and to center on positive contributions and opportunities with their use. Additional recommendations of how to accomplish this are

provided through addressing and decisively engaging the following as actions to be accomplished:

- Nondestructive, Noninvasive, and Nonextractive: The Importance of Developing Relations
- Interweaving Datasets: Working with Knowledge Holders and Rejecting Stereotypes
- Moral Ownership, Data Control, and Intellectual Property

What I find most interesting, of these further recommendations and as associated to the noted comments above about tropes, is there is an assumption that the definitions for these various actions are the same within each tribal community. As well, that there is internal tribal agreement of these as means to address the persistent concerns and suggestions for use of remote sensing and GIS within tribal landscapes and by tribal practitioners. There is an assumption that within IKS and ITEK these exist and are readily available for use in accomplishing these actions. I contend the recommendations are spot on and they are important guidelines, I just have found through my research there are broad assumptions being made about tribal engagement occurring within the ways these guidelines are discussed.

Looking at the overall information provided through this paper, as being a means to assess the 73 public tribal GIS StoryMap for application of these recommendations, or not, I found the following within the 57 projects that were accessed. Again, the low result of observed use of IK, as a system of science and way of knowing, along with application of ITEK creates concern about assumptions that tribal communities have direct access to these and are applying them within such as the StoryMap projects. As noted by Sanger

and Barnett, with an increase of Indigenous practitioners of these technologies creating and providing projects for public viewing, “it will be interesting to see how, or if, this will impact the public view of NDN communities as “antiscientific” or if public perception will change” (199). Additionally, as I have consistently observed, will there be evident use of IKS and ITEK that perpetuates the cultural identities of Indigenous practitioners and of their constituting knowledge sources, versus subsuming or replacing them for western versions.

Nesvold 2023: Off-Earth Ethical Questions and Quandaries for Living in Outer Space. Despite the title pointing to non-earth-based landscapes and issues, this text addresses many of the preliminary concerns expressed by interested parties of this study’s topic. Of particular interest is the issue of “how to balance our other interests and desires with the need to protect the environment from ourselves.”

An intriguing and equally concerning point that Nesvold makes immediately is the consistent response she receives from Space industry folks when she asks questions about ethics, and protection risks, and other such community based concerns about building settlements of humans off-earth. The response, she generalizes, is the “we’ll worry about that later.”

Questions she posed related to being human within a new environment, but with the reality of the cliché, no matter where you go there you are. Her interpretation of these exchanges was that there was much more concern for the technical issues and challenges posed by such endeavors. She is puzzled by this result as it connected with another cliché, being, history tends to repeat itself. She assessed this as a zeal and excitement about what technology affords humans in terms of creatively evolving into “new worlds” and how these are promoted as blank slates for engaging a utopian envisioned reality.

Nesvold, an astrophysicist at MIT, attributes this lack of emphasis on ethics issues, relegating them to the back of the bus, as a result of a minimal education in humanities subjects. An excerpt (viii) of her realization provides

... I was relieved to discover that there are plenty of space ethicists and other scholars who are already considering how we can live justly and ethically in space. There are also countless researchers studying human society on Earth who have never considered their work in the context of space but have much to offer in the way of cautionary tales from our past and analyses of the origins of injustice and exploitation today. But there remains a disconnect between this wealth of knowledge and advice and the people who are actually working in the space industry.

She relates these results to her own experience as a STEM educated academic and scientist. From her research she developed a podcast to “prompt space settlement enthusiasts” to contribute questions that their industry should be asking as humans are closing in on being residents off-earth, whether within structures situated in our atmosphere, or those of other planets or moons, or as settler-residents physically living on these landscapes. Nesvold’s book provides information gathered from her podcasts to inform space industry communities, as well as the whole of an interested humanity, about what she has learned to assist us in designing and building spaces off-earth, being humans off-earth, and how these need not reflect, but need to correct our human experiences on-earth and with earth systems.

Again, even within the focus of a STEM-educated scientist there is need to address the ethics of technology use and its influences upon human perspectives of evolutionary benefits and use of knowledges that are founded within our environments. She points to the values and belief systems that individuals have that are a product of our cultural identities and communities. Further, and additionally related to the topic of this

study, there is discussion about the “anthropocentric view of space, focused on humans as both the decision makers and the potential victims of those decisions ... [and] our ethical responsibilities to the space environment itself” (94). Nesvold points to assumed privilege and power that humans exhibit through assigning value to natural environments and their ecologies based on benefits to humanity. This utilitarian and functional philosophy is also reflected within contemporary Indigenous practices regarding environmental realms, particularly when no evidence of use of IKS is being employed or ITEK is being addressed.

There is an assumption that being Indigenous means there is an inherent, if not only a preference for a, holistic philosophy as a way of knowing, being, and doing that permeates one’s lifeways and relationships with the world, particularly the natural world. Additionally this is compounded by biocentric perspectives, attributed to Indigenous Peoples’, that considers all matter, seen and unseen, to have “intrinsic value, independent of its utility for humans” (95). While there are interpretations that reflect these assumptions as being active within ancient, historical, and contemporary Indigenous knowledge and belief systems, there is also a fatigue occurring within our Indigenous communities about these. It is not about whether or not these are truism, but about the expectations that these are true and that what is provided with identifying as being Indigenous includes Indigenous Knowledges, and as derived from such was as reported through these philosophies.

This is a difficult discussion topic, but is evidenced as a concern within this study’s findings. Nesvold recommends, as do the other five scholars cited in this exercise, that relationship building with those involved in the situations of concern be consulted for

their opinions and advice. The seekers of this advice could well be the Indigenous Peoples' of this planet who are yet dealing with and trying to find means to thrive amidst the realities of the past and present, in order to create visions and social structures for the future that provide well-being for all involved. It is heartening to learn of those Indigenous students and professionals within Outer Space-based academic subjects and industries who are interested in what their personal Indigenous cultures provide as guidance for the type of questions and concerns that Nesvold poses.

There are also interdisciplinary communities that engage active understandings about how to be human off-earth while attending to the issues of being human on this planet. There is ELSI, the "ethical, legal, and social implications of space" organization that is doing good work in these respects. As a synthesized recommendation from Nesvold's work, we can consider that technology is a primary driver and influencing factor of the vision for going off-earth. It is the spatial and geographic technology associated with cartography that has provided the clearest and most intense images of what we previously only imagined could exist. Cases for going into space, as a necessary benefit for humanity, create an inevitability perspective that we must go into outer space, as a right. From an Indigenous perspective of this, and akin to the worldview that Lone Fight has shared, outer space is actually a place of return, particularly for the human descendants of cultures ascribing their existence to places off-earth. What of these origin stories can we connect with technology as a consistent partner with human beings? Is there a familiarity to this relationship then, that requires no emphasis in understanding who influences whom?

Looking at the overall recommendation provided through the work of Nesvold, as being a means to assess the 73 public tribal GIS StoryMap for application of this recommendation, or not, I found the following: the abundance of engagement of tribal persons and nations that provided submissions of their StoryMaps, that utilized remote sensing and GIS technologies evidence of a familiarity with technology. While, as stated earlier, no direct evidence is available of the training provided to Indigenous individuals credited as practitioners of these technologies, there is though the impressive array of creative products from this work. Technology provides a platform for additional artistic avenues for the sharing of Indigenous perspectives, whether they be initiated by Indigenous intentions or not.

Through this exercise of reviewing the findings of the assessment produced through this dissertation work within the recommendations provided by the five scholars chosen for their relevance to the topic, we see that ethics are a connecting thread. Ethics about internal tribal decision-making about use of remote sensing and GIS technologies are at the center, but peripherally are those advisors and practitioners of these technologies who encourage their use. Academic, non-profit, various industries, and funding drivers are implicated in these acts of encouragement as they provide initial purpose for projects to be engaged and provided in public media forms. They also provide incentives for Indigenous students to pursue academic degrees and professional training related to these technologies that assist in fulfilling education and labor market quotas.

It is through forward thinking such as these scholars present, that we are able to imagine and envision Indigenous Knowledges, as not only that retained from the past, but

as emergent in their capacities to address and lend solutions to present ecological issues, and potentiality for those in the future. Overall, through the exercise of reviewing the project assessed through this project with regard to the recommendations provided by the five scholars noted above, there is yet a concern about tribal representation of cultural participation with these recommendations. In otherwards, are the Indigenous participants referred to as needing space that these recommendations afford, practicing these themselves? These are internal tribal and Indigenous individuals ethical domains.

Technology as a Knowing and Seeing-Way

Through the course of engaging the topic of this study and of understanding its findings a central focus has been the type of sources utilized for inquiry and they as examples, as well, of technological ways that impact IKS and ITEK. Looking at the placement of data, as an ESRI ArcGIS StoryMap, within a public digital media social site required consideration of the realms this activity engages. One major realm has been the act of “seeing,” as a way of knowing, through technological means by Indigenous practioners of these at tribal-based landscapes, and of self-in-relation to them. Cultural identity is constituted through such relationships.

Early in my research journey I came across the work of Terence Turner and his 1992 study among the Kayapo, of the Amazon, and their use of video cameras. Turner referred to his study as a finding of “an unprecedented phenomenon: the appropriation and use of the new technologies by indigenous peoples for their own ends” (5). Turner, citing the work of Faye Ginsburg, agrees with the observation that the use of audio/video technologies by Indigenous persons engages “a ‘process of identity construction’ in the

cultural present” (6). He further agrees with Hall (1990, 1992) that observations provide an understanding that this use is “different” from mainstream intentions in that it

... rejects the notion of ‘authenticity’ as applied to an idealized conception of ‘traditional’ culture and emphasizes the ongoing production of ethnic, cultural and subcultural identity through the construction of ‘hybrid’ representations, combining aspects of mass culture and technology with more traditional elements.

Turner further explores the idea of film and video media as bound by a culture that is entangled with a purpose for “mediating culture.” Public media, as a social construct, engages a project of “communication of cultural knowledge” for political and social ends, that requires a condition of determining which member of the community assumes the role of videographer with the understanding that this process may be a formal exercise or not, but generally tends to bring to the surface, often latent, conflict. Here is where tribal leadership decision-making related to cultural community protocols are most evident as needed or are in practice.

In Turner’s paper he further relates a conversation he had with a Kayapo editor of video footage they were reviewing. This individual had received training in Sao Paulo to the degree that he was quite a master of basic editing techniques. There were several “cuts” to the footage and Turner wondered why. The editor responded, “ All over the world people are looking at these videos we are making of ourselves ... it is not Whites who are doing this work ... I have learned this skill to work for our common good ...” (9). The introduction and presence of technology has influenced the ways cultural representation is provided by an Indigenous People and that they can utilize for their own means. They are creating the assumptions and perceptions of their cultural ways of Being and contemporary lifeways.

Turner further relates his findings when comparing the video footage made by non-Indigenous videographers and those made by Kayapo operators. A key aspect I focused on was the initial levels of cultural identity naturally expressed by Kayapo videographers in their daily living and on a personal basis that is observed through their film footage subjectivities versus that of those Kayapo who were “socialized” to white society and cultural ways. Additionally, of interest is the temporal effects of being socialized and how this is reflected in the film footage produced and edited by Kayapo operators.

Results found that as Kayapo became more aware of the presence of these technologies among them and the power that they held as influencing perceptions of self and community to those outside their communities, their forms and messages of self-representation also shifted. This was not solely an external impacting endeavor, as there were uses of technology by internal leadership for personal benefits as well. The dynamics of social and political traditions were impacted. An example found in this study is the use of video by a tribal leader to record the activities he was engaged in for cultural and educational posterity, but also for “establishing his claim to chiefly status” (11). Turner assessed these activities as being evidence of the influence of technology on the “social consciousness” of the Kayapo and as a form of self-objectification of their social realities. The benefits has been seen as providing a deeper and broader sense of agency for the Kayapo, but also, the use of video technologies have provided access to ethnographic means to alter aspects of their cultural ways of knowing, being, and doing that construct their identity as Kayapo. Results of these changes obviously alter, through abandonment of prior cultural ways, or revision to this, or even replacement. These

changes obviously impact inner Kayapo society dynamics and also external perceptions of who Kayapo are today.

This shifting of cultural identity tends to disrupt western views of what are “traditional culture”—anthropologically referred to as *Frankfurtlich*—and an assumed static concept of what traditional Indigeneity looks like. This also troubles the work of such as this study engages, being the operationalizing of beliefs that a tribal People embrace and that construct their cultural lifeways.

To be sure, there is a great amount of attention required for this activity of understanding Indigenous worldviews, and they as defining measures for ways knowing. To be appropriate with this work there is need to be in relationships with the holders of these ways and to understand, at least from a Shoshonean worldview that I find is also a shared Indigenous worldview in some respects, that there is intentional activities performed when accessing traditional knowledges, particularly when seeking insight to what is perceived as contemporary issues. From my Shoshonean perspective one does not just casually seek ecological knowledges for the mere purpose of wonder. There is an intention to the seeking that begins long before the gathering. It is worth considering if gathering by technological means might be by-passing time-honored protocols that attend to the desires and ways for cultural knowledge production that impacts tribal identities.

Further exploration of the use of technological means to see Indigenous culture in action through public media forms is found in the 2006 paper by Kristin Dowell. She reflects on the “arena of cultural production” that media technologies provide as

a practice that simultaneously alters the visual landscape of mainstream media by representing Indigenous faces, histories, and experiences onscreen, while serving a crucial social role offscreen to provide a

practice through which new forms of Indigenous solidarity, identity, and community are created.

This is further expounded on by Dudemaine, Marcoux, and St.Amand (2020), *Indigenous Cinema and Media in the Americas*, who related the conceptual and emerging nature of Indigenous video and film as being a resurgence of the “languages of the place ... along with the philosophies and knowledges they contain” (29). This is further expressed by Michelle Raheja (Seneca), through her 2017 book, *Reservation Reelism: Redfacing, Visual Sovereignty, and Representations of Native Americans in Film* (147), wherein she posits

Film and other forms of new media operate as a space of the virtual reservation, a space where Native American filmmakers put the long, vexed history of Indigenous representations into dialogue with epistemic Indigenous knowledges.

Von Mossner (2017) would reflect on this statement as an embodiment of Affective Ecologies. The embodiment of cognitive experiences is relevant to the conversation about seeing landscapes and their relationships to humans through technological means. Von Mossner posits “embodied cognition plays an important role in the simulation of social experience and moral understanding” (3). “Cues” derived from viewing environmental narratives tap our senses for an emotional response that belies our human-nature relationships. This engages an ecocritical approach to understanding intentionality of sharing lands-based Indigenous knowledges that may engage social, political, and economic considerations outside the evident material being provided. Von Mossner asks, “How do we experience the characters, events and environments we encounter in literature and film on the sensory and emotional level?” (3). Do these experiences create

respect and care? How we present our relationships to those outside them is both indicative and constitutive of the relationship. The depth and amount of information shared publicly about sources of Indigenous Knowledges can be perceived as a persistence in traditional relationality between humans and beyond-humans, or as a shift away from that which has been held sacred, but now through a Commons access, may be seen as a negotiation of the sacred.

Harkening back to Turner, we see his argument emphasizes a driver for use of technology that sees and gathers traditional Indigenous knowledges as being associated with consumption. Western consumerism in its various forms, of say access through education and economics, creates a dynamic of valuation of what one has to offer for gaining what one deems is necessarily needed for well-being. The commodification of Indigenous knowledges is a representation issue that has long been debated within the discourse of tribal sovereignty. Understanding the rights of a People to determine what of their own cultural lifeways is open access is a considerable undertaking as it sets a precedence of anticipation and expectation—possibly even of entitlement—that occurs in the realm of the Commons. It is a difficult platform tribal knowledge holders are being asked to be part of within the quest for solutions to negative effects of Global Change.

With the intersect that this study provides between remote sensing and GIS as tools of landscape survey—along with further production and public presentation of the data in visual forms—and the mainstream production of visual media by Indigenous people, we should be compelled to look at the influence and cultural identity constitutive power that these technologies engage. Working with and through the lenses of remote sensing and

GIS is not disassociated nor a sidebar to the entertainment realm of public media activities.

If anything can be learned and understood from the review of the StoryMaps within this study is that they are not neutral project presentations nor entirely explicit with their intentions. There are tangential threads that are woven, and hanging off of each like barely noticed frayed edges, that when realized they exist should cause consideration of the impacts of these technologies to Indigenous ways of knowing and of being in relationship with the sources of Indigenous knowledges; those teachings found within natural and beyond-human realms.

Taking a moment to consider the non-explicit within StoryMap information, we can understand Gamble's (2008) theory of what he refers to as layered characters within land-human relationships as being "hidden" and even strategically dense "scapes" that are afforded invisibility because of their mundane presence in everyday life. He further refers to these as "inner landscapes, [and] as conceptual devices for identity based on self and personhood [and] depends on ... metaphors (258). Metaphors, per Gamble, are material and represented by such as land and their visible elements. Scapes, then, are the products created by land-human relationships and referred to by Ingold (1993), Hamilakis, Pluciennik, and Tarlow (2002), Thomas (1996) as being bodyscapes, sensescapes, and taskscapes. In these ways then, land-scapes are constitutive. Viewing the digital material shared by tribal practitioners, the StoryMaps, through this understanding we are able to consider that how landscapes are seen, and by who, create cultural identities and the assumptions about what might be their relationship.

How we know and identify ourselves reflects what we hold as necessary to their construction. Culture, being socially constructed, is emphasized within Indigenous communities and many, if not most, assigned this construction to their relationships with their land-based environments and ecologies, and these represent ways of knowing, being, and doing that create Indigenous worldviews. These then guide decisions about how we move within the worlds we occupy and visit.

How we see and engage relationships between the sources of our Indigenous Knowledges and ourselves is increasingly relevant today. Historically Indigenous culture and identities have been the focus of colonialism throughout the world. In the early 1900s there began a campaign and policies that provided access to Indigenous Self-Determination. Culture became a commodity as well as a gateway for bringing to light the atrocities visited upon Indigenous people. Sociopolitical and economic agendas became drivers for elevating voices that had been severely erased, silenced, and also assumed and appropriated. Efforts related to increasing Indigenous presence in labor markets through populating academic institutions with Indigenous students has been a tremendous effort that is now seeing successes. There is a long road to bring parity though, particularly within STEM-based and related fields. This endeavor is woven through another theme, and concern, this study happened upon through conversations with Indigenous graduate students and their recruitment from industries hoping to hire not just them as skilled individuals, but also their assumed culture lens, with which to apply to broader issues for marketplace leverage. This poses existential and identity-engaging questions that impact individual financial well-being as well as issues of

representation. How we present ourselves and that which constitutes this identity is increasingly through vehicles of technology.

StoryMaps, as technological forums, are guided by the intention of providing examples of GIS being utilized within tribal communities through presentations of a project, but their stories are so much more. They are windows into the histories, present day, and futures of the peoples, and those they represent, who participate and create them.

An Indigenous Research Way

Situating the task of doing academic research within a philosophy of understanding this work through Indigenous perspectives is a timely approach to applied anthropological practices that addresses a much needed critical review of these processes.

The seminal work of Māori scholar, Linda Tuhiwai Smith (1999), broke ground with new discourse about Indigenous epistemologies and ontologies as being the basis for the imperative relationship *between* methodologies and methods. In practice, the knowing, being, and doing are relational and interdependent and center Indigenous ways of knowing. It is an iterative process, which challenges most Eurowestern mainstream academic approaches to research design and practice—the creating, selecting, and utilizing ways to make inquiry and provide assessment and interpretation of information.

Consider, in a study analyzing the ratio of quantitative to qualitative methods within Indigenous and local knowledge research (Lam et al 2020), of the fifty-five papers reviewed, 68% exclusively used qualitative methods, with only 26 papers (32%) using a mix of qualitative and quantitative methods. Of these, only 2% utilized an analytic method that was congruent and consistent with the Indigenous methodology of the

research design and methods of inquiry. This prompted these scholars to recommend further study and development of congruent analytic tools.

Regarding Western methods congruency within an Indigenous Methodology, it is paramount to understand that it is not always necessary to “decolonize” research methods in order to utilize them within an Indigenous research methodology. My use of a mixed- and multi-methods approach to inquiry reflects the general wisdom that one must look first at a method’s underlying philosophy—what dominant paradigm it is built on (Wilson 2001). Those methods that have theoretical constructions congruent with an Indigenous methodology—where an Indigenous perspective of relationality and interdependence are centered—are useful and beneficial; these tend to be referred to as “ally” methods (Hart, Straka and Rowe 2017). These coupled with particular Indigenous methods extends what is meant by a multi- or mixed-methods approach to inquiry.

Typically these terms reflect either qualitative or quantitative methodologies. I enhance and extend the idea and use of these methods, as multi and/or mixed, which broadens the approach to be inclusive of methods derived from a particular methodology; such is the case within my study. Further, I recommend there not be an emphasis on a binary position of methods, but that a woven integration of these be engaged. I contend, with my research design, a dialogic approach is achieved that reflects a holistic philosophy through its integrative construction as a responsive Indigenous methodology, which guides the selection of congruent methods.

The dialogic approach I refer to is representational of Nakata’s (2004) argument for Indigenous research design and practices that reveal “understanding of the cross-cultural space in which we [Indigenous peoples] function and produce knowledge (9).

Moreton-Robinson (2016) interprets this as a site of “cultural interface...a space that consists of multiple complex historical and discursive intersections, where Indigenous and non-Indigenous knowledges are entangled; it is a place of constant negotiation, contradiction, and tension” (105).

Barnhardt and Kawagley (2005) refer to this interface as a “two-way street” approach, that responds to the “paradigm shift” occurring within academia, whereby Indigenous ways of knowing are being acknowledged as means for research inquiry and consist of “complex knowledge systems with an adaptive integrity of their own” (Abstract). This shift is also increasingly exemplifying earlier theories that a focus on Indigenous ways of solving problems has significance within non-Indigenous specific contexts (Nader 1996; Freeman 2017).

Anishinabe woman and archaeologist Sonya Atalay (2012) reports that she followed an Ojibwe teaching—by elder Eddie Benton-Benai (1979), this being a “two-path” choice—that called for “finding ways to combine our Indigenous systems of knowledge and traditional ways of understanding with those of Western science...to work cooperatively—to use diverse knowledge sources to build strength on the path to mutual success and peace” (x). Atalay engaged her own “braiding knowledge” concept with that of the Ojibwe call, which she now refers to as a Community-based Participatory Research methodology (CBPR).

This relates to a similar Indigenous perspective provided by Albert Marshall, a Mi’kmaw elder and scholar, who refers to the two-way street, two-path, and CBPR as “Two-Eyed Seeing” (Bartlett, Marshall, and Marshall 2012). Marshall describes this as the ability to “see from one eye with the strengths of Indigenous ways of knowing, and to

see from the other eye with the strengths of Western ways of knowing, and to use both of these eyes together (335).

All of these concepts represent the entanglement of Indigenous knowledge with Western—particularly when considered with the use of an Indigenous methodology with that of such as Participatory Action Research (Peltier 2018). Peltier investigated the practice of the Two-Eyed Seeing approach through a study of co-creating a wellness teaching, as a collective story, that assisted in the transfer of knowledges in problem-solving ways. Consider, what we conceive here is the use of an Indigenous traditional ecological knowledge, in the forms of a medicinal plant and also the manner of its care, that is applied to an applicable situation that is then monitored with use of Western tools. This reveals a partnership—a cultural interface—between otherwise diverse scientific knowledges.

The work of Barnhardt and Kawagley (2005) provides a visual aid for such a cultural interface, exemplified through the work of Bartlett and Marshal (2012) and Peltier (2018), and also as an entangled space where various and diverse knowledges exist. The understanding of how such a mingling of knowledge converges and constitutes the other is still relatively under examined, and their practice as research methods is also underutilized (Nakata et al 2012). This presents a challenge, which I have taken up through creating a research methodology that employs such entangled knowledges and guides the selection of similarly entangled methods, which I refer to as multi- or mixed-methods. I conceive of this entanglement as becoming a convergence of knowledges where the incommensurables perceived in the work of Barnhardt and Kawagley are more closely examined for revelation of being two halves of a once whole source of

knowledge. Goertz and Mahoney (2012) refer to the “two cultures” of research as methods of reasoning that rests on the idea that there only exists qualitative and quantitative means of interpreting information into data. I engage an entanglement theory through consideration of a “whole culture” – this being Indigenous perspectives, as a holistic ideology, representing a mixed-method approach that incorporates both qualitative and quantitative means of reasoning within itself. This is seen through the design and practices of An Indigenous Research Way (AIRW)—whereby we can also see a bridge is present, if not a gap filled, in terms of not only observing issues, but of also interpreting them as solvable through Indigenous Knowledges Systems.

Scientific research seeks to make inferences—“drawing larger conclusions on the basis of specific observations”(Brady and Collier 2010:35). These observations, within study, include an integrative philosophy and teaching about investigating a topic and its questions from a position of what we refer to as “applied” approaches. We see this through the work I referred to by Peltier (2018). Applied approaches, extends beyond the theoretical and standard observational methods, toward development of ways to address issues and problems, as being solvable through a Self-In-Relation process. Kedia and Bennett (2005) provide a generally accepted definition of Applied Anthropology as being the practice of “anthropologists [who] employ knowledge, concepts, and methods from their discipline to address contemporary social, economic, or health problems facing communities or organizations by facilitating positive change” (1). This moves the work of anthropologists beyond the realm of “observation.” The basic tenets of Applied Anthropology are historically present in the activities of exploration, being documented as early as 3100-2900 BCE with Egyptian representatives being sent to the Sudan on

trade missions (2). Cultural knowledges gained about peoples from throughout the world were topics within western educational discourses, that also aided strategic political and economic planning. We see this through the extensive work of such as Alexander von Humboldt.

From an Indigenous perspective, an applied approach is also concerned about incorporating the practice of “learning with” (Wilson 2007) communities and how the work represents an activity toward understanding where mutual benefits may exist, with a focus on answering the question of “How do Indigenous knowledges benefit Indigenous peoples” (Whyte 2018).

Increasingly, Indigenous researchers are voicing their awareness of an evolution occurring within our collective insistence of acknowledgement and practice of Indigenous Methodologies. These concerns and this insistence has become a call for the practice of philosophies—methodologies—that create opportunities for development of ways to solve long standing social issues and associated real-world problems (Bartlett and Marshal 2012; Peltier 2018; Sillitoe 2004/2010; Tharakan 2017; Briggs 2018). This “evolution” is in the form of an Indigenous premised research agenda (Kovach 2009/2018; L.T. Smith 2012; Wilson 2008; Wright et al 2016).

In 2004 and again in 2010, Sillitoe asked if Indigenous Knowledges were capable of moving beyond their philosophical concepts. This request was followed by John Tharakan (2017) with his response: what is needed is to establish a heuristic where Indigenous Knowledge can be reviewed and evaluated within various contexts to determine if the IKS can lead to the development of such as appropriate technology (AT), that additionally addresses needs sustainably. Subsequently, this was picked up by

Briggs in 2018, with a call for this work to be conceived and accomplished, and as means of providing space for the knowledges and voices of Indigenous scholars and their communities.

These concerns are also relevant beyond the local scale of tribal nations. They reflect the challenges of our twenty-first century world, its citizens, and especially the development of increasingly more creative industries that are, thankfully, beginning to receive attention for unchecked levels of risk and benefit. The “Anthropocene” epoch and the inevitable address of this is seen within the United Nations 17 Sustainable Goals project, UNESCOs Futures of Education initiative, as well as scholarship such as that by Jason Moore’s edited text, *Anthropocene or Capitalocene* (2013/2016) and Haraway’s *Tentacular Thinking: Anthropocene, Capitalocene, Chthulucene*” (2016).

Within your reading of this dissertation you have experienced the application of An Indigenous Research Way (AIRW) as a practice to engage the sharing of research accomplished regarding the topic of understanding impacts to Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges from use of remote sensing and GIS technologies. Further, the very design of the practice of the research is a result of application of AIRW. The decision to engage this process was determined upon entry into my doctoral program. AIRW is a continuous improvement model for research design and practice. Application of it for my doctoral project provided added value to this work as I have been able to assess my progress within the guidelines provided by AIRW, and revise it according to my experiences of its use.

In Appendix _1a & b___ I provide both the 2017 and 2021 versions of the AIRW model in graphic form. Additionally, I provide an additional graphic as an element that is

a focal point of this model and this is Preparing To Do Research. Within this dissertation there have been several areas I have observed and experience that will revise these present versions of the AIRW model. At this time, I am not prepared to provide a graphic with these revisions as I am still reflecting on my experience and processing what I have learned. I do though offer the following summary of what I understand revises the AIRW model as a process for integration of Indigenous Research Methodologies and Methods as a means for research design and practice that requires reflexivity and reflection on the part of the researcher.

Overall, there are three primary areas that created associated shifts in the AIRW model and provide enhancement of various sections. Approaching this sequentially, the Preparing To Do Research section, will be enhanced as a practice of a more in-depth and inclusive Self-In-Relation activity. As you read in Chapter 2, I engaged this enhancement as a response to experiences I gained in my exploratory research work wherein I was frequently asked for examples of what my topic referred to and as means to understand my own validity as a participant of this study with broad and lengthy experience with the topic.

The second section to receive enhancement is Theoretical Framework whereby, within my doctoral research practice, I crafted a methodology based on an Indigenous perspective of the theoretical needs for such a study that I was preparing to engage. This created what I shared in Chapter 3 as the Newe Critical Theory of Land-Human Ecological and Technological Relationships framework. I share here a restatement of what I provided in that previous chapter about the need and operationalization of various theories into a single framework as a methodological guide for this study.

[This methodology] ... respects the shared Indigenous research philosophy and practice of crafting a framework that centers an Indigenous researchers socio-cultural positionality and use of specific Indigenous Knowledges, as well as pays attention to environmental and social justice issues within a study's design and implementation (Archibald et al 2019; Paris and Alim 2017; Rowe 2014; Walter and Anderson 2013; L.T. Smith 2012; Atalay 2012; Kovach 2009; Wilson 2008; Nicholas and Hollowell 2007; Brayboy 2005/2008; Barnhardt and Kawagley 2005; et al).

Further, this methodology integrates relevant elements of Tribal Critical Theory (Writer 2008; Brayboy 2005), Tribal Standpoint Theory (Foley 2006); Landscape Archaeology Theory (Brower 2020; Fowler 2016; Ingold 2010; Nicolas and Hollowell 2007; Atalay 2006; Bender 1993; et al); Culturally Sustaining Pedagogical Theory (Windchief and San Pedro 2019; Paris and Alim 2017; Grande 2015), and Social-Cultural Reproduction (Bourdieu 1977; Bourdieu and Passeron 1977). Additional elements of Marxist Socio-Economic Theory of Surplus (Marx 1951), are interwoven as they influenced the social change philosophies of Paulo Friere, Myles Horton, and Bud Hall.

This framework assisted in the selection of methods of inquiry and also the decision, no the imperative need, to develop a congruent analytic method that held to the stated philosophy of this study's methodology, as described above. This represents the third section of revision to the AIRW model.

The section Methodology and Methods, that follows a collective agreement and process of collaboration among the various sections and they as specifically determined by activities of Self-In-Relation and further activities of exploratory research, received the development of the Newe Reasoning analytic method and it was applied within this study. To be noted, this method is a responsive-to model that will consistently reflect the positionality of the research utilizing it, but will shift in its specific heuristic components as a means to acknowledge and engage the contexts of the study site and sources. Within this Case Study approach, this has been represented by the inclusion of ESRI principles

for the creation of StoryMaps as well as incorporation of three considerations related to digital media forms placed in public venues.

The experience of practicing the AIRW model within my doctoral program, that I initially created during my own MA work, has been a tremendous experience that engages pedagogical elements that are proving useful to me as an Indigenous educator.

As a further use of the AIRW model, I have introduced it within my programmatic work and teaching of coursework regarding Indigenous Research Methodologies and Methods (IRM&M). Through a Visiting Indigenous Scholar program, that I re-designed as a primary objective within the Salish Kootenai College's (SKC) Indigenous Research Center (funded through a five-year National Science Foundation grant for Tribal Colleges and Universities) that I have been the Director for since 2021, I have implemented the AIRW model through introducing it as a guideline for learning about and applying IRM&M within research design leading to the production of a formal Research Proposal. Additionally within a Certificate program for IRM&M at SKC, the AIRW model is woven through five separate, but interconnected, courses that I teach and/or co-teach, having designed three of them, and assisted in the re-design of two of them. The reflective-based and reflection-based experiences and knowledges gained through these activities will be added to my personal research and dissertation information and collectively provide revision to the AIRW model.

In summary, the value of learning about and creating a response to the issues and hopes for research to be designed and accomplished from an Indigenous perspective are invaluable. I might add, I have never been so proud of myself and those who have been along on this journey with me. The network and community that this work required is

evidence of the philosophical tenets of IRM&M and as practiced within An Indigenous Research Way.

Concluding Thoughts

Based on what I now know from the experience of this Case study, I provide the following thoughts as an overall summary that integrates and synthesizes my study intentions and approaches, with the resulting findings and their interpretations. I provide this through concluding reflections—as statements—that assemble my thoughts within the three themes of education, technology, and tribal decision-making that guided this dissertation work. I provide thoughts on the implications and value, as well as limitations and delimitations encountered and close with considerations for further study.

Thematic Conclusions

Within this study a guide was created through exploratory research processes that represent an Indigenous research approach to understand a topic, that assists in developing a focus and specific questions of inquiry. This “guide” is the collective conversation about impacts of education, technology, and tribal decision-making and they as being gateways for additional impacts that are interpreted through various assessment and analytic means. This study found that within the following there are impacts occurring that represent both beneficial and non-beneficial results and promote consideration of further study.

Theme 1: Within the theme of *Education*, a focus has been on the drivers of technology, as a STEM-based subject, within Native American education agendas that also attends to associated industry partners.

The adventure-based tour this study represents has brought me continuous opportunities, in various and diverse ways, that caused reflection on my lifelong relationship with landscapes and their ecologies. In the recent past and through to the present, I have also broadened my questions about Indigenous-focused land-human relationships being impacted by technology through making additional inquiry about the national, if not global, drive within education endeavors for increasing the number of Indigenous students within STEM-based subjects and the recruitment and employment of graduate students into STEM-related industries. This is aptly represented by the decades-long drive by national Indian education departments and organizations such as American Indians in Science Society (AISS). Granted, I offer no argument to the validity and much-needed successes of entities such as these, however, my study does bring to the fore tangential effects that require further consideration, such as Indigenous identity definitions and their relationships to engaging Indigenous Knowledge Systems and access and use to Indigenous Traditional Ecological Knowledge.

A timely and relevant impact in these regards is the 2021 Call from the Department of Interior Secretary Deb Haaland (Laguna Pueblo) for “Indigenous Knowledge” to be included with plans to assist US Federal agencies with their consultation responsibilities with tribal nations, and decision-make to address climate change-based issues. This Call was followed up by the U.S. White House with several memorandums creating an initiative and a Working Group to develop Guidelines for

consultation with tribal Nations and use of their Traditional Knowledges. The Guideline document was made available to the public in December 2022.

These two particular national endeavors, being Indigenous students in STEM-based education and industries coupled with the Federal drive to include IK, makes a case for the need of what my study addresses in terms of impacts to IKS and ITEK and evolves this work into an increasingly imperative Call for Action. The action is to dig deeper in terms of understanding access and use protocols from an Indigenous perspective that provides definition of being a cultural citizen of one's people with regard to assumptions of identifying as being of that People.

Here, attention is brought to narratives relating that throughout the history of relationships between Indigenous Peoples and Big Government, there has always been a handing of a script, undeveloped with Indigenous thoughts and concerns as stakeholders at the drafting table, or additionally what is contributed gets appropriated and agendized with little actual benefit to those participating Indigenous Peoples. Here we are in 2023, and as I was writing my dissertation I see and also experience we Indigenous People are again being asked to board a train that is already on a pre-determined route based on assumptions about what are and where Indigenous Knowledges exist, who "holds" them and is culturally worthy (Archibald 2019) and capable of understanding and applying ethics protocols about the appropriate use of such treasures. This study, if anything, addresses the foundational questions specific to Indigenous Peoples' understanding of their present and future ability to participate in riding such a train, and what may need to be considered to revise the route and even conduct it if necessary.

This brings us to back to the reference above about the drive to incorporate Indigenous Knowledges within mainstream endeavors, especially governmental, and particularly those associated with climate change issues, locally and globally. These endeavors also reveal an increasing excitement with the learning about and use of Indigenous knowledges within STEM-based disciplines and these associated with issues related to education-based pedagogy and curriculum development. Never before has there been such heightened interest in knowledges held by Indigenous peoples as sources of scientific relevance.

Further discussion about Haaland's Call in April of 2021, provides a prominent and public case of evidence of the impact that this study found, in relation to low ratios of Tribal initiatives for use of ITEK through remote sensing and GIS technologies versus those requested and/or required by governmental and funding entities.

Haaland, who as a Laguna Pueblo woman represents a first for that department. In April of 2021, I personally became aware of a developing vision of a federal initiative from the Whitehouse. Secretary Haaland spoke at the 20th UN Permanent Forum on Indigenous Issues in New York specifically in support of the rights of Indigenous Peoples. She additionally expressed the importance of Indigenous knowledges with her statement, "With Indigenous knowledge, the world can usher in a new era of peace, justice and strong institutions to meet this moment and move our plant toward a more sustainable future." I admit I watched with a critical eye and ear, mentally tripping over terminology that binds Indigenous ways of knowing, being, and doing.

One example was use of the term "Indigenous knowledge." It took me some time to recover after I ranted about the use of a singular form and noun-basis for the word

“knowledge.” In my Shoshonean perspective, there is a common shared Indigenous worldview that knowledge is a plural term and represents multiples of ways we learn and understand each other as humans and beyond-humans. As human beings, we are also embodiments of these knowledges, as they are constitutive relatives for our cultures. In this way we as human beings are also their ambassadors.

The April address was followed by the November 2021 White House Tribal Nations Summit formalizing Secretary Haaland’s statement as an initiative of the Office of Science and Technology Policy (OSTP) and Council on Environmental Quality (CEQ) that subsequently created the Interagency Working Group on Indigenous Traditional Ecological Knowledge, as a means to develop broad government agency guidance. From April through June 2022 the OSTP and CEQ along with the Domestic Policy Council (DPC) and the Working Group gathered information regarding the development of a Guidance for Federal Decision Making. The overriding goal would be the development and public distribution of a guidance document in late 2022.

In August of 2022 the White House issued an official memorandum from the OSTP and the CEQ as a formal invite to tribal leaders, of tribes federally recognized by the United States government, to a “consultation” as an update on the currently available materials being considered as Guidance for Federal Agencies about and use of Indigenous Knowledge. The meeting was held virtually in September 2022. Within this meeting responses to four questions posed to tribal leaders, within the invite, were discussed. These four questions were:

1. What are specific aspects of the proposed Guidance topics that would help ensure the appropriate consideration of Indigenous Knowledge in Federal decision making?
2. What are specific practices related to the Guidance that would enhance the effective and appropriate elevation of Indigenous Knowledge in Federal decision making?
3. What are some opportunities that are particularly relevant to your Tribal Nation for Federal agencies to consider Indigenous Knowledge in decision making?
4. In Highly Influential Scientific Assessments, like the National Climate Assessment, the Federal government is required to ensure conclusions are supported by evidence of appropriate quality. How should Indigenous Knowledge be evaluated for applications in such scientific assessments?

On November 30, 2022 the White House, released the 46-page guidance document and an associated implementation memorandum.

The purpose of bringing to your attention this story is to relate the validity and value of this study's search for understanding impacts to Indigenous Knowledge Systems (IKS) and Indigenous Traditional Ecological Knowledges (ITEK) from the use of remote sensing and Geographic Information systems (GIS) within tribal landscapes. The impacts found with regard to the theme of education attend to the idea that technology is exciting and is part of the originating and evolving human experience as a species. As Indigenous

Peoples we also have cultural knowledges that profess such relationships existed in ancient times.

This dissertation is ultimately a story about relationships and acknowledgement that Indigenous culture expresses methods of what is becoming increasingly recognized by western mainstream academia as science-based ways of knowing. From a shared Indigenous worldview, not just the epistemological—the knowing—is to be understood and applied, but also the ontological—the Being, and the methods—the Doing. Within this construct there exists the axiological—the ethical considerations to be acknowledged and engaged as responsibilities. A much needed revision to this construct is the return of deontology. This practice of duties of care as means of being accountable is the required balance for a methodological approach to understanding that sources of Indigenous knowledges—these nature-based and beyond-human teachers—co-create human cultures and inform culture-based identities, that are perpetuated and preserved through their practice as human lifeways. How this practice occurs, as influenced by drives of technological interests, is the concern and is represented by the work of this research study. The story of a national call for use of these knowledges, from what I learned within this study, epitomizes the concerns that developed this study's topic and questions that in-turn the data has been found to represent in terms of impacts to IKS and ITEK. How this is related further to the topic of this particular theme can be found in the work of Medin and Bang (2014:241)

What if [Indigenous] scholars saw science careers as the opportunity to express their deepest values and as an effective way to 'give back' to their communities? What if they saw their own culture and background as providing a distinct perspective for contributing to knowledge? And what if our science infrastructure supported diverse perspectives and science teachers

treasured them? It seems to us that these are all ways of opening up science, extending an invitation for all to explore it. Our future as a species may well hinge on our ability to resist narrow conceptions of science and ways of knowing.

I would add to this a caution, that in the acts of acknowledging and inviting Indigenous scholars to participate with the sharing of their cultural ways of knowing, being, and doing, that there be a conscientious invite that takes into account there is still so much healing that is yet to be accomplished. Colonization has robbed many Indigenous people of their means to discern the appropriate ways for understanding that the sources of knowledges—those teachers found within natural places and spaces—are the hosts and should be given the opportunity to make invites for use of their gifts of knowledges. This was the way of our ancestors and provided the practices they lived daily by. This is the core of the stories told among the generations since these knowledges were first provided. Just because we as Indigenous people are kin to these sources we should not override the protocols of respect for access and use of these knowledges.

Theme 2: Within the theme of *Technology* wherein the focus is about training for and of Indigenous individuals as practitioners of remote sensing and GIS technologies, we find there are impacts occurring that are both beneficial and non-beneficial.

Akin to Deb Haaland, as the Secretary for the US Department of the Interior, is another first, associated with understanding impacts to IKS and ITEK related to technology, has been the occurrence of astronaut Nicole Aunapu Mann, a citizen of the Wailaki of the Round Valley Indian Tribes in California, and her assignment with the SpaceX Crew-5 mission to the International Space Station in October 2022. Mann is the

first female astronaut to publicly identify as being Native American. Within discussions with a Dine' student I am mentoring for inclusion of Indigenous Research Methodologies and Methods (IRM&M) within the design and completion of his doctoral research proposal for a study in aeronautics and astronautics, I posed a question to him that I have asked in academic circles since 2014, "are colonial methodologies and methods migrating to outerspace?" Our discussion led to consideration of self-in relation to the topic of being Indigenous off-earth in a science-based capacity. This is a topic I have introduced within various of my Talks, Presentations, and Panel facilitation activities. This led to further discussions among a broader group of Indigenous space industry scholars about ways that technology influences the cultural lens of an Indigenous person. The Dine' student had participated in May 2022 in a Zero-G off-earth flight and provided important insights about preparing to be and then experiencing being Indigenous off-earth. I was particularly interested in elements of these experiences that influenced his culture-based relationship with land and ways of seeing it and with an emphasis on they as kin.

Looking through technological means at value-based aspects of being in relationship with land as a human being does have impacts to one's cultural identity. Within the findings of this study we see this evidenced through the application of the seven Newe Reasoning heuristics and also the assessment with use of ESRI 5 Principles enhanced by Shambu (2020) considerations regarding three elements of Indigenous perspectives of visually representing such relationships. Additionally, this is woven with the scholarship and insights provided by Ryan et al (2016) referenced in this chapter previously.

This all prompted me to share further questions, with the Dine' student, that I had been exploring through my research that addresses the training of Indigenous practitioners of remote sensing and GIS technologies, as lenses that human beings see landscapes through. This led me to dig deeper into what may be available as open access, to gain an understanding of materials and processes being utilized for these technological trainings. I found the following:

In October 2020 United Tribes Technical College partnered with NASA's Earth Science and Applied Sciences division to provide an online training titled, An Introduction to Remote Sensing for Tribal Lands. It was promoted as a Pilot training opportunity <https://appliedsciences.nasa.gov/join-mission/training/english/introduction-remote-sensing-tribal-lands>

There were four, two-part modules delivered over four weeks:

- Week 1: Introduction to Remote Sensing & NASA Data (10/6 and 10/8)
- Week 2: Land Cover Classification (10/13 and 10/15)
- Week 3: Change Detection & Time Series (10/20 and 10/22)
- Week 4: Remote Sensing Webtools (10/27 and 10/29)

The Description of the training provides:

NASA's [Indigenous Peoples Pilot](#) and the United Tribes Technical College (UTTC) are partnering to offer the virtual course "Introduction to Remote Sensing on Indigenous Lands".

This course will consist of four modules: (1) an introduction to remote sensing and NASA data, (2) land cover classification, (3) change detection and time series analysis, and (4) web tools for remote sensing. Each module will be presented with lectures and hands-on lab exercises where participants will analyze data using Geographic Information System (GIS) software. The lab sections of this course will be taught on ArcGIS Pro, with options for ArcGIS Desktop and QGIS (freely-available).

Each theme will also focus on the lands of a tribal partner such as the Navajo Nation, the Sault St. Marie Band of Chippewa Indians, the Samish Indian Nation, the Tulalip Tribes, and others. For each theme, the trainers will be joined by tribal members from the region to discuss the importance of remote sensing to natural and cultural resource management.

AUDIENCE

This training is open to the public with participants eligible to apply for continuing education units (CEUs) from United Tribes Technical College upon completion of all hands on exercises covered in the course. Please indicate on your registration if you're interested in receiving CEUs and staff will follow up closer to the course start date on specifics.

PREREQUISITES

Prerequisites: Intermediate computer skills are a plus. Some knowledge of geospatial data or previous GIS courses recommended.

Software: The course will be taught in ArcGIS Pro. For most exercises, we will also have guidance for ArcGIS Desktop and QGIS, but the course will focus on the ArcGIS Pro examples.

- ArcGIS Pro (paid)
- QGIS (free)

COURSE FORMAT

This training will be conducted virtually and through four, two-part modules:

Week 1: Introduction to Remote Sensing & NASA Data (10/6 and 10/8)

Week 1: Introduction to Remote Sensing & NASA Data (Tuesday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Tuesday, October 6, 2020

- Introduction to the Navajo Nation
- Lecture: Introduction to remote sensing
- Exercise 1: Investigating color in a satellite image

Week 1: Introduction to Remote Sensing & NASA Data (Thursday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Thursday, October 8, 2020

- Lecture: Data portals and spectral indices
- Exercise 2: Accessing and downloading data
- Exercise 3: Vegetation indices

Week 2: Land Cover Classification (10/13 and 10/15)

Week 2: Land Cover Classification (Tuesday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Tuesday, October 13, 2020

- Introduction to the Sault Ste Marie Band of Chippewa Indians
- Lecture: Land cover classification
- Exercise 4: Unsupervised classification

Week 2: Land Cover Classification (Thursday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Thursday, October 15, 2020

- Exercise 5: Supervised classification
- Lecture: Accuracy assessment
- Exercise 6: Accuracy assessment

Week 3: Change Detection & Time Series (10/20 and 10/22)

Week 3: Change Detection & Time Series (Tuesday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Tuesday, October 20, 2020

- Introduction to the Rosebud Sioux Tribe

- Lecture: Overview of change detection
- Exercise 7: Change detection

Week 3: Change Detection & Time Series (Thursday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Thursday, October 22, 2020

- Lecture: Time series analysis
- Exercise 8: Time series analysis
- Week 4: Remote Sensing Webtools (10/27 and 10/29)

Week 4: Remote Sensing Webtools (Tuesday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Tuesday, October 27, 2020

- Introduction to the Samish Indian Nation and the Tulalip Tribes
- Lecture: Webtools for remote sensing
- Exercise 9: Climate Engine and the Drought Severity Evaluation Tool (DSET)

Week 4: Remote Sensing Webtools (Thursday)

12:00 pm ~ 02:00 pm

EDT (UTC-4:00)

Thursday, October 29, 2020

- Exercise 10: FIRMS Active Fire Mapper and Worldview
- Exercise 11: Global Forest Watch

- Course Summary and Feedback

Insights provided by this information were minimal as details about the instructors and specific materials were not available or accessible. However, overall, there is observed that the training is fairly STEM-based and steeped with technological-based information. Where within this is evidence of IKS and/or ITEK present is not ascertained. The statement from the information that “For each theme, the trainers will be joined by tribal members from the region to discuss the importance of remote sensing to natural and cultural resource management” is somewhat rhetorical, it appears, versus an opportunity to hear, see, or experience these technologies in association with IKS and/or ITEK.

As an additional consideration of impacts related to training, there is need to have internal tribal conversations that delve more deeply into the public sharing of tribal information and knowledges via digital media. Through my research I found that within ESRI StoryMaps technology the author of a StoryMap media has an option to keep specific information, or their entire StoryMap, private or to share it publicly through means of their own provided link or strictly through the ESRI website. I found this was the case in several of the projects that prevented access to their StoryMap. There was a requirement pop-up to register for access to a third-party site. Taking this into account, it would seem, on one hand, that all project authors were apprised of this capability. There can be an assumption then that those with open access provided their information knowingly.

ESRI provides extensive discourse, including video tutorials, around the technical aspects of choosing or not choosing to share StoryMaps and their information publicly. Overall, among the many dozens of websites I viewed related to the creation and publication of ArcGIS StoryMaps, I found no explicit emphasis related to the ethics of sharing information, other than a site or two, within State government sites, that had created a committee to approve the content of a StoryMap and offered assistance for training for creating a StoryMap. Quite possibly ethics information is provided to the authors upon agreement to utilize a StoryMap for publication.

Theme 3: Within the theme of *Tribal Leadership Decision-Making* wherein the focus is about the influences that Indigenous individuals as practitioners of remote sensing and GIS technologies, and the technologies themselves, have on the decision-making of tribal leaders regarding their communities cultural heritage and natural resources. Through this study there are found impacts occurring that are both beneficial and non-beneficial. As with the other two themes the data assessed through review of ESRI ArcGIS StoryMaps, as public digital media, has been accomplished as a Case Study to observe the data as a viewer and reader. There has been no personal contact with the authorities involved with these projects, who represent tribal leadership for their People.

As shared in Chapter 5 as findings, there is a high degree of participation by tribal communities with use of remote sensing and GIS technologies. The authority to engage such work as a tribal nation is assumed to have occurred through leadership approvals. This is beneficial in two distinct ways: As tribal individuals are gaining training to be practitioners of these technologies, that represent a major burgeoning STEM-field within

academic and industry sectors, they are also becoming the advisors for these technological opportunities. Their guidance to tribal leadership is an invaluable resources that promotes tribal Nations ability to be informed about the uses of the technologies within their landscapes and their effects on policies and developments related to cultural heritage and natural resources. These two elements of tribal lifeways are foundational to the knowing, being, and doing of Indigenous peoples.

When considering the impacts to tribal leadership decision-making there is need to also understand what crosses through this responsibility for those in the position to guide the lives and well-being of the People and the lands they reside on and with. Brayboy (20005) introduced academia to Tribal Critical Race Theory that is a woven element within tribal sovereignty realms of education, health and food security, transportation, and economic development. Within these are a variety of tangential elements that are equally as important and require an astute understanding in order to govern a tribal Nation and particularly its relationship with the U.S. Federal Government. As shared earlier, presently federal agencies have increased their attention to tribal nations and their cultural practices that create and engage ecological knowledges. This is a next version of the consultation strategy for those tribes recognized as federal trust population. The leaders of these tribes are behooved to understand federal agendas and to engage them with a priority to see that the well-being of their People and lands benefit from their decisions.

The historical relationships between federal governments and Indigenous Peoples is becoming more well-known, and revised, with each passing year. The policies derived from such as Manifest Destiny and Imperialism did not take into account the knowledges

of the Indigenous Peoples' encountered. If they did, these knowledges were appropriated through such works as that engaged by Alexander von Humboldt and his contemporaries. These are stories for another time, but are being told by Indigenous scholars today. What is concerning is that this same information needs to be shared more broadly with and discussed among tribal leaders, for an understanding of the premise of appropriation that is a neoliberal persistence within the realities of each generation of Indigenous people. This is occurring to a degree, but is still engaging a next level of colonization through potential lacks of tribal leadership relationality with their cultural knowledge sources that create their identities.

Within Brayboy's (2005) work, that creates a major discourse with Native American federal law and education, there is need to more fully understand that central to tribal leadership is the ability to be informed of impacts of their decision-making. This can begin with an exercise of self-in-relation, such as this study began with and advocates. Within the various GIS projects assessed through this study there is a gap within understanding the impacts from tribal leadership decision-making, in terms of knowing the level of cultural knowledge leaders brought to their authorizing actions. Were these based on a conscious care of duty for the lands that were being surveyed with remote sensing and GIS technologies?

This question is akin to that posed within themes 1 and 2, as understanding the level and accessibility protocols of cultural knowledge one holds when expected to represent and engage it is of utmost importance within the understanding of what impacts may be occurring that pertain to Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges.

Ultimately, we all should ask, as Medin and Bang (2014) have asked, what can be done in the present that can further help us to create and assist a generation of Indigenous peoples move further toward an intimate relationship with their lands that are the sources of their cultural identities, and be respectful partners of the knowledges that are derived from such relationships? Further, how can we best work with technology to address our concerns, hopes, and aspirations to regenerate and evolve our relationships with our sources of Indigenous Knowledges, that we hold as sacred, within mutually beneficial, albeit negotiated, spaces? These are questions that attend to the past, present, and future.

Technology is exciting and draws us to it whether we're prepared or not to go along with it. In this way technology drives creation of realities that humans and beyond-humans are made to exist in. We see this with the issues with and surrounding Global Climate Change. The Call of the U.S. Federal Government to use Indigenous Knowledges to assist with solving the problems of our world relies on the relationships Indigenous knowledge holders have with the sources of these knowledges. Are Indigenous People's prepared to fulfill this request in mutually beneficial impactful ways? How the land, and its residents, and humans see one another in that relationship is crucial. If technological means are depended upon for this seeing by humans, there needs to be attention to how to see through these means in ways that are respectful and mutually beneficial, and decisions must be made accordingly.

Perceived Limitations of this Study

As referred to previously, the findings of this study reflect an initial approach to understanding, as a dynamic endeavor, impacts to Indigenous Knowledge Systems and

Indigenous Traditional Ecological Knowledges from use of remote sensing and GIS technologies within tribal landscapes. These findings provide foundational information as to the prolific use of these technologies by Indigenous practitioners and within tribal contexts and landscapes and their relevance within the concerns and questions posed by this study. External conditions, as limitations to this study, that have restricted or constrained its scope and initial envisioned outcomes and potentialities, began with the effects of COVID-19. Reduced and removed access to working with a specific community of tribal people who engage remote sensing and GIS technologies, as well as access to training facilities for the technologies of issue, created a need to shift study approaches from a field experimental and experiential endeavor to that of a Case Study. As previously shared, this more fully engaged the philosophy of AIRW in terms of approaches to gain a self-in-relation perspective prior to visiting with participants. The Case Study method required me to create a delimitation to the scope of this study that in actuality addressed a more direct inquiry regarding landscape technologies and a national, if not global, initiative for use of Indigenous Knowledges. The delimitation was through accessing a public digital media site for review of tribal GIS projects, that have been created by tribal persons within tribal landscapes. This decision increased the feasibility of this study and relevance of its findings within the platforms of public media-based impacts to the perceptions and utilization of the sources of Indigenous Knowledges as practices of Indigenous Knowledge Systems.

Implications and Further Study Suggestions

The value of a study such as this is in its ability to shine light on areas of assumed acceptance and benefit of remote sensing and GIS used within tribal landscapes, and by tribal practitioners. Use of technologies such as remote sensing and GIS are not an unfamiliar activity for tribal communities in the United States. The debates regarding the constitutive influences that these technologies promote and require of tribal peoples and the subsequent impacts to cultural identity are necessary to be further explored. The benefits of these technologies to tribal nations assist with understanding ways of adapting to contemporary requirements for ecologically sustainable ways of living, not just as an individual within a distinct community, but also regionally and globally. This can create an informed space that tribal leaders can occupy with added confidence, because their own people are becoming and are the experts in the room, and are fully informed themselves of their cultural protocols and mutually beneficial practices.

As recommendations to continue attention to this topic and its inquiry, I offer the following suggestions that hold to the belief that scholarly research promotes as many questions as it seeks to answer, and provides means for further study that creates additional depth and breadth of the topic.

- A. Such as I had originally planned for my own doctoral research project, I suggest creation of an experiential learning activity that engages a specific Indigenous community and within their inter-generational population. Apply IRM&M through a framework such as An Indigenous Research Way that starts at the point of wonder that moves to Self-In-Relation, then a Case Study approach that informs an enhanced Literature Review process that entails visiting with specific

individuals who are interested parties related to the initial topic and question.

Only after this one should consider proceeding to build relationships with the community and still being prior to any survey or interviewing activities. What this process requires is added attention to timelines for the project to be designed, developed, engaged, and accomplished.

- B. Again, as I had initially intended, acquiring information as to the level of Indigenous cultural knowledge held by students of remote sensing and GIS training would be advantageous to understanding if IKS and ITEK were being impacted in terms of use and application with the practice of these technologies. Create a pre- and post-assessment would provide data in this respect. An associated field activity would be observation of the practice by these students with these technologies.
- C. Further understanding of specific curriculums and coursework as training for Indigenous students of remote sensing and GIS by servicing organization would also be beneficial gaining insights for impacts to IKS and ITEK.

Of course there are myriad additional ways to do a study with the topic focus that this dissertation has shared, and I encourage additional interest and creativity in this regard. The benefits to the relationships between Indigenous People and their communities and the fields of anthropology and archaeology are manyfold. Least among them is the less invasive ways that provide access to knowledges that even Indigenous people have lost, or forgotten, about their lands and their cultures. What is needed is a continuous assessment and conversations of the tangential impacts that do and can occur with use of

these technologies, by Indigenous as well as non-Indigenous practitioners, that cross through social, cultural, economic, and political realms for all involved.

Overall, the value of this study, and as a mixed-methods inquiry, is its tri-fold implications for responding to what is a burgeoning hunger for access and use of Indigenous Traditional Ecological Knowledges. First, designing research and accomplishing it from a perspective of responsibility and accountability that represents a duty of care—such as An Indigenous Research Way model of practice provides—is a means to further understand and experience IRM&M, which implements IK processes. This then enables an engaging of a means to interpret and understand results that take into account the people and contexts of the study topic—such as the necessary creation of a congruent analytic method like Newe Reasoning. Additionally, the focus of the research becomes increasingly relevant beyond the needs of the community you are working with, because it will often also represent a micro version of what the world expresses it needs as a whole system and community.

Second, with application of the AIRW, there is a coming-to-know aspect of the research that delves into personal relationships, through Self-In-Relation activities, that creates a collaborative space of meaning-making between the researcher and the sites and sources of the research. This creates a more intense focus on a topic and questions are zeroed in to reflect foundations of the inquiry. In this study it has been a journey to understand impacts from use of remote sensing and GIS. These technologies are an increasingly utilized tool within a multitude of approaches to gain insight to lands-based and place-based information—these are the basis of IK. These technologies have become transdisciplinary and their use is becoming a norm for research overall.

Then, third, this study is first in response and attends to Indigenous People, particularly Indigenous researchers, and the positions they have been placed in with the Call for use of Indigenous Knowledges. For centuries now Indigenous People have suffered the effects of Imperialism and colonization. We have worked, though, diligently to gain space within those places that have been resistant to our voices, such as within academia. Now there is acknowledgement of our collective value and importance within the world, and this is primarily through the culture-based knowledge systems that are constituted by the lands and their ecologies that we are identify with.

The dilemma here is in addressing the impacts of colonization on these ways of knowing, being, and doing to understand what of these ways are viable today. Are these knowledges, primarily known through philosophies of Being, operationalizable for addressing the issues of Climate Change? This issue is the driver for the increase in attention to Indigenous Knowledges held by Indigenous Peoples. What is necessary to understand is, who are the knowledge holders that are willing to be our teachers? There is an assumption that we who identify as being Indigenous are also holders of our cultural knowledges and have access to them for the uses we personally determine. Within this is a complex story about identity as a cultural citizen—a person who has a consistent relationship with the lands and people from which their culture is derived.

Within the world of Native American education there have been great strides to include Indigenous people within STEM fields. Along with this is the well-known statistic that today 76% of Indigenous people report residing outside their tribal communities. What is becoming more clear then, is what I have expressed above – these assumptions that identifying as an Indigenous person also means being holders of

Indigenous Knowledges—and this has created a scramble for programs to also include inter-generational teaching between Elders who are identified as holders of IK and the youth of their tribes.

What this study has engaged is that there are impacts to the Indigenous Knowledge systems and Indigenous Traditional Ecological Knowledges, that Elders have learned from, and yet require access to. This access has been universally acknowledge as coming from and through relationship with these sources of Indigenous Knowledges. Today, being in relationship with lands and their ecologies is being enhanced, but also replaced by technological means of seeing and being with natural environments. Remote sensing and GIS provide less invasive means of access these environments, and are often mnemonic partners to reveal knowledges long forgotten. However, this seeing is not to be accomplished merely with our eyes. There is a relationality aspect to learning what are Indigenous Knowledges through personal presence and time with these sources. In this way the understanding with what is meant by the knowing, being, and doing of Indigenous Knowledge Systems becomes a necessity of experiential education.

In closing ...

I am frequently approached by individuals, groups, industry partners, etc., to comment or guide a process for “understanding Indigenous Knowledge Systems and Indigenous Traditional Ecological Knowledges and access and use of them.” I typically respond by asking them questions. I ask, what are their intentions. Often I do not receive a direct answer that provides an inclusive perspective. I then lead them through a process I feel is a respectful inquiry method that will hopefully help them understand their intentions, and

where there is need for further thought. I ask, “what specific knowledges are you referring to?” “Where do you think these are located?” “Who are in relationships with the landscapes of that area? They are who you should be visiting with. They belong to those knowledges are guardians and gatekeepers for them.”

Through this study, I have been continuously reflecting on this system of communication I engage regarding access and use of Indigenous Knowledges. I check myself continuously and revise with new information but also, I am careful to remain focused on centering the perspectives of who is a knowledge holder and of understanding what are their intentions for sharing their cultural knowledges in public ways. Are they drawing from their Indigenous Knowledge Systems, and do these yet consider mutual benefit for humans and beyond-humans? From my perspectives and experiences, this is key.

A year ago, as I was walking away from such a request “session,” I stopped and thought, what if these folks go to that land and its’ People and find there is no mutually beneficial ecological traditional knowledge relationship in existence today? What if all that is left is what can be found in books, videos, and online digital information? I whispered to myself, “Well, that would still be something, right?” This though did not comfort me.

As I continued to walk across the hotel lobby and out into the night, I saw the vague sheen of stars and light of the moon and the silhouettes of trees in the park across the roadway. Their details were not visible. I would need to get up close to them to understand their contours, the smell of their bark, their colors, to listen to their language

shared through the whispers of their leaves. I would need to spend time with them to understand their Being, and for them to learn who I am.

For me to say that I am a woman of the lands of my ancestors requires that I know that land for myself, and as myself. A goal is that I have a relationship with this land that reflects a shared responsibility and duty of care that creates the space of where the sacred can exist and persist amidst the persistent monsters, that are part of reality, that roam about. The strength of such a relationship would provide space for possibly embracing these monsters in ways that create balance and well-being for all that exists within these realms.

As I continued to walk along the sidewalk toward the park, intent on spending time with the trees there, a great gust of wind and a sudden deluge of rain stopped me in my path. Just as I was thinking of turning back and into the hotel lobby, the words of Dine' scholar Kelsey Dayle John came to mind, "I remember the destruction that the sacred brings when it's not kept sacred."

My phone suddenly buzzed, and buzzed again as text messages were multiplying. "Ren are you still in the area?" I replied, "No, I am northbound now, why?" The subsequent text responses and phone messages that followed relayed the news of the rising river within the area I had just been in for the past few days. The eventual historic flooding that passed through the landscape of the northern area of Yellowstone National Park was incredible, and deeply alarming. My thoughts immediately went to a conversation I had with other Indigenous people who were part of the project I was co-producing.

We had all commented on the behavior of the elk and bison in the area. They were moving to higher ground, when their seasonal round would have them moving to the valleys where the floral was ripening and sweet. These residents of the area knew what was coming. I cannot say that this was the basis for our decision to leave the area a day earlier than we had planned. I am glad though we were listening to the increasingly vocal wind and felt the dropping temperatures that were bringing rain, that would have challenged our further trekking visits to sites within the landscape.

Still standing on the sidewalk I thought again of Kelsey's words and asked myself, "do we need to feel what those words might mean, the "destruction that the sacred brings when it's not kept sacred," in order to understand our complicity and take care of what yet needs attention, and correction?"

I looked to the sky again, squinting against rain drops, and thought of my work with space industries and organizations working on plans for being off-earth, and visiting other planets, possible taking up residence there. Shaking my head I shouted, "we're not ready yet!" My mind and heart filled with a mix of sadness, but also hope. I thought, we need to find a space within these speedways, to slow down a minute, and consider what is sacred that is being negotiated in diminishing ways, and why. Paramount is the need to continuously ask, understand, and apply the answers to, "who is benefiting and what is being ignored and laid to waste with our endeavors? And how can technology be a true partner and help us to see how to do this work in more ethical ways?

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- March – August, 2020. Planning and development of archaeological field school and instruction about Cultural Sensory Pedestrian Survey method.
 - January 27, 2019. Brainstorming with SIGP recipients regarding research topic and SIGP application essay.
 - June 23, 2019. Table conversation with attendees of University of Montana 21st Century Teaching and Learning Conference.
 - September 9-14, 2019. Conversations while in attendance at National Preservation Institute training seminar: Emerging Technologies for Cultural Resources. Sacramento, California.
 - September 26, 2019. Meeting with Indigenous Scholar and AISES member (01.01) regarding STEM-based learning mandates within Indian Education and its impacts and potential areas of concern.

- October 1, 2019. Meeting with Sloan Foundation Program Auditor J. Mills. University of Montana-Missoula.
- October 2015 – April 2020. Various conversations regarding use of landscape archaeological survey technologies related to data creation, use, and security.
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APPENDICES

List of Appendices

Appendix 1a: 2017 version, An Indigenous Research Way (AIRW), Ren Freeman author

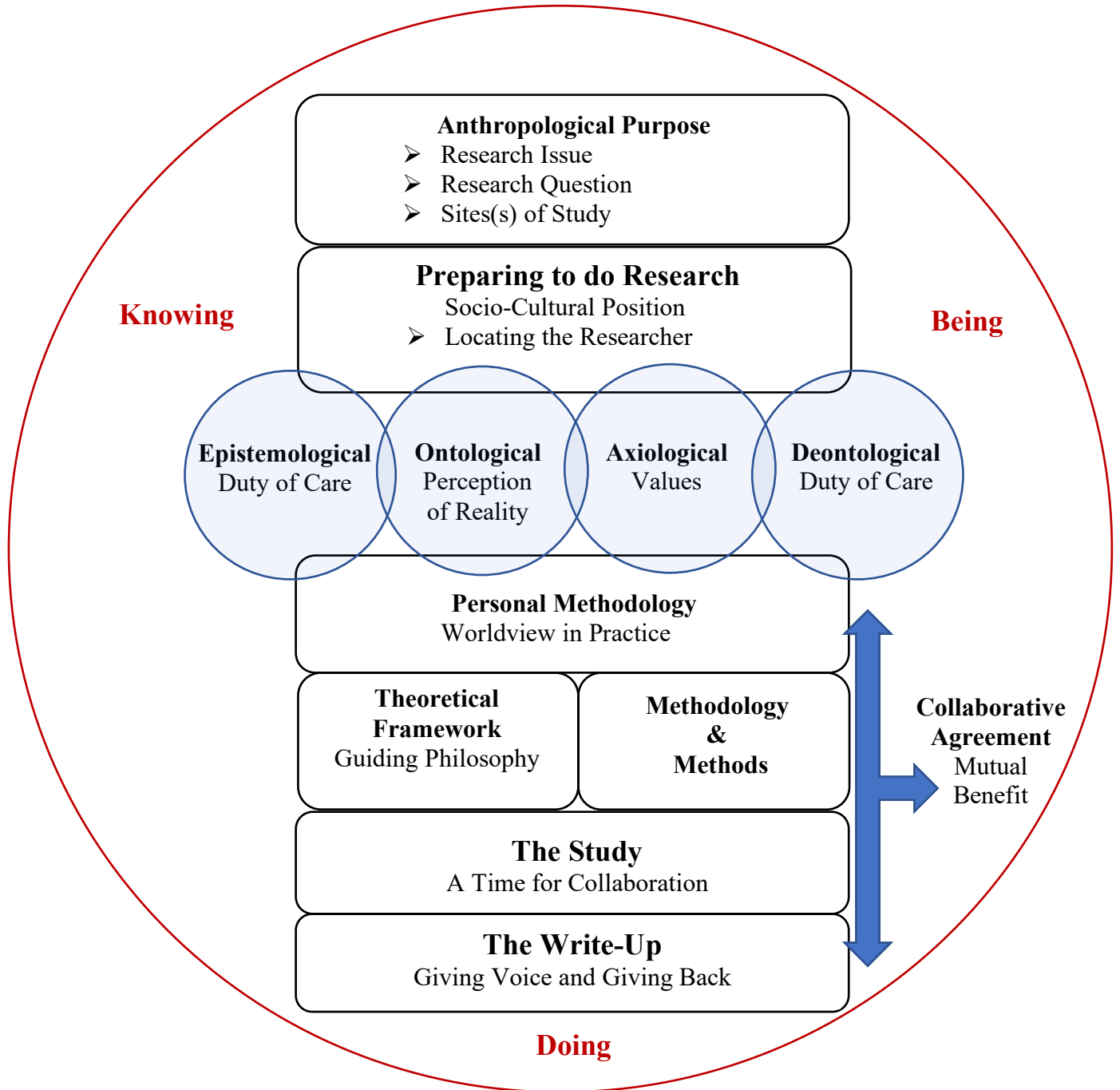
Appendix 2b: 2021 version: An Indigenous Research Way (AIRW), Ren Freeman author

APPENDIX

1a

2017 AN INDIGENOUS RESESARCH WAY (AIRW)

A graphic map



APPENDIX

1b

2021 AIRW version

AN INDIGENOUS RESEARCH WAY (AIRW)

A graphic map



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2. Collage created by Ren Freeman, for personal use, 2020
3. Visual Map of Alaska Native Heritage Center grounds and facilities. Open Access courtesy of Alaskanative.net. Accessed March 2023.
4. 1948 photo with Council for the Hidatsa, Mandan, and Arikara tribes at the signing of the Garrison Dam project authorization. Open Access.